CONSUMPTION OF FOOD PATTERN TO UNDERSTAND MULTIPLE MICRONUTRIENT INTAKE DURING COVID 19, AMONGST 6-12 YEARS – SCHOOL AGED CHILDREN OF URBAN VADODARA IN THE YEAR 2021

JUNE, 2021

MITALI RATHOD
B.Sc. FOODS AND NUTRITION
(Public Health Nutrition)

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A DISSERTATION

SUBMITTED IN PARTIAL FULFILMENT OF THE

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(PUBLIC HEALTH NUTRITION)

BY

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JUNE 2020

CERTIFICATE

*This is to certify that the thesis entitled "**CONSUMPTION OF FOOD PATTERN TO UNDERSTAND MULTIPLE MICRONUTRIENT INTAKE DURING COVID 19, AMONGST 6-12 YEARS – SCHOOL AGED CHILDREN OF URBAN VADODARA IN THE YEAR 2021**" is based on the research work that has been carried out independently by **Ms. Mitali Rathod** under the guidance of **Prof. (Dr.) Sirimavo Nair** in pursuit of Master's degree of Science (Family and Community Sciences) with majorin Foods and Nutrition (Public Health Nutrition) and represents her original work.*

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ABBREVIATIONS

ICDS- Integrated Child Development Service

NFSA- National Food Security Act

SDG- Sustainable development goals

WFP- World Food Programme

WHO- World Health Organization

FSSAI- Food Safety and standardsAuthority of India

UNICEF- United Nations Children'sFund

MMN- Multiple micronutrient

THR- Take Home Ration

MDG's- Millennium development goals

RDA- Recommended dietary allowances

TAPF- The Akshay Patra Foundation

CNNS- Comprehensive NationalNutrition Surveys of Gujarat

HAZ- Height for age

WAZ- Weight for age

BMI- Body mass index

UNICEF - United Nations International Children's Emergency Fund

TUL- Tolerable Upper Level Intake

DNA-Deoxyribonucleic Acid

RNA- Ribonucleic acid

RBCs- Red blood cells

ICMR-The Indian Council of Medical Research

NIN- National Institute of Nutrition

NCDs- Non-Communicable diseases

IEC- Information, Education and Communication

LBW- Low birth weight

PoU- Prevalence of Undernourishment

EED- Environmental entero-pathicdisorder

IFA- Iron and folic acid

WIFA- Weekly iron and folic acidprogram

DAILYs- *disability adjusted life years*

DFS- double fortified salt

GIT- Gastrointestinal tract

sTfR-Soluble transferrin receptor

WRA- Women of Reproductive age

PUFA- polyunsaturated fatty acid

ALA- Alpha Lipoic Acid

LMICs- low and middle-incomecountries

RNI- Recommended nutrient intake HIV- human immunodeficiency virus

ECCE- Early childhood care andeducation

NNMB- National Nutrition MonitoringBureau

AIDS- acquired immunodeficiency syndrome

NTDs- Neural tube defects

DLHS- District Level Household andfacility Survey

NP-NSPE- National Program of Nutritional Support to Primary Education

STC- Special Training Centre

ABSTRACT

Micronutrients are the significant public health concern worldwide, and it affects every age group. Majorly, iron deficiency anemia (IDA), Vitamin A deficiency disorders are globally the major public health concerns. The Mid day meal program inschool is India's most extensive school feeding program, which is designated to offer children nutritional food, while also improving their mental, physical and psychosocial health. However, where growing children could catch their nutritional requirements in schools through school feeding programs, due to lockdown, immediate closure of schools was held, and it greatly impacted their dietary requirements, especially from poor fascinating backgrounds. The World Food Program projected that COVID-19 caused approximately 370 million school-aged children to miss their main meal of the day, affecting their learning outcomes, especially in LMICs. Due to this situation, school feeding programs were severely affected, affecting the child's nutritional status.

In view of this, this study aimed to assess multiple micronutrient intake using the dietary pattern of school-aged children of 6 to 12 years of urban Vadodara. Therefore, purposive sampling was done to select government schools from the north,east, west & south zone of urban Vadodara. (N=51). Five hundred fifteen school-aged children of 6 to 12 years were enrolled from selected 51 municipal schools.

The dietary assessment found that overall micronutrient consumption from the diet was lower in school-aged children aged 6 to 12 years. The least consumed micronutrients were vitamin A, calcium, and iron. The majority of children (98.3 percent) met less than 25% of their RDA for Vitamin A. Similarly, most children,
69.5 % and 46.0 % consumed 25% of the RDA for calcium and iron, respectively. In contrast, most children met 25-50 percent of their RDA for folate, and vitamin C. Few of them met more than 75-100 percent of the RDA for folate and vitamin C, i.e., 5.8 % and 18.6 %, respectively. When energy and protein consumption was compared to the percent RDA (6-12 years), it was found out that the majority of children (79.0 %) met only 25-50 % of the RDA for energy, although the majority of children (42.9 %) met 50-75 % of the RDA for protein. Thus, protein consumption was significantly higher in school-aged children than calorie consumption.

According to the findings, most children did not consume all of the fortified commodities, and there was also a low level of awareness about fortified meals among schoolchildren. The children only ingested fortified salt and oil.

By examining their food consumption patterns, it was found that the large majority of them consumed wheat and rice daily. Almost majority of the vegetables were eaten 2-3 times a week. Pulses such as tur dal were consumed regularly, i.e., 2-3 times a week, whereas rajma and soyabean were not. Cow milk was consumed daily, and milk products such as buttermilk, curd, lassi, and paneer were consumed weekly. Children did not usually consume meat and poultry, as well as fish and seafood.

Due to school closure, the government decided to provide dry ration as an alternative to hot cooked meals to all the eligible children for the mid-day meal. It was observed that all of the children (99.22%) received their dry ration (wheat and rice) from schools, and they all liked and ate the items cooked from the dry ration. However, most children did not eat their meals solely because it was shared with their family members. Due to such factors, nearly half of the children (55.19 percent) indicated that they are not getting sufficient rations.

INTRODUCTION

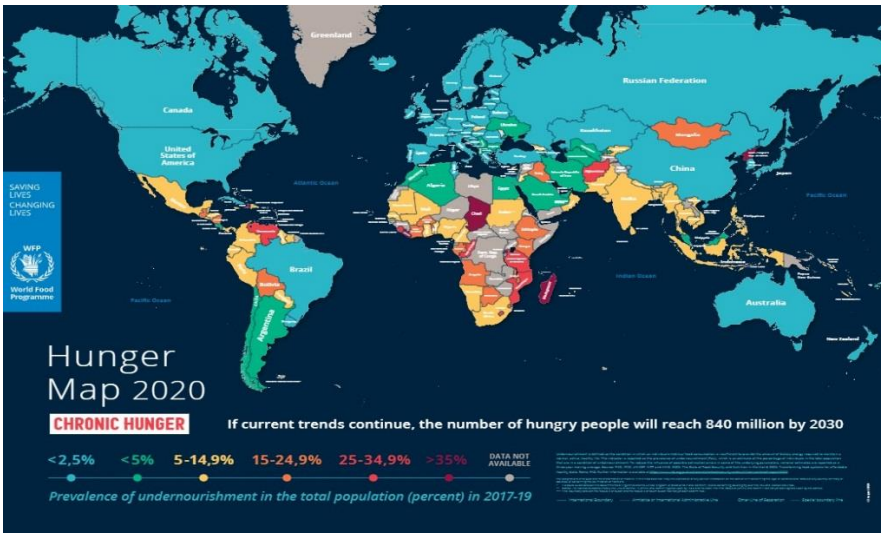
Malnutrition

According to the World Health Organization, Malnutrition is characterized as "deficiencies, excesses, and imbalances in a person's energy and nutrient intake." It refers to three different conditions: Undernutrition, which involves i.e., weight for height (wasting), ii. height for age (stunting) and iii. weight for age (underweight). Micronutrient malnutrition affects micronutrient deficiencies and micronutrient excesses; overweight, obese, and non- communicable diseases involve heart diseases, stroke, diabetes, and cancer. (WHO, 2020).

Malnutrition is a silent crisis that is one of the leading causes of morbidity and death among children and adolescents worldwide. Malnutrition is a significant public health issue indeveloping countries, especially in Southern Asia and Sub-Saharan Africa. (Bhattarai and Bhusal, 2019)

There are 1.9 billion adults who are overweight or obese, and 462 million adults are underweight. In children under 5 years of age, 47 million children were wasted, 14.3 million are severely wasted, whereas 38.3 million are overweight or obese. (WHO, 2020) One-fourth of the population is undernourished in India, and despite this, poverty, food insecurity, and malnutrition remain widespread. (WFP, 2020)

Figure: 1.1 Prevalence of undernourishment in total population



Source: World food program (2020)

India, the world's second-most populous country, has experienced steady economic growth and has recently reached grain self-sufficiency. Nearby, 21.25 percent of the population lives on less than $1.90 per day, resulting in high inequality and social exclusion levels. Undernourished people consuming below the minimum level of dietary energy needs is 14.5 percent, equal to 190.7 million. (WFP,2018)

Causes of malnutrition

Malnutrition is caused by various factors, including dietary issues due to poor accessibility, affordability, availability, psychological issues, digestive problems, stomach conditions, alack of food intake, high food prices, and a lack of breastfeeding practices and infections or diseases. Inadequate daily food intake and a lack of nutritional knowledge are the leading causes of malnutrition in school-age children. Due to poor food distribution in the household, gender biases, poverty, inappropriate cooking food, poor sanitation, wash practices, and poor storage practices of raw and cooked food can lead to malnourished children. (Khan et al.;2017)

Micronutrient malnutrition

Micronutrients are essential vital nutrients that are required in minute quantities. Vitamins and minerals are collectively known as micronutrients. These substances enable the human body to produce enzymes, hormones, and other substances necessary for proper growth and development. The impact of their deficiencies can be a significant threat to the development and health of the human population (WHO, 2004).

Functions of the micronutrients in the human body

(1) Micronutrients such as iodine play a crucial role in brain development and the synthesis of triiodothyronine (T_3) and thyroxin (T_4). The thyroid hormone is again responsible for the conversion of carotene into active vitamin A.

(2) Similarly, iron is an essential element for growth and development. Iron within metalloproteins such as hemoglobin and myoglobin can bind to an oxygen molecule and transport them through the blood capillaries, help in the transport of oxygen throughout the body. Iron is also essential for various other function such as detoxification of drugs, conversion of beta carotene to vitamin A, synthesis of purines (an integral component of DNA and RNA), synthesis of carnitine (A vitamin-like substance needed for the transport of fatty acids), synthesis of collage protein, etc.

(3) Vitamin A has a vital role in the visual cycle; it also helps in growth, cell differentiation, gene expression, immunity, and reproduction in human beings.

(4) Other micronutrients, *viz*. thiamine, riboflavin, niacin, pantothenic acid, folate, vitamin-C, Zinc, Copper, etc., are the various metabolic cycles/pathways such as Glycolysis, Krebs cycle, Beta oxidation of fatty acids, etc. B-group vitamin works asa coenzyme in these cycles. Hence, their regular intake should be in optimal quantities.

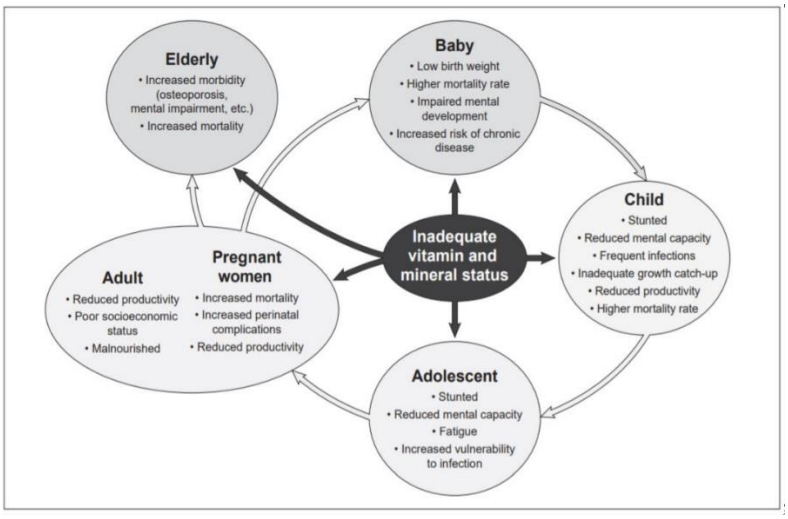
Micronutrients play a crucial role in the health and wellbeing of the human body. Deficiencies of these vital nutrients contribute to low productivity and a vicious cycle of malnutrition. Micronutrient deficiency is a major public health concern globally; nearly more than one-fourth of the global population is affected. Micronutrients are required in small proportions, very important for the functioning of various metabolic pathways of our body. (Toteja & Gonmei,2018)

Micronutrient deficiencies are also interchangeably known as 'Hidden Hunger.' It affects learning ability, health, and wellbeing as well as productivity which leads to high rates of illness, disability, underdevelopment, and poverty. It is estimated that around two billion people in the world are deficient in one or more micronutrients. (Thompson & Amoroso, 2011)

As per the recently released Global Nutrition Report (2020), India is one of the 88 countries globally, which will miss their global nutrition targets (Stunting among under-5 children, anemia among women of reproductive age, Childhood overweight, and Exclusivebreastfeeding) by 2025. India is one of the top three countries globally, following Nigeria and Indonesia with very poor nutrition performance.

The major contributor to childhood morbidity and mortality is micronutrient deficiency. It is associated with several irreversible threatening health conditions. Iron deficiency disorders, vitamin A deficiency, and Iodine deficiency disorders are the three major public health concerns globally (WHO, 2020).

Figure 1.2: The conceptual framework for the cycle of micronutrient inadequacies across the life span



Source: (Bailey et al.,2015)

Anemia is described as a condition of lack of sufficient concentration of hemoglobin in the blood. It is a severe global public health problem that mainly affects young children and pregnant women. *Nutritional anemia* may be defined as the condition in which the erythropoietic tissue cannot sustain an average hemoglobin concentration due to a lack of one or more nutrients, leading to a decrease in the blood circulating hemoglobin.

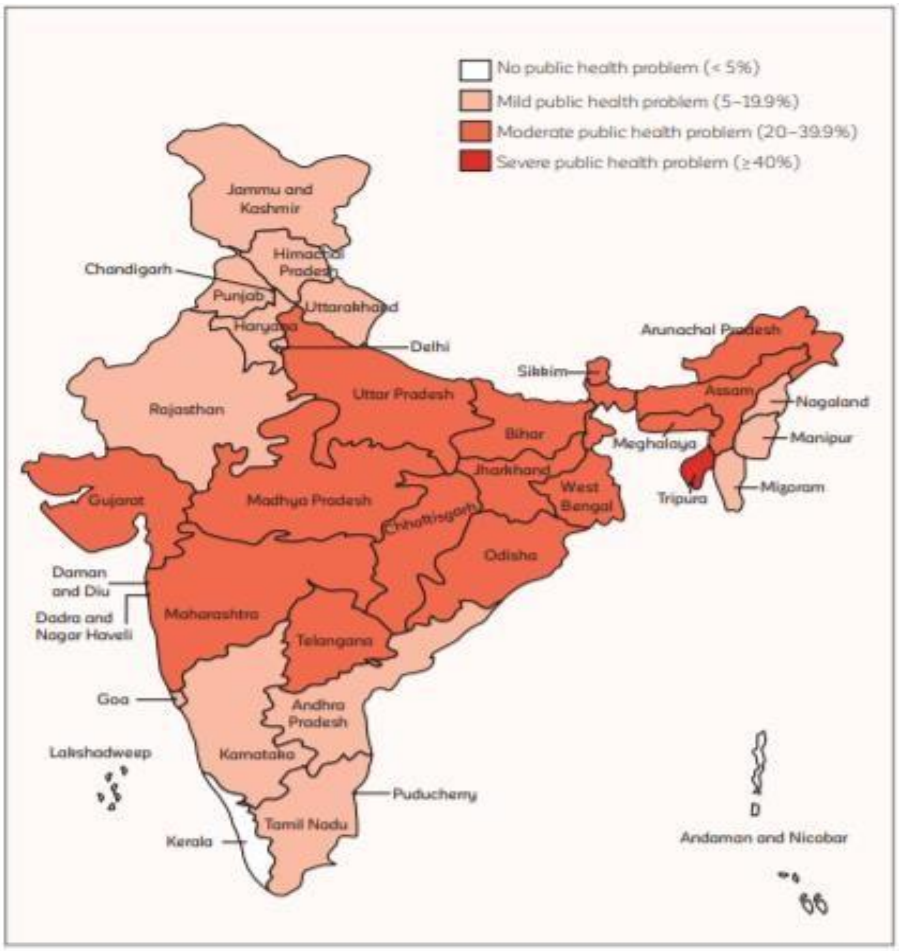
Role of nutrients in erythropoiesis (the process of RBCs formation)

- Proteins such as Glycine, Proline, and Hydroxyl proline are essential for the biosynthesis of the porphyrin ring of hemoglobin, and Histidine acts as a precursor of RBC constituent ergothioneine.
- Iron is essential for heme protein formation, and Copper helps release the stored iron from the ferritin in liver cells.
- Vitamin E gives stability to the RBC membrane, protects it from lipid peroxidation.
- Other nutrients such as riboflavin stimulate reticulocytosis, vitamin C increases the rate of iron absorption into tissues, vitamin B6 helps in incorporating hemoglobin, folate and B12 helps develop RBCs beyond the megaloblastic stage and helps in cell division. Briefly, we can conclude that for the pathophysiology of anemia, various essential micronutrients are essential.

As per the WHO estimates, the prevalence of anemia in children less than five years and pregnant women is 42% and 40%, respectively. (WHO,2020) Anemia is one of three major public health problems persistent at the national level in India.

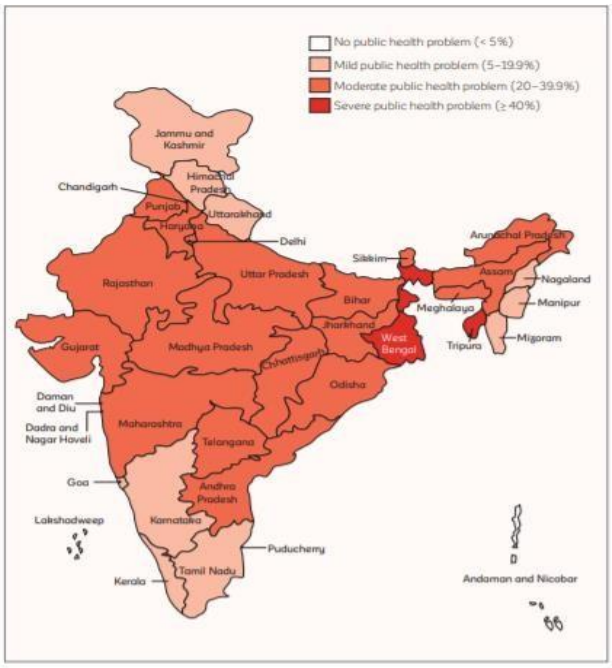
According to the National Family Heath survey-4 (2015-16), in India, at least 59% of the children suffer from anemia, i.e., hemoglobin level <11.0g/dl. The percentage of mild, moderate, and severe anemic children is 28%, 29%, and 2%. Between 2005-06 and 2015-16, the prevalence of anemia among children age 6-59 months declined from 70 percent to 59 percent but continued to be higher among rural children. As per the CNNS (2019), in India, atthe national level, the prevalence of anemia was 41%, 24%, and 29% for children aged 1-4 years, 5-9 years, and 10-19 years, respectively. Similarly, in Gujarat, anemia accounts for 38%, 29%, 33% in children aged 1-4 years, 5-9 years, and 10-19 years, respectively.

Figure 1.3: Prevalence of anemia as a public health problem among children aged 5-9years, India



Source: CNNS, 2016-2018

Figure 1.4: Prevalence of anemia as a public health problem among adolescents aged10-19 years, India



Source: CNNS, 2016-2018

Figure 1.5: Iron requirements in the body

Life Stage	Recommended Level
Birth to 6 months	0.27 mg
Infants 7–12 months	11 mg
Children 1–3 years	7 mg
Children 4–8 years	10 mg
Children 9–13 years	8 mg
Teens boys 14–18 years	11 mg
Teens girls 14–18 years	15 mg
Adult men 19–50 years	8 mg
Adult women 19–50 years	18 mg

Life Stage	Recommended Amount
Adults 51 years and older	8 mg
Pregnant teens	27 mg
Pregnant women	27 mg
Breastfeeding teens	10 mg
Breastfeeding women	9 mg

Source: National Institute of health, 2020

Iron deficiency is the most prevalent MND globally, affecting more than 30% of the global population (roughly 2 billion people). Children born to iron deficient mothers are more likely to have low iron reserves, poor physical and cognitive development, and a weakened immunesystem. At the national and individual level, early life iron status plays a significant role in human ability.

The World Health Organization (WHO) reports that anemia affects 25% of the world'spopulation of 1.6 billion people. The highest prevalence is seen in pre-school-aged children, i.e., 47.7%, and in pregnant mothers, i.e., 41.8%. In general, Southeast Asia has the highest rates of anemia in pre-school children and expectant mothers (65.5% and 48.2%). (Bailey et al.,2015)

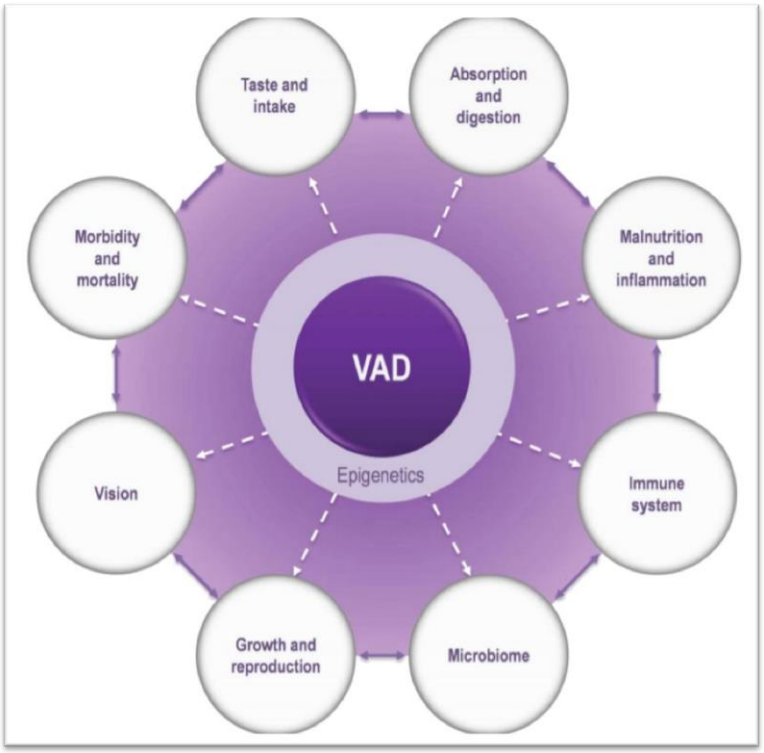
Vitamin A deficiency (VAD)

Vitamin A is a fat-soluble vitamin with a variety of functions that helps with vision, cell division, immune function, fertility, and the development and growth of organs and bones in the human body. (Bailey et al.,2015)

Vitamin A deficiency (VAD) is caused by a chronic lack of vitamin A in the diet. It is especially common during nutritionally challenging stages in life, including early childhood and pregnancy. Inadequate dietary intake of dairy products, eggs, and B-carotene-rich fruits and vegetables can lead to Vitamin A deficiency in school-aged children. VAD is linked to xerophthalmia, night blindness, reduced body immune system, anemia, and increased measlesand diarrhea mortality in children. (P. Song et al.,2017)

In developing countries, Vitamin-A deficiency in children is the leading cause of preventable blindness. Major contributing factors responsible for VAD are the high frequency of infections and inadequate Vitamin A-rich foods. In 2013, World Health Organization declared VAD as a global public health concern, affecting approximately one-third of the children aged 6-59 months. The highest rates were observed in sub-Saharan Africa and South Asia at 48% and 44%. An estimated 2.8 million preschool children are at risk of night blindness from VAD. (UNICEF, 2018)

Figure 1.6: The vicious cycle of vitamin A deficiency (VAD)



Source: Wiseman et al.,2017

The cycle of vitamin A deficiency usually starts with a loss of taste sensation, which leads to reduced food intake. This, along with food absorption and digestion problems, can lead to malnutrition and raise the risk of infection/inflammation, which is aggravated in the state of VAD. At the very same time, VAD can impair the immune system's ability to defend the body, either directly or indirectly, through interactions with immune components/gene expression or the microbiome, resulting in growth and reproduction and bone formation issues in the body. After this, vision becomes distorted as the VAD progresses. All of the above sets the basis for higher morbidity and mortality risk due to VAD, with epigenetic mechanisms playing a part, among others. (Wiseman et al.,2017)

Iodine deficiency disorder

Iodine deficiency is one of the preventable, prevalent causes of brain damage worldwide. A significant cause of poor mental development in children is IDD (Iodine deficiency disorders). Iodine deficiency during pregnancy may lead to impaired thyroid hormones, which ultimately affects fetal abnormal brain development. (Qaboos,2007). Iodine is a necessary component for thyroid hormone production, which regulates metabolism and is also essential for fetal brain development. Thyroid hormone synthesis is impaired by iodine deficiency, which can have a variety of harmful effects. (Niwattisaiwong, et al., 2017).

Consequences of iodine deficiency

Table 1.1: Clinical manifestations of iodine deficiency disorders by age group

SR NO.	AGE GROUP	CLINICAL MANIFESTATIONS
1	Fetus	AbortionStillbirth Increased risk of perinatal deathCretinism
2	Infants	Goiter Hypothyroidism Mental retardation Intellectual impairment
3	Child, adolescent	Goiter Hypothyroidism Intellectual impairment Impaired physical development
4	Adult	Goiter Hypothyroidism Toxic multinodular goiter Increased risk of iodine-induced hyperthyroidism Hypothyroidism Intellectual impairment

Source: (Niwattisaiwong et al., 2017)

Recommended dietary intake of micronutrients (School going children aged 6-12 years)

The Recommended Dietary Allowances (RDA) are the levels of intake of the essential nutrients that are judged to be sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group (Indian Council of Medical Research,2010)

Table 1.2: Summary of RDA for Indians

Age group	Years	Bodyweight (kg)	Iron (mg/dl)	Vitamin C (mg/dl)	Calcium (mg/dl)	Folate (µg/dl)	Vitamin-A (µg/dl)
Children	4-6 y	18.3	11	35	550	135	510
	7-9 y	25.3	15	45	650	170	630
Boys	10-12 y	34.9	16	55	850	220	770
Girls	10-12 y	36.4	28	50	850	225	790

Source: ICMR NIN. (2020). Summary of Recommendations – Icmr-Nin, 2020. *RDA Report.*

Table 1.3: Tolerable upper limit (TUL) for micronutrients

Age group	Years	Iron (mg/dl)	VitaminC (mg/dl)	Calcium (mg/dl)	Folate (µg/dl)	Vitamin-A (µg/dl)
Children	4-6 y	40	550	2500	-	900
	7-9 y	40	800	2500	300	900
Boys	10-12 y	40	1050	3000	600-800 (9-17y)	1700
Girls	10-12 y	40	1300	3000	-	1700

Source: ICMR NIN. (2020). Summary of Recommendations – Icmr-Nin, 2020. *RDA Report.*

Strategies to combat micronutrient malnutrition

Four main strategies for addressing micronutrient malnutrition have been identified by The World Health Organization (WHO) and the United Nations Food and Agriculture Organization (FAO) in 2006. These strategies includes-nutrition education leading to increased diversity and quality of diets, food fortification, biofortification, supplementation, and disease control measures. For achieving maximum impact appropriate mix of these strategies should be used. (WHO/FAO,2006)

Food fortification

Food fortification is one of the long-term food-based strategies to address the problem of micronutrient malnutrition. It is an attractive, effective, scalable strategy that can cater to a more comprehensive section of the population if the technology and food delivery system are already present in the system. (Das et al., 2013).

Fortification can be of various types, which includes

(i) Mass fortification

(ii) Targeted fortification

(iii) Market-driven fortification

Mass fortification is the fortification of foods consumed mainly by the general population on a mass level; it is almost always mandatory. Targeted fortification is to fortify specific demographic groups, like complementary foods for young children or dry rations for displaced people. Depending on the public health significance of the issue, it may be mandatory or voluntary. Whereas Market-driven fortification allows manufacturing people to fortify foods available in the market, it is always voluntary. Mandatory and voluntary fortification of food is mainly dependent on natural circumstances. (Global Progress-Food fortification,2006)

Food fortification is mainly responsible for controlling or eliminating several micronutrient deficiencies in industrialized countries. For instance, In the United States of America and Canada, it was observed that the prevalence of pellagra from niacin deficiency and beriberi from thiamine deficiency were reduced after using high vitamin wheat flour fortification. (CPHA,2015)

Miguel and Kremer, 2004; Bobonis and Sharma, 2006 reported that schools could emerge as an effective channel of delivery for the health programs as they ensure better compliance by avoiding the take-up decision at the household level.

Delivering DFS (double fortified salt) in schools can be an attractive and promising platform because they provide the readily available and extensive infrastructure to reach at-risk children at a low marginal cost. However, some constraints can arise in school-based nutrition intervention, such as low attendance of children and leakage in the program delivery. (Afridi,2011)

Some evidence from the developing countries South Asia (Afridi, 2011) and in Sub-Saharan-Africa (Kazianga, De Walque & Alderman, 2012; Alderman et al., 2012) shows thatpublic schools in rural areas do not suffer from low attendance as school meal programs have improved school attendance and the nutritional status of the children.

National food security act

In India, the National Food Security Act was passed in 2013 to lower hunger and malnutrition. Under this act, there are different component, which involves (i) integrated child development services, (ii) Mid-day meal scheme, (iii) Public distribution system. A targeted public distribution system provided subsidized food grains per month per person, whereas, under ICDS, beneficiaries are provided meal and nutritional supplements to reducepoor dietary outcomes. (A. Kjelsrud, 2016)

Figure 1.7: Nutritional standards in accordance with the ICDS and MDM

Serial number	Category	Type of meal [2]	Calories (Kcal)	Protein (g)
1	2	3	4	5
1.	Children (6 months to 3 years)	Take Home Ration	500	12-15
2.	Children (3 to 6 years)	Morning Snack and Hot Cooked Meal	500	12-15
3.	Children (6 months to 6 years) who are malnourished	Take Home Ration	800	20-25
4.	Lower primary classes	Hot Cooked Meal	450	12
5.	Upper primary classes	Hot Cooked Meal	700	20
6.	Pregnant and Lactating mothers	Take Home Ration	600	18-20

Source: The national food security bill, 2013

Food insecurity can be viewed as a continuum that extends from uncertainty and worries about availability to sufficient and appropriate food at the family level to the extreme hunger situation among children due to a lack of food. Food insecurity and early hunger can have a significant impact on student's development. It has always shown a significant positive effect on overall children's health if their childhood poverty is treated. (George & McKay, 2019). Under this act of national food security, mid-day meal was implemented for school children health. School feeding programs (SFP) are viewed as both a social safety net for underprivileged community segments and an educational intervention aimed at ensuring that children attend school and enhance their learning. (Iyer & Kantawala, 2015)

Mid-day Meal Scheme

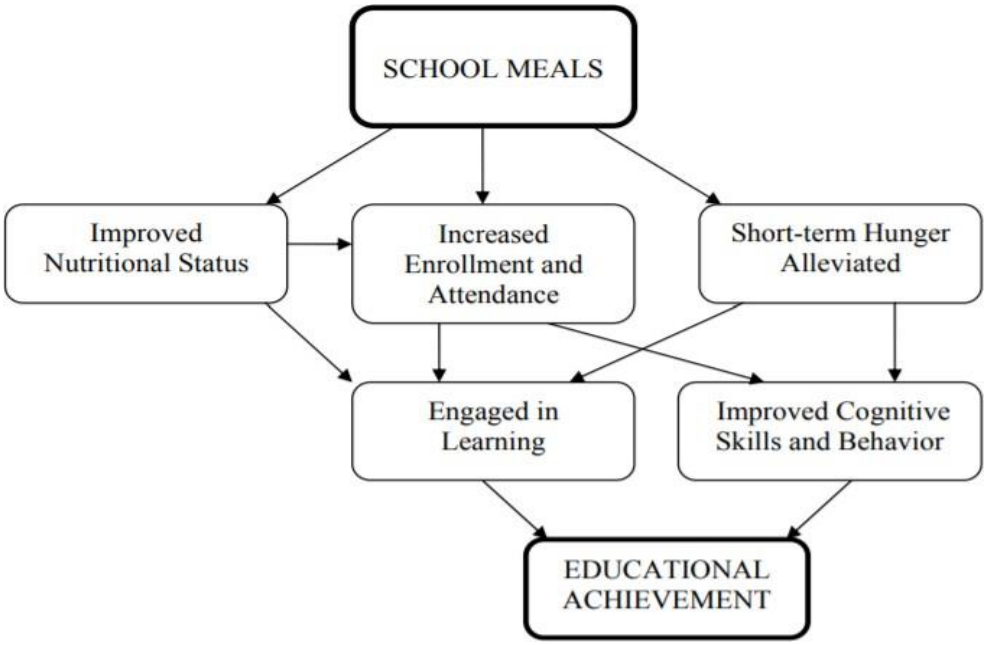
The main focus here is on Mid-day Scheme. In Gujarat, a Mid-day meal was started in 1984 that involves providing free lunch to school-going children in upper and primary level in government schools. It is the world's most extensive supplementary school lunch program. It covers children from 6-14 years of age, including all primary and upper primary government schools. (Patel et al.,2016)

The three main goals for MDM are i) Child nutrition, ii) Educational advancement, and iii) Social equity. (Mid-day Meal, 2018)

This scheme was started to increase the rate of enrolment of children and lower the drop-out rate of school-going children because of various factors like poverty, poor nutritional status, etc. Now, for better health and wellbeing of school-aged children, the government hasinitiated fortification in the school lunch program. For that govt has now mandated to use double fortified salt, fortified wheat flour in this program. (Patel et al.,2016)

Due to COVID-19, India implemented lockdown as an emergency precaution to prevent the spread of the virus, and all schools were closed for about a year. This decision by the Indian government had a significant impact on the nutritional quality and educational outcomes of millions of children attending government and government-aided schools receiving hot cooked meals through mid-day meal programs. Hence, to ensure the nutritional status of school-going children and in light of these circumstances, the government of India had advised state governments and UT administrators to take necessary and appropriate actions for providing *take-home ration* under the food security allowance to all enrolled students under the mid-day meal scheme, as hot meals could not be provided. (D.O. letter dated 13.5.2021 reg. provision of FSA during 2020-21) It was observed that all the enrolledchildren were receiving 50 gm wheat and rice per day for standard I to V, whereas for standard VI to VIII, 75 gm wheat and rice were distributed from the respective schools.

Figure 1.8: Relationship between the School feeding program and their outcomes and impacts on school children



Source: Lawson, 2012

A daily school meal is a powerful motivator to get kids to school and keep them there. Schoolfeeding programs are believed to enhance educational outcomes across these paths, as seen inthe diagram. It helps to increase school children's enrolment and attendance, decrease rates of drop-out and helps to boost cognitive ability by encouraging children to concentrate on their studies. (Lawson, 2012). In this context, a study done in Tamil Nadu pioneered a vision of a Mid-Day Meal Scheme (MDMS) as part of a nutritional supplementation program. The noon meal program was recognized as an effective benefit in registering regular attendance of students enrolled in the government-run school system, commonly known as government schools or public schools.

One of the most significant barriers to rural parents sending their children to school was their inability to feed them daily. At least one afternoon meal supplied in school has the potentialto improve school enrolment as well as their nutritional status. As a result, there is a clear need to reduce hunger while improving school enrolment among these youngsters, and school feeding programs have been designed to address this multidimensional issue. Furthermore, school feeding targets the MDGs of reducing hunger in half, establishing universal primary education, and attaining gender parity and equity in education by 2015. (Arumugam, 2016).

Gujarat mid-day meals or **food security allowance** are provided to the children of grades 1 through 8 in primary school. For this, the first and second stages have been distributed. The letter is given in the third phase for giving the **allowance** from 15-04-2020 to 03-05-2020 (15days in total).

According to the order given by the government and looking to the objectives of the mid-day meal program, the food security allowances are shown in the following table.

1. The amount of dry food ration per child per day
2. Cooking cost decided by the state government

Table 1.4: Food security allowance (cooking cost + food grain)

Standard	**Total enrolled student**	**Cooking cost decided by the government of Gujarat to per student per day (rupees)**	**Total Food grains agreed by the government of India per student per day (grams)**
Std. 1 to 5	3215742	Rs. 4.96	100 gram
Std. 6 to 8	1956546	Rs. 6.95	150 gram

Source: School MDM Food security allowance

The amount of the mid-day meal will be directly credited to the bank accounts of the student/guardian. The commissioner's office for the midday meal program will have to monitor if all beneficiaries reach the kid on time and continue to give progress reports on the work done. Furthermore, considering the local circumstances and strictly adhering to official guidelines, the district primary education officer will be required to complete the food grains distribution in consultation with the supply system, with the cooperation of local school teachers and midday meal center administrators.

By the orders issued with permission of the government, food security allowances distribution is given in the following table:

Table 1.5: Distribution of food security allowances

Round	The time span of MDM food security allowance	Days (except public holidays and Sunday)
1	Date. 16/03/2020 to 29/03/2020	11
2	Date. 30/03/2020 to 14/04/2020	10
3	Date. 15/04/2020 to 03/05/2020	15
4	Date. 04/05/2020 to 07/06/2020	34
5	Date. 08/06/2020 to 30/06/2020	20
6	Date. 01/07/2020 to 31/07/2020	27
7	Date. 01/08/2020 to 31/08/2020	21
8	Date. 01/09/2020 to 28/10/2020	49

Source: MDM All Round (RDRATHOD.IN)

Figure 1.9: Coupon for getting food grains

મણિપુર પ્રાથમિક શાળા, તા. કડી જિ. મહેસાણા મ.ભો.યો. કેન્દ્ર નં. 100

તા.૦૧/૦૯/૨૦૨૦ થી ૨૮/૧૦/૨૦૨૦ સુધીના સમયગાળા માટે MDM FOOD SECURITY ALLOWANCE 49 દિવસ (જાહેર રજા અને રવિવાર સિવાય)

અનાજ મેળવવાની કુપન

કુપન નં 1 તારીખ : 10/09/20

વિદ્યાર્થીનું નામ : A ધોરણ : 1

આપવાપાત્ર થતો અનાજનો જથ્થો (૧) ઘઉં 2.450 કિ.ગ્રા. (૨) ચોખા 2.450 કિ.ગ્રા.

