MODIFICATION AND EVALUATION OF DIETARY QUALITY ASSESSMENT TOOL (DQAT) FOR CHILDREN BELOW 5 YEARS OF AGE

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MODIFICATION AND EVALUATION OF DIETARY QUALITY ASSESSMENT TOOL (DQAT) FOR CHILDREN BELOW 5 YEARS OF AGE

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CERTIFICATE

This is to certify that the research work embodied in the thesis has been carried out independently by **Ms. Gopi Patel** in pursuit of a Degree of Master of Science in Dietetics at the Department of Foods and Nutrition in Family and Community Science under the guidance of Dr. Vijayata Sengar and represents her original work.

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Gopi Patel

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ABBREVIATIONS

WHO - World Health Organisation

EIBF - Early Initiation Beginning of Breastfeeding

UNICEF - United Nations Children's Fund

GHI - Global Hunger Index

WAZ - Weight-for-Age Z score

HAZ - Height-for-Age Z score

WHZ - Weight-for-Height Z score

CNNS - Comprehensive National Nutrition Survey

NFHS - National Family Health Survey

HFSS – High Fat Salt and Sugar

NCD – Non-Communicable Disease

MAD – Minimum Acceptable Diet

MDD – Minimum Dietary Diversity

MAR – Mean Adequacy Ration

HEI – Healthy Eating Index

DGA – Dietary Guidelines for Americans

DQI – Diet Quality Index

DDS – Dietary Diversity Score

DD – Dietary Diversity

DQAT – Dietary Quality Assessment Tool

DBM – Double Burden of Malnutrition

TBM – Triple Burden of Malnutrition

ASPEN - American Society of Parenteral and Enteral Nutrition

IYCF - Infant and Young Child Feeding

AAP - American Academy of Paediatrics

BMI – Body Mass Index

FV – Fruits and Vegetables

GBD – Global Burden of Diseases

FANTA – Food and Nutrition Technical Assistance

MMF – Minimum Meal Frequency

CIDQ - Children's Index of Diet Quality

DQI-I - Diet Quality Index – International

FCTs - Food-Nutrient Conversion Tables

FBQI - Food-Based Quality Index

HFI - Healthy Food Index

FPI - Food Pyramid Index

FFQs- Food Frequency Questionnaires

RDAs - Recommended Dietary Allowances

AHEI - Alternate Healthy Eating Index

USDA - The United States Department of Agriculture

SFA - Saturated Fatty Acids

HLIs - Healthy Lifestyle Indicators

24HR - 24-hour Dietary Recall

NHMRC – National Health and Medical Research Council

TDQ - Toddler Dietary Questionnaire

ADDI - Appropriately Diverse Daily Intake

FCS - Food Consumption Score

IDDS - Individual Dietary Diversity Score

DQAT-K – Dietary Quality Assessment Tool for kids (6 – 24 months)

DQAT-P – Dietary Quality Assessment Tool for Pre-schooler (25 – 59 months)

AWCs - Aanganwadi centres

ICMR – Indian Council of Medical Research

NIN – National Institute of Nutrition

FAO – Food and Agriculture Organization

IAP – Indian Academy of Paediatrics

IFCT – Indian Food Composition Tables

ANOVA – Analysis of Variance

R.O. – Reverse Osmosis

NRC -Nutrition Rehabilitation Centre

CMTC – Child Malnutrition Treatment Centre

NS – Not significant

PCA - Principal Component Analysis

ABSTRACT

ABSTRACT

UNICEF's conceptual framework of factors determining maternal and child nutrition listed an inadequate diet, frequent illnesses, poor breast-feeding techniques, delayed introduction of supplementary meals, and a lack of protein in the diet as the main causes of childhood malnutrition. Most children do not get the variety in diet, timing, or frequency of feedings that they need to reach their full potential in terms of growth and development. Dietary diversity is a promising qualitative tool however, it is more focused on the number of food groups included and does not give any information regarding the quantity of food.

Thus, the present study was planned with the specific objectives of modifying existing Dietary Quality Assessment Tool (DQAT) 2022 and conducting psychometric evaluation of DQAT 2023. Additionally, situational analysis was done to assess nutritional status, IYCF Practices, Socio-economic status and dietary patterns of children under 5 using DQAT 2023 and a manual on dietary quality assessment tool was developed.

A sample of 452 children was selected from randomly selected aaganwadis of four ghataks in urban Vadodara. The study population consisted of around 52% of female and 48% of males.

DQAT 2023 had two categories according to age. DQAT2023-K for children between 6 and 24 months consisted of 15 components, namely: breastmilk; grains; roots and tubers; legumes; nuts; dairy products; flesh foods; eggs; vitamin A-rich fruits; vitamin-rich vegetables; other fruits; other vegetables; high-fat, sugar, and salt foods; total fat; added sugar; whereas in DQAT2023-P for children between 25 and 59 months, there were 14 components, which were similar to those in category 6 to 24 months with the exception of breastmilk.

The prevalence of severe stunting was 16.4 %, wasting 4.4%, and underweight 6.4% (<-3SD). Stunting and underweight prevalence was highest between 25 to 36 months old children. Wasting prevalence was highest in 4-5 years old children due to inappropriate eating habits. There was a significant variation for HAZ, WHZ, and WAZ between both the age groups of below and above 2 years (WHZ f value of 12.073**;

HAZ f value of 17.365*; WAZ f value of 0.267***). Around 72% of mothers reported of early initiation of breastfeeding within 1 hour after birth.

Females had higher intakes of nutrients as % RDA with an exception of calcium and iron. WAZ score had a significantly positive relationship with the mean %RDA for fat in children above and below 2 years. Males showed greater dietary diversity than females, but neither group met the required minimum dietary diversity.

Children between the ages of 25 and 36 months had lowest mean DQAT scores. In comparison to males, females consumed poor-quality food. None of the subjects were having a good-quality diet as per DQAT.

Participants in BPL category had significantly poor-quality diets as compared to those in APL category.

A significant difference existed in mean breastmilk scores for children below the age of 2 years based on gender. With the exception of Vegetables high in vitamin A, there was no significant difference observed for other DQAT 2023-K components age-wise.

Content, Construct and criterion validity were examined for both DQAT2023-K and DQAT2023-P. Both were found to be valid and reliable tools for assessing dietary quality of children between 6 months to 59 months.

Based on the findings from study a manual on enhancing nutrition quality in diet was developed for mothers of young children between 6-59 months of age.

Thus, DQAT2023 can be an easy, simple to use, and effective dietary quality assessment tool for identifying eating habits early in life. This can help mothers or caregivers in identifying the gaps in existing diets and make necessary changes early in life.

INTRODUCTION

INTRODUCTION

Malnutrition is one of the main issues with public health in the world. Malnutrition is essentially an imbalance in either nutrition, which can result from over or undereating. Undernutrition—of which there are essentially three subtypes: wasting, stunting, and underweight—inadequate vitamins and minerals, overweight, obesity, and the ensuing non-communicable diseases linked to diet are all included **(Figure 1.1)**. The most significant measure of a community's nutritional quality and health is considered to be child growth, which is acknowledged on a global scale (WHO Factsheet, 2021).

A child's ability to survive, grow, develop, and learn today is one of the most severely hampered by poor diets. In the first two years of life, when a child's body and brain are quickly developing, the risks are greatest because of how irreparably harmed they can be by inadequate dietary intake of nutrients. A child's route to unhealthy eating, obesity, and diseases linked to diet might be established by foods heavy in sugar, fat, or salt. The effects of inadequate nutrition on children might last their entire lives (Fed to Fail? The Crisis of Children's Diets in Early Life, Child Nutrition Report 2021).

