

Action Research on Advocating Use of Fortified Foods in the Free-Living Population of Urban Vadodara using Diffusion of Innovation Model

Ria Ahuja¹, Mini Sheth²

ABSTRACT

Worldwide, unaffordable healthy diets, dependability over staple food items, and lack of knowledge have been the major cause of malnutrition. Government programs, promoting dietary diversity and supplementation have not given promising results in improving the micronutrient status of the population. Government of India, along with Food Safety and Standards Authority of India have chosen five vehicles, namely, rice, wheat flour, salt, milk, and oil for the fortification process to combat the micronutrient deficiency. Fewer studies aimed at creating advocacy about fortified foods among the free living population and stake holders. The present study undertook the advocacy for fortified foods amongst the free living population using the Diffusion of Innovation Model (DIM) for the purchase of fortified foods. An E- Intervention using graphics, audios and videos were given to the participants on WhatsApp for 1 month. The results in the study have shown significant difference in the awareness, perception and purchase of fortified foods for all the five staples post intervention, which provides enough evidence that the proposed strategy for creating awareness and promoting purchase of fortified foods amongst the selected participants was highly effective. Use of different E-communication channels can be used by researchers at large for creating the awareness about the safe consumption of fortified foods. Besides this, conducive environment is needed for fortification program to be a success, which will ensure the proper supply and demand to make the food fortification program viable.

Keywords: Advocacy, Attitude, Awareness, Food fortification, Micronutrient deficiency, Purchase practice
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INTRODUCTION

More than 3 billion poor people in the world are not availing the minimal healthy diets due to its unaffordability, worsening the nutritional security of the people. Less developed countries rely more on staple foods as they are easily affordable which makes the consumption of vegetables and fruits difficult contributing to micronutrient deficiency. Globally, 144 million children below the age of five, are stunted, 47 million wasted, and 38.3 million are overweight.^[1]

Although micronutrients are required in tiny amounts but are an essential part of the diet for the development and growth purposes in the human body.^[2] Due to the outbreak of COVID-19, food quality and availability have worsen which makes it challenging for the world to achieve the 2025 targets of Sustainable Development Goals of zero hunger.

Several schemes and programs have been going on in India for many years toward eradicating the micronutrient deficiency and reducing the undernutrition status. These include Integrated Child Development Scheme, Mid-Day Meal (MDM) Programs, Anemia Mukh Bharat (Free India from Iron Deficiency), National Iron plus Initiative, and Vitamin A prophylaxis program. However, the burden of all forms of malnourishment continues to be challenging.^[2]

Since the nutritional status of the people is one of the factors in deciding the national productivity, it becomes more important to make contributions in the health systems and policies which can further lift up the nutritional status of every individual in the country.^[3]

Supplementation and dietary diversity are two strategies which can help in overcoming the deficiency rates however the approaches are not practical to target masses.

¹Department of Foods and Nutrition, The Maharaja Sayajirao University of Baroda Vadodara, Gujarat

²Department of Foods and Nutrition, The Maharaja Sayajirao University of Baroda Vadodara, Gujarat

Corresponding Author: Ria Ahuja, Department of Foods and Nutrition, The Maharaja Sayajirao University of Baroda Vadodara, Gujarat, India. Phone: +91-7490029622. E-mail: Ria.ahuja-fnphd@msubaroda.ac.in

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Poor people often find it difficult to include diverse food groups in their diet; hence, it becomes important to employ sustainable solution that will fulfill the micronutrient needs of the people and will also be affordable.^[1]

Food Fortification is a process of adding vitamins and micronutrients to staple food items to tackle the rising micronutrient deficiency rates. It is one of the cost effective and viable approaches as it does not alter the dietary habits of an individual. Government of India, along with Food Safety and Standards Authority of India (FSSAI) have chosen five vehicles, namely, rice, wheat flour, salt, milk, and oil for the fortification process and have given the standards for nutrient incorporation in the gazette, FSSAI, 2017.^[4]

Enough evidence is available for supporting the food fortification as a strategy to overcome the micronutrient deficiency rates amongst the people. A study conducted by Das *et al.*, 2019, has recorded reduction for various micronutrients and vitamins.

