ASSESSING UTILIZATION OF TAKE-HOME RATION PROVIDED TO ADOLESCENT GIRLS (15-18 YEARS) IN RURAL VADODARA AND DEVELOPMENT OF NUTRIENT-RICH RECIPES FOR PROMOTING HEALTHY DIETS

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BACHELOR OF SCIENCE
(FOODS AND NUTRITION-DIETETICS)

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A dissertation submitted for partial fulfillment of the requirement of Master of Science in F.C.Sc. Foods and Nutrition (Public Health Nutrition) to The Maharaja Sayajirao University of Baroda

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CERTIFICATE

This is to certify that the research work embodied in the thesis has been carried out independently by **Ms. Kashish Jain** in pursuit of a degree of Master of Science in Foods and Nutrition (Public Health and Nutrition) in Faculty of Family and Community Sciences under the guidance of Dr. Vijayata Sengar and represents her original work.

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Kashish Jain

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ABBREVIATIONS

ACC	Administrative Committee on Coordination
AFHS	Adolescent-Friendly Health Services
AFHC	Adolescent-Friendly Health Clinics
AGs	Adolescent Girls
APL	Above Poverty Line
ARSH	Adolescent Reproductive and Sexual Health
ASCI	Advertising Standards Council of India
ASHA	Accredited Social Health Activist
AWCS	Anganwadi Centers
AWWS	Anganwadi Workers
BAZ	BMI-for-Age Z-score
BMI	Body Mass Index
BPL	Below Poverty Line
CLFs	Cluster-Level Federations
CNNS	Comprehensive National Nutrition Survey
DDS	Dietary Diversity Score
FAO	Food and Agriculture Organization
FSSAI	Food Safety and Standards Authority of India
GARE	Global Anemia Reduction Efforts
GHI	Global Hunger Index
HAZ	Height-for-Age
HEIA	Health Equity Impact Assessment
HIC	High-Income Countries
ICDS	Integrated Child Development Services
ICF	International Classification of Functioning, Disability, and Health
ICMR	Indian Council of Medical Research

IDA	Iron Deficiency Anemia
IFA	Iron Folic Acid
IIPS	International Institute for Population Sciences
KAP	Knowledge, Attitudes, and Practices
LIC	Low-Income Countries
LMIC	Low- and Middle-Income Countries
MAM	Moderate Acute Malnutrition
MDDW	Minimum Dietary Diversity for Women
MMN	Multiple Micronutrient
MoHFW	Ministry of Health and Family Welfare
MWCD	Ministry of Women and Child Development
NCDs	Non-Communicable Diseases
NCHS	National Center for Health Statistics
NFHS	National Family Health Survey
NHE	Nutrition Health Education
NHM	National Health Mission
NIN	National Institute of Nutrition
NNS	National Nutrition Strategy
NNMB	National Nutrition Monitoring Bureau
OBC	Other Backward Caste
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PURNA	Prevention of Undernutrition and Reduction of Nutritional Anemia
RDA	Recommended Dietary Allowance
RKSK	Rashtriya Kishor Swasthya Karyakram
SABLA	Scheme for Empowerment of Adolescent Girls
SAM	Severe Acute Malnutrition
SCN	Sub-Committee on Nutrition
SDG	Sustainable Development Goals

SDGs	Sustainable Development Goals
SES	Socioeconomic Status
STDs	Sexually Transmitted Diseases
THR	Take-Home Ration
UHC	Universal Health Coverage
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation, and Hygiene
WCD	Women and Child Development
WHO	World Health Organization
WIFS	Weekly Iron and Folic Acid Supplementation

ABSTRACT

BACKGROUND: Adolescence is a time of major physical, emotional, and psychological changes between childhood and adulthood. Recognizing the critical role of nutrition in adolescent health, the *PURNA* program has been launched as a comprehensive initiative to improve adolescent girls' well-being through a multifaceted approach. This program emphasizes the provision of fortified take-home rations, the promotion of diverse and nutrient-rich diets, and the implementation of targeted awareness campaigns to enhance nutritional knowledge and encourage healthier eating habits. Thus, the present study aimed "assessing the utilization of a take-home rotation provided to adolescent Girls (15-18 years) in rural Vadodara and developing nutrient-rich recipes for promoting healthy diets".

MATERIALS & METHODOLOGY: The present study was a cross-sectional study aimed at improving THR utilization and was conducted in rural Vadodara (randomly selected zone). A total of 300 adolescent girls were enrolled in the study from 63 randomly selected anganwadi centers. Face-to-face interviews were conducted with the adolescent girls, and nutrient-rich recipes incorporating THR were developed.

RESULTS: The anthropometric analysis of adolescent girls in the study highlighted significant variations in weight, height, and BMI, with notable cases of undernutrition. The mean weight was 42.22 ± 8.049 kg, and the mean height was 149.35 ± 5.399 cm, reflecting moderate variability among respondents. BMI averaged 18.9 kg/m², gradually increasing across age groups. Nutritional status analysis showed that 3% of the girls were severely thin, 17% had moderate thinness, and 31.6% were mildly thin. Nearly 48.3% had a normal BMI, slightly lower than WHO references. 10.3% of the girls were severely stunted, 36.3% were moderately stunted, and 42% exhibited mild stunting, leaving only 11.3% within the normal height-for-age range.

The study found that all 300 adolescent girls received Purnashakti. THR distribution was primarily done monthly (98%). However, only 21.67% of respondents consumed THR regularly, while 24.67% did not consume it at all. Among those who rarely consumed it,

53.67% had only tasted it once. Among regular THR consumers, Sheera was the most preferred form (89.2%). Awareness about THR benefits was low (70%), with only 16.3% recognizing its nutritional importance. Additionally, 28% were aware of its ingredients, while 56% knew about recipe variations. THR quality perception varied, with 76% rating it as good. The biggest barrier to THR consumption was its taste (85%), followed by texture (6%) and lack of variety (6%). A concerning 91% of non-consumers reported that THR was fed to cattle. Despite these challenges, 93% of girls received encouragement from Anganwadi workers to consume THR. Dietary habits showed a high preference for cereals, with 86% consuming chapati daily and 91% eating khichdi. Pulse consumption was lower, and Milk consumption was also limited, with only 34.7% drinking milk daily and 87% never consuming eggs, chicken, or fish. Vegetables were widely consumed, with 92.3% eating common varieties daily. However, vitamin A-rich yellow and orange vegetables were consumed daily by only 14%. Fruit intake was low, with only 37% eating fruits daily, while 46.33% never consumed amla. Dry fruits and oilseeds were also rarely consumed. However, 37.6% had a dietary diversity score of five or below, indicating a risk of inadequate nutrient intake. Nutrient-rich recipes were developed from the locally available foods and also incorporated THR. A sensory evaluation of the developed recipes was carried out, and Handvo received the highest preference, with 76.67% of participants rating it as "Like very much." Mathri followed closely, with 60% of participants giving it the same rating. 10 videos demonstrating the preparation of nutrient-rich recipes were developed.

CONCLUSION: The assessment of adolescent girls' nutritional status revealed significant concerns regarding undernutrition. While some girls demonstrated adequate growth, the prevalence of underweight and stunting indicates risks of malnutrition that could impact overall health and development. Addressing these issues requires improving dietary intake, ensuring access to nutrient-dense foods, and implementing targeted nutritional interventions to support adolescent growth. Despite 100% distribution of Purna Shakti (THR) through Anganwadi centers, its regular consumption remains low. Many adolescent girls consume THR infrequently, with only a small percentage adhering to the recommended intake. This irregular consumption significantly reduces the intended nutritional benefits, limiting its effectiveness in improving adolescent health outcomes.

The primary barrier is its taste, followed by issues related to texture and limited variety in preparation. A significant proportion of THR is either shared with family members or fed to cattle, leading to wastage and further diminishing its impact on adolescent nutrition. Although the girls were counselled by Aanganwadi workers, the consumption of THR was low. There is a strong need to address the barriers to THR consumption.

The dietary habits of adolescent girls indicated a heavy reliance on staple foods. While vegetables, particularly leafy greens and commonly used varieties, are widely consumed, the intake of protein-rich foods, especially animal-based sources, remains low. The consumption of vitamin A-rich vegetables and fruits is also inadequate, raising concerns about potential micronutrient deficiencies. Furthermore, a low intake of milk and milk products suggested a risk of calcium and protein deficiencies, which could impact bone health and overall growth. Addressing these dietary gaps is essential to ensuring better adolescent nutrition and long-term health.

INTRODUCTION

"The future of our world is only as bright as the future of our girls."

-Michelle Obama

BACKGROUND OF THE STUDY

The time between infancy and adulthood, known as adolescence, which ages from 10 to 19 years, is a critical stage in human longevity (WHO, 2024). The word "adolescence," which comes from the Latin word "adolescere," which means "to grow up or to grow into maturity," was first used in the 1500s (Lerner and Steinberg, 2009). It has been acknowledged as a unique time that calls for particular care. The most eventful phase for mental, emotional, and psychological health is this transitional period (Patton et al., 2016). Growth is accelerating at an extraordinarily high rate during this important time. Only in the final stages of life and the first few months of infancy can the peak growth rates be exceeded (Tanner et al., 1978). However, there is a lot more individual variance in the timing and level of growth compared to infancy. Adolescence is a defining time in the child's development characterized by rapid physical growth and neurological development, the onset of puberty, and sexual maturity – but these changes are not uniform (Srivastava S. et al., 2010).

Adolescence is the second most crucial time in the life cycle for physical growth after the first year; hence, nutrition is crucial at this time. During this stage, there are more internal activities such as secretion, hormonal reactions, basal metabolism, and biochemical reactions. Because adolescence is a time of significant stress owing to physiological and psychological changes, pubertal growth necessitates more body-building substances and an increase in basal metabolic rate, both of which require more energy (Srivastava et al., 2010).

1.1 Global Perspective on Adolescent Nutrition

The global population exceeds 8.0 billion, with 1.3 billion individuals classified as adolescents, making up 16% of the total population (UNICEF, 2022). This group constitutes a sizable portion whose nutritional state substantially impacts socioeconomic development and public health. Adolescents have higher nutritional requirements to sustain a rapid growth spurt, with deficiencies leading to long-term consequences such as impaired immune function, stunted growth, reproductive complications, and increased susceptibility to chronic disease later in life (WHO, 2021). Globally, malnutrition among adolescents is a concerning issue, with a significant number affected by malnutrition, micronutrient deficiencies, and anemia. Proper nutrition during adolescence is vital as it impacts the future health of potential offspring. It also helps in the development of bones and muscles, brain development, as well as cardiorespiratory fitness and immunity (Norris et al., 2021).

Around 390 million adults aged 18 and over were underweight globally in 2022, compared to 2.5 billion who were overweight, including 890 million who were obese. 390 million children and adolescents between the ages of 5 and 19 were overweight, with 160 million of them suffering from obesity. An additional 190 million people had a BMI that was more than two standard deviations below the reference median, indicating that they were thin (WHO, 2022)

About 1.2 billion people, one in six of the world's population, are adolescents aged 10-19 years. Nearly nine out of ten live in low- and middle-income countries (LMICs) where access to health and social services, jobs, and livelihoods are strained. Given that the number of adolescents is expected to rise through 2050, achieving the Sustainable Development Goals (SDGs), including universal health coverage (UHC) requires addressing the needs of this age group. Moreover, an estimated 70% of preventable deaths are from non-communicable diseases (Wrottesley SV, Mates E, Brennan E, et al., 2023).

The United Nations Children’s Fund (UNICEF), in its 2023 report titled "Undernourished and Overlooked," explained that adolescent girls are at a heightened risk of experiencing

insecurity compared to their male counterparts, with millions enduring nutritional deficiencies. The gender disparity in nutritional access is exacerbated by sociocultural factors that restrict girls' opportunities to obtain adequate and nutritious sustenance.

The present time is characterized by numerous challenges related to education, health, nutrition, employment, the acquisition of new skills, and adaptation to different living circumstances. It represents a phase during which significant changes occur. This stage is marked by personal development, where individuals enhance their abilities. Regarding opportunities, adolescents tend to take risks, whether in the company of peers or in solitary situations, which makes the environment susceptible to behaviors that may be harmful in the long term, particularly concerning health, career prospects, and educational attainment. Adequate nutrition plays a crucial role in regulating mood, thereby reducing the likelihood of mental health issues such as depression and anxiety. The onset of puberty triggers changes within the reproductive system, including the menstrual cycle. Providing health education to adolescent girls enables them to make informed decisions, promoting a healthy lifestyle (Oinam A. et al., 2022).

1.2 National Context: Adolescent Nutrition in India

India, with the world's largest adolescent population, is home to 253 million adolescents, making up one in five people, as reported by the Census of India (2011). With people between the ages of 10 and 19 making up over 21% of the total population, India has a sizable adolescent population. Almost 72% of the adolescent population resides in rural areas. The adolescent population in urban areas declined from 21.9% in 2001 to 19.2% in 2011, while it remained roughly the same in rural areas (Chandramouli C. et al., 2011). There are advantages and disadvantages to this demographic shift, especially in terms of nutritional health. Adolescent girls, in particular, experience a significantly higher dropout rate. They are especially susceptible to heightened insecurity stemming from harmful social norms that undermine the value of women. This environment severely restricts their freedom to navigate public spaces and makes it difficult for them to make choices that impact their social, academic, and professional lives. Out of over 137 million

children who began school in 2011, approximately 34 million did not complete their elementary education (UNESCO, 2015).

UNICEF reports that India's adolescent birth rate was 11 per 1,000 girls in 2020, indicating concerns over early childbearing. The adolescent population reached about 250 million in 2023, with adolescent girls increasing by 120 million since 1950, necessitating urgent policy action. In 2023, girls aged 10-19 made up 8% of the female population, highlighting their importance in India's socioeconomic context. Despite educational progress, challenges persist; UNICEF data from 2016 shows that 26% of girls in the appropriate age range are not enrolled in any education, leading to high dropout rates and limited skill development. Furthermore, 82% of girls aged 10–17 were affected by multidimensional poverty in 2015, illustrating the critical need for targeted interventions to enhance education, economic opportunities, and overall well-being for adolescent girls in India. About 43% of female secondary school students are estimated to drop out before finishing their education, primarily due to domestic responsibilities, which include labor exploitation, insufficient career and skills training, lengthy commutes to school, and inadequate sanitation facilities (UNICEF, 2016).

A double burden of malnutrition characterizes the nutritional situation for adolescents in India. Significant percentages of adolescents continue to suffer from stunting, thinness, and micronutrient deficiencies, indicating the persistence of undernutrition. At the same time, overweight and obesity rates are on the rise, particularly in cities, which is indicative of a move toward sedentary lifestyles and a rise in processed food intake (Pandurangi et al., 2022) (Figure 1.1).

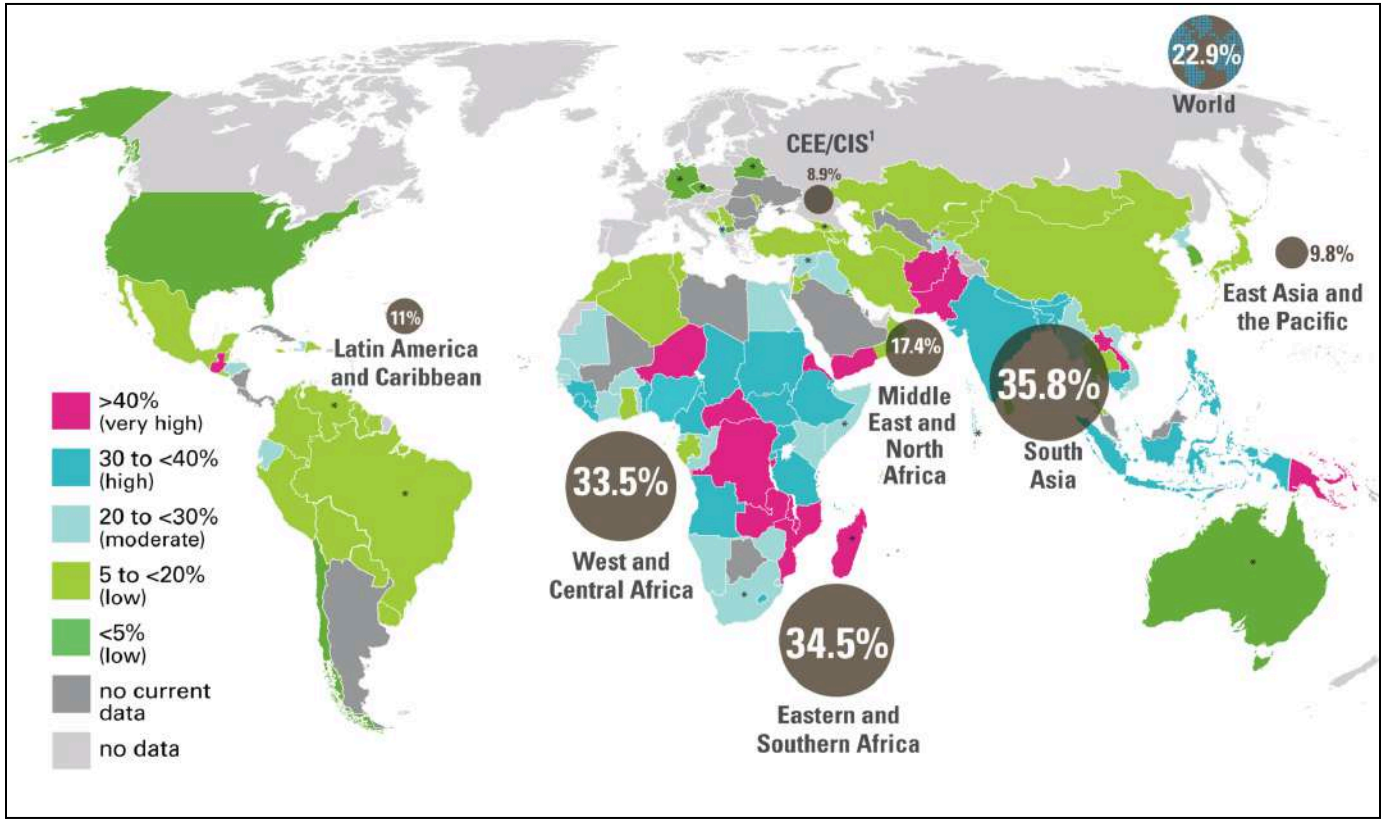
The National Family Health Survey (NFHS) reports highlight concerning trends in the nutritional status of adolescent females in Gujarat and India. According to NFHS-5, the prevalence of total thinness among adolescent females (15-19 years) in Gujarat is 52.5%, showing a 3% increase from NFHS-4 findings. Additionally, anemia rates among these adolescents are reported at 69%, reflecting a 12.5% increase from NFHS-4 (Figure 1.2).

The Indian government has launched several initiatives, most notably the Integrated Child Development Services (ICDS) program, to address these problems. The **Integrated**

Child Development Services (ICDS) Scheme was launched on 2 October 1975, the 106th birth anniversary of Mahatma Gandhi–the Father of the Nation. ICDS is the most unique program for early childhood care and development encompassing integrated services for developing children below six years, pregnant and nursing mothers, and adolescent girls living in the most backward, rural, urban, and tribal areas. ICDS provides its beneficiaries with health, nutrition, immunization, preschool education, health and nutrition education, and referral services. ICDS also empowers mothers to take better care of their children. The program provides a well‑integrated package of services through a network of community‑level Anganwadi Centers (AWC). One of the important services of AWCs is the Supplementary Nutrition Program (SNP). The SNP provides supplementary food to children between 6 months and 6 years of age, adolescent girls, and pregnant and lactating mothers. Every beneficiary under supplementary nutrition (SN) is to be provided supplementary nutrition for 300 days a year (Khan A. et al.,2016).

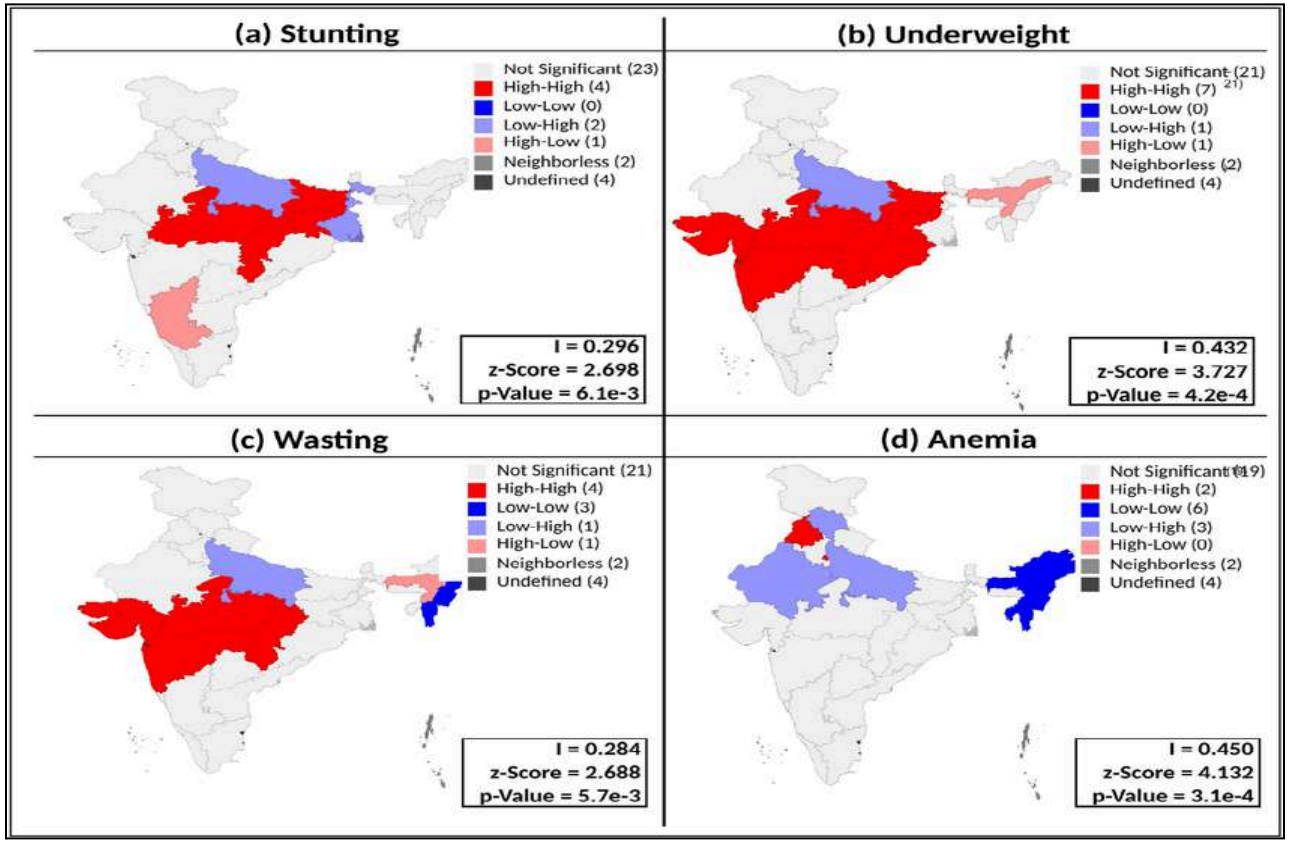
The rationale for including adolescents in the ICDS program stems from the understanding that adolescence is a second window of opportunity after the first thousand days of life to improve nutritional inadequacies and inadequate growth and development from childhood. Interventions during this stage can have a significant impact on long-term health outcomes, breaking the intergenerational cycle of malnutrition and poor health. By addressing the specific needs of adolescents, ICDS aims to improve their nutritional status, reduce the prevalence of anemia, and enhance their overall quality of life. The program's comprehensive approach aligns with global and national priorities for adolescent health and development, contributing to the broader goals of improving maternal and child health, reducing gender disparities, and promoting social equity (Ministry of Women and Child Development, 2020; World Health Organization, 2018).

Fig. 1.1: Global malnutrition rates among adolescent girls



(source: https://data.unicef.org/topic/nutrition/malnutrition/)

Figure 1.2: Adolescent Undernutrition in India



(source: Global Moran's I statistics and bivariate LISA cluster maps of India)

A study in Odisha revealed that out of a total of 240 recipients of supplementary nutrition, 188 (78.3%) consumed it. The consumption of supplementary food was least among adolescent girls i.e. 34 (70.8) out of 48. The main reason cited for not using the services was that they did not like the taste of food (53.8%). It was also found that all the beneficiaries of THR shared supplementary food with their family members (Smaranita S et al, 2021).

1.3 Regional context: Nutritional status of Adolescent girls in Gujarat

Gujarat, a state in western India, highlights the national nutritional difficulties among adolescents; undernutrition and micronutrient deficiencies are prominent among this cohort.

According to the Comprehensive National Nutrition Survey (CNNS) report in 2019, the prevalence of moderate to severely thin (BMI for age z-score < -2 SD) adolescent girls aged 15-19 in Gujarat was reported at 22.4%. The prevalence of severely thin (BMI for age z-score < -3 SD) adolescent girls aged 15-19 was reported at 5.2%. The prevalence of overweight (BMI for age z-score > +1 SD) among adolescent girls aged 15-19 was reported at 6.3%. The prevalence of obesity (BMI for age z-score > +2 SD) among adolescent girls aged 15-19 was reported at 1.4%. Additionally, the prevalence of anemia among females aged 10-19 in Gujarat was recorded at 45.8%, with a range of 36.2% to 55.7%.

To combat the nutritional challenges adolescents face, the Gujarat government launched the **PURNA (Prevention of Undernutrition and Reduction of Nutritional Anemia) project in 2018,** under the leadership of Chief Minister Vijay Rupani. Under the supplementary nutrition program, Gujarat ICDS provides adolescent girls aged 15-18 years non-school going "Purna Shakti," a nutrient-dense supplement to meet 1/3rd of their daily requirement containing 600 kcal, 18g of fat, 19.5g of protein, and essential vitamins and minerals. Double fortified sattva (DFS) salt is provided at Anganwadi centers for usage during the preparation of the hot cooked meals and DFS is given to pregnant and lactating mothers and adolescent girls 1kg per month as THR. (WCD Gujarat, 2023).

The objectives of the PURNA program are as follows:

- The primary objective is to decrease the prevalence of malnutrition and anemia among adolescent girls in Gujarat.
- By empowering girls with knowledge and resources, the program aims to prevent early marriage, ensuring better health outcomes.
- Educate adolescent girls on nutrition, health, and various life skills to enhance their self-competency and decision-making abilities.
- To increase awareness about legal rights, vocational training opportunities, and the effective use of social media to promote personal development.

This scheme has two main components: Nutritional and Non-nutritional components for Adolescent girls aged 15-18 years in both school-going and non-school-going groups.

1. **Nutritional Components:**

➢ **Supplementary Nutrition:** Provision of take-home ration "Purna Shakti" containing 9 different types of micronutrients once a month. Teaching them to prepare various dishes that can be made from "Purna Shakti" and to identify the various green vegetables available at the local level along with giving information on how they can be used to the maximum extent in food to meet daily dietary requirements, addressing calorie and protein deficiencies (Figure 1.3; Table 1.1).

➢ **Micronutrient Supplementation:** Distribution of iron and folic acid (IFA) tablets, once a week to combat anemia and other micronutrient deficiencies.

➢ **Health Check-ups:** Regular medical examinations to monitor health status and early detection of nutritional deficiencies.

2. **Non-Nutritional Components:**

➢ **Life Skills Education:** Training sessions focusing on communication, decision-making, and problem-solving skills to enhance personal development.

- **Legal Rights Awareness:** Workshops to educate girls about their legal entitlements, aiming to empower them to protect and assert their rights.
- **Vocational Training:** Skill development programs to provide economic opportunities and promote financial independence.
- **Social Media Literacy:** Guidance on the safe and effective use of social media platforms for personal growth and community engagement.
- **Nutrition and Health Education (NHE)**
- **Awareness of family and welfare, adolescent reproductive and sexual health** (ARSH), and child care.

In Gujarat, adolescent girls are provided 4 packets of Purnashakti, each of 1 kg. Purna Shakti Premix is made of wheat flour, soya flour, maize flour, rice flour, gram flour, sugar, and oil. All premixes are in dry form, energy-dense, and enriched with essential micronutrients. The premixes can be consumed with lukewarm water. The products have a shelf life of 4 months. The guidelines issued in 2009 by the Ministry of Women & Child Development allowed for the fortification of supplementary nutrition up to 50% of the recommended dietary allowance (RDA) level per beneficiary per day. This Home Ration is being supplied by the Gujarat Cooperative Milk Marketing Federation and respective dairy unions (NITI Aayog THR report, 2022).

By integrating these components, the PURNA program adopts a holistic approach to improving the nutritional status and overall well-being of adolescent girls in Gujarat, thereby contributing to their empowerment and societal advancement.

Fig. 1.3: Purnashakti Take-Home Ration

Table 1.1 Nutritional Composition of Take-Home Ration

Ingredients	Qty (gm)	Fortification	Per day consumption	Frequency of distribution	Weight of 1 packet
Wheat	40	Iron, Vitamin A, Calcium, Thiamine, Riboflavin, Niacin, Vitamin C and Folic Acid at 50% RDA	145 g	Monthly (4 packets)	1000 g
Besan	4				
Soybean flour	19				
Maize	19				
Rice	15				
Sugar	31				
Oil	17				

(source: NITI Aayog THR report, 2022)

A study in Ahmedabad, Gujarat, revealed that out of 200 beneficiaries, 97.5% of them procured THR packets, but only 66% of beneficiaries used them regularly. Major suggestions from the beneficiaries/parents to overcome these constraints in THR were that there should be more varieties in THR packets (60,30%) and that the taste of THR packets should be spicy rather than sweet (52,26%). Challenges faced by the beneficiaries/parents regarding THR were lack of time and lack of knowledge for making different recipes from THR packets (Sisodiya A. et al., 2022).

Adolescents: An Overlooked Population

Despite these initiatives, research on adolescent nutrition is underfunded, limiting policy development. Adolescents face changing food environments, persistent micronutrient deficiencies, and rising obesity rates. There are still barriers to using THR effectively. Taste preferences, cultural tolerance, and ignorance of the nutritional advantages are some of the factors that can prevent optimal usage. A study that looked at how program administrators and beneficiaries perceived obstacles to THR usage was carried out in Bhavnagar, Gujarat. It highlighted problems such as inconsistent supply, poor quality, and a lack of diversity in the rations that were offered (Trivedi B. et al., 2023).

2. RATIONALE OF THE STUDY

While the National Family Health Survey (NFHS) provides large-scale data on health indicators, it predominantly focuses on children under 5 and pregnant/lactating women, leaving a gap in data on adolescent nutrition programs. This gap includes crucial information on interventions like Home Ration coverage and consumption for adolescents aged 15-18 years.

The THR program under ICDS has the potential to significantly improve the nutritional status of adolescent girls. However, the effectiveness of this intervention depends on its acceptance and proper utilization by the target population. Developing nutrient-rich, culturally acceptable recipes using THR ingredients could enhance the program's impact by promoting better dietary practices and improving overall health outcomes.

There is a strong need to understand and assess the utilization of the Take-Home ration

along with understanding the barriers faced by adolescents in consuming Take-Home ration (THR) for breaking the intergenerational cycle of malnutrition. **Well-nourished adolescent girls are more likely to become healthy adults and mothers, thereby contributing to improved health outcomes for future generations.**

By examining THR consumption and its nutritional impact, the study aims to contribute to improving adolescent health outcomes in Gujarat and to provide updated data and insights into the current nutritional status and effectiveness of supplementary nutrition services for adolescent girls in Vadodara.

Thus, the present study has been designed with the **broad objective** of assessing the Utilization of a Take-Home rotation provided to adolescent Girls (15-18 years) in rural Vadodara and developing nutrient-rich recipes for promoting healthy diets.

Specific Objectives:

- To assess the socio-economic and nutritional status of the enrolled subjects
- To collect information on dietary practices and knowledge attitudes and practices related to the take-home ration consumption of the enrolled subjects
- To develop nutrient-rich recipes using THR and conduct the sensory evaluation.
- To develop videos demonstrating acceptable recipes and circulate the same among adolescent girls and functionaries

REVIEW OF LITERATURE

2.1 An Overview of Adolescence

Adolescence is a developmental stage that spans the age range of 10 to 19 years. According to the World Health Organization (WHO), this period is crucial for human development, characterized by rapid physical growth, maturation, and psychosocial changes. It is imperative during this stage to establish a foundation for future health, with optimal nutrition playing a vital role. India comprises approximately 21% of its population in the adolescent age group, highlighting the necessity of addressing their nutritional requirements (UNICEF, 2022). Ultimately, adolescence is the period of transition from childhood to adulthood, generally co-occurring with the onset of puberty and culminating with the achievement of legal independence from parents/guardians i.e. 'adulthood' (Jaworska & MacQueen, 2015). Adolescence is a critical life stage characterized by major biological, psychological, emotional, and social growth and development. Adolescence, which is referred to as the second "developmental period," is characterized by a high rate of physical and cognitive development which is second only to the rate in infancy (Larsen & Luna, 2018) (Best & Ban, 2021).

2.2 Importance of Nutrition for Adolescent Girls

2.2.1 Relationship Between Long-term Health Outcomes and Nutrition

To support rapid physiological growth and development and to establish the foundation for long-term good health, adequate nutrient consumption is essential at all stages of life, but especially during adolescence. The children of today are expected to live long and productive lives due to consistent gains in life expectancy. Health and well-being throughout life are impacted by the type and amount of nutrients consumed during the early years of adolescence. The importance of societies prioritizing the nutritional needs of adolescents and offering clear dietary guidelines and action on nutrition for adolescents has been emphasized by leading nutrition experts (Moore Heslin & McNulty, 2023).

Growth and development during adolescence are life-changing and have a significant impact on a person's health in later life as well as the health of any future children. Adolescents of the current generation are growing up in an era of unparalleled food environment change, with rising rates of overweight and obesity as well as persistent nutritional issues such as micronutrient deficiencies and food insecurity. Nutrition plays a formative role in the timing and pattern of puberty throughout late childhood and early adolescence, which has implications for the accumulation of adult height, muscle, and fat mass as well as the risk of non-communicable diseases later in life. Beyond physical growth, nutrition has an impact on immunological function, neurodevelopment, and cardiorespiratory fitness in adolescents. In many nations, high rates of early adolescent pregnancy continue to endanger the development and nutrition of adolescent girls, with long-term effects on the following generation. Adolescence is a time of growth that is sensitive to nutrition, and many other physiological systems benefit from a healthy diet during this time (Norris et al., 2022).

Any country's future lies with its adolescents, and the health of society depends on their nutritional status. Preventing chronic diseases and ending the intergenerational cycle of starvation require addressing adolescent's nutrition. Fetal undernutrition is strongly associated with an increased risk of chronic diseases in adulthood, according to epidemiological research conducted in both developed and developing countries (ACC/SCN, 2000). At any time in life, but especially during adolescence, malnutrition can have serious health effects, including iron deficiency anemia, stunted physical and cognitive development, and an increased risk of non-communicable diseases in later life. Adolescent malnutrition can also lead to long-term health problems in maturity, such as decreased physical ability and an increased risk of chronic diseases (Figure 2.1).

Adolescence and young adulthood have completely distinct meanings from three different angles. First and foremost, adolescence's vital developmental tasks—such as gaining the emotional and cognitive skills necessary for independence, finishing school and entering the workforce, participating in civic life, and establishing lifelong relationships—are supported by health and well-being. Second, it is possible to view

adolescence and early adulthood as the time for establishing the health foundations that will influence health outcomes throughout the lifespan. Last but not least, adolescents are the next generation to become parents, and their health reserves greatly influence the healthy start they provide for their children (Patton et al., 2016).

For the cerebral cortex to function at its best, a healthy diet rich in vitamins, minerals, and iron is needed. To help support evidence-based policies and interventions, UNICEF's Multiple Indicator Cluster Surveys (MICS) offer useful information on the nutritional status of adolescents worldwide. Malnutrition behavioral, environmental, and socioeconomic causes were examined, emphasizing the necessity of context-specific interventions (UNICEF, 2019). The idea of nutrition-sensitive programming is highlighted, supporting programs that address nutritional inadequacies directly while also taking into account more general factors like gender equality, education, and sanitation (UNICEF, 2018).

Adolescence is a crucial time for development and growth. However, the extent to which adolescents in low- and middle-income countries (LMICs) were impacted by this double burden of malnutrition is unknown (Caleyachetty et al., 2018). In the global health community, adolescents—a significant and vulnerable group—remain generally ignored (Patil, N., Jagadeesh, et al. 2018). The group is challenging to quantify and reach, and adolescent girls' needs in particular were frequently disregarded. Adolescents' nutritional status is crucial to their growth and development, and their nutritional needs were at their highest at this time (Teji, K., Dessie, et al. 2016).

The Global Anemia Reduction Efforts (GARE) initiative highlights the high prevalence of affected individuals worldwide (World Health Organization, 2011). Iron supplements, dietary variety, and awareness programs highlighting the importance of nutrition in preventing anemia are some examples of these strategies. To guarantee successful prevention and control, gender-sensitive measures were emphasized, acknowledging the increased vulnerability of female adolescents (World Health Organization, 2016).

2.2.2 Role of Take-Home Ration in Improving Adolescent Health

The Government of India has initiated various programs aimed at mitigating nutritional challenges faced by adolescent girls, notably the flagship initiative known as the Integrated Child Development Services Scheme (ICDS), in Gujarat ICDS under the Prevention of Undernutrition and Reduction of Nutritional Anemia among adolescent girls PURNA program provisions of supplementary nutrition, which includes the distribution of Take Home Ration designed to fulfill the dietary needs of target group which is school-going and out-of-school girls aged 15-18 years.

This review highlights the nutritional status of adolescent girls at the Global, National, and Regional (Gujarat) levels. It evaluates the utilization of ICDS services and the consumption pattern of THR among adolescent girls in Gujarat.

2.3 Global Insights on Adolescent Nutrition

2.3.1 Prevalence of Malnutrition among Adolescents

All women of reproductive age and adolescent girls suffer from poor nutrition, but the hazards to their health and the health of their unborn children are especially significant during pregnancy and after childbirth. The nutrition of women and adolescent girls is not improving quickly enough and is in danger. Over a billion adolescent girls and women have anemia, shortages in vital micronutrients, and undernutrition (including underweight and low stature), which has a catastrophic impact on their lives and general health. Only a little decrease in the prevalence of underweight in women (from 12 to 10 percent) and no change in the prevalence of underweight in adolescent girls (8 percent) has occurred since 2000. More than two-thirds of girls and women (69%) have vitamin deficiencies, and the prevalence of anemia is still significant and unabated (30%), Undernutrition, anemia, and/or micronutrient deficiencies affect at least two-thirds of adolescent girls and women (UNICEF, 2023).

Around 390 million adults aged 18 and over were underweight globally in 2022. An additional 190 million people had a BMI that was more than two standard deviations below the reference median, indicating that they were thin (WHO,2024).

The 2030 worldwide targets to cut low birthweight in newborns by 30% and anemia in adolescent girls and women by half are not being met in any area. Adolescent girls and women's nutrition has made poor progress, and the present food and nutrition crisis may make matters worse. According to analysis, in 12 countries most affected by the global food and nutrition crisis, the number of pregnant and lactating adolescent girls and women experiencing acute malnutrition has increased by 25% since 2020. This indicates that there are now 6.9 million impacted women and girls, up from 5.5 million (UNICEF, 2023).

According to Figure 2.2, 8% of adolescent girls (49 million) and 10% of women (154 million) worldwide were underweight, a symptom of their inability to eat enough food to maintain a healthy body weight.

Adolescent females were particularly affected by anemia because of their higher iron needs during growth spurts and menstruation, according to the State of the World's Children reports (UNICEF, 2021). The article discusses the negative impacts of anemia on both physical and cognitive development, highlighting the need for focused interventions. Stressing the value of dietary diversity, iron supplementation, and raising community awareness (UNICEF, 2018).

Approximately 13% of adolescents worldwide suffer from undernutrition, according to the Global Strategy for Women's, Children's, and Adolescent Health (World Health Organization, 2016). Adolescents' general well-being is impacted by this undernutrition, which shows up as stunted growth, delayed puberty, and reduced cognitive development (Sawyer et al., 2018).