1.1: Child Malnutrition: Global, Region, and National Scenario

In 2020, it was projected that there would be 6.7%-wasted children and 149.2 million stunted children worldwide. A forecasted 38.9 million children under the age of five were overweight. In 2020, Asia and Africa together accounted for more than half of all children under the age of five who were stunted. Of those children under 5 affected by waste, more than 2/3 lived in Asia, and more than 14% did so in Africa (Joint Child Malnutrition Estimates - United Nations Children's Fund (UNICEF), 2021 edition).

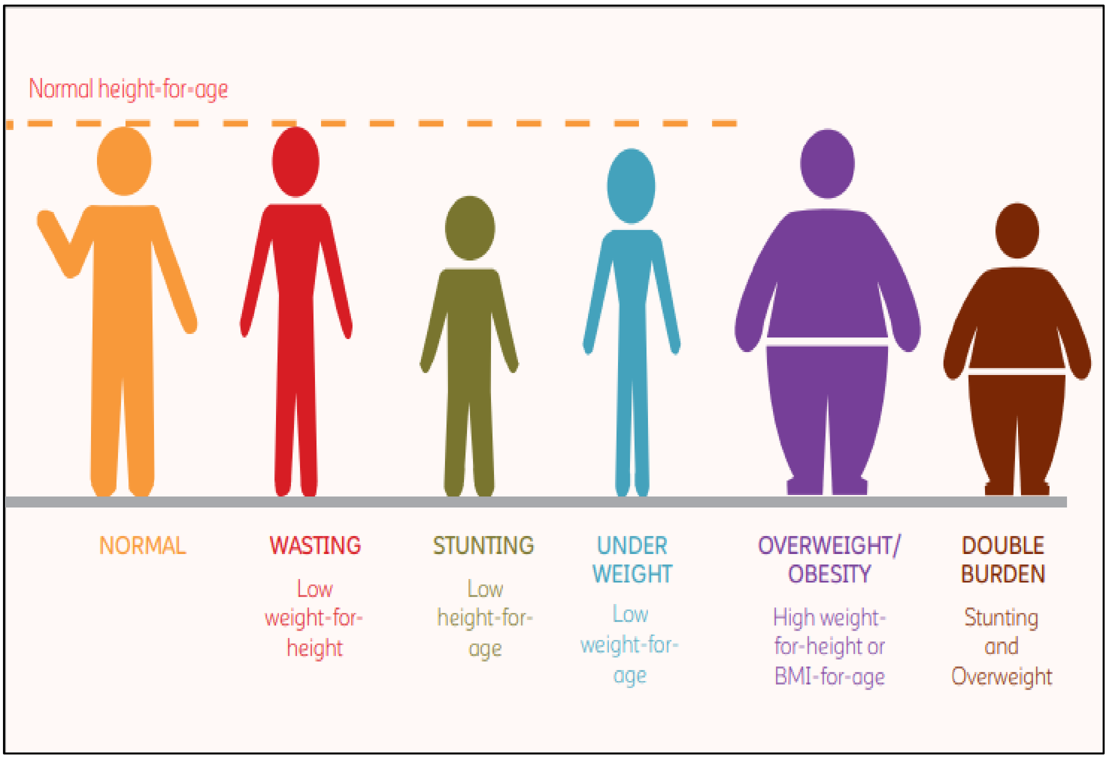
More than 14 percent of all children under 5 who were overweight or obese lived in Africa, and nearly half were from Asia (Joint Child Malnutrition Estimates - United Nations Children's Fund (UNICEF), 2021 edition).

Even though their aggregate scores do not place them in the top categories of hunger, a few countries have particularly high values for one or more of the variables utilized in the calculation of the GHI scores. For instance, despite having a GHI score in the serious category, Timor-Leste has the third-highest child stunting rate of any country in the world according to data, at 46.7%. With a GHI score of severe, India has the highest child-wasting rate in the world at 19.3%; rates are also very high in Sri Lanka, Sudan, and Yemen. Haiti and the Democratic People's Republic of Korea have the third- and fourth-highest rates of undernourishment among All the countries having data, at 47.2 and 41.6 percent, respectively (Von Grebmer, 2022).

Nigeria, which suffers from severe malnutrition, has the second-highest child death rate in the world, only after Somalia (11.5%). To guarantee that these issues are not ignored, it is vital to be aware of which nations struggle the most based on each indicator (Von Grebmer, 2022).

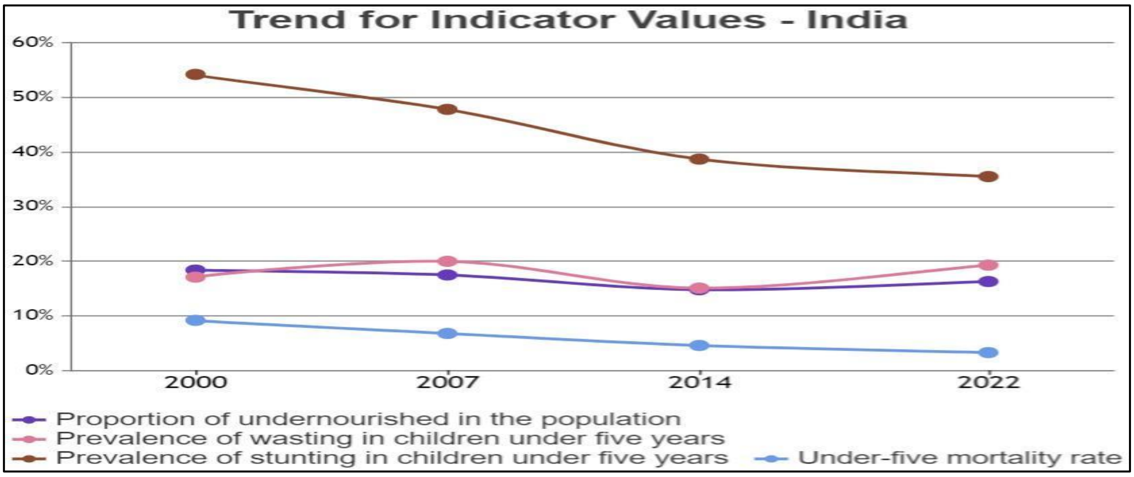
Although India has made significant strides since 2000, there are still some areas that warrant worry, notably concerning undernutrition in young children. The Global Hunger Index score for India has dropped from 38.8 in 2000 to 29.1 in 2022, which is considered a substantial decline. While child stunting has significantly decreased from 54.2 percent in 1998–1999 to 35.5 percent in 2017–2021, it is still regarded as being at an extremely high level. India has the highest child-wasting rate among all GHI-compliant nations, at 19.3%, according to the most recent data (Von Grebmer, 2022) **(Figure 1.2)**.