Iron deficiency anemia got reduced by 72%, Vitamin A by 58%, Vitamin B2 by 64%, Vitamin B6 by 91%, and Vitamin B12.^[5] Studies have also undertaken clinical trials and have reported similar findings as of other researchers.^[5-8] However, few studies aimed at creating advocacy about fortified foods amongst the free living population and stake holders. The present study was, therefore, planned to undertake the advocacy for fortified foods amongst the free living population using the Diffusion of Innovation Method to create social marketing for promoting purchase of fortified foods.

The Diffusion of Innovation theory, by Rogers "is a theory that seeks to explain how, why, and at what rate new ideas and technology spread." In this model, adopters are categorized on the basis of their rate of adoption as innovators, early/late adopters and laggards.^[9]

The data presented in this study is the part of the research to fulfill Doctoral research work of the researcher.

METHODS

Sampling

Using a cross-sectional study design parents of the students (n = 1600) from the Foods and Nutrition department of the Maharaja Sayajirao University of Baroda were screened to elicit the data, of which 349 parents participated until the completion of the study [Figure 1]. Subjects who were responsible for buying groceries for the family, having active internet and WhatsApp connection and can comprehend in Hindi language were included in the study.

Base Line Data Collection

Pre-tested questionnaires were used to collect the data on socio-demographic information, awareness, perception, and purchase of fortified foods using Google form from September 2020 to March 2021.

E- Intervention

The details of the E- Intervention on creating awareness, improving perceptions, and purchasing practices of fortified foods. The details of E- intervention are presented in Figure 2.

List of Messages that were shared during the E- Intervention Period

1. What is Fortification
2. Why it is important
3. Current deficiency rates of different vitamin/micronutrients

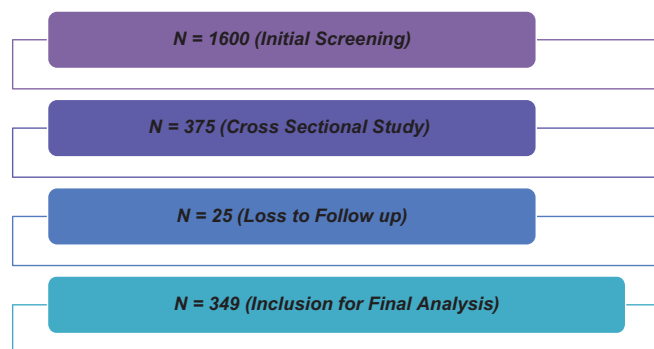


Figure 1: Sample Selection for the study

4. Staples which are being fortified and their fortificants
5. Fortified foods availability
6. Disclaimer on vegetarian sources being used for fortification purposes
7. Identification of logo only on Packed Branded foods and Not on Loose Food Items
8. Message on fortification does not change taste, smell, shelf life of the product and its consumption is safe
9. List of available fortified brands as per the request from subjects [Figure 3].

Post data were collected on the parameters similar to the baseline.

Statistical Analysis

Categorical variables were presented as proportions while continuous variables were either presented as mean with standard deviation or median with range. Categorical variables were compared by Fisher exact test or Pearson's Chi-square test. The McNemar test was used to determine if there were differences on a dichotomous dependent variable between two related groups.

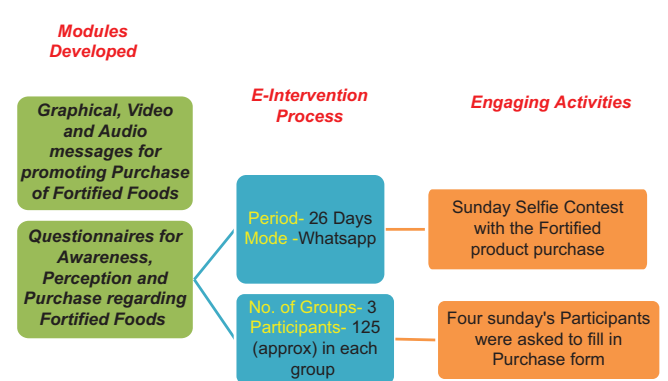


Figure 2: The E-intervention methodology



Figure 3: Glimpse of the Graphics developed in Hindi for E-Intervention strategy

All tests were two-tailed and $P < 0.05$ was considered as significant. Data were analyzed using SPSS software version 25 (Armonk IBM Corp). The Statistical analysis was outsourced by the professional statistician.

ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the institutional review board of the Department of Foods and Nutrition, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda. The ethical approval number of the study is IECHR/FCS/2020/62. Participants were enrolled on the basis of their consent.

RESULTS

Socio-demographic Characteristics of Subjects

The gender profile of the study population revealed that 76% of females and 24% were males. Most of the respondents were in the age group of 41–50 years (47.7%). Most of the respondents had honors degree (57.6%), followed by high School (15.2) and intermediate (11.5). The data on occupation shows that majority of the respondents were either unemployed or belonged to Professional category. Majority of the households belonged to Upper Middle Class (48.3), followed by Lower Middle Class (39.5) [Table 1].

Effect of the Intervention on Subject's Awareness of Fortified Food before and after the Intervention

The impact of the E-intervention session was studied amongst the 349 subjects for the various awareness parameters, presented graphically in Figure 4.

Figure 4 shows the percent of subjects who gave correct responses at the baseline and post-intervention. There was shift of 62%, 73%, and 88% for subjects who gave correct response for what are fortified foods, identification of correct +F logo and for the participants who agreed fortified foods is essential for everyone respectively. Using McNemar's test, it was determined that the results post-intervention were highly significant for all the awareness parameters with $P < 0.001$.

Impact of Intervention on Awareness of Fortified Staples Under FSSAI Regulations 2018

Impact of advocacy regarding staples that are being fortified (FSSAI 2018 regulations in India) is presented graphically in Figure 5. It is evident from the figure that post-intervention, there was a drastic improvement in the awareness of fortified staples. One hundred and sixty one, 157,252,183 and 185 subjects marked correct response for rice, wheat flour, and oil, salt, and milk, respectively.

Table 1: Socio-demographic characteristics the enrolled subjects

Indicators	No. of subjects	Percent
Gender		
Male	90	24
Female	285	76
Age group (in Years)		
20–30	--	--
31–40	103	27.5
41–50	179	47.7
51–60	93	24.8
Education		
Graduate	37	9.9
Honors	216	57.6
Intermediate	43	11.5
High school	57	15.2
Middle school	16	4.3
Primary school	6	1.6
Profession		
Profession	125	33.3
Semi profession	23	6.1
Clerical	36	9.6
Skilled	34	9.1
Unskilled	24	6.4
Unemployed	133	35.5
Monthly income of the family (in Rupees)		
199,862	-	-
99,931–199,861	32	8.5
74,755–99,930	73	19.5
49,962–74,755	159	42.4
29,973–49,961	111	29.6
Type of family		
Nuclear family	283	75.5
Joint family	92	24.5
Socioeconomic group		
Upper	7	1.9
Upper middle	181	48.3
Lower middle	148	39.5
Upper Lower	39	10.4

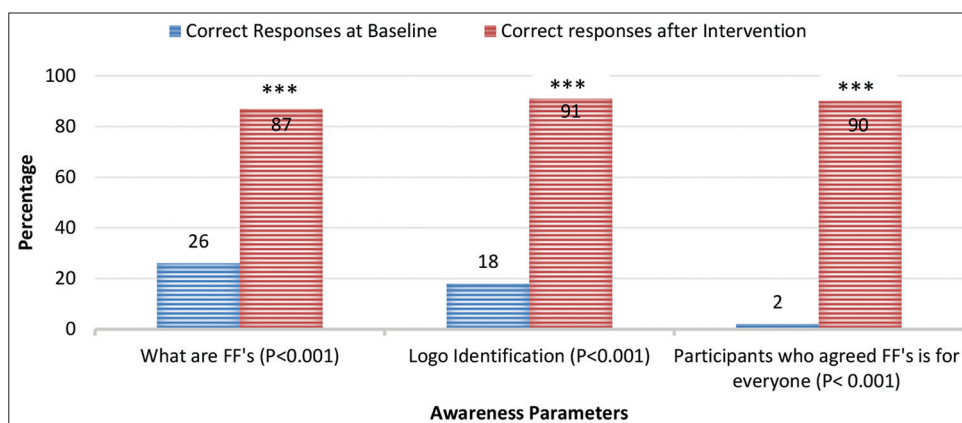


Figure 4: Increase in awareness of fortified foods

Impact of Intervention on Subject's Perception for Fortified Foods

Results on subject's perceptions for preferring fortified foods before and after the intervention are presented graphically in Figure 6. Post-intervention, there was a positive shift in the perception of most of the subjects with regards to safety of fortified foods (40%), their willingness to pay more (26%). Many participants (23%) perceived fortified foods as healthy, 35% accepted that the taste and smell of fortified foods does not get altered. The E- Intervention could persuade 26% of the participants to shift to other brands for choosing fortified staples over the non-fortified staples.