વર્ગ શિક્ષકની સહી આચાર્યની સહી અને સિક્કા

જથ્થો મળ્યા બદલ વિદ્યાર્થીની/વાલીની સહી

તારીખ : / / 2020

Source: MDM All Round (RDRATHOD.IN)

According to the method prescribed at the district level for the distribution of food grains, thequantity of food grains can be brought to the school from the fair price shop (FPS) and given to the parents. In this operation, ensure that social distance is maintained and the health department's instructions are followed. These instructions of the department of health will also be followed to hot spot areas.

Therefore, the current study is kept in mind viewing the Covid situation to understand thebest modality by which their nutrition would be addressed through the existing MDM system.

REVIEW OF LITERATURE

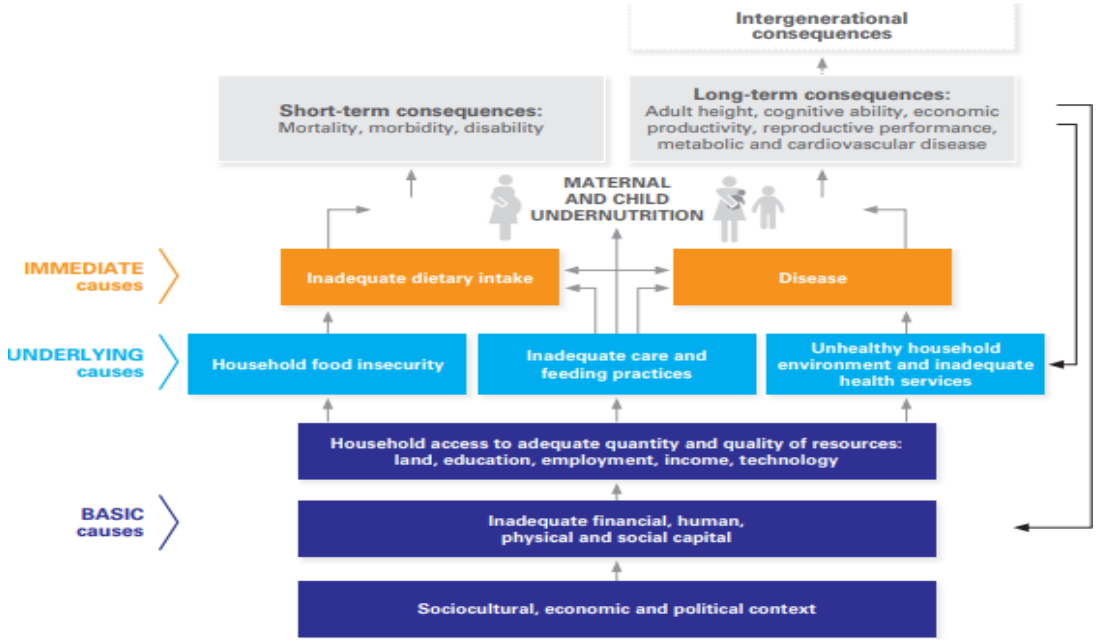
For a healthy mind and body, a balanced diet is very important. According to World Health Organization, "***Malnutrition refers to deficiencies or excesses in nutrient intake, imbalance of essential nutrients or impaired nutrient utilization***" Malnutrition is an umbrella term that encompasses both under-nutrition and over-nutrition (over weight and obesity as well as diet-related NCDs). Term Under-nutrition manifests in four major forms *wasting* (*low weight*-for- height), *stunting* (*low* height-for-*age*), *underweight* (*low weight-for-age*) and *micronutrient deficiencies*.

According to UNICEF, 2013 three broad factors, *viz.* food, health, and care, affect an individual's nutritional status. Adequate nutritional status can be achieved only if the following factors can be ensured;

- Accessibility to affordable diverse & nutrient-rich food
- Appropriate maternal and child-care practices
- Adequate health services
- Healthy surroundings including safe water, sanitation, and good hygiene practices

Children born with LBW (Low birth weight) can lead the greater chances of mortality and morbidity. Less space between two pregnancies and having several children can lead to the transfer of deficiencies into children. When infection and undernutrition interact with each other, they ended up in the vicious cycle of malnutrition. (UNICEF, 2013)

Figure2.1: Conceptual framework of the determinants of child under-nutrition



The black arrows show that the consequences of under-nutrition can feedback to the underlying and basic causes of under-nutrition, perpetuating the cycle of under-nutrition, poverty, and inequities.

Source: UNICEF, (1990)

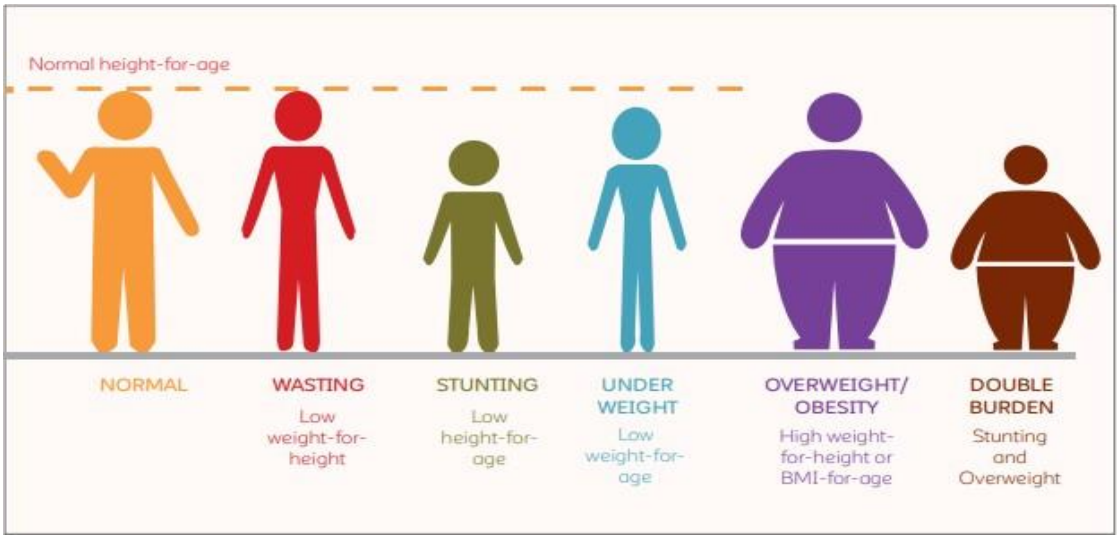
If we take a look into the condition of malnutrition belt of the world, we can say that it is widespread in Sub Saharan Africa; 19.1% (more than 250 million), Latin America; 7.4% (48 million), and it is estimated that 381 million children are undernourished in the Asiancontinent. In Asia, the Prevalence of Undernourishment (PoU) was 8.3%. However, it is lower than the world average of 8.9%. These figures clearly state the high prevalence of food insecurity. Further, this report highlights that more than 2 billion people suffer from food insecurity, out of which 5.9 million in Oceania, 88 million in Northern America and Europe,

205 million in Latin America, 675 million, and *1.03 billion in Asia*. Worldwide the prevalence of childhood stunting in 2019 is 21.3%, i.e., 144 million children and several stunted children in Asia and Africa constitute 54% and 40%, respectively. For achieving the global goal of ***Zero hunger*** of United Nations Sustainable Development Goals, by 2030, it is a precise prediction that Asia, Africa, and Latin American countries are going off track to *Agenda 21*. FAO (2019)

As per the National Family Health Survey-4 (2015-16) report, it is evident that childhood stunting and wasting are very prevalent among the school-aged children of India. Wasting denotes acute malnourishment, whereas Chronic malnourishment of children may lead to stunting. Nutrition during the first 1000 days of life influences the later growth and development of a child. Evidence generated through extensive research suggests that appropriate complementary feeding practices can prevent the likelihood of stunting. It is also very prominent from the research that children who live in unhygienic surroundings are more prone to develop Environmental entero-pathic disorder (EED), making them more susceptible to symptomatic and asymptomatic infections. EED is characterized by mucosal inflammation, altered barrier integrity, and reduced absorption; it may further compromise growth and development. (CNNS, 2018-19)

According to CNNS, (2018-19) in India prevalence of stunting (HAZ <-2 SD), underweight (WAZ <-2 SD), and wasting (BMI-for-age <-2 SD) is 10%, 4% and 23% respectively. The overall prevalence of malnutrition among school-aged children is 22%. Stunting/ low height for age denotes inadequate long-term nutrition due to chronic illness; wasting represents the recent inadequate nutrition due to acute illness, whereas weight for age is a composite index representing both acute and chronic undernourishment. (WHO, Child growth standard median 2009) unfortunately, the prevalence of overweight and obesity is also increasing in India.

Figure2.2: Types of Malnutrition and references measures, India, CNNS 2016-2018



Source: CNNS (2018-19)

Data presented by the Comprehensive National Nutrition Surveys of Gujarat (2018-19) revealthat the prevalence of anemia among children (1-4 years), (5-9 years), and (10-19 years) is 38.5%, 28.5%, and 33.4% respectively. The highest prevalence of anemia was reported in females of 10-19 years of age group, i.e., 45.8%, compared to 21.0%.

STRATEGIES TO OVERCOME MICRONUTRIENT MALNUTRITION

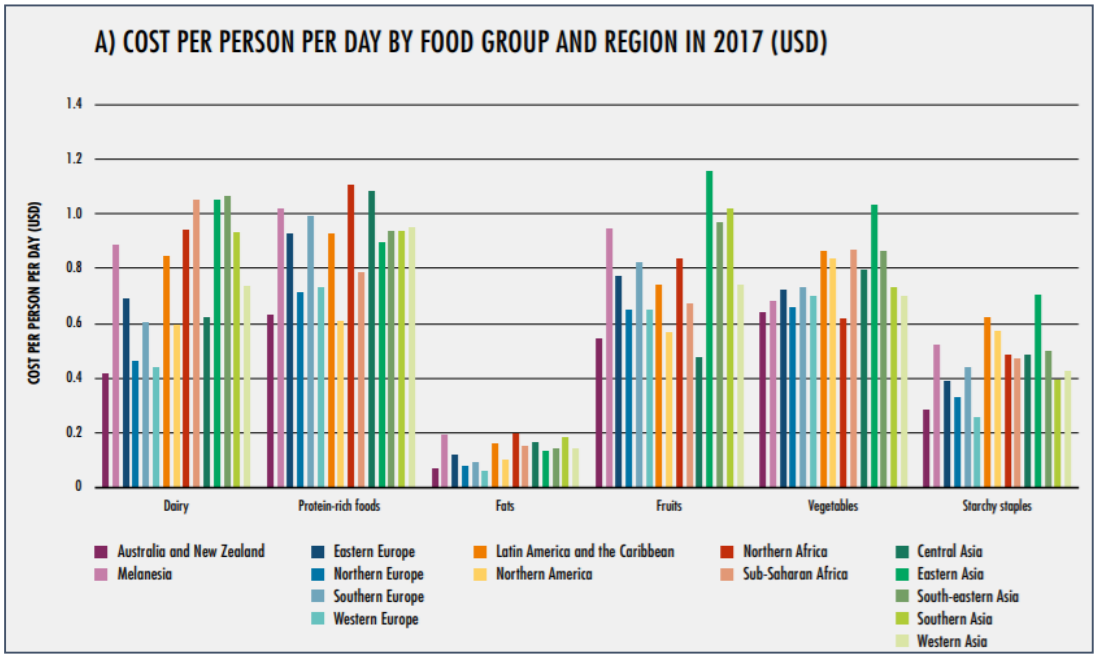
For addressing the micronutrient deficiencies, countries are required to adopt a comprehensive approach. Micronutrient deficiencies are alternately known as Hidden hunger.

(A) **Supplementation-** Supplementation is described as supplying large doses of micronutrients in pills, capsules, or syrups. *Supplementation* is the fastest method of providing micronutrients in a highly absorbable form among public health intervention measures. To control the high prevalence of MMDs in developing countries, the World Health Organization has recommended using supplementationfor Iron and folic acid (IFA), vitamin A syrup for pregnant women and children under5 years of age. India's Weekly iron and folic acid program (WIFA) is an example of this. For water-soluble nutrients, supplements need to be taken more frequently than lipophilic nutrients such as vitamin A, D, E, and K. Supplementation is quite expensive compared to food fortification.

(B) **Improving the diversity of food-** one of the food-based approaches is to include all the five major food groups in your daily routine. However, this approach is also not away from challenges: low purchasing power, non-availability of different food choices, weak food system, high postharvest losses, lack of nutrition education, and taboos towards certain foods. The inclusion of different food choices may lead to appropriate consumption of micronutrients, phytochemicals, and antioxidants, which may further reduce the likelihood of non-communicable diseases. For improving the dietary diversity of the poorest of the poor, there is a need to educate the local community towards locally grown food crops. (21, fortification guidelines2006 WHO)

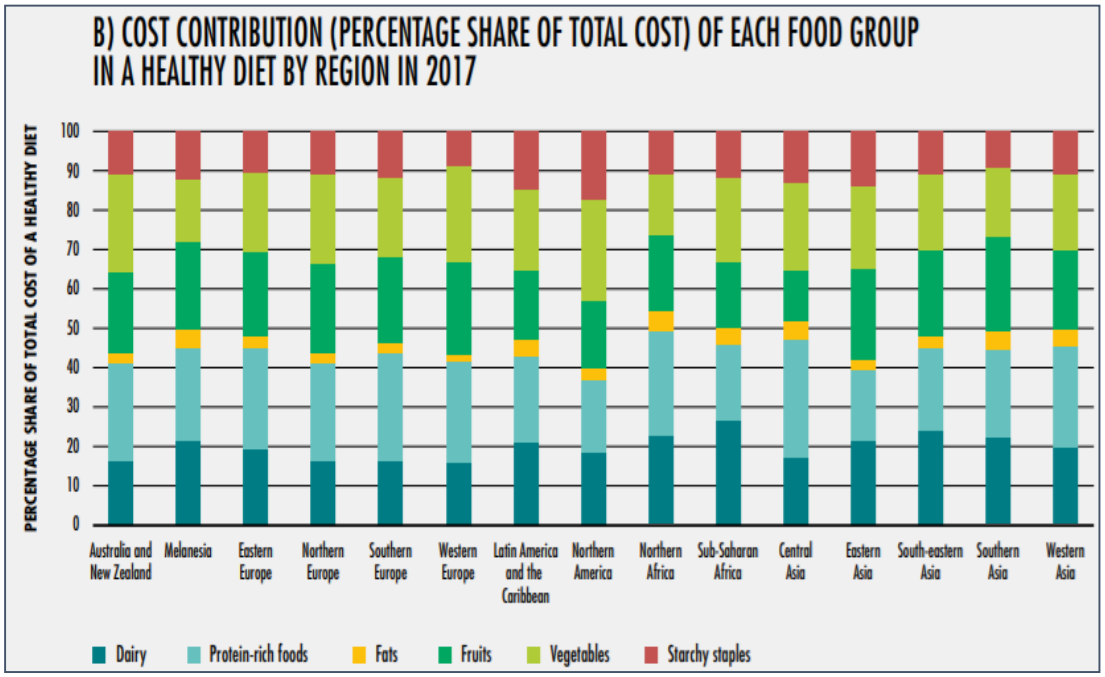
According to Food and Agricultural Organization (FAO), dairy, fruits, vegetables, andprotein-rich foods are the highest-cost food groups for a healthy diet globally in 2017.

Figure 2.3: Cost per person per day by food group and region in 2017 (USD)



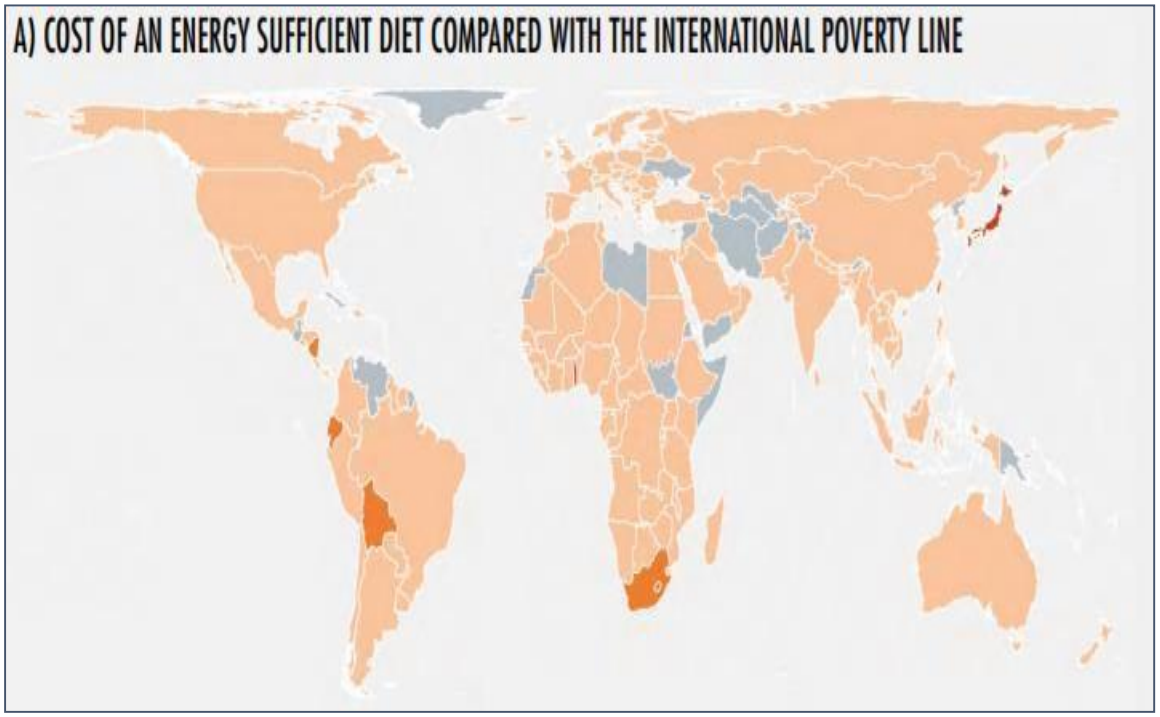
Source: FAO, (2020)

Figure 2.4: Cost contribution (percentage share of total cost) of each food group in ahealthy diet by region in 2017



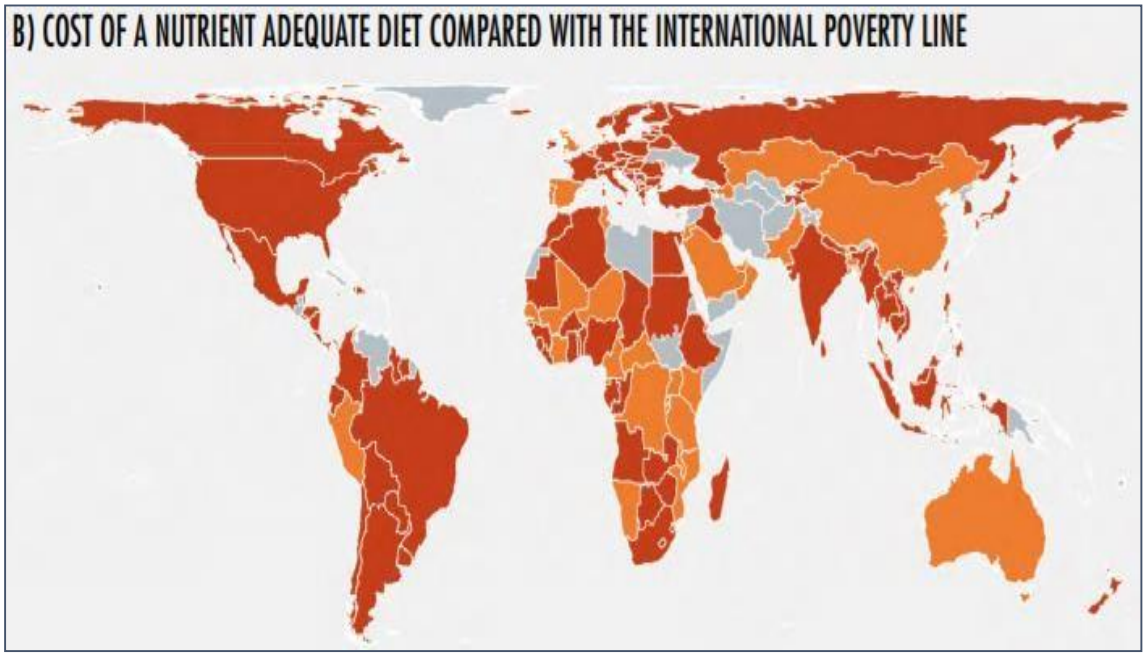
Source: FAO, (2020)

Figure 2.5: Cost of an energy sufficient diet compared with the international poverty line



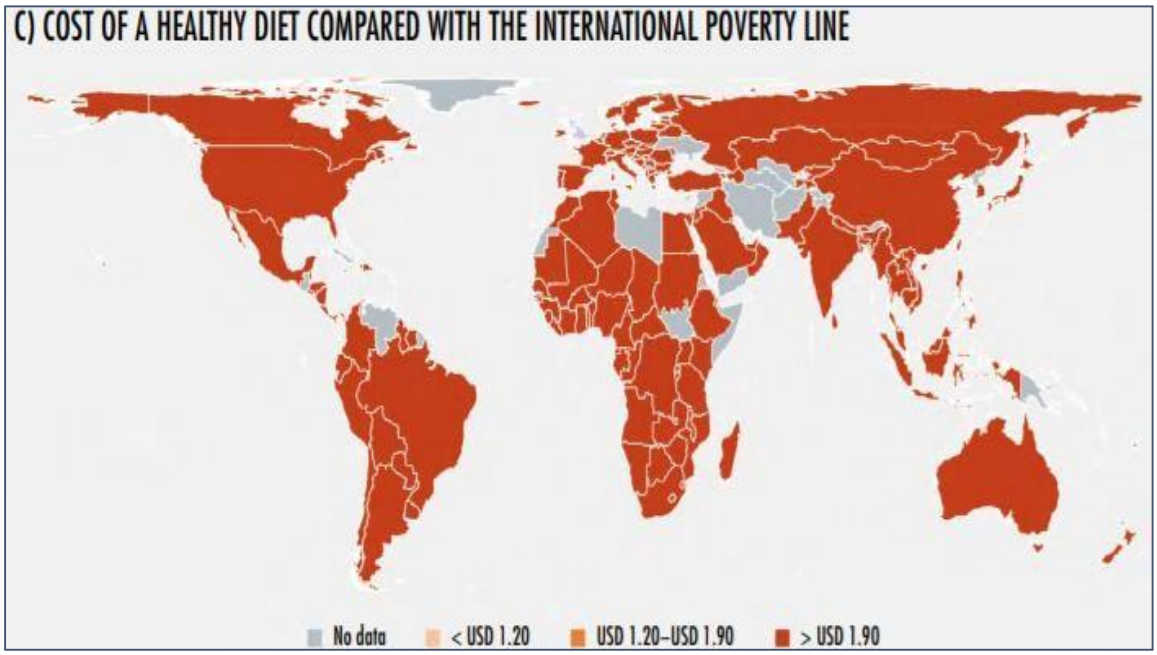
Source: FAO, (2020)

Figure 2.6: Cost of a nutrient adequate diet compared with the international povertyline



Source: FAO, (2020)

Figure 2.7: Cost of a healthy diet compared with the international poverty line



Source: FAO, (2020)

(C) **Food Fortification-** ***WHO*** (2006) defined fortification as the process of „***deliberately adding key vitamins and minerals (including trace elements) in a food to improve the nutritional quality of the food supply and provide a public health benefit with minimal health*** risk.' Fortification can lead to remarkable progress in reducing the high prevalence of micronutrient deficiencies among the low- and middle-income countries if an appropriate distribution system is present in a country. It is regarded as a very cost-effective public health intervention by the Copenhagen consensus 2013. The effectiveness of a fortification program depends upon consumption pattern and acceptability of fortificant vehicle by a large section of sensitive population.

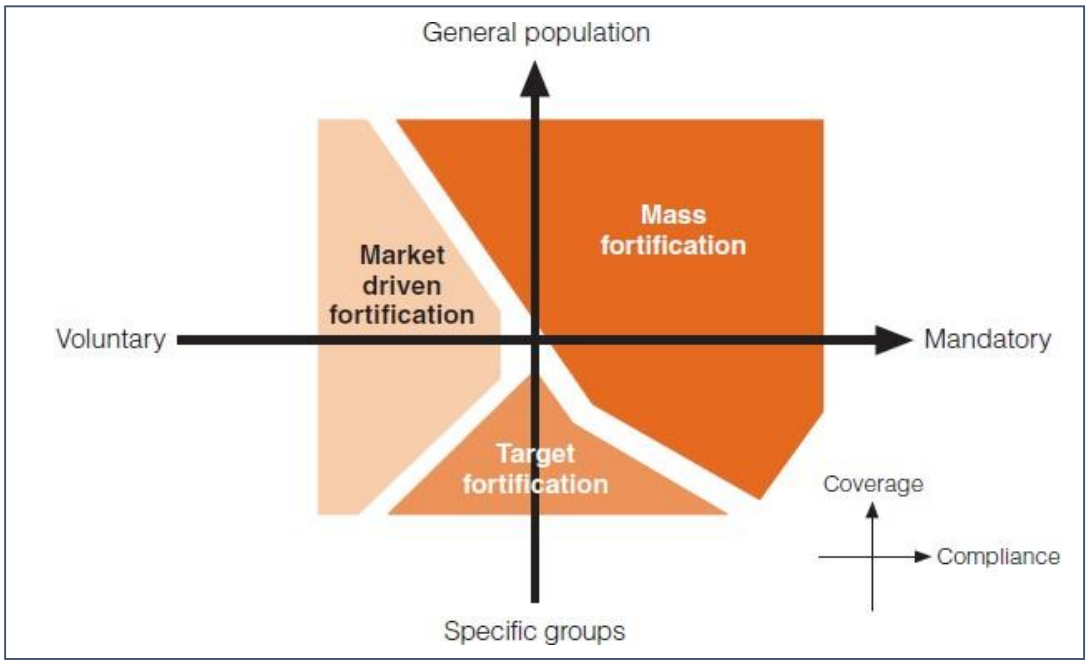
Depending upon the prevalence of a public health problem, fortification can be adopted in several forms. Fortification can be classified into three forms;

(a) ***Mass fortification*** is required when a large section of a population is affected by a specific micronutrient deficiency, and it is generally mandatory. Some examples of mass communication include; Fortification of Folic acid in wheat flour in the United States of America, Canada, and in Latin American countries, the Salt iodizationprogram of India.

(b) ***Targeted fortification*** is introduced when a particular subgroup of a population is affected by a public health concern. It can be either mandatory or voluntary. Some evidence of targeted food fortification is complementary food for infants and young children, blended foods, special foods for school-aged children, special biscuits for high-risk populations, etc.

(c) ***Market-driven fortification*** is described as when a food manufacturer voluntarily fortifies certain food products. It is always mandatory. However, the manufacturer abides by the regulatory norms of the government. Market-driven fortification canplay an essential role in reducing the prevalence of an existing deficiency. It has been observed that Market-driven fortification is a common practice in industrialized countries; however, the evidence is quite limited from the developing countries.(Fortification guidelines, WHO, 2006).

Figure2.8: The interrelationship between the level of coverage, compliance, and the different types of food fortification



Source: WHO (2006)

Advancement in agricultural technologies has opened doors for new ways of growing crops. Genetic engineering technologies are getting attention. Gene transfer techniques are now usedin changing the nutrient content of various crops. Biofortification of crops is becoming a common practice. In India, Biofortified pearl millets ICTP 8203 Fe, released as „***Dhanshakti'***in 2013 in Maharashtra and for all-India cultivation in 2014.

In 2016 Indian Agricultural Research Institute, New Delhi, released genetically modified rice „***Golden rice'*** enriched withpro-vitamin A for preventing vitamin A deficiency disorders. However, this technique is also surrounded by various ethical limitations, and a more significant number of efficacy studies is required before releasing the varieties for general consumption. Biofortification involves creating micronutrient-dense staple crops using traditional breeding techniques and biotechnology.

HISTORY OF FOOD FORTIFICATION (GLOBAL SCENARIO)

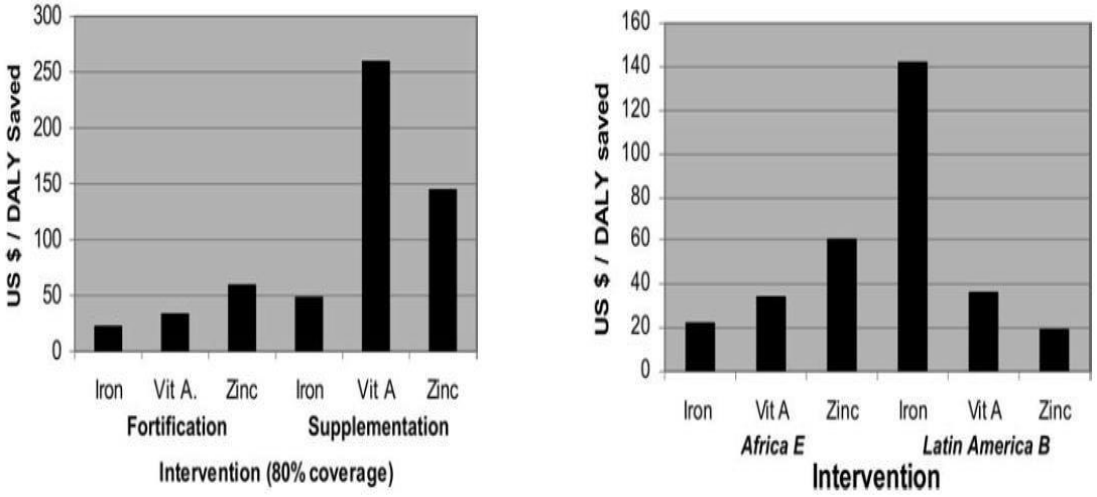
Food fortification is not a new approach for addressing micronutrient deficiencies. Several developed countries have set a landmark in reducing micronutrient deficiencies by successfully monitoring the fortification program. The first fortification vehicle was iodized salt, introduced somewhere in 1920 in Switzerland and the United States of America. Now iodized salt is used as an intervention measure for reducing the likelihood of iodine deficiency disorders in most industrialized and developing countries. Early 1940 was when new doors for fortification of B-group vitamins (*Thiamin, Riboflavin, and Niacin*) were opened. For introducing these vitamins, cereal products were chosen, and the United States of America again came up with another success by mandating fortified wheat flour with B group vitamins. Denmark launched fortification of Margarine with vitamin A and milk with vitamin D was initiated by the United States of America. Later on, fortification of food for young children also became common practice for preventing iron deficiency. In recent years, wheat flour fortification is widespread and adopted by Latin American countries. Now Central American countries are also using fortified sugar to reduce the high prevalence of micronutrient deficiencies. Similar experiences have also been reported from the sub-SaharanAfrican countries. Zambia is currently witnessing the first sugar fortification program.

It can be started from the above discussion that fortification is now becoming a widespread practice as a public health intervention in the less industrialized countries as well.

The Cost-effectiveness of a program influences its public health impact. In other words, the cost-effectiveness of a program directly affects its extent of implication as a public health policy among low- and middle-income countries. The Cost-effectiveness of a

public health intervention is measured by *cost per death averted or cost per disability-adjusted life years (DALYs) saved.* Food fortification has long been considered a preventive public health care intervention. Globally, food fortification is emphasized by various research workers as a long-term public health intervention program as its cost-effectiveness is high as compared to other health interventions.

Figure 2.9: Cost per DALY saved, Africa E, micronutrient interventions and Comparison of the cost-effectiveness of fortification, two regions



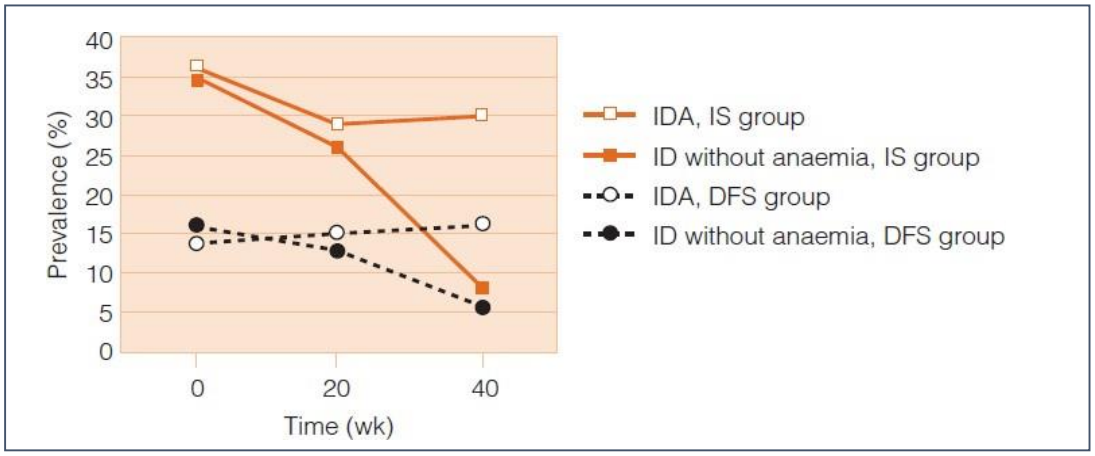
Source: The Economics of Food Fortification, 2006

Despite being a potential health intervention strategy, some lacunae are also faced with a fortification program. Presently very little evidence is available which evaluates the changes in the degree of malnutrition status. Evidence regarding the efficacy trials (trials conducted in controlled feeding situations) is numerous. In contrast, data regarding program effectiveness, which is obtained by measuring the changes in the nutritional status and other outcomes, are less widely available.

In most of the efficacy trials (impact of test intervention under ideal condition) of food fortification, most of the studies reveal an improvement in the micronutrient status of the test subjects.

A randomized, double-blind trial in Morrocan school-aged children (n=367) was carried out for assessing the impact of DFS (double fortified salt with Iron and iodine). It was highlighted that DFS intervention significantly improves the iron and iodine level in school- aged children. It was further noticed that fortified iron groups showed a reduction in thyroxin synthesis; iodine prophylaxis is influenced in iron-deficient subjects.

Figure 2.10-Effect of DFS on the iron and iodine status of Morrocan School-aged children



Source: WHO (2004)

Guatemala initiated fortification of sugar in 1974 for improving the serum retinol level. Itwas noticed that the prevalence of VAD was reduced up to 9% at the end-line compared to 26% at the baseline line.

In 2002, a study was carried out among Brazilian preschool-aged children to assess the impact of fortified orange juice on iron status. It was four months (total of 84 days) intervention trial. Only one child developed diarrhea, but it was disappeared after four days. There was no GIT disturbance observed during the study. Anthropometric measurement and Hb estimations were analyzed. No variation was observed in all the three anthropometric indicators, whereas the prevalence of anemia was reduced up to 20% with the only 4mo of intervention. (Almeida et al., 2002)

Priest et al., 2009 conducted a cross-sectional study to assess preschool-aged children from five different Ontario, Canada. Total 254 preschool-aged ethnically diverse children (3-5 Years) were enrolled for the task. Out of 254 children, the proportion of girls and boys was 130 and 124 respectively. The targeted population consumed different fortified foods (Bread, Pasta, bagels, cookies, and breakfast cereals). When the total intake of folic acid (fortified food & multivitamin supplements) was calculated, the values were above the tolerable upper-level intake (TUL), i.e., 2% for 3Y and 4% for 5Y old children. Whereas children who consumed only fortified food with no multivitamin supplements, their folic acid level was below the TUL. Hence, this efficacy trial shows that consumption of fortified folic acid foodshelps maintain appropriate dietary levels of folate among preschool-aged children.

A randomized, double-blind, controlled trial was carried out in school-aged children of 5-12 years to assess the improvement in the serum transferrin concentration of (sTfR). *Tubani* (a local Ghanian dish made from cowpea flour) was used as a fortification vehicle. The treatment group received 17.2±2.5 mgFe/d, and the control group consumed 10.3±1.3mg Fe/d. This study demonstrates that consumption of fortified cowpea flour significantly improved both functional and storage iron status. Hence it has the potential of reducing the likelihood of iron deficiency anemia and iron deficiency**.** (Abizari et al., 2012)

Friesen et al., 2020 conducted a cross-sectional study in four African countries: South Africa, Tanzania, Nigeria, and Uganda on 18-49 years of WRA (women of reproductive age). This study reveals that fortified foods are the main contributor to regular vitamin A and iodine intake in all four countries. At the same time, iron fortification programs are underperformingdue to the poor quality of iron fortificant, fulfilling only 0-13% of RNI. This study highlights that fortified foods are meeting the RNI intake for vitamin A and Iodine but not for Iron.

Figure2.11: Summary of assumptions regarding effectiveness and program unit costs of fortification

Micronutrient	Assumption
Iodine	Universal salt fortification completely eliminates goiter in the long run
Iodine	Cost approximately $0.10/(person·year) for salt (11)
Iron	Fortification of wheat flour reduces prevalence of anemia by nine percentage points for benefit:cost calculations (6)
Iron	Fortification reduces perinatal and maternal mortality by one-third for cost per DALY calculations (5) (supplementation assumed to reduce mortality by two-thirds)
Iron	Cost approximately $0.12/(person·year) for wheat flour (12)
Vitamin A	Fortification of foods consumed by infants and children ages 6 to 24 months can be adequate to eliminate subclinical vitamin A deficiency (same for high-dose supplementation at 6, 12, and 18 mo)
Zinc	"Home fortification" with 5 mg of zinc gluconate administered 60 times over a 4-mo period is enough to protect children from higher diarrhea risk in situations of intermediate/high deficiency
Zinc	Cost approximately $0.90/child for 2-mo course (annual cost would be 6 times this) for home fortification including other micronutrients (7); fortification cost of wheat flour with zinc sulfate approximately $0.24/(person·year) (author's estimate); zinc oxide could be as low as $0.06/(person·year) (author's estimate)

Source: The Economics of Food Fortification, 2006

According to the Copenhagen consensus, investing about $120 million in micronutrient interventions in south Asia and sub-Saharan Africa (bio-fortification, zinc, and vitamin A) can reduce DAILY losses attributable to micronutrient malnutrition by 2 million DAILY's. Investing about $ 800 million in nutrition education (breastfeeding and complementary feeding) can reduce DAILY losses attributable to stunting and wasting by 10 million DAILYs. Copenhagen Consensus, (2008)

The effectiveness of the fortification program is controlled by various groups of factors such as quantitative and qualitative characteristics of premix, consumption pattern of the vehicle, organoleptic properties of a vehicle, etc. (Dwyer et al., 2015).