Figure 2.1: Vicious Cycle of Intergenerational Malnutrition (ACC/SCN, 2000)

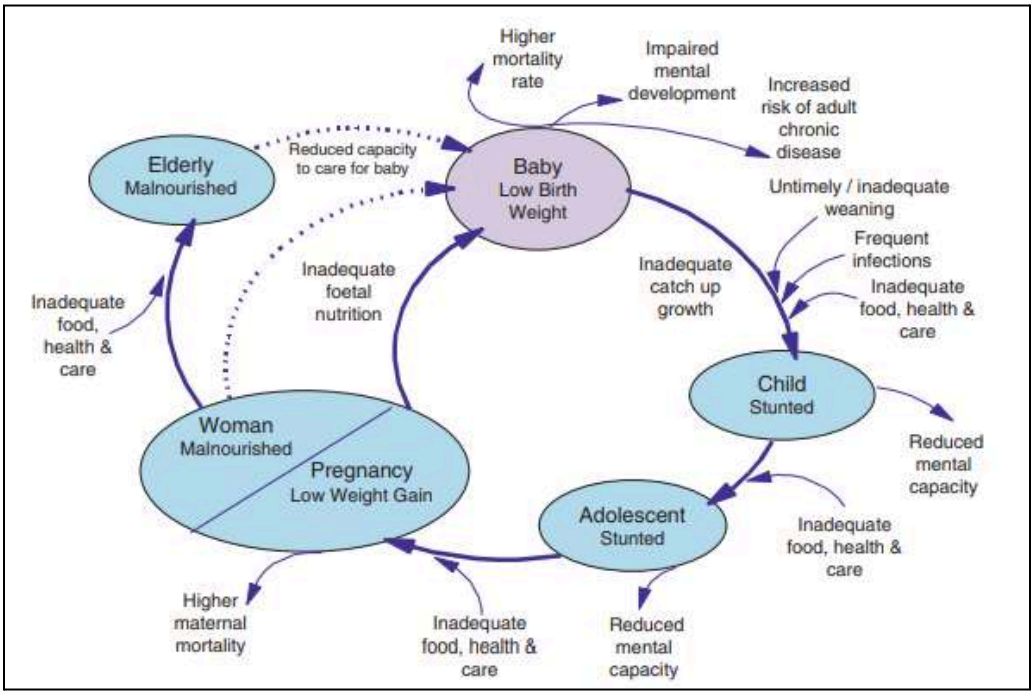
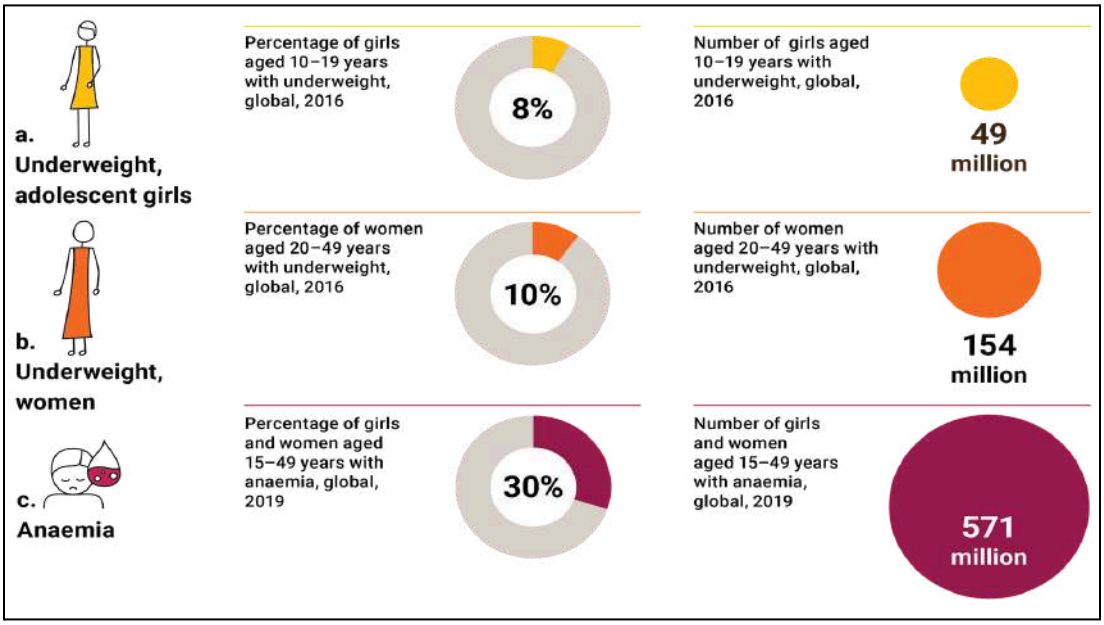


Figure 2.2 The prevalence, expressed in millions, of (a) underweight in adolescent girls, (b) underweight in women, and (c) anemia in adolescent girls and women worldwide



(source: hhttps://data.unicef.org/resources/undernourished-and-overlooked/)

Fighting malnutrition requires integrated approaches that take into account the intricate interactions between dietary practices, socioeconomic variables, and health systems (World Health Organization, 2017).

The "triple burden" of malnutrition, which includes undernutrition, micronutrient deficiencies, and overnutrition, is particularly dangerous for adolescents. Adolescent undernutrition and obesity were common in both low- and middle-income nations, with obesity being the most common dietary problem among adolescents in high-income nations (Rah et al., 2021).

Malnutrition poses serious dangers to the 1.8 billion adolescents worldwide, affecting their development, growth, and general health. Undernutrition and overnutrition both raise the risk of non-communicable diseases and have an impact on academic performance, among other health issues. By PRISMA principles, this systematic review evaluated how well health education interventions improved adolescents' malnutrition-related knowledge, attitudes, and behaviors. Eight randomized controlled trials were analyzed, and the results showed that school-based and community-based interventions had different degrees of success. The results showed a rising incidence of overnutrition and widespread iron and iodine deficits among adolescent girls. Adolescence was highlighted in the study as a critical time for lifestyle modifications and the requirement for focused health education initiatives. Although the majority of interventions showed beneficial effects, the evaluation noted the dearth of community-based programs for adolescent girls and emphasized the efficacy of theory-based methods. Enhancing intervention standards, carrying out context-specific research, and customizing tactics to various adolescent subgroups—with an emphasis on community and parental engagement—were some of the main recommendations (Iamail et al., 2020).

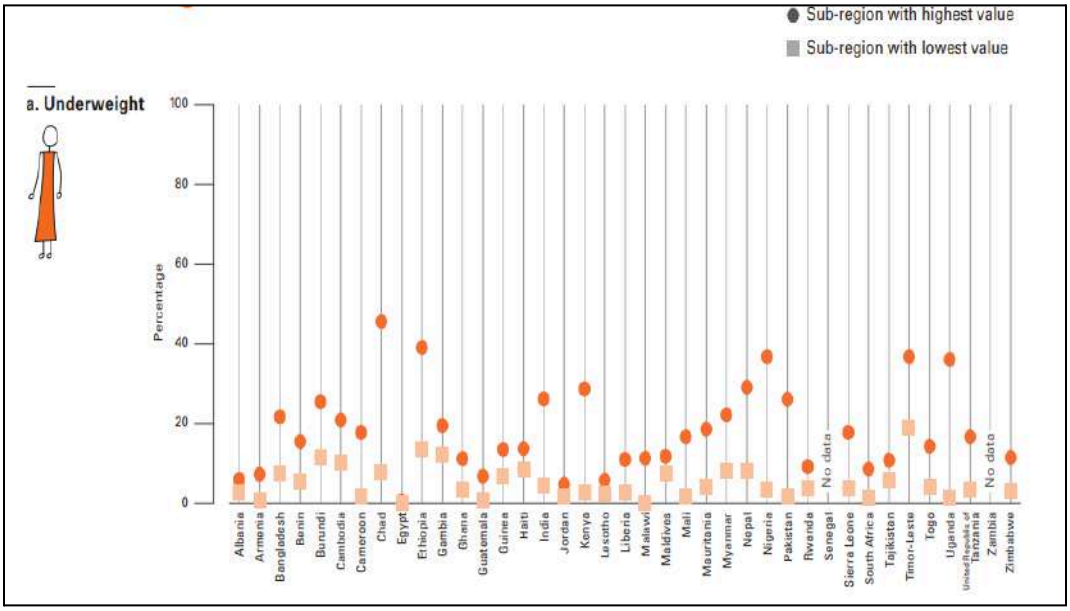
In addition to having a higher chance of giving birth to small infants with inadequate body nutrient stores who experience wasting and stunting during the critical early years of life, undernourished girls and women who become pregnant face the highest risks to

their health and survival (Black et al., 2013; Victora et al., 2021). Given that over 70% of all infants born with low birth weight and children experiencing stunting and wasting in their early years reside in South Asia and sub-Saharan Africa, it is no surprise that these regions are also the global epicenter of low birth weight and child undernutrition (United Nations Children's Fund & WHO, 2019; United Nations Children's Fund, WHO, & World Bank, 2021).

Adolescents comprised of 23.2% of Tanzania's population, with a larger percentage in areas with severe socioeconomic and health issues. With stunting rates of 64.2% in rural regions and 3.9% in urban areas, and underweight prevalence of 10.9% and 6.2%, respectively, malnutrition is still a serious problem. There were few national statistics on adolescent malnutrition, especially for adolescents who were not enrolled in school. The frequency and determinants of malnutrition among adolescents enrolled in and not enrolled in school were investigated in a Dodoma study. Of the 1,226 respondents, the majority of homes had 5–9 people, 55.30% were female, and 66.72% were between the ages of 10 and 14. Approximately 73.25% of adolescents were enrolled in school, while 12.81% were not. According to the survey, 14% of people were thin, 4% were severely thin, and 18% were stunted. Additionally, 5.23% of people were overweight and obese (Ismail A. et al., 2019).

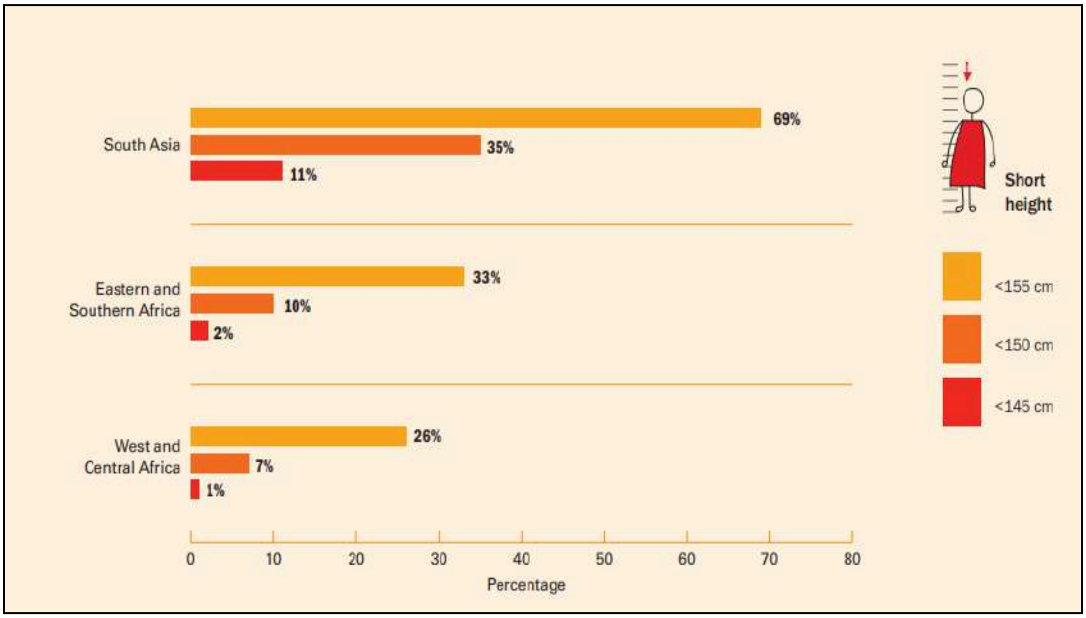
Chronic and multigenerational undernutrition were indicated by short height. In contrast to underweight and anemia, there is no universally accepted measure of short height in women; instead, cut-offs for height often fall between 145 and 155 cm. (Victora et al., 2021) The greatest risk of negative outcomes at birth and in early childhood, such as preterm birth, small-for-gestational-age children, and stunting, is connected with a height of less than 145 cm; however, higher height categories were also linked to an increased risk of negative outcomes (Ozaltin, Hill, & Subramanian, 2010; Kozuki et al., 2015).

Figure 2.3: National averages reflect differences in adolescent girls and women's nutrition within countries



(source: UNICEF analysis based on Demographic and Health Surveys)

Figure 2.4 Percentage of short-height adolescent girls and women (15–49 years old) by UNICEF region, 2020



(source: UNICEF analysis based on Demographic and Health Surveys)

Table 2.1 The Global Prevalence of Thinness among Adolescent Girls

Name of the Author	Year	Age Group	Place	Thinness	Stunting
Dereje Yohannes Teferi et al	2018	10-19	Southern Ethiopia	1.1%	4.40%
Engidaw M T et al	2018	11-19	Somali Regional state	Severe- 26.1%	8.0%
Hassen et al	2017	10-19	Southwest Ethiopia	10.9%	16.0%
Sabujkanti Mistryat et al	2017	10-19	Bangladesh	60.2%	-
Teji K et al	2016	11-19	Babile district, Easter Ethiopia	21.6%	59.55%
Mansur et al	2015	9-16	Nepal	14.94%	21.08

Using information from nationally representative household surveys (Demographic and Health Surveys) carried out between 2014 and 2020, 37 low- and middle-income nations girls and women between the ages of 15 and 49 were found to have short height. With the height cut-off, the prevalence estimates of short height increase (see Figure 2.4). For instance, 11 percent of adolescent girls and women in South Asia were under 145 cm, 35 percent were under 150 cm, and 69 percent were under 155 cm. The percentage of adolescent girls and women under 150 cm varies by area as well; in West and Central Africa, it is 7% (9 million), in Eastern and Southern Africa, it is 10% (15 million), and in South Asia, it is 35% (171 million) (UNICEF, 2023).

2.3.2 Academic Achievement and Cognitive Development

Malnutrition affects millions of adolescents globally, impeding their potential, growth, and development, according to the State of the World's Children reports (UNICEF, 2021). According to the Adolescent Development and Participation section, deficits in iron, zinc, and omega-3 fatty acids, among other nutrients, can harm memory, cognitive function, and academic achievement (World Health Organization 2019). Adolescents' overall well-being is enhanced by nutritional education and policies that take cognitive development into account (World Health Organization, 2019).

2.3.3 Deficiencies in essential micronutrients among adolescents globally

Adolescent girls and women are rarely deficient in a single micronutrient. Instead, diets that are low in a variety of foods (such as meat, poultry, vegetables, fruits, and fortified foods) are frequently low in multiple micronutrients, putting them at risk for multiple micronutrient deficiencies (UNICEF, 2023).

According to a recent study that included data from 19 nations, over two-thirds of adolescent girls and women who were not pregnant (69 percent; 1.2 billion) were iron, zinc, and/or folate deficient. This analysis may understate the actual severity of micronutrient deficits because it only looks at three micronutrients. The highest rates of micronutrient deficiencies (iron, zinc, and/or folate) were found in sub-Saharan Africa (80%, 161 million) and South Asia (72%, 307 million) (Stevens et al., 2022).

Adolescent females were particularly affected by anemia because of their higher iron needs during growth spurts and menstruation, according to the State of the World's Children reports (UNICEF, 2021). The article discusses the negative impacts of anemia on both physical and cognitive development, highlighting the need for focused interventions. Stressing the value of dietary diversity, iron supplementation, and raising community awareness (UNICEF, 2018).

Adolescents are typically at significant risk of dietary inadequacy due to their increased nutritional needs, as well as changes in their eating habits, behaviors, and environmental exposures. (Norris et al., 2022) (U.S. Department of Agriculture & U.S. Department of Health and Human Services, 2020). With vitamins A, B6, B2, D, E, folate, calcium, iron, iodine, zinc, and selenium identified as micronutrients of particular concern for this age group and globally, (Estecha Querol et al., 2020) adolescents, along with women and children, have been found to bear a significant portion of the worldwide burden of micronutrient deficiencies (Bailey, West, & Black, 2015).

About 40–60% of adult bone mass is accumulated throughout adolescence, making it a critical period for bone mineralization (Golden, 2014). Adolescence therefore has higher calcium and phosphorus needs than at any other time in life, and it is therefore recommended that this age group consume more vitamin D. In context with this, it is common for adolescents to consume insufficient amounts of calcium and vitamin D (Institute of Medicine, 2011); data from Europe, UK (See et al., 2013) (Public Health England, 2020), the United States (Bailey et al., 2010), and Brazil (de Assumpção et al., 2016), suggest that most adolescents do not consume enough of these nutrients. In Ireland, 94% of adolescents have been found to consume insufficient amounts of vitamin D, while 67% consume less calcium than is advised (Cashman et al., 2022). Concerns about the long-term effects on bone health for this age group were raised by evidence of decreasing dairy product consumption and low supplement use among Irish adolescents (Hohoff et al., 2021).

It has been proposed that the adolescent years offer the possibility of catch-up growth and nutrition, which could help to mitigate the effects of childhood malnutrition and stunted growth (Campisi et al., 2018). Adolescence is a time of increased cognitive malleability because of the rapid growth and remodeling of the brain throughout this stage of life (Steinberg, 2014) (Fuhrmann, Knoll & Blakemore, 2015). Because of this increased flexibility, the brain is more susceptible to environmental and nutritional hazards, including dietary deficits. The building and fortification of neurocircuitry can be significantly impacted by nutritional intake; undernutrition in energy and protein, high-fat and high-sugar diets, and insufficient intake of vital nutrients such as B vitamins, iron, iodine, zinc, and polyunsaturated fats were all regarded as hazards to neurodevelopment (Galler et al., 2017; Lowe et al., 2020). To build good health in adolescents and prepare them for long, healthy, and productive lives, it is crucial to ensure proper food consumption, especially critical micronutrients (Norris et al., 2022).

Optimizing dietary consumption during adolescence is crucial for maintaining both the health of the adolescents and their future children (Patton & Sawyer, 2015). Because around one-third of women worldwide fall pregnant when still in their teens, vulnerable young mothers and babies must receive enough nourishment. Iron, iodine, and folic acid were highlighted as nutrients of special importance in adolescent moms, whose suboptimal micronutrient status is a major dietary problem. Iodine is an essential mineral for thyroid hormone synthesis and healthy neurodevelopment; in adolescents, iodine shortage is linked to problems with both mental and physical functioning (Zimmermann, 2011).

As women approach childbearing age, adequate iodine intakes become even more crucial, as a lack of iodine can cause intellectual deficiencies as well as cognitive and behavioral issues in their offspring (Bath, 2019). Adolescents in Europe, especially girls, have been found to routinely consume less iodine than other age groups (Bath et al., 2022).

To avoid neural tube abnormalities during pregnancy, it is advised that all women begin taking folic acid supplements as soon as they reach childbearing age. However, adolescent girls worldwide did not take many folic acid supplements, and they were not well informed about the need for folic acid (Viswanathan et al., 2017; Matsuo et al., 2017). Only 14% of all adolescents in Ireland reported taking supplements, indicating low overall supplement consumption. Although the population's folate status had improved as a result of the voluntary fortification of food products with folic acid, more folic acid fortification is required, as is the use of outreach and education to encourage adolescents to consume more folic acid (Pfeiffer et al., 2019). Ensuring nutritional adequacy in adolescent females is one of the many crucial efforts that should be made to improve the lives and safety of adolescents, as the overall risk of complications in maternal and neonatal health outcomes is significantly higher for adolescent mothers than for adult women (Gurung et al., 2020).

We look at the required fortification of staple foods within the food system. Even though fortification offers one of the most economical ways to provide adolescent girls and women with essential micronutrients, too few countries have made it mandatory for wheat flour (45 percent) and vegetable oil (24 percent). This is especially true for non-pregnant girls and women who frequently lack essential micronutrients but infrequently receive nutrition services (Kassie et al., 2020).

2.3.4 Dietary Practices Among Adolescents

Poor diet consumption is regarded as a major modifiable risk factor for chronic diseases and is one of the main causes of the worldwide burden of non-communicable diseases. Among all demographic groups, adolescents have been found to have the lowest-quality diets (Green et al., 2016)(Winpenny et al., 2018). As children grow into adolescents, the quality of their diets tends to decline; those between the ages of 14 and 18 score about ten points lower on the Healthy Eating Index than younger children (Banfield et al., 2016). Adolescents have a poor diet, which is typically defined as consuming more candy, sugar-filled drinks, fats, processed meats, refined grains, and prepared foods than fruit, vegetables, whole grains, lean meat, and low-fat dairy (Liu et al., 2020).

Adolescence is a crucial period for human growth during which characteristics and routines that last a lifetime can be found and formed. Adolescence has been described as a "window of opportunity" for the development of eating patterns, and this stage of life has been emphasized as a crucial but underappreciated period for the construction of long-lasting health behaviors (Chong, 2022). Dietary habits from childhood have been demonstrated to carry over quite well into adulthood, with late-adolescent behaviors showing the best persistence into adulthood (Craigie et al., 2011).

2.3.5 Influence of Traditional Dietary Practices

Bhutan's populace is presently going through a shift in their eating habits and nutritional status. particularly children and adolescents at school. One in three adolescent females suffers from anemia. Poor diets that are mostly composed of nutrient-poor rice and restricted intake of fresh fruits, vegetables, and nutrient-dense foods like meat, legumes, and dairy have been the cause of both micronutrient deficiencies and overnutrition. To improve the nutritional condition of children and adolescents, WFP collaborated with the Ministry of Education (MoE) and offered technical help to its School Health and Nutrition Division to address these dangers to the health and well-being of the next generation. WFP is working to impact food choices both within and outside of schools through social behavior change (SBC) in addition to improving the quality of school meals (WFP, 2024).

2.3.6 Global Barriers to Improving Adolescent Nutrition

Individual factors affecting adolescent health and well-being

It has long been believed that adolescence is a time of "storm and stress," during which mood swings, a rise in risk-taking behavior, and heightened conflict with parents or guardians can all lead to unpredictable feelings, ideas, and actions (Arnett, 1999). Adolescence is characterized by significant changes in dietary habits, lifestyle, and exposure to environmental factors, all of which can make this age group more nutritionally vulnerable. Personal factors like body image, preferences, degree of autonomy, interest in health, and nutrition knowledge have been identified as important

considerations for health and food choices in adolescents. A previous review has presented the motivations and barriers to healthy food choices in adolescents (Daly, O'Sullivan, & Kearney, 2022). Adolescent eating habits and dietary intake were also significantly influenced by a variety of biological determinants, such as appetite, hunger, taste, weight status, and allergies, as well as psychosocial factors, such as attitudes, beliefs, self-efficacy, food preferences, mood, and mental health (Watts et al., 2022).

Social determinants of adolescent health and nutrition

Adolescence is a time of increased social involvement and connection with relatives, peers, and the larger community. Adolescence is a time when the "social brain" develops, making this age group especially sensitive to and cognizant of how other people affect their decision-making (Andrews, Ahmed, & Blakemore, 2021). Adolescents' lifestyles and diets were significantly impacted by parental traits such as education level, social status, income, health, marital relationships, parenting style, stress, efficacy, habits, and preferences (Zhang et al., 2020).

Environmental elements affecting the diet and health of adolescents

Dietary and health-related behaviors were significantly influenced by the physical, economic, social, cultural, and political settings. Adolescents' food choices were primarily influenced by external environmental factors, such as price, convenience, food attributes, and physical and social surroundings, rather than by intrapersonal factors like emotions and self-control These findings suggest that modifying the external food environment and employing focused health promotion messaging could help improve the dietary choices of adolescents (Daly et al., 2021).

2.3.7 Social and Cultural Norms Influencing Food Choices

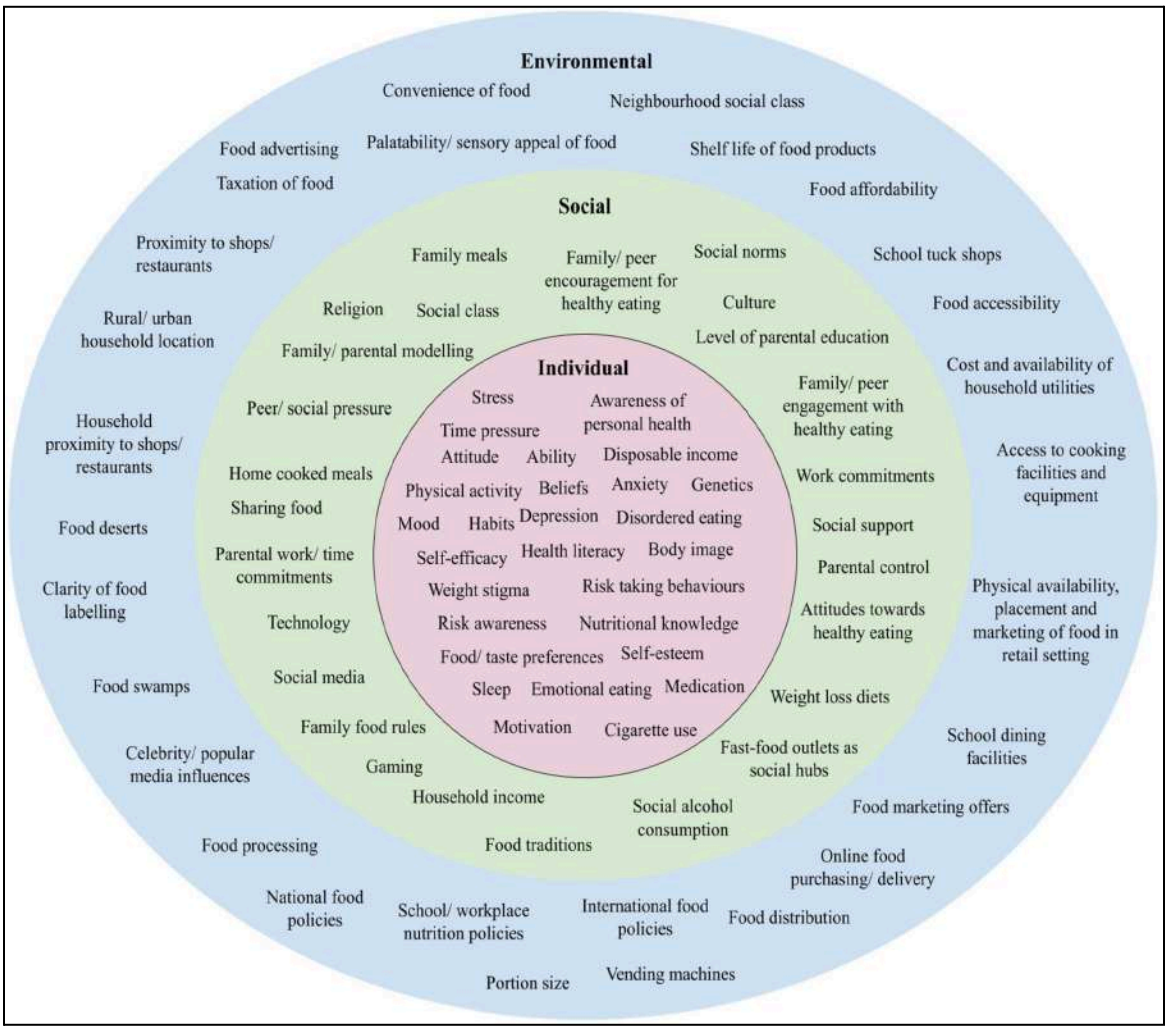
Socio-Economic Barriers

Undernutrition and anemia primarily impact underprivileged adolescent girls and women, especially in poorer regions. In South Asia and sub-Saharan Africa, 68% of them were underweight, and 60% suffer from anemia. Girls and women with less education, those in

rural areas, and lower-income families were more susceptible to being underweight and anemic.

Many adolescent girls, particularly those from lower-income families and those residing in rural regions, do not eat the range of foods necessary for proper nutrition. A threat to proper nutrition is emerging from the widespread availability of inexpensive, ultra-processed foods that are low in nutrients, as the growing food and nutrition crisis makes it even harder for women and adolescent girls to locate and purchase a variety of nutrient-dense foods.

Figure 2.5 Adolescent diet and nutrition are influenced by environmental, social, and personal variables



(source: Cambridge University Press)

There is significant heterogeneity in the diversity of diets among nations, according to a study of data from 20 national household surveys (including national nutrition surveys and Demographic and Health Surveys). In nations impacted by conflict or institutional and social instability, such as Sudan (10%), Burundi (12%), Burkina Faso (17%), and Afghanistan (26%), the percentage of teenage girls and women who meet MDD-W is incredibly low. Only three nations—Gambia, Mongolia, and Tajikistan—have an MDD-W of 70% or greater. In sum, 47% of adolescent girls and women in the 20 nations follow a diet that satisfies the MDD-W (Oxfam, 2019; Quisumbing et al., 2011).

Adolescent girls and women were disproportionately affected by conflict, poverty, climate change, and economic shocks, with worsening nutritional status expected due to global crises in 2023. Access to healthy foods is difficult, and dietary diversity among them is low, particularly in developing nations. In Sudan (10%), Burundi (12%), Burkina Faso (17%), and Afghanistan (26%), fewer than one in three adolescents had sufficiently varied diets. Access to minimally varied diets in Niger dropped from 53% to 37% from 2020 to 2022 (UNICEF, 2023).

Gender Disparities

Nutritional progress is hindered by societal and gender biases that restrict access to nutritious foods and necessary services. **Discriminatory norms limit decision-making, and access to resources, increase domestic work, and restrict job opportunities for adolescent girls and women.** During food crises, these gender disparities were most pronounced. Despite declining teenage pregnancies, 12 million births occur to girls aged 15 to 19 who haven't yet matured, mostly in South Asia and sub-Saharan Africa (66%) (UNICEF, 2023).

Research conducted in Pakistan and India has revealed that adolescent females' diets were less varied than those of boys (Akter et al., 2021; Ganpule-Rao et al., 2021). Furthermore, it is abundantly evident that women with more agency have more varied diets than those with less decision-making authority (Menendez et al., 2006; Amugsi et al., 2016).

Some people in Asia and Africa follow socially accepted norms that male household members should eat first and/or receive a larger portion and higher quality of food, and women were unable to make decisions about household food purchases. (Kavle & Landry, 2018; ROSHNI, 2018; Girard et al., 2012; Chhoun et al., 2016). During periods of food and nutrition crises, these long-standing gender disparities in food distribution were typically most noticeable (Bryan, Ringler, & Lefore, 2022; United Nations Women, 2022).

There are international guidelines for preventing and treating malnutrition, and it is generally agreed upon that adolescent girls and women of reproductive age are particularly susceptible to inadequate nutrition. However, analysis of government regulations shows that they do not adequately protect the nutrition of women and adolescent girls. It is difficult to make the right policy decisions, monitor progress, and keep duty-bearers accountable when there are gaps in the data, information, and evidence about the state and determinants of nutrition in adolescent girls and women (UNICEF, 2023).

Poor nutrition can have long-lasting effects on women and adolescent girls, making them more vulnerable to infections, mental health issues, and chronic diseases linked to diet, as well as making it harder for them to make a living and lead dignified lives. These consequences make it considerably more difficult for women and adolescent girls to leave poverty and create better futures, which perpetuates gender inequality. Adolescent girls and women who were most at risk—those with lower levels of education, those from low-income families, and those who reside in rural areas—are more likely to suffer from malnutrition and be less equipped to handle the fallout (McGovern et al., 2017; Victora et al., 2021; Wassef, Nguyen, & St-André, 2019; Gombart, Pierre, & Maggini, 2020).

2.3.8 Global Nutrition Initiatives to Enhance the Health of Adolescents

Contribution of the World Health Organization

Given that adolescent's health has a substantial influence on future generations, the WHO Adolescents Nutrition Guidelines (2021) highlight the importance of a life-course approach to nutrition. By supporting evidence-based interventions like dietary diversity, fortification, and supplementation programs, these guidelines aim to reduce undernutrition, obesity, and micronutrient deficiencies. Given that iron deficiency is one of the most common dietary problems affecting teenagers worldwide, WHO emphasizes the value of iron and folic acid supplements in lowering anemia among adolescent girls. WHO also suggests school-based nutrition initiatives to decrease the consumption of processed foods high in sugar and trans fats, encourage physical activity and improve dietary habits. To guarantee that vulnerable adolescent populations were the focus of public health interventions, food security, and access to wholesome meals, the WHO also works with governments to incorporate adolescent nutrition policies into national health strategies. To provide a holistic approach to nutritional well-being, the organization also promotes nutrition-sensitive interventions, such as integrating adolescent nutrition programs with mother and child health services (WHO, 2021).

Initiatives by UNICEF

Through its Adolescent Nutrition Strategy (2020) and other national programs targeted at enhancing young people's nutritional outcomes and food intake, UNICEF has played a significant role in tackling adolescent nutrition. In recognition of the twin burden of malnutrition impacting adolescents worldwide, UNICEF's programs address both undernutrition and overweight/obesity issues.

The Adolescent Nutrition Program is a flagship initiative under UNICEF's nutrition initiatives, with a focus on:

- Micronutrient Supplementation: To avoid deficiencies and associated health issues, extensive programs for iron, folic acid, vitamin A, and zinc supplementation are being implemented.
- School Nutrition Programs: Ensuring that adolescents have access to nutrient-rich meals through the promotion of healthy eating practices, nutrition education, and enhanced school lunch programs.

- Community-Based Approaches: Including parents, educators, and medical professionals in behavior change communication plans, awareness campaigns, and adolescent counseling.
- To improve nutritional quality, nutrient fortification involves collaborating with governments and the commercial sector to add vital micronutrients to basic foods (such as flour, rice, and salt) (UNICEF, 2020).

Given that adolescent girls are more likely to suffer from malnutrition as a result of biological and sociocultural causes, UNICEF also prioritizes gender-sensitive nutrition programs. In nations like Ethiopia, Bangladesh, and India, initiatives like female' Iron-Folate Tablet Supplementation (GIFTS) have been effectively used to lower the prevalence of anemia in teenage females. Furthermore, UNICEF collaborates with other international organizations to provide emergency nutrition interventions in areas impacted by poverty, conflict, and food insecurity (UNICEF, 2020).

2.3.9 Programs for Supplementary Nutrition in Different Nations

Forty lakh girls were in danger due to the failure to contain malnutrition that causes vitamin and mineral deficiencies, including anemia, according to the World Food Program's report on malnutrition among adolescent girls, the nutrition gap analysis done by the World Food Program, and the Government of Uganda. Premature deliveries, low birth weight, stillbirths, and maternal and infant deaths were also possible outcomes. WFP School Ration + Fresh Foods + Supplements were the solutions. One of the best ways to connect with adolescent girls is through school, Girls in Uganda must continue attending school and be fed a healthy diet. Uganda must adopt a lifetime approach to combat hunger, paying particular attention to children under two, adolescent girls, expectant mothers, and new mothers (WFP, 2018).

2.4 Country-Specific Perspectives: Adolescent Nutrition in India

2.4.1 Nutritional Status of Indian Adolescents

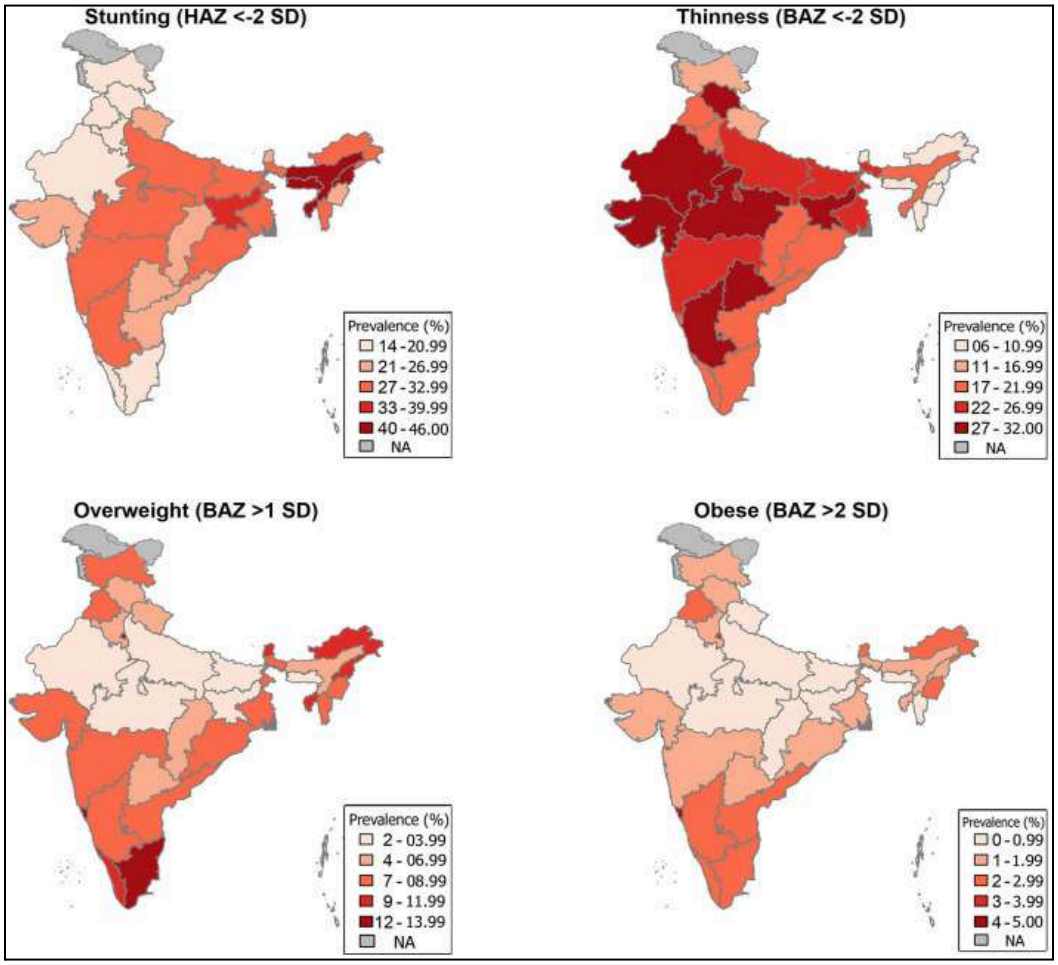
Significant nutritional issues, particularly stunting, underweight, and anemia, affect adolescent girls in India. Although there is a lack of comprehensive national data on

stunting and underweight, particularly among adolescent females, the available numbers show alarming trends: The frequency of underweight among adolescent females (ages 15 to 19) has slightly increased globally, from 5.5% in 2000 to 5.7% in 2016. In India, 9.7% of women between the ages of 20 and 49 were underweight. The prevalence of anemia among women of reproductive age (15–49 years) increased from 31.6% in 2000 to 32.8% in 2016, indicating that it is still a widespread problem. Anemia affects a large percentage of people in India; 53% of women between the ages of 15 and 49 suffer from anemia. Improving the growth and well-being of Indian adolescent females requires addressing these dietary issues (Global Nutrition Report, 2018).

National Family Health Survey (NFHS-5), which was carried out in 2019–21. It focuses on anemia, underweight, stunting, wasting, and Body Mass Index (BMI). Although the survey's primary focus is on children under five years old nutritional condition, it also reveals troubling patterns in adolescent nutrition, particularly about anemia. According to the results, the prevalence of anemia in adolescents has significantly increased since the last NFHS-4 survey (2015–16). The frequency of anemia among adolescent girls between the ages of 15 and 19 increased from 54.1% in NFHS-4 to 59.1% in NFHS-5. To address iron and micronutrient deficits in Indian adolescents, these findings underscore the urgent need for focused nutritional interventions. 41.9% of adolescent girls between the ages of 15 and 19 were underweight. The NFHS-5 data highlights the necessity of strengthened national initiatives aimed at improving the nutrition of adolescents. Adolescent malnutrition can be effectively addressed with interventions such as nutritional variety, enhanced school lunch programs, and iron and folic acid supplements. Furthermore, to guarantee that advancements in child nutrition result in improved health outcomes for adolescents and adults, ongoing monitoring and region-specific approaches are required. The complete NFHS-5 report is available on the Ministry of Health and Family Welfare's official website for a more thorough examination and state-by-state data. (NFHS-5, 2019)
A study that examined malnutrition in 35,831 Indian adolescents (10–19 years old) used data from the Comprehensive National Nutrition Survey (CNNS) and found that 27.4% of adolescents were stunted, meaning they had a height-for-age z-score below -2 standard deviations, while 24.4% were classified as thin, having low body mass relative to their

height. Furthermore, 8.6% of adolescents experienced both stunting and thinness simultaneously, while 0.8% had coexisting stunting and being overweight, indicating complex nutritional challenges. According to the study, 24.4% of adolescents were categorized as thin, meaning they had low body mass with their height, and 27.4% were stunted, indicating their height-for-age z-score was less than -2 standard deviations. Additionally, 8.6% of adolescents had both stunting and thinness at the same time, and 0.8% had both stunting and overweight at the same time, suggesting that there were complicated dietary issues. Stunting prevalence varied greatly by geography, with the North-Eastern states exhibiting rates that were much higher than the 27.4% national average. In particular, the highest prevalence was found in Meghalaya (45.9%), followed by Nagaland (41.8%), Assam (41.3%), and Jharkhand in that order. Similarly, several states, notably Telangana (29.1%) and Karnataka (27.3%), had thinness rates that were higher than the national average, indicating inadequate nutritional status in these regions. The study highlighted disadvantaged groups at higher risk by identifying multiple determinants of stunting. Adolescents between the ages of 15 and 19 were 23% more likely to be stunted than those between the ages of 10 and 14. In addition, females were more vulnerable than males. Adolescents from scheduled castes and scheduled tribes were more at risk than those from other social categories, indicating the importance of socioeconomic variables. Additionally, there was a clear association between economic position and malnutrition, with adolescents from families with the lowest wealth index having 2.54 times the odds of being stunted. Another risk factor was illiteracy; adolescents who never went to school were 33 percent more likely to suffer from stunting. Likewise, several sociodemographic characteristics were linked to thinness. The probabilities of being thin were 66% higher for adolescents from the lowest wealth index families and 26% higher for adolescents from other backward classes (OBC). Additionally, adolescents from western India were more likely to be thin. Nonetheless, other groups were less likely to be thin, such as older adolescents (15–19 years), who were 32% less likely to be thin than those between the ages of 10 and 14, and females, who were 43% less likely to be thin than males. Additionally, compared to their northern Indian counterparts, adolescents from eastern India and northeastern India had a decreased likelihood of being thin (Pandurangi et al., 2022).