McNemar's test was applied for all the parameters of perception which determined that there was a statistically significant difference post-intervention, $P < 0.001$.

Impact of Intervention on Subject's Purchase Practices regarding Fortified Foods

Figure 7 shows significant increase in the purchase practices of all the staples post-intervention ($P < 0.001$). The purchase of fortified foods at baseline was unintentional for 60% of the subjects; however, post-intervention it was observed that the purchase of five fortified staples increased intentionally.

Using McNemar's test, it was determined that there was a statistically significant difference in the proportion of purchase practices of fortified rice, wheat flour, salt, milk, and oil, post-intervention, with $P < 0.001$.

Barriers for Change in Behavior Toward Purchase of Fortified Foods as Reported by the Subjects

Subjects were asked about the reasons that were impeding their purchase of fortified foods. Majority (38%) of subjects reported unavailability of fortified foods in the nearest store, followed by preference toward buying local/unpacked staples such as rice and wheat kernels (34%) [Table 2].

Association Between Pre and Post Intervention Results for Awareness, Perception, and Practice using Wilcoxon Signed-Ranks Test

Using Wilcoxon signed-ranks, for the three parameters (Awareness, Perception, and Purchase) it can be seen that the positive ranks were more, that is, improvement from pre- to post-intervention data. There was a significant improvement for all the parameters ($P < 0.001$) [Table 3].

Analysis Based on Diffusion of Innovation Model (DIM) for Purchase Practices

Using DIM, purchasing practices were categorized on the basis of adopters, depending on the rate of adoption which was adopted by the enrolled subjects. The results revealed that 12.4% of the subjects were categorized as innovators, 24.3% as early adopters, 26.2% as early majority, 8.2% as late majority, and 24.7% as laggards. Table 3 clearly describes the week of adoption and the category of the subjects following the DIM [Table 4].

The proposed bell shaped curve by Roger's has not been observed in the study as it varies with the product that is being promoted or diffused amongst the subjects, along with

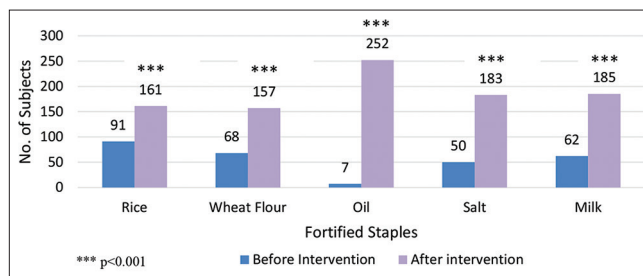


Figure 5: Impact of intervention on awareness of fortified staples among the subjects (n = 349)

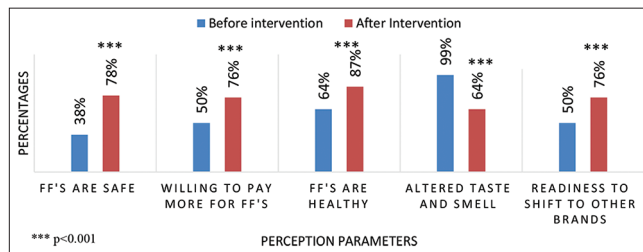


Figure 6: Percent increase in the perception of fortified foods post-intervention

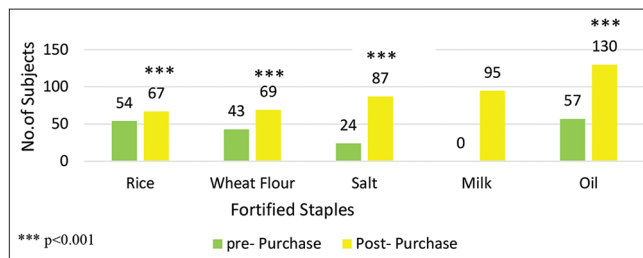


Figure 7: Impact of intervention on purchase practices for the five staples

Table 2: Barriers for change in behavior towards purchase fortified foods by the subjects