INDIAN EVIDENCE

Muthayya et al., 2009 conducted an efficacy trial on 6-10 years school-aged children of Bangalore, Karnataka, for assessing the correlation of n-3 PUFA (polyunsaturated fatty acid) and linear growth of children. For conducting the study, four intervention groups were decided, i.e. (High micronutrient, high n-3), (High micronutrient, low n-3), (Lowmicronutrient, high n-3), (Low micronutrient, low n-3). Results of their study reported that among all the four intervention groups, children who received higher micronutrient intervention (900 mg Alpha linoleic acid and 100mg of DHA) showed significant improvement in linear growth at the end-line of the study, i.e. (12 months) compared to low micronutrient intervention (140mg ALA with no DHA). Further increase in haemoglobin, ferritin, body iron stores, vitamin B12, and the folic acid level was significant.

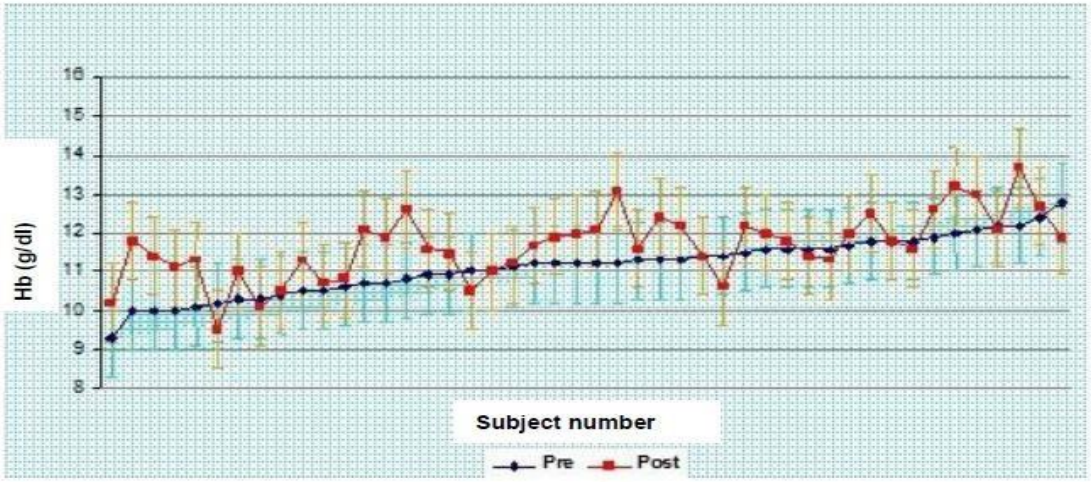
Thankachan et al., 2012 carried out randomized, double-masked placebo control trials on 6- 12 years school-aged children of Karnataka. For providing nutrition interventions, three interventions groups were developed *viz*; first groups received extruded fortified rice with 12.5 mg Fe/g; the second group received multiple micronutrients fortified rice with an iron concentration of 6.5mg/g, and the third group received an identical control meal of unfortified rice for six months at a rate of 6 days/week. No IFA deworming tablet was given to enrolled children (i.e., 258). End-line results of the study reveal that the hemoglobin level of the first and second treatment group was increased compared to their baseline results. Still,it was unaffected

in the control group at ($p<0.05$). In both the groups who received fortified rice, homocysteine level decreased, and plasma B_{12} level increased ($p<0.001$). However, no difference was observed in serum retinol, thiamin, zinc concentration, and anthropometric measurement and morbidity symptoms among the control and treatment groups at 6 months. The researchers also stated that the iron concentration of fortified rice (6.25-12.5 mg) is muchlesser than the concentration of IFA (20mg of $FeSO_4$).

Muthayya et al., 2012 carried out a study in 379 school-aged children (n=186; treatment group and n=193 control group) of Karnataka. The study's experimental group received three chapattis made by 100gram of fortified wheat flour/meal daily. The treatment group received 11.2±0.7 mg Fe, and the control group received 5.1±0.6 mg Fe. Because of the excellent organoleptic properties of ferric sodium ethylene diamine tetraacetate (NaFeEDTA), this particular fortificant was used. This study supported that NaFeEDTA is an excellent fortificant for wheat flour fortification.

Nair et al., 2013 conducted a study for assessing the impact of DFS on iodine and iron status of school-aged children (6-12 Y) of rural Vadodara. A total of ten villages were randomly selected. Improvement in the hemoglobin status [11.1 mg/dl (Base-line) 11.6mg/dl (End-line)] was observed at the end of the supplementation period, i.e., two months. In contrast, urinary iodine status was increased from 44.4 µg/L[Base-line] to 110.2 µg/L [End-line].

Figure2.12 : Distribution of Hb before and after DFS supplementation



Source: Nail et al., 2013

Joshi and Nair, 2014 conducted a DFS based intervention among 947 school-aged children upto 9 months in Vadodara, Gujarat. They reported that the mean height of the children was increased by 6.36 ±1.86 cm (122 (Base-line) -128.42 (End-line) and mean weight by 3.40 ±

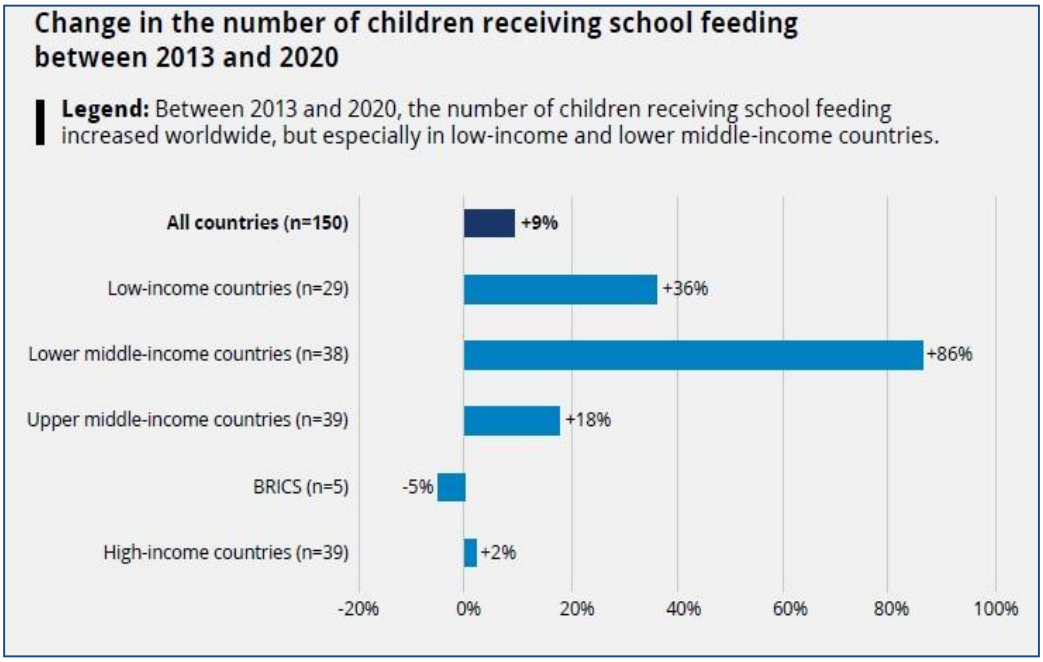
1.80 kg [20.83 (Base-line) - 24.23 (End-line). The DFS+DW group highest increment in height and weight was observed compared to the DFS, IS+DW, and IS group. Furtherhemoglobin concentration among the experimental groups (DFS+DW & DFS) after receiving intervention was increased from [(8.67 (Base-line)-9.09 (End-line)] however it was decreasedsignificantly ($p<0.001$) in the control groups [(-0.54 g/dl) (IS+DW and IS)].

IMPACT OF COVID-19 OVER MALNUTRITION

SARS-nCoV-2 is popularly known as COVID-19 is declared a pandemic by the World Health Organization on the 11th of March 2020. This was the fifth pandemic following 1918 influenza virus (H1N1), 1957 influenza virus (H2N2), 1968 influenza virus (H3N2), and 2009 Pandemic flu (H1N1), that resulted in the human deaths of around 50 million, 1.5 million, 1 million, and 300 000, respectively (Liu et al., 2020). COVID-19 adversely affected the poorest segment of the population globally; due to the restriction in movement and social distancing measures adopted by countries, food supply chains were severely disrupted. Further prolonged lockdown increases the atrocities for the marginalized section of thepopulation. It impacted the lives of millions of people in India. COVID-19 has emerged as a storm of global malnutrition. It declines individuals' dietary quality, especially among the low and middle-income countries (LMICs). School feeding programs were severely affectedduring this lockdown which directly influences a child's nutritional status. According to Heady and Ruel, 2020 prevalence of malnutrition will be increased during COVID-19 due to failure of the health care system as the current focus is to provide health care services to the patient suffering from infection rather than delivering nutritional benefits to the vulnerable section of the population.

Due to the urgent need for a lockdown to prevent the spread of deadly viruses, approximately every country adopted lockdown as a preventive measure. But it exacerbated the cycle of malnutrition, especially among children, due to the closure of their school. According to the State of World School Feeding Program of WFP, 2020 school feeding programs are currently the most prominent social protection program benefitting approximately 388 million children globally. It was observed that from 2013- 2020, the school feeding program increased from 20% to 75%, and these programs are concentrated mainly in the LMICs.

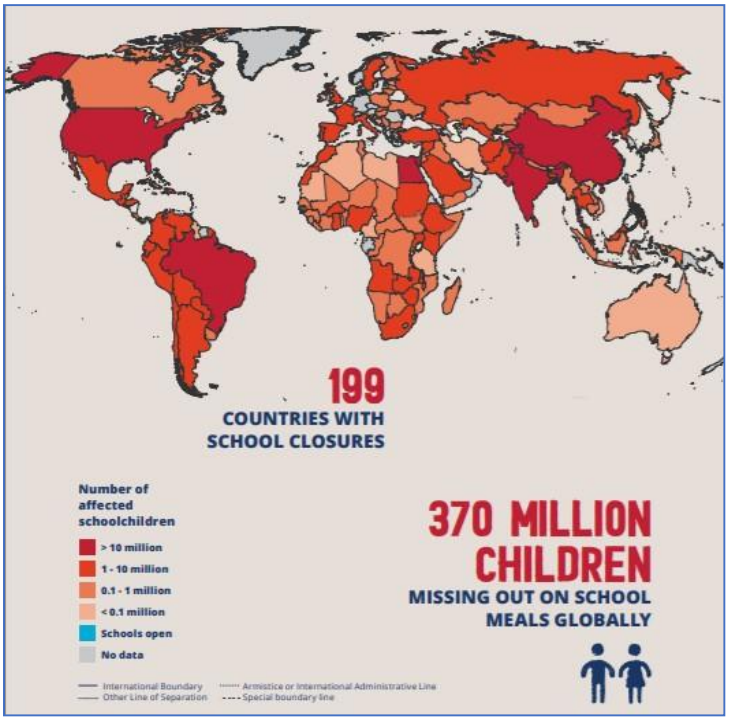
Figure2.13 : Change in the number of children receiving school feeding between 2013 and 2020



Source: WFP, (2020)

COVID-19 adversely affected the school feeding programs throughout the World. United Nations Nobel Peace prize winner of 2020, the World Food Program, estimated that approximately 370 million school-aged children missed their main meal of the day due to the COVID-19 health crisis, also known as the „***Historical Education Crisis'*** deprived about 1.5 billion children of their regular schooling. Children from LMICs were the most affected victims of this pandemic.

Figure2.14 : WFP global monitoring of school meals during COVID-19 school closures



Source: World Food Program, (April 2020)

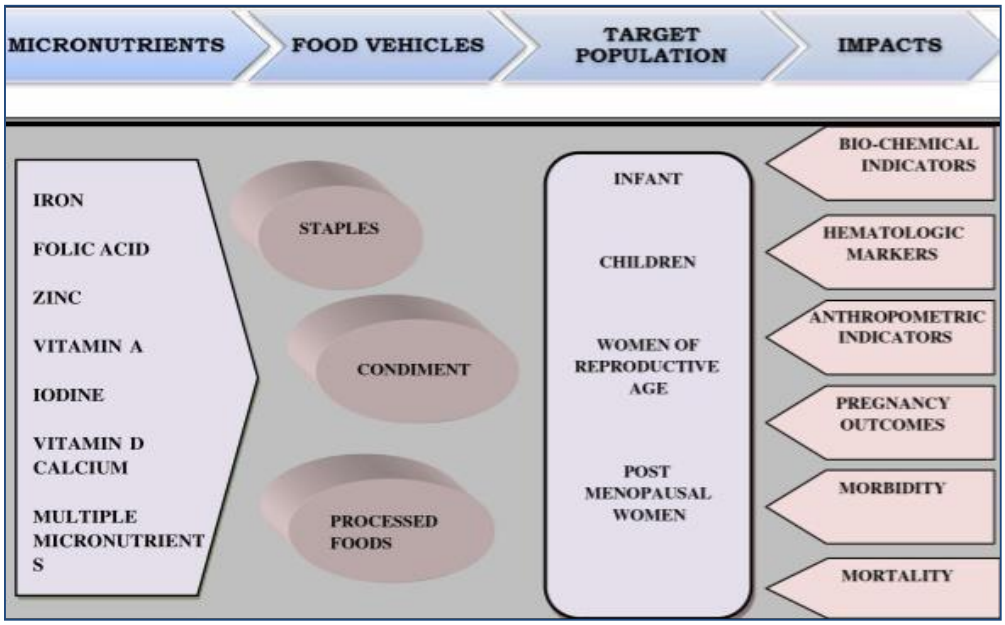
COVID-19 affected the nutritional status of school-aged children and significantly affected the learning outcomes of the children. Due to the urgent closure of the school in many developing countries, children were not exposed to ECCE (early childhood care and education) and foundational literacy, which hampered their educational outcomes. This process further leads to inequality in terms of educational outcomes, mainly among the LMICs. Countries should reopen schools, but following preventive fundamental measures need to be taken;

- ✓ Mechanisms to prevent infections such as hygiene and environmental cleaning to limit exposure
- ✓ Mechanisms to screen for infections by training teachers and school administrators on COVID-19 preventative measures and essential case management
- ✓ Mechanisms to isolate students or staff who shows signs of infection by ensuring the availability of a designated room or separate area, while measures are taken to transport the person to a health care facility and trace potentially exposed individuals. (UNESCO et al., 2020)

MICRONUTRIENT DEFICIENCY

Micronutrient deficiencies are defined as imbalances in the consumption of vitamins and Minerals. Micronutrient deficiencies (MMDs) are a very prevalent health concern globally. Unfortunately, MMDs are widespread in every age group. Globally vitamin A deficiency disorders, Iron deficiency anemia (IDA), and Iodine deficiency disorders (IDD) are the primary public health concern. WHOs south-East Asian region is home to approximately one-quarter of a population, i.e., nearly two billion people. (WHO, 2021)

Figure2.15 : Conceptual Framework of Micronutrient fortification



Source: Das et al., 2013

Risk factors for micronutrients malnutrition are;

- Consumption of Monotonous diet
- Low consumption of animal source foods
- Low micronutrient density of complementary food
- Increased excretion (e.g., due to schistosomiasis)
- Seasonal variations in food availability, food shortages
- Social deprivation, illiteracy, low education
- Poor economic status and poverty

- Increased physiological demands for growth during pregnancy and lactation
- Increased demand due to acute infection (especially if infection episodes are frequent), chronic infection (e.g., tuberculosis, malaria, and HIV/AIDS), and disease (e.g., cancer)
- Mal-absorption due to diarrhea or the presence of intestinal parasites (e.g., *Giardia lamblia*, hookworms) (WHO, 2006)

PREVALENCE OF MICRONUTRIENT DEFICIENCY

From India's *Comprehensive National Nutrition Survey*, *2018*, it can be clearly stated that appropriate data is not available on micronutrient deficiencies across all the age groups (among preschool children and school-aged children). Earlier national and sub-national surveys (NNMB, NFHS, DLHS, and AHS) provided some but insufficient information on risk factors for non-communicable diseases in children.

For the first time, CNNS (2018) presented the prevalence of crucial micronutrient deficiencies in Indian children.

(A) ANEMIA

According to the World Health Organization, "***Anemia is a condition of low blood hemoglobin level (<11.0g/dl)"***. The following table represents the cut-off values for anemia for different age groups.

Table2.1: Cut off values for Anemia

Anemia	Hemoglobin level (g/dl)		
	Children aged (1-4 years)	**Children aged (5–11 years)**	**Adolescents aged (12–14 years)**
Any anemia	<11.0 g/dl	<11.5 g/dl	< 12.0 g/dl
Mild anemia	10.0–10.9 g/dl	11.0–11.4 g/dl	11.0–11.9 g/dl
Moderate anemia	7.0–9.9 g/dl	8.0–10.9 g/dl	8.0–10.9 g/dl
Severe anemia	<7.0 g/dl	<8.0 g/dl	<8.0 g/dl

Source: Haemoglobin concentration for diagnosis of anemia and assessment of severity, Geneva, WHO, 2011

The severity of anemia denotes its public health concern (i.e., mild, moderate, and severe) ina country. The following table represents the cutoff values for anemia.

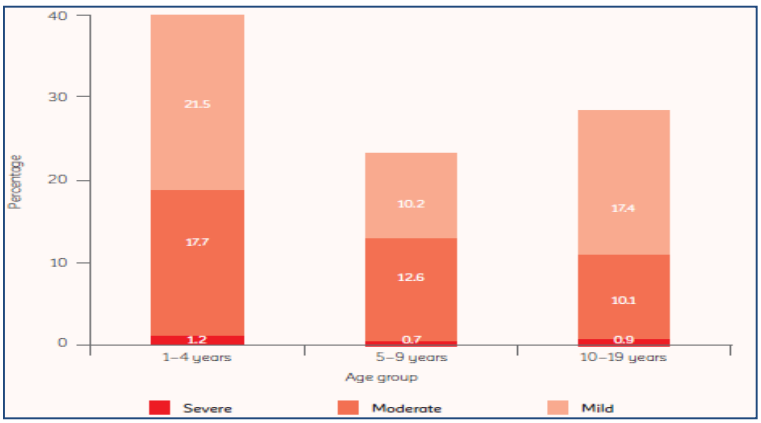
Table2.2 : Level of public health concern

Prevalence of anemia (%)	Category of public health significance
< 5%	No public health problem
5% - 19.9%	Mild public health problem
20% - 39.9%	Moderate public health problem
>40%	Severe public health problem

Source: Department of Nutrition for Health and Development, World Health Organization, 2011

Let's look into the national anemia status of all the Indian states. We can say that anemia is at least a mild public health problem in all the states except Kerala. In 15 states, it is a moderate to severe public health concern among school-aged children (5-9 years), whereas, among preschoolers, it is a moderate to severe public health concern in 27 states in India.

Figure2.16: Severity of anemia across the three age groups



Source: CNNS, (2018)

(B) Vitamin A Deficiency Disorders

Vitamin A is required in small concentrations for regular maintenance of cells, immune system, visual cycle, and reproductive health. In nature, vitamin A found in two forms, i.e., pro-formed vitamin A (plant-based diet) and preformed vitamin A (animal-based diet). Based on the evidence, it can be clearly stated that vitamin A deficiency is an important determinant of child survival and safe motherhood. Contributing factors responsible for VAD are a diet low in sources of vitamin A (i.e., dairy products, eggs, fruits, and vegetables), poor nutritional status, and a high rate of infections, particularly measles and diarrheal diseases. (WHO, 2006)

Figure 2.17: Criteria for assessing the public health severity of vitamin A deficiency

Criteria for assessing the public health severity of vitamin A deficiency

Indicator	Population group	Prevalence indicating a public health problem (% of the population)
Night blindness	Pregnant women	>5
Night blindness	Children 24–71 months	>1
Bitot's spots	Children 24–71 months	>0.5
Serum retinol <0.7 µmol/l (<20 µg/dl)	Children 6–71 months	≥10

Source: WHO, Fortification Guidelines (2006)

In India, as per the CNNS-2018, school-aged children are at the highest at-risk age group for developing VAD. It was estimated that approximately 22% of school-aged children, 18% preschoolers, and 16% adolescents (10-19 years) are very prone to VAD. It was also observed that the prevalence of VAD is more among poorer households, i.e., 24%, compared to the rich, i.e., 11%. In India, 12 states come under severely affected with VAD among preschool-aged children and in four states among adolescents.

(C) Iodine Deficiency Disorders (IDD)

Iodine is present in minimal quantity in the thyroid gland. IDD is a significant public health concern among pregnant and young children. Iodine deficiency is very well known for cognitive impairment, decreased fertility, goiter, increased susceptibility of the thyroid gland to nuclear radiation, and increased perinatal death and mortality rate. Median urinary iodine and total goiter prevalence are used to assess the extent of public health concerns in a region. The following table represents the cut-off values for iodine status in an individual.

Figure 2.18: Criteria for assessing the public health severity of iodine deficiency

Severity of public health problem	Indicator	
	Median urinary iodine (µg/l)	Total goitre prevalence (%)
Mild	50–99	5.0–19.9
Moderate	20–49	20–29.9
Severe	<20	>30

Source: WHO, (2001)

According to World Health Organization, an adult requirement of iodine is 150 microgram/day. According to ICMR, recommended dietary allowance for Indian preschool children and school-aged children varies from 90 micrograms to 150 micrograms per day.

(D) Vitamin B9 (Folate) and Vitamin B_{12} (Cyanocobalamine)

Vitamin B_9 is also known as folate. It plays a central role in the synthesis and methylation of nucleotides. Both the micronutrients work for the erythropoiesis repair of body cells etc. It works very closely with vitamin B12 in protein synthesis and metabolism. When B_{12} and folate are present in low concentrations, developing megaloblastic anemia could be high. In adults, both B9 and B12 deficiency can lead to increased susceptibility to cardiovascular diseases, cancer, impaired cognitive function, and pregnant women's chance of giving birth toinfants born with NTDs.

Figure 2.19: serum vitamin B_{12} concentration and serum erythrocyte folate concentration to diagnose deficiency among children and adolescents

Age	Vitamin B12 deficiency	Folate deficiency
1–9 years	Serum vitamin B12 < 203 pg/ml	Serum erythrocyte folate < 151 ng/ml
10–19 years	Serum vitamin B12 < 203 pg/ml	Serum erythrocyte folate < 151 ng/ml

Source: World Health Organization, (2008)/ guidelines

Among children, the highest prevalence of folate deficiency was reported in school-aged children (5-9 years) and adolescent (10-19 years) is 28% and 37%, respectively, whereas, among preschoolers, it is approximately 23%. Prevalence of B12 deficiency ranged from 2%

-24% among children aged 1–4 years in West Bengal and Gujarat. From 0% in Nagaland and 1% in Kerala to 31% in Uttar Pradesh and 32% in Punjab among children aged 5–9 years and2% in Kerala and Nagaland to 48% in Gujarat among adolescents aged 10–19 years. (CNNS, 2018-19)

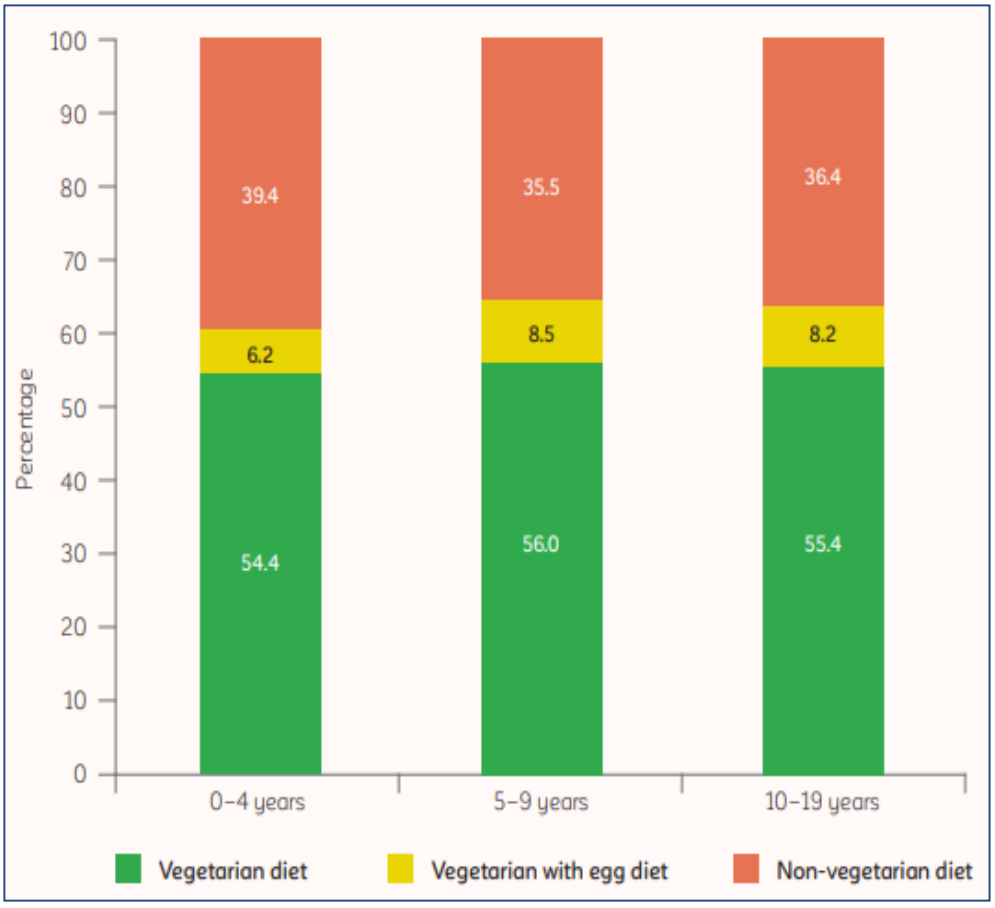
DIET QUALITY OF INDIANS

Diet plays a crucial role in dealing with deficiencies. A well-balanced diet consists of an adequate proportion of nutrients, i.e., carbohydrates, fat, protein, vitamins, and minerals.

Perishable food products are rich in micronutrients, but they are costly compared to staple food products. India is known for its diverse cuisine, and some food products have a social identity. The majority of the people in India follow vegetarian diets, which are high in fruits, vegetables, and pulses. However, there is a difference in dietary patterns across the various regions of India. Still, the North and western parts of India showed some similarities compared to the east and south. With time it was also observed that trend of consumption of unhealthy food is increasing. The dietary pattern is now more of high in energy, salt, and sugar. Green et al. (2016)

Data on weekly dietary consumption of children demonstrates that approximately 85% of children consume cereals while only <5% of children consume protein-rich foods such as eggs, fish, and chicken. It was estimated that nearly 85% of school-aged children consume green leafy vegetables once a week, whereas approximately one-third of children take eggs/ meat/fish once a week. About 60% of the children take milk or curd only once a week. CNNS, (2018)

Figure 2.20: Type of diet consumed by age group



Source: CNNS, (2018)

POLICIES OF THE GOVT. OF INDIA FOR ENSURING NUTRITION SECURITY

For improving the nutritional status of household social safety net programs such as Public distribution scheme (PDS), Integrated child development services (ICDS), Mid-day meal (MDM) was launched by the Government of India in 1947, 1975, and 1995. In October 2007,the Ministry of Agriculture launched the National Food Security Mission for ensuring nutritional security of the entire population with a motto of increasing the production of wheat, rice, and pulses. This scheme increased the production of staples and continued duringthe 12^{th} five-year plan or the final five-year plan (2012-17) of the planning commission of India. Later on, in 2013 National Food Security Act (NFSA) was launched to ensure nutritionsecurity to almost 50% of the urban and 70% of India's rural population. All these schemesare doing remarkable work in their respective spheres.

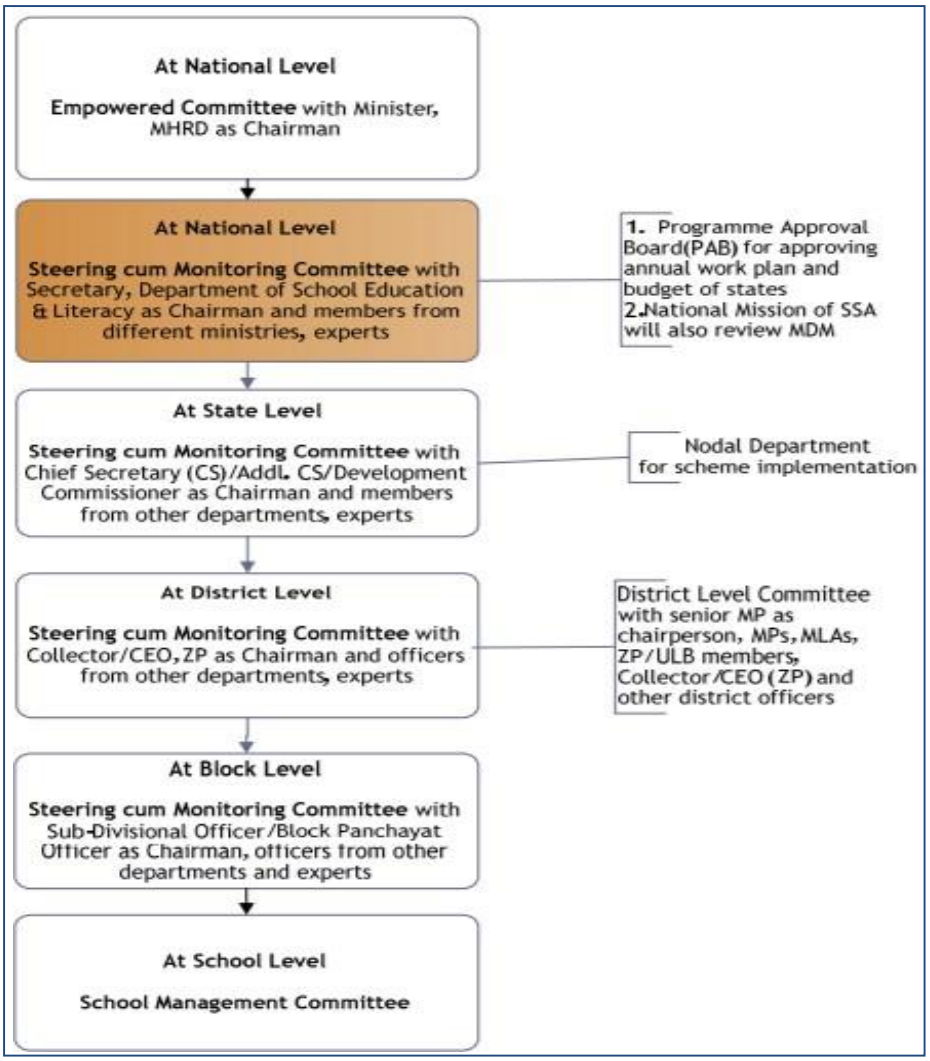
MIDDAY MEAL- A NUTRITIONAL MANAGEMENT STRATEGY FOR SCHOOL AGED CHILDREN IN INDIA

For reducing the prevalence of malnutrition among children (preschoolers and school-aged children), India is currently operating the two most extensive feeding program in the world, i.e., Integrated Child Development Services (works under the Ministry of Women and Child Development) and Mid Day Meal Scheme (operated by the Ministry of Education). Since its inception, it has been more than 25 years to MDM and more than 45 years to ICDS. Still, we did not get remarkable success against malnutrition. The target of zero hunger or No hungerof United National Sustainable development goals is still miles away to achieve.

Improving the nutritional status of *school-aged children*, the National Program of Nutritional Support to Primary Education (NP-NSPE), commonly known as *the Mid-day meal scheme*, was launched in 1995 as a centrally sponsored scheme for children studying in Govt. schools under the leadership of former Prime Minister P.V. Narsimha Rao. Officially Tamil Naduwas the first state from where the provision of the hot cooked meal was started in 1925during the reign of British administration in India. Gujarat was the second state that started MDM in 1982 but later on, due to some reasons, it discontinued. In the year 2008-09, this scheme was extended up to upper primary classes. (Ministry of Education, Govt. of India, 2021)

For effectively implementing the MDM, the following institutional framework has been designed by the Government of India.

Figure 2.22: Institutional Structure of Mid-Day Meal



Source: Mid-Day Meal Scheme Manual, (2017)

Mid Day Meal Scheme was launched with the following objectives;

(1) Increasing the Gross enrollment ratio of school children

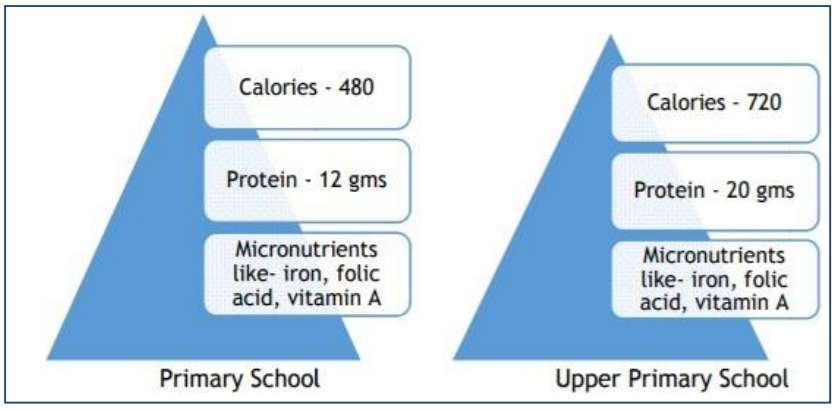
(2) Reducing the dropout rate among school-aged children (6-14 years)

(3) Ensuring nutrition security of school children studying in Govt., local body Govt. aided schools, Special Training Centre (STC), Madarsas and Maqtabs supported under the Serva Sikha Abhiyan (now Samagra Siksha Abhiyan)

(4) Attracting children from a disadvantaged section of the society

(5) Providing nutritional support to children belonging from drought-affected areas during summer vacation

Figure 2.23: Quantity of food calories and protein intake



Source: MDM scheme Manual, (2017)

Figure 2.24: Nutrient content of mid-day meal/day

Item	Primary (class one to five)	Upper primary (class six to eight)
Calories	450	700
Protein (in grams)	12	20
Rice / wheat (in grams)	100	150
Dal (in grams)	20	30
Vegetables (in grams)	50	75
Oil and fat (in grams)	5	7.5

Source: Ministry of Education, Govt. of India, (2021)

Figure 2.25: Children receiving Mid day meal

Source: MDM, 2021

Figure 2.26: Revised cooking Cost per child per day

Revised Cooking cost per child per school day w.e.f. 1.07.2016						
Stage	Total Cost	Central-State Sharing				
		Non-NER States (60:40)		NER-States (90:10) & 3 Himalayan States		All UTs (100%)
		Central	State	Central	State	
Primary	Rs.4.13	Rs.2.48	Rs.1.65	Rs.3.72	Rs.0.41	Rs.4.13
Upper Primary	Rs. 6.18	Rs. 3.71	Rs. 2.47	Rs. 5.56	Rs. 0.62	Rs. 6.18

Source: FFRC, FSSAI, (2021)

Recently the Department of Food & Public Distribution has concurred *the "additional allocation of 445705.12 MTs of food grains comprising 165595.16 MTs of wheat and 280109.96 MTs of rice vide O.M. No. 4-2/2020-BP-II(e-370832) dated 12.02.2021 at National Food Security Act (NFSA) rates, i.e., Rs.2.00 per kg for wheat and Rs.3.00 per kgfor rice to 22 States & UTs under National Programme of Mid-Day Meal in Schools (MDMS)for the additional coverage of children and working days over and above the PAB-MDM approval for the financial year 2020-21".(*As per the order of MDM, 2021)

Figure2.27: Allocation of additional food grains to 22 States & UTs over and above the PAB approval for 2020-21 under Mid Day Meal

Sl.No	Name of the States/UTs	Additional food grains (in MTs)						Total (in MTs)		
		Primary		Upper Primary		STCs				
		Rice	Wheat	Rice	Wheat	Rice	Wheat	Rice	Wheat	Total
1	Andhra Pradesh	2503.93		2820.15		0.00		5324.08	0.00	5324.08
2	Assam	1270.50		6924.02		0.00		8194.52	0.00	8194.52
3	Chhattisgarh	2231.56		2178.32		0.00		4409.88	0.00	4409.88
4	Goa		144.00		301.69			0.00	445.69	445.69
5	Gujarat	8203.34	8203.34	6661.20	6661.20			14864.54	14864.54	29729.08
6	Jharkhand	10133.11		4012.50		0.00		14145.61	0.00	14145.61
7	Kerala	783.16		1996.01		0.00		2779.17	0.00	2779.17
8	Madhya Pradesh	8964.92	19316.28	9636.51	18393.66	41.97	40.76	18643.40	37750.70	56394.10
9	Manipur	276.83		133.16		0.00		409.99	0.00	409.99
10	Meghalaya	531.49		835.86				1367.35	0.00	1367.35
11	Odisha	10390.77		11515.53		0.00		21906.30	0.00	21906.30
12	Punjab	2255.93	2255.93	1831.54	1831.54	0.00		4087.47	4087.47	8174.94
13	Rajasthan	8264.52	16529.05	5883.02	11766.04			14147.54	28295.09	42442.63
14	Uttar Pradesh	84250.74	41496.59	61696.27	30387.71			145947.01	71884.30	217831.31
15	Uttarakhand	1082.20		1035.80		0.00		2118.00	0.00	2118.00
16	West Bengal	4714.79		4290.90				9005.69	0.00	9005.69
17	A&N Islands	70.07		74.51		0.00		144.58	0.00	144.58
18	Chandigarh	271.76	181.18	456.29	304.19			728.05	485.37	1213.42
19	D&NH & Daman&Diu	131.93		341.36		0.00		473.29	0.00	473.29
20	Delhi	3684.73	3684.73	4097.27	4097.27	0.00		7782.00	7782.00	15564.00
21	Jammu & Kashmir	1702.05		1916.01		0.00		3618.06	0.00	3618.06
22	Lakshadweep	7.31		6.12		0.00		13.43	0.00	13.43
	Total	**151725.64**	**91811.10**	**128342.35**	**73743.30**	**41.97**	**40.76**	**280109.96**	**165595.16**	**445705.12**

Source: Ministry of Education, Govt. of India, (2021)

FORTIFIED STAPLES UNDER THE GOVT. SAFETY NET PROGRAMS

The Food Safety and Standards Authority of India (FSSAI), established under the FSSAI act 2006, is an autonomous organization that works under the Ministry of Health and Family Welfare. FSSAI released fortification standards under the ***Draft Food Safety & Standards (Fortification) Regulation in 2016*** for staple commodities (Fortified Rice, Fortified Wheat Flour, Double fortified Salt, fortified Milk, and fortified oil).