Figure 1.1: Different types of malnutrition



(Source: (Comprehensive national nutrition survey, 2016-2018)

Figure 1.2: Trend for indicator values in global hunger index for India



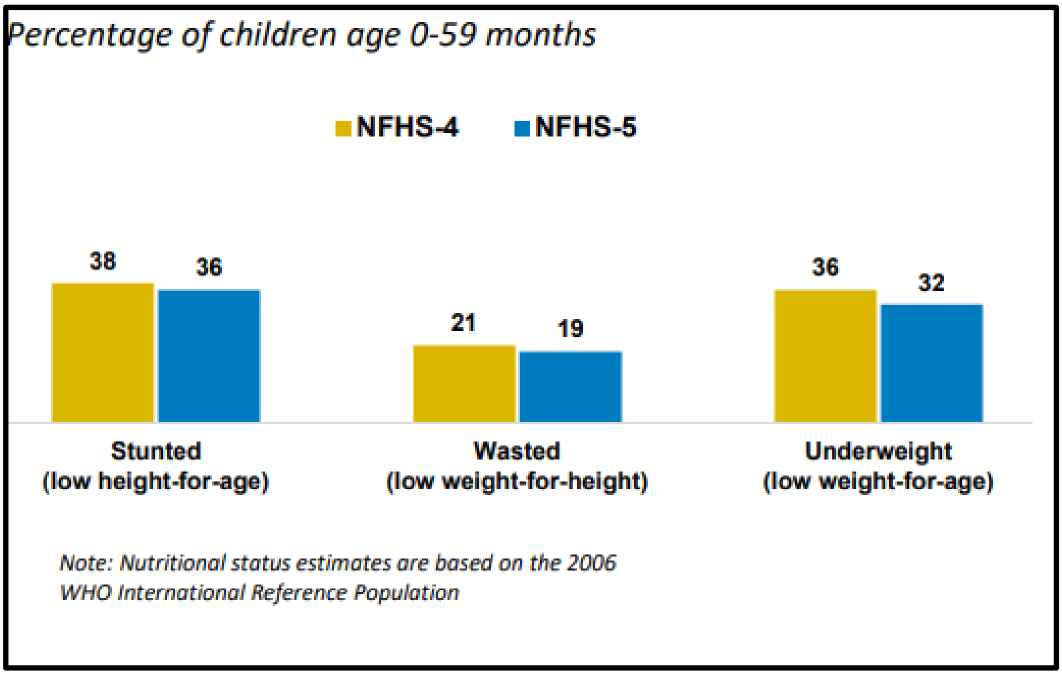
(Source: (Von Grebmer, 2022))

India is ranked 107th out of 121 nations having enough data to compute the 2022 Global Hunger Index rankings. India has a serious level of hunger with a score of 29.1 (Von Grebmer, 2022).

In India, nearly 1/3rd of children under five years of age are stunted. It is due to chronic malnutrition. Acute malnutrition leads to wasting, the prevalence of wasting among children under five years of age is around 19%. Nearly 32% of children are underweight while 3% of children under five years of age are overweight. Stunting is higher among children in rural areas (37%) than in urban areas (30%) (National Family Health Survey (NFHS-5), India, 2019-2021).

Since 2015–16, there has been a decline in the prevalence of stunting and underweight. Stunting's percentage dropped from 38% in 2015–16 to 36% in 2019–21. The prevalence of wasting has decreased during the same time frame, falling from 21% in 2015–16 to 19% in 2019–20 **(Figure 1.3)**.

Figure 1.3: Trends in Nutritional Status of Children in India

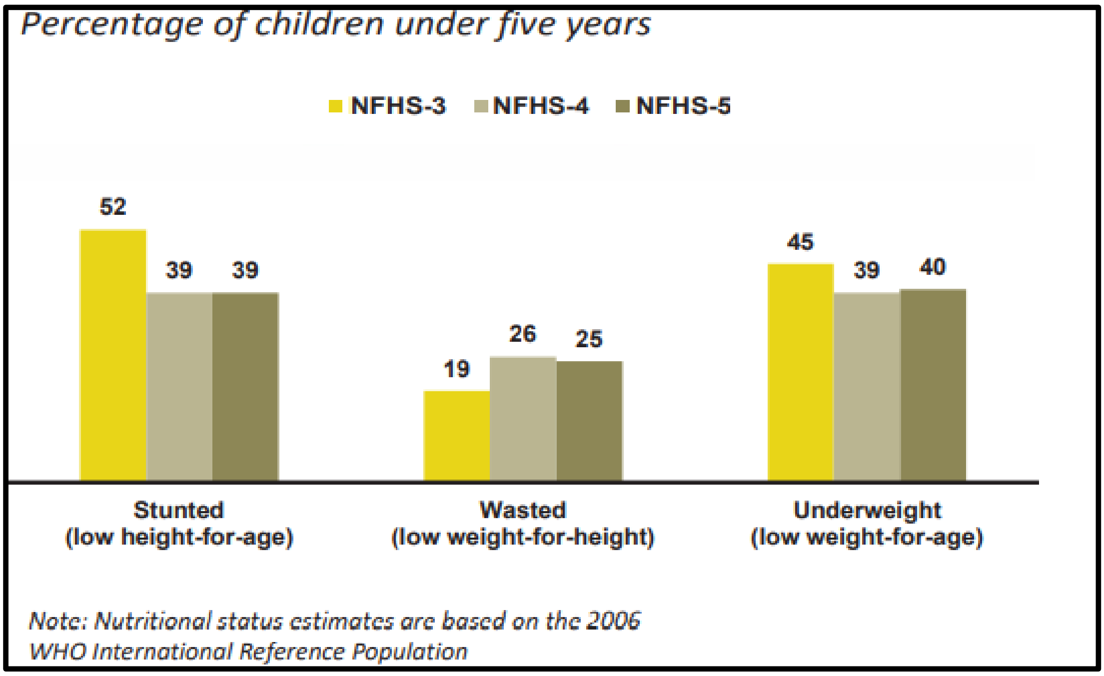


(Source: (National Family Health Survey (NFHS-5), India, 2019-2021)

In India, undernutrition in children is a leading cause of death and a contributor to childhood illnesses. The fact that 39% of children under the age of five are stunted, or excessively short for their age, suggests that they have likely been malnourished for a while. A recent sickness that caused weight loss may have caused 25 percent of people to be wasted or too thin for their height, and 11 percent are seriously wasted. When chronic and acute undernutrition are both taken into consideration, 40% are considered underweight. even when practically all infants are nursed during the first six months of life, 27 percent of kids are stunted and 32 percent are wasted or underweight (National Family Health Survey (NFHS-5), India, 2019-2021).

By many accounts, Gujarati children's nutritional status hasn't altered much since NFHS-4. In the four years between NFHS-5 and NFHS-4, the proportion of stunted children (39%) remained constant. Since NFHS-4, the percentage of underweight children has only slightly increased (from 39% to 40%) while the percentage of wasting children has somewhat decreased (26% to 25%). Gujarat's persistently high rates of undernutrition remain a serious issue, nevertheless (National Family Health Survey (NFHS-5), India, 2019-2021) **(Figure 1.4).**

Figure 1.4: Trends in Nutritional Status of Children in Gujarat



(Source: (National Family Health Survey (NFHS-5), India, 2019-2021)

Anemia affects 67% of children aged 6 to 59 months, which is greater than the NFHS-4 estimate of 59% (National Family Health Survey (NFHS-5), India, 2019-2021).

The incidence of stunting among children under the age of five is highest in Meghalaya (47%), followed by Bihar (43%) and the states of Uttar Pradesh, and Jharkhand, and each has a rate of 40%. The rates are lowest in Puducherry (20%) and Sikkim (22%). Bihar has the highest percentage of underweight children (41%) while Maharashtra has the highest percentage of waste (26%). In Gujarat, 39% of children under five were impacted by stunting (National Family Health Survey (NFHS-5), India, 2019-2021).