Bottlenecks	No. of subjects (n=326)
Unavailability in the nearest store	144 (38.4)
It's expensive	2 (0.5)
Prefer buying loose products/Local	129 (4.4)
Preferred brand is not fortified	51 (13.6)

socioeconomic characteristics of the adopters [Figure 8]. Orange line in the graph shows the trend followed by the subjects during the E-intervention study with regard to purchase practices. Degree of adoption was higher in the 1st week as compared to the DIM, however in the 2nd and 3rd weeks of intervention the degree of adopters were more or less similar to DIM. Upto 5th week, post-intervention the adopters in the intervention group reduced to 20% and many subjects (21%) remained in the category of laggards who did not report to purchase FF's during the study period.

DISCUSSION

The increased micronutrient deficiency has given food fortification a way to combat the situation, as it is one of the cost effective and viable approaches.^[10] The advantage of the strategy is to

Table 3: Wilcoxon signed-ranks test for awareness, perception and practice pre- and post-intervention

Pre –Post intervention parameters	n	Mean rank
Post – pre-awareness		
Negative ranks	4 ^a	28.00
Positive ranks	95 ^b	50.93
Ties	9 ^c	
Total	108	
Wilcoxon signed-ranks test		
Z	-8.480 ^b	
P-value	<0.001	
Post – pre-perception		
Negative ranks	80 ^a	136.30
Positive ranks	236 ^b	166.03
Ties	33 ^c	
Total	349	
Wilcoxon signed-ranks test		
Z	-8.731 ^b	
P-value	<0.001	
Post - pre purchase		
Negative ranks	6 ^a	66.25
Positive Ranks	232 ^b	120.88
Ties	116 ^c	
Total	354	
Wilcoxon signed-ranks test		
Z	-13.203 ^b	
P-value	<0.001	

^aPost < Pre, ^bPost> Pre, ^cpost= Pre

Table 4: Comparison between the percent adopters in the study and the standard DIM

Week of adoption	No. of subjects	Percent adopters during intervention	Percent adopters as per DIM
1 st week - innovators	47	13	2
2 nd week-early adopters	73	20.3	14
3 rd -4 th week early majority	87	24.2	34
5 th week – late majority	68	20	34
>5 th week -laggards	74	21.2	16

DIM: Diffusion of innovation model

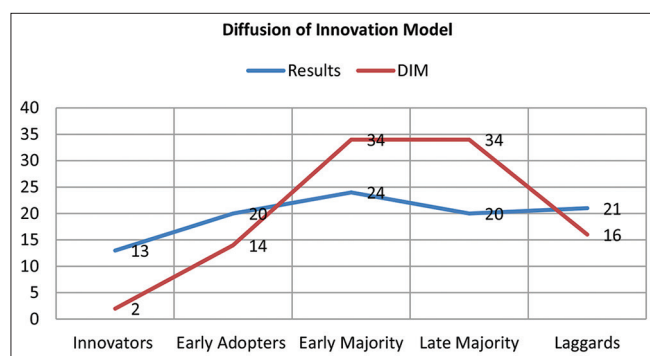


Figure 8: Rate of adoption for the purchase of fortified foods during the intervention

provide micronutrients without altering the dietary practices of the population. The vehicles for fortification are chosen on the basis of staple foods that are consumed frequently and in large quantities.^[11]

Few researchers have collected the data from the different communities regarding the consumer's knowledge, attitude, and practice for fortified foods which created the need for intervention based studies.