Figure 2.6 Prevalence of obesity, overweight, thinness, and stunting in Indian children aged 10 to 19 in each state



(source: Front Public Health. 2022 Jun 15;10:877073. Doi: 10.3389/fpubh.2022.877073)

According to a study on 420 adolescents, which included 91 urban and 65 rural females (37% total), the prevalence of malnutrition among adolescents was 46% overall, with 18% of them being underweight. 13 percent of underweight adolescents were thin, and five percent were extremely thin. Undernutrition was much more common in rural areas (27.6%) than in urban areas (8.6%), most likely as a result of things like gender prejudice, physically demanding lifestyles, and ignorance of calorie needs. These differences were further supported by the fact that the mean BMI of urban adolescents (22.13 ± 2.65) was substantially higher than that of rural participants (19.81 ± 2.55). Interestingly, underweight rates were higher among rural girls (44.6%) than males (20%), suggesting a possible dietary disparity based on gender. Early detection and opportunistic screening are essential because a lot of adolescents are not aware of the risk factors and long-term health effects of malnutrition. To effectively address both undernutrition and overnutrition in this susceptible age group, it is therefore imperative that current national programs about adolescent health and nutrition be strengthened and expanded (Anand A. et al., 2023).

A study of 583 adolescent girls in rural Maharashtra revealed high rates of underweight (36.54%), stunting (48.37%), and thinness (18.87%). The average height was 145.03±9.90 cm, weight 37.58±8.33 kg, and BMI 17.66±2.42 kg/m². Factors associated with underweight included late adolescents (40.00%), Hindus (38.32%), girls from nuclear homes (39.81%), illiterate girls (50.00%), and married women (64.29%), with marital status being statistically significant. Stunting affected 48.37% of participants, especially early adolescents (57.60%) and primary school girls (59.52%), showing a significant correlation. Gender and socioeconomic factors also influenced stunting prevalence. Thinness prevalence was 18.87%, highest in early teens (19.93%), girls with primary education (20.24%), and unmarried girls (19.16%). A significant correlation was found between thinness and socioeconomic class I (33.33%), Buddhist females (27.27%), and girls from nuclear homes (22.88%). These findings indicate a high malnutrition burden among rural adolescent girls, particularly through stunting and underweight, highlighting the need for effective nutritional interventions, awareness programs, and policy measures to enhance health in this vulnerable group (Nair A. et al., 2015).

A cross-sectional study with multistage random sampling was used in a study on the use of supplemental nutrition services at Anganwadi Centers (AWCs) in a block in Ganjam District, Odisha. 24 AWCs were picked from a total of 239 blocks in Ganjam, while Chatrapur was chosen by lottery out of the 22 blocks. 12 recipients were chosen at random from each AWC out of 240 who qualified for supplemental nutrition. The results showed that 188 out of 240 recipients, or 78.3%, consumed the additional food that was given. However, only 70.8% (34 out of 48) of adolescent girls used the service, which was the lowest consumption rate. Dislike of the food's flavor was the main excuse given for not eating it (53.8%). Furthermore, every Take-Home Ration (THR) beneficiary shared the additional food they had with family members, suggesting that food may be distributed inside the household. These results emphasize the necessity of making supplemental nutrition more palatable and acceptable to increase adherence, especially among adolescents, and to ensure that the program's entire nutritional advantages were received by those who were supposed to benefit (Smaranita S. et al., 2021).

Table 2.2 National Prevalence of Thinness among Adolescent Girls

Name of the Author	Year	Age Group	Place	Thinness	Stunting
Nagaraj Patil et al	2018	10-19	North Karnataka	15.6 mild	-
Naveen Kumar Boiroju et al	2018	12-18	Bundelkhand	20.9%	-
Psaravan kumar Muthusundari et al	2017	10–19	Tamil Nadu	60%	-
Gurram Sudha rani et al	2017	11-19	Hyderabad, Telangana	38%	-
Dekh C et al	2016	10-19	Assam	20%	29%

2.4.2 Limitations of Take-Home Ration Implementation

Significant gaps in service delivery and community participation were identified by a mixed-methods descriptive case study assessing the Integrated Child Development Services (ICDS) program's implementation in a Delhi urban slum. In addition to secondary data from Anganwadi Center (AWC) records, data were gathered through interviews with program personnel, health professionals, and community leaders using a modified ICDS monitoring instrument. The results showed that the overall mean coverage of ICDS services was 58.3%, with nutrition and health education (NHE) having the lowest coverage and supplementary nutrition (SN) having the highest. When it came to particular services, nutrition health education was most used by infants between the ages of 0 and 6 months (85.7%), but it was not very popular with women of reproductive age (14.19%). Although 86.9% of adolescents used adolescent health services, important programs like Nutrition, Health, and Education Days (NHED) were never held. Despite the regular implementation of SN, vaccination, preschool education (PSE), and growth monitoring for children ages 0–3, mother and child health services were determined to be inadequate. Furthermore, except for SN, the community had a negative opinion of AWC and ICDS services. The study found that insufficient coverage, poor infrastructure, and little community involvement hampered ICDS services in the slums. The need for better intersectoral coordination was further highlighted by inadequate referral networks and dysfunctional immunization systems. According to the study, customized monitoring technologies might be used to evaluate service deficiencies and enable focused enhancements in the implementation of ICDS (Meena J. et al., 2017).

2.4.3 Actual Consumption Patterns of Take-Home Ration

A cross-sectional observational study measuring the acceptance of Supplementary Nutrition (SN) services at Anganwadi Centres (AWCs) in a rural block of Bareilly district identified critical issues in the implementation of the ICDS system. 22 AWCs were selected from 156 total, and the study was carried out in the Bhojipura block, which was picked at random from 15 blocks. Interviews were conducted with 506 beneficiaries, 66 of whom were adolescent girls (AGs). The results showed that although AWW records indicated that 78.8% (52 out of 66) of AGs were using SN services, beneficiary

self-reported data showed a considerable discrepancy. Merely 24.2% (16 out of 66) reported using SN services, and only 15 (93.7%) of those reported eating the food, meaning that the actual consumption rate was only 22.8%. The taste of the supplementary food was the main reason given for not consuming it; all 14 AGs (100%) who did not eat SN cited this as their main deterrent. The study offers important insights into the gaps in service delivery and beneficiary acceptance of SN under the ICDS program, though being restricted to specific ICDS project locations. Notwithstanding the program's goal of combating malnutrition and enhancing adolescent nutrition, low rates of use and consumption show that a more comprehensive strategy is required to maximize its effectiveness. The results highlight the need to update policies about women's and children's development to more accurately adapt SN services to the dietary requirements and preferences of recipients. Important actions to increase the efficacy of the ICDS program include strengthening service delivery systems, raising the standard and acceptance of supplementary nutrition, and launching focused awareness campaigns. To guarantee that the program fulfills its potential and meets the requirements of the most vulnerable and impoverished groups, quick and calculated action is required (Khan et al., 2016).

The provision and use of Supplementary Nutrition (SN) among adolescent girls (AGs) in both rural and urban settings were evaluated in an assessment study of the Integrated Child Development Services (ICDS) program in Rajasthan, India. A total of 54 Anganwadi Centers (AWCs) were assessed for the study, with 15 located in urban areas and 39 in rural areas. To collect thorough information, Anganwadi Workers (AWWs) were interviewed and official documents were examined. To guarantee the accuracy of the data gathered, the study used a questionnaire that had been previously created and tested. Results showed that urban and rural areas had different SN coverage. Only 600 out of 901 (66.5%) of the registered AGs in rural areas were actively receiving SN, compared to 264 out of 289 (91.3%) in urban areas. In total, 864 out of 1,190 (72.6%) registered AGs in both urban and rural areas were getting SN under the ICDS program. The study emphasizes how SN services were more easily accessible and used in urban areas than in rural ones. This could be because of things like improved infrastructure,

increased awareness, and easier distribution. The study emphasizes the necessity of focused interventions to enhance SN service adoption in rural areas, even if the ICDS program has been crucial in addressing adolescent nutrition. To guarantee fair access to nutrition services, it is essential to address barriers like inefficient supply chains, ignorance, and issues with food acceptability. The overall impact of the ICDS program in Rajasthan can be increased by fortifying monitoring systems, enhancing outreach initiatives, and customizing SN to accommodate beneficiaries' dietary requirements and preferences (Singh M. et al.,2015).

An assessment of adolescent girls' knowledge, use, and perceptions of the Take-Home Ration (THR) program was carried out by the Maharashtra government. 81% of the females were aware of the THR program, according to the survey, but a noteworthy 72% were unaware of its true advantages. Just 1% thought THR was good because it tasted good, and only 27% thought it was nourishing and essential for growth. Every female who responded to the survey said she consumed THR for a variety of reasons. 49% were urged to do so by their families, who thought it was necessary for healthy growth and development, and 42% drank it on the recommendation of Anganwadi staff. The majority of THR consumption occurs at home, while delivery occurs once a month in Anganwadi Centers. According to the study, 67% of the females had only been using THR for six months, compared to 3% who had been taking it for a year, 17% for two to three years, and 13% for more than four years. Shira, Upma, Milk, Khichdi, Sevai, Bal-Aahar, Harabara, Laapsi, Ugal, Vatane, Sukdi, Moongdal, Masurdal, Soyabean, and Chavali were among the many food products included in the THR packets. The majority of the females were happy with the quantity, and 81% of them reported receiving three packets weighing one kilogram each. Though they all agreed that THR increased their weight, improved their health, and gave them more energy for everyday tasks, only 1% thought the food tasted good. With an average age of 16, 942 girls between the ages of 15 and 18 took part in the poll. Of them, 84% were aware of the THR program; however, 16% did not fully comprehend how THR improved their nutrition and health and only knew about it because of their mothers or younger siblings. In terms of THR's perceived advantages, 27% acknowledged its nutritional worth and its function in fostering weight gain, growth,

and general health, whereas 72% acknowledged their ignorance. The fact that 66% of the girls in this group were not using THR at the time of the study was a significant finding, suggesting a lack of accessibility, knowledge, or interest in the program (Maharashtra THR report, 2019).

To evaluate 400 adolescents' access to and use of Anganwadi Center (AWC) services, a study on the usage of the Integrated Child Development Services (ICDS) program by adolescent females in urban Rishikesh, India, was carried out. With only 3.75% of adolescent girls using the Supplementary Nutrition Program (SNP), 3.25% taking Iron and Folic Acid (IFA) supplements, and only 0.25% attending Nutrition and Health Education (NHE) classes, the results showed incredibly low usage rates. The study found that adolescent girls' awareness, knowledge, attitudes, and practices about anemia were significantly lacking, which led to a low uptake of ICDS services. Several barriers to the effective implementation of ICDS were found. Anganwadi Workers (AWWs) have to deal with issues like inconsistent IFA tablet supplies, poor infrastructure, a lack of training, inefficient monitoring and reporting systems, and no oversight from higher-ups. The program's outreach was further diminished by the restricted space in AWCs, which made it difficult to hold health education training sessions. The study underlined the necessity of a focused strategy to enhance service delivery, especially for adolescent girls who were not enrolled in school and who depend entirely on AWCs for nutrition and health care (Khapre et al., 2019).

A study was conducted among adolescent girls (ages 17-19) in Sambalpur, Odisha, revealing trends in fast food consumption and nutritional knowledge. Despite understanding the detrimental effects of fast food on health, most respondents consume it regularly due to its taste, affordability, and convenience. This preference for fast food is driven by factors like long academic hours, limited lunch breaks, and the influence of Western food culture. Anthropometric measurements indicated that a significant portion of the surveyed girls were either underweight or overweight, with only a minority falling within the normal weight range. This underscores the impact of dietary choices on body weight and overall health. Additionally, the study finds a lack of awareness among

adolescents regarding nutrition, balanced diets, and the health implications of fast-food consumption. Despite initiatives to enhance knowledge through counseling sessions, a substantial number of respondents still lack an understanding of nutritional requirements and the significance of healthy eating habits. The study emphasizes the need for comprehensive nutrition education programs aimed at adolescents to address misconceptions and promote healthier dietary practices. In conclusion, the widespread fast-food consumption among college girls in Sambalpur poses serious risks to their health and well-being. Efforts to raise awareness about the importance of nutrition, balanced diets, and the adverse effects of fast food were crucial in reducing these risks and encouraging healthier eating habits among adolescents. Moreover, interventions should empower young individuals to make informed decisions about their dietary habits to effectively support their growth and development (Bil and Samantaray, 2022).

2.4.4 Interventions by the GOI and THR Initiatives

One of India's oldest and most extensive programs for maternal health, adolescent nutrition, and early childhood care is the Integrated Child Development Services (ICDS) Scheme. In rural, urban, and tribal communities, ICDS has played a significant role in combating malnutrition, enhancing health outcomes, and fostering early childhood development since its launch on October 2, 1975, which coincided with Mahatma Gandhi's 106th birthday. To guarantee that vulnerable groups receive critical health, nutrition, and educational services, the program focuses on children under the age of six, pregnant and breastfeeding mothers, and adolescent girls. Supplementary nutrition, vaccinations, health examinations, referral services, non-formal preschool education, and nutrition and health education are all included in the program's well-rounded package of services. The Supplementary Nutrition Program (SNP), one of the main pillars of ICDS, provides vulnerable individuals with Take-Home Ration (THR) and hot-cooked meals to prevent malnutrition and micronutrient deficiencies. Adolescent females (ages 11–18, particularly those who are not enrolled in school), pregnant and nursing mothers, and children ages 6 months–6 years are the program's specific beneficiaries. While smaller children under three, adolescent girls, and pregnant and nursing women receive THR packets for 300 days a year, children aged three to six receive hot prepared meals at

AWCs for 25 days a month. For children aged 7 months to 3 years, the THR contains specialized fortified foods like Balbhog, an energy-dense micronutrient-fortified extruded blended food. Adolescent girls, pregnant women, and lactating women receive Sukhdi (1 kg/month), Sheera (3 packets of 500g each), and Upma (2 packets of 500g each). With 703.74 lakh children under six, 171.86 lakh pregnant and breastfeeding women, and 14-15 lakh out-of-school adolescent girls (ages 11-14) as of July 2019, ICDS has a huge reach and impact. As a result, ICDS is among the largest state-led food distribution programs in the world that aim to combat malnutrition. The ICDS program is essential to ending the cycle of malnutrition and enhancing general public health in India since it combines nutritional supplementation with healthcare, education, and vaccination. To guarantee that nutritional support reaches the most vulnerable segments of society, especially in underserved and backward areas, the program keeps improving its service delivery systems (Maharashtra THR report, 2019).

Under the guidance of the State Women and Child Development (WCD) Department, Gujarat Chief Minister Mr. Vijay Rupani started the PURNA (Prevention of Under Nutrition & Reduction of Nutritional Anemia) program on April 3, 2018. Recognizing the urgent need for nutritional interventions in this susceptible age group, this project attempts to prevent anemia and malnutrition among adolescent females. The program, which has a budget of Rs. 270 crores, aims to help almost 60 lakh adolescents in Gujarat utilizing a network of 53,000 Anganwadi Centers (AWCs). To ensure that nutrition support reaches those most at risk of undernutrition and anemia, the target population consists of both school-going and non-school-going adolescent girls aged 15 to 18. To enhance the general health and well-being of adolescent girls, the PURNA program offers Take-Home Ration (THR) through Anganwadi services, emphasizing nutritional diversity, nutrition education, and iron and folic acid supplements. On the fourth Tuesday of each month, four packets of Purna Shakti are sent to each AG. 645 kcal, 18g fat, 101g carbs, 19.5g protein, and other minerals and vitamins are included in each 1 kg packet. (per 145 grams) Wheat flour, soy flour, maize flour, rice flour, gram flour, sugar, and oil are the ingredients of the Purna Shakti premix. All of the premixes are energy-dense, dry, and enhanced with vital micronutrients. The state government's dedication to combating adolescent malnutrition via a planned and community-driven strategy is demonstrated by

this extensive program (NITI Aayog THR report, 2021).

The Indian government acknowledges that mortality, morbidity, population growth, and general health indices are significantly influenced by adolescent health. On January 7, 2014, the Ministry of Health and Family Welfare (MoHFW) introduced the Rashtriya Kishor Swasthya Karyakram (RKSK) in an attempt to support the holistic development of adolescents. Targeting 253 million adolescents nationwide—male and female, rural and urban, married and single, in-school and out-of-school—this program focuses on underprivileged and underrepresented populations. By addressing nutrition, injury, and violence prevention (including gender-based violence), non-communicable illnesses, mental health, and substance abuse, the RKSK program expands the scope of adolescent health services beyond sexual and reproductive health. RKSK's approach to health promotion, which moves the emphasis from clinic-based treatments to preventative measures, is one of its main advantages. By actively involving teenagers in their settings—schools, families, and communities—the program creates an environment that is conducive to their wellbeing. The main interventions of RKSK include facility-based counseling, social and behavior change communication techniques, counselor outreach in the community, and the improvement of Adolescent Friendly Health Clinics (AFHCs) at different healthcare levels. To foster a more supportive environment for adolescent health, RKSK also engages parents and the community, acknowledging that adolescents frequently lack autonomy in decision-making. To address the special health requirements of teenagers, the program is designed to restructure the public health system and provide them with a full range of preventative, promotive, curative, and counseling services. Furthermore, RKSK offers routine primary, secondary, and tertiary healthcare check-ups, ensuring that all adolescents, irrespective of gender or marital status, can access services. RKSK seeks to equip adolescents with the information, tools, and assistance required for their general development and well-being through its inclusive and integrated approach (Ministry of Health and Family Welfare, 2014).

In 2018, the Prime Minister's overall Scheme for Holistic Nutrition, or POSHAN

Abhiyaan, was introduced by the Indian government to support ICDS. This flagship initiative has a strong emphasis on using technology-driven monitoring, behavioral change communication, and inter-ministerial collaboration to improve nutritional outcomes in a targeted manner. Through digital tracking tools, the distribution of THR has been enhanced under POSHAN Abhiyaan, guaranteeing transparency and effective delivery to beneficiaries. Through Village Health and Nutrition Days (VHNDs) and the use of technology, like POSHAN Tracker, to track service delivery and nutrition status, the program also encourages community involvement and awareness. By improving the availability and quality of supplemental nutrition, especially through THR distribution, the joint activities of ICDS and POSHAN Abhiyaan significantly contribute to tackling India's high rate of malnutrition (Ministry of Women and Child Development, 2023).

Through the Mid-Day Meal (MDM) program, the Gajapati Rice Fortification Project was started to fight anemia among Odisha school children. To enhance children's nutrition, the Odisha government and the World Food Programme (WFP) worked together to fortify rice with iron.

Among the initiative's salient features were: utilizing MDM to reach 99,231 students across 1,449 schools. Good Results Hemoglobin levels improved, school meal intake rose, and the prevalence of anemia decreased by 20%. The Gajapati model demonstrated that fortification may dramatically lower anemia when incorporated into government welfare programs and was found to be cost-effective, scalable, and sustainable. Expanding this program could improve India's public health (World Food Program, 2017).

Using data gathered from 3,199 respondents, a study on the Mid-Day Meal (MDM) program in India looked at how it affected physical development from childhood to adolescence. Boys and girls made up an equal portion of the sample, while the majority of participants were from Hindu homes (85%) and lived in rural areas (81–85%). Among children who received early MDM support, the prevalence of underweight decreased by about 4%. The results show that although the MDM program was successful in lowering underweight rates, it had less of an impact on children from low-income families. The

study supports the wider advantages of school meals on school enrollment, attendance, and nutrition and highlights the necessity of ongoing program growth, especially for children from low-income families. According to the study's findings, the MDM program successfully decreased the prevalence of underweight among its participants (Gharge S. et al., 2024).

The literature from India highlights how important diet is for adolescent cognitive development. Iron, iodine, vitamins, and other essential nutrients are necessary for the brain to function at its best. Studies like the Indian Council of Medical Research's (ICMR) School Children Mental Health Study (ICMR, 2017) have shown how malnutrition affects cognitive and academic performance. Government programs like the Mid-Day Meal Scheme help to improve the nutritional status of adolescents enrolled in school by giving them free meals. To guarantee the success of these initiatives, however, issues like irregular participation and dropout rates must be resolved (Ministry of Human Resource Development, Government of India, 2020)

2.4.5 Effectiveness of Take-Home Ration Among Adolescent Girls in Rural India

Adolescent girls' nutrition has improved due to the Take-Home Ration (THR) program run by ICDS and POSHAN Abhiyaan, especially in rural regions (NIN, 2022). THR helps lower underweight, stunting, and anemia by providing fortified food that is high in iron, folic acid, and protein. Frequent ingestion has raised hemoglobin levels and enhanced nutritional diversity. There are still issues, though, such as uneven availability, sharing with family members, and low consumption because of taste preferences. NIN (2022) suggests enhancing and diversifying THR, raising awareness through community engagement, and strengthening monitoring measures to guarantee effective distribution and consumption to maximize impact.

According to the 2016–18 Comprehensive National Nutrition Survey (CNNS), almost one in three Indian adolescents suffers from undernutrition (Ministry of Health and Family Welfare, Government of India, 2019). Undernutrition limits this population's potential by causing stunted growth and delayed development. Government programs

like the National Nutrition Mission (Poshan Abhiyan) demonstrate India's dedication to combating malnutrition. To prevent adolescent malnutrition, this initiative integrates health, education, and community engagement through a multi-sectoral strategy (Ministry of Development of Women and Children, Government of India, 2017).

A comprehensive framework, the National Nutrition Strategy (NNS) aims to prevent malnutrition at all stages of life, with a focus on adolescents and other vulnerable groups. The approach places a strong emphasis on enhancing dietary diversity, micronutrient intake, and general nutritional health because it acknowledges the crucial role that adolescence plays in ending the intergenerational cycle of malnutrition. Due to their fast physical growth, higher energy needs, and socioeconomic variables that affect their food choices, adolescents have particular nutritional issues. The significance of community-based approaches, taking into account local sociocultural aspects in nutrition interventions, is emphasized by the National Nutrition Strategy (NNS) (NITI Aayog, 2017). The effort helps to change cultural views around nutrition for adolescent girls by emphasizing the value of the girl child and guaranteeing access to education (Ministry of Women and Child Development, Government of India, 2014).

To achieve long-lasting results for adolescents, the programming framework highlights the significance of integrating nutrition-specific and nutrition-sensitive interventions (UNICEF, 2018). The life-cycle approach is the main focus of the National Nutrition Strategy (NNS), which acknowledges adolescence as a crucial window of opportunity for interventions. The NITI Aayog-created National Nutrition Strategy of India (2017) offers a path to "Kuposhan Mukt Bharat" (Malnutrition-Free India). It is in line with the National Nutrition Mission's (POSHAN Abhiyaan) overarching objectives, which include lowering low birth weight, anemia, and undernutrition. By taking a life-cycle approach, the strategy makes sure that maternal and child health is given equal weight to adolescent nutrition. It emphasizes how crucial Mid-Day Meal (MDM) programs and Integrated Child Development Services (ICDS) are to enhancing the nutritional outcomes of adolescents. The strategy also suggests deworming programs, boosting iron and folic acid supplementation (IFA), bolstering school-based nutrition programs, and raising

awareness of healthy eating habits. To address the various nutritional difficulties that adolescents encounter, it highlights the necessity of community-based methods, nutritional education, and cross-sector collaboration (NITI Aayog, 2017).

2.5 Nutritional Challenges among Adolescents- Gujarat

2.5.1 Nutritional Deficiencies among Adolescent girls

To evaluate and enhance the nutritional condition of Gujarat adolescent girls, a mixed-method study was carried out with an emphasis on the prevalence of undernutrition, overweight, and anemia. In addition to a primary evaluation of anthropometric measurements of height and weight, the study included a secondary data analysis comparing results from the Comprehensive National Nutrition Survey (CNNS) and the National Family Health Survey-5 (NFHS-5). The NFHS-5 data showed alarming trends in malnutrition among Gujarat adolescent girls aged 15 to 19. This group's overall thinness (underweight) prevalence was 52.5%, which was 3% higher than NFHS-4. Adolescent female anemia also increased to 69%, a noteworthy 12.5% increase over the previous survey. Disparities according to socioeconomic and regional characteristics were also revealed by the study. Undernutrition was more widespread in tribal areas, and urban adolescent girls were more likely than their rural counterparts to be overweight or obese. The CNNS report's findings supported increasing worries over adolescent malnutrition. At the national level, 5% of adolescent girls aged 10 to 19 were overweight or obese, and 24% were thin. Particularly in Gujarat, 8% of adolescent girls were obese or overweight. The study's basic data also showed that, in Gujarat, the overall thinness rate was 50% while the prevalence of overweight among adolescent girls was 8.9%. The study emphasized that adolescent malnutrition is still a significant public health concern in Gujarat and throughout India. Even though adolescents make up a sizable section of the population, they were often overlooked in national nutrition programs, which typically concentrate more emphasis on young children and pregnant and breastfeeding mothers. The structural and functional hurdles in implementing adolescent-focused nutrition programs have further worsened the issue, with constraints such as inadequate resources and shortages in staff skills affecting program efficacy (Parmar et al., 2022).

A study into the nutritional status of adolescents in rural Gujarat—more especially, in the Talod block of the Sabarkantha district—was carried out. The study focused on adolescents who participated in the 16 Adolescent Health Days (AHD) that the health department hosted. Both school-going (SG) and non-school-going (NSG) adolescents were included in the cross-sectional study design. Body Mass Index (BMI) screening and hemoglobin measurement were the main techniques used for nutritional evaluation to determine the participants' prevalence of anemia and undernutrition. The majority of the 821 adolescents who took part in the survey (84%) were enrolled in school, while 16% were not. In the NSG group, girls attended the AHDs at a higher rate (85%) than boys (14%). The results of the investigation showed alarming patterns in adolescent malnutrition. 17% of adolescents were classed as severely thin, while 30.8% were classified as thin overall. In terms of gender, 27.4% of females were thin. Girls made up 18.9% of those who were considered to be extremely thin. According to the report, adolescents in rural Gujarat confront severe nutritional difficulties, underscoring the urgent need for focused nutrition initiatives to fight undernutrition. To improve the efficacy of current programs, it also emphasizes the need for additional study and thorough documentation of adolescents' nutritional status. The study emphasizes the significance of enhancing adolescent nutrition through school- and community-based health efforts, given the high prevalence of thinness and the comparatively low incidence of overweight or obesity (Trivedi et al., 2016).

Table 2.3 Nutritional Status of Adolescents

Adolescent females	NFHS-5 (2019-2020)	CNNS (2016-2018)	Primary survey (2021)
Moderately/severely thin (BMI: ≤17.0)	27.40%	10.50%	22.16%
Thin (BMI: >17.0-<18.5)	25.10%	30.20%	28.23%
Mild anemia (11-11.9 g/dL)	25.90%	17.80%	NA
Moderate anemia (8-10.9 g/dL)	39.40%	12.90%	NA
Severe anemia (<8 g/dL)	3.70%	2.70%	NA

Measures were derived for aged 15-19 years based on NFHS-5 unit-level data. CNNS refers to the age-group 10-19 years; primary survey refers to aged 11-19 years

2.5.2 Knowledge and Attitudes Regarding Take-Home Ration

A cross-sectional study was conducted to evaluate the utilization, satisfaction levels, and challenges faced by beneficiaries regarding the Take Home Ration (THR) program in urban Anganwadis of Ahmedabad, Gujarat. 40 Anganwadi centers located in the urban field practice region participated in the study. 200 beneficiaries were also purposefully chosen from five groups: 40 children aged 6 months to 3 years, 40 children aged up to 6 years, 40 adolescent girls, 40 pregnant mothers, and 40 lactating women. The results showed that beneficiaries' ignorance of the THR program's advantages, their lack of experience preparing meals with THR, and their displeasure with the items' flavors were the primary barriers AWWs experienced while putting the program into practice. Convincing beneficiaries of the promised benefits and promoting consistent use provided the biggest barrier for AWWs. 98.5% of the subjects had insufficient understanding of THR contents, and the majority (66%) could only identify the products by looking at the packaging photos. Only 66% of the subjects frequently used the THR packages, even though 97.5% of them received them from Anganwadis. Just 58.3% of the 120 pregnant, nursing, and adolescent girls who were eligible to get Sattva Namak were using it. Measuring total use, only 56% of the consumers were making use of every THR product that was made available to them. Beneficiaries' satisfaction levels differed. The majority expressed satisfaction with the timely distribution (71%), frequency of distribution (70%), and packing quality (68%); nonetheless, 20% expressed displeasure with flavor. Lack of time to prepare various recipes (31%), lack of variety in THR products (30%), difficulty preparing separate food for the beneficiary (24%), ignorance of how to prepare food using THR (7%), and inadequate storage facilities (5%), were the main barriers that beneficiaries faced when using THR. 64% of beneficiaries reported no complaints about THR packages despite these worries. Beneficiaries recommended that the government enhance the variety of THR packets (30%), make the taste spicier rather than sweet (26%), introduce new flavors (6%), and supply raw food components rather than pre-mixed packets (34%). Overall, the study found that although AWWs had an acceptable level of awareness about the THR system, beneficiaries' use of it was poor. Convincing beneficiaries to comprehend the advantages of THR and utilize it regularly was the biggest challenge that AWWs had to overcome. To increase acceptability and

compliance among beneficiaries, the study strongly suggested enhancing the taste and variety of THR items (Sisodiya et al., 2022).

Adolescent girls (N=1252) from all four blocks of the Dev Bhumi Dwarka area in Western India participated in a descriptive cross-sectional study to evaluate their nutritional status, knowledge, and use of nutritional services. Data on anthropometry, food, physical activity, and sociodemographic traits were gathered, and BMI was categorized using WHO guidelines. According to the survey, 34% of adolescent girls did not attend school, 19.6% were underweight, 8.9% were overweight, and 2.6% were obese. The average height was 149.15 cm, and the average BMI was 19.77±2.42 kg/m². Only 43.2% of participants received iron and calcium tablets, 51.4% received counseling, 47.4% received take-home rations (THR), 62.9% received weight checks, and 43.3% received height and weight checks, indicating insufficient use of health and nutritional services. 77% of THR participants said they only received one or two packets (Saha et al., 2021).

Major variations in service delivery were discovered in research assessing supplementary nutrition programs under the Integrated Child Development Services (ICDS) in 60 Anganwadi Centers (AWCs) spread throughout many districts of Gujarat, including 46 urban and 14 rural centers. 86.7% of adolescents, 88.3% of expectant women, and 91.7% of nursing moms reported receiving Take-Home Ration (THR). However, there were gaps in the distribution of meals, since only 25% of AWCs were serving Hot Cooked Food (HCF) to children between the ages of three and six. Nutrition and Health Day was also observed by 66.6% of the centers, demonstrating initiatives to raise awareness and encourage participation in nutritional programming. The results point to the necessity of improved implementation techniques to increase the efficacy and reach of supplementary nutrition services provided under ICDS (Chudasama et al., 2013).

2.5.3 Barriers to Effective THR Utilization

The challenges to using the strengthened Take-Home Ration (THR) provided by the Integrated Child Development Services (ICDS) were investigated in a study carried out in

the urban health training center field practice region of Bhavnagar, Gujarat. According to Anganwadi workers, beneficiaries were throwing away the ration rather than eating it, even though Matru Shakti, Purnashakti, and Bal Shakti THR packages were regularly distributed. Even during specific nutritional awareness events like Suposhan Divas, Anna Prasan Divas, and Baltula Divas, which were conducted every Tuesday at Anganwadi centers, this was especially noticeable. The improper use of THR for livestock feed was a further major challenge. According to some recipients, THR's high protein content will increase cattle's milk production, giving them the chance to make more money. They consequently fed the food to their animals rather than eating it themselves. The low acceptance of THR was also significantly influenced by taste preferences. A lot of participants said the dish was too sugary and tasteless. According to some, they tried using the THR to cook, but the overly sugary food deterred them from routinely eating it. Others were hesitant to include it in their regular meals since they thought the taste was different from what they were used to. Selling the THR in return for buttermilk or other food products was another major problem. Despite their best attempts to guarantee prompt distribution, several Anganwadi personnel observed that beneficiaries were selling their THR packages to third parties rather than using them themselves. This practice was especially prevalent in places where individuals prioritized short-term financial gains above long-term nutritional benefits due to financial restrictions. Additionally, a barrier to utilization was the difficulty of preparation. The THR flour crumbled easily and was hard to cook correctly, according to some beneficiaries who had trouble processing it. They became frustrated as a result, which made them even less likely to use the ration regularly. Another major barrier was found to be a lack of awareness and expertise regarding the THR program. Many beneficiaries did not know how to make meals with THR and were not aware of its nutritional worth. Some people questioned the value of THR in their diet and just did not think it was helpful. This study emphasizes the urgent need for tailored initiatives to raise awareness and utilization, better THR formulations to accommodate regional taste preferences, and behavioral change communication tactics (Trivedi B. et al 2023).

Table 2.6 Departmental Studies on Nutritional Status of Adolescents

Name of the Author	Year	Age	Place	Thinness	Stunting
Gala and Gandhi	2023	15-18	Urban Vadodara	15.06% 4.83 severe	7.10%
Prajapati and Kantawala	2019	11-18	Urban Vadodara	8.79%	5.9 severe 14.98 moderate
Patel et al	2018	9-18	Rural Vadodara	32.1%	34.8%
Dhruv and Ahir	2018	13-18	Adarsh Niwas Shala	34.7% moderate 3.5% severe	36.7% moderate, 8.5% severe
Dhruv and Barman	2017	10-19	Vadodara	43.15%	74.,4%
Nambiar and Banerjee	2016	13-19	Rural Vadodara	12%	-
Dhruv and Tripathi	2014	6-16	Rural Vadodara	26.57%	24.06%

2.5.4 Assessment of Awareness, Accessibility, and Consumption of THR

Important findings regarding the nutritional status and Take-Home Ration (THR) consumption patterns were revealed by a study on the PURNA Program that evaluated the service delivery and utilization of nutrition and health components through Nutrition Health Education (NHE) among adolescent girls (15-18 years old) in Rural Vadodara. 352 adolescent girls were surveyed; of these, 15.06% were considered thin, 4.83% severely thin, and 7.10% stunted, suggesting chronic undernutrition. Even though the mandated four packets of THR Purnashakti were given to 99.15% of adolescent girls, only 73.86% of them ate it, indicating gaps in effective usage. Furthermore, only 4.55% of girls consumed THR daily, indicating that regular consumption remained low. This highlights the need for increased knowledge, better palatability, and ways to promote consistent intake for improved nutritional outcomes (Gala Z. et al.,2023).

Major concerns about the nutritional status and accessibility of government nutrition programs were found in a study on the use of Integrated Child Development Services (ICDS) by adolescent females (ages 11 to 18) living in Vadodara's urban slums. The results showed that 5.9% of adolescent females were severely stunted and 14.98% were moderately stunted, underscoring the ongoing problem of chronic undernutrition in this susceptible population. Acute malnutrition and insufficient nutritional intake were also suggested by the 8.79% of the girls who were categorized as severely thin (Prajapati et al., 2019).

The nutritional health of adolescent girls between the ages of 13 and 18 was evaluated in a cross-sectional study carried out in Vadodara's Adarsh Nivasi Shala (Aadi Jati). All of the girls enrolled in the study were evaluated for their nutritional health using both direct and indirect measures, such as anthropometric measurements, clinical signs, biophysical and biochemical indicators, socioeconomic status (SES) data, and information on dietary intake. The results showed that among the subjects, stunting and thinness were highly prevalent. Of the girls, 36.7% had moderate stunting, and 8.5% had severe stunting, which denotes growth retardation and chronic malnutrition. Furthermore, among the adolescents, 34.7% were slightly thin, 10.1% were moderately thin, and 3.5% were

severely thin, indicating widespread undernutrition and insufficient nutritional intake. These findings demonstrate how urgently focused dietary interventions are needed to enhance the growth and health of adolescent females in underprivileged settings (Ahir et al., 2018).

The literature review highlights the ongoing challenges of undernutrition, micronutrient deficiencies, and the increasing double burden of malnutrition among adolescent girls. Adolescence is a critical period for growth and development, and inadequate nutritional status during this phase can have long-term impacts on physical health, cognitive abilities, reproductive health, and future economic productivity. Findings from various studies indicate low awareness, poor utilization of Take-Home Ration (THR), limited dietary diversity, and gaps in supplementary nutrition programs.

This study is significant as it aims to assess and improve the nutritional status of adolescent girls enrolled in Anganwadi Centers (AWCs). By evaluating their dietary practices, knowledge, and attitudes towards THR consumption, the study offers valuable insights into existing barriers and gaps. Additionally, through developing and sensory evaluating nutrient-rich recipes that incorporate THR, it seeks to enhance the acceptability and utilization of supplementary nutrition.

The research contributes to policy recommendations and program improvements by identifying factors influencing THR consumption, dietary diversity, and nutritional deficiencies. The findings can serve as a foundation for strengthening adolescent nutrition interventions, ensuring better program implementation, and improving health outcomes. Ultimately, by effectively addressing adolescent malnutrition, this study aligns with national initiatives such as POSHAN Abhiyan, the PURNA program, and the Rashtriya Kishor Swasthya Karyakram (RKSK), playing a crucial role in breaking the cycle of intergenerational malnutrition and fostering healthier futures for adolescent girls.

METHODOLOGY

Adolescence is a crucial time for growth and development, and healthy eating is essential to maintaining mental, emotional, and physical health. Long-term health effects of malnutrition at this period include stunting, underweight, micronutrient deficiencies, and an elevated risk of non-communicable illnesses (Norris et al., 2022). To enhance the nutritional status of adolescent girls, the Integrated Child Development Services (ICDS) in Gujarat implemented Take-Home Ration (THR) as a part of the PURNA Program. Its efficacy is hampered by issues like poor consumption, ignorance, and a lack of dietary variety.

Large-scale health surveys like the National Family Health Survey (NFHS), which mostly focuses on children under five and pregnant/lactating women, continue to ignore adolescent nutrition. An important knowledge vacuum regarding the efficacy of dietary interventions for adolescents, specifically the Take-Home Ration (THR) program under ICDS, is left by this lack of data. The success of THR primarily rests on its acceptance, use, and dietary integration, even though it can enhance the nutritional status of adolescent girls. The coverage, consumption trends, and barriers related to THR use among adolescent girls between the ages of 15 and 18 must be evaluated immediately. Adolescent girls who receive proper nutrition have a higher chance of becoming healthy adults, which will improve their long-term health. By offering recent data on the efficacy of Supplementary Nutrition Services (SNS) and pointing out areas for program improvement, the findings will support Gujarat's adolescent nutrition initiatives, especially in rural Vadodara.

Therefore, the present study was planned with the **broad objective** of assessing the Utilization of a Take-Home ration provided to adolescent Girls (15-18 years) in rural Vadodara and developing nutrient-rich recipes for promoting healthy diets.

This chapter covers the detailed methodology used for the research.

Specific Objectives

Phase Ⅰ Situational Analysis

- ➢ To collect socio-demographic and anthropometric data of adolescent girls (aged 15-18 years) to assess their nutritional status.
- ➢ To evaluate the knowledge, attitudes, and practices (KAP) of adolescent girls regarding Take-Home Ration (THR) consumption.
- ➢ To assess dietary practices using the Food Frequency Questionnaire (FFQ) and Minimum Dietary Diversity Score (MDD-W).