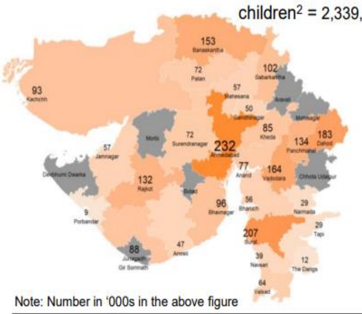
Children who are severely malnourished have lower infection resistance, which increases their risk of death. Those who make it through the first stage of development may experience low growth and failure to thrive (National Family Health Survey (NFHS-5), India, 2019-2021).

According to the NHFS- 5 Data, practically all of Gujarat's districts have worsening nutritional conditions for children under the age of five. Increases in stunting (from 38.5% to 39%), wasting (from 9.5% to 10.6%), underweight (from 39.3% to 39.9%), and overweight (from 1.9% to 3.9%) have all been made (National Family Health Survey (NFHS-5), India, 2019-2021) **(Figure 1.5).**

Figure 1.5: Numbered of stunted, wasted, and underweight children <5 years in Gujrat

Map 1. Stunting

Number of stunted children[2] = 2,339,857



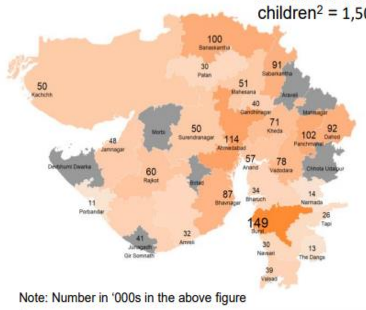
Note: Number in '000s in the above figure

Highest burden districts		
1	Ahmadabad	232,221
2	Surat	207,246
3	Dahod	182,940
4	Vadodara	164,380
5	Banas Kantha	152,911

No. of districts with public health concern[1]: 32 of 33

Map 3. Wasting

Number of wasted children[2] = 1,509,957



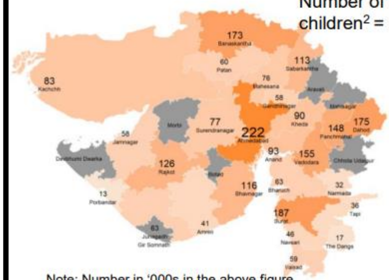
Note: Number in '000s in the above figure

Highest burden districts		
1	Surat	149,263
2	Ahmadabad	114,475
3	Panch Mahals	101,938
4	Banas Kantha	99,980
5	Dahod	91,966

No. of districts with public health concern[1]: 33 of 33

Map 5. Underweight children

Number of underweigh children[2] = 2,379,195



Note: Number in '000s in the above figure

Highest burden districts		
1	Ahmadabad	222,409
2	Surat	186,579
3	Dahod	175,331
4	Banas Kantha	172,907
5	Vadodara	155,054

No. of districts with public health concern[1]: 33 of 33

(Source: (National Family Health Survey (NFHS-5), India, 2019-2021)

1.2 Determinants of Child Malnutrition

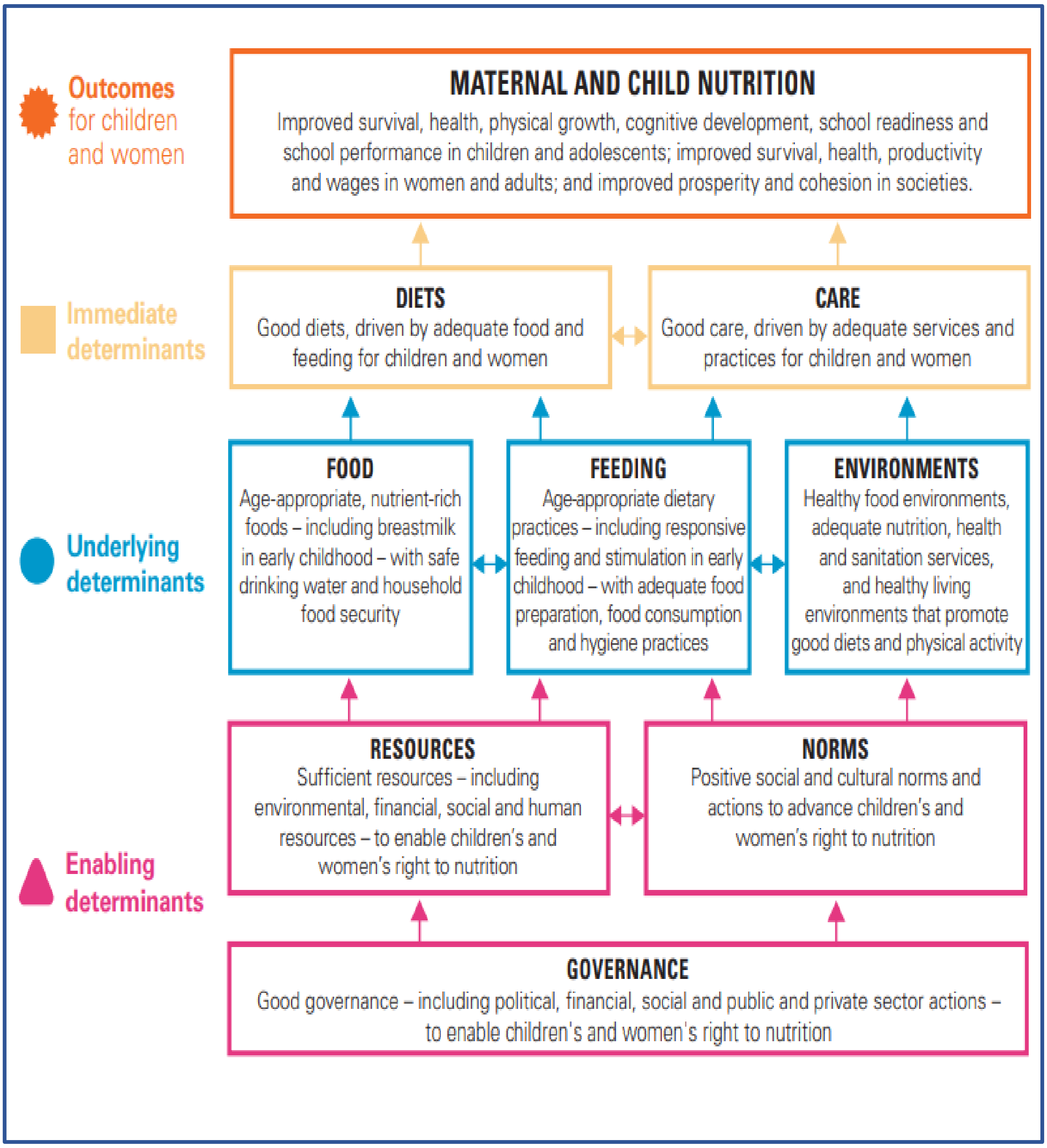
Each child must have adequate nutrition in the early years to reach their full potential, with the first two years of life being regarded as a crucial window of time for growth and development. Inadequate food intake is one of the immediate causes of malnutrition, according to the conceptual framework developed by UNICEF **(Figure 1.6).**

In 2006, UNICEF listed inadequate diet, frequent illnesses, poor breastfeeding techniques, delayed introduction of supplementary meals, and a lack of protein in the diet as the main causes of childhood malnutrition. In addition, factors including growth, personal eating preferences, dietary taboos, and health conditions might affect food consumption. Malnutrition can be caused by abuse, inconsistent mealtimes, a shortage of food sources, and uneducated parents (Ansuya, 2018).