Salt shall be fortified with Iodine and may also be fortified with iron in combination with iodine, at the level given in the table below:

Table 2.3: Fortification standards for Double Fortified Salt

Sl. NO.	Component	Levels of nutrients	Source of nutrients
1.	Iodine content		
	(a) Manufacture level (b) Distribution channel including retail level	20-30 parts per million (ondry weight basis) 15-30 parts per million (ondry weight basis)	Potassium Iodate
2.	Iron content (as Fe)	850-1100 parts per million	Ferrous sulphate or Ferrous Fumarate

Source: Food Safety and Standards (Fortification of Foods) Regulations,2017

Toned milk, double toned milk, skimmed milk and standardized milk, when fortified, shall befortified with the following micronutrients at the level of given in the table below:

Table 2.4: Fortification Standards for Milk

SI.No.	Nutrients /Source	Level of nutrient per litre of Species identified milk (namely buffalo milk, cow milk, goat milk, sheep milk and camel milk)/ full cream milk/toned milk/double toned milk/skimmed milk/standardized milk
1.	Vitamin A (µgRE)-Retinyl acetate or Retinyl palmitate	270 - 450
2.	Vitamin D (µg) *Cholecalciferol or*Ergocalciferol (*Only fromPlant source)	5-7.5

Source: Food Safety and Standards (Fortification of Foods) Regulations,2017

Vegetable oil shall be fortified with the following micronutrients, at the level of given belowin table:

Table 2.5: Fortification Standards for Edible oil

SI. No.	Nutrient	Level of nutrient	Source of nutrient
1.	Vitamin A	6 µg RE - 9.9 µg RE per gm of oil	Retinylacetate orRetinyl palmitate
2.	Vitamin D	0.11 µg– 0.16 µg pergm of oil.	Cholecalciferol orErgocalciferol (Only from Plant Source)

Source: Food Safety and Standards (Fortification of Foods) Regulations,2017

Atta, when fortified with shall contain added iron, folic acid, and vitamin B12 at the level ofgiven in the table:

Table 2.6: Fortification standards for Wheat flour

SI. No.	Nutrient	Level of fortificant per Kg
1.	**Iron**- Ferrous citrate or Ferrous lactate or Ferrous sulphate or Ferric pyrophosphate or electrolytic iron or Ferrous fumarate or Ferrous BisGlycinate;	28 mg- 42.5 mg*
	or Sodium Iron (III) Ethylene diamine tetra AcetateTrihydrate (Sodium feredetate-Na Fe EDTA);	14 mg- 21.25 mg
2.	**Folic acid**	75 µg- 125 µg
3.	**Vitamin B12**- Cyanocobalamine or Hydroxycobalamine;	0.75 µg- 1.25 µg

Source: Food Safety and Standards (Fortification of Foods) Regulations,2017

Table 2.7: Fortification Standards for Rice

Sl.No.	Nutrient	Level of fortification per Kg
1.	**Iron**- (a)Ferric pyrophosphate	28 mg- 42.5 mg *
	Or (b) Sodium Iron (III) Ethylene diamine tetra Acetate Trihydrate (Sodium feredetate -Na Fe EDTA);	14 mg- 21.25 mg
2.	**Folic acid**-Folic acid;	75 µg- 125 µg
3.	**Vitamin B12**- Cyanocobalamine or Hydroxycobalamine;	0.75 µg- 1.25 µg

Source: Food Safety and Standards (Fortification of Foods) Regulations,2017

Figure 2.28: Status of Fortification in MDM

MDM Status						
Sl. No	State	Status				
1	Andhra Pradesh	Fortified Oil (4 District)	Fortified Rice (2 Districts) (1 District - Pipeline)	DFS (4 Districts)		
2	Bihar			DFS (2 Districts)		
3	Chhatisgarh	Fortified Oil (1 District)		DFS (1 Districts)		
4	Gujarat		Fortified Rice (1 Districts)	DFS (Pipeline)		Fortified Wheat Flour (4 Districts)
5	Goa	Fortified Oil (All)		DFS (All)		
6	Haryana	Fortified Edible Oil (All)			Fortified Milk (All)	Fortified Wheat Flour (6 Districts)
7	Himachal Pradesh	Fortified Edible Oil (All)				
8	karnataka	Fortified Edible Oil (All Districts)	Fortified Rice (4 Districts - Pipeline)	DFS (6 Districts)		
9	Kerala		Fortified Rice (4 Districts - Pipeline)		Fortified Milk (All - Pipeline)	
10	Madhya Pradesh			DFS (All)	Fortified Milk (All)	
11	Maharashtra	Fortified Edible Oil (2 Districts)		DFS (2 Districts)		Fortified Wheat Flour (2 Districts)
12	Odisha	Fortified Oil (4 Districts)	Fortified Rice (2 Districts) (14 Districts - Pipeline)	DFS (4 Districts)		
13	Rajasthan			DFS (9 Districts)		Fortified Wheat Flour (1 Districts)
14	Tamil Nadu	Fortified Oil (All)	Fortified Rice (5 Districts - Pipeline)	DFS (All)		
15	Telangana	Fortified Oil (4 District)	Fortified Rice (1 District)	DFS (4 District)		
16	Tripura	Fortified Oil (1 District)	Fortified Rice (All - Pipeline)	DFS (1 District)		
17	Uttar Pradesh	Fortified Oil (1 District)	Fortified Rice (2 Districts)	DFS (1 District)		Fortified Wheat Flour (2 Districts)

MDM Status						
Sl. No	Union Territory	Status				
1	Andaman & Nicobar Island					
2	Chandigarh		Fortified Rice (All)			Fortified Wheat Flour (All)
3	Dadar & Nagar Haveli		Fortified Rice (All - Pipeline)			
4	Daman & Diu		Fortified Rice (All - Pipeline)			
5	Delhi	Fortified Oil (All)		DFS (All)		

Source: FSSAI, 2021

MATERIALS AND METHODS

Rationale

Adequate nutritional status is most important for the growth and development of children. Healthy dietary practices ensure rapid growth spurts, prevent non-communicable diseases (NCDs), and reduce the likelihood of micronutrient malnutrition. (WHO 2020) Malnutrition can affect the health and productivity of school-aged children in their later adult life. Several studies determined that school-age children have rapid growth and development, and poor nutritional status and severe micronutrient deficiencies can lead to many functional disturbances. (Adams et al., 2017) Good health is every person's fundamental human right. Several countries have enshrined nutrition in their constitutions. In India, under directive principles of state policy under article 47th of the constitution, it is the supreme duty of every state government to provide sufficient food grains to the general public. Improving the nutritional status of children MDM program was launched. Due to the current pandemic of COVID-19, schoolchildren did not receive MDM; instead of that, they received THR. The proposed study is an attempt to assess the nutritional status of school children during this challenging time of the pandemic. The primary focus of the research is on assessing the multiple micronutrients intake during COVID 19 in 6-12 years school-aged children of urban Vadodara, and to carry out the present study following methodology was used, keeping the objectives in mind.

Objectives Broad objective

- To assess the multiple micronutrient deficiency in school-going children (6-12 years).

Specific objective

- To assess the consumption pattern of fortified foods at the household level.
- To assess the dietary intake by Food Frequency Questionnaire and 24-hour dietaryrecall method.
- To assess the optimal calorie consumption of school-aged children during the pandemic situation.

Sampling

Purposive sampling was done to select government schools from the north, east, west & southzone of urban Vadodara. Systematic random sampling was done to choose school children.

Sample size

The sample size of children (n=515) is calculated by using the statistical formula: $x = \frac{z^2 \times (1-P)}{P \times e^2}$

where,

- *P_1 - Prevalence of anemia in Gujarat for 5-9 years of children = 28.8%. (CNNS,2019)*
- *P_2 - Prevalence of anemia in Gujarat for 10-19 years of age = 33.4% (CNSS,2019)*
- *Confidence limit = 95%*
- *Relative precision of the estimate (e) = 20%*
- *Attrition: 20%*

Thus, sample size (n,) for children 5-9 years of age:

$$n, = \frac{z^2 \times (1-P,)}{P, \times e^2}$$

$$n. = \frac{(1.96)^2 \times (1-0.288)}{P, \times e^2}$$

$$\text{n.} = \frac{3.8416 \times 0.712}{0.288 \times 0.04}$$

$$\text{n.} = 237.43$$

Sample size (n,) for children 10-19 years of age:

$$\text{n.} = \frac{z^2 \times (1-P,)}{P, \times e^2}$$

$$n. = \frac{(1.96)^2 \times (1-0.334)}{0.334 \times (0.2)^2}$$

$$\text{n.} = \frac{3.8416 \times 0.666}{0.334 \times 0.04}$$

$$\text{n.} = 191.50$$

Thus, $n, + n,$ = 237.43 + 191.50 = 428.93

20 % Attrition is applied after adding both the age groups of 5-9 years and 10-19 years ofchildren.

Total sample size (n)=428.93+85.786

= 514.71

≈ **515**

Site of the study

The study was carried out on school-aged children of 6 to 12 years old studying in the government schools of urban Vadodara. The education administrator gave the list of 105 schools, and from that list total of 51 schools were enrolled in the study covering each zone, i.e., north, south, east, and west. The list of selected schools from each zone is given in the table.

Table 3.1: List of schools from each zone

SN	Zones	Total School	Selected schools
1.	North	27	13
2.	South	33	17
3.	East	23	9
4.	West	22	12
	Total	105	51

Study design

The study was conducted by using *a random sampling method*, and it was divided into three phases:

Phase I (Situational analysis of the schools)

This phase includes situation analysis of schools and school-aged children. Due to the pandemic of COVID-19, only those schools were selected, giving consent for conducting the nutritional survey in their premises and accessible. At the start of this study, COVID infections were increasing in Baroda. Hence, the telephonic interview

method was chosen for the data collection, but this method was not followed for long due to the mothers' poor response rate. Special permission was taken from the District Education Officer of Vadodara to collect the data following a strict social distancing. The nutritional status of the children was assessed by using a *semi-structured questionnaire of 24-hour dietary recall* of the past three consecutive days, and *a Food frequency questionnaire,* and *semi-structured questionnaire micronutrient deficiencies* and an additional questionnaire set specifically on Mid-day meal was prepared. In Mid-day meal questionnaire major focus was given to the frequency and delivery of the services available during the COVID time. For the data collection process ***mother and child pair*** were enrolled. Addressing the challenge of social distancing during this period of COVID, mother and the children was called in different time slots at the school premises. Total time taken by a mother and children pair varied from 15-20 minutes. All the dietary information was collected from mothers and the child.

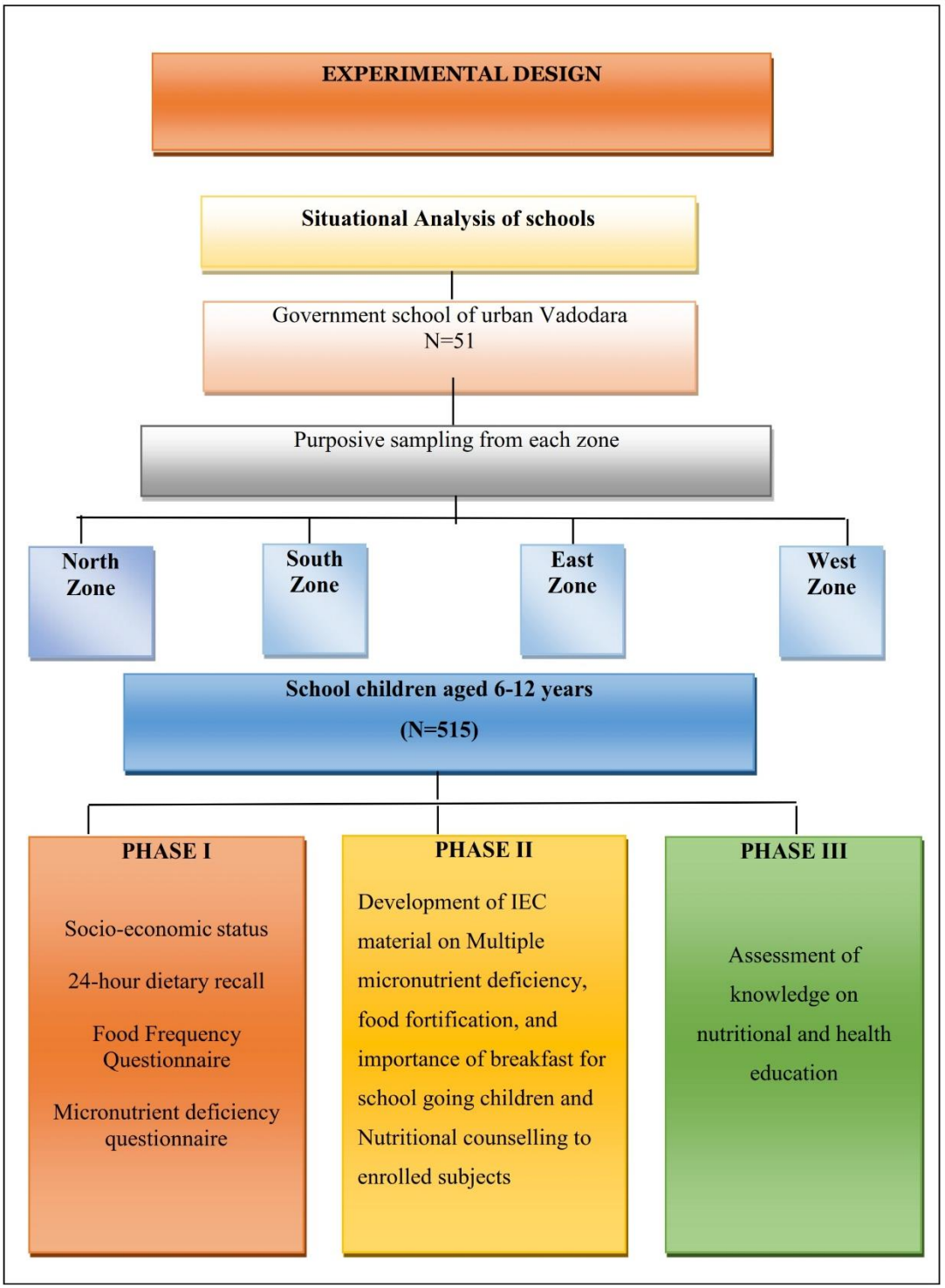
Phase II (Development of the IEC material for nutrition and health education)

The IEC material was developed for the mother and child pair of 6 to 12 years, school-aged children. It involved topics related to nutrition and health education. As the central focus of this study was the assessment of micronutrient deficiencies, IEC's theme was mainly confinedto the essential micronutrients only. Spreading the awareness among mothers, attractiveposters were developed with a significant focus on micronutrients such as iron-rich foods, signs and symptoms of anemia, vitamin A rich foods, Deficiency of vitamin A, vitamin B_{12} rich foods, Iodine rich foods, and possible deficiency disorders, etc. Other posters on food fortification were also developed, including awareness of fortified foods and identifying fortified foods, types of fortified foods available and their benefits of consumption, and posters on the importance of healthy breakfast and their benefits to school-going children were also developed.

Phase III (Assessment of knowledge gain after getting nutrition counseling)

Assessment of knowledge gain on nutritional and health education was planned in a phased manner, but it was not possible due to the pandemic and school closure.

**Due to the increasing incidences of COVID-19 infection in the study site, sensitization was not done.*


EXPERIMENTAL DESIGN
Situational Analysis of schools
Government school of urban Vadodara
N=51
Purposive sampling from each zone
North Zone
South Zone
East Zone
West Zone
School children aged 6-12 years
(N=515)
PHASE I
Socio-economic status
24-hour dietary recall
Food Frequency Questionnaire
Micronutrient deficiency questionnaire
PHASE II
Development of IEC material on Multiple micronutrient deficiency, food fortification, and importance of breakfast for school going children and Nutritional counselling to enrolled subjects
PHASE III
Assessment of knowledge on nutritional and health education

Inclusion and Exclusion criteria

Inclusion criteria

- Children studying in Govt. school receiving MDM will be included.
- Children residing in the urban Vadodara will be enrolled in the study.
- Children from 6-12 years of age will be included.

Exclusion criteria

- Children whose age is lower or higher than the desired group
- Children not studying in the public school
- School drop-out children.
- Children not residing in the urban Vadodara

Material for data collection

Table 3.2: Questionnaire Schedule for collecting the data

SN	Indicators	Procedure
1.	Socio economic status	Semi-structured questionnaire
2.	Dietary Intake	24-hour dietary recall of three consecutive days
3.	Consumption pattern of different foods	Food frequency questionnaire

- **Assessment of Socioeconomic statusKuppuswamy socioeconomic scale**

  The family's socioeconomic status is the most significant indicator in determining the nutritional status of a family. It demonstrates the level of income-expenditure by the family on the food. In this study, ***the modified Kuppuswamy socioeconomic scale*** was used to assess the socioeconomic status of a family. This scale not only determines the SES of an individual but also a whole family. Parameters of this scale are; education of head, occupation of the head, and monthly income of the family. Each parameter has been divided into other subgroups with designated scores. It classifies families into five groups, and the total score of SES ranges from 3-29. (Saleem and Jan, 2021)

Dietary Assessment Methods

24-hour dietary recall: The 24-hour dietary recall method is the qualitative, comprehensive method in which all types and quantities of foods and beverages consumed by the individual during the previous 24 hours are recorded. It describes the intake of food items from the early morning snacks to dinner and even after an individual's dinner. Nutrient content of the population is analyzed by using 24hr. It also offers a high degree of accuracy for assessing the nutrient intake of food relative to the food frequency questionnaire. (Framework, G. 2019)

Food frequency questionnaire: A food frequency questionnaire schedule is used to assess the frequency of food group consumption daily, weekly, monthly, occasionally, seasonal basis. It is inexpensive, easy to develop, and provides the most helpful information on dietaryhabits by listing food items. (Rodriguez et al., 2019)

Data Collection

Data was collected by visiting the enrolled government schools (n=51) in all the working days of schools from all four zones of urban Vadodara. Before starting the Data collection process, permission was taken from the DEO of Vadodara. The consent form for cooperation in this work was signed by the all the head/Principal of the school.

Data Analysis

Dietary data collected using the 24-hour dietary recall method and food frequency questionnaire was analyzed using Diet Cal software and MS excel, respectively. The collected data were entered into Microsoft Excel, and it was further sorted.

For conducting the study following approvals was obtained:

(i) Permission from Education Administrator, Vadodara

(ii) Permission from school principals and teachers

Medical Ethics and approvals:

The study was approved by the Institutional Medical Ethical Committee and has been given the ethical clearance no. **IECHR/FCSC/2020/51**

RESULT AND DISCUSSION

Children are the most significant investment of a nation that is capable of transforming a nation's development. The school feeding program is the world's most extensively spread social safety net, which is currently serving the nutritional needs of 388 million children globally, whereas it was 353 million children in 2013. A significant improvement is observedin the school feeding programs. Among all the WHOs region South Asian region has the largest School Feeding Program 107 million children, followed by Latin America and the Caribbean (78 million), East Asia and the Pacific (58 million), and Sub-Saharan Africa (53 million). Globally 80% of countries have school feeding policies. Countries with the largest network of school feeding programs are India (90 million), China and Brazil (40 million), the USA (30 million), and Egypt (11 million). It was also noticed that nearly half of the school children receiving school meals are lives in one of the BRICS nations (i.e.188 million). (WFP, 2020)

Most of the school feeding programs are domestically funded in various LMICs, and a considerable improvement has also been seen from 2013-2020, i.e., a shift from 17-28%, respectively. It is also observed that the cost of school feeding per child has been changed since 2013. The data indicate a cost of US$55 (up from US$50 in 2013) in low-income countries and US$41 (down from US$46) in lower-middle-income countries. Countries with the lowest Gross Domestic Product (GDP) have a relatively greater cost of school feeding than the others. Cost-benefit analysis studies also highlight that school feeding programs (SFPs) have a higher return in health, education, local agriculture, and social protection. According to an estimate, the return can be as high as US$9 for every US$1 invested in implementing SFPs (WFP, 2020)

As an immediate response to the COVID-19 pandemic, almost every Nation adopted the lockdown. In contrast, some countries adopted school closure to prevent the spread of this deadly virus, which eventually affected the nutritional status of millions of children worldwide where school meal was the only full meal in a day for them. According to the World Bank estimate, school closure affected the whole spectrum of child life. Due to school closure, learning and educational outcomes are affected. For most preschool-aged children, their foundational years are getting affected due to the prolonged lockdown. (World Bank, 2020)

The present study highlighted the impact of global pandemic COVID-19 on India's largest lunch program, i.e., The Mid Day Meal scheme. This program is a boon for millions of unprivileged children of India who can't even afford a single full meal of a day. In September 2009 Govt. of Gujarat introduced fortified wheat flour for improving the nutritional status of children studying in elementary classes (1-8 standards). In all over India, the implementation of MDM varies from one state to another; in Gujarat, this scheme is strengthened by Non- Governmental organizations such as '***The Akshya Patra Foundation***.' Since 2000 this foundation is trying to fill the gap between Hunger and education. (Upton et al., 2007)

According to Iyer & Kantawala, 2015 school meals provided by the Akshaya Patra foundation were hygienic, nutritious, and most children (99.99%) liked the food served by them. Their observation also highlighted that the most desired items by school children were Sukhadi,dal, rice i.e., 79.5%, 70.2%) and 63.8% respectively, whereas Masala and Plain Roti were the least preferred food items. Similarly, Samson et al. (2007) also reported that the most preferred menus by children were dal chawal, chole chawal, and pooris compared to another menu supplied in the MDM program. Afridi et al., 2014 carried out a study on 400 school- aged children of poor-performing schools of Delhi NCR. Their observation reveals that the provision of school meals improves classroom attention. In the Burdhawan district of West Bengal, a study was undertaken by Paul & Mondal, (2012) for assessing the impact of mid- day meal on the academic performance of school-aged children. It was revealed from the survey that both are positively associated with each other.

India adopted lockdown as an emergency measure for preventing the spread of infection, where all the schools were also closed for approximately one year. This decision of the Govt. of India affected the nutritional status and educational outcomes of millions of children studying in Govt. and Govt. aided schools. However, during this time, supporting the nutritional needs of children, the Indian Govt. adopted ***Take Home Ration (THR)*** as a measure where all the children studying from class 1- 8th receive 5Kg of dry ration, specifically wheat and Rice, every month from their respected schools. (MDM, MoE, 2021)

According to The World Food Program's ***state of school feeding report***, 2020, due to millions of children's global pandemic, nutritional status was affected. Approximately 388 million children globally did not receive school meal due to the school closure. As per the Ministry of Education's MDM guidelines, it is mandatory for every Govt. or Govt. aided school to provide 450Kcal -700 Kcal of energy with 12-20 grams of protein every school day primary and upper primary school children, respectively. Since 1995 MDM program isoperational in all the states and Union territories of India, it can be concluded after looking into evidence generated in the past that the primary focus of this program is to reduce the prevalence of protein and calorie malnutrition or classroom hunger. However, it is neglecting the importance of micronutrient requirements (vitamins and minerals) for the growth and well-being of children. For the proper growth and development of children, a sufficient amount of micronutrients are essential.

The Mid day Meal or *Madhayan Bhojan* has significantly improved the gross enrollment rate of school children. In 2011 a study was carried out in Chandigarh by Nagadia and Poonam to assess the impact of MDM on children's school attendance. Results of this study revealed thata positive association was found. Timothy et al., 2010 stated that school feeding programs positively impact school attendance and enrollment. Further, it was also noticed that children who received regular school meals performed better than those who did not receive regular meals.

In 2010 Gupta et al. stated that the MDM provided by the schools in Ghaziabad, Uttar Pradesh is slightly less than the guidelines provided by the Government. As per their observation, the reported values were protein (10.58 g), energy (458.12 kcal), calcium (40.18 mg), riboflavin (0.05 mg), vitamin C (6.57 mg), iron (2.90 mg), fat (5.26 g) and carbohydrate (92.01g). In 2008 Kushwaha reported that the mid-day meal provided in Allahabad is not fulfilling 1/3 of the recommended dietary allowances of a child.

Our Nation witnessed the initial spread of Covid 19 from October 2019. Its aftermath had been severe and affected school children adversely, which was a challenge mentally and physically. Apart from the children, parents were equally faced with many unanswered questions. These posed multiple challenges, which were being tried to address by school authorities, govt officials, and parents together. However, the situation worsened when the widespread became more intense, and it brought complete closedown of schools. Schools are a place where a child expresses himself or herself without any fear and hesitation.

Our MDM programs paved an open door to reach out to all the vulnerable to addressmalnutrition, stunting, and wasting. Thus, with one meal in the mid of the day, we weretrying to address malnutrition in a separate domain. Unfortunately, the pandemic and subsequent lockdown tarnished the school meal picture. School-aged children have high growth and developmental needs. FSSAI in 2011 and 2017 has implemented the provisions toprovide DFS and fortified wheat flour/Rice respectively in the MDM program.

Thus, this study was planned to understand various aspects like the multiple micronutrient intake existing in the study population and to assess school-aged children's optimal calorie consumption (6-12year) where fortified food staples were being provided. Another significant aspect was providing appropriate nutritional counseling to both mothersand children to encourage the consumption of fortified commodities and diversified nutrient- dense foods to ensure nutrition security.

The impact of school closure on the nutritional status of school-aged children of urban Vadodara was assessed where children from all the four zones (East, West, North, and South Zone) were included. The primary focus of the current study was to assess the pattern of foodconsumption of school-aged children during the pandemic and how inadequate consumption of food influences the micronutrient status of children.

A total of 51 schools were selected based on a random sampling method. From each zone, i.e., north zone (n=13), south zone (n=17), east zone (n=9), and west zone (n=12), schools were included in the study so that an appropriate proportion of children can be included in thesample from all the four zones. Out of all the 51 schools, a total of 515 school children enrolled for the study.

Table 4.1: List of schools from each zone

Sr. No	Zones	Total School	Selected schools	Male (%)	Female (%)
5.	North	27	13	38.23	61.76
6.	South	33	17	49.41	50.58
7.	East	23	9	43.33	56.66
8.	West	22	12	47.00	52.99
	Total	105	51	44.85	55.14

The school-aged children's nutritional and dietary practices were assessed through Food Frequency Questionnaire and the 24-hour dietary recall method. Due to the COVID, all the schools were closed earlier. Hence telephonic interview was used for conducting the pilot work. Later on, in February, the school was opened in a phased manner with a strict guideline of social distancing. To assess dietary diversity, all the enrolled students were interviewed with their mothers to monitor dietary recall.

Socio-economic profile of the households

The socio-economic questionnaire was administered to the enrolled students. The data analyzed as gender showed that from the findings of all schools covered in four zones of Vadodara, the Majority of them were girls, i.e., 284 (55.14%), and 231 (44.85%) of themwere boys from the total (515) in urban Vadodara.

Table 4.2: Distribution of gender in four zones

GENDER						
SN	**Zone**	**Total Students**	**Boys (N)**	**Boys (%)**	**Girls (N)**	**Girls (%)**
1	West	117	55	47	62	52.99
2	East	90	39	43.33	51	56.66
3	South	172	85	49.41	87	50.58
4	North	136	52	38.23	84	61.76
5	Total	515	231	44.85	284	55.14

Similarly, in the west zone, 47% were boys, and 52.99% were girls, in the east zone 43.33% were boys, and 56.66% were girls, in the south zone 49.41% were boys and 50.58% were girls, and from the north, zone boys were 38.23%, and girls were 61.76%.

Table 4.3: General profile of the subjects

Characteristics	**Boys (N=231)**		**Girls (N=284)**		**Total (N=515)**	
Religion	**N**	**%**	**N**	**%**	**N**	**%**
Hindu	158	68.4	206	72.5	364	70.68
Muslim	71	30.7	71	25.0	142	27.57
Sikh	1	0.4	7	2.5	8	1.55
Christian	-	-	-	-	-	-

Others	1	0.4	-	-	1	0.19
Family Type	**N**	**%**	**N**	**%**	**N**	**%**
Nuclear	156	67.5	167	58.8	323	62.72
Extended nuclear	54	23.4	87	30.6	141	27.38
Joint	21	9.1	30	10.6	51	9.90

The current findings showed that the majority of subjects were Hindu (70.68%), followed by Muslims (27.57%), Sikh (1.55%), and others (0.19%). Nearly 62.72% of the population belonged to a nuclear family, 27.38% of children were from extended families, and 9.90% belonged to a joint family. The majority of girls (167) were from nuclear families comparedto boys (156). Similarly, from extended family, the majority were girls (87), followed byboys (54), and in the joint family majority were girls (30), and boys were 21.

As per the kuppuswamy scale of socioeconomic status for assessing the occupation of the family in the current study, the father of children was considered as the head of the family, and it was observed that the majority of head of the household were *Skilled Workers and Shop & Market Sales Workers*, i.e., 46.60% while 34.17% were working in Elementary Occupation. However, 4.7% of the study subjects did not know about their parent's occupational status. As per the kuppuswamy socioeconomic scale, the economic status of the family was observed, and it was revealed that the majority of the family (48.30%) were scored as one, i.e., the income range was ≤ 10,001 whereas 17.50% were received a scoretwo, i.e., income ranges from 10,002–29,972.

Table 4.4: Kuppuswamy socioeconomic status scale

Socioeconomic status of Families	**Scores**	**N**	**%**
Upper (I)	26-29	-	-
Upper Middle (II)	16-25	2	0.4
Lower Middle (III)	11-15	45	8.7
Upper Lower (IV)	5-10	387	75.1
Lower (V)	<5	81	15.7

For assessing the economic class of families, the respective score was calculated by the sum of scores of the head's education, occupation of the head, and total monthly income of family members. The findings suggested that the majority of the families belonged to the upper lower class, i.e., 75.1%, whereas 15.7% of the family belonged to the lower class and 8.7% ofthe family were from the lower middle class.

NUTRITIONAL STATUS ASSESSMENT

Assessing the difference in the dietary intake of school-aged children during the pre-COVID- 19 period and during the COVID-19 period menu of MDM was also asked by the school teachers. In most of the schools, the following menu was used as ***the Akshaya Patra Foundation*** served it. It can be noticed from the menu that most of the food served in school campuses is carbohydrate-based with a bit of focus on protein requirement; however, micronutrient needs of school-aged children are partially fulfilled.

Figure 4.1: Weekly Menu of Mid-day Meal

MENU CARD			
Mid-day Meal scheme → Gujarat Government → Metropolitan municipality			
SN	**Day**	**Breakfast**	**Lunch**
1	Monday	Sukhadi	Vegetable Khichadi
2	Tuesday	Channa chat	Thepla, Suki bhaji
3	Wednesday	Mix dal/Beans/Usad	Vegetable pulao
4	Thursday	Channa chat	Dal dhokali
5	Friday	Muthiya	Dal-rice
6	Saturday	Channa chat	Vegetable pulao

Source: The Akshaya Patra foundation (2020-2021)

Assessing the dietary intake of school-aged children, the twenty-four-hour dietary recall method was used to estimate the average nutrient intake of children for the three consecutive days. The Mean nutrient intake of the children is shown in the following table;

Table 4.5: Mean consumption of children aged 6 to 12 years of Macronutrients (MEAN±SD)

Age (In Years)	Gender	Energy	Protein
6 YRS	Boys	582.71±110.68	13.47± 2.66
	Girls	651.47±160.03	14.52± 2.28
7 YRS	Boys	662.92±122.00	17.75± 3.53
	Girls	744.70±176.61	19.74± 6.27
8 YRS	Boys	686.93±228.85	16.73± 4.91
	Girls	738.45±279.16	17.79± 3.79
9 YRS	Boys	671.94±174.05	17.03± 4.58
	Girls	702.06±157.09	18.50± 3.81
10 YRS	Boys	814.93±249.47	21.31± 5.92
	Girls	778.02±241.22	20.58± 7.32
11 YRS	Boys	736.00±195.44	19.49± 5.89
	Girls	741.32±210.61	19.35± 5.92
12 YRS	Boys	765.35±193.71	20.83± 6.73
	Girls	750.53±228.57	19.65± 6.20

Table 4.6: Mean consumption of children aged 6 to 12 years for micronutrient (MEAN±SD)

Age Years	Gender	Iron	Folate	Calcium	Vitamin C	Vitamin A
6 YRS	Boys	4.39±1.63	76.85±29.52	159.70±34.54	23.25±10.21	40.04±15.07
	Girls	4.50±1.58	73.63±23.52	153.32±61.40	20.69±8.01	53.78±27.63
7 YRS	Boys	5.06±1.07	97.57±35.10	199.05±71.33	28.99±10.75	50.29±12.63
	Girls	5.59±2.39	92.97±38.61	173.44±55.91	24.70±9.87	45.02±21.14
8 YRS	Boys	5.07±1.90	86.16±34.96	149.57±74.57	28.20±11.53	38.82±35.26
	Girls	4.89±1.25	90.18±35.20	152.26±63.35	25.20±13.63	47.36±27.04
9 YRS	Boys	4.84±1.44	95.38±36.18	171.48±75.77	29.70±11.68	51.15±29.99
	Girls	5.53±1.66	104.48±46.22	197.64±68.00	28.66±13.25	47.01±27.49
10 YRS	Boys	5.87±2.15	101.78±41.10	186.10±120.08	26.88±16.43	58.24±59.71
	Girls	5.12±1.97	89.96±36.24	167.08±73.50	24.47±12.96	54.98±41.24
11 YRS	Boys	5.29±2.09	86.13±33.84	175.56±92.92	24.82±11.29	54.45±36.61
	Girls	4.77±1.80	82.65±35.42	166.54±72.16	22.82±13.34	51.46±32.24
12 YRS	Boys	5.07±1.86	92.22±41.79	196.06±122.77	25.61±11.57	73.70±103.22
	Girls	5.21±2.49	91.05±41.19	157.44±68.78	26.21±12.24	41.17±24.57

Table 4.7: Dietary nutrient intake (Mean and as a difference with percent RDA)

Nutrient	Gender	6 years		7-9 years		10-12 years	
		Mean±SD	Diff with %RDA	Mean±SD	Diff with %RDA	Mean±SD	Diff with %RDA
Energy	Boys	582.71±110.68	57.15	675.71±185.29	60.25	761.43±205.83	65.70
	Girls	651.47±160.03	52.10	728.57±206.14	57.14	754.63±225.18	63.37
Protein	Boys	13.47± 2.66	15.77	17.09±4.43	25.69	20.34±6.25	36.44
	Girls	14.52± 2.28	9.20	18.73±4.85	18.56	19.80±6.41	39.99
Iron	Boys	4.39±1.63	60.07	4.98±1.55	66.74	5.31±2.02	66.79
	Girls	4.50±1.58	59.08	5.36±1.86	64.25	5.03±2.13	82.01
Folate	Boys	76.85±29.52	43.07	92.25±35.18	45.73	91.28±38.61	58.51
	Girls	73.63±23.52	45.45	95.96±40.29	43.55	87.80±37.92	60.98
Calcium	Boys	159.70±34.54	70.96	169.44±75.48	73.93	185.49±110.07	78.18
	Girls	153.32±61.40	72.12	175.02±64.24	73.07	163.23±71.02	80.80
Vitamin C	Boys	23.25±10.21	33.56	28.93±11.22	35.69	25.50±12.38	53.63
	Girls	20.69±8.01	40.88	26.18±12.24	41.83	24.55±12.84	50.90
Vitamin A	Boys	40.04±15.07	92.15	46.39±28.86	93.78	62.91±74.25	92.76
	Girls	53.78±27.63	91.85	46.37±24.83	93.13	48.38±32.58	94.36

Table 4.5 shows the mean consumption of Energy and Protein of the age 6-12 years and it was observed that the average calorie intake of Boys was 582.71 Kcal in 6 years of age and as the ageincreases their calorie consumption in boys also increased, i.e., 662.92 Kcal in 7 years, 686.93 Kcal in 8 years, 671.94 Kcal in 9 years, 814.93 Kcal in 10 years, 736.00 Kcal in 11 years and 765.35 Kcal in 12 years of age. However, boy's average minimum calorie intake was observed in6 years, i.e., 357.56 Kcal, and the maximum calorie intake of boys were observed in 10 and 12 years, i.e., 1524.32 Kcal in school-aged children.

The average calorie intake in Girls was 651.47 Kcal in 6 years, 744.70 Kcal in 7 years, 738.45 Kcal in 8 years, 702.06 Kcal in 9 years, 778.02 Kcal in 10 years, 741.32 Kcal in 11 years, and 750.53 Kcal in 12 years of age. It was observed that the minimum and maximum calorieconsumption has happened in 12 years of girls, i.e., 314.49 Kcal (min) and 1803 Kcal (max).

For protein, the mean intake was seen more in girls as compared to boys in age 6 years, 7 years,8 years, and 9 years. Whereas in the age of 10 years, 11 years, and 12 years, the average protein consumption was more in boys than girls. With regards to protein, the intake was much better as compared to calories.

The table 4.7 shows the dietary intake of nutrients, which includes mean and percentage RDA values, and the data was segregated in the three age groups, i.e., 6 years, 7-9 years, and 10-12 years for boys and girls.

Findings showed that in energy as the aged increased, the nutrient gap was increased in both boys and girls, i.e., In boys, the difference with percent RDA was 57.15% in age 6 years, followed by 60.25% in 7-9 years and 65.70% in age 10-12 years and in girls, the nutrient gap was 52.10% in 6 years, followed by 57.14% in 7-9 years, and 63.37% in 10-12 years. However, around 50-60% of the nutrient gap were observed for energy in both boys and girls.

The data revealed that there was not a huge nutrient gap for protein intake compared to energy. However, the mean intake of girls was more in the age of 6 years and 7-9 years than boys, whereas it was less in girls of age 10-12 years in comparison. A nutrient gap of 9.20%, 18.56%, and 39.99% was found in girls, whereas; 15.77%, 25.69%, and 36.44% were seen in boys for the age group of 6 years,7-9 years, and 10-12 years. A similar scenario was seen in that the nutrient gap increased as the aged increased.

The mean consumption of iron was noted very low in both boys and girls. According to ICMR NIN RDA, 2020, the iron consumption should be 11mg/dl in 6 years, 15mg/dl in 7-9 years, 16mg/dl in boys, and 28 mg/dl in girls for age 10-12 years. But the data revealed that there was anutrient gap of 60.07% and 59.08% in boys and girls of age 6 years. In the age group of 7-9 years, it was noted that there was a nutrient gap of 66.74% in boys and 64.25% in girls. Iron requirements for girls are more in the age group of 10-12 years, and findings showed that its dietary iron intake in girls was poor as compared to boys, i.e., a nutrient gap of 82.01% was seen in girls and 66.79% in boys.

The mean folate consumption in 6 years was 76.85±29.52 in boys and 73.63±23.52 in girls, anda gap of 43.07% was observed in boys, and 45.45% were in girls. In the age group of 7-9 years, a 45.73 % gap was observed in boys, and a 43.55 % gap was in girls. Similarly, in the age group of10-12 years, the percent RDA difference was 58.51% and 60.98 % in boys and girls. Thus, a nutrient gap was observed to be more in the higher age of 10-12 years compared to the age groupof 6 and 7-9 years.

Children from their diets poorly consumed calcium, and data showed that there was a nutrientgap of 70.96% in boys and 72.12% in girls of age 6 years. Whereas, findings suggested that a similar gap was observed in boys and girls of age group 7-9 years, i.e., 73.93 % in boys and 73.07 % in girls. However, the nutrient gap was noted to be more in girls as compared to boys in the higher age group of 10-12 years, i.e., 80.80% in girls and 78.18% in boys.