Phase Ⅱ A: Development of Nutrient-Rich Recipes Using THR

- ➢ To develop nutrient-rich recipes using THR (Purna Shakti) with a focus on improving palatability, acceptability, and nutritional value.

Phase Ⅱ B: Sensory Evaluation and Dissemination

- ➢ To conduct a sensory evaluation of the developed recipes to assess acceptability among adolescent girls.
- ➢ To develop videos demonstrating acceptable and easy-to-prepare THR-based recipes.
- ➢ To share developed recipes with adolescent girls and Anganwadi workers for better program implementation.

ETHICAL APPROVAL

The ethical approval of the study design and protocol was granted from the institutional review board, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda. The ethical approval number of the study was IECHR/2024/35

STUDY AREA

The study was conducted in rural Vadodara, Gujarat. The selection process followed a random sampling approach. Initially, one rural block was randomly selected from the two rural blocks of rural Vadodara. Within this block, Anganwadi Centers (AWCs) were randomly chosen, ensuring a representative sample of adolescent girls accessing

supplementary nutrition services. Finally, adolescent girls aged 15-18 years were randomly enrolled in the study.

STUDY DESIGN

This study was a two-phase cross-sectional study aimed at assessing THR utilization in rural Vadodara.

PHASE I: SITUATIONAL ANALYSIS

Enrolment of subjects

From one block of rural Vadodara, by using tables of random numbers, 63 AWCs were selected. Four to five registered adolescent girls from each AWC between the age group of 15-18 years were enrolled in the study.

Sample size calculation for enrolled subjects

The sample size was calculated by taking the utilisation of any kind of services from the anganwadi center, which was 78% (NFHS 4, 2015-16). Taking this as p, with confidence interval of 95% and an allowable error of 5%, sample size was calculated. Adding 10% attrition rate, the sample size was estimated to be 289, which was rounded off to 300.

Using, $n= Z^2 pq/d^2$

$N= 1.96 \times 1.96*0.78*0.22/ (0.05)^2$
$= 3.84*0.1716/ 0.0025$
= **289 (rounded off to 300)**

Where, P= Prevalence rate= 78%
d= deviation= 5%
Cl= Confidence Interval= 95%

Adolescent girls who were registered at the AWCs and were willing to participate in the study. Consent and assent forms were filled for the enrolled subjects. A total of 300 adolescent girls were enrolled in the study.

Background Information

Data on the socio-economic status of subjects using a semi-structured questionnaire was collected, i.e., information regarding age, education, father's occupation, mother's education, and monthly income based on Kuppuswamy socio-economic scale was obtained.

Anthropometric measurements

To assess the prevalence of malnutrition, indices, namely BMI for age and height for age (WHO 2007 standard), were calculated.

Weight (Principle)

Weight is a key anthropometric measurement of body mass. It is a sensitive indicator of malnutrition and can be useful for estimating the status of an individual.

Procedure

Weight measurement was done for all the subjects using a calibrated digital weighing scale. It is portable and can be conveniently used in the field. The subject was asked to stand erect on the scale without touching anything, with no heavy clothing or foot wear and looking straight ahead. It was ensured that the adolescents were not wearing any heavy jewellery while taking the weight. The weight was then taken twice in order to ensure accuracy.

Height (Principle)

Height refers to the measurement of an object or person from its base to its top or from its bottom to its highest point. In the context of an individual, height specifically refers to the vertical measurement from the ground to the top of the head (National Center for Health Statistics [NCHS], 2021).

Procedure

The height measurements of all the subjects were taken using a flexible, non-stretchable fiberglass tape. The tape was fixed vertically on a smooth wall of the house, perpendicular to the ground, ensuring that the floor was smooth. The subject was asked to stand erect with the shoulders, hips, and heels touching the wall and with no footwear, heels together, and looking straight ahead. The head was held

comfortably erect, arms hanging loosely by the sides. A thin, smooth scale was held on top of the subject's head in the centre, crushing the hair at the right angles to the tape, and the height of the subject was read from the lower edge of the ruler to the nearest 0.1 cm.

Body Mass Index (BMI)

BMI or the Quetelet's index was calculated using the following formula:

BMI= Weight (Kg)/Height $(m)^2$

Nutritional Status Assessment

Weight and height were the parameters for the assessment of nutritional status. Anthropometry is widely used as it is an inexpensive and non-invasive measure to know the general nutritional status of an individual or a population. Anthropometric indices used were:

- ➔ BMI-for-Age (Thinness)
- ➔ Height-for-Age (Stunting)

Once height and weight were correctly measured and age had been recorded, nutritional status was assessed by using age and specific growth references to calculate BMI-for-age z-scores (BAZ) and Height-for-age z-scores (HAZ). WHO Anthro plus software was used for the same.

Z-scores of these indices were used to classify adolescent girls in the thinness category using WHO (2007) growth standards.

Knowledge, attitudes, and practices (KAP) of adolescent girls regarding Take-Home Ration (THR) consumption

Knowledge, attitudes, and practices (KAP) of adolescent girls regarding Take-Home Ration (THR) was obtained through semi-structured questionnaire.

Dietary Information

Food Frequency Questionnaire (FFQ)

The Food Frequency Questionnaire (FFQ) is a dietary assessment method designed to estimate an individual's habitual food intake over a specific period. It works on the principle that frequency and portion size of food consumption can reflect dietary

patterns. The method relies on self-reported data where participants indicate how often they consume specific food items, allowing researchers to assess nutrient intake, dietary diversity, and adherence to dietary recommendations.

Procedure

The Food Frequency Questionnaire (FFQ) method involved selecting a comprehensive list of food items categorized into major food groups. Respondents reported their frequency of consumption (daily, weekly, monthly, or never) through interviews. Standardized portion sizes using visual aids or household measures ensure accuracy. Data was then recorded, converted into intake values, and analyzed to assess dietary patterns.

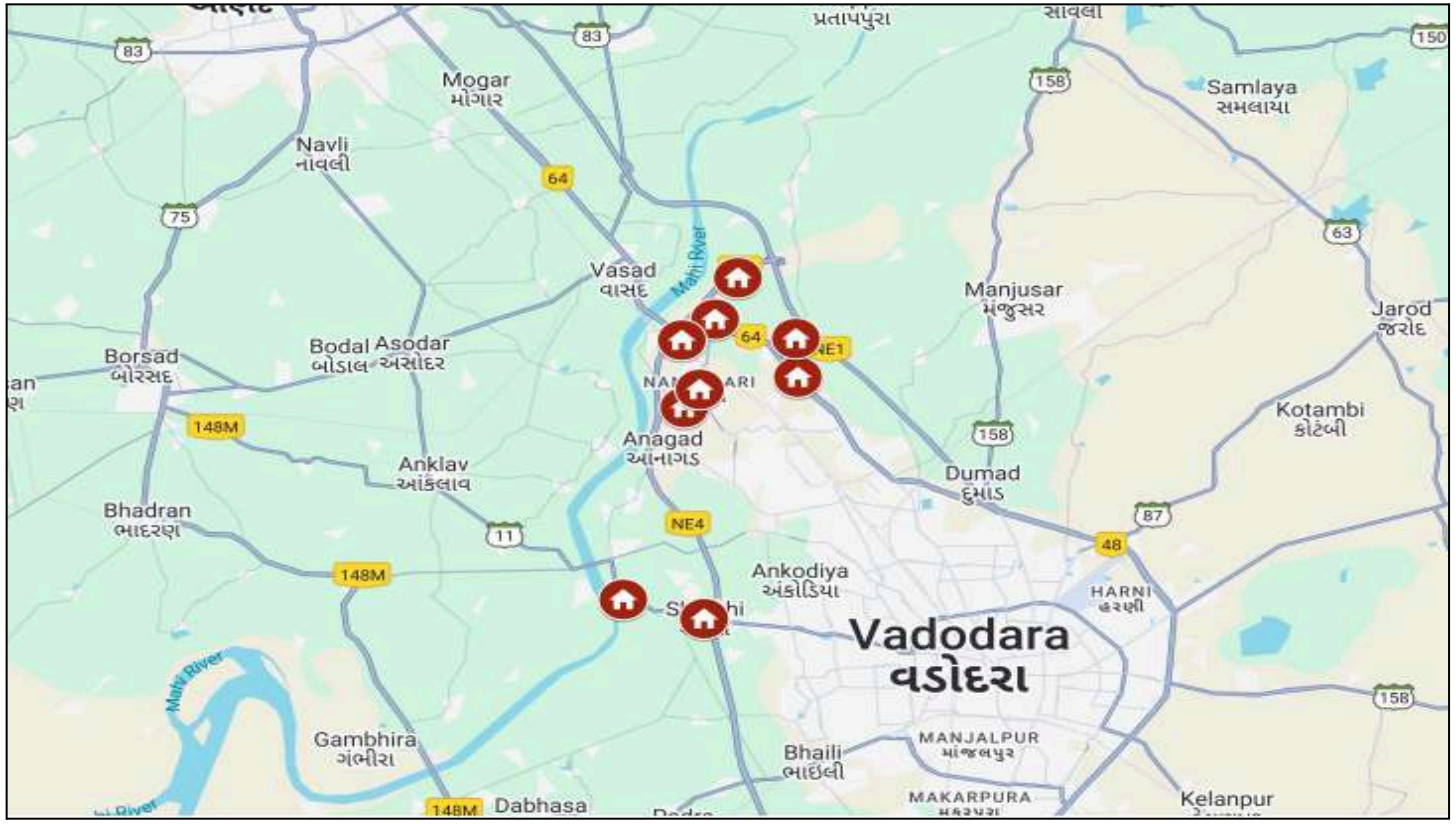
Minimum Dietary Diversity for Women of Reproductive Age (MDDW)

MDDW is a dichotomous indicator of whether or not adolescent girls 15-18 years of age have consumed at least five out of ten defined food groups the previous day or night. The proportion of adolescent girls 15-18 years of age who reach this minimum in a population can be used as a proxy indicator for higher micronutrient adequacy, an important dimension of diet quality (FAO, 2021).

Procedure

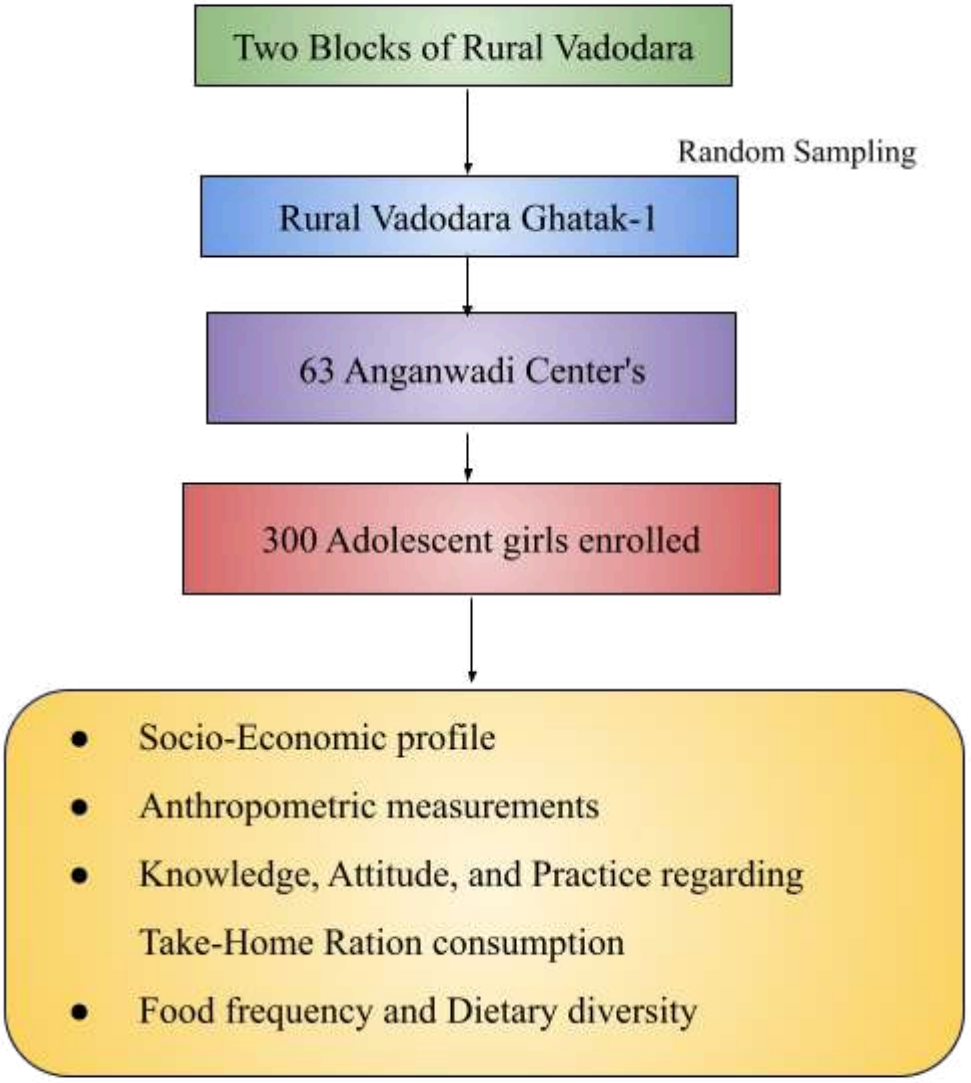
To assess Minimum Dietary Diversity for Women (MDD-W) using the 10 food groups method, respondents were asked to recall all foods and beverages consumed in the past 24 hours. Ten food groups were: Grains, white roots, tubers, plantains, Pulses (beans, peas, and lentils), Nuts and seeds, Dairy, Meat, poultry, fish, Eggs, Dark green leafy vegetables, other vitamin A-rich fruits and vegetables, other vegetables, and other fruits. The score was given if the adolescent girl had consumed the food group; then we gave a score of 1, and if they had not consumed then we gave them a 0 score for each food group. If an individual consumed food from at least 5 out of 10 groups, they met the minimum dietary diversity criteria.

Figure 3.1 Study Area Map



(source: google my maps)

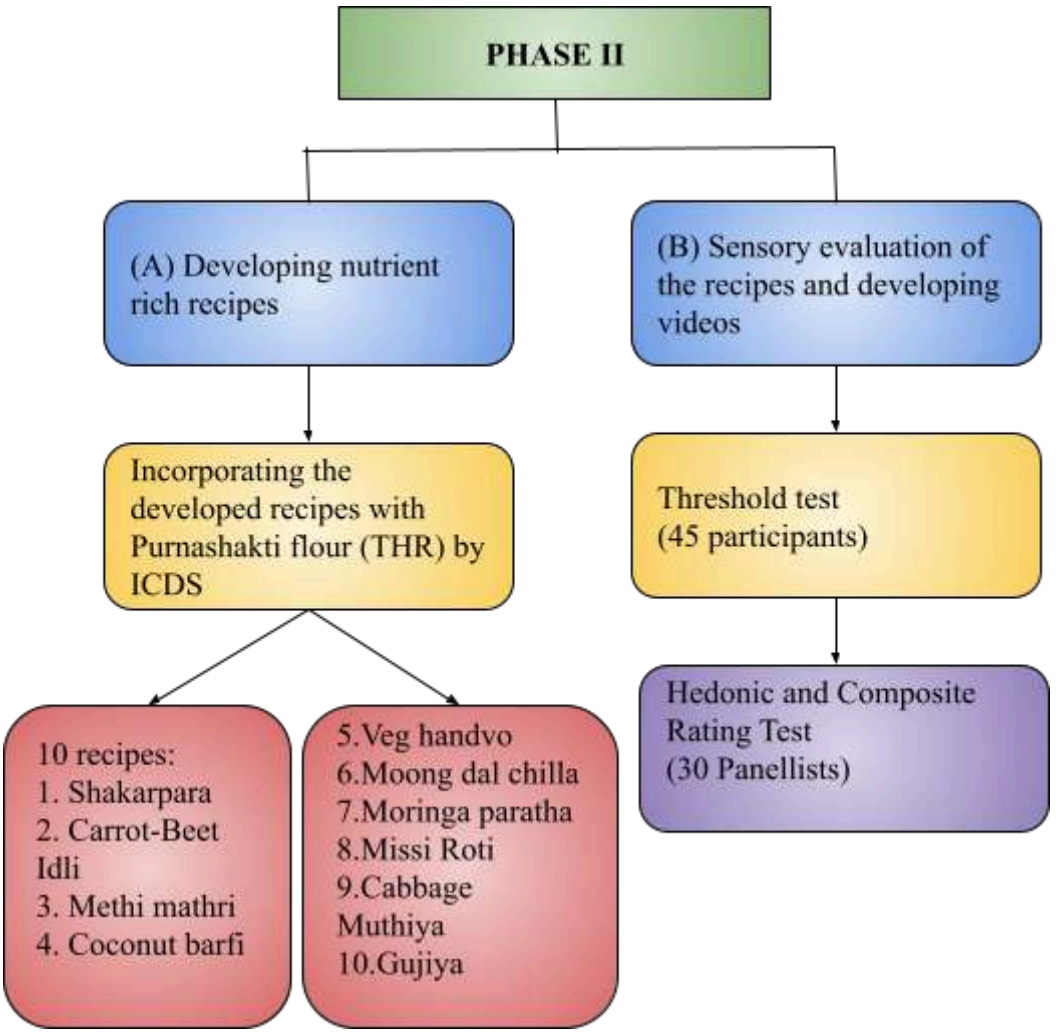
Figure 3.2 Study Design for PHASE-I



PHASE II (A): DEVELOPMENT OF RECIPES INCORPORATING THE TAKE-HOME RATION

This phase aimed to develop nutrient-rich recipes using locally available foods and Take-Home Ration (THR) provided under the ICDS program, known as Purnashakti, specifically designed for adolescent girls. Figure 3.3 shows the study design for Phase II. The recipes were carefully formulated to cater to the taste preferences, cooking habits, and dietary needs of adolescents. Since many adolescent girls did not prefer or have the time to cook daily, special longer shelf-life recipes such as Shakarpara, Methi Mathri, and Gujiya were developed. Additionally, recipes were designed to incorporate traditional flavors and easy preparation methods to encourage regular consumption of THR. A detailed description of these recipes, including their ingredients and preparation methods, is provided in the section below:

Figure 3.3 Study Design for Phase II



NUTRIENT RICH RECIPES INCORPORATING THR

1. SHAKARPARA

Ingredients

- 1 cup Take-Home Ration (THR) flour
- ¼ cup of all-purpose flour
- 1 tablespoon of powdered sugar
- 1 tablespoon of ghee
- ½ cup Oil

Preparation Method:

- ➢ In a mixing bowl, combine the THR flour, all-purpose flour, powdered sugar, and ghee.
- ➢ Gradually add water and knead into a firm yet pliable dough.
- ➢ Cover and let it rest for 10-15 minutes.
- ➢ Using a rolling pin, roll out the dough into a thin, even sheet (like a roti).
- ➢ Cut the rolled dough into small, diamond-shaped pieces using a knife or cutter.
- ➢ Heat oil in a deep pan over medium heat.
- ➢ Once the oil is hot, carefully add the cut pieces in batches.
- ➢ Fry until they turn golden brown and crispy.
- ➢ Remove with a slotted spoon and place them on absorbent paper to remove excess oil.
- ➢ Allow the Shakarpara to cool completely before storing it in an airtight container.
- ➢ It can be stored for 2-3 weeks and enjoyed as a nutritious snack.

2. CARROT-BEET IDLI

Ingredients:

- 1 cup Take-Home Ration (THR) flour
  ¾ cup rava (semolina)
- 2 tablespoons besan (gram flour)
- 1 cup grated bottle gourd (dudhi)
- ¼ tablespoons grated carrot
- 2 tablespoons finely chopped cabbage
- 2 tablespoons green peas
- ¼ cup grated beetroot
- ½ teaspoon chopped green chilies
- ½ teaspoon ginger-garlic paste
- ½ cup curd
- ½ teaspoon black salt
- ¼ teaspoon baking soda
- ½ lemon juice

Preparation Method:

- ➢ In a large mixing bowl, combine the THR flour, rava, besan, grated bottle gourd, carrot, cabbage, peas, beetroot, green chilies, and ginger-garlic paste.
- ➢ Add curd and mix well to form a thick batter. If needed, add a little water to adjust consistency.
- ➢ Let the batter rest for 15 minutes to allow the flavors to blend.
- ➢ Just before steaming, add black salt, baking soda, and lemon juice. Mix gently to aerate the batter.
- ➢ Grease the idli molds and pour the batter into each section.
- ➢ Steam for 12-15 minutes until the idlis turn soft and fluffy.
- ➢ Serve hot with chutney or sambhar for a nutritious and fiber-rich meal!

3. METHI MATHRI

Ingredients:

- ¼ cup dried methi leaves
- ½ teaspoon ajwain
- 1 cup Take-Home Ration (THR) flour
- ½ teaspoon salt
- ½ teaspoon red chili powder
- ¼ cup all-purpose flour
- 5 teaspoons oil (for binding)
- ½ cup oil (for deep frying)

Preparation Method:

- ➢ In a mixing bowl, combine the THR flour, all-purpose flour, dried methi leaves, ajwain, salt, and red chili powder.
- ➢ Add 5 teaspoons of oil and mix well until the flour becomes crumbly.
- ➢ Gradually add water and knead into a stiff dough.
- ➢ Cover and let the dough rest for 15–20 minutes.
- ➢ Divide the dough into small portions and roll them into small puris.
- ➢ Heat ½ cup of oil in a pan and deep fry the mathris on low-medium heat until golden brown and crispy.
- ➢ Drain excess oil on paper towels and allow them to cool before storing in an airtight container.

This crispy and nutritious mathri is an excellent snack enriched with THR.

4. BESAN BARFI

Ingredients:

- 2 tablespoons ghee
- ½ cup besan (gram flour)
- 1 cup Take-Home Ration (THR) flour
- ¼ cup sugar
- ½ cup grated coconut
- ¼ cup peanut powder
- 2 cloves of elaichi (cardamom)
- 1 cup milk
- 2 tsp Oil

Preparation Method:

➢ Heat 1 tablespoon of ghee in a pan and roast the besan for 2 minutes until it turns aromatic. Remove and set aside.

➢ In the same pan, add 1 tablespoon of ghee and roast the THR flour for 2 minutes until lightly golden.

➢ In a separate bowl, mix the sugar with 2 teaspoons of oil and stir until well combined.

➢ Add the roasted besan and the THR flour to the sugar mixture.

➢ Stir in the grated coconut, peanut powder, and crushed elaichi.

➢ Gradually add the milk while continuously stirring to form a smooth, thick mixture.

➢ Pour the mixture into a greased tray and spread it evenly.

➢ Let it cool for 30 minutes, then cut into square or diamond-shaped pieces.

➢ Store in an airtight container.

5. MIX VEGETABLE HANDVO

Ingredients:

- 1 cup Take-Home Ration (THR)
- ¾ cup rava (semolina)
- 2 tablespoons chana flour (gram flour)
- 1 cup grated carrot
- 1 tablespoon green peas
- 2 teaspoons garlic, green chili, and ginger paste
- 1 teaspoon turmeric powder
- ½ cup curd
- ½ teaspoon black salt
- ¼ teaspoon baking soda
- Juice of ½ lemon
- 1 tablespoon oil
- 2 teaspoons white sesame seeds
- 1 cup grated bottle gourd
- ½ teaspoon jeera (cumin seeds)
- ½ teaspoon hing (asafoetida)
- 2-3 curry leaves
- 2 dried red chilies
- ½ teaspoon black sesame seeds

Preparation Method:

➢ In a mixing bowl, combine THR, rava, chana flour, grated carrot, grated bottle gourd, green peas, garlic-chili-ginger paste, turmeric powder, black salt, and curd. Mix well.

➢ Let the mixture rest for 15 minutes for slight fermentation and better texture.

➢ Just before cooking, add baking soda and lemon juice. Mix well.

➢ Heat 1 tablespoon oil in a pan, add jeera, hing, white sesame seeds, black sesame seeds, curry leaves, and dried red chilies. Let them splutter.

➢ Pour the batter into the pan and spread evenly. Cover and cook on low heat for 10-15 minutes until golden brown.

➢ Flip the handvo carefully and cook the other side for 5-7 minutes.

➢ Cut into pieces and serve hot with chutney or yogurt.

6. MOONG DAL CHILLA

Ingredients

- 1 cup moong dal (green gram, soaked for 4-5 hours)
- 1 cup Take-Home Ration (THR)
- 1 teaspoon ginger, grated
- 1 teaspoon green chili, finely chopped
- ½ teaspoon turmeric powder
- ½ teaspoon cumin seeds (jeera)
- 2 tablespoons coriander leaves, chopped
- ½ teaspoon salt (to taste)
- ½ cup water (as required)
- 1 tablespoon oil (for cooking)

Preparation Method:

➢ Soak moong dal for 4-5 hours, then drain and blend it into a smooth batter with minimal water.

➢ Transfer the batter to a bowl and add THR, ginger, green chili, turmeric powder, cumin seeds, coriander leaves, and salt. Mix well.

➢ Add water gradually to achieve a smooth, pourable batter (not too thick or runny).

➢ Heat a non-stick or iron pan, grease lightly with oil, and pour a ladleful of batter. Spread evenly into a thin circle.

➢ Drizzle a little oil around the edges and cook for 2-3 minutes on medium flame until the edges lift slightly. Flip and cook the other side for 1-2 minutes until golden brown.

➢ Serve hot with mint chutney, yogurt, or tomato ketchup.

7. MORINGA PARATHA

Ingredients:

- 1 cup chopped moringa leaves
- 1 teaspoon coriander powder
- 1½ cups Take-Home Ration (THR)
- ½ teaspoon turmeric powder
- 3 tablespoons besan (gram flour)
- ½ teaspoon sesame seeds
- ½ teaspoon cumin powder
- 2 green chilies, finely chopped
- ½ teaspoon salt
- ¼ cup chopped fresh coriander leaves
- Water (as needed for kneading)
- Ghee or oil (for roasting)

Preparation Method:

➢ In a large mixing bowl, combine the THR, besan, chopped moringa leaves, coriander powder, turmeric, sesame seeds, cumin powder, green chilies, salt, and fresh coriander leaves.

➢ Mix all dry ingredients well, then slowly add water and knead into a soft dough. Let it rest for 10 minutes.

➢ Divide the dough into equal portions and roll out each portion into a flat, round paratha.

➢ Heat a tawa (griddle) and cook the paratha on medium heat. Flip when bubbles appear, and apply ghee or oil on both sides.

➢ Once golden brown, remove from heat and serve hot with curd, chutney, or pickle.

8. MISSI ROTI

Ingredients:

- 2 cups besan (gram flour)
- 1 cup Take-Home Ration (THR).
- 1 teaspoon salt
- ½ teaspoon ajwain (carom seeds)
- ½ teaspoon turmeric powder
- ½ teaspoon jeera (cumin) powder
- 1 tablespoon freshly chopped coriander
- 1 teaspoon ginger and green chili paste
- 1 teaspoon ghee (for dough)
- Water (as required for kneading)

For Topping:

- 1 small onion, finely chopped
- 1 tablespoon freshly chopped coriander
- ½ teaspoon dry-roasted coriander seeds
- A pinch of chaat masala
- Ghee or butter for roasting

Preparation method:

➢ In a mixing bowl, combine besan, THR, salt, ajwain, turmeric, jeera powder, coriander leaves, ginger-chili paste, and ghee. Gradually add water and knead into a soft dough. Cover and let it rest for 10 minutes.

➢ In another bowl, mix the chopped onion, coriander leaves, dry-roasted coriander seeds, and chaat masala.

➢ Divide the dough into equal portions and roll each into a thin roti.

➢ Sprinkle the prepared topping mixture evenly over the roti and gently press it down.

➢ Heat a tawa (griddle) and place the roti on it. Cook on medium flame for 1-2 minutes until bubbles appear. Flip and cook the other side while applying ghee or butter.

➢ Once golden brown and crisp, remove from heat and serve hot with curd, pickle, or chutney.

9. CABBAGE MUTHIYA

Ingredients:

- 1 cup Take-Home Ration (THR)
- ½ cup Kanki Korma
- 1 tablespoon grated ginger
- ½ teaspoon salt
- 3-4 green chilies, finely chopped (adjust as per taste)
- ½ teaspoon ajwain (carom seeds)
- Juice of ½ lemon
- ½ teaspoon turmeric powder
- 4-5 cloves garlic, finely minced
- ½ cup finely chopped cabbage
- 1 tablespoon oil (for binding)
- 2 teaspoons sesame seeds
- 2 teaspoons oil (for shallow frying)

Preparation Method:

➢ Combine THR, Kanki Korma, ginger, salt, green chilies, ajwain, lemon juice, turmeric, garlic, and chopped cabbage in a mixing bowl.

➢ Add 1 tablespoon of oil and mix well to form a firm dough. If needed, add a little water to adjust the consistency.

➢ Divide the dough into equal portions and roll them into log-shaped rolls.

➢ Place the rolls in a steamer and steam for 15-20 minutes until firm and cooked through.

➢ Heat 2 teaspoons of oil in a pan, add sesame seeds, and let them splutter. Slice the steamed muthiya into pieces and shallow fry them until they turn golden brown.

10. Coconut GUJIYA

Ingredients:

- 1 cup Take-Home Ration (THR)
- ½ teaspoon elaichi (cardamom powder)
- ½ cup grated coconut
- 1 tablespoon ghee (for dough)
- 1 cup maida (all-purpose flour)
- ½ cup water (for dough preparation)
- ½ cup oil (for deep frying)

Preparation method:

➢ In a mixing bowl, combine maida, 1 tablespoon ghee, and water.
➢ Knead into a smooth, firm dough and let it rest for 10 minutes.
➢ In another bowl, mix THR, grated coconut, and elaichi powder.
➢ Ensure the mixture is well combined and aromatic.
➢ Roll out small portions of dough into thin circles.
➢ Place a spoonful of the filling in the center of each circle.
➢ Fold it into a semi-circle and seal the edges by pressing firmly or using a fork.
➢ Heat oil in a pan over medium flame.
➢ Fry the gujiyas until they turn golden brown and crisp.
➢ Let them cool slightly before serving.

PHASE II (B): SENSORY EVALUATION AND DEVELOPMENT OF VIDEOS

This phase assessed the organoleptic attributes of the developed recipes, followed by the development of videos demonstrating acceptable recipes and sharing videos with beneficiaries. Figure 3.3 shows the experimental design for Phase II of the study.

➢ Selection of judges for organoleptic evaluation

a) **Screening of Panellists:** In this phase, the selection of panel members was carried out based on the threshold test. Students from the Faculty of Family and Community Sciences were selected for threshold testing. Threshold is defined as the stimulus scale at which a transition in a series or judgment occurs. A scorecard was prepared and pre-tested for the Threshold test (Ranganna 1995) (Appendix). Each perspective panel member was given three sets of the solution, i.e, Set 1, Set 2, and Set 3, having three solutions of different concentrations of salt, sugar, and citric acid, respectively, and was arranged in random order. The participants were asked to identify and rank the samples according to the concentration of taste from the test solutions offered. Subjects who succeeded in passing the threshold test were included further in evaluating the organoleptic characteristics of the food products. 45 subjects were enrolled to carry out sensory evaluation, and 30 subjects who passed the threshold test were included further for sensory evaluation of the developed recipes.

b) Organoleptic evaluation:

The organoleptic evaluation tool selected was the Hedonic Rating Scale and composite rating scale.

Hedonic Rating Scale:

This is a test that uses a 7-point rating scale ranging from “Like very much” to “Dislike very much,” with “neither like nor dislike” as the middle score that helped in identifying the most or the least liked product from the various recipes.

Composite rating scale

The 10-point scoring test was conducted so that specific characteristics of the product could be rated separately. It helps to point out which specific attribute is not acceptable or is at fault. All the developed recipes were evaluated for the following

attributes: colour & appearance, aroma, texture, taste, after-taste, mouthfeel, and overall acceptability.

To check the acceptability for the following 10 prepared recipes, the sensory evaluation was conducted with 30 panel members selected based on the Threshold test.

After the sensory evaluation, a recipe demonstrating videos were made for adolescent girls in the local language, Gujarati, and shared.

Table 3.1 Tools and Parameters

Sr. No	Parameters	Tools
1	Socio-Economic Status	Structured Questionnaire
2	Knowledge, Attitude, Practices of Take-Home Ration	Semi-Structured Questionnaire
3	Anthropometric Measurements • Height • Weight	 Stadiometer Weighing Scale
4	Dietary Practices • Food Frequency • MDD-W	 Structured Questionnaire Structured Questionnaire

Inclusion and Exclusion Criteria

Inclusion criteria

- All adolescent girls between 15 and 18 years registered in the selected AWCs and are willing to participate.

Exclusion criteria

- Pregnant and lactating adolescent girls
- Adolescent girls with reported allergies to certain foods

DATA MONITORING, MANAGEMENT, AND ANALYSIS

The data was entered and then analysed using Microsoft Excel (2016 or above) and SPSS version 20 or above.

- Frequency distribution and percentage were calculated for all parameters that were expressed in a rank order fashion.
- Means and standard errors were calculated for all parameters that were expressed numerically.

RESULTS AND DISCUSSION

Adolescence, in contrast to infancy, is characterized by significant individual differences in the timing and size of growth. Since this stage accounts for 15-20% of adult height and is the second most important time for physical growth after the first year of life, nutrition is crucial. The body's nutritional needs are increased by increased secretion, hormonal responses, and metabolic processes (Senderowitz, 1995; Spear, 2002; Corkins, 2016) In particular, for girls who will need sufficient nutrient reserves for pregnancy and nursing, proper nutrition during adolescence is crucial for both growth and future reproductive health (UNICEF, 2018). Adolescents' health, education, and awareness have a big influence on India's economic development because they will make up the majority of the country's future workforce. Therefore, meeting their dietary requirements and general health is essential to creating a society that is healthier and more productive (WHO, 2018).

One important program that aims to improve the health, education, and empowerment of Adolescent girls of Gujarat is the Prevention of Undernutrition and Reduction of Nutritional Anemia (PURNA) program. The program, which targets girls between the ages of 15 and 18, emphasizes nutrition education, hygiene awareness, and vocational training. Its main goals are to improve life skills, commercial knowledge, legal knowledge, and access to public resources while lowering anemia, child marriage, and malnutrition. Research assessing the PURNA program's effects are still lacking, nevertheless. Thus, the present study was planned to assess the utilization of the Take-Home Ration by adolescent girls.

The study was conducted in two primary phases, with Phase Ⅱ further divided into Phase Ⅱ-A and Phase Ⅱ-B. Each phase addressed specific aspects of adolescent nutrition, dietary practices, and Take-Home Ration (THR) utilization.

Phase I included baseline data collection and assessment of the socioeconomic status, nutritional status of adolescent girls, assessment of knowledge, attitude, and practices (KAP) of adolescent girls regarding Take-Home Ration (THR) consumption, and

evaluation of dietary practices using food frequency and dietary diversity score methods to understand nutritional intakes.

Phase II-A included the development of nutrient-rich recipes incorporating THR (Purna Shakti), and Phase II-B included sensory evaluation, video development, and dissemination.

Each phase contributed to a comprehensive understanding of adolescent nutrition, helping bridge the gap between THR distribution and effective consumption while addressing challenges related to dietary diversity and nutritional adequacy.

The results are presented under the following headings:

- Socio-demographic profile of enrolled subjects
- Nutritional Status of Adolescent Girls
- Knowledge, attitude, and practice of Take-Home Ration (THR) Utilization
- Dietary Diversity and Food Consumption Patterns
- Sensory Evaluation of Recipes prepared incorporating THR

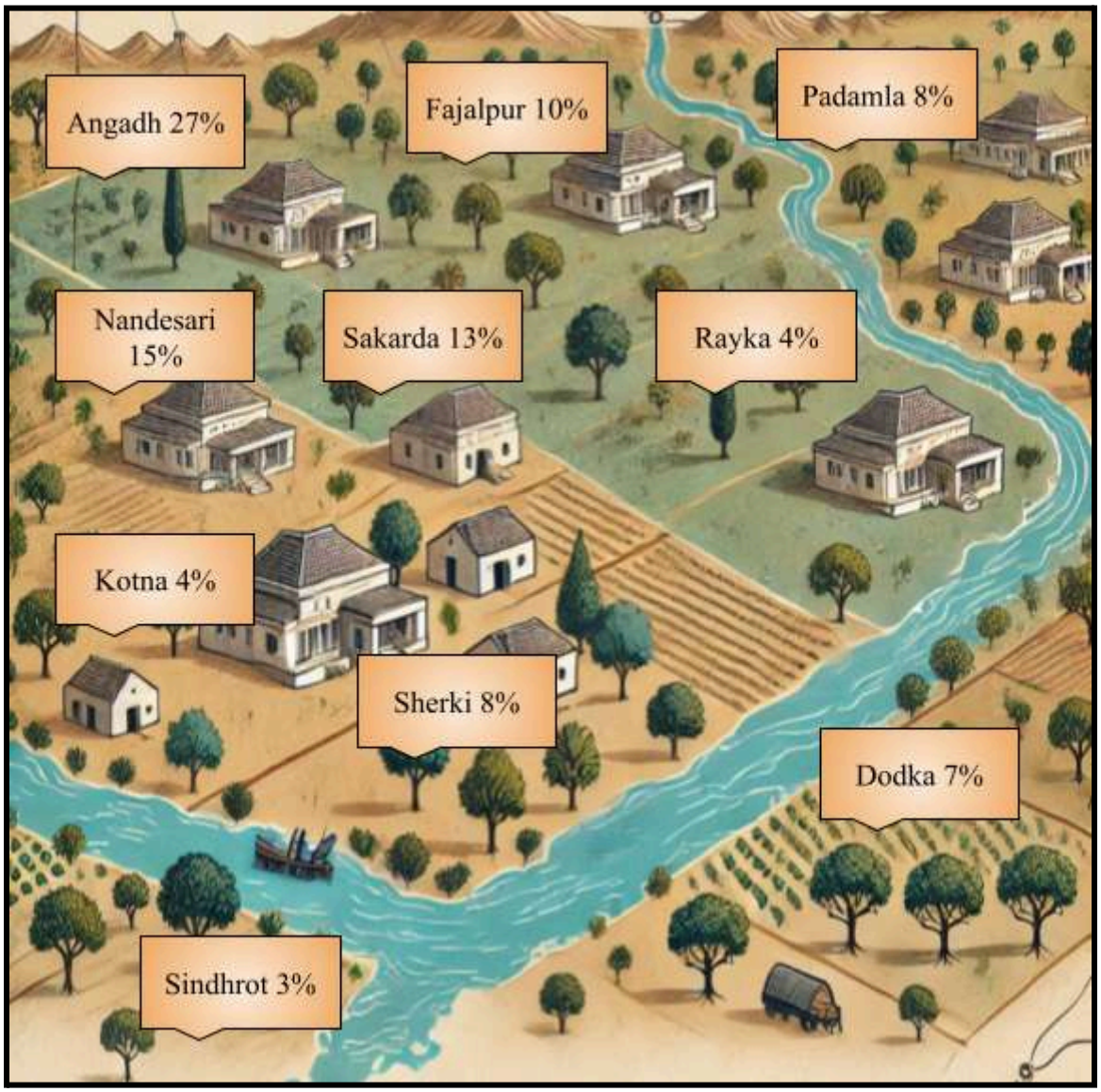
Situational Analysis

Phase I of the study focuses on understanding the current nutritional status of adolescent girls and the extent to which they utilized the Take-Home Ration (THR). Data collection involves socio-demographic profiling and anthropometric measurements to assess indicators like height, weight, and BMI. A comprehensive evaluation of knowledge, attitudes, and practices (KAP) regarding THR consumption was conducted to identify gaps in awareness and barriers to utilization. Additionally, dietary intake was assessed using Food Frequency Questionnaires (FFQ) and Minimum Dietary Diversity Scores (MDD) to determine dietary patterns and nutritional adequacy. This phase aimed to highlight factors influencing THR consumption, traditional food preparation methods, and the dietary diversity of adolescent girls, providing essential insights for targeted nutritional interventions.

Number of adolescent girls enrolled in the study

The study was carried out at 63 Anganwadi centers in rural Vadodara, and 300 adolescent girls were enrolled. The respondent's distribution differed by village, with Angadh having the largest percentage (27%), followed by Nandesari (15%) and Sakarda (13%). Fajalpur (10%), Padamla (8%), Sherki (8%), Dodka (7%), Rayka (4%), Kotna (4%), and Sindhrot (3%) were among the other villages with differing participation rates. The information offers important insights into the reach and engagement of Anganwadi activities in rural areas and shows the wide representation of these populations (Figure 4.1).