Inadequate dietary exposures during the complementary feeding period have been shown a negative impact on future food and taste (Summers, 2018), resulting in the development of unhealthy eating habits that may increase the risk of childhood obesity (Mazarello Paes, 2015), a problem that is becoming more and more widespread in the world (The Lancet, 2021).

Malnutrition causes one out of every three children to grow poorly. Due in part to lower food affordability due to decreasing earnings, which in turn resulted in a decline in food variety and diversity, the pandemic aggravated food insecurity in many parts of the world (Christophe Béné, Deborah Bakker, Anne Sonneveld, 2021).

Figure 1.6: UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition, 2020



(Source: ((UNICEF), December 2020))

One of the biggest barriers to children's survival, development, growth, and learning today is their poor-quality diets. The risks are greatest in the first two years of life when a child's quickly developing body and brain can be irreversibly harmed by low nutrient intake. A child's poor eating habits, obesity, and diseases associated with diet can all be brought on by foods heavy in sugar, fat, or salt (Fed to Fail? The Crisis of Children's Diets in Early Life, Child Nutrition Report 2021)

Conflict, economic shocks, climatic instability, extremes, and rising inequality are hindering the world from eliminating hunger by 2030. People who experience food instability and hunger have been more prevalent since 2014. Due to the COVID-19 pandemic, the situation worsened and around 150 million more people experienced hunger in 2021 than in 2019. In other words, 1 in 10 people globally is said to be hungry. Additionally, 2.3 billion people, or about 1 in 3, had moderate to severe food insecurity in 2021, which meant they frequently lacked access to enough food. Since the pandemic's beginning, this has amounted to an increase of roughly 350 million people. Sub-Saharan Africa experienced the most alarming rise, followed by Central and Southern Asia, Latin America, and the Caribbean (DESA, July 2022).

Asia continues to have 381 million undernourished people, which is the majority of the world's population. Africa has a population of over 250 million, and it is the region of the globe with the fastest rate of increase in the number of undernourished people. Roughly 750 million people worldwide, or nearly one in ten, experienced extreme food insecurity in 2019. In 2019, an estimated 2 billion people worldwide lacked regular access to sufficient, wholesome, and safe food. By 2030, there will be more than 840 million hungry people in the world, or 9.8% of the entire population, if current trends continue. In 2019, stunting afflicted 144 million children under the age of 5, with three-quarters of those children residing in Southern Asia and sub-Saharan Africa. Acute undernutrition, often known as wasting, is a disorder brought on by a lack of nutrients and infection that affected 6.9% (or 47 million) children under the age of five in 2019 (DESA, July 2022).

1.3 Diet Quality of Children

Cookies, chips, confectionery, sweet drinks, and sweetened purees and juices are examples of foods that are high in sugar, salt, trans, and saturated fats but low in nutrition. Commercially prepared foods may also contain excessive amounts of sugar, salt, and bad fats. These items may replace nutritious diets and increase the risk of obesity ((UNICEF), December 2020). Low consumption of fruits and vegetables is one of the main causes of non-communicable diseases and death worldwide (Dr. Stephen S Lim Ph.D., 2012).

Indian Academy of Pediatrics recommendations state that infants and toddlers under the age of one should not consume any foods heavy in fat, salt, or sugar (HFSS) (Indian Academy of Pediatrics, 2019).

The cornerstone of long-term health is sound nutrition, which is defined as the consumption of sufficient, well-balanced food to fulfill the body's dietary and energy needs (World Health Organization, 2018). Unhealthy diets raise the risk of obesity and non-communicable diseases like hypertension, cardiovascular disease, diabetes, some malignancies, and different atopic disorders. Unhealthy diets include excessive consumption of saturated fats, trans fatty acids, sugar, and salt (C. Agostoni M. C., 2012); (C. Agostoni H. P., 2013); (L. Brazionis, 2013); (M.J. Brion, 2008,); (F.J. He, Salt, blood pressure and cardiovascular disease, 2007); (F.J. He, A comprehensive review on salt and health and current experience of worldwide salt reduction programs, 2009); (NCDs collaboration, 2017) ; (J. Pearce, 2013); (Stanhope, 2016); (nutrition, 2018)). Therefore, it is crucial to develop healthy eating habits early in life. This can be accomplished efficiently if the dietary quality is accurately assessed and early behaviors are changed.

Age, sex, country of origin, and/or culture of the individual, as well as the individual's cultural and dietary surroundings, socioeconomic status, child and family food preferences, and nutrition recommendations pertinent to age, sex, country, and/or culture, are examples of confounding factors that can affect diet quality (Marshall S, 2014).

Increasing variety in one's diet is advised in the majority of dietary guidelines around the world because it is linked to consuming enough energy and key nutrients. In populations where micronutrient shortage is more frequent and diets based on starchy staples are consumed, dietary diversification is particularly crucial (MT., 2003).

A breastfed youngster who eats meals from at least five of the eight food groups the day before qualifies as having a minimum diverse diet (UNICEF global databases - Infant and Young Child Feeding, 2008).

Two out of every three children aged 6-23 months (72%) are not given even the most basic variety diet necessary for good growth, according to the most recent data on the quality of complementary foods and feeding habits. Although the majority of children in this age range (more than 75%) are fed breastmilk and grains (such as wheat, rice, or corn), 46% aren't given any fruits or vegetables, and 60% aren't given nutrient-dense foods like eggs, fish, or meat. Although general recommendations state that young infants should regularly consume certain foods (or as often as possible) ((UNICEF), December 2020).

South Asia (18%) and sub-Saharan Africa have the lowest rates of dietary diversification, according to regions (22 percent). Globally, there are noticeable differences in the minimal dietary diversity prevalence according to wealth position. Less than one in five children (18%) from the poorest households eats foods from at least five of the eight food groups, showing that access to varied and nutrient-dense supplemental foods is hampered by one's ability to pay. Less than two in five children (38%) are fed a minimum diverse diet even in higher-income households, indicating that factors other than income are at play, such as knowledge, practicality, and attractiveness ((UNICEF), December 2020).

According to studies on newborn feeding practices in low- and middle-income environments, young infants were more likely to be fed commercially produced snack foods than nutrient-rich complementary foods, and children's preferences for such foods outweighed affordability and other considerations in mothers' decision-making (Pries, 2017).

Between the ages of two and four, toddlers begin to choose their meals and occasionally dine outside the home, exposing them to new influences. The healthy eating patterns and behaviors of caregivers, family members, teachers, and classmates become more influential throughout this stage of life (De Cosmi, 2017).

All of the nutrients that children require throughout their first 180 days of life are present in breast milk. For children, it provides a source of pure nutrients. Only breast milk is given to 64% of newborns younger than six months. Many children in that age group also ingest supplemental foods (11%) and other liquids, such as plain water (10%), other milk (8%), or other foods. Rural communities typically breastfeed their infants longer than metropolitan areas do (NHFS-5). To promote proper growth and development, infants and young children should be fed a minimum acceptable diet (MAD) (National Family Health Survey (NFHS-5), India, 2019-2021).