A nutrient gap in vitamin C was less in age 6 years, i.e., 33.56% in boys and 40.88% in girls. But, as the age increased, the nutrient gap of vitamin C was noted to be increased, i.e., 35.69% inboys and 41.83% in girls of age group 7-9 years. However, the maximum gap was noted in age 10-12 years, i.e., 53.63% in boys and 50.90 % in girls. Hence it was also seen that a nutrient gap was more in girls of age 6 and 7-9 years of age as compared to boys.

Findings also revealed that vitamin A intake was the least consumed nutrient from their diets as compared to other nutrients. It may be due to poor intake of vitamin A-rich fruits and vegetables.It was noted that a gap of 92.15% was in boys, and 91.85% were in girls of age 6 years. Similarly, in the age group of 7-9 years, 93.78% in boys and 93.13 % in girls, and in the age group of 10-12 years, 92.76% in boys and 94.36% in girls.

The Indian Council of Medical Research released Recommended Dietary Allowances, 2020,with various modifications in nearly all the nutrients. The following list entails the daily nutrient requirement by all the age groups of the Indian population.

Figure 4.2: ICMR, NIN-RDA, (2020)

Age Group	Category of work	Body Wt	Protein	Dietary Fibre*	Calcium	Magnesium	Iron	Zinc	Iodine	Thiamine	Riboflavin	Niacin	Vit B6	Folate	Vit B12	Vit C	Vit A	Vit D
		(kg)	(g/d)	(g/d)	(mg/d)	(mg/d)	(mg/d)	(mg/d)	(µg/day)	(mg/d)	(mg/d)	(mg/d)	(mg/d)	(µg/d)	(µg/d)	(mg/d)	(µg/d)	(IU/ d)
Men	Sedentary	65	54.0	32	1000	440	19	17	150	1.4	2.0	14	1.9	300	2.2	80	1000	600
	Moderate			41						1.8	2.5	18	2.4					
	Heavy			52						2.3	3.2	23	3.1					
Women	Sedentary	55	46.0	25	1000	370	29	13	150	1.4	1.9	11	1.9	220	2.2	65	840	600
	Moderate			32						1.7	2.4	14	1.9					
	Heavy			41						2.2	3.1	18	2.4					
	Pregnant woman	55 + 10	+9.5 (2nd trimester) +22.0 (3rd trimester)	-	1000	440	27	14.5	250	2.0	2.7	+2.5	2.3	570	+0.25	+15	900	600
	Lactation 0-6m		+17.0	-	1200	400	23	14	280	2.1	3.0	+5	+0.26	330	+1.0	+50	950	600
	7-12m		+13.0							2.1	2.9	+5	+0.17	330				
Infants	0-6 m*	5.8	8.0	-	300	30	-	-	100	0.2	0.4	2	0.1	25	1.2	20	350	400
	6-12m	8.5	10.5	-	300	75	3	2.5	130	0.4	0.6	5	0.6	85	1.2	30	350	400
Children	1-3y	12.9	12.5	15	500	90	8	3.3	90	0.7	1.1	7	0.9	120	1.2	30	390	600
	4-6y	18.3	16.0	20	550	125	11	4.5	120	0.9	1.3	9	1.2	135	1.2	35	510	
	7-9 y	25.3	23.0	26	650	175	15	5.9	120	1.1	1.6	11	1.5	170	2.2	45	630	
Boys	10-12y	34.9	32.0	33	850	240	16	8.5	150	1.5	2.1	15	2.0	220	2.2	55	770	600
Girls	10-12y	36.4	33.0	31	850	250	28	8.5	150	1.4	1.9	14	1.9	225	2.2	50	790	600
Boys	13-15y	50.5	45.0	43	1000	345	22	14.3	150	1.9	2.7	19	2.6	285	2.2	70	930	600
Girls	13-15y	49.6	43.0	36	1000	340	30	12.8	150	1.6	2.2	16	2.2	245	2.2	65	890	600
Boys	16-18y	64.4	55.0	50	1050	440	26	17.6	150	2.2	3.1	22	3.0	340	2.2	85	1000	600
Girls	16-18y	55.7	46.0	38	1050	380	32	14.2	150	1.7	2.3	17	2.3	270	2.2	70	860	600

Source: ICMR, NIN-RDA, (2020)

From the dietary intake of enrolled subjects, Macronutrients and micronutrients were analyzedon the basis of gradation for % RDA (Recommended dietary allowances) consumption. The data was segregated into a gradation of % RDA, i.e., ≤25%, 25.1-50%, 50.1-75%, 75.1-100%, >100% for the age group of 6 years, 7-9 years, and 10-12 years and for both boys and girls. The gender and age-specific consumption of nutrients as per the percent RDA are shown in the following tables.

Table 4.8: Distribution of Children Based on grades of % RDA for Energy

ENERGY						
Girls						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N =22)	(%)	(N =75)	(%)	(N=187)	(%)
≤25%	-	-	-	-	24	12.8
25.1-50%	15	68.2	58	77.3	144	77.0
50.1-75%	7	31.8	15	20.0	18	9.6
75.1-100%	-	-	1	1.3	1	0.5
>100%	-	-	1	1.3	-	-
Boys						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=8)	(%)	(N =58)	(%)	(N=165)	(%)
≤25%	-	-	1	1.7	22	13.3
25.1-50%	8	100	50	86.2	132	80.0
50.1-75%	-	-	7	12.1	11	6.7
75.1-100%	-	-	-	-	-	-
>100%	-	-	-	-	-	-
Total						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=30)	(%)	(N =133)	(%)	(N=352)	(%)
≤25%	-	-	1	0.8	46	13.1
25.1-50%	23	76.7	108	81.2	276	78.4
50.1-75%	7	23.3	22	16.5	29	8.2
75.1-100%	-	-	1	0.8	1	0.3
>100%	-	-	1	0.8	-	-

Table 4.9: Distribution of Children Based on grades of % RDA for Protein

PROTEIN						
Girls						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N =22)	(%)	(N =75)	(%)	(N=187)	(%)
≤25%	-	-	-	-	2	1.1
25.1-50%	1	4.5	3	4.0	61	32.6
50.1-75%	1	4.5	27	36.0	86	46.0
75.1-100%	16	72.7	36	48.0	31	16.6
>100%	4	18.2	9	12.0	7	3.7
Boys						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=8)	(%)	(N =58)	(%)	(N=165)	(%)
≤25%	-	-	-	-	-	-
25.1-50%	1	12.5	4	6.9	44	26.7
50.1-75%	-	-	31	53.4	76	46.1
75.1-100%	7	87.5	17	29.3	39	23.6
>100%	-	-	6	10.3	6	3.6
Total						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=30)	(%)	(N =133)	(%)	(N=352)	(%)
≤25%	-	-	-	-	2	0.6
25.1-50%	2	6.7	7	5.3	105	29.8
50.1-75%	1	3.3	58	43.6	162	46.0
75.1-100%	23	76.7	53	39.8	70	19.9
>100%	4	13.3	15	11.3	13	3.7

Mean Energy intake at various levels of RDA

From the segregated data of Energy as per the % RDA shown in table 1, the findings suggested that in the age of 6 years, the majority of girls (68.2%) met 25-50% of RDA and 31.8% of girls consumed 50-75% of RDA. The observed energy intake as per RDA was low in boys as compared to girls, where all-boys (100%) met only 25-50% of RDA.

In the age group of 7-9 years, the data suggested that there was more energy consumption in girls than boys. The majority of girls (77.3%) and boys (86.2%) met 25-50% of RDA. And 20.0% of girls and 12.1% of boys met 50-75% of RDA. Only a single girl child was observed who met more than 100% of RDA, whereas, for boys, nobody's intake was more than 75% of RDA.

Similarly, in the age group of 10-12 years, the majority of girls (77.0%) and boys (80.0%) met only 25-50% RDA. 12.8 % of girls consumed less than 25% of RDA, and in boys, 13.3% ofthem met less than 25 % of RDA. However, in boys, nobody consumed more than 75% of RDA for energy. Hence, there was an inadequate intake of energy from their diets in all the three age groups as per the RDA given by ICMR, NIN-RDA, (2020), which are age and gender-specific.

Mean Protein intake at various levels of RDA

The mean protein intake of children on gradations of % RDA for the specific age group and gender is shown in table 2, and the findings showed that the protein in girls was better as compared to boys. It represents that majority of girls, i.e., 72.7%, and boys, i.e., 87.5%, met 75- 100% of RDA while 18.2 % of girls met more than 100% of RDA, and in boys, nobody met above 75-100% in the age of 6 years.

The mean protein intake for all the three groups of age was almost above 25% of RDA. For the age of 7-9 years, the protein intake was more in girls, and the majority of girls (48.0) met 75- 100% of RDA, whereas the majority of boys (53.4%) met 50-75% of RDA. However, in age 10-12 years, the majority of girls (46.0%) and boys (46.1%) both met 50-75 % of RDA, and a total of 3.7% of the children met more than 100% of RDA. Hence, inadequate intake of protein for the majority of children was observed from their dietary intake.

Table 4.10: Distribution of Children Based on grades of % RDA for Iron

IRON						
Girls						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N =22)	(%)	(N =75)	(%)	(N=187)	(%)
≤25%	4	18.2	13	17.3	161	86.1
25.1-50%	13	59.1	54	72.0	25	13.4
50.1-75%	5	22.7	7	9.3	1	0.5
75.1-100%	-	-	1	1.3	-	-
>100%	-	-	-	-	-	-
Boys						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=8)	(%)	(N =58)	(%)	(N=165)	(%)
≤25%	2	25	12	20.7	45	27.3
25.1-50%	4	50	42	72.4	103	62.4
50.1-75%	2	25	4	6.9	15	9.1
75.1-100%	-	-	-	-	2	1.2
>100%	-	-	-	-	-	-
Total						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=30)	(%)	(N =133)	(%)	(N=352)	(%)
≤25%	6	20.0	25	18.8	206	58.5
25.1-50%	17	56.7	96	72.2	128	36.4
50.1-75%	7	23.3	11	8.3	16	4.5
75.1-100%	-	-	1	0.8	2	0.6
>100%	-	-	-	-	-	-

Table 4.11: Distribution of Children Based on grades of % RDA for Folate

FOLATE (B9)						
Girls						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N =22)	(%)	(N =75)	(%)	(N=187)	(%)
≤25%	-	-	-	-	49	26.2
25.1-50%	9	40.9	34	45.3	94	50.3
50.1-75%	10	45.5	29	38.7	36	19.3
75.1-100%	3	13.6	6	8.0	8	4.3
>100%	-	-	6	8.0	-	-
Boys						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=8)	(%)	(N =58)	(%)	(N=165)	(%)
≤25%	-	-	1	1.7	27	16.4
25.1-50%	4	50	28	48.3	96	58.2
50.1-75%	2	25	23	39.7	33	20.0
75.1-100%	2	25	3	5.2	8	4.8
>100%	-	-	3	5.2	1	0.6
Total						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=30)	(%)	(N =133)	(%)	(N=352)	(%)
≤25%	-	-	1	0.8	76	21.6
25.1-50%	13	43.3	62	46.6	190	54.0
50.1-75%	12	40.0	52	39.1	69	19.6
75.1-100%	5	16.7	9	6.8	16	4.5
>100%	-	-	9	6.8	1	0.3

Table 4.12: Distribution of Children Based on grades of % RDA for Vitamin C

VITAMIN C						
Girls						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N =22)	(%)	(N =75)	(%)	(N=187)	(%)
≤25%	-	-	12	16.0	41	21.9
25.1-50%	10	45.5	16	21.3	67	35.8
50.1-75%	6	27.3	25	33.3	44	23.5
75.1-100%	5	22.7	20	26.7	32	17.1
>100%	1	4.5	2	2.7	3	1.6
Boys						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=8)	(%)	(N =58)	(%)	(N=165)	(%)
≤25%	1	12.5	5	8.6	28	17.0
25.1-50%	1	12.5	11	19.0	68	41.2
50.1-75%	3	37.5	23	39.7	45	27.3
75.1-100%	2	25	16	27.6	21	12.7
>100%	1	12.5	3	5.2	3	1.8
Total						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=30)	(%)	(N =133)	(%)	(N=352)	(%)
≤25%	1	3.3	17	12.8	69	19.6
25.1-50%	11	36.7	27	20.3	135	38.4
50.1-75%	9	30.0	48	36.1	89	25.3
75.1-100%	7	23.3	36	27.1	53	15.1
>100%	2	6.7	5	3.8	6	1.7

Table 4.13: Distribution of Children Based on grades of % RDA for Vitamin A

VITAMIN A						
Girls						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N =22)	(%)	(N =75)	(%)	(N=187)	(%)
≤25%	21	95.5	75	100.0	186	99.5
25.1-50%	1	4.5	-	-	1	0.5
50.1-75%	-	-	-	-	-	-
75.1-100%	-	-	-	-	-	-
>100%	-	-	-	-	-	-
Boys						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=8)	(%)	(N =58)	(%)	(N=165)	(%)
≤25%	8	100	57	98.3	159	96.4
25.1-50%	-	-	1	1.7	4	2.4
50.1-75%	-	-	-	-	2	1.2
75.1-100%	-	-	-	-	-	-
>100%	-	-	-	-	-	-
Total						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=30)	(%)	(N =133)	(%)	(N=352)	(%)
≤25%	29	96.7	132	99.2	345	98.0
25.1-50%	1	3.3	1	0.8	5	1.4
50.1-75%	-	-	-	-	2	0.6
75.1-100%	-	-	-	-	-	-
>100%	-	-	-	-	-	-

Table 4.14: Distribution of Children Based on grades % RDA for Calcium

CALCIUM						
Girls						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N =22)	(%)	(N =75)	(%)	(N=187)	(%)
≤25%	7	31.8	38	50.7	150	80.2
25.1-50%	14	63.6	36	48.0	36	19.3
50.1-75%	1	4.5	1	1.3	1	0.5
75.1-100%	-	-	-	-	-	-
>100%	-	-	-	-	-	-
Boys						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=8)	(%)	(N =58)	(%)	(N=165)	(%)
≤25%	2	25	34	58.6	127	77.0
25.1-50%	6	75	20	34.5	31	18.8
50.1-75%	-	-	4	6.9	4	2.4
75.1-100%	-	-	-	-	3	1.8
>100%	-	-	-	-	-	-
Total						
%RDA	**6 years**		**7 – 9 years**		**10-12 years**	
	(N=30)	(%)	(N =133)	(%)	(N=352)	(%)
≤25%	9	30.0	72	54.1	277	78.7
25.1-50%	20	66.7	56	42.1	67	19.0
50.1-75%	1	3.3	5	3.8	5	1.4
75.1-100%	-	-	-	-	3	0.9
>100%	-	-	-	-	-	-

Mean Iron intake at various levels of RDA

In the case of total Iron intake mentioned in table 4.10, Maximum children from age 6 years (56.7%) and 7-9 years (72.2%) met only 25-50% of RDA, and for age 10-12 years, the majority of them, i.e., 58.5% met lesser than 25% of RDA. It was observed that nobody's RDA exceeded from 100%. Hence, as the age increased from 9 years, the dietary intake of iron decreased in age 10-12 years.

At 6 years of age, only 22.7% of girls and 25.0% of boys met 50-75% of iron. Whereas, in age 7-9 years, 9.3 % of girls and 6.9 % of boys consumed 50-75 % of RDA. However, in girls aged 10-12 years, nobody consumed more than 75 %, and only 1.2% of boys met 75-100% of RDA for iron. Hence, the majority of them had a very poor intake of iron from their diets, and in total, only 3 individuals were noted who met 75-100% of RDA, which were from the higher age groupof 7-9 and 10-12 year.

Mean Folate (B9) intake at various levels of RDA

The % RDA for mean folate (B9) intake, according to the specific age and gender, is shown in table 4.11; where total maximum children had met only 25-50% of RDA, i.e., 43.3% was observed in 6 years, 46.6 % was in 7-9 years and 54.0% of children in the age group of 10-12 years. In contrast, 75-100% of RDA was met by very few, i.e., 16.7% of children in 6 years, 6.8 % of children in 7-9 years, and 4.5% of children in 10-12 years of age.

The gender-wise comparison indicates that in 6 years of age, most boys, i.e., 25%, could meet 75-100% of RDA compared to girls, i.e., 13.6%. The intake was almost the same in boys and girls of the age group 10-12 years, i.e., 4.3% of girls and 4.8% of boys who met 75-100% of percent RDA. However, it indicates that children's diet was deficient in nutrient folate, which could lead to folate deficiencies in the body.

Mean Vitamin C intake at various levels of RDA

With regards to Vitamin C, the mean intake of children based on gradation is represented in table no 4.12. When comparison was made between girls and boys, it was observed that in 6 years the % intake of RDA in boys was more as compared to girls, i.e., majority of boys (37.5%) were able to meet 50-75% of RDA, whereas, for girl’s majority were 45.5% who were able to meet only 25-50% of RDA form their diets.

Whereas, in age 7-9 years, there was no difference observed between girls and boys, and in both,most children consumed 50-75% of RDA. (33.3% in 7-9 years girls, 39.7% in 7-9 years boys).In the age of 10-12 years, the majority of children in boys and girls met only 25-50% of RDA (35.8% in 10-12 years girls, and 41.2 % in 10-12 years boys)

Total findings suggested that in 6 years of age, only 6.7% of children consumed more than 100%& 23.3% of children met 75-100% of RDA. Similarly, in 7-9 years and 10-12 years, very few of them, i.e., 27.1 % and 15.1 % of children, met 75-100% of RDA.

Mean Vitamin A intake at various levels of RDA

Table 4.13 shows the mean intake of Vitamin A in children of specific age and gender. The results showed that nobody consumed more than 50% of RDA in girls, whereas, in boys, only two individuals (n=2) met 50-75% of RDA.

Hence, the percent RDA was very low compared to the required amounts. The majority of boys and girls consumed less than 25 % of RDA in all the three-age groups of children, i.e., for girls,it was 95.5% in 6 years, 100% in 7-9 years, and 99.5% in 10-12 years. Similarly, it was 100% in

6 years for boys, 98.3 % in 7-9 years, and 96.4% in 10-12 years.

However, vitamin A intake from their diets was comparatively very poor, wherein total children,none of them could catch 75-100% of RDA in all the three age groups of 6 years, 7-9 years, and 10-12 years. This could possibly lead to vitamin A deficiencies in children.

Mean Calcium intake at various levels of RDA

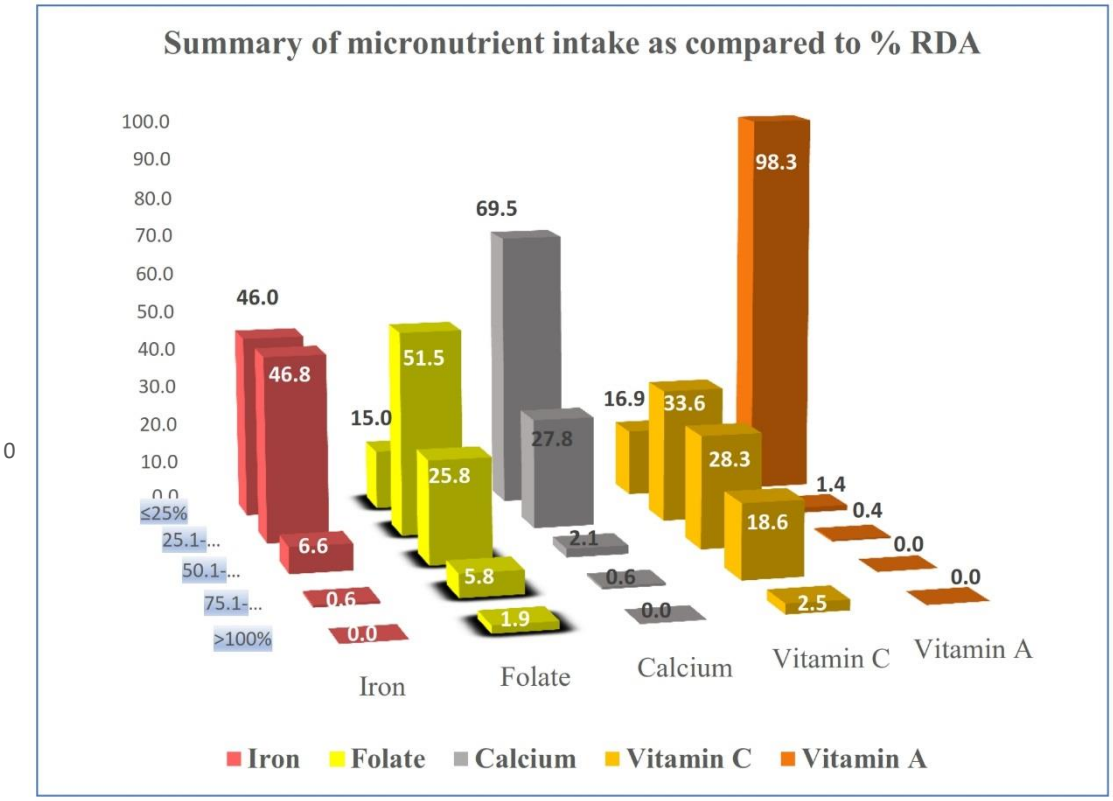
Findings from Table 4.14 shows that the total mean calcium intake decreases as the age increased, i.e., in the age of 6 years, the majority of children (66.7%) met 25-50% of RDA from their diet and in the age group of 7-9 years and 10-12 years, maximum children met less than 25% of RDA. (54.1% in 7-9 years and 78.7 % in 10-12 years*)*

Overall, no children could meet more than 100% of RDA for calcium, and there was no such difference observed even between the girls and boys. The majority of girls (63.6%) and boys (75.0%) in 6 years met only 25-50% of RDA. Whereas less than 25 % of RDA was met by boys and girls of 7-9 years and 10-12 years. (58.6% boys and 50.7% of girls in 7-9 years, 77.0% boys and 80.2% girls in 10-12 years)

However, **overall only 3 individuals (n=3)** could meet 75-100% of RDA for calcium in 10-12 years, and for 6 years and 7-9 years, nobody could meet more than 75% of RDA from their diets.

SUMMARY OF NUTRIENT INTAKE IN CHILDREN AGED 6 TO 12 YEARS AS COMPARED TO % RDA

Figure 4.3: Summary of micronutrient intake as compared with the percent RDA



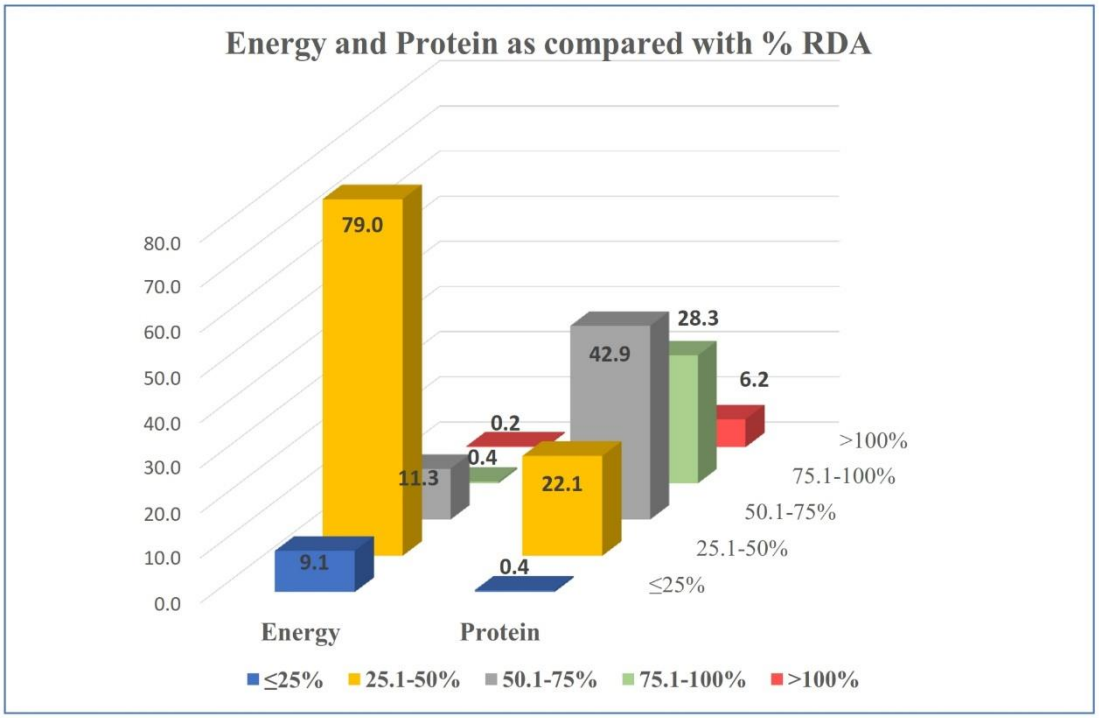
The above figure 4.3 represents the summary of micronutrient consumption for children aged 6-12 years which includes Iron, Folate (B9), Calcium, Vitamin C, and Vitamin A. The intake level was observed and analyzed by comparing it with percent RDA and data segregated into specific grades, i.e., less than and equal to 25 %; 25.1%-50%; 50.1% - 75%; 75.1% - 100%, and greater than 100%.

Findings showed that overall there was a low consumption of micronutrients in schoolchildren from their diets. Vitamin A, Calcium and Iron were the least consumed nutrient as compared with other two nutrients, i.e., folate and vitamin C. Majority of children (98.3%) of them metless than 25% of RDA for Vitamin A. Similarly, for Calcium and the Iron majority of them, i.e., 69.5% and 46.0% consumed <25 % of RDA respectively.

Whereas for folate (B9) intake, maximum children (51.5%) were consuming 25-50% of RDA, and 33.6% of children were able to meet 25-50% of RDA for vitamin C from their dietary intake.

It was noted that for Iron, Vitamin A, and Calcium, nobody could meet more than 100% of the requirements, whereas only 1.9% and 2.5% of children met >100% of RDA for folate and Vitamin C. However, very few percentages of children, i.e., 0.6%, were noted who could consume 75-100% of RDA for Iron and Calcium. Thus, inadequate intake of micronutrients was observed from their diet for three consecutive days. It could lead to micronutrient deficiencies in children, such as night blindness, iron deficiency anemia, etc.

Figure 4.4: Energy and Protein consumption as compared with the percent RDA



The above figure 4.4 represents the data of calorie consumption and protein consumption as per the recommended dietary allowances, and findings suggested that the majority of children (79.0%) met only 25-50% of RDA for energy, whereas as for protein, the majority of children (42.9%) met 50-75 % of RDA. The protein intake was observed to be better as compared to the energy in school-age children.

The energy intake showed that only 0.2% of children met >100% of RDA, and very few of them, i.e., 0.4 %, could even meet 75-100% of RDA. Although 11.3% of children were able to consume 50-75% of RDA and 9.1% were noted with less than 25 % of RDA for energy.

The protein intake from the diet was more than energy, where 28.3 % of children were able to meet 75-100% of RDA and 6.2% met more than the recommended values. However, 22.1% of children met 25-50% of RDA, and very few of them, i.e., only 0.4% of children, met less than 25% of RDA.

Out of 515 school-aged children, a protein energy ratio was calculated on a sub sample, with a focus on those whose RDA for protein was between 25 - 50 percent. A total of 114 school-aged children (6 to 12 years) were found to be consuming 25-50 percent of protein as compared with the RDA and from those a sub-sample of 50 school-aged children were assessed for energy protein ratio (EPR).

Since we observed the protein consumption pattern was good in these children, we made an attempt to understand its role in the daily metabolic activity. Thus, an assessment of the protein energy ratio was calculated for the study project.

Nutrient energy ratios have been utilized as indices of dietary quality in relation to numerous specific nutrients, as well as to describe nutrient goals, which in turn, are the basis for dietary guidelines. A recommended P.E ratio specifies the quantity of protein that the diet should give in relation to total energy. (FAO, 1985)

The energy protein ratio is frequently used to describe a diet's 'protein quality.' This ratio is commonly stated as a percentage of protein energy in the diet, with 1 g protein providing 4 Kcal or 16.7 KJ of metabolizable energy. It is abbreviated as P/E ratio.

The assessment was carried out for children age 6 years, 7-9 years, and 10-12 years and is given in table no. which shows the average energy protein ratios (EPR) of children’s diets for different age groups.

Table 4.15: Energy protein ratio of diets of the children of different age groups.

Age group (Age in years)	Mean energy intake (Kcal)	Mean protein intake (Kcal)	Protein calories	Calculated EPR
6 years	357.56	7.84	31.36	4.39
7-9 years	437.66	10.48	41.92	7.99
10-12 years	555.36	13.18	52.72	8.96

The average energy protein ratio of the diets of the children for age group of 6 year was 4.39, 7.99 for children aged 7-9 years, and 8.96 for children aged 10-12 years, which was below the ideal ratios, showing that their diets were not meeting protein requirements and their calorie intake was also insufficient, resulting in retarded growth. Energy protein ratios of diets of these children were below the suggested ratios indicating that the children were not obtaining the required quantity and quality of protein. There was the small improvement in energy protein ratio with increasing the age indicating slight improvement in protein adequacy in older children. This could be due to children eating a larger variety of foods as they become older, or to progressive the children's adaptability to the family or diet for adults.

A similar study was conducted in Mysore, India by Kulsum et al to analyse energy protein adequacy of the diets of Indian children residing in an urban slum between the ages of 4-14 years. Their findings showed that only 22% of children enjoyed a diet adequate in protein and calories.

The average energy protein ratio (EPR) was 12.4 in 4-6 years, 12.6 in 7-9 years and 12.7 in 10-12 years of the school aged children which were above the ideal suggested ratios with a slight increment in ratio with increasing age. Although nearly half of the children (41%) had appropriate protein meals, they were deficient in energy, which is not ideal because protein will be used to meet energy needs rather than supporting growth, a characteristic feature observed in these children. Hence, none of the children were receiving adequate quantities of both nutrients for the age group of 4 to 6 years.

In summary, just 22% of the children were consuming growth-promoting diets that were adequate in both protein and energy, whereas the majority of children (65%) were receiving adequate protein exclusively. However, the majority of their protein came from plant food, which is of lesser quality than protein from animal sources. (Kulsum et al., 2008).

Similarly, a study was conducted in Andhra Pradesh, India to ascertain to understand protein energy requirement in the breakfast habits of 10–15-year-old school children and were assessed to know the quality of this meal as well as its relationship to the food consumption pattern for the full day. The results revealed that; 40.3% of the boys and 32.1% of the girls studied were found to be underweight. Protein intake was also inadequate among boys and girls, although a higher percentage of children met their protein requirements. (Chitra and Reddy, 2007)

A study was conducted in urban Bangladesh to investigate the dietary pattern and nutritional status of adolescent girls aged 10-16 years attending schools in Dhaka city. Nutrient intake was assessed using the 24-hr recall method and the usual pattern of food intake was examined using a 7-day food frequency questionnaire. The findings showed that 91% had energy intakes below the RDA and about 83% had protein intakes below the RDA. Thus, a greater number of children consumed 100% of RDA for protein as compared to energy. (Ahmed et al.,1998)

Status of Consumption of Fortified foods

All the respondents were interviewed about the awareness of fortified commodities and their frequency of consumption, i.e., fortified rice, wheat, oil, milk, and double fortified salt. As per the results, most of the school-aged children did not consume fortified commodities. It was also observed that population awareness and consumption of fortified commodities were very less in the study. Fortified oil and fortified singe iodized salt were available in the open market. It was observed that i.e., 97.6% from the south zone, and 100% of subjects from the north, east, and west zone consumed fortified oil. Whereas, 94.1%from the north zone, 95.9% from the south zone, 98.2% from the west zone, and 100% from the east zone consumed Fortified Salt.

Table 4.16: Consumption of fortified foods

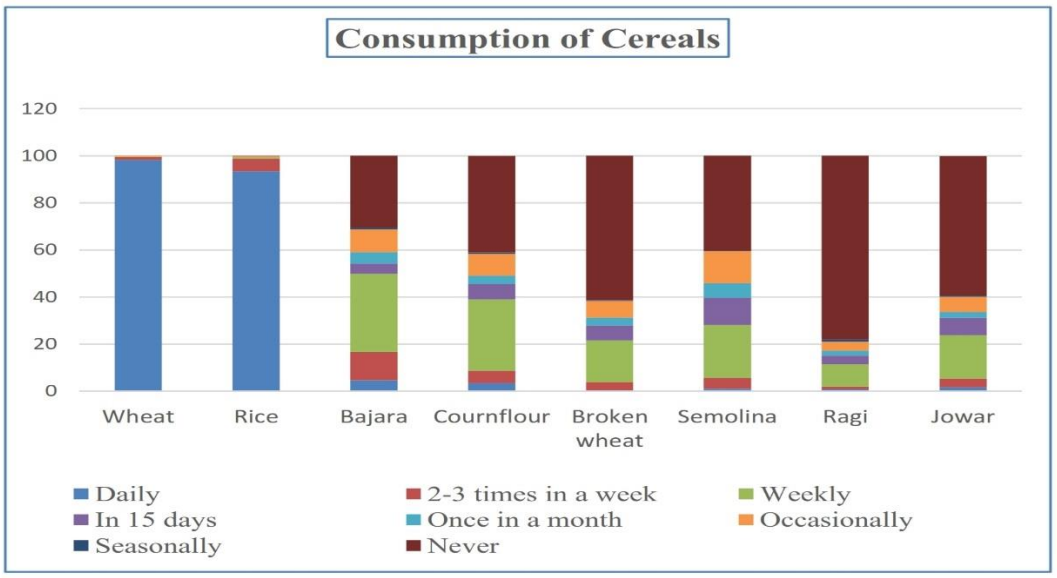
SN	Consumption	North Zone (N=136)	South Zone (N=172)	East Zone (N=90)	West Zone (N=117)
1.	Fortified Rice	-	-	-	-
2.	Fortified Wheat	-	-	-	1
3.	Fortified Oil	136	168	90	117
4.	Fortified Milk	-	-	-	1
5.	Fortified Salt	128	165	90	115
6.	Double fortified salt	-	-	-	-

Status of frequency pattern of foods

The Food frequency questionnaire was administered to the enrolled subjects, and they wereasked about the consumption pattern of local foods over a period of time. Here, the food frequency questionnaire (FFQ) consists of 63 food item list from 11 food groups: (a) Cereals; (b) Roots and tubers; (c) Vegetables; (d) Fruits; (e) Pulses/legumes/nuts; (f) Milk and milk products;

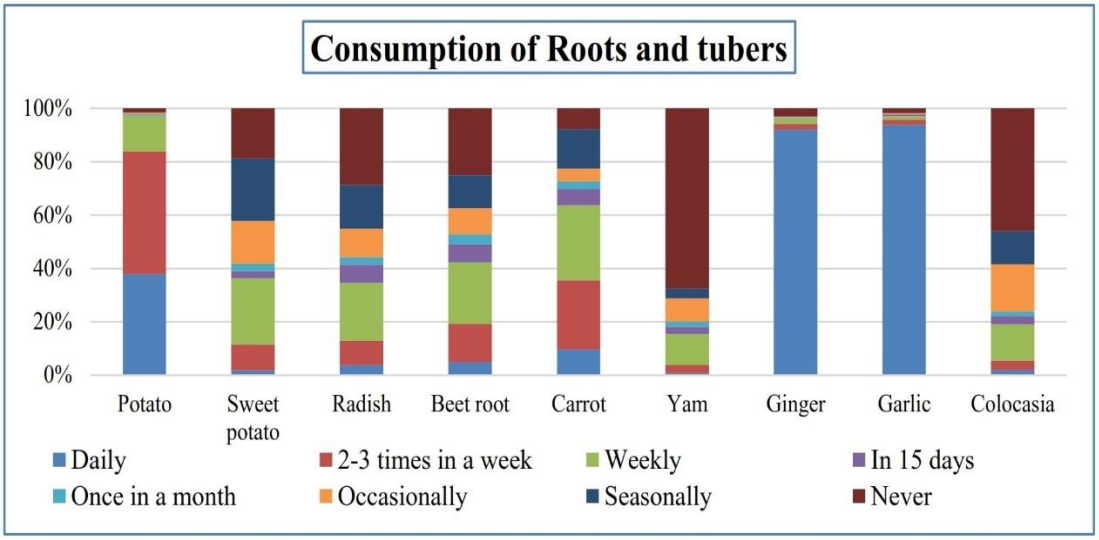
(g) Oil and fats; (h) Sugar/honey; (i) Meat and poultry; (j) Fish and seafood. Frequency intake was evaluated for each item by using 8 categories: (a) Daily; (b) 2-3 times in a week; (c) Weekly; (d) In 15 days; (e) Once in a month; (f) Occasionally; (g) Seasonally; (h) Never.

Figure 4.5: Frequency of consumption of Cereals



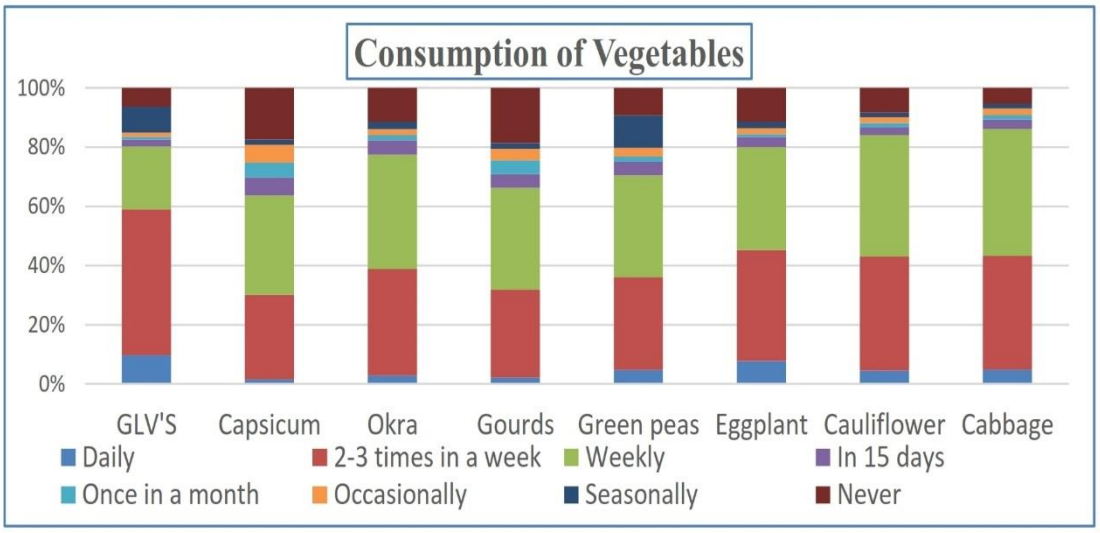
Total 8 items were listed from the cereals, including wheat, rice, bajara, cournflour, broken wheat, semolina, Ragi, and jowar. It was observed that there was daily consumption of wheat and rice; whereas the intake of bajara and cournflour were consumed weekly. However, majorityof them never consumed ragi & broken wheat.