Figure 4.1 Adolescent girls enrolled in the study



4.1 Socio-Economic Profile of Adolescent Girls

4.1.1 Age profile of adolescent girls

The age distribution of respondents in the study ranged from 15 to 18 years. Out of the total 300 respondents, 12.3% were 15 years old, 24% were 16 years old, 30.3% were 17 years old, and the highest proportion, 33.3%, were 18 years old. This distribution provides a comprehensive understanding of the age demographics of adolescents accessing Anganwadi services in rural Vadodara (Figure 4.2).

4.1.2 Background Information on Adolescent Girls

Among the total respondents, the majority 49% belonged to the Antyodaya Ration Card category, indicating that nearly half of the respondents were from the most economically disadvantaged households. One-fourth were from the Above Poverty Line (APL) category, while 15.3% belonged to the Below Poverty Line (BPL) category. Additionally, 2.7% did not have any documents, and 7.7% were unaware of their ration card status. This data provides valuable insights into the socioeconomic status of the adolescent beneficiaries accessing Anganwadi services in rural Vadodara (Table 4.1).

The educational background of the mothers of adolescent girls in the study reflected varying levels of literacy and schooling. Among the total respondents, the highest proportion, 39.7%, had mothers who completed primary school, followed by 33% whose mothers had attained middle school education. A total of 14% had mothers who completed high school, while only 2.7% had mothers with an intermediate-level education or diploma. Notably, 8.7% of the respondents' mothers were illiterate, and only 0.3% had a mother with a professional degree. Additionally, 1.7% reported having no guardian. This data indicates that a significant portion of adolescent girls in rural Vadodara come from households where mothers have limited formal education, which could influence their access to knowledge and awareness about health, nutrition, and overall well-being (Table 4.1).

The occupational distribution of the respondents' fathers highlights a significant engagement in elementary occupations and labor-intensive work. Among the total respondents, the majority, 47.3%, had fathers working in elementary occupations,

followed by 23.7% employed as plant and machine operators and assemblers. A total of 11.7% were engaged in skilled agricultural and fishery work, while 5.3% worked in skilled trades, shopkeeping, and market sales. Additionally, 1.7% were employed in technical or associate professional roles, and only 0.7% were professionals. A small proportion, 0.7%, were in craft-related trades, while just 0.3% were in managerial or senior official positions. Notably, 3.7% were unemployed, and 5% of respondents reported having no guardian. This data suggests that most respondents come from families with fathers engaged in labor-intensive, low-skilled occupations, which may affect household income, economic stability, and resource access (Table 4.1).

The socioeconomic classification of the respondents, based on the Kuppuswamy 2023 Scale, revealed that the majority, 67.2%, belonged to the lower middle class (₹7,316 - ₹21,913 per capita monthly income). A significant proportion of enrolled subjects, 19.9%, were from the lower class (≤₹7,315). The middle class (₹21,914 - ₹36,526) comprised 4.7%, while the upper middle class (₹36,527 - ₹45,588) had only 0.6%. Higher-income categories were less represented, with just 0.3% each in the upper class (₹73,054 - ₹109,579), upper-middle class (₹54,651 - ₹59,251), and high-income middle class (₹45,589 - ₹54,650). This distribution highlighted the predominance of lower socioeconomic strata among the study participants (Table 4.1).

The educational status of adolescent girls in the study revealed that 47.3% were currently attending school, while 52.7% were not enrolled in any educational institution. Among those attending school or college, the majority 66.2% were enrolled in government schools, followed by 25.4% in private schools. A small proportion of students, 4.9%, were pursuing education at the college level, while 2.8% were studying in government-aided schools. Additionally, 0.7% reported studying in other types of educational institutions. These findings indicate a considerable proportion of adolescent girls who were out of school, emphasizing the need for targeted interventions to improve educational retention in this area (Table 4.1).

Table 4.1 Background information of Adolescent girls (N=300)

Parameters	Categories	Respondents	
		n	%
Social Category	Antyodaya Ration card	147	49%
	APL	76	25.33%
	BPL	46	15.33%
	Do not have the mentioned documents	8	2.66%
	Do not know	23	7.66%
Mother's Education	High School	42	14%
	Illiterate	26	8.66%
	Intermediate/Diploma	8	2.66%
	Middle School	99	33%
	No Guardian	5	1.66%
	Primary School	119	39.66%
	Professional Degree	1	0.33%
Father's Occupation	Craft and related trade workers	2	0.66%
	Elementary occupation	142	47.33%
	Legislators, Senior officials, managers	1	0.33%
	No Guardian	15	5%
	Plant and machine operators and assemblers	71	23.66%
	Professional	2	0.66%
	Skilled agricultural and Fishery worker	35	11.66%
	Skilled workers, shop and market sales workers	16	5.33%
	Technical/Associate Professionals	5	1.66%
	Unemployed	11	3.66%
Family Income	≤7,315	64	21.33%
	21,914-36,526	15	5%
	36,527-45,588	2	0.66%
	45,589-54,650	1	0.33%
	54,651-59,251	1	0.33%
	7,316-21,913	216	72%
	73,054-109,579	1	0.33%
School	Going	142	47%
	Non-going	158	52%
Type of School	College	7	5%
	Govt. Aided School	4	3%
	Govt School	94	66%
	Others	1	1%
	Private School	36	25%

Values in parentheses indicate percentages.

4.2 Nutritional Status Assessment

4.2.1 Anthropometric measurements

The anthropometric data of enrolled subjects in the study indicate variations in both weight and height. Among the respondents, 50% weighed ≤40 kg, followed by 36% in the 41-50 kg range, 11% in the 51-60 kg range, and only 3% weighing more than 60 kg. In terms of height, the majority, 54.3%, were ≤150 cm, while 45% of girls fell within the 151-160 cm range, and only 0.7% had a height above 160 cm. These findings highlighted the overall nutritional and growth status of the adolescents surveyed (Table 4.2).

4.2.2 Mean anthropometric measures

The analysis of anthropometric measurements among the adolescent girls revealed that the mean weight was 42.22 ± 8.049 kg. This indicated a considerable variation in weight among the respondents. The findings suggested differences in nutritional status, with some girls potentially falling into underweight or overweight categories. The analysis of height showed a mean height of 149.35 ± 5.399 cm. The mean BMI of the respondents was 18.9 kg/m² with a standard deviation of 3.35. This indicated a moderate variation in height within the study population. The findings provide insights into the growth patterns of adolescent girls in the region, emphasizing the importance of nutritional and health interventions to support optimal physical development (Table 4.3)

4.2.3 Mean weight, height, and BMI of adolescent girls (Mean ± SD)- Agewise

An age-wise analysis of mean weight among adolescent girls showed a gradual increase in weight with age. The mean weight for 15-year-old girls was 41.5 kg ± 8.82, while for 16-year-olds, it was slightly lower at 40.7 kg ± 7.49. Among 17-year-olds, the mean weight increased to 42.2 kg ± 7.64, and the highest mean weight was observed in 18-year-old girls at 43.6 kg ± 8.38. The mean height for 15-year-olds was 150 cm ± 4.73, while for 16-year-olds, it was slightly lower at 149 cm ± 5.76. Similarly, 17-year-olds had a mean height of 149 cm ± 5.46, and 18-year-olds showed a marginal increase with a mean height of 150 cm ± 5.31. These findings indicated relatively stable height measurements across the age groups, with minor fluctuations likely influenced by

individual growth patterns and nutritional factors. The mean Body Mass Index (BMI) of adolescent girls varied slightly across different age groups. 15-year-olds had a mean BMI of 18.3 ± 3.55, while 16-year-olds showed a similar BMI of 18.4 ± 3.35. The 17-year-olds exhibited a slight increase with a mean BMI of 19.0 ± 2.96, and the 18-year-olds had the highest BMI at 19.5 ± 3.57 (Table 4.9).

Figure 4.2 Age Distribution of Adolescent Girls

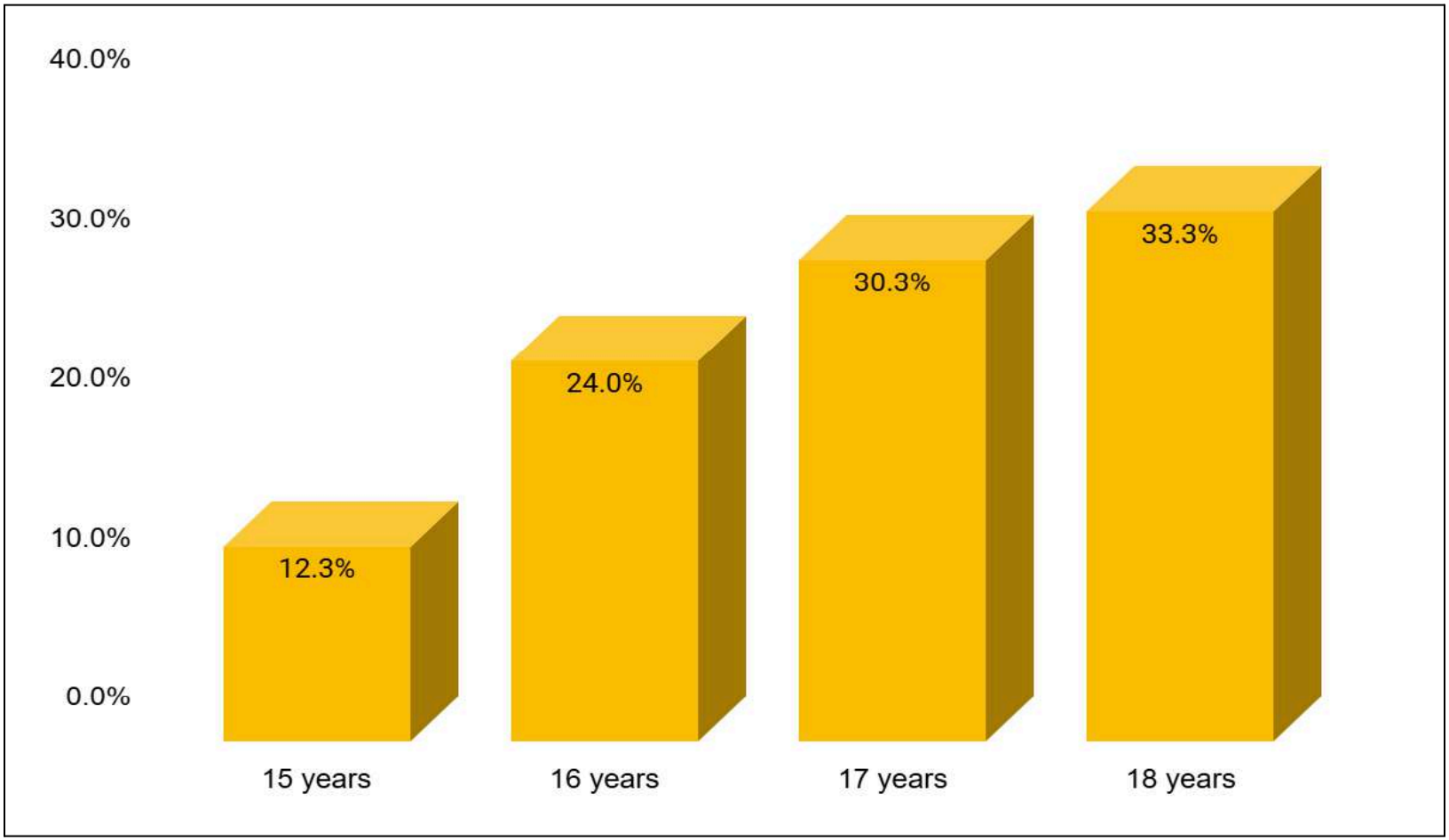


Table 4.2 Anthropometric measurements of enrolled subjects (N=300)

Parameters	Categories	Respondents	
		n	%
Weight (kg)	≤40	150	50%
	41-50	108	36%
	51-60	33	11%
	>60	9	3%
Height (cm)	≤150	163	54.33
	151-160	135	45
	>160	2	0.66

Values in parentheses indicate percentages.

Table 4.3 Mean anthropometric measurements (N=300)

	Weight (kg)	Height (cm)	BMI (kg/m²)
Mean	42.22 ± 8.049	149.35 ± 5.399	18.9 ± 3.35
Standard Deviation	8.049	5.399	3.35

Table 4.4 Mean weight, height, and BMI- Agewise (N=300)

Age (years)	N=300	Weight (kg)	Height (cm)	BMI (kg/m²)
15	37	41.5 ± 8.82	150 ± 4.73	18.3 ± 3.55
16	72	40.7 ± 7.49	149 ± 5.76	18.4 ± 3.35
17	92	42.2 ± 7.64	149 ± 5.46	19.0 ± 2.96
18	100	43.6 ± 8.38	150 ± 5.31	19.5 ± 3.57

4.2.4 Nutritional Status of Adolescent Girls

BMI for age (BAZ) z score

The comparison of BMI-for-Age Z-scores (BAZ) from the study with the WHO 2007 Growth Standards revealed significant trends in the nutritional status of adolescent girls. According to the WHO classification, severe thinness is defined as ≤ -3 SD, moderate thinness falls between -3 SD and -2 SD, normal weight is within -2 SD to +1 SD, overweight is > +1 SD to +2 SD, and obesity is > +2 SD. In the current study, 3% of adolescent girls were classified as severely thin, and 17% fell into the category of moderate thinness, highlighting a higher prevalence of undernutrition compared to global estimates. Additionally, 31.6% were mildly thin (-2 SD to -1 SD), suggesting a risk of chronic malnutrition and poor growth outcomes.

Nearly 48.3% fell within the normal BMI for age category (-1 SD to +1 SD), aligning with WHO's global reference distribution where 50-60% of adolescents in well-nourished populations maintain normal BMI-for-age.

The findings indicated that a significant proportion of adolescent girls were at risk of undernutrition, requiring urgent nutritional interventions such as improved dietary diversity, micronutrient supplementation, and effective utilization of Take-Home Ration (THR) programs. Given the high prevalence of severe and moderate thinness (20% combined) in comparison to WHO standards, targeted strategies should focus on addressing chronic energy deficiency, improving iron and micronutrient intake, and promoting adolescent health education. The study underscores the need for comprehensive nutrition programs and policy interventions to improve adolescent nutritional outcomes in rural settings (Table 4.4).

The findings indicate a progressive increase in the prevalence of thinness as age advances from pre-adolescence to late adolescence. The lowest prevalence was observed in pre-adolescents (7%), suggesting that younger individuals may have better nutritional status or lower metabolic demands compared to older age groups. However, thinness

prevalence rises to 14% in early adolescence, followed by a further increase to 15% in mid-adolescence, and reaching its peak at 17% in late adolescence (Figure 4.5).

4.2.5 Comparison of Height-for-Age Z-Scores (HAZ) with WHO 2007 Growth Standards

The analysis of Height-for-Age Z-scores (HAZ) in the study population was compared against WHO 2007 Growth Standards, which classifies severe stunting as ≤ -3 SD, moderate stunting as between -3 SD and -2 SD, mild stunting as between -2 SD and -1 SD, and normal height as ≥ -1 SD.

In the present study, 10.3% of adolescent girls were found to be severely stunted (≤ -3 SD), while 36.3% fell into the category of moderate stunting (-3 SD to -2 SD). Additionally, 42% exhibited mild stunting (-2 SD to -1 SD), indicating a high prevalence of growth retardation among the adolescents studied. Only 11.3% fell within the normal height range (≥ -1 SD).

Comparatively, WHO estimates suggest that in populations with adequate nutrition, the prevalence of severe and moderate stunting should not exceed 20-25%, yet the current study reports a combined prevalence of 46.6% for these categories, indicating chronic undernutrition, delayed growth, and potential long-term developmental consequences. This high prevalence of stunting is a reflection of early-life malnutrition, inadequate dietary intake, and possible micronutrient deficiencies during critical growth periods. The findings indicate that stunting remains a major concern among rural adolescent girls, and concerted efforts are needed to improve their nutritional status to ensure proper physical growth and development (Table 4.5).

The findings of the present study indicate a progressive increase in stunting prevalence across different stages of adolescence, with 10% in pre-adolescence, 21% in early adolescence, 27% in mid-adolescence, and 30% in late adolescence. This pattern highlighted a worsening nutritional deficit over time, suggesting that adolescents did not receive adequate nutritional support during their critical growth years (Figure 4.6).

Table 4.5 BMI for age-scores (N=300)

Nutritional Status (Z-scores)	n	%
BMI for age-Z scores		
≤-3	9	3.0
-2 to >-3	51	17.0
<-1 to >-2	95	31.7
>-1 to <1	129	45.42
>1 to 2	11	3.66
>2 to 3	5	1.66
Total	300	100

Values in parentheses indicate percentages.

Table 4.6 Height-for-age Z score (N=300)

Nutritional Status (Z-scores)	n	%
Height-for-age Z scores		
≤-3	31	10.3
-2 to -3	109	36.3
<-1 to >-2	126	42.0
>-1 to <1	34	11.3
Total	300	100

Values in parentheses indicate percentages.

Figure 4.3 Prevalence of Thinness (N=300)

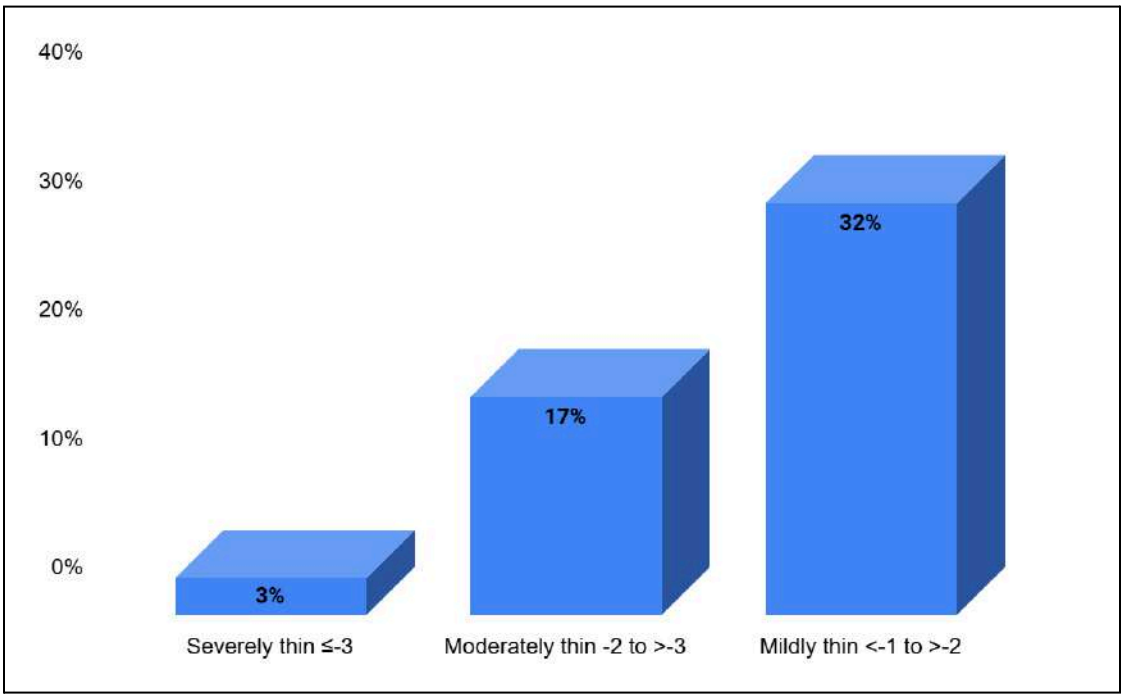


Figure 4.4 Prevalence of Stunting (N=300)

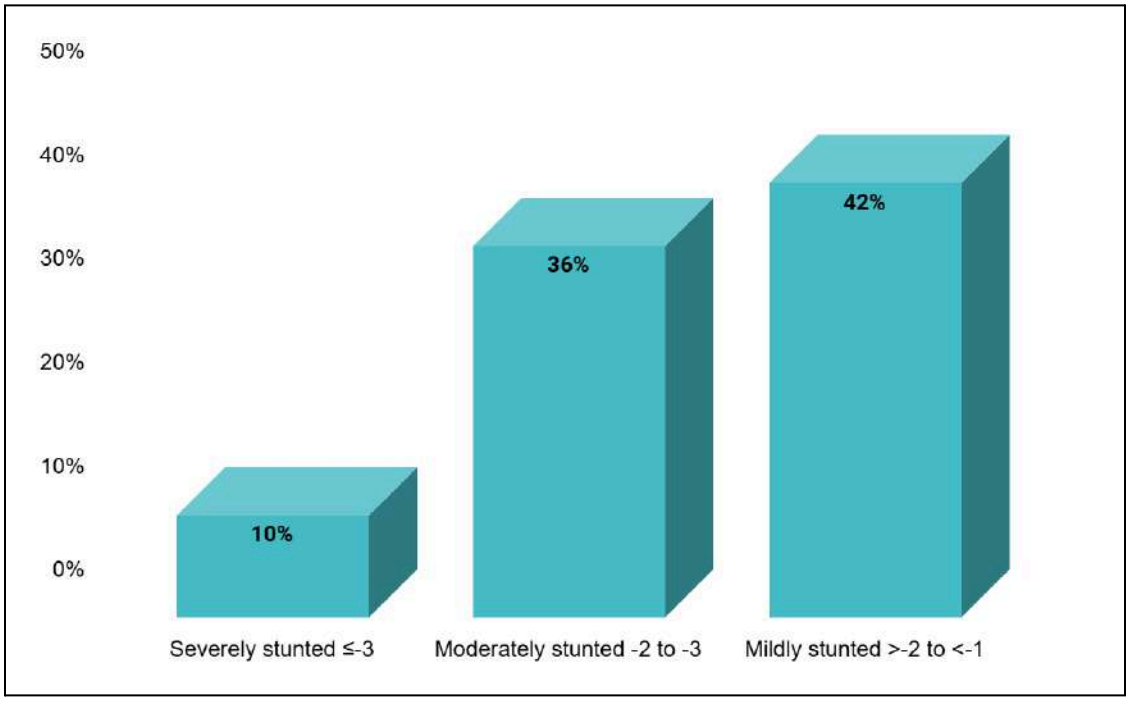


Figure 4.5 Prevalence of thinness according to stage of adolescence (%) (N=300)

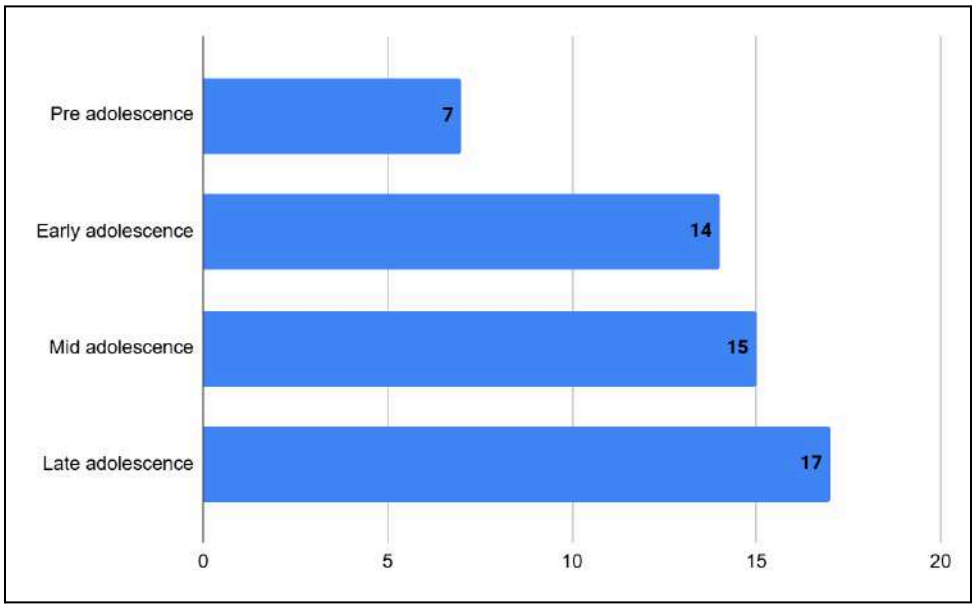
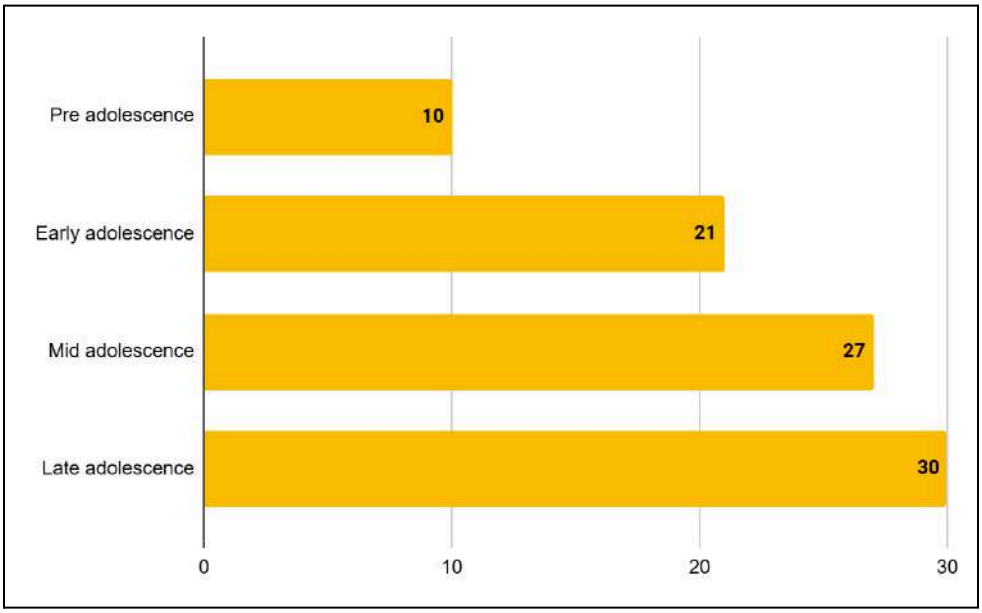


Figure 4.6 Prevalence of stunting according to stage of adolescence (%) (N=300)



4.3 Take-Home Ration Utilization

4.3.1 THR coverage

The coverage of Take-Home Ration (THR) among adolescent girls in the study was 100%, with all 300 respondents reporting that they received Purnashakti as their ration. In terms of duration, the majority 57.7% had been receiving THR since 2-3 years, while 17.7% had been beneficiaries for one year. Additionally, 14% had been receiving THR for four years, and 10.7% had started receiving it within the last six months or less. These findings indicated a well-established distribution system for THR, though variability in the duration of receipt suggests potential gaps in consistent access for some beneficiaries. The frequency of receiving Take-Home Ration (THR) packets varied among respondents. The majority of adolescent girls, 98%, received their ration every month, while 1.3% received it fortnightly, and 0.7% received it once every three months. In terms of the number of packets distributed, 90.3% received 4 packets, followed by 5.3% who received 3 packets, 3% who received 2 packets, and 1.3% who received 5 packets. This indicated that while most girls consistently received their THR, there were slight variations in distribution frequency and quantity (Table 4.7).

Table 4.7 Take-Home Ration Coverage (N=300)

Parameters	Categories	Respondents	
		n	%
Procurement of Take-Home ration	Yes	300	100
Type of Ration	Purnashakti	300	100
Since when is receiving Ration?	1 year	53	17.7%
	2-3 years	173	57.7%
	4 years	42	14.0%
	6 months or less	32	10.7%
Frequency of receiving	Fortnight	4	1.3%
	Monthly	294	98.0%
	Once in 3 months	2	0.7%
How many packets	2	9	3%
	3	16	5.3%
	4	271	90.0%
	5	4	1.3%

Values in parentheses indicate percentages.

4.3.2 Consumption of Take-Home Ration by Enrolled Subjects

Consumption of THR

The consumption of Take-Home Ration (THR) among adolescent girls showed a significant gap between procurement and actual usage. Out of 300 respondents, only 21.67% reported consuming THR, while a majority, 24.67%, did not consume it at all. This highlighted a crucial issue in the utilization of nutritional interventions; addressing these issues is essential to improving the effectiveness of the THR program in ensuring adequate adolescent nutrition (Figure 4.7). The data on consumption patterns of Take-Home Ration (THR) among adolescent girls indicated that a significant portion of recipients did not consume it regularly. Out of 235 respondents who do not consume THR, 53.67% reported consuming it rarely, including just tasting it once.

Form of THR consumed

The form of Take-Home Ration (THR) consumption among adolescent girls varied between those who consumed it regularly and those who consumed it rarely. Among the 21.7% girls who consumed THR regularly, the majority 89.2% consumed it in the form of Sheera, followed by Roti 6.1%, Thepla 1.5%, and raw consumption 3.1% (Table 4.8). Among the 161 girls who consumed THR rarely, 76.4% reported consuming it as sheera, while 9.3% had it as roti, 11.2% as thepla, and a small percentage consumed it Raw 1.2%, Dhokla 0.6%, or in other forms 1.2%. These findings highlighted that sheera was the most commonly preferred form of THR consumption, suggesting that enhancing its taste and variety may encourage more frequent consumption among adolescent girls (Table 4.8).

Amount of THR consumed

Among the adolescent girls who consumed Take-Home Ration (THR) regularly, the majority 63% consumed 100g, while 26.1% consumed less than 100g. A small proportion consumed 140g (3%), 150g (6.1%), and only 1.5% reported consuming 200g. These findings indicate that although THR is provided, most adolescent girls consume it in

limited quantities and don't know the actual amount to be consumed, which may impact its effectiveness in improving their nutritional status (Table 4.6)

Figure 4.7 Percentage of Consumption (N=300)

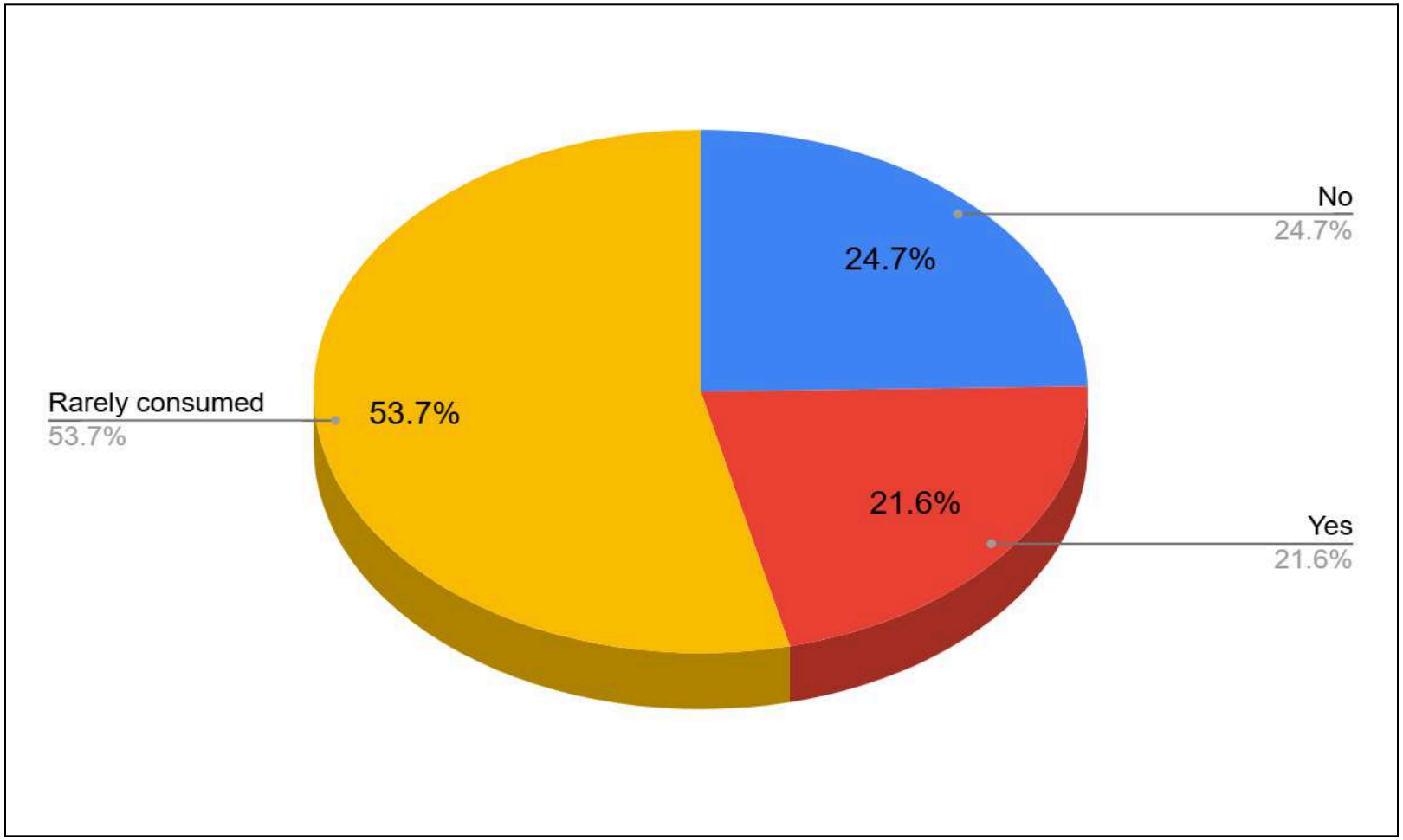


Table 4.8 Utilization of Take-Home Ration

Parameters	Categories	Respondents	
		n=65	
Form of THR consumption (Regularly)	Sheera	58	89%
	Roti	4	6%
	Thepla	1	1%
	Raw	2	3%
		n=161	
Form of THR consumption (Rarely)	Sheera	123	76%
	Roti	15	9%
	Thepla	18	11%
	Raw	2	1%
	Dhokla	1	1%
	Other	2	1%
		n=65	
THR amount consumed (Regularly)	<100g	17	26%
	100g	41	63%
	140g	2	3%
	150	4	6%
	200	1	1%

Values in parentheses indicate percentages.

Frequency of Take-Home Ration Consumption

The frequency of Take-Home Ration (THR) consumption among adolescent girls varied significantly. Only 6% consumed THR daily, which is far below the ideal recommended intake of 145g per day. A small proportion, 3%, consumed THR 4-5 times a week, while 12% had it 2-3 times a week. A notable 25% reported consuming THR once a week, and 68% consumed it rarely, despite its limited shelf life of 7 days after opening. These findings highlight poor adherence to regular THR consumption, which may reduce its intended nutritional benefits (Figure 4.8).

4.3.3 Adolescent's knowledge regarding benefits of Take-Home Ration consumption

The awareness of the benefits of consuming take-home ration (THR) among adolescent girls was notably low. Out of the total respondents, a majority 70% reported that they did not know about its benefits. Only 16% recognized that THR provided nutritious food required for growth, while 6% believed it contributed to good health. Additionally, 5% associated THR with weight gain, and just 1% mentioned that the Anganwadi worker informed them about its benefits (Figure 4.9).

Figure 4.8: Frequency of THR consumption (N=65)

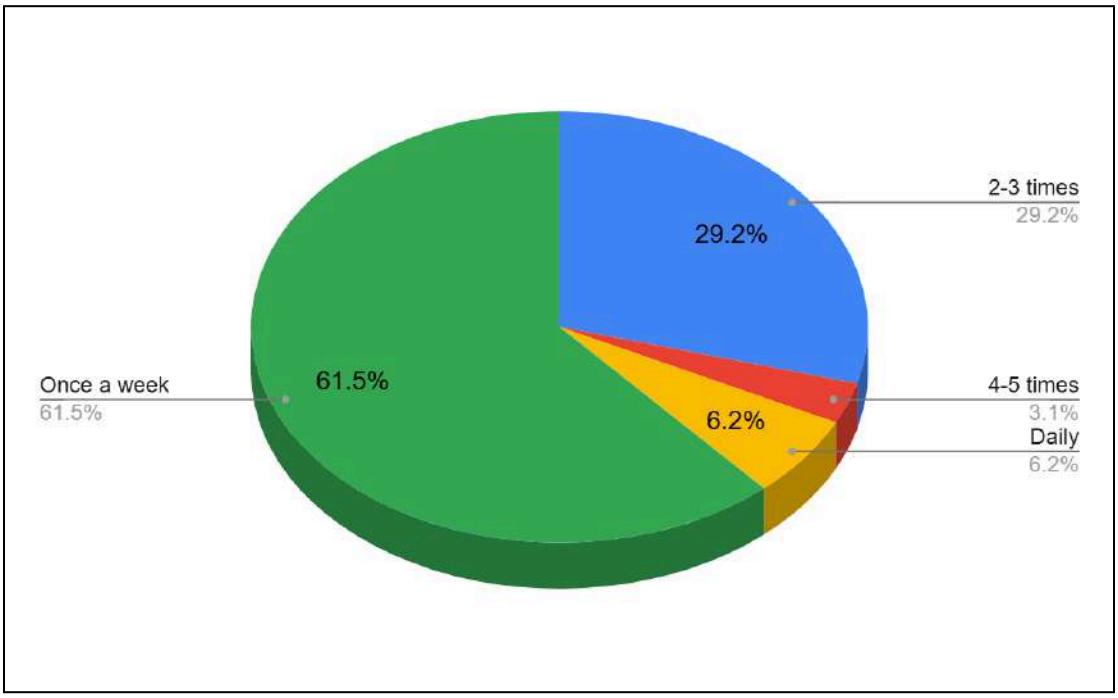
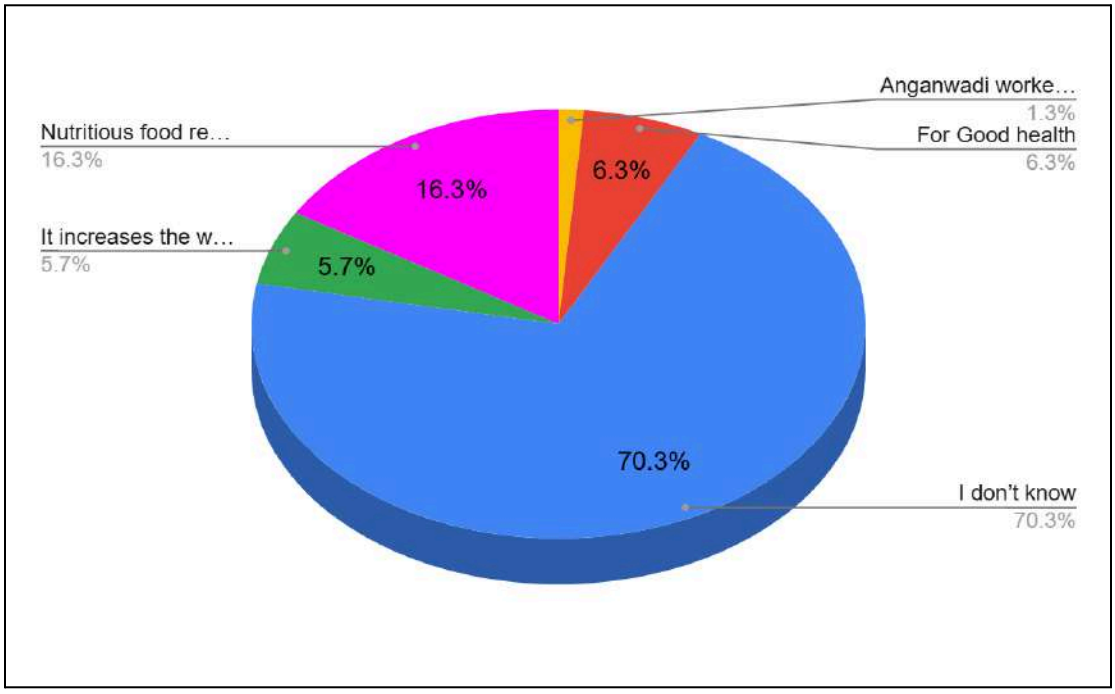


Figure 4.9 Awareness of THR benefits (N=300)



4.3.4 Knowledge of Ingredients and Nutrients in Take-Home Ration

The awareness regarding the ingredients and nutrients in take-home ration (THR) among adolescent girls was low. Out of the total respondents, only 28% knew the ingredients and nutrients present in THR, while a majority of 72% of girls were unaware. This indicates a significant gap in nutritional awareness, which could impact the acceptance and regular consumption of THR (Figure 4.10).

The awareness about different recipes that can be prepared using Take-Home Ration (THR) was relatively moderate among adolescent girls. Almost half of the subjects reported knowing about various recipes that can be made from THR, while 44% of girls did not know alternative ways to consume it. This highlighted the need for enhanced awareness programs and demonstrations to promote the diverse usage of THR, which could improve its acceptance and regular consumption (Figure 4.11).