A study conducted among 150 urban women in Delhi, reported good (48%) awareness on fortified foods logo, where 69.8% agreed to consumption of fortified foods as essential.^[10] An interventional study conducted by Sirohi^[12] among 400 subjects, recorded awareness of fortification as 12% at the baseline which increased to 72% after the intervention. A study conducted in Kenya on 1435 subjects found that only 28% of the respondents had awareness about "fortified foods." Findings of the present study have also recorded knowledge at baseline at 26% which increased to 88% after the E-intervention.^[13]

A study conducted in NkowaNkowa Township, Africa, to determine the knowledge of women on fortification reported, majority (57%) of the participants were able to define food fortification correctly, and 72% of the participants were aware about the foods that are being fortified, the staple that is being fortified in South Africa is maize, which was reported by 70% of the participants. The target group for which fortification is essentially being done are the children (<6 years of age) was answered correctly by 72% of the participants. However, in the present study after the intervention, 87% of the subjects gained knowledge on "What is fortification" however only 26% could give correct responses at the baseline. Fifty-seven percent of the subjects were able to identify fortification logo correctly, 18% of the participants were able to identify the correct fortification logo at the baseline, and 91% of the participants were able to identify, post intervention.^[14] The possible reason for better knowledge amongst the Africans was the mandatory use of fortification logo on breads, flour, and maize, however in India the +F logo for identification of fortified foods was created in 2016 after the development of food fortification resource center.^[15]

The subjects in the present study were willing to pay more for fortified foods by 50% at the baseline, which increased to 76% after the E-intervention. The results of Garg and Kumar^[10] also observed the similar findings ($P < 0.01$). On questioning about the difficulties for purchase of fortified foods, only 0.5% of the subjects marked price as one of the reason for not buying fortified foods, while unavailability (38%) and preference toward buying unpacked staples (38%) were the other reasons which jeopardized the purchase of fortified staples amongst the participants. A report by Dalberg estimated that 40–60% of the fortified food production in India is not reaching the general population. Thus, it becomes important to create supply and demand for fortified foods simultaneously.^[15] An Australian research found that the notion among the participants who were skeptical regarding purchase of brand products was that fortification is being followed only by expensive products. However, in India and as well as other developing countries, staples are being fortified and even sold through the other government channels.^[16]

A cross-sectional study conducted in 13 counties among 1435 subjects to collect information on fortification awareness studied the association of knowledge with different socioeconomic characteristics. It was found that awareness was significantly associated with occupation ($P < 0.001$), education levels ($P < 0.001$), and age ($P < 0.025$) (13); however, no such association was observed in the present study.^[13]

The results in the study have shown significant difference in the awareness, perception, and purchase of fortified foods for all the five staples post-intervention, which provides enough evidence that the proposed strategy for creating awareness and promoting purchase of fortified foods among the selected participants was highly effective.

A cross-sectional study conducted among school going kids in Benghazi city, among 200 students, observed significant reduction in the consumption of chocolate ($P < 0.01$), chips ($P < 0.01$), bread and other fast foods, post-nutrition intervention;^[17] however, due to pandemic E- education sessions using WhatsApp as the education platform proved to be highly effective in terms of improving the awareness, perception, and purchase practices.

In an educational intervention study, carried out among 400 subjects, the improvement in knowledge for soybean oil increased to 62% from 10%, knowledge about various fortified food products also enhanced to 83% from 40%,^[12] There are multiple studies that have undertaken advocacy strategies for improvement in the knowledge, attitude, and practices of the subjects; however, the results of the intervention can vary depending on the outcome variables, characteristics of the subjects and the tool used for advocacy strategies.^[18]

Besides, the impact of the intervention, the study has also used Diffusion of Innovation theory to track the adopter's categories. According to Rogers's model, the four components that can persuade the person toward adoption of innovation are relative advantages, compatibility, complexity, and trialability, which were considered while sharing the messages on WhatsApp during intervention. Messages regarding advantages of food fortification, safe use while cooking and consumption, and the availability of fortified foods in the markets for promoting trialability were ensured. The DIM model has been applied in agricultural, public health, social marketing, and educational based interventions.^[19]

The success of DIM can vary with the type of technology and innovation that is being promoted to the target audience. However, the graph observed in the present study was similar to the bell shaped graph that was proposed by Roger's in his model.

CONCLUSION

The study has shown a significant impact of the adopted E-intervention strategy for advocacy of fortified foods using DIM. The adoption of DIM has helped categorize characteristics of the participants enrolled in the study based on their rate of adoption and practicing purchase of fortified foods. Use of different E-communication channels can be used by researchers at large for creating the awareness about the safe consumption of fortified foods.

Besides this, conducive environment is needed for fortification program to be a success, which will ensure the proper supply and demand to make the food fortification program a success.

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