Figure 4.6: Frequency of consumption of Roots and Tubers



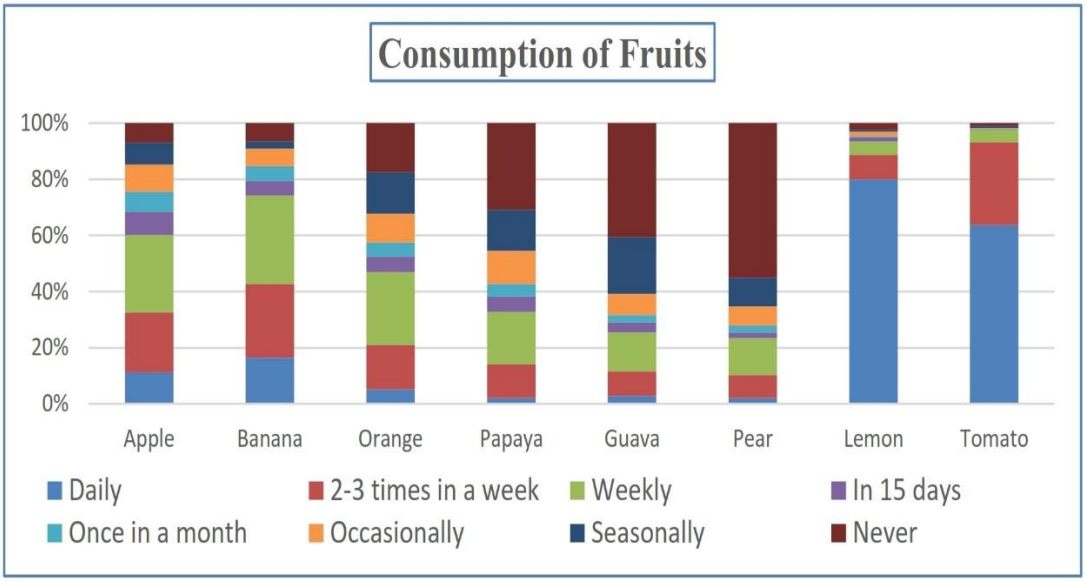
The 9 items were listed from the roots and tubers food group: potato, sweet potato, radish, beetroot, carrot, yam, ginger, garlic, and colocasia. Ginger and garlic were observed to be frequently consumed daily. The potato was consumed 2-3 times a week. Whereas sweet potatoand carrot were consumed weekly. Radish, Yam, and Colocasia were least consumed from all the food items.

Figure 4.7: Frequency of consumption of Vegetables



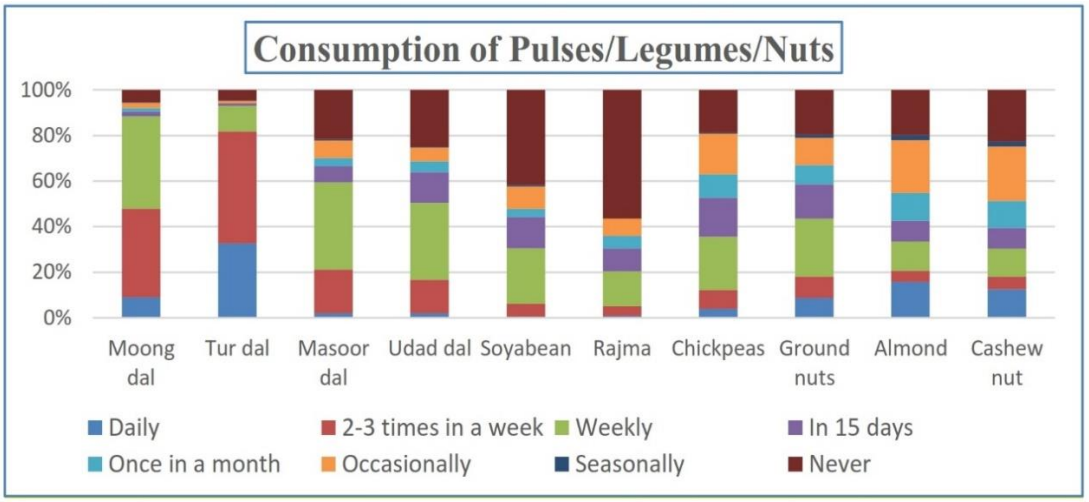
The consumption of all vegetables was almost 2-3 times a week. Green leafy vegetables wereconsumed 2-3 times a week. The eggplant was also observed to be consumed 2-3 times in a week. Other vegetables like cabbage, cauliflower, and okra were consumed weekly.

Figure 4.8: Frequency of consumption of Fruits



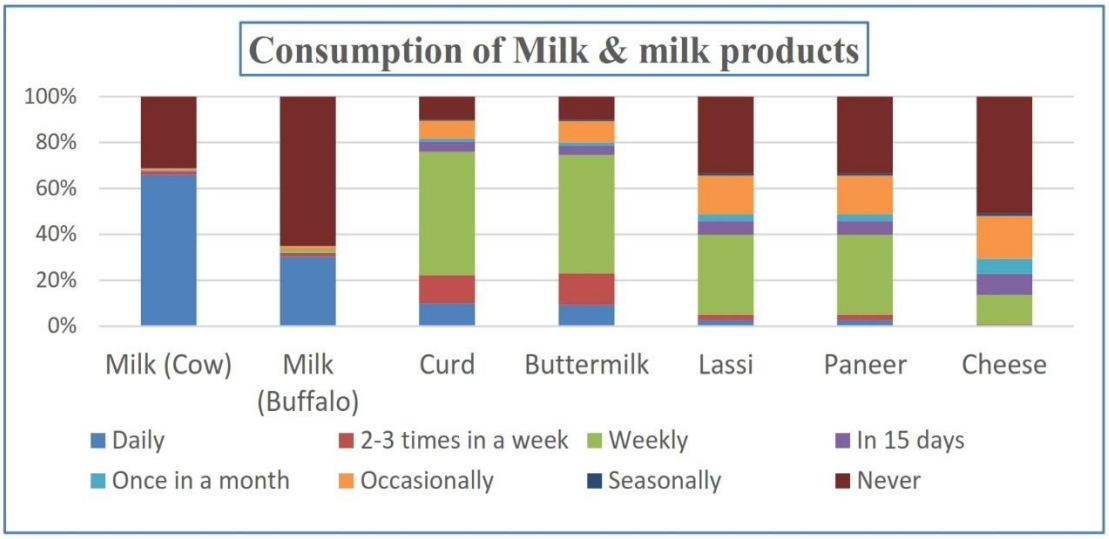
The consumption of locally available 8 fruits was observed, i.e., apple, banana, orange, papaya,guava, pear, lemon, and tomato. Findings showed that Lemon and tomato were commonly consumed, and other fruits like apple, banana, and orange were consumed weekly. However, Pear, Guava and Papaya were not consumed frequently.

Figure 4.9: Consumption of pulses/Legumes/Nuts



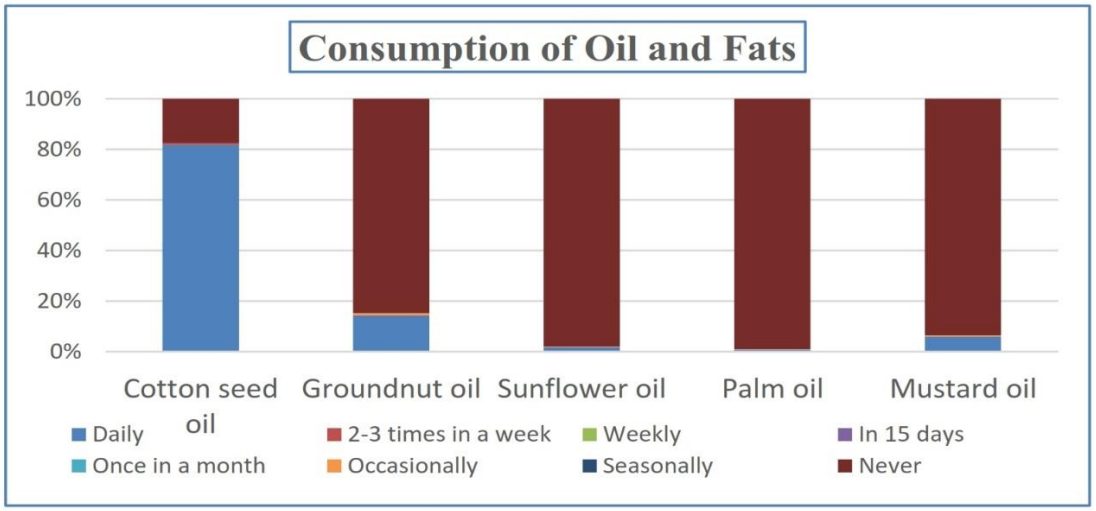
Pulses are good sources of protein and contain important vitamins and minerals like folate, iron,and potassium. 10 items were listed, and it was observed that the most frequently consumed pulses were tur dal (2-3 times in a week). Whereas Moong dal, Masoor dal, and Udad dal were consumed weekly. Rajma and Soyabean were not consumed frequently. However, the consumption of almond and cashew nuts was done occasionally.

Figure 4.10: Frequency of consumption of milk and milk products



From milk and milk products, 7 items were listed: milk (cow), milk (buffalo), curd, buttermilk,lassi, paneer, and cheese. It was observed that the consumption of cow milk was more than buffalo milk daily. Curd, buttermilk, lassi, and paneer were consumed weekly by the subjects. However, there was the least consumption of cheese.

Figure 4.11: Consumption of Oil and Fats



Fats and oils have important functions in the body. It provides energy and helps in the absorptionof fat-soluble vitamins (A, D, E, K). Consumption patterns of five types of oils were asked, including cottonseed oil, groundnut oils, sunflower oil, palm oil, and mustard oil. It was observed that the most commonly consumed oil was cottonseed oil. However, sunflower and palm oil were not at all consumed.

Figure 4.12: Frequency of Consumption of Sugar

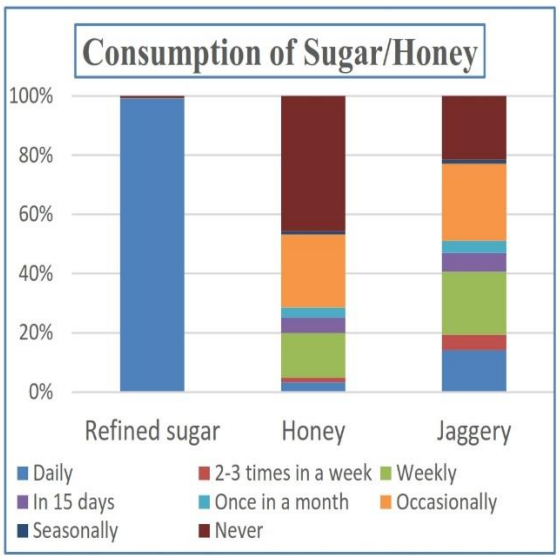
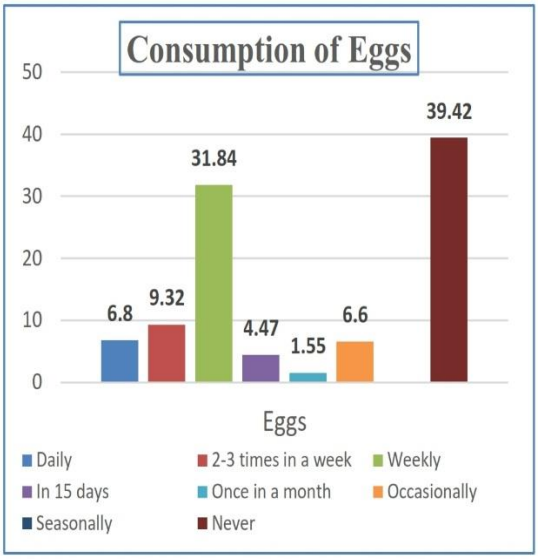


Figure 4.13: Frequency of consumption of Eggs



The consumption of Refined sugar was observed daily, whereas; honey was consumed 2-3 timesin a week. Jaggery, which may contain small amounts of B vitamins and minerals were consumed occasionally. The consumption of eggs was observed weekly.

Figure 4.14: Frequency of consumption of Figure 4.15: Frequency of consumption of Meat and Poultry of Fish and Seafood

Figure 4.14: Frequency of consumption of of Meat and Poultry

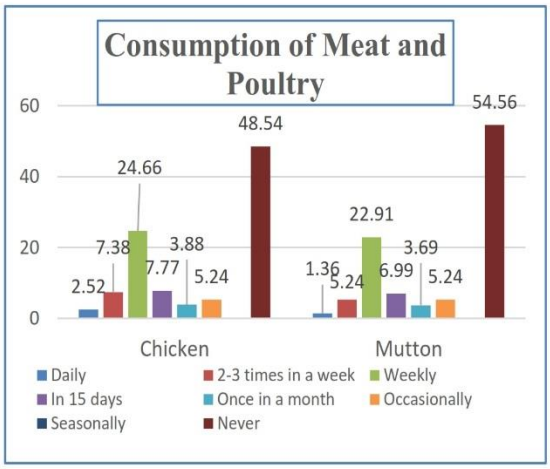
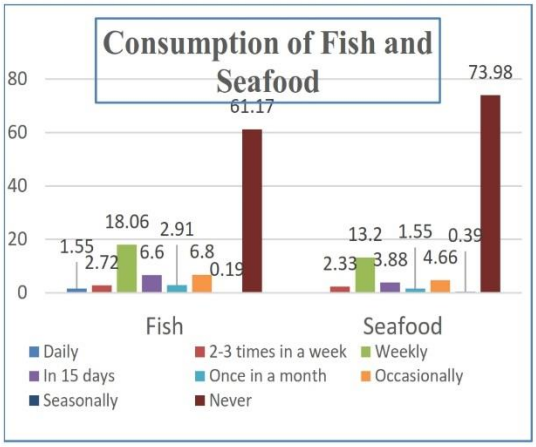


Figure 4.15: Frequency of consumption of Fish and Seafood



The consumption of meat and poultry was not observed frequently; Chicken and Mutton wereconsumed weekly by a few of them, and the majority were not consuming it. For fish and seafood, there was a similar scenario, and it was the least consumed.

Status of Mid-Day Meal program in COVID situation

Under the National Food Security Act of 2013 (NFSA), the National Programme of Mid-Day Meal in Schools, also known as the Mid-Day Meal Scheme, is one of the most essential rights- based Centrally Sponsored Schemes. Under this, the ministry of education has approved the pattern of funds for providing hot cooked meals to all the students of elementary classes on working days of schools in all the government and government-aided schools to fulfill the primary objective of improving the nutritional status of children.

The unexpected COVID pandemic has made the years 2021-22 extremely difficult for everyone. The Massive increase in cases all over the country has forced the respective state governments totake strict actions. Several states announced the closure of schools and other educational institutions to ensure the safety of school-going children and break the chain of spreading the virus. After the lockdown in March, the schools were shut down, and as per the number of cases decreased, the orders came to reopen schools in a phased manner. However, due to the recent increase in the number of cases of COVID-19 again, the authorities have been ordered to closeall the schools.

Due to the pandemic, the hot cooked meal served to school children under the mid-day meal scheme was not functional. Since the hot cooked meal was the only main meal for most students studying in government and government-aided schools because of the poor background, to ensure their nutritional status and to look to these circumstances, the government of India had advice state government and UTs administrators to take necessary and appropriate actions for providing "take-home ration" under the food security allowance to all the enrolled students under mid-day meal scheme, since it was not possible to provide hot meals. The state governments and UTs administrators decided the quantity and items according to their entitlements using per meal cost with grains. (D.O. letter dated 13.5.2021 reg. provision of FSA during 2020-21)

Under this provision, it was observed in the Vadodara district of an urban area; wheat and rice were provided to all eligible school children of primary and upper primary sections. The distribution of ration was done from the specified fair price shops in which eligible students were provided coupons of wheat and rice from their respected

schools, or it was supplied from respected schools themselves. The following table shows the amount and quantity of dry ration provided:

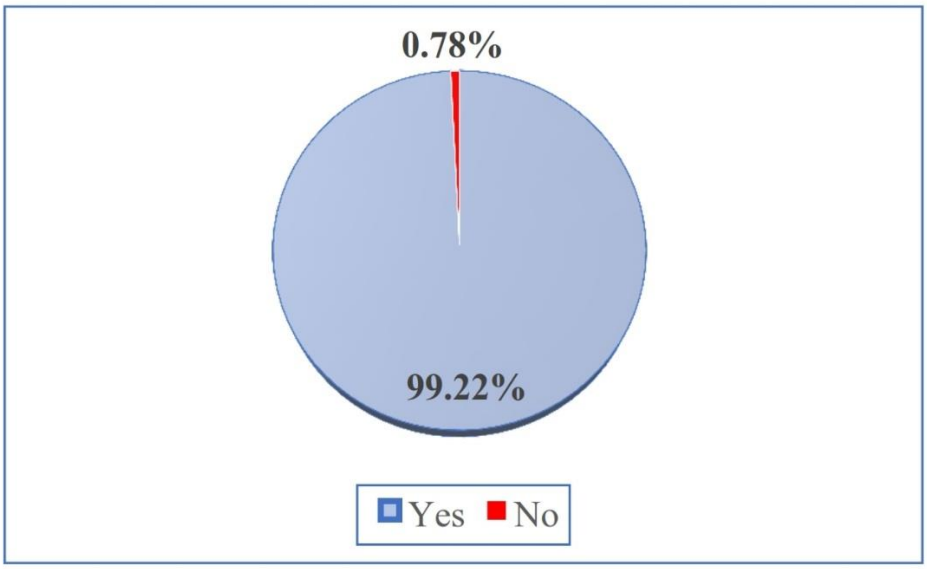
Table 4.17: Quantity of ration and cash intensives

Standard	Ration (Wheat & Rice)	Cash intensive (Rupees)
I to V	50 grams per day	4.97 per day
VI to VIII	75 grams per day	7.45 per day

The dry rations were given excluding the holidays, which are the working days of schools andthe amount provided to students were the cooking costs entitled under the mid-day meal scheme.The mode of cash-intensive payment of honorarium was e-transferred by the holiday's state government.

The semi-structured questionnaire was administered to the enrolled subjects regarding the current services provided.

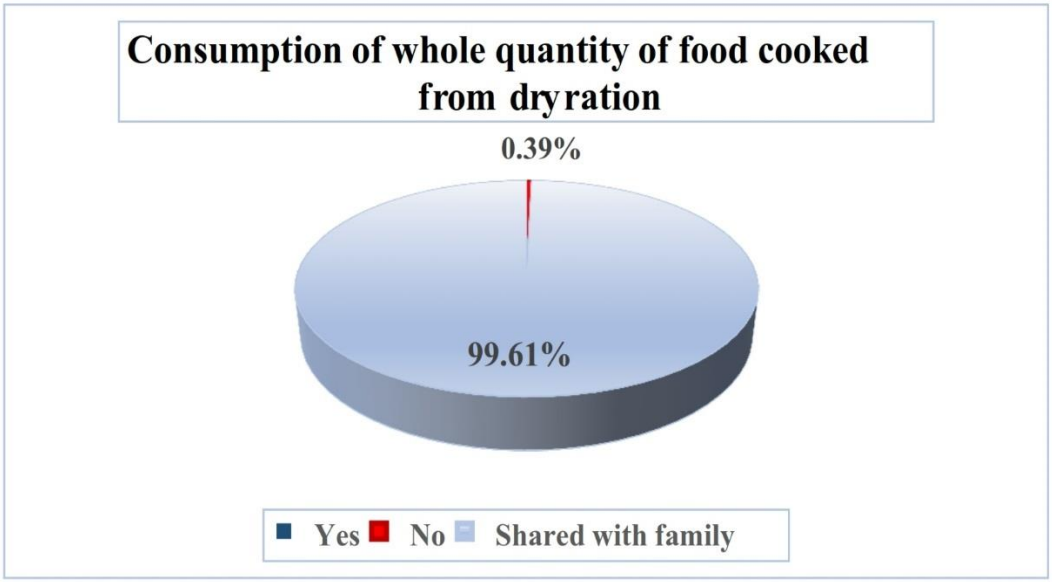
Figure 4.16: Children aged 6-12 years receiving dry ration



It was observed that the majority of the students (n=511) were receiving dry ration, i.e., wheat and rice, both from the respected schools. However, it was noted that 4 students were not gettingthe dry ration because they were newly admitted in schools. Delivery of services in the covid situation was good and parents of enrolled subjects were receiving through appropriate protocolsand safety measures. From all those (n=511) who were receiving dry ration, findings showedthat majority of 99.22% were eating

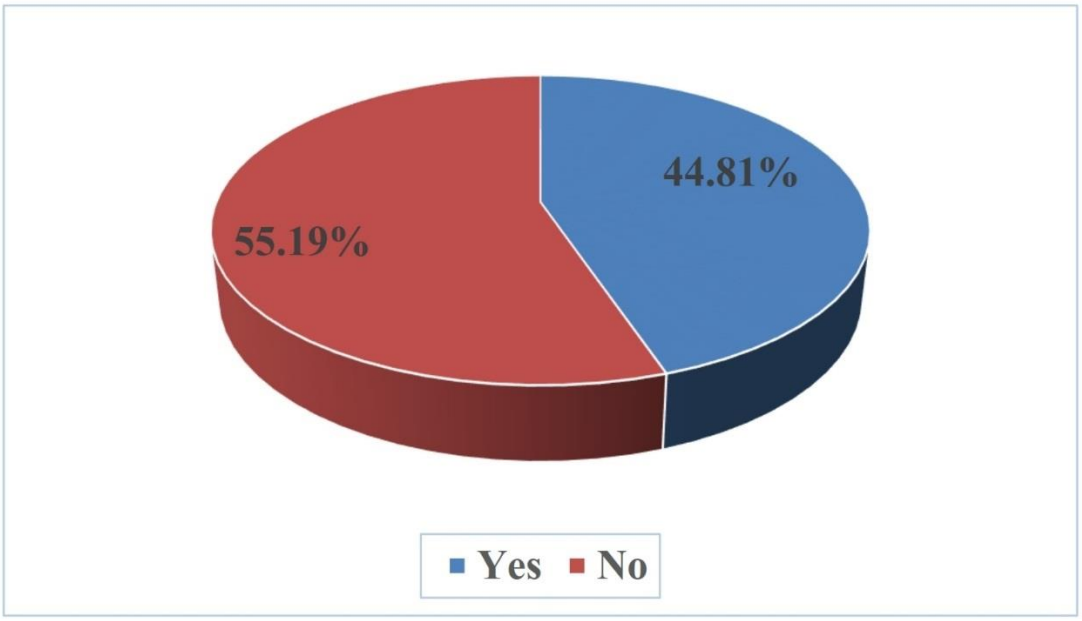
food cooked from dry ration and majority of children, i.e., 99.02 % were liking the foods cooked from wheat and rice.

Figure 4.17: Consumption of whole quantity of dry ration by children (6-12 years)



As per the findings, results suggested that the majority of them children who were eating foods cooked from dry ration have not consumed whole quantity of wheat and rice solely. 99.61 % of children were noted who shared that ration with their respective families and hence the ration given to them were divided with their total family members. Due to such reasons, most children claimed that the quantity of wheat and rice gave was not enough. The majority of them belongedto the upper lower class of families as per the kuppuswamy scale, and their incomes were not very fascinating to fulfill basic food needs.

Figure 4.18: Dry ration received as per community's perception



The above figure 4.18 shows that most children, i.e., 55.19%, were not getting dry ration (wheat and rice) as much as they needed to fulfill their family's food needs, whereas 44.81 % noted that theywere getting as much as they want.

Status of awareness on multiple micronutrients

The semi-structured questionnaire was administered to the enrolled subjects to known their awareness about multiple micronutrients. Awareness of their body functions, deficiency, and foods rich in iron, iodine, vitamin A, and vitamin B12 was seen.

[1] Iron

Iron deficiency anemia is the major public health problem among the general population in developing countries. So, it necessitates their importance of awareness on how it occurs and can be prevented in our population.

Hussain, T et al.,2010 did research on awareness on iron deficiency and reviewed that becauseof the high iron deficiency and anemia in the population of developing countries like India, China, and Pakistan, their economic conditions are affected because there is a population who perform physical labor as their sources of income. It also hinders the growth and learning of children.

Similar research was done in Bahir Dar city administration, North West Ethiopia, on irondeficiency among school adolescent girls of rural areas. Their results concluded that the awareness of term anemia was poor. Amongst the participants, more than three-fourth of subjects, i.e., 78.5 %, have never heard about the term anemia. (Mengistu et.al.,2019)

In this study, all the enrolled subjects were administered semi-structured questionnaires, and awareness of iron deficiency anemia was asked, and the following figures describe the results.

Figure 4.19: Awareness on term Anemia

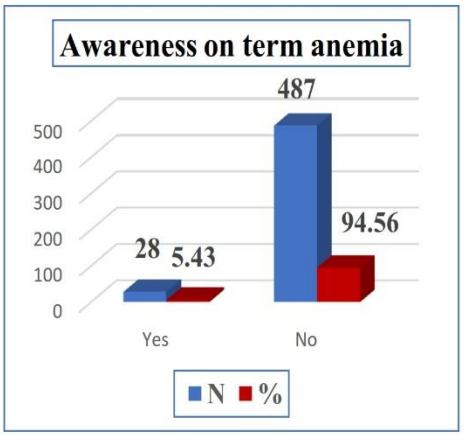
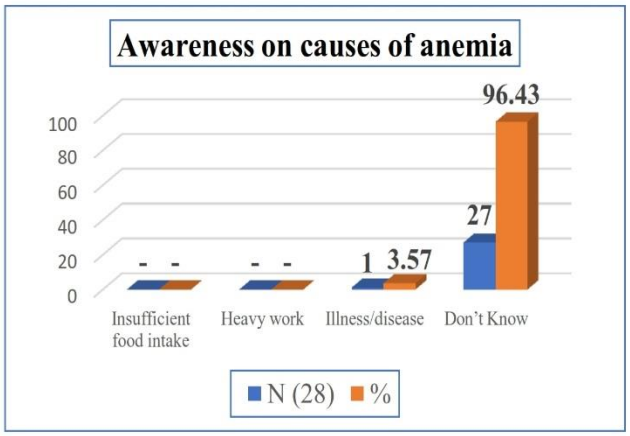
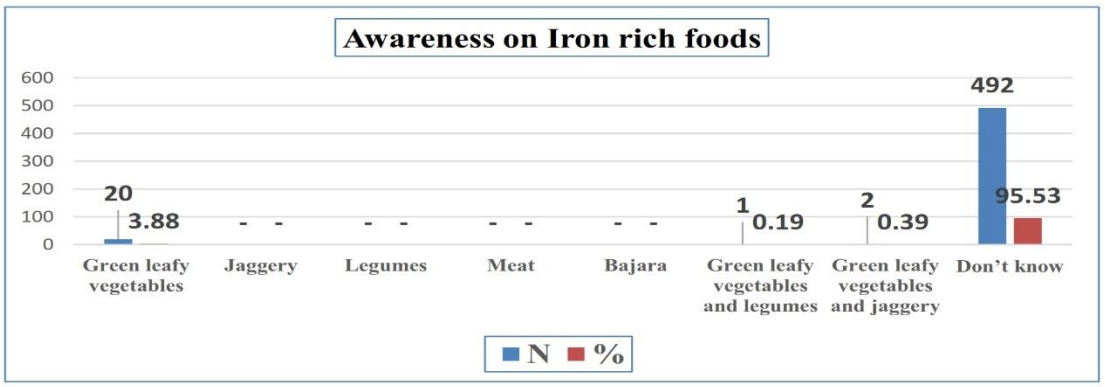


Figure 4.20: Awareness of causes of anemia



It was found that most of them were not aware of the term iron deficiency anemia (IDD); only (n=28) 5.43 % knew about the term anemia. Those who have heard the term anemia were asked about how anemia occurs, but almost all of them (96.43%) responded with don't know.

Figure 4.21: Awareness of foods rich in iron



Awareness on locally available foods and rich in iron were asked, which included green leafy vegetables, jaggery, legumes, bajara and meat. The findings reflected that most of the subjects (95.53%) did not know the rich sources of iron. However, only (n=20) subjects responded green leafy vegetables as a good source of iron.

[2] Iodine

Figure 4.22: Awareness of Iodine

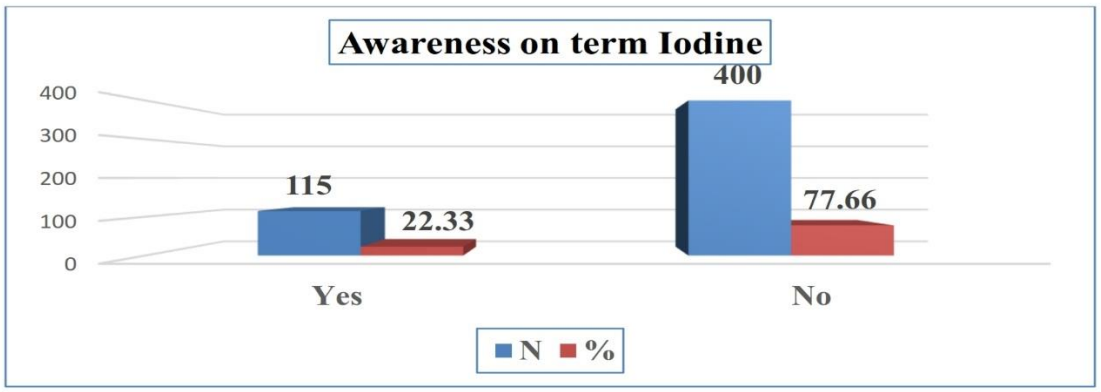


Figure 4.23: Awareness of Iodine rich foods

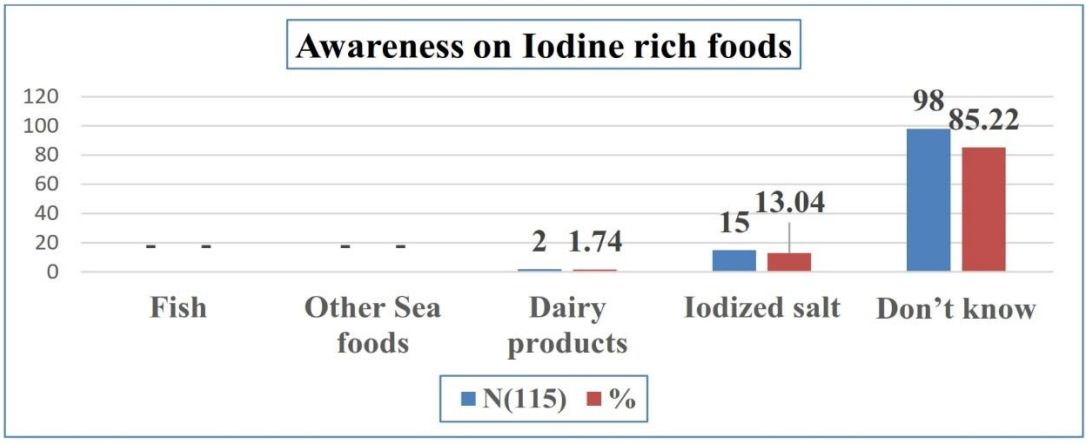
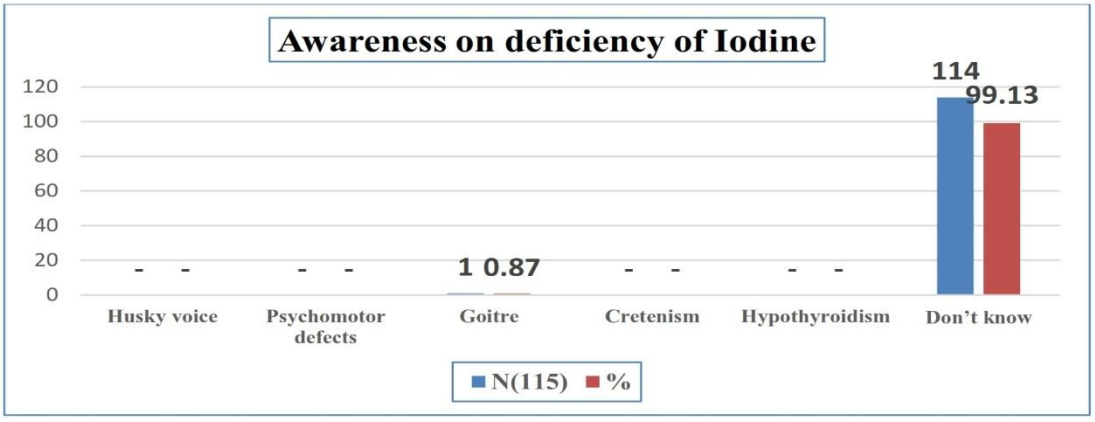


Figure 4.24: Awareness of the deficiency of Iodine



Iodine is a necessary micronutrient for sustaining several physiological functions in our body; however, iodine deficiency can lead to a wider range of health issues. Thus, awareness of havingiodine-rich foods, their deficiency, and outcomes are important

aspects that may prevent IDD in the general population. (Hailu et al.,2016)

Heidari et.al. in 2019 had conducted a study in Iran on iodine status and knowledge about the iodine deficiency disorders in adolescent school girls. Their results revealed that there was avery poor knowledge in school going students about and the factors which lead to iodine deficiency (7.2%), iodine deficiency issues or complications (6.3%), iodine element (10.3%), term goiter (19.3%), and foods which are rich in iodine (24.4%).

A study was conducted in the Kerema district on the iodine status of children and knowledge, attitude, and iodized salt use in 2018. It showed very limited awareness of iodine deficiency among school children aged 6 to 12 years. The subjects were asked about the health risk ofiodine in the diet, and the majority, n=153 (100%), reported don't know. However, nobody knewabout what iodine deficiency is and how it can be prevented. (Goris et al.,2018)

In this study, awareness of the term iodine was asked to the subjects, and the findings showed that 22.33% of children were aware. In contrast, most of them, i.e., 77.66%, were not aware of the element iodine.

Results on awareness of iodine-rich foods showed that 85.22% of people did not know about iodine sources, and only 13.04% of them knew that they get iodine from iodized salt in their diet. However, there was almost no awareness regarding the deficiency of iodine and on-term goiter.

Children with awareness regarding iodized salt were 19.61% (n=101). Those children who have heard about the term iodized salt were asked how to recognize them, and the majority reported that they didn't know how to recognize the iodine salt. However, 23.76% had some knowledge that they can identify by watching labels on the packet, 8.91% knew about the sun smiling logo, and almost nobody (0.99%) was aware of the F plus logo used to identify the fortified food pack.