Figure 4.10 Awareness regarding Ingredients in Take-Home Ration (N=300)

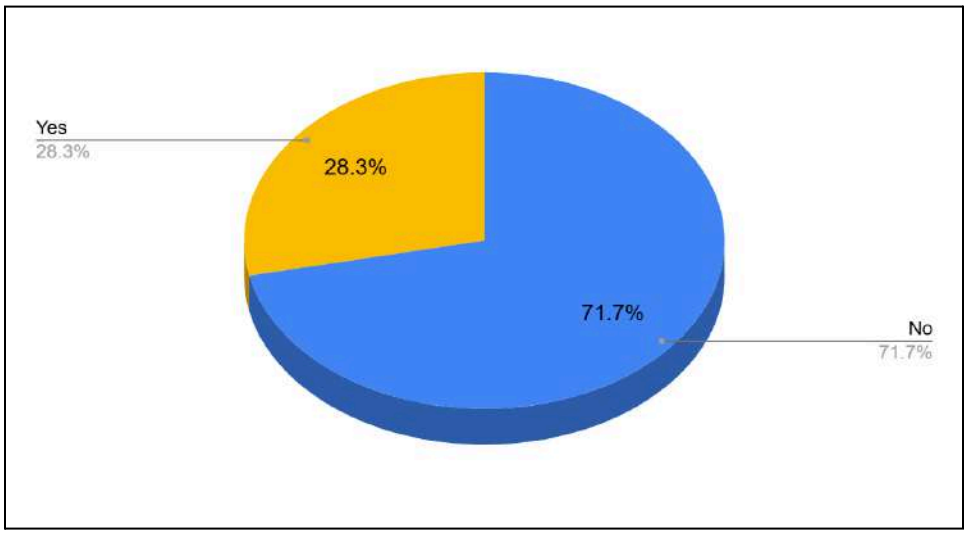
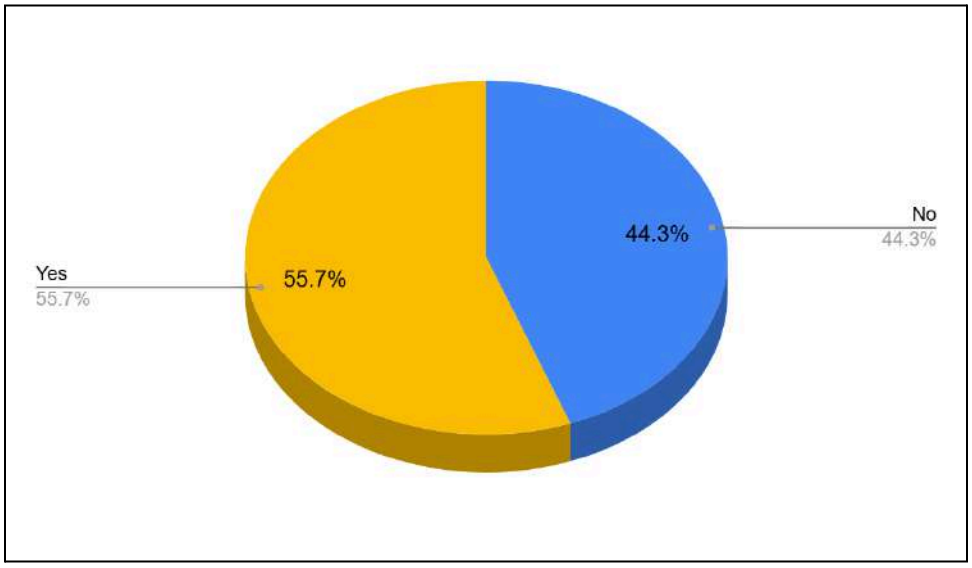


Figure 4.11 Utilization of Take-Home Ration (N=300)



4.3.5 Quality perception for THR

The perception regarding the quality of take-home ration (THR) quality among adolescent girls varied. Out of the total respondents, the majority, 76%, rated the quality as good, while 18% found it to be fair. A smaller proportion, 5%, considered it poor, and only 0.3% rated it as very good. These findings suggested that while most adolescents were satisfied with the quality of THR, there is still a need for quality improvement efforts to address concerns among those who rated it as fair or poor (Figure 4.12).

4.3.6 Barriers to the consumption of Take-Home Ration (THR)

A significant proportion of adolescent girls reported barriers to consuming THR, highlighting key challenges in its acceptance and utilization. Among 235 respondents who did not consume THR, the most common reason was disliking the taste (85%). Additionally, 6% found the texture unappealing, while 6% perceived a lack of variety in THR. A small number of respondents mentioned time constraints for preparation 0.8%, never having consumed it before 0.8%, external influence discouraging consumption 0.4%, and not receiving THR at all 0.4% as added barriers. Another 0.4% cited other reasons. These findings suggested that taste preferences, monotony, and texture concerns are major deterrents to THR consumption, indicating the need for sensory improvements, recipe diversification, and awareness campaigns to enhance acceptance and usage (Table 4.9).

4.3.7 Alternative uses of non-utilized THR

Among the 235 respondents who did not consume THR, the majority (91%) reported that the ration was fed to cattle, indicating a significant diversion from its intended use. A small proportion of respondents mentioned giving it to someone else (4%), while 3% stated that other household members consumed it. Additionally, 2% admitted to simply keeping the ration at home without using it. (Table 4.9)

These findings suggest that despite the intended beneficiaries not consuming the distribution of THR, a large portion led to wastage or alternative uses within households.

This highlights the need for sensory improvements, awareness campaigns, and targeted interventions to ensure better utilization of THR for adolescent nutrition (Table 4.9).

4.3.8 Encouragement for THR Consumption by Anganwadi Workers

The majority of adolescent girls (93%) reported receiving encouragement from Anganwadi workers to consume the Take-Home Ration (THR). However, around 6% stated that they did not receive any motivation to consume it. These findings indicated that while most girls were encouraged to utilize THR, a small percentage might not have received adequate support or awareness about its benefits. Strengthening interpersonal communication and counseling efforts by Anganwadi workers may help improve THR consumption among adolescents (Table 4.9).

4.3.9 Sharing of THR by Other Family Members

The study found that a significant proportion of the Take-Home Ration (THR) was being consumed by other family members. Nearly 67% of the subjects reported that their family members also consumed the THR, while 33% stated that other members of their household did not consume it. This indicated that THR, intended for adolescent girls, was often shared within the household, potentially reducing the intended nutritional benefits for the targeted beneficiaries (Table 4.9).

Among the total respondents, 27% reported experiencing some nutritional improvements after consuming the Take-Home Ration (THR), while 73% stated that they did not observe any noticeable changes. This suggested that while a portion of the adolescent girls may have benefited from THR, a majority did not perceive significant nutritional improvements, possibly due to irregular consumption, sharing of THR within the household, or the overall quality and quantity of intake (Table 4.9).

Figure 4.12 Quality Perception of THR (N=300)

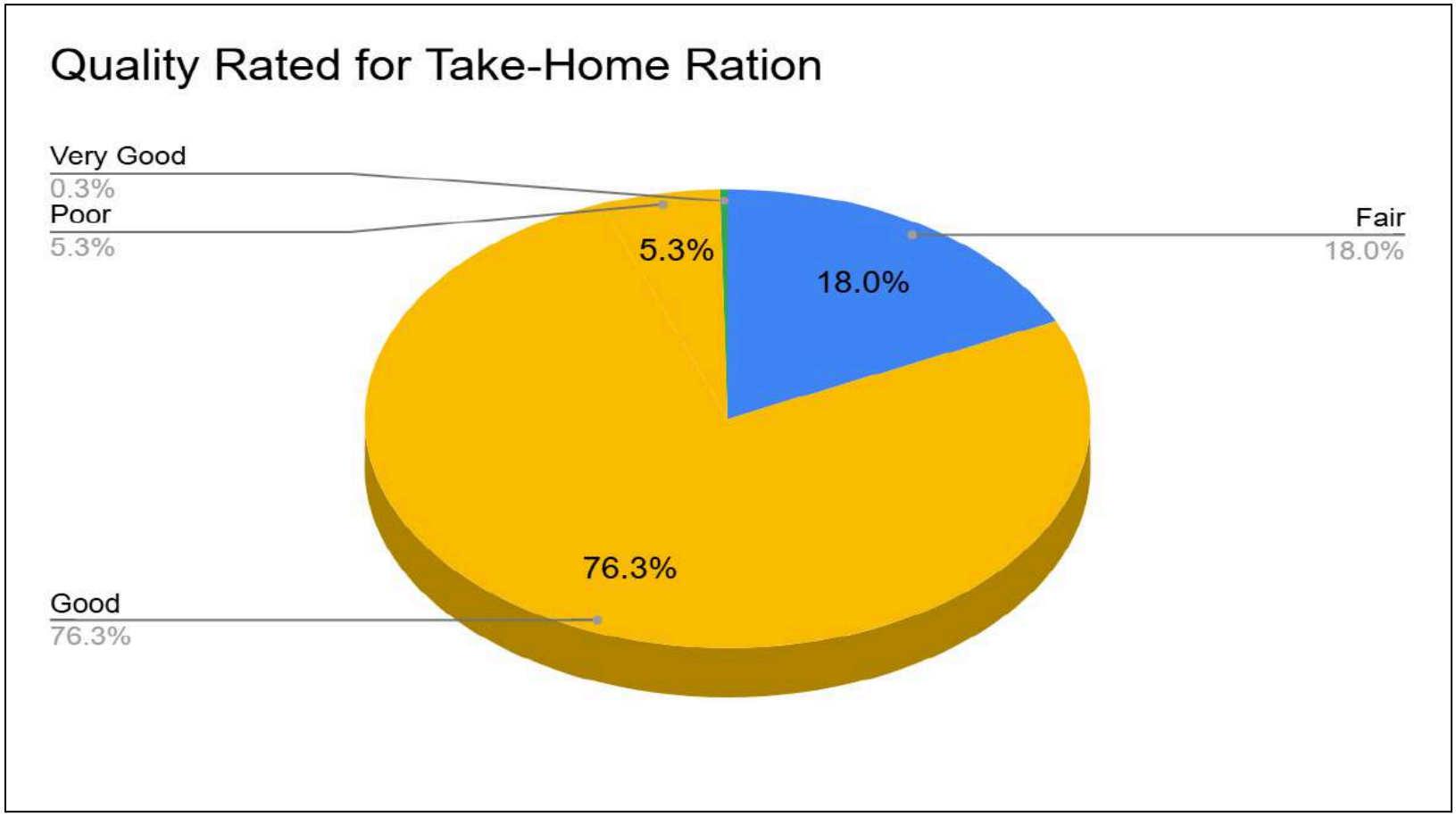


Table 4.9 Barriers to Utilization of THR (N=300)

Parameters	Categories	Respondents	
Reasons for not consuming THR (n=235)	I do not like the taste	199	84%
	Influence from others to avoid consuming THR.	1	0.42%
	Do not get enough time to prepare.	2	0.85%
	Never consumed	2	1%
	Not received THR.	1	1%
	Other	1	1%
	Perceived lack of variety	14	6%
	The texture of THR might not be appealing.	15	6%
Unused THR (n=235)	Feed Cattle	214	91%
	Give it to someone	9	38%
	Just keep it at home	5	2%
	Other household members use it.	7	23%
Received encouragement for consuming THR (n=300)	Yes	281	93%
	No	19	63%
Other family members consuming THR (n=300)	Yes	200	67%
	No	100	33%
Any Nutritional changes after THR consumption (n=300)	Yes	81	27%
	No	219	73%

Values in parentheses indicate percentages.

4.4 Dietary Practices Assessment

4.4.1 Frequency of Consumption of Various Foods

The frequency of food consumption among adolescent girls in rural Vadodara revealed significant dietary patterns. The dietary habits of adolescent girls revealed a strong preference for certain cereal products in their daily meals. The most frequently consumed cereal items included chapati (86% daily), bhakhri (77% daily), and rice (73% daily), indicating their staple nature in the diet. Additionally, 4.67% of participants consumed chapati once a week, while 13% consumed rice once a week, showcasing moderate variations in frequency. Phulka, another common flatbread, was consumed once a week by 7.67% of the participants, but a significant 56% reported never consuming it, suggesting regional or household-specific food preferences.

In contrast, certain cereal-based foods were consumed less frequently. Puri was consumed by 58.67% once a month and 20.33% once a week, reflecting its occasional inclusion in meals, likely during special occasions or festive meals. Similarly, bread was consumed once a month by 67% of participants, while 16% reported eating it once a week, suggesting it is not a staple but rather a supplementary food item. Other processed cereal products, such as puffed rice, were consumed twice a week by 13.3%, while 17.33% never consumed it, and 28.6% ate it once a week.

Consumption of traditional snacks like dhokla and flattened rice also varied among the adolescent girls. Dhokla was consumed once a month by 19.67%, whereas 21.33% never ate it, and 37% included it in their diet once a week. Similarly, flattened rice was consumed once a week by 36%, showing moderate consumption. Among staple dishes, khichdi was the most commonly consumed, with 91% eating it daily, reflecting its popularity as a nutritious, easy-to-digest meal. On the other hand, paratha was consumed once a week by 36%, suggesting that while it is not a daily food, it is still a part of the diet for a significant portion of the participants. These findings highlighted the dominance of traditional cereal products like chapati, bhakhri, rice, and khichdi in the

regular diet, while processed or deep-fried options such as puri, bread, and puffed rice were consumed less frequently.

Pulses such as dals and whole legumes were consumed at least once a week by most respondents, with 22.3% having dals daily, 14.3% consuming them on alternate days, 21.3% twice a week, and 36% once a week. This indicates that a majority of the girls (over 90%) included dals in their diets regularly, highlighting their importance as a primary protein source. Similarly, whole legumes were consumed daily by 16.67%, on alternate days by 13.33%, twice a week by 23%, and once a week by 30%. A small percentage (8.67%) reported never consuming whole legumes, indicating that while pulses and legumes are a staple, certain dietary patterns or preferences might limit their intake for some individuals.

Milk and milk products showed varied consumption patterns, with 34.7% consuming milk daily, 26.33% consuming paneer once a week, and a similar proportion (26.0%) consuming it only once a month. Notably, 32% of the respondents never consumed paneer, suggesting that it is not a staple food in their diet. This could be due to factors such as affordability, dietary preferences, or cultural eating habits. Given that paneer is a rich source of protein and calcium, its moderate consumption highlights a potential gap in dairy-based protein intake among adolescent girls. Encouraging its inclusion in meals, particularly for those who rarely or never consume it, could contribute to improved nutritional outcomes. The intake of butter among adolescent girls was very low, with 85.33% never consuming it, while only 7% consumed it once a week. This indicates that butter is not a common part of their diet, possibly due to dietary habits or economic constraints. Similarly, ghee consumption was also limited. While 10.3% of the respondents consumed ghee daily, a small proportion (8%) had it once a week. However, a significant 67.67% never consumed ghee, highlighting a potential lack of traditional fat sources in their diet.

Protein-rich foods like eggs, chicken, and fish were rarely included in the diet, with over 87% of respondents never consuming these items. Vegetables formed a crucial part of the daily diet among adolescent girls, with a high frequency of consumption observed across

different categories, Vegetables, particularly leafy greens and commonly used vegetables like tomatoes and brinjal, peas, were widely consumed daily (87.6% and 92.3%, respectively), highlighting their importance as a key source of iron, fiber, and essential vitamins. Root and tuber vegetables like onions, potatoes, radishes, and beetroots were also dietary staples, with 90.67% of the respondents eating them daily.

The consumption of yellow and orange vegetables like pumpkin and carrot showed considerable variation among respondents. Only 14% consumed them daily, while 5.67% ate them on alternate days. A moderate number of participants incorporated these vegetables twice a week (15%), whereas 25.67% included them once a week. However, 9.67% consumed them only once a month, and 27% never consumed yellow and orange vegetables. Given their high vitamin A content, the relatively low intake of these vegetables highlights a gap in dietary diversity, emphasizing the need for better nutritional awareness and interventions to promote their inclusion in daily diets.

Fruit consumption was lower, with only 37% of respondents consuming fruits daily, while 19% eating them twice a week, and 27.33% consuming them once a week. Among specific fruits, apple, banana, pear, and litchi were consumed daily by 36.33% of the participants, while 17% had them twice a week, and 28.67% included them once a week. Notably, 6.33% of respondents never consumed these fruits, indicating gaps in fruit intake.

The consumption of yellow-orange fruits, which are rich in vitamin A, showed a more distributed pattern. Almost one-fifth (22%) consumed them daily, 26.1% on alternate days, 20% twice a week, and 11.3% once a week, while 8.4% reported rare consumption. Amla, a rich source of vitamin C, was consumed daily by only 8.33%, twice a week by 9%, and once a week by 21.33%, whereas 46.33% of respondents never consumed amla, highlighting a gap in the intake of this nutrient-dense fruit. The overall fruit consumption data suggested the need for increased awareness regarding the importance of fruit diversity in daily diets.

The intake of dry fruits and oilseeds was sporadic, with over 50% rarely or never consuming them. Processed and convenience foods, including biscuits and tea, are

popular, with 67% consuming biscuits and 76.7% consuming tea daily. On the other hand, instant soups, coffee, and milkshakes were rarely consumed.

The overall dietary trends suggested a high reliance on staple grains, limited protein intake, and infrequent consumption of nutrient-dense foods like fruits, dry fruits, and protein sources, highlighting the need for improved nutritional awareness and dietary diversification. (Table 4.10)

Table 4.10 Frequency of consumption of various foods (N=300)

Food Item	Daily	Alternate days	Twice a week	Once a week	Twice a month	Once a month	Rarely	Never
Cereals (%)								
Chapati	86.0	5.0	3.33	4.67	3.33	0.67	0	0.33
Pulka	26.6	1.67	3.33	7.67	0.33	3.33	1.0	56.00
Bhakri	77.0	3.0	3.0	4.67	0	1.0	0	11.33
Puri	0.67	0.33	1.67	20.33	4.67	58.67	1.67	12.0
Bread	1.67	0.33	3.67	16.00	1.0	9.67	0.67	67.0
Rice	73.0	2.0	8.3	13.0	0	2.0	0	1.67
Puffed Rice	31.3	1.33	13.3	28.6	2.0	6.0	0	17.33
Dhokla, Khaman	0.67	2.33	3.67	37.6	3.67	19.67	0.33	21.33
Paratha	5.0	4.0	16.0	36.0	3.0	14.0	1.0	21.0
Flaked rice, Upma	7.67	5.0	15.0	36.0	2.67	6.0	0	27.67
Khichdi	91.0	1.33	1.33	3.67	0	0.67	0	2.0
Pulses (%)								
Dals	22.33	14.3	21.3	36.0	2.0	3.0	0	1.0
Whole legumes	16.67	13.33	23.0	30.0	2.33	5.67	0.33	8.67
Milk and Milk products (%)								

Food Item	Daily	Alternate days	Twice a week	Once a week	Twice a month	Once a month	Rarely	Never
Milk	34.67	2.0	3.0	9.33	0.67	0	0.33	50.0
Curd/ buttermilk	27.67	6.0	19.0	23.0	0.67	2.0	0	21.67
Paneer	0.33	2.0	7.67	26.33	4.67	26.0	1.0	32.0
Cheese	0.67	0.33	1.67	4.67	1.33	7.0	1.33	83.0
Butter	1.0	0.33	1.67	7.0	0.33	3.33	1.0	85.33
Ghee	10.3	2.0	5.3	8.0	2.0	4.3	0.3	67.67
Poultry, Meat, Fish (%)								
Eggs	0	0	2.67	5.67	0	4.0	0	87.33
Chicken, Chicken products	0	0.33	2.0	4.33	0.67	2.0	0	90.67
Meat	0	0.67	1.0	1.33	0	0.3	0	96.67
Fish	0	0	0.67	0.67	0.33	0	0.33	98.0
Vegetables (%)								
Green leafy vegetables	87.6	2.33	3.67	5.0	0.33	0.33	0	0.67
Cauliflower, ladyfinger, brinjal, peas, tomato	92.33	3.33	1.67	2.0	0.33	0.33	0	0

Food Item	Daily	Alternate days	Twice a week	Once a week	Twice a month	Once a month	Rarely	Never
Onion, potato, radish, Beetroot	90.67	3.67	3.0	1.67	0	0.33	0	0.67
Yellow & orange veg. pumpkin, carrot	14.0	5.67	15.0	25.67	2.33	9.67	0.67	27.0
Fruits Overall Consumption (%)	37.0	5.3	19.0	27.33	2.67	3.0	0.33	5.33
Apple, banana, Pear, Litchi,	36.33	6.0	17.0	28.67	1.67	3.67	0.33	6.33
Yellow-orange fruits	22.0	26.1	20.0	11.3	5.7	2.9	8.4	3.6
Amla	8.33	2.0	9.0	21.33	1.67	9.67	1.67	46.33
Dry fruits	16.67	2.67	6.67	24.0	2.0	13.0	0.67	34.33
Oil seeds	10.00	1.33	11.33	14.67	0.33	9.00	0.67	52.67
Biscuits	67.0	2.33	7.3	7.67	0	0.33	0	15.33
Instant soups	0	0.33	1.33	6.0	0.33	5.33	0.33	86.33

Food Item	Daily	Alternate days	Twice a week	Once a week	Twice a month	Once a month	Rarely	Never
Tea	76.67	0.33	1.67	0.67	0	0	0	20.67
Coffee	3.0	0	1.67	2.33	0.67	2.0	0.67	89.67
Milkshakes	2.0	0	0.67	4.67	0.33	2.33	0.33	89.67
Sweets	19.33	4.33	18.67	15.67	1.67	17.00	1.67	21.67
Snacks	39.0	4.0	10.0	14.0	1.0	2.33	0.67	29.0

Values in parentheses indicate percentages.

4.4.2 Dietary Diversity amongst the Subjects

Among the total respondents, 87.3% of girls consumed more than 5 food groups, meeting the minimum dietary diversity threshold. However, 37.6% had a dietary diversity score of only 5 or below, indicating a risk of inadequate micronutrient intake. Specifically, 12.6% consumed 5 or fewer food groups. Cereals (99.33%), Dark green leafy vegetables (90.33%), and other vegetables (91.66%) also had high intakes. Legumes, nuts, and seeds (71.66%), milk and milk products (71%), and Vitamin A-rich vegetables (66%) showed moderate intake. Sweets were consumed by 85% of the respondents. Vitamin A-rich fruits (4.66%) and other fruits (46.6%) had low intake. Animal protein sources were rarely consumed: flesh meat (0%), eggs (1.33%) (Table 4.11).

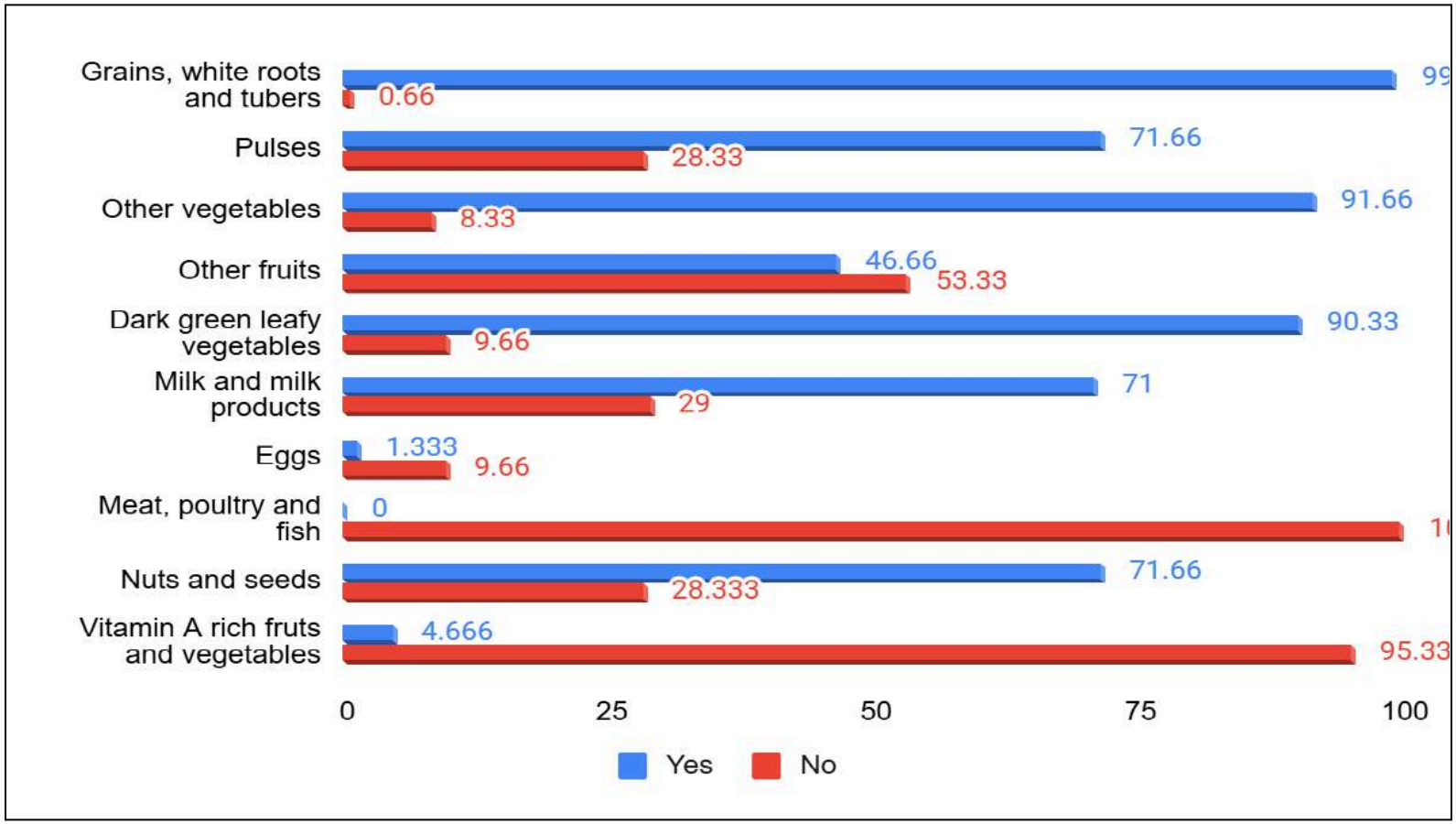
The results indicate that staple foods were widely consumed, while protein sources and fruits were severely lacking in the diets of adolescent girls. While a majority met the minimum dietary diversity criteria, interventions are needed to improve the intake of animal-source proteins, fruits, and micronutrient-rich foods to ensure balanced nutrition (Table 4.11).

Table 4.11 Food groups consumed (N=300)

No	Food groups	Frequency Yes n(%)	Frequency No n(%)
1	Grains, white roots, and tubers	298(99.3)	2(0.7)
2	Pulses	215(71.7)	85(28.3)
3	Other vegetables	275(91.7)	25(8.3)
4	Other fruits	140(46.7)	160(53.3)
5	Dark green leafy vegetables	271(90.3)	29(9.7)
6	Milk and milk products	213(71)	87(29)
7	Eggs	4(1.3)	296(9.7)
8	Meat, poultry, and fish	0 (0)	300 (100)
9	Nuts and seeds	215(71.7)	85(28.3)
10	Vitamin A-rich fruits and vegetables	14(4.7)	286 (95.3)

Values in parentheses indicate percentages

Figure 4.13 Dietary Diversity amongst the subjects (N=300)



4.4.3 MINIMUM DIETARY DIVERSITY WOMEN (MDD-W)

Dietary diversity was measured by counting the number of food groups consumed by the subjects as adapted from "MDD-W: A guide for measurement. "Minimum dietary diversity for women or MDD-W is a dichotomous indicator of whether or not women of 15-49 years of age have consumed at least 5 out of 10 defined food groups the previous day or night. The proportion of these women who achieve this minimum in a population can be used as a proxy indicator for higher micronutrient adequacy, as an important dimension of diet quality" (FAO Minimum Dietary Diversity for Women Guide 2021).

Study shows that 91.7% of the subjects consumed foods from five or more food groups out of the 10 specified food groups the previous day. Only 8.3% consumed fewer than 5 food groups. The analysis revealed that for the 10 food groups, the mean score was 6.06 ± 1.209.The dietary diversity score across different stages of adolescence shows slight variation, reflecting subtle shifts in eating habits as girls grow older. Pre-adolescent girls (mean DDS = 6.22 ± 1.13) exhibited the highest dietary diversity, possibly due to greater parental control over meal planning and food choices. In early adolescence, the mean DDS slightly declined to 5.96 ± 1.24; during mid-adolescence, the mean score modestly increased to 6.01 ± 1.24, suggesting a slight improvement in food variety, though still below pre-adolescent levels. By late adolescence, the dietary diversity improved further to 6.12 ± 1.19. Overall, while dietary diversity remains relatively consistent across stages (Figure 4.15).

Figure 4.14 Minimum Dietary Diversity for Women (MDD-W) (N=300)

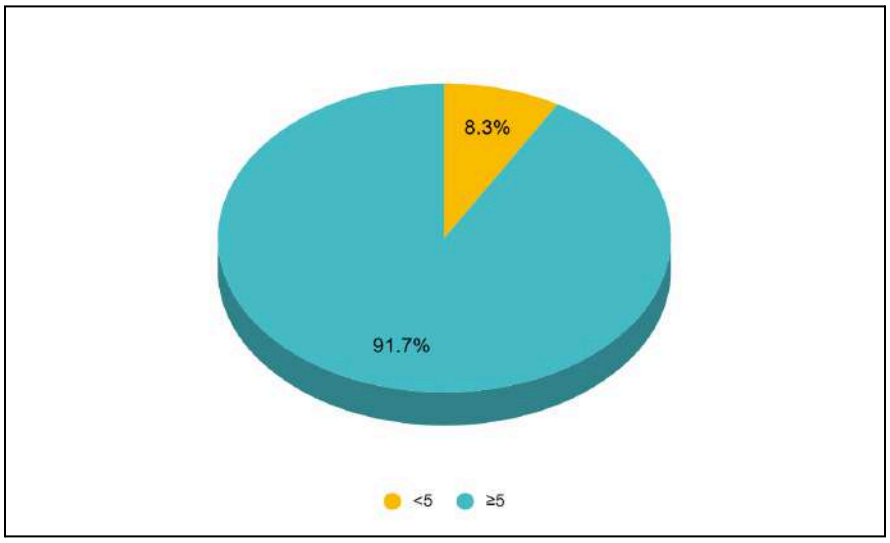
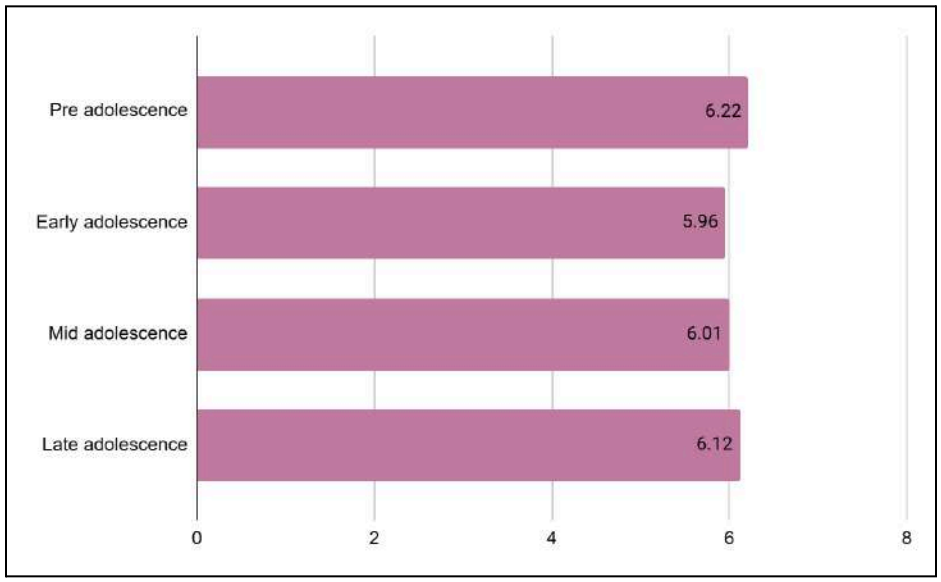


Figure 4.15 Mean Dietary Diversity Score-Agewise (N=300)



PHASE II (A): DEVELOPMENT OF NUTRIENT-RICH RECIPES USING THR

This stage involved creating nutrient-dense recipes using locally sourced ingredients and combining adolescent girls' take-home ration (THR), which was given by ICDS. Various recipes were developed and standardized using THR. Names of the recipes developed were;

- Shakarpara
- Carrot-Beet idli
- Methi mathri
- Besan barfi
- Mixed vegetable handvo
- Moong dal chilla
- Moringa paratha
- Missi roti
- Cabbage muthiya
- Coconut gujiya

PHASE-II (B) SENSORY EVALUATION OF RECIPES AND DEVELOPMENT OF VIDEOS

This phase assessed the organoleptic attributes of the developed recipes, followed by the development of videos demonstrating acceptable recipes and sharing videos with beneficiaries, along with general information about THR.

In this phase, the selection of panel members was carried out using threshold testing. The threshold is defined as a stimulus scale at which a transition in a series or judgment occurs. For conducting this test, a scorecard was prepared and pre-tested. Each perspective panel member was given three sets of the solution, i.e., Set 1, Set 2, and Set 3, having three solutions of different concentrations of salt, sugar, and citric acid, respectively, and the sets were arranged in random order. The participants were asked to identify and rank the samples according to the concentration of taste from the test solutions offered. 45 subjects were enrolled to carry out sensory evaluation, and 30

subjects who passed the threshold test were included further for sensory evaluation of the developed recipes.

The organoleptic evaluation tool selected was the Hedonic Rating Scale and composite rating scale.

Hedonic Rating Scale

This is a test that uses a 7-point rating scale ranging from “Like very much” to “Dislike very much,” with “neither like nor dislike” as the middle score, to help identify the most or least liked product from the various recipes.

Composite Rating Scale

The 10-point scoring test was conducted so that specific characteristics of the product could be rated separately. It helps to point out which specific attribute is not acceptable or is at fault. All the developed recipes were evaluated for the following attributes: Colour and appearance, Aroma, Texture, Taste, Aftertaste, mouthfeel, and Overall acceptability. To check the acceptability for the following 10 prepared recipes, the sensory organoleptic evaluation was conducted with 30 panel members selected based on the Threshold test.

4.5.1 Rating of Developed Recipes Based on the Hedonic Scale

The sensory evaluation of recipes based on the Hedonic scale revealed that Handvo received the highest preference, with 76.7% of participants rating it under the "Like very much"category, followed closely by Mathri at 60% in the same category. Most recipes were well-received, with minimal or no "Dislike" ratings, indicating a high level of acceptability. Paratha had a more mixed response, with 10% rating it as "Like very much," 50% as "Like moderately," and 3.33% as "Dislike moderately."