Most children don't get the variety in diet, timing, or frequency of feedings that they need to reach their full potential in terms of growth and development. In 2020, one in four, or 27% of infants between the ages of 6 and 8 months, did not receive any supplemental foods. 48 percent of infants and toddlers between the ages of 6 and 23 months who weren't given the minimal number of meals and snacks per day that are advised – known as the minimum meal frequency – were not fed at all. The metric known as minimum dietary diversity shows that 71% of children aged 6 to 23 months were not given food from at least five of the eight food groups. More than half of children (55%) did not take any of these nutrient-rich foods during the previous day, according to the indicator known as egg and/or flesh food consumption, despite the recommendation that children aged 6-23 months be fed eggs, fish, or meat regularly (Diets - UNICEF, 2022).

To reflect the various elements of the human diet, several dietary quality indexes have been established. The Mean Adequacy Ratio (MAR) evaluates micronutrient intakes concerning Dietary Reference Intakes, whereas the Healthy Eating Index (HEI) assesses adherence to the Dietary Guidelines for Americans (DGA) primarily based on food intake (Jun 2019). To assess dietary quality rather than quantity, the HEI 2015 rates densities of consumed food groups and nutrients rather than absolute amounts (Jun 2019).

Few indices, meanwhile, have had their validity, reliability, or associations with health outcomes examined. From the 15,577 data that were screened, 128 distinct pediatric diet quality indicators from 33 different nations were found. Only 37 indicators had their validity and/or reliability assessed. For children under the age of five, there was no DQI available in India (Dalwood, 2020).

Around the world, there isn't much research on the caliber of young children's diets. Additionally, they neglect to consider the amount of food that kids consume since they are more concerned with food intake frequency and diet variety.

1.4 Rationale

Dietary diversity is an absolutely promising tool for assessing diet quality. However, it requires more research on it to improve and systematize the measurement approaches and indicators.

Dietary diversity is a qualitative tool and it is more focused on the number of food groups included but it does not give any information regarding the quantity of food.

Diet quality assessment tools for children under 5 years of age could be used to simplify managing and accessing healthy dietary patterns at an early age of life. It would also suggest the consumption of different food groups with quantity.

The previous year, a dietary quality assessment tool was developed for children below 5 years however, due to paucity of time it could not be evaluated.

As shown in the review most of the dietary quality assessment tools were not tested for validity and reliability. Therefore, the present study deals with the modification of DQAT 2022 as per the latest guidelines and norms as well as psychometric evaluation of the same.

1.5 Objectives

Board objective of the study

- To modify and evaluate the Dietary Quality Assessment Tool 2022 for children below 5 years of age.

Specific objectives of the study

- To modify the existing Dietary Quality Assessment Tool 2022.
- To assess the socio-economic status, nutritional's status, and dietary intakes of children and assess the quality of diets using DQAT 2023.
- To conduct a psychometric evaluation of Dietary Quality Assessment Tool 2023.
- To develop manual on assessing and improving diet quality in children

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Malnutrition in children is a triple global burden. For the developing world, particularly India, malnutrition is a serious public health issue (Pal A, 2017). India is still the country that contributes the most to the global malnutrition rate. Malnutrition can have a serious impact on a child's survival as well as their growth and development. One of the proven causes of sickness and mortality among children worldwide is malnutrition (Lahariya.C, 2008).

Recently, micronutrient deficiencies were added to the double burden of malnutrition (Awasthi S, 2020). Also a few research have focused on the coexistence of the triple burden of malnutrition (TBM), which includes obesity, micronutrient deficiencies and undernutrition in children (Agnihotri SB. Ain A, 2020). Consistently linked to both undernutrition in children and obesity for women is household poor access, a condition caused by poverty that hinders access to a healthy diet (Gubert MB, 2017).

Healthy diets power expanding bodies, strengthen immune systems, and nourish developing brains. Children who are well-nourished are more equipped to realize their rights, including those to live healthy lives, learn, access opportunities, and start down a path to long-term success and prosperity (Fed to Fail? The Crisis of Children’s Diets in Early Life, Child Nutrition Report 2021).

Families all throughout the world rejoice over a child's first mouthful of food. It signals the beginning of a new stage of exploration—new tastes, textures, and scents. Additionally, it heralds the beginning of the critical period from 6 months to 2 years of age, which determines how well a kid will grow, develop, and succeed in life (Fed to Fail? The Crisis of Children’s Diets in Early Life, Child Nutrition Report 2021).

Good nutrition is not only for physical strength. Strong minds need it just as much. Without a doubt, malnutrition can cause illness and stunt a child's development. However, illnesses associated with malnutrition can also lead to cognitive delays that impair a child's capacity to study and even make a living in the future (Britto, 2017).

The nutrition transition, the epidemiological transition, and the demographic transition are a series of epidemiological shifts that are linked to the double burden of malnutrition. The term "nutrition transition" refers to the changes in eating habits, consumption, and energy usage that are a result of economic growth over time, frequently in the context of globalisation and urbanisation. This trend is linked to an increase in overweight, obesity, and non-communicable diseases (NCDs), which previously predominated in communities due to undernutrition (WHO, The double burden of malnutrition-Policy brief, 2017).

The nutritional status of communities is significantly impacted by the quality, quantity, and production processes of foods. Over the past fifty years, the portion sizes of many packaged, restaurant-, and take-out snacks and meals have increased while their relative prices have declined. In the meantime, the price of fresh produce has gone up, which is especially bad for the poor in low- and middle-income nations and nations that import food (Rising food prices- Causes and consequences, 2008).

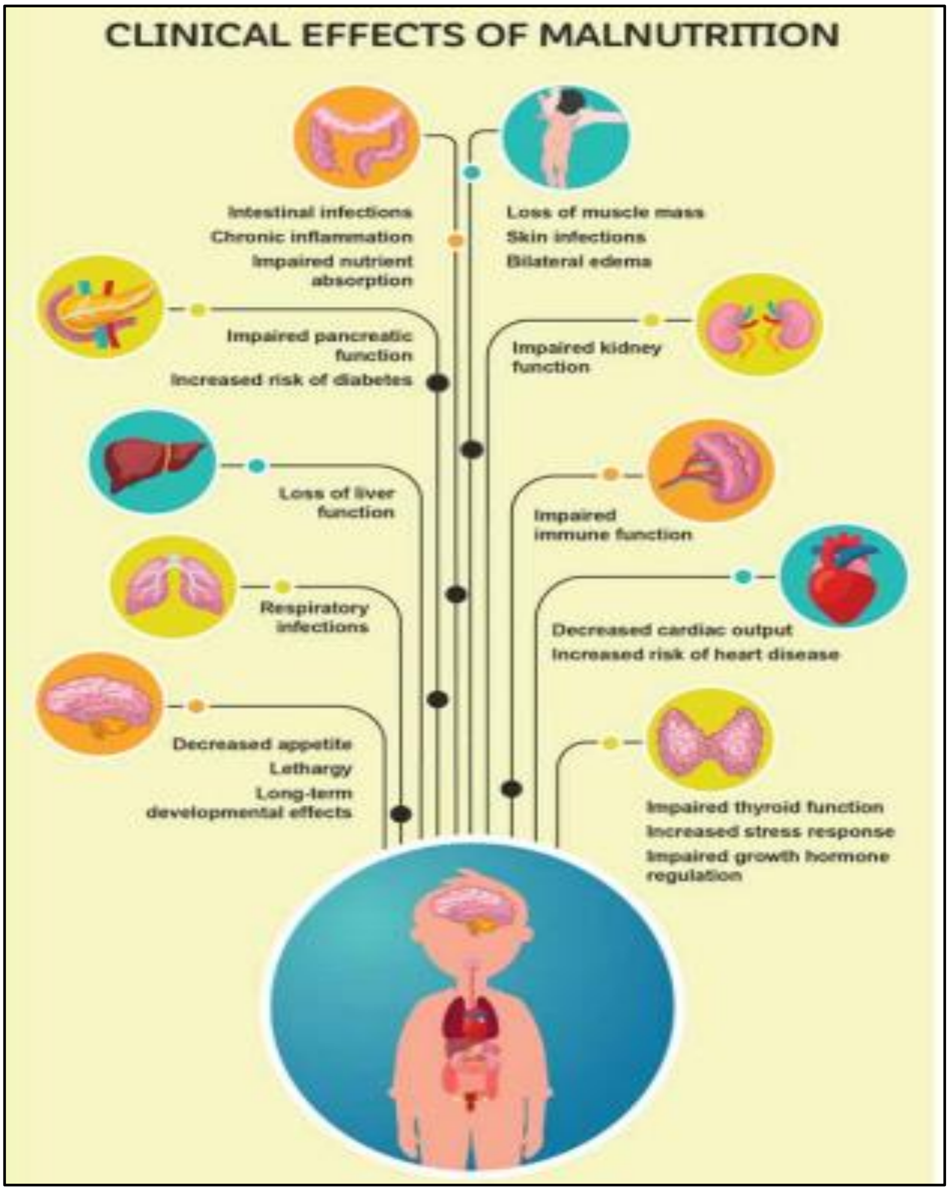
In places where there is insecurity, violence, or natural disasters, food becomes expensive and difficult to get. Inadequate food intake, portion sizes that don't satisfy the nutrition and energy needs of developing children, and food that is either scarce or inaccessible all lead to undernutrition, which increases the risk of illness, wasting, and even stunting (WHO, The double burden of malnutrition-Policy brief, 2017).