[3] Vitamin A

Figure 4.25: Awareness on term vitamin A

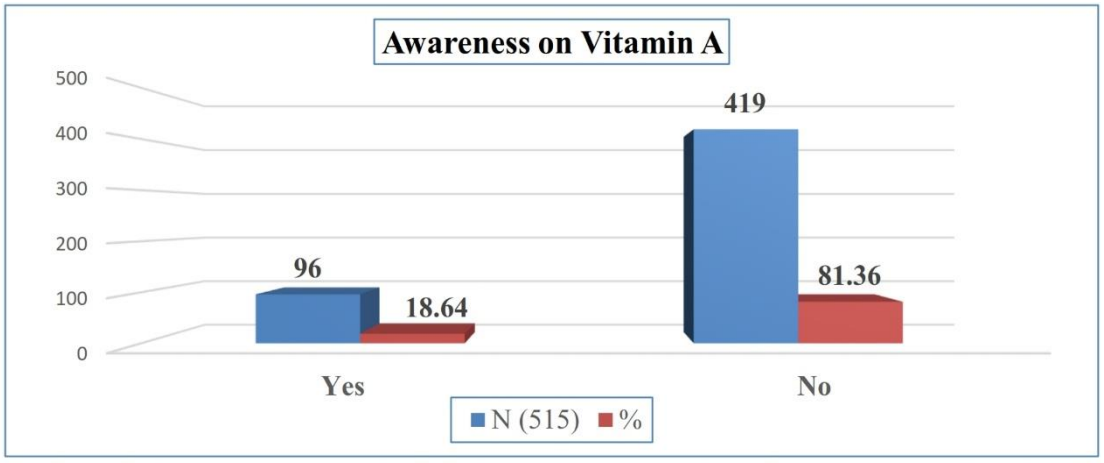


Figure 4.26: Awareness of Vitamin A rich foods

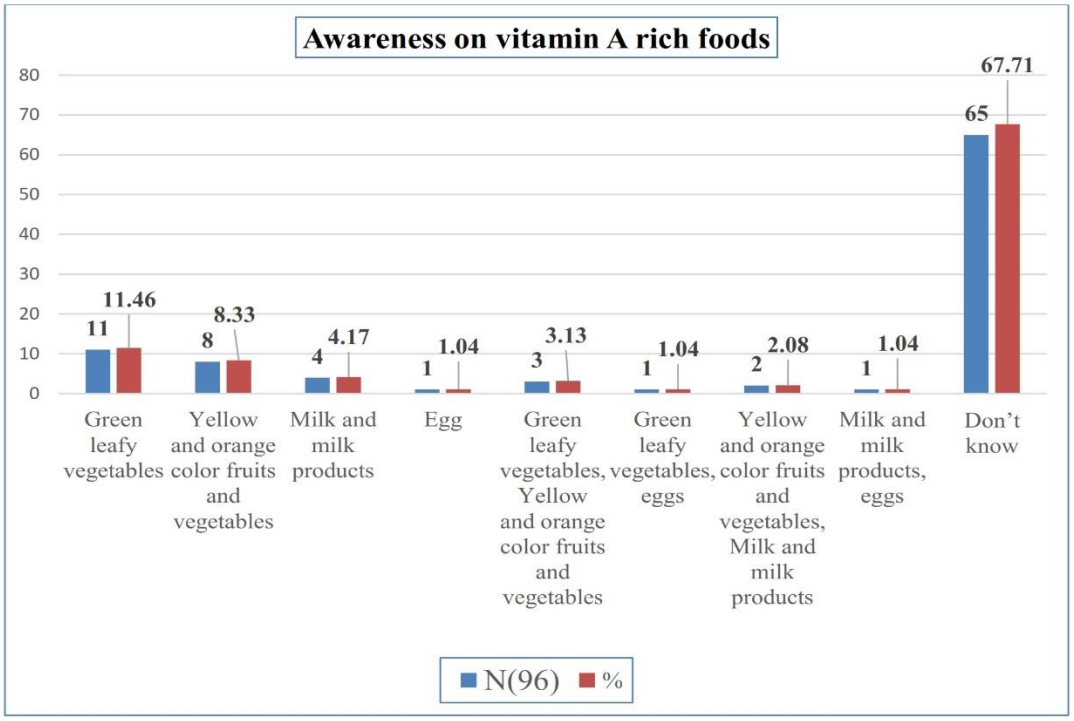


Figure 4.27: Awareness of functions of vitamin A in the body

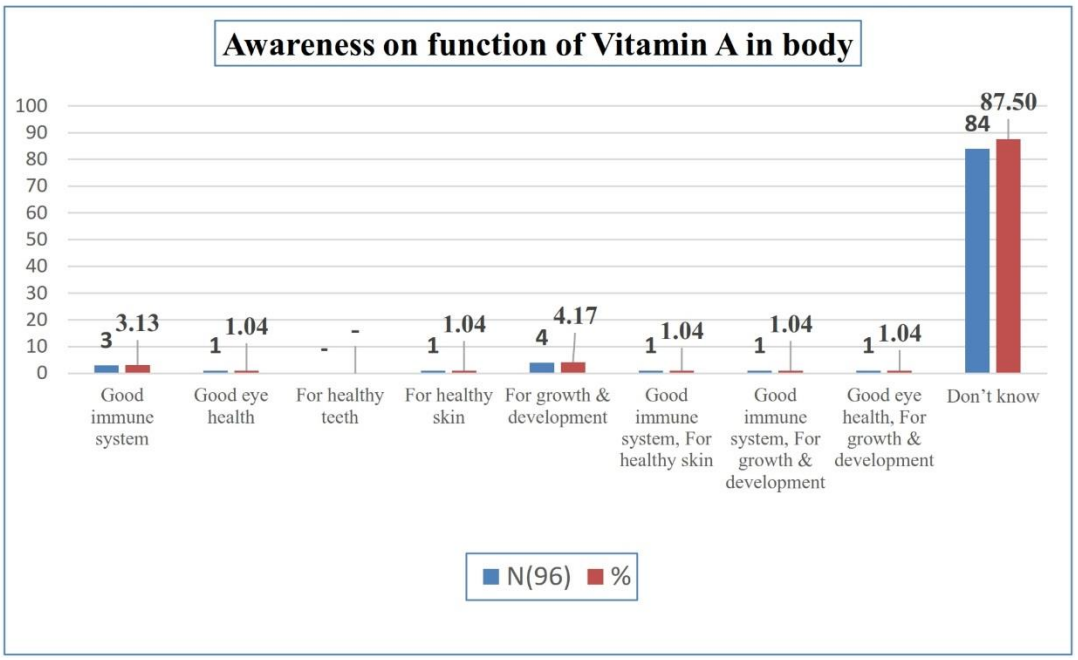
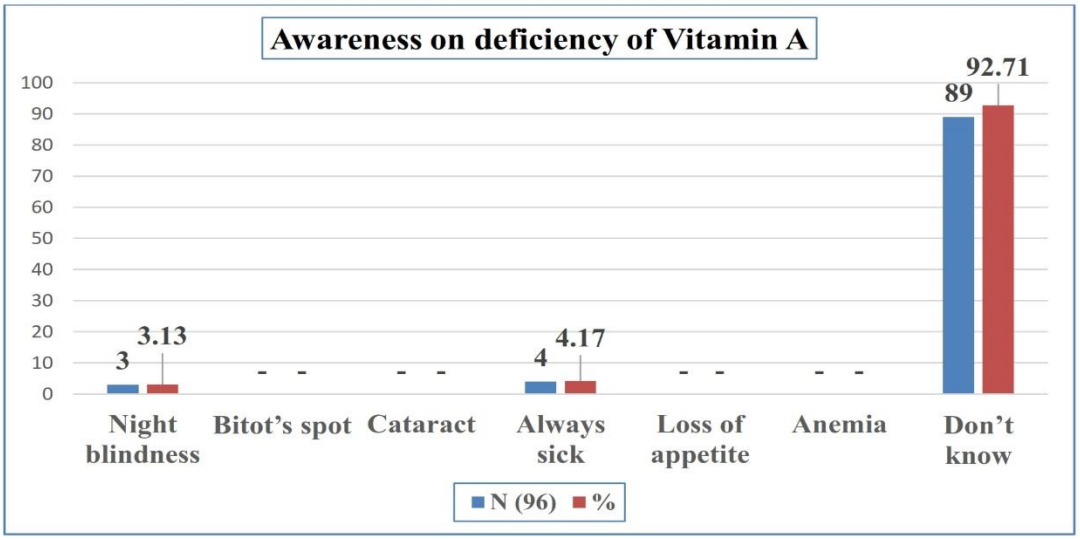


Figure 4.28: Awareness on the deficiency of Vitamin A



Findings showed that the children were majorly unaware of vitamin A terms, their deficiency, functions in the body, and vitamin A-rich foods. 18.64% of them showed that they knew about the term vitamin A. Whereas, when those were asked about which foods are rich in Vitamin A, itrevealed that 11.46 % said green leafy vegetables, 8.33% said yellow and orange color fruits andvegetables, and 4.17% said milk and milk products. Very few of them noted multiple answers, i.e., 3.13% responded both GLV's / Yellow and orange color fruits and vegetables, and only 2.08% responded Yellow and orange color fruits and vegetables / Milk and milk products.

Awareness on functions and deficiencies were asked, and it showed that majority of them didnot know about the function of vitamin A in the body and their deficiencies. Only 3.13% of themwere noted with a good immune system, and 4.17% knew that vitamin A is good for growth and development. However, 3.13% knew that deficiency of vitamin A could lead to night blindness.

Figure 4.29: Awareness on term Vitamin B12

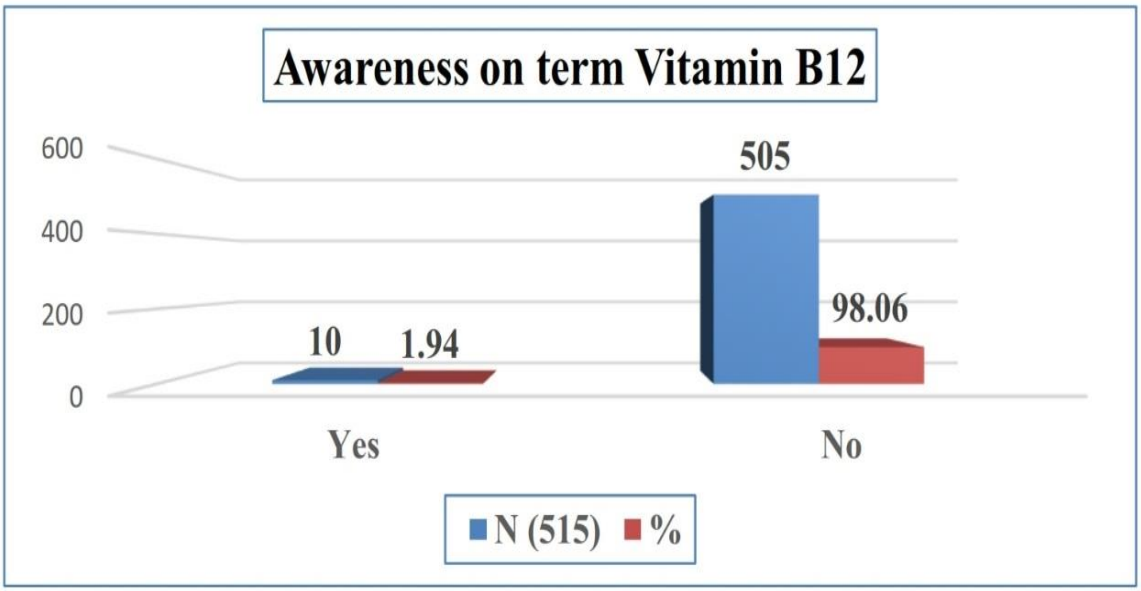


Figure 4.30: Awareness of foods rich in vitamin B12

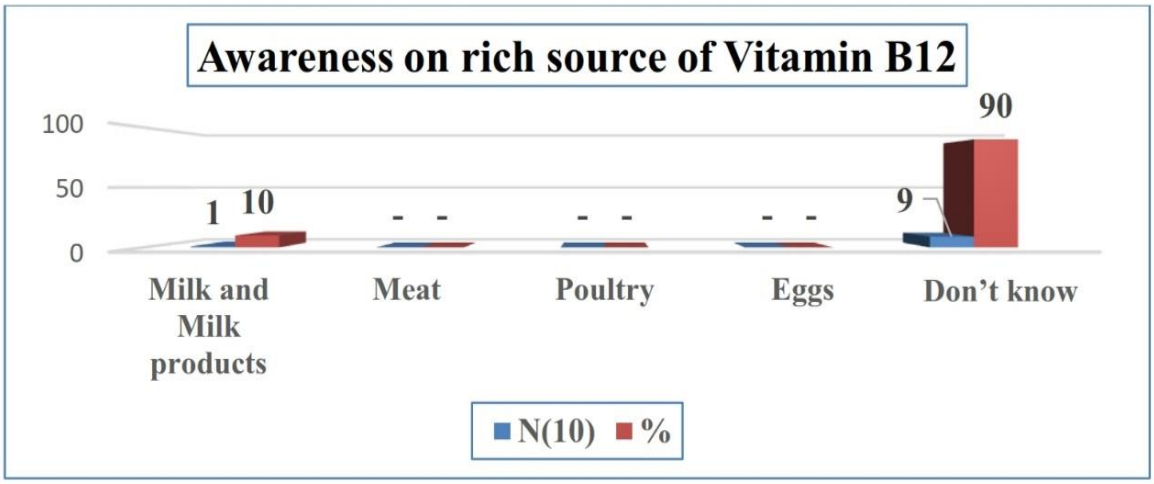
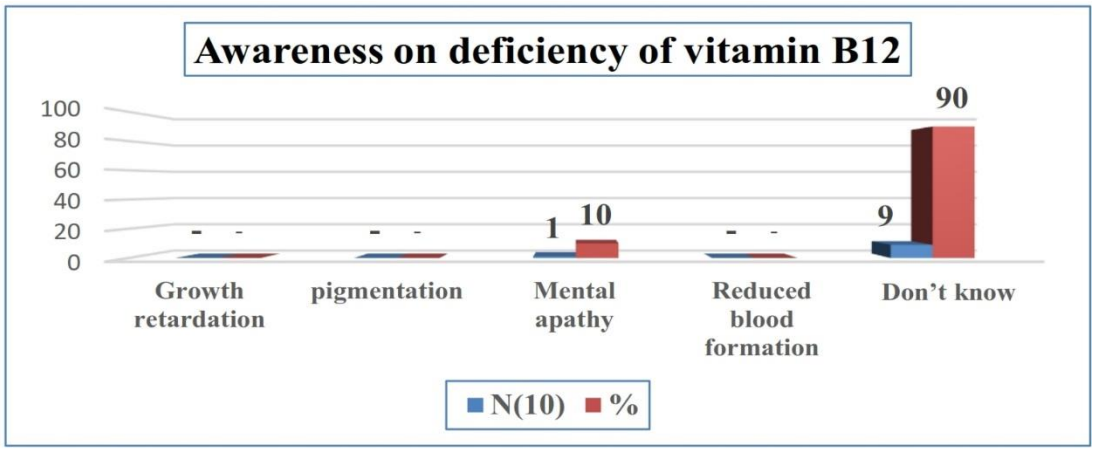


Figure 4.31: Awareness of the deficiency of Vitamin B12



It showed that there was almost no awareness of the term vitamin B12. The majority of 98.06 % of subjects didn't know about the element vitamin B12. However, only 10 individuals were noted who have heard about vitamin B12. From those individuals who have some idea regarding the nutrient, it was seen that there was no awareness on foods rich invitamin B12 and their deficiencies in our body. However, 90% of them were noted with don't know the response.

Signs and symptoms of nutritional deficiency disorders among school-aged children Micronutrient deficiency has been assessed by the clinical signs and symptoms of the school- going children. A semi-structured questionnaire was administered to all the subjects. Signs and symptoms were seen for nutritional deficiency disorders, including anemia, night blindness for vitamin A deficiency, and Vitamin B12 deficiency symptoms. Iron deficiency anemia is a major public health problem, especially in developing countries, and it is linked to poor cognition and motor development. Anemic infants may continue to perform poorly in school and can have behavioral issues in later life. Although there are different causes of anemia, nutritional deficiencies are the major ones of all. Hence to assess their nutritional deficiencies, their signs and symptoms were seen, which include [1] frequent tiredness, [2] pale nails, [3] pale tongue, [4] pale skin, [5] pale palm/eyes, and [6] shortness of breath.

Table 4.18: Percentage of children who experienced tiredness

Tiredness	N (515)	%
Yes	116	22.52
No	399	77.47

Findings showed that 22.52% of children frequently experienced tiredness, and the remaining 77.48% did not experience tiredness. About 3.88% of children were experiencing shortness of breath, 1.79 % experienced pale eyes and palm, 1.36% experienced pale skin, and 3.10% experienced multiple responses. Although, the majority (88.35%) didn't experience any sign and synonyms for anemia. However, from those who experienced symptoms, it was noticed that 41.67 % were experiencing such signs and symptoms weekly.

Table 4.19: Signs and Symptoms for Vitamin A deficiency

Difficulties in seeingobjects in the dark	**N (515)**	**%**
Yes	43	8.35
No	472	91.65
Dryness/Roughness ineyes	**N (43)**	**%**
Yes	7	16.28
No	36	83.72

Vitamin A deficiency was presented by asking in the form of difficulty in seeing objects in darkness and dryness or roughness in eyes; as VAD is the leading cause of preventable night blindness in children, it has been the most important indicator for assessing signs and symptoms.Findings suggested that 8.35% of children experienced difficulties seeing objects in the dark or seam/dull light. Whereas, from those 16.28 % children were experiencing dryness/roughness in their eyes frequently.

Similarly, signs and symptoms for vitamin B12 deficiencies were seen, and it was observed that the majority (79.61%) of them did not experience any symptoms of it. Only 20.39% experienced symptoms from which maximum children experienced abdominal discomfort, i.e., 2.52% (n=13), followed by 1.36% experiencing weakness, 1.17% with frequent diarrhea, 1.17% with multiple responses of weakness abdominal discomfort, respectively. Although, from those who experienced signs and symptoms, maximum children (62.86%) were noted with monthly experience of those signs and symptoms of B12 deficiency.

SUMMARY AND CONCLUSIONS

Micronutrient malnutrition is widely spread, and the nutritional community has recognized thatit is likely one of the world's major nutritional issues. COVID-19, declared a pandemic by the world health organization, has affected many parts of the global population. Food supply networks were disrupted very severely due to the complete lockdown where mobility restrictions and social distancing were incorporated. Majorly in developing countries, food security in the most inferior part of the population was severely affected. Although malnutrition, particularly among growing children, is one of the most severe public health issues in many parts of the world today, developing countries are particularly vulnerable to its consequences. Hence COVID-19 has emerged as a global storm of malnutrition. According to the CNNS-2018, school-aged children are the most susceptible age group in India to acquiring VAD. Poor dietary sources of vitamin A and poor nutritional status are responsible for VAD. Iron deficiency anemia is a very prevalent and major public health concern. If we look into the national anemia status of all the Indian states, in 15 states, it is a moderate to severe public health concern among school-aged children (5-9 years). However, dietary modifications, particularly micronutrient-richfoods, play a critical role in addressing multiple micronutrient deficiencies. (Herrador et al.,2014)

In the study from the urban Vadodara, 515 school children were enrolled, and data was collected. The significant findings of the study were given below:

Nutritional status assessment in Covid situation was seen. The mean consumption of Energy of the age 6-12 years was observed and from the data analyzed it can be interpreted that the average calorie intake of Boys was 582.71 Kcal in 6 years of age and as the age increases their calorie consumption in boys also increased, i.e., 662.92 Kcal in 7 years, 686.93 Kcal in 8 years, 671.94 Kcal in 9 years, 814.93 Kcal in 10 years, 736.00 Kcal in 11 years and 765.35 Kcal in 12 years of age.

In girls, the average calorie intake was observed to be 651.47 Kcal in 6 years, 744.70 Kcal in 7 years, 738.45 Kcal in 8 years, 702.06 Kcal in 9 years, 778.02 Kcal in 10 years, 741.32 Kcal in 11years, and 750.53 Kcal in 12 years of age respectively. As the age increased, the nutrient gap was increased in both boys and girls. However, around 50-60% of the nutrient gap was observed for energy in both boys and girls.

Overall, the mean intake was higher in girls than boys in age 6 years, 7 years, 8 years, and 9 years for protein. Whereas in the age of 10 years, 11 years, and 12 years the average protein consumption was more in boys than girls. A nutrient gap of 9.20%, 18.56%, and 39.99% was found in girls, whereas; 15.77%, 25.69%, and 36.44% were seen in boys for 6 years,7-9 years, and 10-12 years in protein.

Overall, the mean consumption of iron was observed to be very low in both boys and girls. The maximum nutrient gap of 82.01% was seen in girls and a gap of 66.79% in boys of age group 10-12 years in iron.

In folate, the nutrient gap was observed to be more in higher age of 10-12 years than the age group of 6 and 7-9 years. However, most of the gap was observed in the age group of 10-12 years, where the percent RDA difference was 58.51% and 60.98 % in boys and girls.

Calcium was poorly consumed through their diets, and the nutrient gap was noted to be more in girls than boys in the higher age group of 10-12 years, i.e., 80.80% in girls and 78.18% in boys.

A maximum gap was noted in vitamin C in the age group of 10-12 years, i.e., 53.63% in boys and 50.90 % in girls. A nutrient gap was more in girls of age 6 and 7-9 years of age than boys.

Vitamin A consumption was inferior as compared to other nutrients. At the age of 6 years, a nutrient gap for vitamin A was 92.15% in boys and 91.85%. A similar gap was noticed in the age group of 7-9 years, 93.78% in boys and 93.13 % in girls and age group of 10-12 years, 92.76% in boys and 94.36% in girls.

Overall there was a lower consumption of micronutrients in school-age children of 6 to 12 years from their diets. Vitamin A, Calcium, and Iron were the least consumed micronutrients. The majority of children (98.3%) met less than 25% of RDA for Vitamin A. Similarly, for Calcium and Iron, most children, i.e., 69.5% and 46.0%, consumed < 25 % of RDA, respectively. For iron, calcium, and vitamin A, nobody consumed more than 100% of RDA. Whereas, for folate and vitamin C, most children met 25-50% of RDA. Very few met more than 75-100% of RDA for folate and vitamin C, i.e., 5.8% and 18.6%. Energy and protein consumption were compared with the percent RDA (6-12 years), and it was observed that the majority of children (79.0%) met only 25-50% of RDA for energy, whereas as for protein, the majority of children (42.9%) met 50-75 % of RDA.

Results suggested that most of the children were not consuming all the fortified commodities, and also, the awareness of fortified foods was significantly less among school children. The children consumed only fortified salt and oil.

From the consumption of cereals, children were consuming wheat and rice daily, whereas most children did not consume the Ragi and broken wheat. The majority of consumption was done weekly from roots and tubers, which included sweet potato and carrot. However, radish, yam, colocasia were least consumed. Almost all the vegetables were consumed 2-3 times a week. The consumption of fruits was observed weekly, including bananas, apples, and orange. However, Pear, Guava, and Papaya were not consumed frequently. In pulses like tur dal were often consumed, i.e., 2-3 times a week, whereas rajma and soyabean were not frequently consumed. Occasionally, there was a consumption of almonds and cashew nuts. The consumption of cow milk was daily, and milk products like buttermilk, curd, lassi, paneer were consumed weekly by the subjects. It was also observed that the most commonly consumed oil was cottonseed oil. Children did not widely consume meat and poultry, fish, and seafood.

Due to school closure, the government decided to provide dry ration as an alternative of hot cooked meals to all the eligible children for the mid-day meal. It was observed that per day 50- gram wheat and rice were given to children of I to V standard, and per day, 75-gram of wheatand rice were given to children of VI to VIII standard. It was noted that cash-intensive was also provided, and it was directly e-transferred by state governments. Rupees 4.97 per day were givento children of I to V standard, and rupees 7.45 per day were given to children of VI to VIII standard. All the children (99.22%) received their dry ration (wheat and rice) from schools, and all of them liked and ate the foods cooked from the dry ration. The majority of the children were not having their food solely as it was shared with their respective family members. Due to such reasons, almost half of the children (55.19%) claimed that they are not getting ration as per their requirements. However, the quantity of wheat and rice gave was not enough for them. The majority of them belonged to the upper lower class of family as per the kuppuswamy scale, and their incomes were not very fascinating to fulfill basic food needs.

It was observed that there was inferior awareness regarding the micronutrients like iron, iodine, vitamin A and Vitamin B12. The majority of them were noticed that they did not know about foods rich in micronutrients, their deficiencies, and their functions in the body. Although awareness of fortified foods was also poor, nobody was aware of the F plus logo used to identifythe fortified foods.

Signs and Symptoms of nutritional deficiencies in school-age children were observed. Foranemia, it was observed that 22.52% of children experienced tiredness frequently, and theremaining 77.48% of children did not experience fatigue. 3.88% of children were experiencing shortness of breath, 1.79 % of children experienced pale eyes and palm. 8.35% of children experienced difficulties seeing objects in the dark or seam/dull light for vitamin A deficiency. Whereas, from those 16.28 % children were experiencing dryness/roughness in their eyes frequently. For vitamin B12, it was observed that 20.39% experienced symptoms from which maximum children experienced abdominal discomfort, i.e., 2.52% (n=13), followed by 1.36% experiencing weakness, 1.17% with frequent diarrhea.

Limitations of the study

- Due to the increasing incidences of COVID-19 infection, in the study site sensitization, anthropometric measurements and hemoglobin estimations were not carried out.
- The major limitation for collecting the food data was the reachability to household, we were not able to quantify the cooked portion size as per standards

Future scope

- Assessment of serum parameters for micronutrients would give a clear picture ofdeficiency/sufficiency.
- Similar studies can be attempted in other socio-economic strata of the population.
- Looking into in-depth results, policy for the school-going children should be modified by provision of dry ration by fortified food staples.

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ANNEXURES

ANNEXURE 1A
PERMISSION OBTAINED FROM EDUCATION ADMINISTER

જા.બા.નં.શિ.સ/વહીવટ/ ૧૭૫૧
નગર પ્રાથમિક શિક્ષણ સમિતિ
વડોદરા. તા.૧૫/૦૨/૨૦૨૧
૧૬/૨/૨૦૨૧

પ્રતિ,
હેડ ઓફ ડિપાર્ટમેન્ટ એન્ડ ગાઇડ,
ડિપાર્ટમેન્ટ ઓફ ફેમિલી એન્ડ કોમ્યુનિટી રિસોર્સ મેનેજમેન્ટ,
ફેકલ્ટી ઓફ ફેમિલી એન્ડ કોમ્યુનિટી સાયન્સ,
એમ.એસ.યુનિવર્સિટી, વડોદરા.

વિષય : ડીપાર્ટમેન્ટ ઑફ ફુડ એન્ડ ન્યુટ્રીશીયનમાં અભ્યાસ કરતી બે વિદ્યાર્થીનીઓ "Multiple micronutrients Deficiency Disorders in 6-12 years school aged children in urban Vadodara" વિષય અંગેના રીસર્ચ કરવા અંગે મંજુરી આપવા બાબત

સંદર્ભ : આપના તા.૦૬/૦૧/૨૦૨૧ના પત્ર અન્વયે

મહાશય,

સવિનય ઉપરોક્ત વિષય તથા સંદર્ભ લગત જણાવવાનું કે, તમોએ એમ.એસ.યુનિવર્સિટીના ડીપાર્ટમેન્ટ ઑફ ફુડ એન્ડ ન્યુટ્રીશીયનમાં અભ્યાસ કરતી બે વિદ્યાર્થીનીઓ "Multiple micronutrients Deficiency Disorders in 6-12 years school aged children in urban Vadodara" વિષય અંગેના રીસર્ચ હેતું માટે નગર પ્રાથમિક શિક્ષણ સમિતિ, વડોદરા હસ્તકની તમામ શાળામાંથી ૬ થી ૧૨ વર્ષની ઉંમરવાળા ૫૧૫ વિદ્યાર્થીઓ તેમજ વિદ્યાર્થીઓના વાલીઓ સાથે સર્વે કરવા માંગણી કરેલ છે.

સદર બાબતે બે વિદ્યાર્થીનીઓ "Multiple micronutrients Deficiency Disorders in 6-12 years school aged children in urban Vadodara" વિષય અંગેના રીસર્ચ હેતુ માટે નગર પ્રાથમિક શિક્ષણ સમિતિ, વડોદરા હસ્તકની તમામ શાળામાંથી ૬ થી ૧૨ વર્ષની ઉંમરવાળા ૫૧૫ વિદ્યાર્થીઓ તેમજ વિદ્યાર્થીઓના વાલીઓ સાથે તા.૨૦/૦૪/૨૦૨૧ સુધી સર્વે કરવા વિદ્યાર્થીઓના અભ્યાસને નુકશાન ન પહોંચે તેવી શરતે મંજુરી આપવામાં આવે છે.

શાસનાધિકારી
નગર પ્રાથમિક શિક્ષણ સમિતિ
વડોદરા

નકલ રવાના : ૧// તમામ મુ.શિક્ષકશ્રીઓ તરફ જાણ તથા અમલ સારૂ..

D:\Nikita\Muniabhai\Manjuri Patr

ANNEXURE 1B

Institutional Ethics Committee for Human Research (IECHR)

FACULTY OF FAMILY AND COMMUNITY SCIENCES
THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA

Ethical Compliance Certificate 2020 – 2021

This is to certify that **Ms. Rathod Mitali Dhirendrakumar**'s study titled, "**Consumption of food pattern to understand multiple micronutrient intake during Covid 2019, amongst 6-12 years-school aged children of urban Vadodara in the year 2021**" has been approved by the Institutional Ethics Committee for Human Research (IECHR), Faculty of Family and Community Science, The Maharaja Sayajirao University of Baroda. The study has been allotted the ethical approval number **IECHR/FCSc/2020/51.**

Prof Mini Sheth
Member Secretary
IECHR

Prof Shagufa Kapadia
Chairperson
IECHR

ANNEXURE 2A

The Maharaja Sayajirao University of BarodaFaculty of Family and Community Sciences
Department of Foods and Nutrition

ASSENT FORM (Children)

Research Topic: Consumption of food pattern to understand multiple micronutrient intake during Covid 19, amongst 6-12 years - school aged children of urban Vadodara in the year 2021

Primary Investigator: Prof. (Dr.) Sirimavo NairStudent: Mitali Rathod

Micronutrients are essential vital nutrients which are required in minute quantities. Deficiencies of these vital nutrients can contribute to long lasting impact on the human beings. Low intake of micronutrient can lead to low productivity, poor learning ability, illness, disability, underdevelopment and poverty, particularly in children of low-income countries. Prevalence of micronutrients deficiencies are more severe in developing countries due to the low purchasing power and poor living conditions. In the current COVID-19 situation food security is an emerging issue which is exacerbating the vicious cycle of malnutrition.

Keeping this in mind, I am conducting my Master's research to assess the multiple micronutrient deficiency in school going children (6-12 years).

I require information about your socio-economic status, food pattern (24-hour dietary recall, Food Frequency Questionnaire) and willingness to acquire the nutritional and health information provided withthe help of teacher.

This will take approximately 20-30 minutes. The information you have shared with me will remain confidential and shall be used only for research purpose. If you wish I will share the information that will become available during course of research.

If you have any further queries regarding this study, you may contact Prof. (Dr.) Sirimavo Nair-

9898608039 or Mitali Rathod- 7487819698

I_____give my free and informed consent to participate in the study. I have been explained the purpose of the study and informed that I can quit the study at any point without giving any explanation.

Address: _____
_____

Contact number: _____ Signature: _____

ANNEXURE 2B

The Maharaja Sayajirao University of Baroda
Faculty of Family and Community Sciences
Department of Foods and Nutrition

ASSENT FORM (Children)

સંશોધન વિષય: શહેરી વડોદરાના 6 થી 12 વર્ષની વયના બાળકોમાં બહુવિધ સુક્ષ્મ પોષકતત્વોની ઉણપ વિકાર

મુખ્ય સંશોધક: પ્રોફેસર (ડો.) સિરિમાવો નાયર
વિધાર્થી: મીતાલી રાઠોડ

સુક્ષ્મ પોષકતત્વો આવશ્યક પોષક તત્વો છે જે પ્રામાણિક માત્રા માં જરૂરી છે. આ મહત્વપૂર્ણ પોષક તત્વોની ઊણપ માનવો પર લાંબા સમય સુધી અસરમાં ફાળો આપી શકે છે. ખાસ કરીને ઓછી આવક ધરાવતા દેશોમાં,સુક્ષ્મ પોષકતત્વોના ઓછા સેવનથી ઓછી ઉત્પાદકતા, નબળી ભણવાની ક્ષમતા, માંદગી, અપંગતા, અવિકસિતતા અને ગરીબી થઈ શકે છે. ઓછી ખરીદી શક્તિ અને જીવન નિર્વાહની નબળી પરિસ્થિતિઓને લીધે વિકાસશીલ દેશોમાં સુક્ષ્મ પોષકતત્વોની ઊણપ વધુ તીવ્ર છે. વર્તમાન કોવિડ-19 પરિસ્થિતિમાં ખાદ્ય સુરક્ષા એ ઉભરતો મુદ્દો છે જે કુપોષણના દુષ્ટ ચકને વધારી રહ્યો છે.

આને ધ્યાનમાં રાખીને, મારા માસ્ટરસનું સંશોધન શાળામાં જતા બાળકો (6-12 વર્ષ) માં બહુવિધ સુક્ષ્મ પોષકતત્વોની ઉણપને જોવા માટે કરી રહી છું.

મારે તમારી સામાજિક-આર્થિક સ્થિતિ, ફૂડ પેટર્ન (24-કલાક ડાયેટરી રિકોલ, ફૂડ ફ્રીક્વન્સી પ્રશ્નાવલિ) અને શિક્ષકની સહાયથી પૂરા પાડવામાં આવેલ પોષક અને આરોગ્ય માહિતી પ્રાપ્ત કરવાની ઇચ્છા વિશેની માહિતીની જરૂર છે.

આમાં 30 મિનિટથી વધુ સમય લાગશે નહીં. તમે મારી સાથે શેર કરેલી માહિતી ગુપ્ત રહેશે અને તેનો ઉપયોગ ફક્ત સંશોધન હેતુ માટે કરવામાં આવશે. જો તમે ઈચ્છો તો જ હું તે માહિતી શેર કરીશ જે સંશોધન દરમિયાન ઉપલબ્ધ થશે.

જો તમને આ અધ્યયન સંબંધિત કોઈ પ્રશ્નો હોય, તો તમે નીચે આપેલા નંબર પર સંપર્ક કરી શકો છો. પ્રો. (ડો.) સિરિમાવો નાયર- 9898608039 અથવા મીતાલી રાઠોડ- 7487819698

હું _____ અધ્યયનમાં ભાગ લેવા માટે મારી જાણકાર સંમતિ આપું છું. મને અભ્યાસનો હેતુ સમજાવવામાં આવ્યો છે અને માહિતી આપવામાં આવી છે કે હું કોઈ પણ ખુલાસો કર્યા વિના કોઈપણ તબક્કે અભ્યાસ છોડી શકું છું.

સરનામું:

_____

_____

સંપર્ક નંબર: _____

હસ્તાક્ષર: _____

ANNEXURE 3A

The Maharaja Sayajirao University of BarodaFaculty of Family and Community Sciences
Department of Foods and Nutrition CONSENT FORM (Mother)

Research Topic: Consumption of food pattern to understand multiple micronutrient intake during Covid 19, amongst 6-12 years - school aged children of urban Vadodara in the year 2021

Primary Investigator: Prof. (Dr.) Sirimavo Nair

Student: Mitali Rathod

Micronutrients are essential vital nutrients which are required in minute quantities. Deficiencies of these vital nutrients can contribute to long lasting impact on the human beings. Low intake of micronutrient can lead to low productivity, poor learning ability, illness, disability, underdevelopment and poverty, particularly in children of low-income countries. Prevalence of micronutrients deficiencies are more severe in developing countries due to the low purchasing power and poor living conditions. In the current COVID-19 situation food security is an emerging issue which is exacerbating the vicious cycle of malnutrition.

Keeping this in mind, I am conducting my Master's research to assess the multiple micronutrientdeficiency in school going children (6-12 years).

I require information about your child's socio-economic status, 24-hour dietary recall, Food Frequencyand willingness to acquire the nutritional and health information provided with the help of teacher.

This will take approximately 20-30 minutes. The information you have shared with me will remain confidential and shall be used only for research purpose. If you wish I will share the information that will become available during course of research.

If you have any further queries regarding this study, you may contact Prof. (Dr.) Sirimavo Nair-

9898608039 or Mitali Rathod- 7487819698

_____

I_____give my free and informed consent to participate in the study. I have been explained the purpose of the study and informed that I can quit the study at any point without giving any explanation.

Address: _____
_____

Contact number: _____ Signature: _____

ANNEXURE 3B

The Maharaja Sayajirao University of Baroda
Faculty of Family and Community Sciences
Department of Foods and Nutrition
CONSENT FORM (Mother)

સંશોધન વિષય: શહેરી વડોદરાના **6** થી **12** વર્ષની વયના બાળકોમાં બહુવિધ સુક્ષ્મ પોષકતત્વોની ઉણપ વિકાર

મુખ્ય સંશોધક: પ્રોફેસર (ડો.) સિરિમાવો નાયર

વિધાર્થી: મીતાલી રાઠોડ

સુક્ષ્મ પોષકતત્વો આવશ્યક પોષક તત્વો છે જે પ્રામાણિક માત્રા માં જરૂરી છે. આ મહત્વપૂર્ણ પોષક તત્વોની ઊણપ માનવો પર લાંબા સમય સુધી અસરમાં ફાળો આપી શકે છે.

ખાસ કરીને ઓછી આવક ધરાવતા દેશોમાં,સુક્ષ્મ પોષકતત્વોના ઓછા સેવનથી ઓછી ઉત્પાદકતા, નબળી ભણવાની ક્ષમતા, માંદગી, અપંગતા, અવિકસિતતા અને ગરીબી થઈ શકે છે. ઓછી ખરીદી શક્તિ અને જીવન નિર્વાહની નબળી પરિસ્થિતિઓને લીધે વિકાસશીલ દેશોમાં સુક્ષ્મ પોષકતત્વોની ઊણપ વધુ તીવ્ર છે. વર્તમાન કોવિડ-19 પરિસ્થિતિમાં ખાદ્ય સુરક્ષા એ ઉભરતો મુદ્દો છે જે કુપોષણના દુષ્ટ ચકને વધારી રહ્યો છે.

આને ધ્યાનમાં રાખીને, મારા માસ્ટરસનું સંશોધન શાળામાં જતા બાળકો (6-12 વર્ષ) માં બહુવિધ સુક્ષ્મ પોષકતત્વોની ઉણપને જોવા માટે કરી રહી છું.

મારે તમારી સામાજિક-આર્થિક સ્થિતિ, ફૂડ પેટર્ન (24-કલાક ડાયેટરી રિકોલ, ફૂડ ફ્રીક્વન્સી પ્રશ્નાવલિ) અને શિક્ષકની સહાયથી પૂરા પાડવામાં આવેલ પોષક અને આરોગ્ય માહિતી પ્રાપ્ત કરવાની ઇચ્છા વિશેની માહિતીની જરૂર છે.

આમાં 30 મિનિટથી વધુ સમય લાગશે નહીં. તમે મારી સાથે શેર કરેલી માહિતી ગુપ્ત રહેશે અને તેનો ઉપયોગ ફક્ત સંશોધન હેતુ માટે કરવામાં આવશે. જો તમે ઈચ્છો તો જ હું તે માહિતી શેર કરીશ જે સંશોધન દરમિયાન ઉપલબ્ધ થશે.

જો તમને આ અધ્યયન સંબંધિત કોઈ પ્રશ્નો હોય, તો તમે નીચે આપેલા નંબર પર સંપર્ક કરી શકો છો.
પ્રો. (ડો.) સિરિમાવો નાયર- 9898608039 **અથવા** મીતાલી રાઠોડ- 7487819698

હું _____ અધ્યયનમાં ભાગ લેવા માટે મારી જાણકાર સંમતિ આપું છું. મને અભ્યાસનો હેતુ સમજાવવામાં આવ્યો છે અને માહિતી આપવામાં આવી છે કે હું કોઈ પણ ખુલાસો કર્યા વિના કોઈપણ તબક્કે અભ્યાસ છોડી શકું છું.

સરનામું: _____

_____

સંપર્ક નંબર: _____

હસ્તાક્ષર: _____

ANNEXURE 4A

The Maharaja Sayajirao University of BarodaFaculty of Family and Community Sciences
Department of Foods and Nutrition CONSENT FORM (School teacher/principal)

Research Topic: Consumption of food pattern to understand multiple micronutrient intake during Covid 19, amongst 6-12 years - school aged children of urban Vadodara in the year 2021

Primary Investigator: Prof. (Dr.) Sirimavo Nair

Student: Mitali Rathod

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Keeping this in mind, I am conducting my Master's research to assess the multiple micronutrientdeficiency in school going children (6-12 years).

I require information about students list, contact number, background information on service delivery ofration provided under MDM.

This will take approximately 20-30 minutes on call. The information you have shared with me will remain confidential and shall be used only for research purpose. If you wish I will share the information that will become available during course of research.

If you have any further queries regarding this study, you may contact Prof. (Dr.) Sirimavo Nair-

9898608039 or Mitali Rathod- 7487819698

_____

I_____give my free and informed consent to participate in the study. I have been explained the purpose of the study and informed that I can quit the study at any point without giving any explanation.

Address: _____
_____

Contact number: _____ Signature: _____

ANNEXURE 4B

The Maharaja Sayajirao University of Baroda
Faculty of Family and Community Sciences
Department of Foods and Nutrition
CONSENT FORM (School teacher/principal)

સંશોધન વિષય: શહેરી વડોદરાના 6 થી 12 વર્ષની વયના બાળકોમાં બહુવિધ સુક્ષ્મ પોષકતત્વોની ઉણપ વિકાર

મુખ્ય સંશોધક: પ્રોફેસર (ડો.) સિરિમાવો નાયર
વિધાર્થી: મીતાલી રાઠોડ

સુક્ષ્મ પોષકતત્વો આવશ્યક પોષક તત્વો છે જે પ્રામાણિક માત્રા માં જરૂરી છે. આ મહત્વપૂર્ણ પોષક તત્વોની ઊણપ માનવો પર લાંબા સમય સુધી અસરમાં ફાળો આપી શકે છે.ખાસ કરીને ઓછી આવક ધરાવતા દેશોમાં,સુક્ષ્મ પોષકતત્વોના ઓછા સેવનથી ઓછી ઉત્પાદકતા, નબળી ભણવાની ક્ષમતા, માંદગી, અપંગતા, અવિકસિતતા અને ગરીબી થઈ શકે છે. ઓછી ખરીદી શક્તિ અને જીવન નિર્વાહની નબળી પરિસ્થિતિઓને લીધે વિકાસશીલ દેશોમાં સુક્ષ્મ પોષકતત્વોની ઊણપ વધુ તીવ્ર છે. વર્તમાન COVID-19 પરિસ્થિતિમાં ખાદ્ય સુરક્ષા એ ઉભરતો મુદ્દો છે જે કુપોષણના દુષ્ટ ચક્રને વધારી રહ્યો છે.