Figure 4.16 Hedonic Scale Rating for Shakarpara

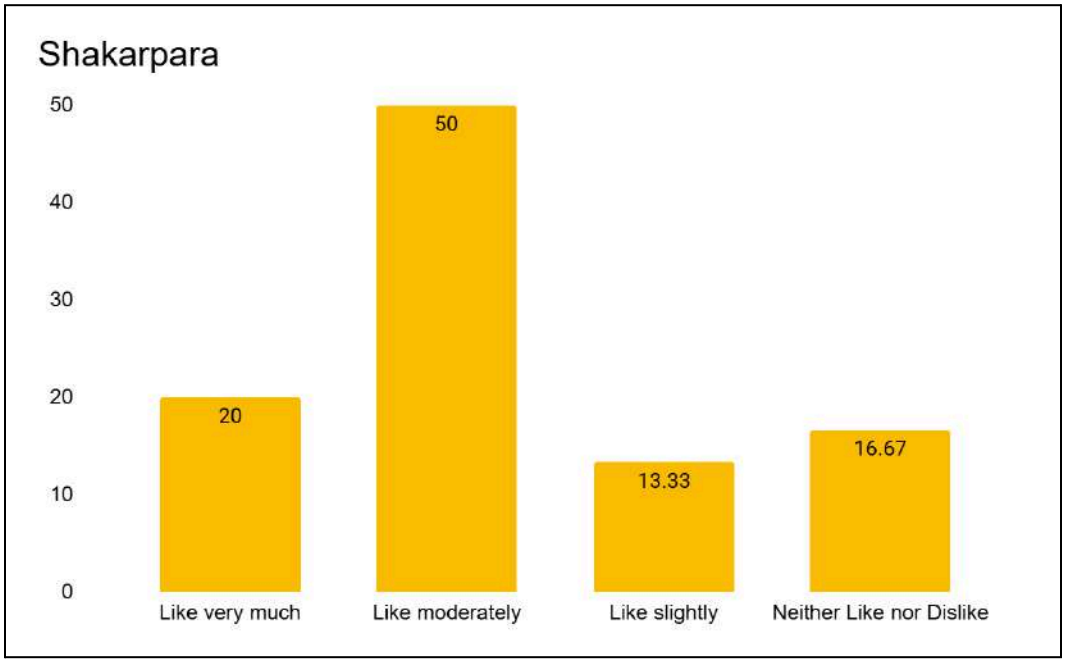


Figure 4.17 Hedonic Scale Rating for Idli

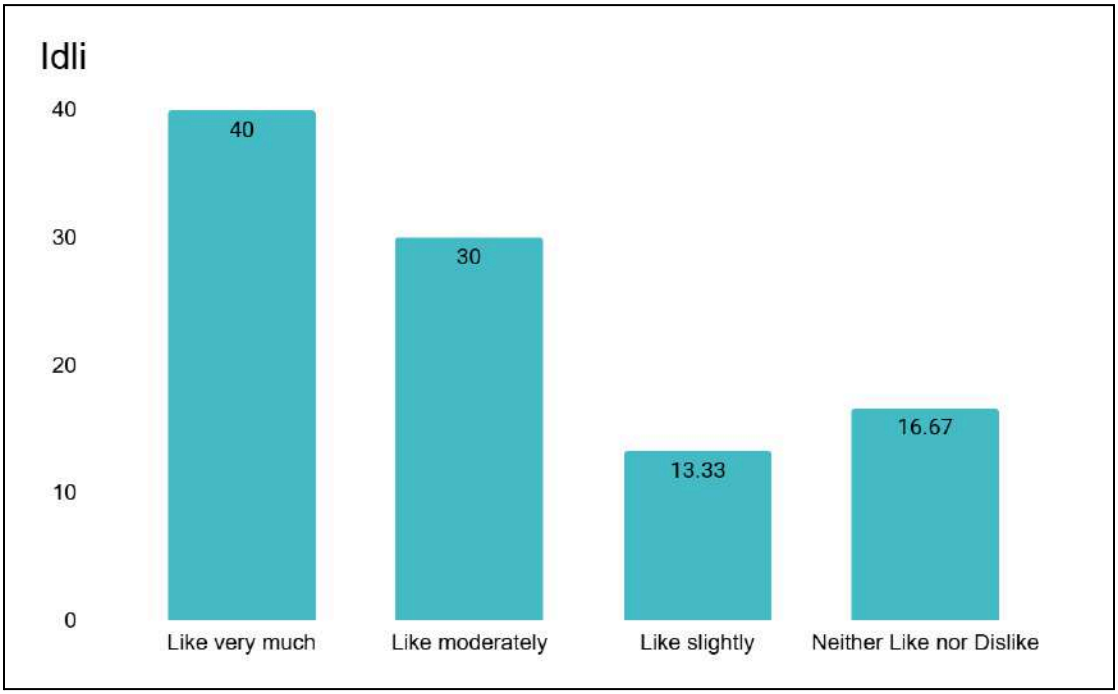


Figure 4.18: Hedonic scale rating for mathri

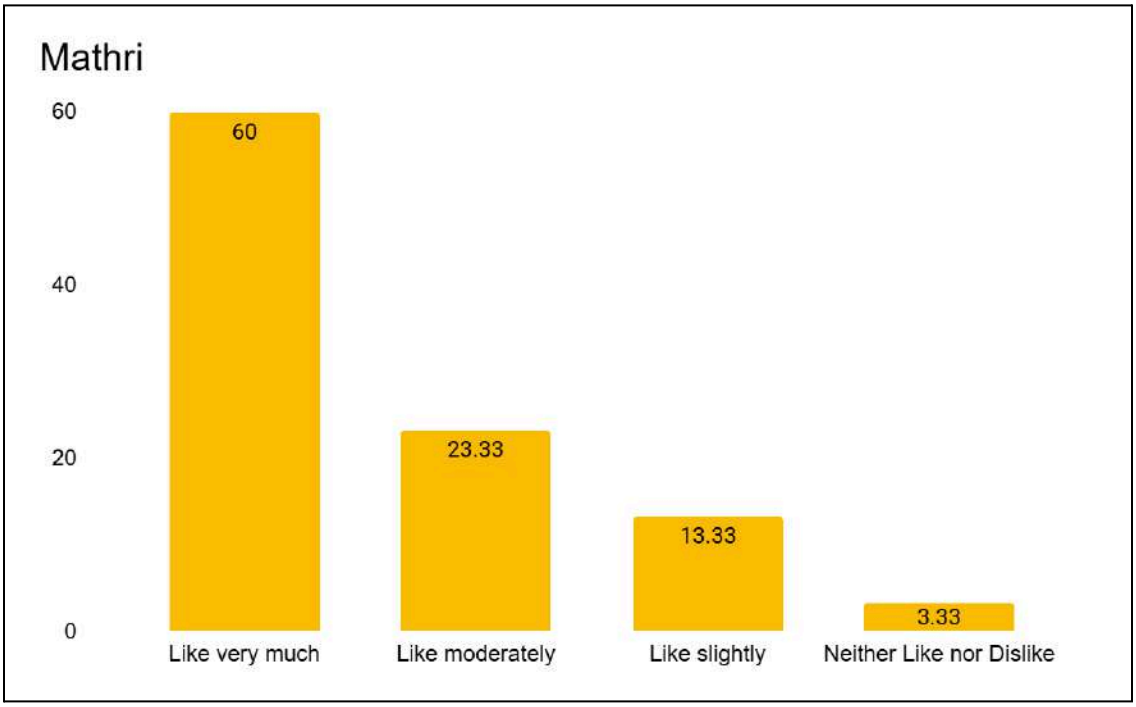


Figure 4.19: Hedonic scale rating for barfi

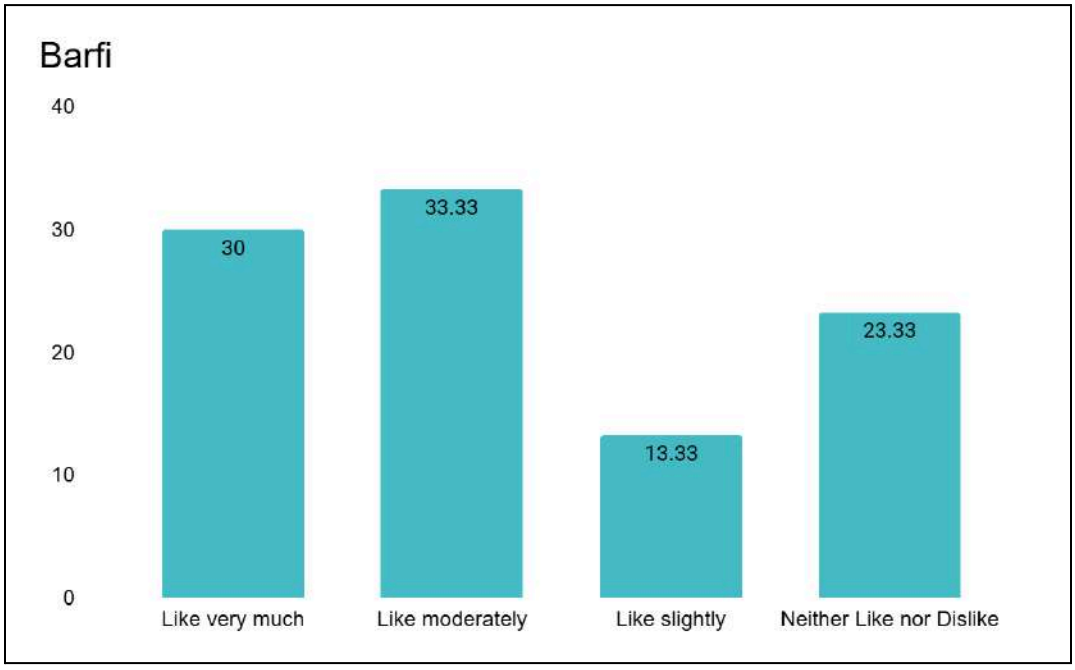


Figure 4.20: Hedonic scale rating for Handvo

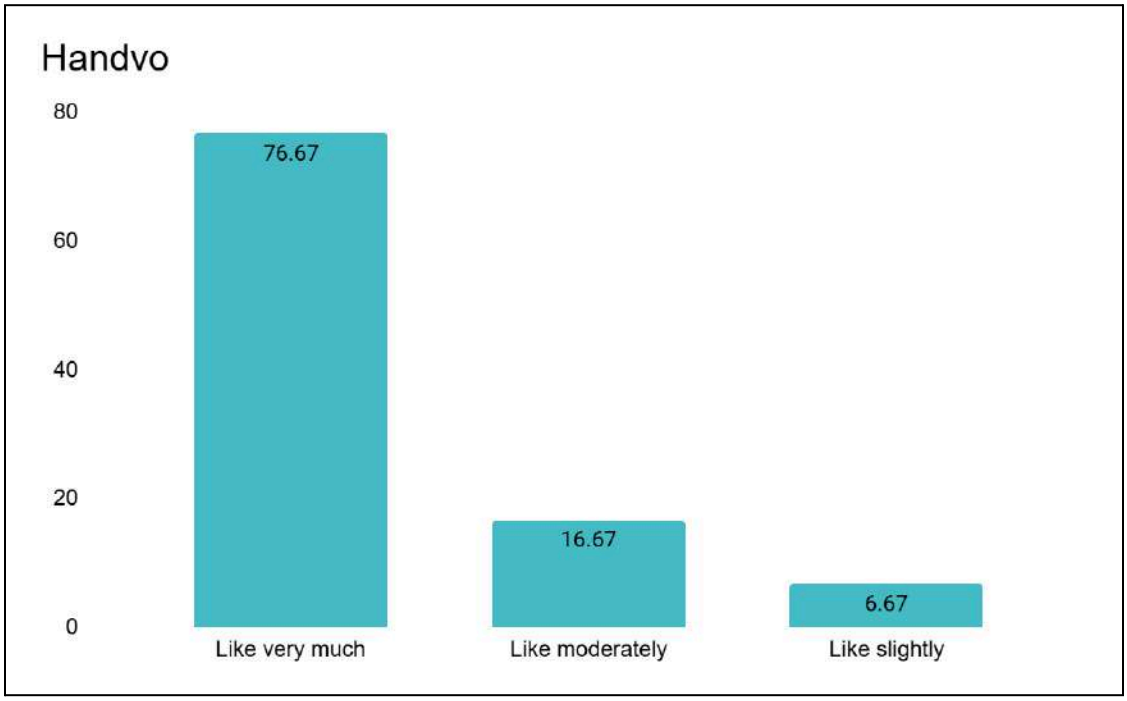


Figure 4.21: Hedonic scale rating for moongdal chilla

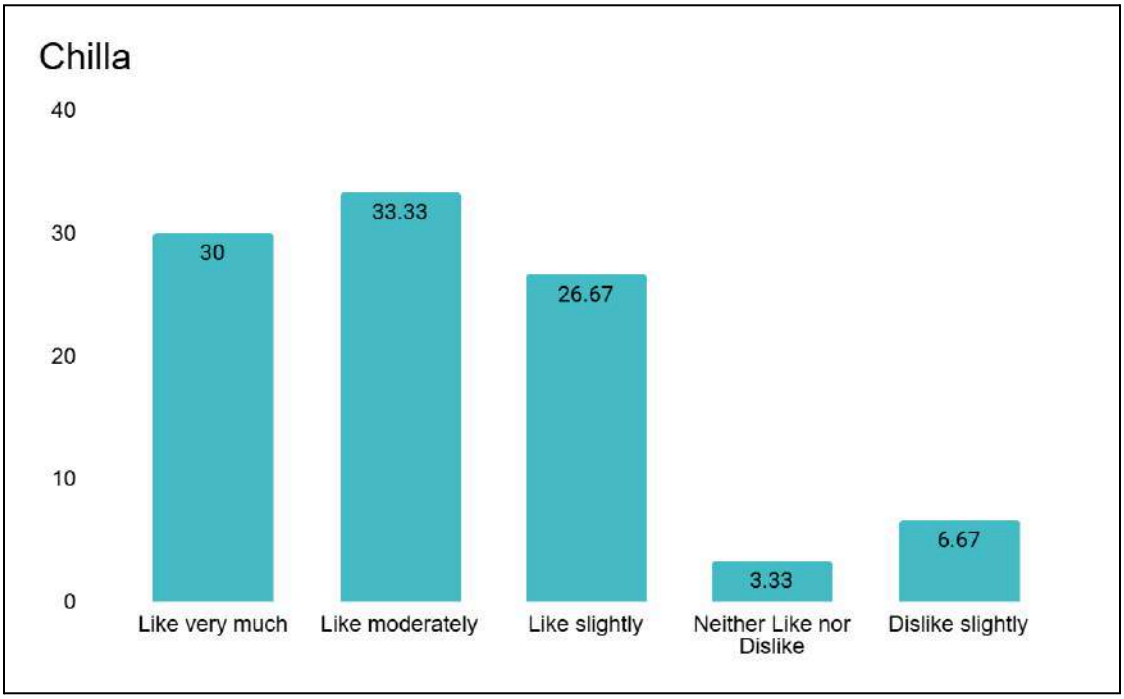


Figure 4.22: Hedonic scale rating for paratha

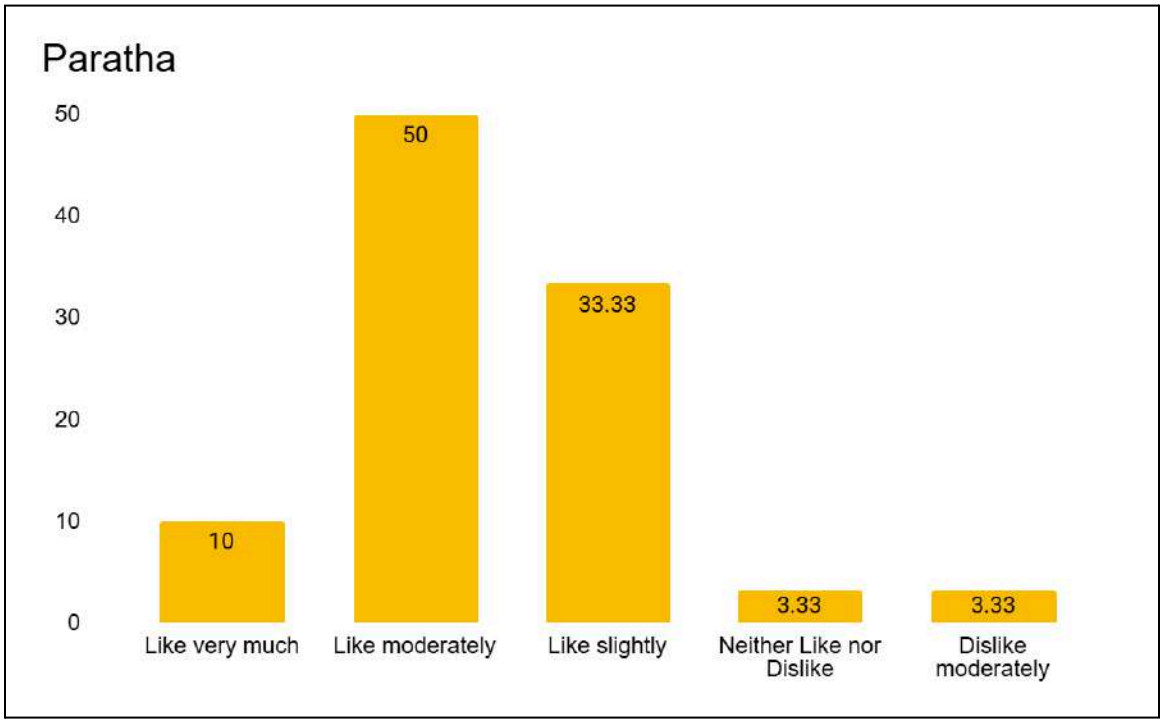


Figure 4.23: Hedonic scale rating for missi roti

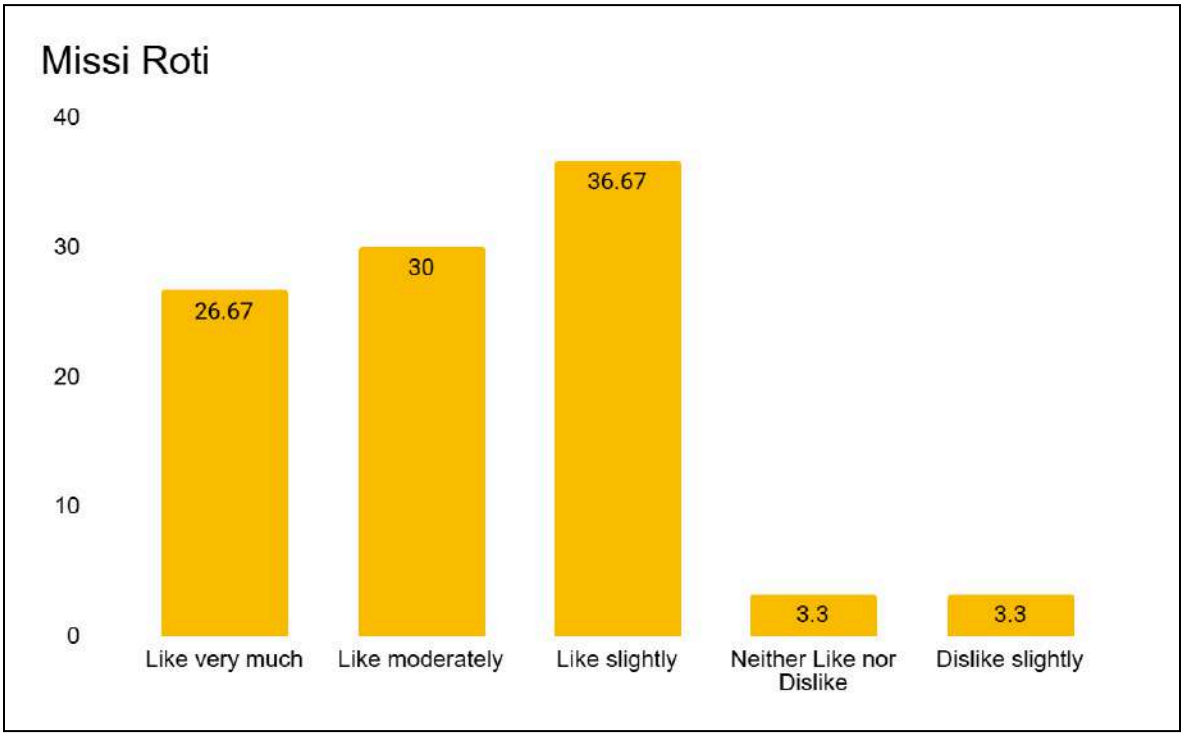


Figure 4.24: Hedonic scale rating for muthiya

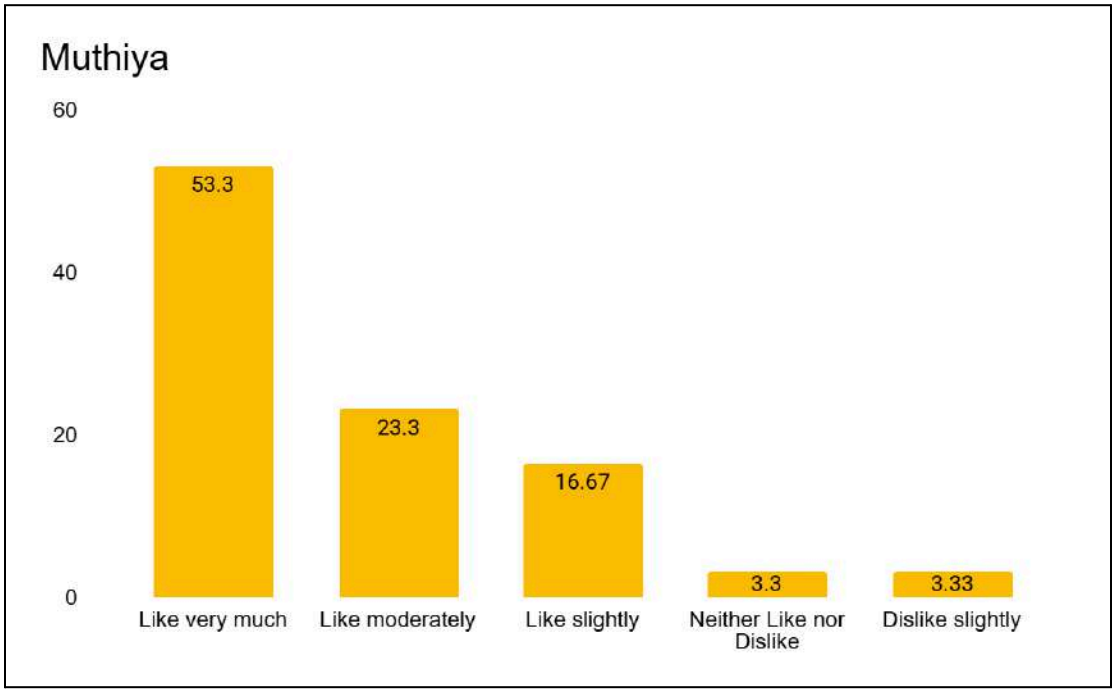
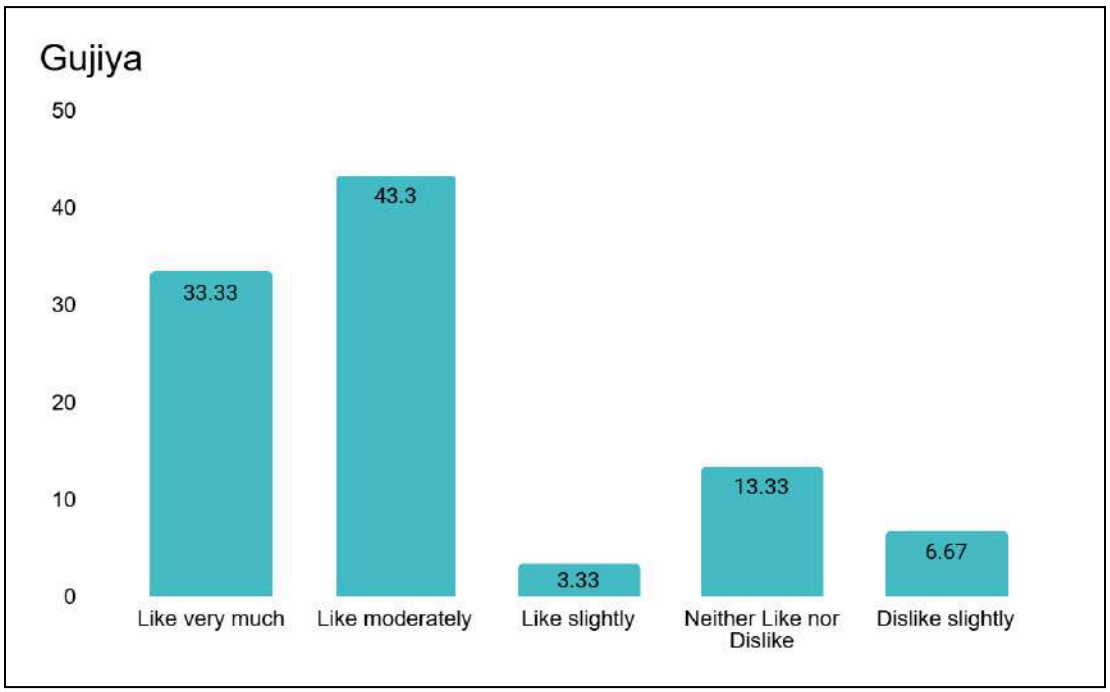


Figure 4.25: Hedonic scale rating for gujiya



4.5.2 Analysis of Composite Scale Ranking for Different Recipes

1. Shakarpara

Shakarpara was one of the highly rated recipes, particularly appreciated for its crunchy texture mean 8.300±1.417 and appealing appearance 17.0±2.83. It received consistently high scores in mouthfeel and overall acceptability, 17.3±2.23. However, the taste was rated slightly lower compared to other attributes, indicating that while the texture and appearance were well-received, there may be room for slight improvements in flavor.

2. Carrot-Beet Idli

Idli was a well-liked recipe, receiving high scores for its soft texture and uniform appearance 16.9±3.86. Panelists appreciated its lightness and smooth consistency, making it a favorable choice. The color 8.817±1.567 of the idli was rated highly, which suggests that the preparation method resulted in an appealing visual presentation. However, some panelists rated the mouthfeel slightly lower, indicating that minor textural refinements could further enhance its acceptability.

3. Methi Mathri

Mathri emerged as one of the top-rated recipes across all sensory parameters. Panelists particularly liked its crispy texture 9.167±1.01, golden-brown color 9.210±1.06, and balanced taste. The high scores in color and taste suggest that the recipe was well-executed and met the expectations of the evaluators. The overall acceptability of Mathri was among the highest, making it one of the most successful recipes in this evaluation.

4. Besan Barfi

Barfi had a balanced rating across all attributes, indicating a well-received product. The texture 8.917±1.06 and color were appreciated by the panelists, highlighting its smooth consistency and appealing appearance 17.1±2.37. However, the taste received slightly lower scores, suggesting that while the sweetness level was acceptable at 17.2±2.39, there may be room for flavor enhancement to make it more appealing.

5. Mix veg Handvo

Handvo was one of the most favored recipes in the study, receiving exceptionally high ratings in color 9.533±0.68, texture 9.400±0.8550, and overall acceptability 19.2±1.48. The golden-brown crust and soft, flavorful inside contributed to its strong preference among panelists. The recipe was appreciated for its moist yet firm texture, making it a highly recommended preparation.

6. Moongdal Chilla

Chilla received moderate ratings across all attributes, with texture being the least appreciated aspect. While it was accepted by most panelists, improvements could be made to enhance its mouthfeel and crispness. The overall acceptability was decent at 16.5±2.23, indicating that the recipe was generally well-received but had room for slight modifications.

7. Moringa Paratha

Paratha was among the lower-rated recipes, primarily due to its texture and feel in the mouth. Some panelists found it less appealing compared to other recipes, possibly due to variations in preparation methods or ingredient composition. While the taste was acceptable, the overall acceptability of 15.9±2.54 was slightly lower, indicating that adjustments in flavor balance and texture could enhance its ratings.

8. Missi Roti

Missi Roti performed well in all categories, particularly in color and taste. The golden-brown appearance and earthy flavor of the dish were appreciated by panelists. The overall acceptability was high at 16.9±2.75, showing that this traditional recipe was well-accepted and could be a good option for incorporation into regular meals.

9. Cabbage Muthiya

Muthiya was one of the strongest performers, receiving high ratings across color, taste, and overall acceptability 18.2±2.31. The soft, steamed texture combined with its savory

taste made it a popular choice. Many panelists appreciated its balanced flavor and visually appealing presentation, contributing to its high acceptability.

10. Coconut Gujiya

Gujiya received moderate-to-high ratings, with its appearance being its most appreciated attribute. The golden-brown crust and traditional shape were appealing to the panelists. However, the taste and mouthfeel were slightly lower in comparison, suggesting that minor improvements in the sweetness level or filling consistency could enhance its overall acceptability.

Among all the recipes, Mathri and Handvo were the most well-received, showing the highest ratings in overall acceptability. On the other hand, Chilla and Paratha received relatively lower scores, primarily due to texture and mouthfeel concerns. Recipes that featured a crispy or well-balanced texture with appealing color tended to perform better. The findings suggested that texture, taste, and visual appeal play a significant role in determining the acceptability of a dish, and slight modifications can further improve lower-rated recipes.

Table 4.12: Composite Rating scale ranking for THR incorporated recipes

Recipes	Color (10)	Texture (10)	Taste (20)	Mouth feel (10)	Appearance (20)	After taste (10)	Overall acceptability (20)	Total Score (100)
Shakarpara	8.500±1.14	8.300±1.42	15.5±4.58	7.72±1.66	17.0±2.83	8.07±1.96	17.3±3.23	82.4±13.2
Idli	8.817±1.56	8.717±1.40	17.7±3.13	8.250±1.784	16.9±3.86	8.317±1.5674	17.8±2.19	86.0±11.8
Mathri	9.210±1.06	9.167±1.01	18.3±2.33	9.03±1.09	18.1±2.30	9.10±1.30	18.8±1.30	91.7±9.62
Barfi	8.70±1.24	8.92±1.07	16.8±2.87	8.433±1.36	17.1±2.37	8.03±1.63	17.2±2.39	85.2±10.6
Handvo	9.53±0.68	9.40±0.855	18.8±2.27	9.27±1.01	18.5±2.19	9.400±0.968	19.2±1.48	94.1±8.26
Chilla	8.733±1.01	7.97±1.43	16.2±2.95	7.917±1.25	16.0±2.57	7.97±1.19	16.5±2.23	81.3±9.86
Paratha	8.300±1.57	8.000±1.58	15.2±2.97	7.433±1.41	15.7±1.63	7.690±1.46	15.9±2.54	78.3±12.3
Missi Roti	8.43±1.36	8.27±1.48	16.9±2.72	8.17±1.32	16.8±2.86	8.32±1.16	16.9±2.75	83.7±11.5
Muthiya	9.12±1.28	8.90±1.37	17.9±2.44	8.81±1.32	17.6±2.50	9.07±1.20	18.2±2.31	89.7±11.3
Gujiya	8.67±1.66	8.27±1.64	16.1±3.42	7.93±1.76	17.1±3.00	8.10±1.92	16.8±3.08	82.9±15.1

Values in parentheses indicate percentages.

Development of videos

A total of 10 demonstration videos were developed to guide adolescent girls and their families on how to effectively utilize Take-Home Ration (THR) ingredients in preparing nutritious and culturally acceptable recipes. Each video was designed to provide clear, step-by-step instructions to ensure easy replication at the household level.

Introduction to Take-Home Ration and Its Ingredients

- ★ Each video begins with a brief introduction to the Take-Home Ration (THR) program, highlighting its significance in improving adolescent nutrition.
- ★ Information was provided on the nutritional benefits of THR ingredients such as cereals, pulses, and fortified foods.
- ★ The importance of utilizing THR effectively to enhance daily nutrient intake is also emphasized.

Detailed Ingredient List with Specific Measurements

- ★ A comprehensive list of ingredients required for the recipe was displayed.
- ★ The exact quantities of each ingredient are mentioned.
- ★ Special attention was given to locally available and affordable ingredients to encourage widespread adoption.

Step-by-Step Cooking Process

- ★ The videos provided easy-to-follow cooking instructions.
- ★ The method of preparation, including washing, cutting, mixing, and cooking techniques, was clearly explained.
- ★ Alternative cooking methods (e.g., steaming instead of frying) were suggested to promote healthy cooking practices.
- ★ A well-captured photo of the finished recipe was displayed to provide a visual reference for viewers.

Conclusion

The study highlighted the coverage and utilization of Take-Home Ration (THR) among adolescent girls, revealing that while THR is available, its acceptance and regular consumption vary, often influenced by factors. The nutritional status assessment indicates that undernutrition remains a concern, with a notable proportion of girls being thin and stunted as per WHO 2007 growth standards. Dietary diversity analysis showed that 91.7% of girls consumed five or more food groups, yet the intake of protein-rich foods and vitamin A-rich fruits remained low, indicating dietary gaps. To enhance THR utilization, nutrient-rich, culturally acceptable recipes were developed and evaluated, ensuring better palatability and acceptance. These findings emphasize the need for strengthening nutrition education, improving THR distribution, and promoting innovative dietary strategies to enhance adolescent health outcomes.

DISCUSSION

The nutritional status of adolescent girls in the present study highlighted a concerning prevalence of thinness. In the present study, 3% of adolescent girls were found to be severely thin, 17% were moderately thin, and 31.7% were mildly thin. Comparatively, NFHS-5 (2019-2020) reported 52.5% total thinness, with 27.4% classified as severely or moderately thin and 25.1% as mildly thin. While the NFHS-5 data suggests a higher overall burden of thinness, the present study indicates a greater proportion of mild thinness, which could reflect differences in sampling, data collection methods, or regional dietary patterns. This comparison highlights the persistent issue of adolescent malnutrition and the need for continued nutrition-focused interventions (NFHS-5, 2019-2020).

The CNNS (2016-2018) findings also emphasized the burden of thinness among adolescent girls, though they report slightly lower figures compared to NFHS-5. The CNNS data shows that 40.7% of adolescent girls were thin, with 10.8% classified as severely or moderately thin and 30.2% as mildly thin. The present study reports a lower proportion of severely thin adolescents (3%) but a higher mild thinness prevalence (31.7%), which aligns closely with CNNS data. This suggests that while severe undernutrition may have improved slightly, a large proportion of adolescent girls continue to suffer from mild undernutrition, indicating the need for enhanced dietary interventions and nutrition education (CNNS, 2016-2018).

A departmental study by Dhruv and Ahir (2018) reported that the prevalence of moderate stunted was 36.7%, followed by 8.5% severe stunting amongst adolescent girls. It was observed that 34.7% were mildly thin, 10.1% moderately thin, and 3.5% severely thin.

Similarly, Parmar et al. (2022) found that 50% adolescent girls were totally thin, with 22.4% classified as moderately to severely thin and 5.2% experiencing severe thinness, while 28.2% were mildly thin. Compared to this, the present study reports a lower proportion of severe and moderate thinness but a slightly higher prevalence of mild thinness. These variations could be attributed to regional differences in dietary habits, socioeconomic factors, or sample characteristics, yet both studies emphasize that mild

thinness remains a major concern that requires nutrition-focused policies and interventions (Parmar et al., 2022).

Another study by Trivedi P. et al. (2016) reported that 17% of adolescents were severely thin, while 30.8% were classified as thin overall. Among females, 27.4% were thin, and 18.9% were severely thin, emphasizing a severe nutritional crisis among rural adolescents in Gujarat. The persistent high burden of mild thinness (31.6%) in the present study underscores the ongoing risks of chronic malnutrition and poor growth outcomes. Both studies stress the need for targeted nutrition programs, particularly in rural Gujarat, along with school- and community-based interventions to enhance adolescent nutrition and prevent long-term health consequences.

The comparison between the study by Nair A. et al. (2015) and the present study reveals a consistently high burden of stunting among adolescent girls, indicating significant growth retardation and chronic undernutrition. Nair A. et al. (2015) found that 48.37% of adolescent girls were stunted, with early adolescents (57.60%) and primary school girls (59.52%) being the most affected. This suggests that younger girls were at greater risk, likely due to poor early childhood nutrition and inadequate dietary intake during critical growth periods. In contrast, the present study reported 10.3% severe stunting (≤ -3 SD), 36.3% moderate stunting (-3 SD to -2 SD), and 42% mild stunting (-2 SD to -1 SD), with only 11.3% of adolescents falling within the normal height range. While the overall prevalence is comparable, the present study provides a more detailed breakdown of severity levels, showing that a significant proportion (42%) of adolescents experience mild stunting, which, although less severe, still indicates chronic nutritional deprivation and suboptimal growth.

The stunting prevalence in the present study was significantly higher compared to the findings of Saha et al. (2021). In the current study, 10.3% of adolescent girls were classified as severely stunted (≤ -3 SD), 36.3% were moderately stunted (-3 SD to -2 SD), and 42% exhibited mild stunting (-2 SD to -1 SD). This means that a total of 88.6% of the adolescent girls had some degree of stunting, which is alarmingly high and suggests chronic undernutrition and growth retardation.

The findings of the present study indicated a progressive increase in stunting prevalence across different stages of adolescence, with 10% in pre-adolescence, 21% in early adolescence, 27% in mid-adolescence, and 30% in late adolescence. This pattern highlighted a worsening nutritional deficit over time, suggesting that adolescents did not receive adequate nutritional support during their critical growth years. The increasing trend in stunting prevalence as age advances implies that growth faltering is not adequately addressed in earlier stages, leading to deficits in height during late adolescence.

The utilization of Take-Home Ration (THR) was found to be suboptimal in the present study, aligning with previous research that reported a significant gap between THR distribution and actual consumption. In this study, only 21.67% of adolescent girls consumed THR regularly, while 24.67% did not consume it at all. This discrepancy was also observed in Smaranita et al. (2021), where 78.3% of beneficiaries were recorded as receiving THR, but only 70.8% of adolescent girls consumed it. The gap between provision and utilization suggests issues such as food acceptability, awareness, and distribution challenges, which reinforces the need for improved program monitoring and outreach efforts (Smaranita et al., 2021).

Similarly, Khan et al. (2016) identified a stark difference between reported THR distribution and actual consumption. While Anganwadi records indicated a 78.8% utilization rate, self-reported data revealed that only 24.2% of adolescent girls consumed THR, with just 22.8% consuming it regularly. These findings mirror the present study, where a substantial proportion of girls rarely or never consumed THR, indicating that official distribution figures do not always reflect actual utilization patterns. This highlights the need for a more transparent monitoring system to ensure that THR is not just distributed but also effectively consumed (Khan et al., 2016).

The Maharashtra THR Report (2019) further supports this trend, revealing that 66% of adolescent girls did not consume THR at all, primarily due to lack of accessibility, inadequate knowledge, and general disinterest. The present study similarly found that a large proportion of girls either did not consume THR or consumed it infrequently,

reinforcing the urgent need for awareness programs to improve THR acceptance. These findings suggest that low THR consumption is a widespread issue across multiple regions, and addressing barriers such as taste, convenience, and awareness could significantly enhance its impact (Maharashtra THR Report, 2019).

One of the most significant barriers to THR consumption in the present study was taste and acceptability, with 85% of respondents citing taste as the primary reason for non-consumption. This issue was also highlighted by Smaranita et al. (2021), where 53.8% of beneficiaries disliked the taste, discouraging them from regular consumption. Improving the flavor profile and variety of THR could significantly enhance its acceptability, making it a more appealing nutrition source for adolescent girls (Smaranita et al., 2021).

Beyond taste, Sisodiya et al. (2022) identified preparation difficulties as another major barrier, with 31% of beneficiaries lacking time to prepare THR-based meals and 24% finding it difficult to prepare separate meals for adolescent girls. In the present study, while only 0.8% of respondents cited time constraints, the issue of meal preparation difficulties aligns with Sisodiya et al.'s findings, emphasizing the need for ready-to-eat THR formulations or simple preparation methods (Sisodiya et al., 2022).

When adolescent girls do not consume THR, it is often misused or wasted, further reducing its impact. In the present study, 91% of non-consumers reported feeding THR to cattle, which mirrors findings from Trivedi et al. (2023). Anganwadi workers in Trivedi et al.'s study observed that many beneficiaries threw away THR rather than consuming it, while some fed it to livestock due to its perceived high protein content. The present study further confirms that economic considerations often lead families to prioritize livestock feeding over adolescent nutrition, highlighting the need for stricter monitoring and behavioral change campaigns to ensure that THR is consumed as intended (Trivedi et al., 2023).

Finally, limited awareness and knowledge about THR's nutritional benefits emerged as a significant concern in the present study, with 70% of adolescent girls being unaware of its benefits. This aligns with findings by Sisodiya et al. (2022), where they reported that

many beneficiaries lacked knowledge about how to prepare THR-based meals, contributing to its low acceptance. Similarly, Trivedi et al. (2023) reported that some respondents questioned the nutritional value of THR, reflecting a broader need for stronger education campaigns and community engagement initiatives (Sisodiya et al., 2022; Trivedi et al., 2023).

Singh M. et al. (2015) emphasized that supplementary nutrition services are more accessible and better utilized in urban areas, while rural beneficiaries face challenges such as supply chain inefficiencies, lower awareness, and food acceptability issues. The low THR consumption (21.67%) in present rural study suggests that accessibility and awareness issues persist, reinforcing Singh M. et al.'s argument that strengthening monitoring systems and outreach initiatives is essential to improving THR adoption (Singh M. et al., 2015).

The present study found that only 21.67% of adolescent girls consumed THR, while 24.67% did not consume it at all, and 53.67% of non-consumers consumed it rarely, indicating low acceptance and adherence due to barriers like taste, variety, and awareness. Malnutrition was prevalent, with 3% severely underweight, 17% moderately thin, and 31.6% mildly THIN. In contrast, a departmental study in urban Vadodara (Gala et al., 2023) reported 15.06% thinness, 4.83% severe thinness, and 7.10% stunting, suggesting lower malnutrition rates likely due to better food access and health services. Despite 99.15% receiving THR, only 73.86% consumed it, and just 4.55% consumed it daily, highlighting irregular intake.

This highlights a geographical disparity in THR utilization and malnutrition prevalence. The current study (rural Vadodara) exhibited lower THR consumption rates (21.67%) than the urban Vadodara study (73.86%), indicating that urban adolescents were more likely to consume THR when provided, possibly due to better awareness. However, in both cases, the proportion of girls consuming THR daily remained low, reinforcing the challenge of ensuring consistent and effective intake. In terms of malnutrition, the current study reported higher rates of thinness and stunting compared to the urban study, which

can be attributed to poorer dietary diversity, lower health service coverage, and more persistent food insecurity in rural areas.

The present study highlighted key suggestions from Anganwadi workers and adolescent girls regarding Take-Home Ration (THR) improvements. Many adolescents preferred a spicy THR premix, as they previously received Spicy Upma, and disliked the current sweet premix. The major barriers to THR consumption included its sweetness, lack of preparation time, and limited awareness about its ingredients and benefits. While Anganwadi workers encouraged consumption, many girls lacked knowledge about THR's nutritional value and often shared it with family members rather than consuming it themselves.

To address these challenges, recipes were developed, incorporating THR into easy-to-make, storable recipes using locally available ingredients and aligned with adolescent food preferences observed during the survey. These recipes aimed to balance out the sweetness and provide practical preparation solutions. Additionally, demonstration videos were developed to increase awareness by explaining THR’s ingredients, benefits, and importance for adolescent health. This initiative ensures that THR becomes more acceptable, accessible, and regularly consumed, ultimately improving adolescent nutrition.

SUMMARY AND CONCLUSION

The purpose of the study was to assess the Utilization of a Take-Home ration provided to adolescent Girls (15-18 years) in rural Vadodara and to develop nutrient-rich recipes for promoting healthy diets.

The chapter presents the summary of the present study. One rural block was randomly selected from the two rural blocks of rural Vadodara. Within this block, 63 Anganwadi Centers (AWCs) were randomly chosen, ensuring a representative sample of adolescent girls accessing supplementary nutrition services. Finally, 300 adolescent girls aged 15-18 years who were registered with the Anganwadi were randomly selected and enrolled in the study after obtaining their consent.

Phase-I Situational Analysis

Phase-I was conducted to obtain the socio-demographic data, anthropometric data, knowledge, attitude and practice regarding consumption of Take-Home ration, and dietary practices were recorded through the food frequency questionnaire method, and Minimum dietary diversity score for Women (MDD-W) was calculated based on dietary diversity scores.

Phase-II Recipe development & sensory evaluation

Phase II was divided into two sections, including the development of nutrient-rich recipes incorporating THR (Purna Shakti) and locally available foods, and Phase II b included sensory evaluation (Hedonic & Composite rating scale), video development, and dissemination. Data were collected with the help of Epicollect 5 software by conducting interviews with the adolescent girls.

MAJOR FINDINGS OF THE STUDY

Socio-demographic profile of the subjects

- The study included 300 adolescent girls aged 15 to 18 years, with the highest proportion (33.3%) being 18 years old, followed by 30.3% at 17 years, 24% at 16 years, and 12.3% at 15 years.
- In terms of socioeconomic status, nearly 49% of respondents belonged to the Antyodaya Ration Card category, indicating extreme poverty. Additionally, 25.3% were from APL, 15.3% from BPL, while 2.7% had no documents and 7.7% were unaware of their ration card status.
- The mothers' education levels showed that 39.7% had primary education, 33% completed middle school, and 14% finished high school. Only 2.7% had intermediate-level education or diplomas, while 8.7% were illiterate, and 0.3% had a professional degree. 1.7% of respondents had no guardian.
- Regarding fathers' occupations, 47.3% were engaged in elementary labor work, 23.7% were machine operators or assemblers, and 11.7% worked in agriculture or fisheries. A small proportion (5.3%) were in skilled trades or market sales, while 1.7% held technical or associate professional roles. Only 0.7% were professionals, 3.7% were unemployed, and 5% had no guardian.
- The socioeconomic classification (Kuppuswamy 2023 Scale) revealed that 67.2% of the respondents were from the lower middle class (₹7,316 - ₹21,913 per capita monthly income), 19.9% belonged to the lower class (≤₹7,315), and 4.7% were from the middle class (₹21,914 - ₹36,526). The upper middle class (₹36,527 - ₹45,588) comprised only 0.6%, while the high-income groups (₹45,589 and above) were minimally represented at 0.3% each.
- Education-wise, 47.3% of adolescent girls were attending school, while 52.7% were not enrolled. Among students, 66.2% studied in government schools, 25.4% in private schools, 4.9% were in college, and 2.8% attended government-aided schools.