unhealthy habits that make you more energetic Consumption may occasionally be the result of automatic or trained responses to cues or nudges in the immediate surroundings rather than conscious decisions. These behaviours have the potential to develop into habits that cause long-term weight gain and make it harder to lose weight (Dietz WH, 2015).

Health is significantly and frequently permanently impacted by the eating environments experienced throughout pregnancy and infancy. The type and amount of nutrition taken throughout foetal development and infancy has an impact on the body's immune system, cognitive growth, and management of energy storage and expenditure, including fat reserves (Bruce KD, 2010); (Schellong K, 2012).

Poor maternal nutrition during and throughout pregnancy might raise the risk of maternal anaemia, preterm birth, and low birth weight in babies. Babies who are born

Figure 2.1: Clinical effects of malnutrition



Source: (comprehensive national nutrition survey, 2016-2018)

underweight may subsequently be more susceptible to metabolic illness and abdominal obesity (Bruce KD, 2010);(Godfrey KM, 2016);(Schellong K, 2012).

2.1 Current Scenario of Malnutrition

A safe and nutritious diet helps maintain good health and guards against all types of malnutrition. Additionally, it lowers the risk of noncommunicable diseases (NCDs), which include several cancers, heart disease, diabetes, and stroke, and it fosters a robust immune system that guards against infection. The fundamental right to appropriate food and nutrition belongs to every person. However, a poor diet is one of the major risk factors for the global burden of disease and, along with maternal and child malnutrition, is responsible for nearly one-fourth of all fatalities worldwide. A third of the population experiences malnutrition in some way, whether it is undernutrition, vitamin or mineral deficiencies, overweight, or obesity (WHO, A healthy diet sustainably produced, 2020).

Children and teenagers who are undernourished are more likely to experience stunted growth, weakened immunity, delayed mental development, and even death (Black RE V. C., 2013).

Increased rates of overweight and obesity put people at higher risk of developing non-communicable diseases like diabetes, cardiovascular disease, and hypertension as India undergoes significant economic, demographic, and nutritional changes (Kalra S, 2012).

In the CNNS, 35% of young Indian children (ages 0–4) had stunted growth. Stunting was prevalent (37–42%) in a number of the most populous states, including Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh. Goa and Jammu and Kashmir had the lowest rates of stunting (16–21%). In comparison to urban areas, rural areas have a greater frequency of stunting in children under the age of five (37% vs. 27% there). Additionally, 49% of children in the lowest wealth quintile received gifts, as opposed to 19% in the highest quintile (CNNS, 2019).

In India, children aged 0 to 4 who were wasted made up 17% of the population. West Bengal, Tamil Nadu, Madhya Pradesh, and Jharkhand were among the states with a high prevalence (20%). Manipur, Mizoram, and Uttarakhand (each with a prevalence of 6%) were the states with the lowest rates of underweight wasting. Comparisons between states and surveys must take seasonal fluctuation into account because it can significantly affect the status of acute malnutrition in children under five. When compared to children in the highest wealth quintile (13%), a greater percentage of children under the age of five in the lowest wealth quintile (21%) were wasted (CNNS, 2019).

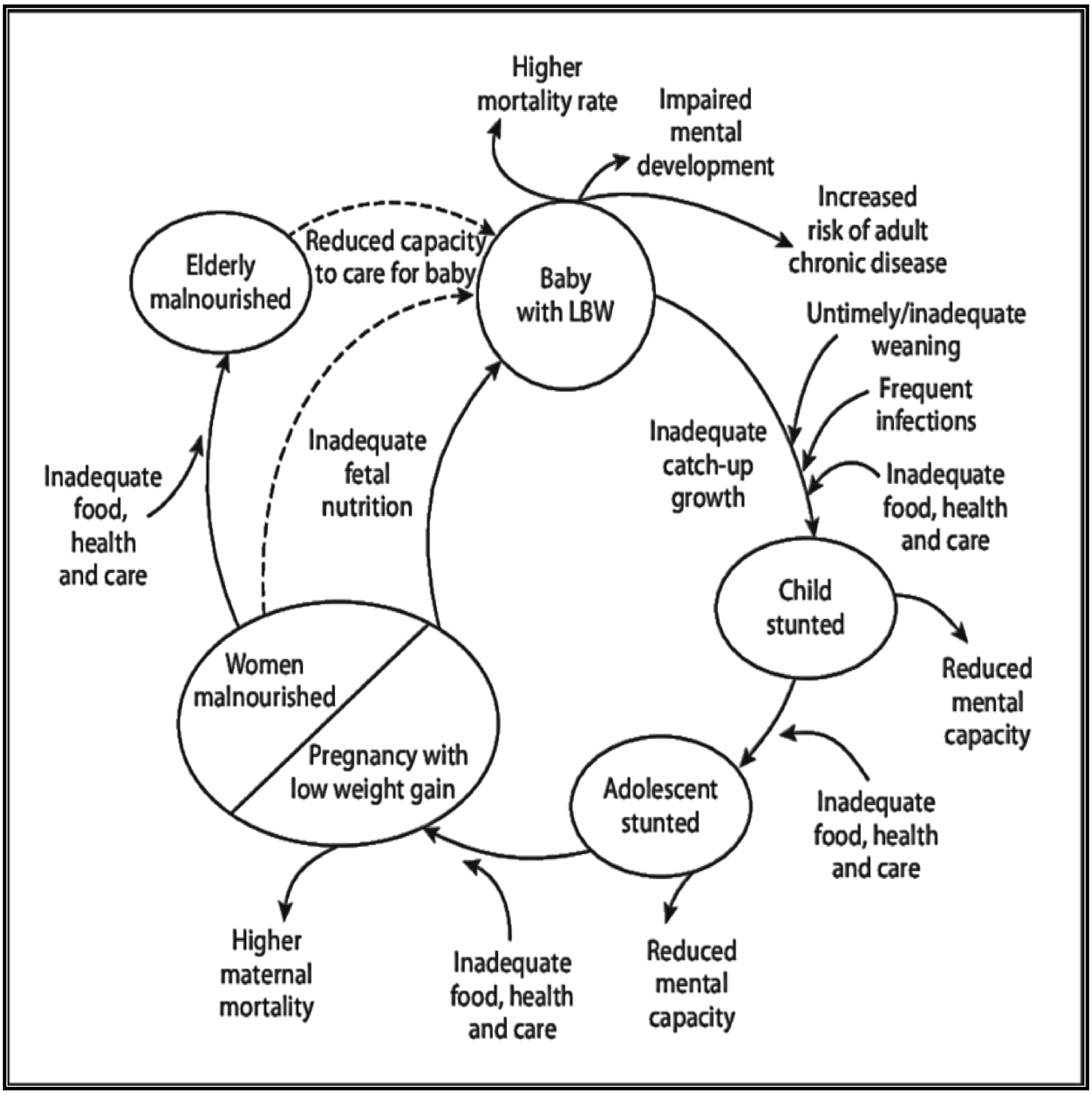
In total, 33% of Indian children between the ages of 0 and 4 were underweight. The prevalence of underweight was lowest (16%) in many north-eastern Indian states, including Mizoram, Sikkim, Manipur, Arunachal Pradesh, and Nagaland. The four states with the highest rates of underweight people were Bihar, Chhattisgarh, Madhya Pradesh, and Jharkhand (39%). Underweight in children under five was more common in rural areas (36%) than in urban areas (26%). Compared to scheduled castes (36%), other backward classes (33%), and other groups (27%), scheduled tribes had the highest frequency of underweight (42%). Similar to stunting, the prevalence of underweight was more than twice as high in children under the age of five from homes in the lowest wealth quintile (48% vs. 19%) (CNNS, 2019).