આને ધ્યાનમાં રાખીને, મારા માસ્ટરસનું સંશોધન શાળામાં જતા બાળકો (6-12 વર્ષ) માં બહુવિધ સુક્ષ્મ પોષકતત્વોની ઉણપને જોવા માટે કરી રહી છું.

મને વિદ્યાર્થીઓની સૂચિ, સંપર્ક નંબર, એમડીએમ હેઠળ પૂરા પાડવામાં આવતા રેશનની સેવા પહોંચાડવાની પૃષ્ઠભૂમિ વિશેની માહિતીની જરૂર છે.

આમાં 30 મિનિટથી વધુ સમય લાગશે નહીં. તમે મારી સાથે શેર કરેલી માહિતી ગુપ્ત રહેશે અને તેનો ઉપયોગ ફક્ત સંશોધન હેતુ માટે કરવામાં આવશે. જો તમે ઈચ્છો તો જ હું તે માહિતી શેર કરીશ જે સંશોધન દરમિયાન ઉપલબ્ધ થશે.

જો તમને આ અધ્યયન સંબંધિત કોઈ પ્રશ્નો હોય, તો તમે નીચે આપેલા નંબર પર સંપર્ક કરી શકો છો.
પ્રો. (ડો.) સિરિમાવો નાયર- 9898608039 અથવા મીતાલી રાઠોડ- 7487819698

હું _____ અધ્યયનમાં ભાગ લેવા માટે મારી જાણકાર સંમતિ આપું છું. મને અભ્યાસનો હેતુ સમજાવવામાં આવ્યો છે અને માહિતી આપવામાં આવી છે કે હું કોઈ પણ ખુલાસો કર્યા વિના કોઈપણ તબક્કે અભ્યાસ છોડી શકું છું.

સરનામું: _____

સંપર્ક નંબર: _____ હસ્તાક્ષર: _____

ANNEXURE 5A

SOCIO ECONOMIC SURVEY QUESTIONNAIRE

Date:__/_____/___

Name of the investigator: _____Name of the school: _____ Mother's Contact no: _____

[A]Background Information:

1.	Name of the student	
2.	Sex	1. Male 2. Female 3. Others
3.	Standard	
4.	Section	
5.	Roll No	
6.	Date of Birth	
7.	Age	
8.	Name of Father	
9.	Name of Mother	
10.	Education of Father	
11.	Education of Mother	
12.	Occupation of Father	
13.	Occupation of Mother	
14.	Religion	1. Hindu 2. Muslim 3. Sikh 4. Christian 5. Others
15.	Caste	1. General 2. SC 3. ST 4. BC 5. OBC 6. Others
16.	Type of Family	1. Nuclear 2. Extended Nuclear 3. Joint
17.	Number of Family members	Total:_____ Elderly:_____ Adults:_____ Children: _____
18.	Family Income	Salary/month_____ Daily wages_____ No. of days/week_____
19.	Per capita income	

ANNEXURE 5B

સામાજિક આર્થિક અને પૃષ્ઠભૂમિ માહિતી

તારીખ : /____/___ ફોર્મ નંબર : _____

ચકાસણી કરનારનું નામ: _____

શાળાનું નામ: _____

1.	વિદ્યાર્થીનું નામ	
2.	જાતિ	1. પુરુષ 2. સ્ત્રી 3. અન્ય
3.	ધોરણ	
4.	વર્ગ	
5.	રોલ નંબર	
6.	જન્મ તારીખ	
7.	ઉમર	
8.	પિતાનું નામ	
9.	માતાનું નામ	
10.	પિતાનું ભણતર	
11.	માતાનું ભણતર	
12.	પિતા નો વ્યવસાય	
13.	માતાનો વ્યવસાય	
14.	ધર્મ	1. હિન્દુ 2. મુસ્લિમ 3. શીખ 4. ખ્રિસ્તી 5. અન્ય
15.	જાતિ	1. સામાન્ય 2. એસ.સી. 3. એસ.ટી. 4. બી.સી. 5. ઓ.બી.સી. 6. અન્ય
16.	કૌટુંબીક નો પ્રકાર	1. વિભક્ત 2. વિસ્તૃત વિભકત 3. સંયુક્ત કુટુંબ
17.	તમારા ઘરમાં કેટલા વ્યકિતઓ છે ?	કુલ : _____ ઉમર લાયક _____ ૧૮ વર્ષ થી ઉપર: _____ ૧૮ વર્ષ થી નીચે : _____
18.	કૌટુંબિક વાર્ષિક આવક	પગાર / મહિને _____ રોજંદાર _____ દિવસે / સાપ્તાહીક _____
19.	માથાદિઠ આવક	

ANNEXURE 6A

DIETARY DIVERSITY

Foods	Daily	2-3 timesin a week	Weekly	In 15 days	Once in a month	Occasionally	Seasonally	Never
Cereals:								
Wheat								
Rice								
Bajara								
Cournflour								
Broken wheat								
Semolina								
Ragi								
Jowar								
Roots and tubers:								
Potato								
Sweet potato								
Radish								
Beet root								
Carrot								
Yam								
Ginger								
Garlic								
Colocasia								
Vegetables:								
GLV"s								
Capsicum								
Okra								
Gourds								
Green peas								
Eggplant								
Cauliflower								
Cabbage								
Fruits:								
Apple								
Banana								
Orange								
Papaya								
Guava								
Pear								
lemon								
Tomato								

Pulses/legumes/nuts								
Moong dal								
Tur dal								
Masoor dal								
Udad dal								
Soyabean								
Rajma								
Chickpeas								
Ground nuts								
Almond								
Cashew nut								
Milk and milk products								
Milk(cow)								
Milk (buffalo)								
Curd								
Buttermilk								
Lassi								
Paneer								
Cheese								
Oil and fats:								
Cotton seed oil								
Groundnut oil								
Sunflower oil								
Palm oil								
Mustard oil								
Sugar/honey:								
Refined sugar								
Honey								
Jaggery								
Eggs:								
Eggs								
Meat and poultry:								
Chicken								
Mutton								
Fish and sea food:								
Fish								
Seafood								
Fortified food:								
Fortified salt								
Fortified wheat flour								
Fortified oil								
Fortified milk								

ANNEXURE 6B

ફૂડ ફ્રીકવન્સી પ્રશ્નાવલી

ખોરાક	દરરોજ	અઠવાડિયા માં ૨-૩ વખત	અઠવાડિયે	દર પંદર દિવસે	મહિને એક વખત	કોઈક વખત	મોસમી	કયારેક
અનાજ :								
ઘઉ								
ચોખા								
બાજરી								
મકાઇ નો લોટ								
તૂટેલા ઘઉ (દલીયા)								
રવો								
રાગી								
જુવાર								
મૂળ અને કંદ :								
બટાકા								
સક્કરીયા								
મુળી								
બીટ								
ગાજર								
રતાળું								
આદું								
લસણ								
પતરવેલ ના પાના (પાના)								
શાકભાજી :								
લીલા શાકભાજી								
શીમલા મીર્ચ (કેપ્સીકમ)								
ભીંડી								
દુધી								
વટાણા								
રીંગણ								
ફલાવર								
કોબી								
ફળ :								
સફરજન								
કેળા								
મોસંબી								
પપૈયા								
જામફળ								
પેરું (આલુ)								
લીંબું								
ટામેટું								

કઠોળ / કળો / બદામ :								
મૂગ દાળા								
તુવેર દાળ								
મસુર દાળ								
અડદની દાળ								
સોયા બીન								
રાજમા								
ચણા								
શીંગ								
બદામ								
કાજુ								
દુધ અને દુધ થી બનતા પદાર્થો								
દુધ (ગાયનું)								
દુધ (ભેંસનું)								
દહી								
છાસ								
લસ્સી								
પનીર								
ચીઝ								
તેલ અને ચરબી યુક્ત								
મગફળીનું તેલ								
સૂર્યમુખી તેલ								
પામ તેલ								
સરસવનું તેલ								
ખાંડ / મધ :								
શુધ્ધ ખાંડ								
મધ								
ગોળ								
ઈંડા :								
ઈંડા								
માંસ અને મરઘાં								
ચીકન								
મટન								
માંછલી અને સમૃદ્ધી ખોરાક								
માંછલી								
સમૃદ્ધી ખોરાક								
કોર્ટિકાઇડ ખોરાક:								
ડબલ કોર્ટિકાઇડ મીઠું (ઓયોડિન)								
કોર્ટિકાઇડ ઘઉ નો લોટ								
કોર્ટિકાઇડ તેલ								
કોર્ટિકાઇડ દુધ								

ANNEXURE 7A

24-HOUR DIETARY RECALL

DAY 1/2/3	Food Item	Ingredients	Amount(gm/ml)
Breakfast			
Morning snacks			
Lunch			
Afternoon snacks			
Dinner			
After dinner			

ANNEXURE 7B

24-કલાક આ રિકોલ

દિવસ -૧/૨/૩	ખાવાની વસ્તુ	ઘટકો(ઇન્ગ્રીડીએન્સ)	કિમત (ગ્રામ/મીલી)
સવારનો નાસ્તો			
બ્રન્ચ (સવારનો નાસ્તો અને બપોરનું જમવાના વચ્ચે નો સમય)			
બપોરનું જમવાનું			
સાંજનો નાસ્તો			
રાતનું જમવાનું			
રાતના જમ્યા પછી.			

ANNEXURE 8A

QUESTIONAIRE FOR SCHOOL CHILDREN (6-12YEARS)

1.	Do you get dry ration from your school?	1.Yes 2.No
2.	If yes, how much dry ration do you get from your school?	
3.	If yes, do you eat?	1.Yes 2.No
4.	If yes, do you like the food cooked from dry ration?	1.Yes 2. No
5.	If yes, do you consume whole quantity of food made from ration?	1.Yes 2. No 3.shared with family
6.	If yes, what kind of food ration is given?	1.Wheat and Rice 2. Only Wheat 3.Only Rice
7.	If yes, do you get as much as you want?	1.Yes 2.No
8.	If no, why?	
9.	Have you ever heard about the term fortification?	1.Yes 2.No
10.	If yes, do you know what is fortified foods?	1.Yes 2.No
11.	If yes, then which foods are fortified in India?	1.Salt 2.Wheat 3. Oil 4.Rice 5.Milk
12.	If yes, do you consume fortified foods?	1.Yes 2.No
13.	If yes, which foods do you consume?	1. Fortified Salt 2. Fortified Wheat 3. Fortified Oil 4. Fortified Rice 5. Fortified Milk
14.	If yes, do you know fortified foods are good for our health?	1.Yes 2. No

ANNEXURE 8B

૬-૧૨ વર્ષ દરમ્યાના શાળાના વિદ્યાર્થીઓ માટે ના મધ્યાહન ભોજન

1.	ચકાસણી કરનારનું નામ	
2.	તારીખ	
3.	દિવસ	
4.	શાળાનું નામ	
5.	પ્રિન્સીપાલ નું નામ	
5.	વિદ્યાર્થીનું નામ	
6.	તમે કયા વર્ગમાં ભણો છો ?	
7.	મધ્યાહન ભોજન તરફથી તમને રાશન મળે છે ?	1. હા 2. ના
8.	જો હા, તો તમે ખાવો છો ?	1. હા 2. ના
9.	તમને આપવામા આવેલ રાશન માથી બનાવેલ ખોરાક ગમે છે.	1. હા 2. ના
10.	રાશનમાંથી બનાવેલો ખોરાક તમો પૂરો ખાઇ લો છો ?	1. હા 2. ના 3. પરિવાર સાથે વહેંચીને ખાવો છો.
11.	જો ના તો કેમ ?	
12.	તમને કયા પ્રકારનું રાશન આપવામાં આવે છે ?	
13.	તમે કયારેક ફોર્ટીફીકેશન વિશે સાંભળ્યું છે ?	1. હા 2. ના
14.	જો હા તો, તમો જાણો છો કે ફોર્ટીફાઇડ ખોરાક શું છે ?	1. હા 2. ના
15.	જો હા તો, ભારતમાં કયા પ્રકારના ફોર્ટીફાઇડ ખોરાક છે ?	1. મીઠું 2. ઘઉ 3. તેલ 4. ચોખા
16.	તમો ફોર્ટીફાઇડ ખોરાક ખાવો છો ?	1. હા 2. ના
17.	જો હા તો, કયા ખાવો છો ?	
18.	શું તમો જાણો છો કે મધ્યાંહન ભોજનનો ખોરાક ફોર્ટીફાઇડ હોય છે ?	1. હા 2. ના
19.	શું તમો જાણો છો ફોર્ટીફાઇડ ખોરાક તમારા સ્વાસ્થય માટે સારું છે ?	1. હા 2. ના

ANNEXURE 9A

Micronutrients questionnaire		
Sr No.	**IRON**	
1.	Did you have your breakfast/lunch?	1. Yes 2. No
2.	Do you consume tea/coffee along with your meals?	1. Yes 2. No
3.	Did you play today?	1. Yes 2. No
4.	If yes, then which game?	
5.	Do you feel tired frequently?	1. Yes 2. No
6.	Do you feel you have any of these symptoms frequently?	1. Pale nails 2. Pale tongue 3. Pale skin 4. Pale palm/Eyes 5. Shortness of breath
7.	If yes, how frequently you observe these symptoms?	1. Daily 2. Weekly 3. Monthly
8.	Have you heard about ***anaemia***?	1. Yes 2. No
9.	If yes, can you tell me how does anaemia occur?	1. Insufficient food intake 2. Heavy work 3. Illness/disease 0. Don't know
10.	Can you tell me which foods are rich in iron?	1. Green leafy vegetables 2. Jaggery 3. Legumes 4. Meat 5. Bajra 0. Don't know
11.	Have you tested your hemoglobin level?	1. Yes 2. No
12.	If yes, then what was your Hb level?	
13.	Do you get IFA tablets from school?	1. Yes 2. No
14.	If yes, which color of IFA tablets do you get from school?	1. Blue 2. Pink 3. Red 0. Don't know
	IODINE	
1.	Do you like salty foods?	1. Yes 2. No
2.	Which salt do you consume at your home?	1. Whole salt/loose salt 2. Refined Salt 3. Crushed Salt
3.	How do you store salt?	1. Open Jar/Bottle 2. Close Jar/Bottle 3. In packet only
4.	Have you heard of iodized salt?	1. Yes 2. No

5.	If yes, how do you know that it is iodized salt?	1. Smiling sun logo 2. Plus F logo 3. Labels
6.	Are you aware about the term ***Iodine***?	1. Yes 2. No
7.	If yes, do you know about iodine rich foods?	1. Fish 2. Other Sea foods 3. Dairy products 4. Iodized salt 0. Don't know
8.	If yes, do you know the deficiency of iodine may leadsto?	1. Husky voice 2. Psycomotor defects 3. Goiter 4. Cretenism 5. Hypothyroidism 0. Don't know
9.	Do you know what is goiter?	1. Yes 2. No
	VITAMIN A	
1	Do you face difficulty in seeing objects in dark?	1. Yes 2. No
2	If yes, do you feel dryness/roughness in your eyes frequently?	1. Yes 2. No
3	Have you ever heard about vitamin A?	1. Yes 2. No
4	If yes, do you know about Vitamin A rich foods?	1. Green leafy vegetables 2. Yellow and orange color fruits and vegetables 3. Milk and milk products 4. Egg 0. Don't know
5	If yes, what does vitamin A do for our body?	1. Good immune system 2. Good eye health 3. For healthy teeth 4. For healthy skin 5. For growth &development 0. Don't know
6	If yes, deficiency of vitamin A may lead to-	1. Night blindness 2. Bitot‟s spot 3. Cataract 4. Always sick 5. Loss of appetite 6. Anemia 0. Don't know
	VITAMIN B12	
1.	Do you feel any of these symptoms frequently?	1. Inflammation of tongue 2. Abdominal discomfort 3. Frequent diarrhea

		4. Weight loss 5. Weakness 6. Difficulty in walking 7. Coldness of extremities 8. Numbness of limbs 9. Dizziness
2.	If yes, how frequently?	1. Daily 2. Weekly 3. Monthly
3.	Are you aware of water-soluble vitamins?	1. Yes 2. No
4.	Have you ever heard ***B-complex*** vitamins?	1. Yes 2. No
5.	Have you ever heard about vitamin B12?	1. Yes 2. No
6.	If yes, can you tell the rich sources of vitamin B12?	1. Milk and milk products 2. Meat 3. Poultry 4. Eggs 0. Don't know
7.	If yes, with vitamin B12 deficiency what observationscan be made?	1. Growth retardation 2. Pigmentation 3. Mental apathy 4. Reduced blood formation 0. Don't know

ANNEXURE 9B

સૂક્ષ્મ પોષકતત્ત્વ પ્રશ્નાવલિ		
Sr No.	આયર્ન	
1.	શું તમે તમારો સવારનો નાસ્તો કર્યો?	1. હા 2. ના
2.	શું તમે તમારા ભોજનની સાથે ચા / કોફીનું સેવન કરો છો?	1. હા 2. ના
3.	તમે આજે રમ્યા છો?	1. હા 2. ના
4.	જો હા, તો પછી કઈ રમત?	
5.	શું તમે વારંવાર થાક અનુભવો છો?	1. હા 2. ના
6.	શું તમને લાગે છે કે તમને આમાંથી કોઈ લક્ષણો વારંવાર જોવા મળે છે?	1. પીળો નખ 2. પીળી જીભ 3. પીળો ત્વચા 4. પીળી હથેળી / આંખો 5. શ્વાસની તકલીફ
7.	જો હા, તો તમે આ લક્ષણોને કેટલી વાર અવલોકન કરો છો?	1. દૈનિક 2. સાપ્તાહિક 3. માસિક
8.	તમે એનિમિયા વિશે સાંભળ્યું છે?	1. હા 2. ના
9.	જો હા, તો તમે મને કહો કે એનિમિયા કેવી રીતે થાય છે?	1. અપૂરતું ખોરાક લેવો 2. ભારે કામ 3. માંદગી / રોગ 4. ખબર નથી
10.	શું તમે મને કહી શકો કે કયા ખોરાકમાં આયર્ન ખૂબ સમૃદ્ધ છે?	1. લીલા પાંદડાવાળા શાકભાજી 2. ગોળ 3. ફણગો 4. માંસ 5. બાજરા 6.ખબર નથી
11.	શું તમે તમારા હિમોગ્લોબિન સ્તરનું પરીક્ષણ કર્યું છે?	1. હા 2. ના
12.	જો હા, તો પછી તમારું હિમોગ્લોબિન સ્તર શું હતું?	
13.	શું તમને શાળામાંથી આઇ.એફ.એ. ગોળીઓ મળે છે?	1. હા

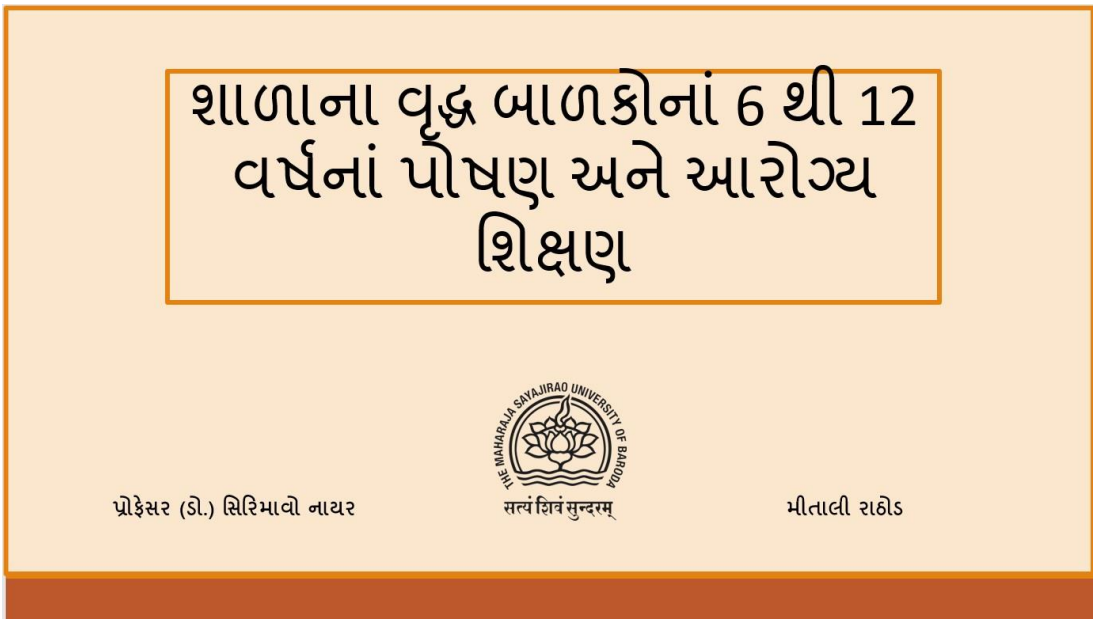
		2. ના
14.	જો હા, તો તમે શાળામાંથી કયા રંગના આઈએફએ ગોળીઓ મેળવો છો?	1. વાદળી 2. ગુલાબી 3. લાલ 4.ખબર નથી
	<u>આયોડિન</u>	
1	શું તમને મીઠાવાળા ખોરાક ગમે છે?	1. હા 2. ના
2.	તમે તમારા ઘરે કયા મીઠાનું સેવન કરો છો?	1. સંપૂર્ણ મીઠું / છૂટક મીઠું 2. રિફાઇન્ડ મીઠું 3. કચડી મીઠું
3.	તમે મીઠું કેવી રીતે સંગ્રહિત કરો છો?	1. ખુલ્લી જાર / બોટલ 2. બંધ જાર / બોટલ 3. ફક્ત પેકેટમાં
4.	તમે આયોડાઇઝ્ડ મીઠું વિશે સાંભળ્યું છે?	1. હા 2. ના
5.	જો હા, તો તમે કેવી રીતે જાણો છો કે તે આયોડાઇઝ્ડ મીઠું છે?	1. હસતા સૂર્યનો લોગો 2. પ્લસ એફ લોગો 3. લેબલ્સ
6.	શું તમે આયોડિન શબ્દ વિશે પરિચિત છો?	1. હા 2. ના
7.	જો હા, શું તમે આયોડિન સમૃદ્ધ ખોરાક વિશે જાણો છો?	1. માછલી 2. અન્ય સમુદ્ર ખોરાક 3. ડેરી ઉત્પાદનો 4. આયોડાઇઝ્ડ મીઠું 5. ખબર નથી
8.	જો હા, શું તમે જાણો છો આયોડિનની ઉણપ થી શું તકલીફ આવી શકે છે?	1. કર્કશ અવાજ 2. સાયકોકોટર ખામી 3. ગોઇટર 4. કર્ટેનિઝમ 5. હાઇપોથાઇરોડિસમ 6. ખબર નથી
9.	શું તમે જાણો છો ગોઇટર શું છે?	1. હા 2. ના
	<u>વિટામિન એ</u>	
1	શું તમને સાંજ ના સમયે વસ્તુ ઓ જોવા માં તકલીફ આવે છે?	1. હા 2. ના

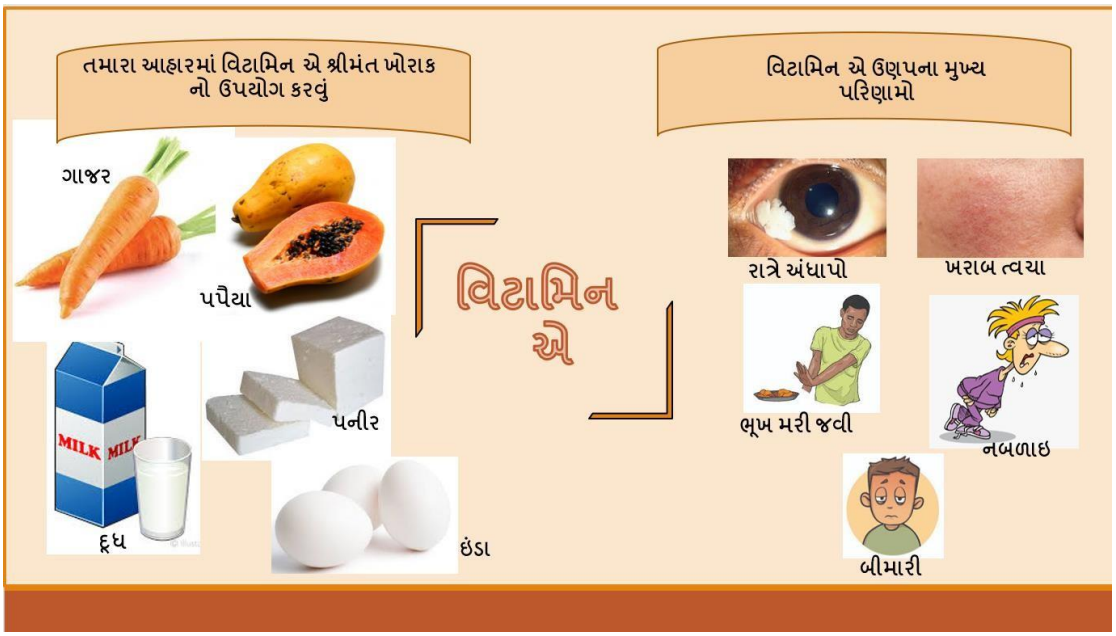
2	જો હા, શું તમે વારંવાર તમારી આંખોમાં શુષ્કતા / કડકતા અનુભવો છો?	1. હા 2. ના
3	તમે ક્યારેય વિટામિન એ વિશે સાંભળ્યું છે?	1. હા 2. ના
4	જો હા, તો શું તમે વિટામિન એ સમૃદ્ધ ખોરાક વિશે જાણો છો?	1. લીલા પાંદડાવાળા શાકભાજી 2. પીળો અને નારંગી રંગ ફળો અને શાકભાજી 3. દૂધ અને દૂધના ઉત્પાદનો 4. ઇંડા 5. ખબર નથી
5	જો હા, તો વિટામિન એ આપણા શરીર માટે શું કરે છે?	1. સારી રોગપ્રતિકારક શક્તિ 2. આંખનું સારું સ્વાસ્થ્ય 3. તંદુરસ્ત દાંત માટે 4. તંદુરસ્ત ત્વચા માટે 5. વિકાસ માટે 6. ખબર નથી
6	જો હા, વિટામિન એ ની ઉણપ થી શું તકલીફ આવી શકે છે?	1. રાત્રે અંધત્વ 2. બીટોટનું સ્થળ 3. મોતિયા 4. હંમેશા બીમાર 5. ભૂખ ઓછી થવી 6. એનિમિયા 7. ખબર નથી
	<u>વિટામિન બી 12</u>	
1.	શું તમને આ લક્ષણોમાંથી કોઈ વારંવાર લાગે છે?	1. જીભની બળતરા 2. પેટની અસ્વસ્થતા 3. વારંવાર ઝાડા 4. વજન ઘટાડો 5. નબળાઇ 6. ચાલવામાં મુશ્કેલી 7. હાથપગની શરદી 8. અંગોની નિષ્ક્રિયતા 9. ચક્કર
2.	જો હા, તો કેટલી વાર?	1. દૈનિક 2. સાપ્તાહિક 3. માસિક

3.	શું તમે પાણીમાં દ્રાવ્ય વિટામિન્સથી વાકેફ છો?	1. હા 2. ના
4.	તમે ક્યારેય બી-જટિલ વિટામિન્સ સાંભળ્યા છે?	1. હા 2. ના
5.	તમે ક્યારેય વિટામિન બી 12 વિશે સાંભળ્યું છે?	1. હા 2. ના
6.	જો હા, તો તમે વિટામિન બી 12 ના સમૃદ્ધ સ્રોતો વિશે કહી શકો?	1. દૂધ અને દૂધના ઉત્પાદનો 2. માંસ 3. મરઘાં 4. ઇંડા 5. ખબર નથી
7.	જો હા, વિટામિન બી 12 ની ઉણપ સાથે કયા અવલોકનો કરી શકાય છે?	1. વિકાસ મંદી 2. રંગદ્રવ્ય 3. માનસિક ઉદાસીનતા 4. લોહીની રચનામાં ઘટાડો 5. ખબર નથી

ANNEXURE 11

IEC MATERIAL




તમારા આહારમાં વિટામિન એ શ્રીમંત ખોરાક નો ઉપયોગ કરવું
વિટામિન એ ઉણપના મુખ્ય પરિણામો
ગાજર
પપૈયા
વિટામિન એ
દૂધ
પનીર
ઇંડા
રાત્રે અંધાપો
ખરાબ ત્વચા
ભૂખ મરી જવી
નબળાઇ
બીમારી


વિટામિન બી 12 સમૃદ્ધ ખોરાક
ઇંડા
દૂધ અને દૂધ ઉત્પાદનો
માંસ અને મરઘાં

આયોડિન સમૃદ્ધ ખોરાક

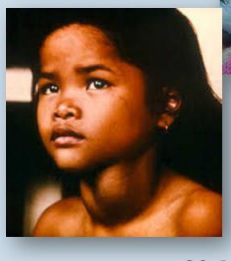
માછલી

આયોડિન યુક્ત મીઠું

ઝીંગા

દૂધ અને દૂધના પદાર્થ

આયોડિનની ઉણપ



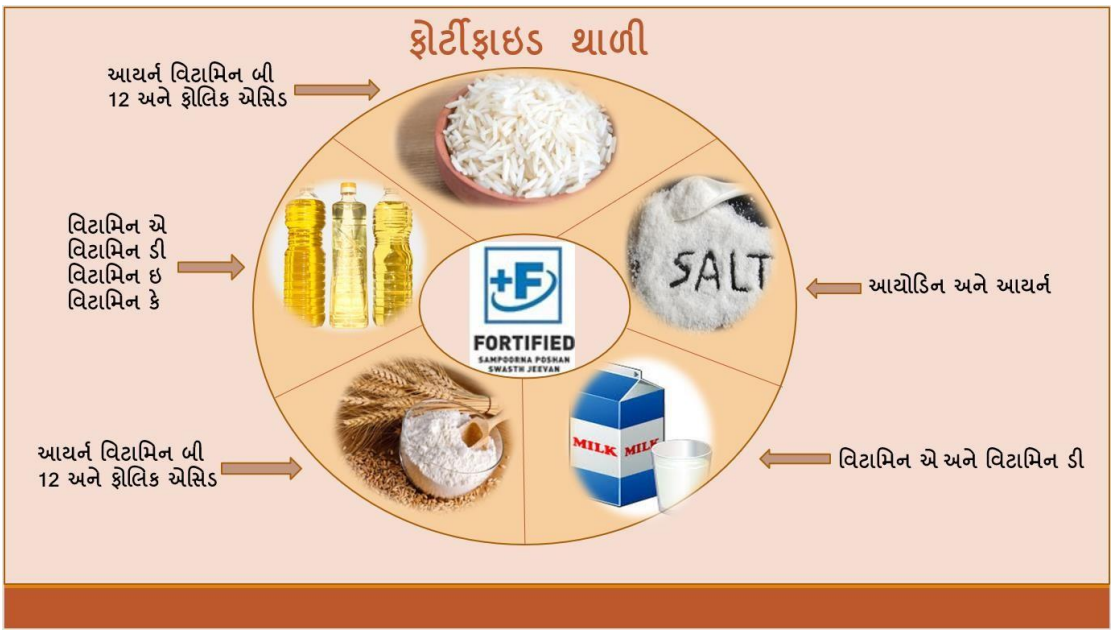
ગલગંડ

FORTIFIED
SAMPOORNA POSHAN
SWASTH JEEVAN

ફોર્ટિફિકેશન શું છે

ખોરાકની મજબૂતીકરણને ખોરાકમાં આવશ્યક સુક્ષ્મ પોષકતત્વોની સામગ્રીમાં જાણી જોઈને વધારો કરવા તરીકે વ્યાખ્યાયિત કરવામાં આવી છે જેથી ખોરાકની પોષક ગુણવત્તામાં સુધારો થાય અને આરોગ્યના ન્યૂનતમ જોખમો સાથે જાહેર આરોગ્ય લાભ મળે


તમે ફોર્ટિફાઇડ ફૂડ
પેકેટ પર પ્લસ એફ
લોગો જોઈને
ફોર્ટિફાઇડ ખોરાકને
ઓળખી શકો છો
FORTIFIED
SAMPOORNA POSHAN
SWASTH JEEVAN
ફોર્ટિફાઇડ
તેલ


ફોર્ટીફાઇડ થાળી
આયર્ન વિટામિન બી
12 અને ફોલિક એસિડ
વિટામિન એ
વિટામિન ડી
વિટામિન ઇ
વિટામિન કે
આયોડિન અને આયર્ન
આયર્ન વિટામિન બી
12 અને ફોલિક એસિડ
વિટામિન એ અને વિટામિન ડી
SALT
MILK
FORTIFIED
SAMPOORNA POSHAN
SWASTH JEEVAN


ડબલ ફોર્ટિફાઇડ મીઠું
આયર્ન
એનિમિયા સામે લડવામાં મદદ કરે છે
રોગપ્રતિરક્ષા વધારે
સાંદ્રતા સુધારે
FORTIFIED
SAMPOORNA POSHAN SWASTH JEEVAN
SALT
આયોડિન
સામાન્ય વિકાસ અને મગજના વિકાસમાં મદદ કરે છે
એનિમિયા અને આયોડિનની ઉણપના વિકારોથી બચવા માટે ડબલ ફોર્ટિફાઇડ મીઠું ખાઓ


વિટામિન એ
વિટામિન ડી
ફોર્ટિફાઇડ તેલ
FORTIFIED

ફોર્ટિફાઇડ દૂધ

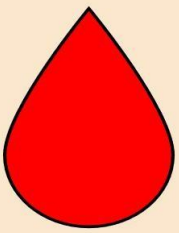
વિટામિન ડી

વિટામિન એ

ફોર્ટિફાઇડ ઘઉંનો લોટ

ફોર્ટિફાઇડ ચોખા

આયર્ન



એનિમિયા સામે લડવામાં મદદ કરે

વિટામિન બી - ૧૨

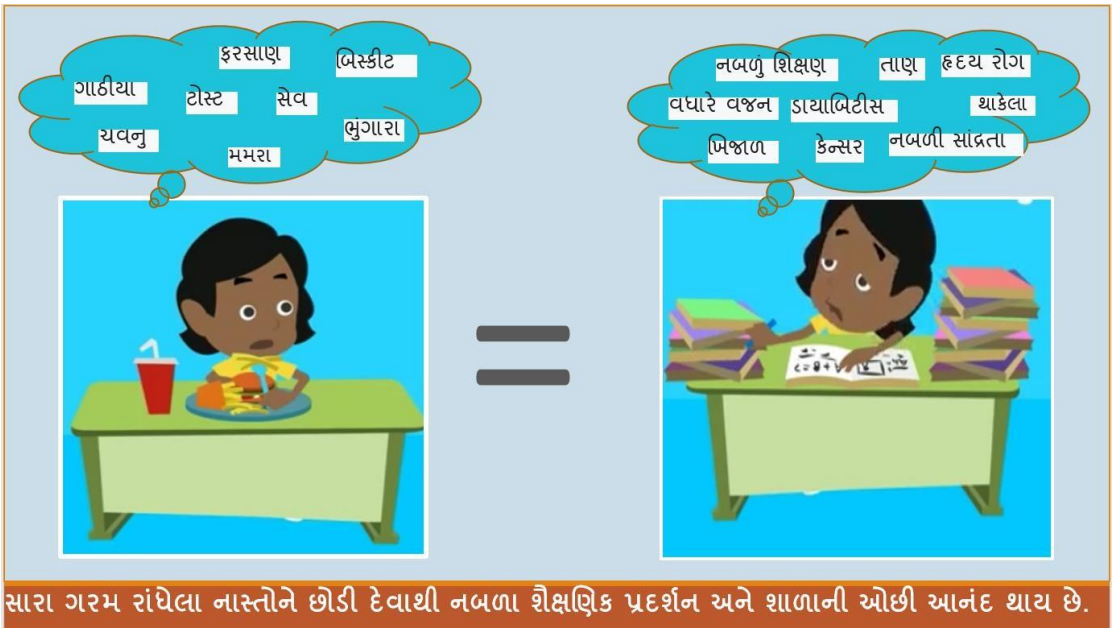
યાદશક્તિ અને મગજની સામાન્ય કામગીરીમાં મદદ કરે

ફોલિક એસિડ

ન્યુરલ ટ્યુબ ખામીને અટકાવે

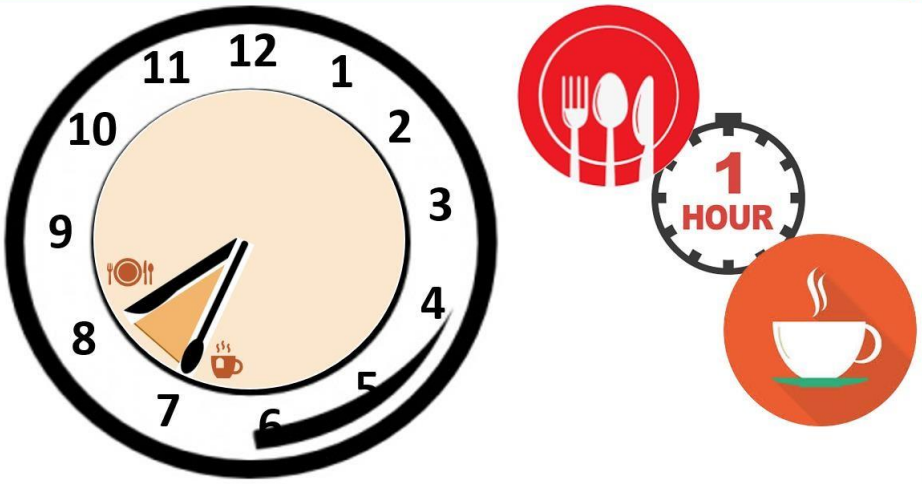
દરરોજ તંદુરસ્ત નાસ્તો ખાઓ

સવારના નાસ્તામાં બિનઆરોગ્યપ્રદ ખોરાક ન ખાવો



સારા ગરમ રાંધેલા નાસ્તોને છોડી દેવાથી નબળા શૈક્ષણિક પ્રદર્શન અને શાળાની ઓછી આનંદ થાય છે.

સવારના નાસ્તા અને ચા / કોફી વચ્ચે એક કલાકનો વિરામ રાખો



શાળાએ જતા બાળકો માટે સવારના નાસ્તાનું મહત્વ

તંદુરસ્ત નાસ્તો કરનારા વિદ્યાર્થીઓ શૈક્ષણિક સફળતા શીખવા અને પ્રાપ્ત કરવા માટે હંમેશાં વધુ તૈયાર રહે છે


ચા / કોફી સાથે તમારા નાસ્તા ટાળો

PHOTO GALLERY

DATA COLLECTION

Consistency of Dal

Distribution of Dry Ration

Visit to government schools