Anthropometric measurements of enrolled subjects

- The analysis of anthropometric measurements among adolescent girls in the study revealed a mean weight of 42.22 ± 8.049 kg, indicating considerable variation among respondents, with some falling into underweight categories. The mean height was 149.35 ± 5.399 cm, showing moderate variation in height within the study population. Additionally, the mean BMI was 18.9 kg/m² with a standard deviation of 3.35, reflecting differences in nutritional status and body composition.
- The analysis of age-wise mean weight among adolescent girls showed a gradual increase with age. The mean weight was 41.5 kg ± 8.82 for 15-year-olds, slightly lower at 40.7 kg ± 7.49 for 16-year-olds, increasing to 42.2 kg ± 7.64 for 17-year-olds, and reaching the highest at 43.6 kg ± 8.38 for 18-year-olds.
- The mean height remained relatively stable across age groups, with 15-year-olds averaging 150 cm ± 4.73, 16-year-olds slightly lower at 149 cm ± 5.76, and 17-year-olds at 149 cm ± 5.46. A marginal increase was observed in 18-year-olds, with a mean height of 150 cm ± 5.31. The findings of the present study indicate a progressive increase in stunting prevalence across different stages of adolescence, with 10% in pre-adolescence, 21% in early adolescence, 27% in mid-adolescence, and 30% in late adolescence, suggesting that adolescents do not receive adequate nutritional support during their critical growth years.
- The mean Body Mass Index (BMI) varied slightly with age. The mean BMI was 18.3 ± 3.55 for 15-year-olds and 18.4 ± 3.35 for 16-year-olds. A slight increase was observed in 17-year-olds with a mean BMI of 19.0 ± 2.96, while 18-year-olds had the highest BMI at 19.5 ± 3.57. These findings indicate a gradual increase in BMI with age, reflecting growth and body composition changes during adolescence.

Information regarding nutritional status of adolescent girls

- The analysis of BMI-for-Age Z-scores (BAZ) based on the WHO 2007 Growth Standards found that 3% of the respondents were classified as severely

underweight (≤ -3 SD), while 17% fell into the category of moderate thinness (-3 SD to -2 SD), indicating a high prevalence of undernutrition. Additionally, 31.6% were mildly underweight (-2 SD to -1 SD), suggesting a risk of chronic malnutrition and poor growth outcomes. Nearly 48.3% of the adolescents fell within the normal weight category (-1 SD to +1 SD), which is slightly lower than the WHO global reference, where 50-60% of adolescents in well-nourished populations maintain normal BMI-for-age.

- The study also assessed Height-for-Age Z-scores (HAZ) and compared them with the WHO 2007 Growth Standards, which showed that 10.3% of adolescent girls were classified as severely stunted (≤ -3 SD), while 36.3% fell into the category of moderate stunting (-3 SD to -2 SD). Additionally, 42% exhibited mild stunting (-2 SD to -1 SD), indicating a high prevalence of growth retardation among the study population. Only 11.3% of the respondents had a normal height-for-age (≥ -1 SD), which is significantly lower than the expected 50-60% normal range in well-nourished populations.

Information regarding Take-Home ration coverage

- The study found 100% coverage of Take-Home Ration (THR), with all 300 adolescent girls receiving Purnashakti. Most participants (57.7%) had been receiving THR for 2-3 years, while 17.7% had been beneficiaries for one year, 14% for four years, and 10.7% for six months or less, indicating variability in duration. In terms of distribution frequency, 98% received THR monthly, while 1.3% received it fortnightly and 0.7% once every three months. Regarding quantity, 90.3% received four packets, 5.3% received three, 3% received two, and 1.3% received five packets.

Information on consumption of Take-Home ration

- Out of 300 respondents, only 21.67% reported consuming THR, while 24.67% did not consume it at all. Among the 235 respondents who did not consume THR, 53.67% reported consuming it rarely, with some having only tasted it once.

- The consumption patterns of Take-Home Ration (THR) varied between those who consumed it regularly and those who consumed it rarely. Among the 21.7% of adolescent girls who consumed THR regularly, the majority (89.2%) preferred it in the form of Sheera, followed by Roti (6.1%), Thepla (1.5%), and Raw consumption (3.1%).
- Among the 161 girls who consumed THR rarely, 76.4% reported having it as Sheera, while 9.3% consumed it as Roti, 11.2% as Thepla, and a small percentage consumed it Raw (1.2%), Dhokla (0.6%), or in other forms (1.2%). These findings indicate that Sheera is the most commonly preferred form.
- Among the adolescent girls who consumed Take-Home Ration (THR) regularly, the majority 63% consumed 100g, while 26.1% consumed less than 100g. A small proportion consumed 140g (3%), 150g (6.1%), and only 1.5% reported consuming 200g.
- The frequency of Take-Home Ration (THR) consumption among adolescent girls showed very few adhering to the recommended intake. Only 6% consumed THR daily, far below the ideal 145g per day. A small proportion (3%) consumed it 4-5 times a week, while 12% had it 2-3 times a week. A notable 25% reported consuming THR once a week, and the majority (68%) consumed it rarely, despite its limited shelf life of just 7 days after opening.

Knowledge about THR among adolescents

- Awareness of the benefits of consuming Take-Home Ration (THR) among adolescent girls was low (70%), and it was reported that they were unaware of its benefits. Only 16.3% recognized that THR provides essential nutrition for growth, while 6.3% believed it contributes to good health. Additionally, 5.7% associated THR with weight gain, and just 1% mentioned receiving information from an Anganwadi worker.
- Awareness of the ingredients and nutrients in Take-Home Ration (THR) among adolescent girls was low, with only 28% knowing its composition, while a majority (72%) were unaware. However, awareness about different recipes that

can be prepared using THR was relatively better. While 56% of girls knew about alternative ways to consume it, 44% were unaware of recipe variations.

- The perception of Take-Home Ration (THR) quality among adolescent girls varied, with the majority (76%) rating it as good. However, 18% found it fair, 5% considered it poor, and only 0.3% rated it as very good.

Information regarding Barriers to the consumption of Take-Home Ration (THR)

- A significant proportion of adolescent girls reported barriers to consuming Take-Home Ration (THR). Among the 235 respondents who did not consume THR, the most common reason was disliking the taste (85%). Additionally, 6% found the texture unappealing, while another 6% cited a lack of variety.

Information regarding alternative uses of non-utilized THR

- Among the 235 respondents who did not consume Take-Home Ration (THR), the majority (91%) reported that the ration was fed to cattle, indicating a significant diversion from its intended use. A small proportion of respondents mentioned giving it to someone else (4%), while 3% stated that other household members consumed it. Additionally, 2% admitted to simply keeping the ration at home without using it.
- About 67% of respondents reported that their family members also consumed the THR, while 33% stated that other members of their household did not consume it.
- The majority of adolescent girls (93%) reported receiving encouragement from Anganwadi workers to consume the Take-Home Ration (THR). However, 6% stated that they did not receive any motivation to consume it.

Information regarding consumption of various foods by the subjects

- The dietary habits of adolescent girls revealed a strong preference for staple cereal products. Chapati was the most frequently consumed, with 86% eating it daily, followed by bhakhri (77%) and rice (73%). Other cereal-based foods, such as puri, bread, and puffed rice, were consumed less frequently, mostly on a weekly

or monthly basis. Khichdi was the most commonly eaten staple dish, with 91% consuming it daily, while paratha was included in the diet once a week by 36%.

- Around 22.3% of the girls consumed dals (pulses) daily, while 14.3% had them on alternate days, and 57.3% ate them once or twice a week. Whole legumes showed a similar trend, with 16.67% consuming them daily and 23% having them twice a week. However, 8.67% of respondents never consumed whole legumes, indicating some dietary gaps in protein intake.
- Milk and milk product consumption varied significantly. While 34.7% of the girls drank milk daily, paneer was consumed less frequently, with 26.33% eating it once a week and 32% never consuming it. Butter intake was extremely low, with 85.33% of participants never consuming it, while ghee consumption was also limited, with only 10.3% consuming it daily.
- Protein-rich foods like eggs, chicken, and fish were rarely included in the diet, with over 87% of respondents never consuming them.
- Vegetables formed a crucial part of the diet, with leafy greens and commonly used vegetables like tomatoes, brinjal, and peas being widely consumed daily (87.6% and 92.3%, respectively). Root and tuber vegetables, such as onions, potatoes, radishes, and beetroots, were also staple items, with 90.67% of respondents eating them daily. However, the intake of vitamin A-rich yellow and orange vegetables was lower, with only 14% consuming them daily and 27% never including them in their diet, indicating a potential risk of vitamin A deficiency.
- Fruit consumption was relatively low, with only 37% eating fruits daily, while 46.33% of respondents never consumed amla, a key source of vitamin C. The intake of dry fruits and oilseeds was also sporadic, with over 50% rarely or never consuming them.
- Processed and convenience foods like biscuits and tea were popular, with 67% consuming biscuits and 76.7% drinking tea daily. However, items like instant soups, coffee, and milkshakes were rarely consumed.

Information regarding dietary diversity amongst the subject

- The majority of adolescent girls (87.3%) consumed more than five food groups, meeting the minimum dietary diversity threshold. However, 37.6% had a dietary diversity score of five or below, indicating a risk of inadequate nutrient intake.
- Cereals (99.33%), dark green leafy vegetables (90.33%), and other vegetables (91.66%) had high intakes, while legumes, nuts, and seeds (71.66%), milk and milk products (71%), and Vitamin A-rich vegetables (66%) showed moderate intakes.
- Sweets were consumed by 85%, but Vitamin A-rich fruits (4.66%) and other fruits (46.6%) had low intake. Animal protein sources were rarely consumed, with no intake of flesh meat and only 1.33% consuming eggs.

Development of nutrient-rich recipes

- Nutrient-rich recipes were developed from locally available foods and also incorporating (THR)
- The following recipes were developed:

1. Shakarpara
2. Carrot-Beet idli
3. Methi mathri
4. Besan barfi
5. Mixed vegetable handvo
6. Moong dal chilla
7. Moringa paratha
8. Missi roti
9. Cabbage muthiya
10. Coconut gujiya

Sensory evaluation and development of videos

- The sensory evaluation of recipes based on the Hedonic scale showed that Handvo received the highest preference, with 76.67% of participants rating it as

"Like very much." Mathri followed closely, with 60% of participants giving it the same rating.

- Most recipes were well-received, with minimal or no "Dislike" ratings, indicating a high level of acceptability. Paratha had a more mixed response, with 10% rating it as "Like very much," 50% as "Like moderately," and 3.33% as "Dislike moderately."
- The composite scale analysis assessed attributes such as color, texture, taste, mouthfeel, and overall acceptability. Shakarpara was highly rated, especially for its crunchy texture (8.300±1.417) and appearance (17.0±2.83). It scored well in mouthfeel and overall acceptability (17.3±3.23), though its taste was slightly lower, suggesting room for flavor improvements.
- Idli received high ratings for its soft texture (8.817±1.567) and uniform appearance (16.9±3.86). Its lightness and smooth consistency were appreciated, but minor textural refinements could further improve its mouthfeel. Mathri was one of the top-rated recipes, excelling in its crispy texture (9.167±1.01), golden-brown color (9.210±1.06), and taste. Its high overall acceptability made it one of the most successful recipes in the evaluation.
- Barfi had balanced ratings across all attributes. Its texture (8.92±1.07) and color (8.70±1.24) were well-received, but the taste (16.8±2.87) was slightly lower, indicating potential for flavor enhancement. Handvo was a favorite, with top ratings in color (9.53±0.68), texture (9.40±0.85), and overall acceptability (19.2±1.48). Its golden-brown crust and soft interior made it highly preferred among panelists.
- Chilla received moderate ratings, with texture being its weakest aspect. While generally well-accepted, improvements in mouthfeel and crispness could enhance its appeal. Paratha had lower ratings, mainly due to its texture. Though taste was acceptable, its overall acceptability (15.9±2.54) suggests that adjustments in flavor and texture could improve its rating.
- Missi Roti performed well, especially in color and taste. Its golden-brown appearance and earthy flavor led to high acceptability (16.9±2.75), making it a well-accepted traditional dish. Muthiya received high ratings in color, taste, and

acceptability (18.2±2.31). Its soft, steamed texture and savory flavor made it a popular choice among panelists. Gujiya was well-rated for its golden-brown crust and traditional shape.

CONCLUSIONS

The assessment of adolescent girls' nutritional status revealed concerns regarding undernutrition, highlighting the need for improved dietary intake and intervention programs. While some girls showed adequate growth, a significant proportion had lower-than-expected anthropometric measures, indicating risks of malnutrition. Ensuring access to nutrient-dense foods and promoting better eating habits are essential to addressing these gaps.

While THR was distributed to adolescent girls through Anganwadi centers, its regular consumption remained low. Many girls consume THR infrequently, and only a small percentage adhered to the recommended intake. This irregular consumption reduced the intended nutritional benefits, limiting its impact on adolescent health.

Several challenges hinder the effective utilization of THR. The most common barrier was the taste, followed by texture issues and lack of variety in preparation. Additionally, some girls faced time constraints or external influences discouraging them from consuming THR. A significant proportion of THR was also shared with family members or fed to cattle, leading to wastage and further limiting its effectiveness in improving adolescent nutrition.

Anganwadi workers play a critical role in promoting THR consumption by encouraging adolescent girls to incorporate it into their diets. Most girls reported receiving motivation from these workers.

The dietary habits of adolescent girls indicated a high reliance on staple foods such as chapati, bhakhri, rice, and khichdi. Vegetables, particularly leafy greens and commonly used vegetables like tomatoes, brinjal, and peas, were widely consumed. However,

protein intake, especially from animal-based sources, remains low. The consumption of vitamin A-rich vegetables and fruits was also limited, raising concerns about micronutrient deficiencies. Low consumption of milk and milk products among adolescent girls indicated a potential risk of calcium and protein deficiencies.

RECOMMENDATIONS

- Research can be conducted on modifying THR formulations as per the preferences. THR variants to prevent montony can also be worked upon.
- Establish a feedback mechanism where beneficiaries can report issues related to THR quality, taste, or distribution delays.
- Future research can focus on using school-based awareness programs to educate girls about the health benefits of THR engagingly and interactively.
- Organize incentive-based programs to encourage consistent consumption.
- Educate families about the importance of THR for adolescent nutrition to discourage sharing with other household members or feeding it to cattle.
- Introduce a monitoring system where Anganwadi workers track THR utilization and follow up with families to ensure proper consumption.

LIMITATIONS OF THE STUDY

Sensory evaluation was conducted among a limited group of adolescent girls, which may not fully represent the preferences of a larger population.

Due to time constraints, the promotion of video-based demonstrations was not extensively explored, which could be a more effective method to improve THR acceptability.

Future studies could incorporate a larger sample size and long-term monitoring of THR's impact on adolescent nutrition.

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ANNEXURE-I

ETHICAL CERTIFICATE

Institutional Ethics
Committee for Human
Research
(IECHR)

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

Ethical Compliance Certificate 2024-2025

This is to certify Ms. Kashish Jain study titled; "Assessing Utilization of Take-Home Ration Provided to Adolescent Girls (15-18 years) in Rural Vadodara and development of Nutrient-rich recipes for Promoting Healthy Diets." from Department of Foods and Nutrition has been approved by the Institutional Ethics Committee for Human Research (IECHR), Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda. The study has been allotted the ethical approval number IECHR/FCSc/M.Sc./10/2024/35.

Komal

Prof. Komal Chauhan
Member Secretary
IECHR

Prof. Mini Sheth
Chairperson
IECHR

Chair Person
IECHR
Faculty of Family & Community Sciences
The Maharaja Sayajirao University of Baroda

ANNEXURE-II (A)

INFORMED CONSENT FORM-English

Title of the study: Assessing Utilization of Take-Home Ration Provided to Adolescent Girls (15-18 years) in Rural Vadodara and Development of Nutrient-rich Recipes for Promoting Healthy Diets.

Researcher:

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Introduction & Purpose:
The assessment of adolescent girls' THR intake will be the primary objective of the current study. You will be interviewed regarding dietary practices, and consumption of THR and data will be collected for anthropometric parameters (weight and height).

Benefits: If you wish and agree to let your girl child join the study, she will be provided with nutrition and health education. Various information will be collected from the girl, such as family details and Take Home ration utilization. The girl's weight and height will be taken. Also, if the girl consents, information about traditional recipes and dietary practices will be taken.

Risks:
There are no known risks associated with participating in this study. The information collected will help us understand adolescents' nutritional practices and needs, which may contribute to improving nutrition programs and policies.

Confidentiality:
All information collected will be kept confidential and only used for research purposes. Your name or identifying information will not be included in any reports or publications.

Voluntary Consent: If you have any doubts about the study, you can ask the person filling out the consent form before signing this consent form.

Researcher's statement: All explanations regarding this research are given by me. The adolescent girl who wants to participate in this study and her parents are given ample opportunity to discuss about it.

Declaration of the parent of the participating child: After reading the above information, I consent to my child's participation in the study.

Signature of Guardian: Mobile no.
Date:

ANNEXURE-II (A)

INFORMED CONSENT FORM-Gujarati

સંમતિ પત્ર

અભ્યાસનું શીર્ષક: ગ્રામીણ વડોદરામાં કિશોરીઓ (15-18 વર્ષ)ને આપવામાં આવતા ટેક-હોમ રાશનના ઉપયોગનું મૂલ્યાંકન અને સ્વસ્થ આહારને પ્રોત્સાહન આપવા માટે પોષક તત્વોથી ભરપૂર વાનગીઓનો વિકાસ.

સંશોધક
કશિશ જૈન
Sr. MSc પબ્લિક હેલ્થ ન્યુટ્રીશન
ફૂડ એન્ડ ન્યુટ્રિશન ડિપાર્ટમેન્ટ.
ફેકલ્ટી ઓફ ફેમિલી એન્ડ કમ્યુનિટી સાયન્સિસ
ધ મહારાજા સયાજીરાવ યુનિવર્સિટી ઓફ બરોડા
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ડૉ. વિજયતા સેંગર
માર્ગદર્શિકા
ફૂડ એન્ડ ન્યુટ્રિશન ડિપાર્ટમેન્ટ
ફેકલ્ટી ઓફ ફેમિલી એન્ડ કમ્યુનિટી સાયન્સિસ
ધ મહારાજા સયાજીરાવ યુનિવર્સિટી ઓફ બરોડા
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પરિચય અને હેતુ: કિશોરવયની છોકરીઓના THR સેવનનું મૂલ્યાંકન વર્તમાન અભ્યાસનો પ્રાથમિક ઉદ્દેશ્ય હશે. તમારી ડાયેટરી પ્રેક્ટિસ સંબંધિત ઇન્ટરવ્યુ લેવામાં આવશે, અને THR નો વપરાશ અને એન્થ્રોપોમેટ્રિક પરિમાણો (વજન અને ઊંચાઈ) માટે ડેટા એકત્રિત કરવામાં આવશે.

લાભો: જો તમે ઇચ્છો છો અને તમારી છોકરીને અભ્યાસમાં જોડાવા દેવા માટે સંમત થશો, તો તેને પોષણ અને આરોગ્ય શિક્ષણ આપવામાં આવશે. છોકરી પાસેથી વિવિધ માહિતી એકત્રિત કરવામાં આવશે, જેમ કે કુટુંબની વિગતો અને ટેક હોમ રાશનનો ઉપયોગ. યુવતીનું વજન અને ઊંચાઈ લેવામાં આવશે. ઉપરાંત, જો છોકરી સંમતિ આપે તો પરંપરાગત વાનગીઓ અને આહાર પદ્ધતિઓ વિશેની માહિતી લેવામાં આવશે.

જોખમો: આ અભ્યાસમાં ભાગ લેવા સાથે સંકળાયેલા કોઈ જાણીતા જોખમો નથી. એકત્રિત કરવામાં આવેલી માહિતી અમને કિશોરોની પોષણની પદ્ધતિઓ અને જરૂરિયાતોને સમજવામાં મદદ કરશે, જે પોષણ કાર્યક્રમો અને નીતિઓને સુધારવામાં યોગદાન આપી શકે છે.

ગોપનીયતા: એકત્રિત કરવામાં આવેલી તમામ માહિતી ગોપનીય રાખવામાં આવશે અને તેનો ઉપયોગ માત્ર સંશોધન હેતુઓ માટે કરવામાં આવશે. તમારું નામ અથવા ઓળખની માહિતી કોઈપણ અહેવાલો અથવા પ્રકાશનોમાં શામેલ કરવામાં આવશે નહીં.

સ્વૈચ્છિક સંમતિ: જો તમને અભ્યાસ અંગે કોઈ શંકા હોય, તો તમે આ સંમતિ ફોર્મ પર સહી કરતા પહેલા સંમતિ ફોર્મ ભરનાર વ્યક્તિને પૂછી શકો છો.

સંશોધકનું નિવેદન: આ સંશોધન અંગેના તમામ ખુલાસાઓ મારા દ્વારા આપવામાં આવ્યા છે. આ અભ્યાસમાં ભાગ લેવા માંગતી કિશોરી અને તેના માતાપિતાને તેના વિશે ચર્ચા કરવાની પૂરતી તક આપવામાં આવે છે.

ભાગ લેનાર બાળકના માતાપિતાની ઘોષણા: ઉપરોક્ત માહિતી વાંચ્યા પછી હું અભ્યાસમાં મારા બાળકની ભાગીદારી માટે સંમતિ આપું છું.

વાલીની સહી:
તારીખ:

મોબાઈલ નં:

ANNEXURE-II (B)

ASSENT FORM-English

Title of the study: Assessing Utilization of Take-Home Ration Provided to Adolescent Girls (15-18 years) in Rural Vadodara and Development of Nutrient-rich Recipes for Promoting Healthy Diets.

Researcher:

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Mobile no. 9879540227
Email: vijayata.sengar-fn@msubaroda.ac.in

Introduction & Purpose:
The assessment of adolescent girls' THR intake will be the primary objective of the current study. You will be interviewed regarding dietary practices and consumption of THR, and data will be collected for anthropometric parameters (weight and height).

Risks/Benefits:
There are no known risks associated with participating in this study. The information collected will help us understand the nutritional practices and needs of adolescents, which may contribute to improving nutrition programs and policies.

Confidentiality:
All information collected will be kept confidential and only used for research purposes. Your name or identifying information will not be included in any reports or publications.

Voluntary Participation:
Participation in this study is voluntary, there will be no monetary benefit involved. You have the right to refuse to participate or withdraw from the survey without any consequences.

Consent:
I have read and understood the information provided above. I voluntarily agree to participate in the survey and consent to collecting and using my information as described.

Adolescent's Name:
Signature: Place:
Date:

ANNEXURE-II (B)

ASSENT FORM-Gujarati

Assent form

અભ્યાસનું શીર્ષક: ગ્રામીણ વડોદરામાં કિશોરીઓ (15-18 વર્ષ)ને આપવામાં આવતા ટેક-હોમ રાશનના ઉપયોગનું મૂલ્યાંકન અને સ્વસ્થ આહારને પ્રોત્સાહન આપવા માટે પોષક તત્વોથી ભરપૂર વાનગીઓનો વિકાસ.

સંશોધક	
કશિશ જૈન	ડૉ. વિજયતા સેંગર
Sr. MSc પબ્લિક હેલ્થ ન્યુટ્રીશન	માર્ગદર્શિકા
ફૂડ એન્ડ ન્યુટ્રિશન ડિપાર્ટમેન્ટ.	ફૂડ એન્ડ ન્યુટ્રિશન ડિપાર્ટમેન્ટ
ફેકલ્ટી ઓફ ફેમિલી એન્ડ કમ્યુનિટી સાયન્સિસ	ફેકલ્ટી ઓફ ફેમિલી એન્ડ કમ્યુનિટી સાયન્સિસ
ધ મહારાજા સયાજીરાવ યુનિવર્સિટી ઓફ બરોડા	ધ મહારાજા સયાજીરાવ યુનિવર્સિટી ઓફ બરોડા
મોબાઈલ નં: 6355605200	મોબાઈલ નં. 9079540227
ઇમેઇલ: viskashish@mail.com	ઇમેઇલ: vijayata.sengar-fn@msubaroda.ac.in

પરિચય અને હેતુ: કિશોરવયની છોકરીઓના THR સેવનનું મૂલ્યાંકન વર્તમાન અભ્યાસનો પ્રાથમિક ઉદ્દેશ્ય હશે. તમારી ડાયેટરી પ્રેક્ટિસ સંબંધિત ઇન્ટરવ્યુ લેવામાં આવશે, અને THR નો વપરાશ અને એન્થ્રોપોમેટ્રિક પરિમાણો (વજન અને ઊંચાઈ) માટે ડેટા એકત્રિત કરવામાં આવશે.

જોખમો લાભ: આ અભ્યાસમાં ભાગ લેવા સાથે સંકળાયેલા કોઈ જાણીતા જોખમો નથી. એકત્રિત કરવામાં આવેલી માહિતી અમને કિશોરોની પોષણની પદ્ધતિઓ અને જરૂરિયાતોને સમજવામાં મદદ કરશે, જે પોષણ કાર્યક્રમો અને નીતિઓને સુધારવામાં યોગદાન આપી શકે છે.

ગોપનીયતા: એકત્રિત કરવામાં આવેલી તમામ માહિતી ગોપનીય રાખવામાં આવશે અને તેનો ઉપયોગ માત્ર સંશોધન હેતુઓ માટે કરવામાં આવશે. તમારું નામ અથવા ઓળખની માહિતી કોઈપણ અહેવાલો અથવા પ્રકાશનોમાં શામેલ કરવામાં આવશે નહીં.

સ્વૈચ્છિક ભાગીદારી: આ અભ્યાસમાં સહભાગિતા સ્વૈચ્છિક છે, તેમાં કોઈ નાણાકીય લાભ સામેલ હશે નહીં. તમને કોઈ પણ પરિણામ વિના સર્વેમાં ભાગ લેવાનો અથવા પાછી ખેંચવાનો ઇનકાર કરવાનો અધિકાર છે.

સંમતિ

મેં ઉપર આપેલી માહિતી વાંચી અને સમજી લીધી છે. હું સર્વેક્ષણમાં ભાગ લેવા માટે સ્વેચ્છાએ સંમત છું અને વર્ણવ્યા પ્રમાણે મારી માહિતી એકત્ર કરવા અને તેનો ઉપયોગ કરવા માટે સંમતિ આપું છું.

કિશોરનું નામ:	
હસ્તાક્ષર:	તારીખ:
સ્થળ :	મોબાઈલ નં:

ANNEXURE-IV
QUESTIONNAIRE

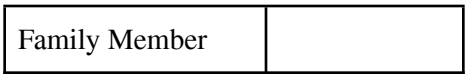
S. no.	**Basic Information**	**Response**
1)	Name of Interviewer	
2)	Date of Interview	___/_____/_____
3)	Start time	_____am/pm
4)	AWC name	
5)	AWC number	
6)	Interviewee name	
7)	Age of Interviewee	
8)	Date of birth of interviewee	
9)	Location of the Interview	A. House B. AWC C. Other places

Section A: Basic details		
S. no	Question	Options
1)	What does your family have?	A. APL card B. BPL card C. Antyodaya ration card D. Do not know E. I do not want to mention it.
2)	Are you going to school?	A. Yes B. No
3)	Which type of School do you study in?	A. Govt. School B. Private School C. Govt. aided School D. Others E. College
4)	Education	A. Professional Degree B. Graduate C. Intermediate/ Diploma

		D. High School E. Middle School F. Primary School G. Illiterate H. No Guardian
5)	Occupation	A. Legislators, Senior officials, managers B. Professional C. Technical/Associate Professionals D. Clerk E. Skilled workers, shop and market sales workers F. Skilled agricultural and Fishery worker G. Craft and related trade workers H. Plant and machine operators and assemblers I. Elementary occupation J. Unemployed K. No Guardian
6)	Income	A. ≥ 146,104 B. 109,580-146,103 C. 73,054-109,579 D. 68,455-68,454 E. 59,252-63,853 F. 54,651-59,251 G. 45,589-54,650 H. 36,527-45,588 I. 21,914-36,526 J. 7,316-21,913 K. ≤7,315

Section B: Supply and Utilization of Supplementary Nutrition		
S. no	Questions	Options
1)	Are you familiar with the distribution of THR at Anganwadi centers?	A. Yes B. No
2)	Do you know the benefits of consuming THR?	A. Increase in Weight B. Good taste C. Good for health D. Food Required for Growth E. I don't know

3)	If yes, then by whom have you received information about THR?	A. Anganwadi Worker B. ANM C. ASHA D. Anganwadi Helper E. School teacher F. Community Leader G. Family member H. Peer or friends I. Newspaper J. Other
4)	Do you receive take-home rations from the Anganwadi Center?	A. Yes B. No
5)	What do you receive as THR?	A. Purnashakti B. Balshakti C. Matrushakt D. Others:- Grains, Oil, Sugar, Salt
6)	How frequently did you receive take-home rations?	A. Monthly B. Fortnight C. Once in 3 months D. Once in 6 months E. Not regular
7)	How many packets of THR do you receive/month?	A. 4 B. 5 C. 3 D. 2
8)	Do you consume THR? (If no, then skip to question no. 12)	A. Yes B. No C. Consumed from someone else's THR
9)	If yes, then how many times a week do you consume THR?	A. Daily B. 4-5 times C. Thrice a week D. Twice E. Once a week
10)	In what form is THR consumed?	A. Sheera B. Thepla C. Roti D. Dhokla E. Others_____ F. Raw
11)	Have you received any information	A. Yes

	about different recipes being prepared from THR?	B. No
12)	If not, then why don't you consume THR?	A. Do not like the taste B. Do not know how to prepare. C. Do not get enough time to prepare. D. The texture of THR might not be appealing. E. Influence from others to avoid consuming THR. F. Due to the repetitive taste of THR. G. Perceived Lack of Variety H. Lack of Awareness. I. The received THR is not of good quality. J. There are insects in the THR. K. Anganwadi Center is far. L. Not received THR. M. Others _____
14)	If you do not consume THR, what do you do with unused THR?	A. Discard B. Feed Cattle C. Give it to someone D. Other household members use it. E. Sell the THR to generate income. F. Others
15)	Are there other family members who are consuming from your THR?	A. Yes B. No
16)	Did you receive any encouragement from AWW to consume THR?	A. Yes B. No
17)	Have you noticed any changes in your nutritional status since you started consuming THR?	A. Yes B. No
18)	How would you rate the quality of Purna Shakti you have received?	A. Very Good B. Good C. Fair D. Poor E. Very Poor
19)	Rank who influences your food choices, dietary habits, and exercise routine.	

		<table><tr><td>Relatives</td><td></td></tr><tr><td>Friends</td><td></td></tr><tr><td>School Teacher</td><td></td></tr><tr><td>ASHA worker</td><td></td></tr><tr><td>AWW</td><td></td></tr><tr><td>Doctor</td><td></td></tr><tr><td>Religious Leader</td><td></td></tr><tr><td>Social Media</td><td></td></tr></table>
20)	Were you counseled about how to use THR?	A. Yes B. No
21)	Since how long have you been availing THR?	A. 6 months or less B. One year C. Two- three years D. Four years years E. Currently not availing
22)	If you are consuming, then how much per day?	A. 100gm B. 140gm C. 200gm D. 150gm E. <100gm
23)	Do you know which ingredients are in THR?	A. Yes B. No

Section C: Anthropometric Measurements		
1	Weight	
2	Height	

Section D: Dietary Practices- Food Frequency Questionnaire

Food Item	Daily (Amount gm)	Alternate days	Twice a week	Once a week	Twice a month	Once a month	Rarely	Never
Chapati								
Pulka								
Bhakri								
Puri								
Bread								
Rice								
Puffed Rice								
Dhokla, Khaman								
Paratha								
Flaked rice, Upma								
Khichdi								
Dals								
Whole legumes								
Milk								
Curd/ buttermilk								
Panner								
Cheese								
Eggs								
Chicken/ Chicken products								

Meat								
Fish								
Green leafy vegetables								
Cauliflower, beans, ladyfinger, brinjal, cabbage, peas, tomato, cucumber								
Onion, potato, radish, Beetroot,								
Yellow & orange veg. pumpkin, carrot								
Fruits								
Apple, banana, Pear, Litchi,								
Yellow-orange fruits								
Amla								
Butter								
Ghee								
Dry fruits								
Oil seeds								
Biscuits								
Instant soups								
Tea								
Coffee								

Milkshakes								
Sweets								
Snacks								

Section D: Dietary Practices- Dietary Diversity								
Question number	Food Group	Examples	YES =1 NO= 0					
1	CEREALS	corn/maize, rice, wheat, sorghum, millet, or any other grains or foods made from these (e.g. bread, noodles, porridge, or other grain products) + insert local foods e.g. ugali, porridge or pastes or other locally available grains						
2	VITAMIN A RICH VEGETABLES AND TUBERS	pumpkin, carrots, squash, or sweet potatoes that are orange inside + other locally available vitamin-A rich vegetables (e.g. red sweet pepper)						
3	WHITE TUBERS AND ROOTS	white potatoes, white yams, white cassava, or other foods made from roots						
4	DARK GREEN LEAFY VEGETABLES	dark green/leafy vegetables, including wild ones + locally available vitamin-A-rich leaves such as amaranth, cassava leaves, kale, spinach, etc.						

5	OTHER VEGETABLES	other vegetables (e.g. tomato, onion, eggplant), including wild vegetables						
6	VITAMIN A RICH FRUITS	ripe mangoes, cantaloupe, apricots (fresh or dried), ripe papaya, dried peaches + other locally available vitamin A-rich fruits						
7	OTHER FRUITS	other fruits, including wild fruits						
8	ORGAN MEAT (IRONRICH)	liver, kidney, heart or other organ meats or blood-based foods						
9	FLESH MEATS	beef, pork, lamb, goat, rabbit, wild game, chicken, duck, or other birds						
10	EGGS	chicken, duck, guinea hen or any other egg						
11	FISH	fresh or dried fish or shellfish						

ANNEXURE V

INFORMED CONSENT FOR SENSORY EVALUATION

CONSENT LETTER FOR SENSORY EVALUATION

STUDY TITLE: Assessing Utilization of Take-Home Ration Provided to Adolescent Girls (15-18 years) in Rural Vadodara and Development of Nutrient-Rich recipes for Promoting Healthy Diets

RESEARCHER

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PROTOCOL OF THE STUDY

If you decide to join this study, you will be required to taste nutrient-rich recipes incorporated with Purnashakti–Take Home Ration provided to adolescent girls from Anganwadi and carry out the sensory evaluation of the recipes using the hedonic rating scale and composite rating scale. 10 nutrient-rich recipes will be prepared, and a sensory evaluation will be conducted.

COSTS

This study only requires your time and cooperation. All the costs incurred will be borne by the researcher, and there is no financial compensation for your participation in this research.

POSSIBLE BENEFITS AND RISKS

This study will help to increase sensory knowledge about the taste and overall acceptability of nutrient-rich recipes. The recipes include nuts, oilseeds, cereals, pulses, dehydrated fruits, vegetables, and Take-Home Ration.

CONFIDENTIALITY

In the study, your identity will be kept confidential. The results of the study may be published for scientific purposes but will not reveal your name or include any identifiable references to you.

RIGHT TO WITHDRAW

Your decision to join the study is voluntary. You may quit at any time, for any reason, without notice. We hope you will take part in the entire study period because we need all the information to draw correct conclusions.

AVAILABILITY OF RESULTS
At the end of the study, relevant information will be shared with you.

VOLUNTARY CONSENT
Your cooperation is important for the success of this study. Unless many volunteers like you participate in this study will not be possible.

INVESTIGATOR'S STATEMENT
I have explained the research program, the purpose of the study, and the possible benefits and risks of participating in the study. The participants were allowed to discuss the procedures and to ask any additional questions.

_____
Signature of Investigator
Date:

PARTICIPANT STATEMENT

I certify that I have read the information given above. By signing this form, I am attesting that I have understood the description of the study.

I give my consent to be included as a subject in the study being carried out by Dr. Vijayata Sengar and Ms. Kashish Jain at The Maharaja Sayajirao University of Baroda to determine the acceptability of nutrient-rich recipes
I understand that the study requires the participant to taste nutrient-rich recipes

I am not allergic to any specific food

I have had a chance to ask questions about the study

I understand that I may ask further questions at any time

I have been explained to my satisfaction the purposes of this study and I am also aware of my right to opt out of the study at any time

_____
Participant’s name and signature
Date:

THRESHOLD TEST

Threshold Test
Name: _____
Date: _____

You are provided with a series of containers having solutions with increasing concentrations of three of the taste qualities (sweet, salty, sour, bitter, etc). Please start with Sample No. 1 and continue with the rest. The samples are not allowed to be retested. Please describe the taste or give intensity scores using the scoring pattern shown separately here below.

Use the following intensity scale:
0 = none or taste of water
? = different from water but taste quality not identifiable
X = threshold very weak (identify the taste)
1 = Weak taste
2 = Medium
3 = Strong

Sweet		Sour		Salty	
Sample No.	Description of taste and feeling factors	Sample No.	Description of taste and feeling factors	Sample No.	Description of taste and feeling factors
A		A_1		A_2	
B		B_1		B_2	
C		C_1		C_2	
D		D_1		D_2	

Signature of judge

ANNEXURE-VI

SCORE CARD: HEDONIC SCALE

Name- **Date-**

Hedonic Rating Scale

Test this sample and check the appropriate box to indicate how much you like or dislike it. Use the proper attitude scale to check the point that best describes your feelings about the sample.

Scale point description	Assigned value	Sample A	Sample B	Sample C	Sample D	Sample E
Like very much	7					
Like moderately	6					
Like slightly	5					
Neither Like nor Dislike	4					
Dislike slightly	3					
Dislike moderately	2					
Dislike very much	1					

Composite Rating Scale

Attributes	Total Marks	Score for Sample A	Score for Sample B	Score for Sample C	Score for Sample D	Score for Sample E
Color	10					
Texture	10					
Taste	20					
Mouthfeel	10					
Appearance	20					
After taste	10					
Overall acceptability	20					

ANNEXURE-VII

RECIPE VIDEOS INCORPORATING THR


तन्वं शिवं नुन्दरम्
Nutrient Rich Homemade Indian Recipes
Methi Mathri
पूर्णाशक्ति Take Home Ration
गुजरात ICDS पूर्णा योजना હેઠળ શાળાએ ન જતી કિશોરીઓ માટે ઘરે લઈ જવાનો રાશન પૂરું પાડે છે.
➡ ઊર્જા: 600 kcal
➡ ફેટ: 18 ગ્રામ
➡ પ્રોટીન: 19.5 ગ્રામ
➡ વિટામિન્સ અને ખનિજ: 9 વિટામિન્સ અને ખનિજ
સામગ્રી: ઘઉંનો લોટ ,સોયા લોટ ,મકાઈનો લોટ ,ચોખાનો લોટ ,ચણા લોટ ,ખાંડ,તેલ
Ms. Kashish Jain & Dr. Vijayata Sengar
Dept. of Foods and Nutrition
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
तन्वं शिवं नुन्दरम्
Nutrient Rich Homemade Indian Recipes
Coconut gujiya
पूर्णाशक्ति Take Home Ration
गुजरात ICDS पूर्णा योजना હેઠળ શાળાએ ન જતી કિશોરીઓ માટે ઘરે લઈ જવાનો રાશન પૂરું પાડે છે.
➡ ઊર્જા: 600 kcal
➡ ફેટ: 18 ગ્રામ
➡ પ્રોટીન: 19.5 ગ્રામ
➡ વિટામિન્સ અને ખનિજ: 9 વિટામિન્સ અને ખનિજ
સામગ્રી: ઘઉંનો લોટ ,સોયા લોટ ,મકાઈનો લોટ ,ચોખાનો લોટ ,ચણા લોટ ,ખાંડ,તેલ
Ms. Kashish Jain & Dr. Vijayata Sengar
Dept. of Foods and Nutrition
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
तन्वं शिवं नुन्दरम्
Nutrient Rich Homemade Indian Recipes
Moong dal chilla
पूर्णाशक्ति Take Home Ration
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तन्वं शिवं नुन्दरम्
Nutrient Rich Homemade Indian Recipes
Missi roti
पूर्णाशक्ति Take Home Ration
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PHOTO GALLERY

Photo No.1: Collecting data from adolescent girls

Photo No.2: Measuring height

Photo No.3: Threshold test performed

Photo No.4: Preparing recipes for sensory evaluation (Handvo)

Photo No.5: Prepared recipes incorporating THR

Photo No.6: Prepared recipes incorporating THR

Photo No.6: Sensory evaluation done by panelist