It is clear from the CNNS data that adult diseases begin in childhood. An increased risk of maternal anaemia and low birth weight can result from inadequate teenage and/or maternal nutrition before and during pregnancy. Undernutrition during pregnancy and the early years of childhood can make people more likely to gain weight as adults and acquire noncommunicable diseases like diabetes and heart disease (WHO, Nutritional anaemias: tools for effective prevention and control., 2017).

Obesity and overweight in children are also linked to maternal obesity. Children who experience early acute malnutrition may be predisposed to excess weight and the hazards linked with it as adults if they gain weight quickly afterward (Bruce, 2010). Under five-year-olds who were overweight or obese made up just 2% of the population overall (CNNS, 2019).

Paediatric malnutrition is described as "an imbalance between nutrient requirement and intake, resulting in cumulative deficits of energy, protein, or micronutrients that

Figure 2.2: The intergenerational cycle of malnutrition



Source: (ACC/SCN, 2000)

may adversely affect growth, development, and other relevant outcomes," by the American Society of Parenteral and Enteral Nutrition (ASPEN). Malnutrition can have two different etiologies: it can be induced by illness (one or more diseases or injuries directly lead to nutrient imbalance), or it can be brought on by environmental or behavioural variables that result in decreased nutrient intake and/or delivery (Mehta, et al., 2013).

2.2 Infant and Young Child Feeding (IYCF) Practices

Infant and young child feeding (IYCF) practices have a long-term impact on child survival, health, and development outcomes, in addition to the nutritional status of children under two years of age. For older children and teenagers, dietary diversity indicates availability to a range of foods and the diet's sufficiency in nutrients (CNNS, 2019).

The healthy growth and development of children under the age of two depend on optimal feeding practises during infancy and early childhood, including early breastfeeding initiation, exclusive breastfeeding for the first six months of life, continued breastfeeding through age one, timely introduction of complementary foods, diversity in diet, and frequency of feeding (CNNS, 2019).

2.3 Early Initiation of Breastfeeding

The best source of nourishment for an infant's healthy growth and development is breastmilk. The World Health Organization (WHO) advises early initiation beginning of breastfeeding (EIBF) as it enhances the duration of nursing, lowers infant mortality, and stimulates the production of breastmilk (WHO, 1998); (UNICEF, 2002). The colostrum generated by the mother in the first few days following delivery is full of nutrients and antibodies that guard the baby against disease and infection (Edmond KM, 2006).

Exclusive breastfeeding for the first six months of a baby's existence is sufficient and advantageous for their health, growth, and development since breastmilk includes all the nutrients, they require for proper development (Edmond KM, 2006).

The WHO promotes exclusive breastfeeding for the first six months of life since it is regarded as a critical intervention for lowering early infant morbidity and death. Given that breastmilk is a substantial source of energy and essential nutrients, the WHO advises maintaining breastfeeding after the initial six-month period and supplementing with safe and nutrient-dense meals (WHO, Global strategy for infant and young child feeding, 2003).

As an evolutionary extension of the intrauterine to extrauterine environment, breastmilk contains a number of chemicals that serve as mediators between mother and child, building a physiological and biochemical communication network (Bernt KM, 1999).

Human milk is helpful in the care and management of premature newborns, according to a 1997 American Academy of Paediatrics report (AAP, 1997).

In order to provide adequate nutrition, it is necessary to take into account the unique requirements of premature newborns that come from metabolic and gastrointestinal immaturity, immunologic compromise, and concomitant medical problems. For intrauterine growth rates and nutrient accretion to occur, nutrition is necessary (Ziegler EE, 1976).

2.4 First 1000 Days of Life

The most crucial time for body and brain development occurs during the first 1000 days of life, which is from conception to age two. During this time, obesity and its negative effects can be prevented and minimised (Brambilla, Bedogni, Pietrobelli, Cianfarani, & Agostoni, 2016); (Rudolf, 2011); (Fraser, et al., 2013);(Blake-Lamb, et al., 2016).

During this complicated stage of life, there are many elements that influence growth, including hormone regulation, diet, and genetic and epigenetic factors. Therefore, the difficulty lies in maximising the potential for normal growth while reducing the danger of related problems (Brambilla, Bedogni, Pietrobelli, Cianfarani, & Agostoni, 2016).

In a recent omni-comprehensive review article, Woo Baidal et al. noted strong evidence for risk factors during pregnancy (high maternal pre-pregnancy body mass index, excess gestational weight gain, gestational diabetes, tobacco exposure), infancy (high infant birth weight, accelerated infant weight gain), as well as other factors. They did this while keeping in mind modifiable risk factors for childhood obesity occurring in the first 1000 days of life (i.e., parent-infant relationship, infant sleep, inappropriate bottle use, introduction of solid food before four months of life) (Woo Baidal, Cheng, Blake-Lamb, Perkins, & Taveras, 2016).

Between birth and the age of two, enormous physiological changes occur. The brain of a child expands to a size that is 75% that of an adult (O'Sullivan, 2020), and more than 1 million new synaptic connections are made every second (Child, 2007).

Height increases by 75% and body weight quadruples throughout this period. Due to these significant changes, young children have extremely high nutritional needs (WHO, 2006).

In fact, compared to any other period of life, children's nutritional needs per kilogramme of body weight are highest between the ages of 6 months and 2 years (Dewey, 2013).

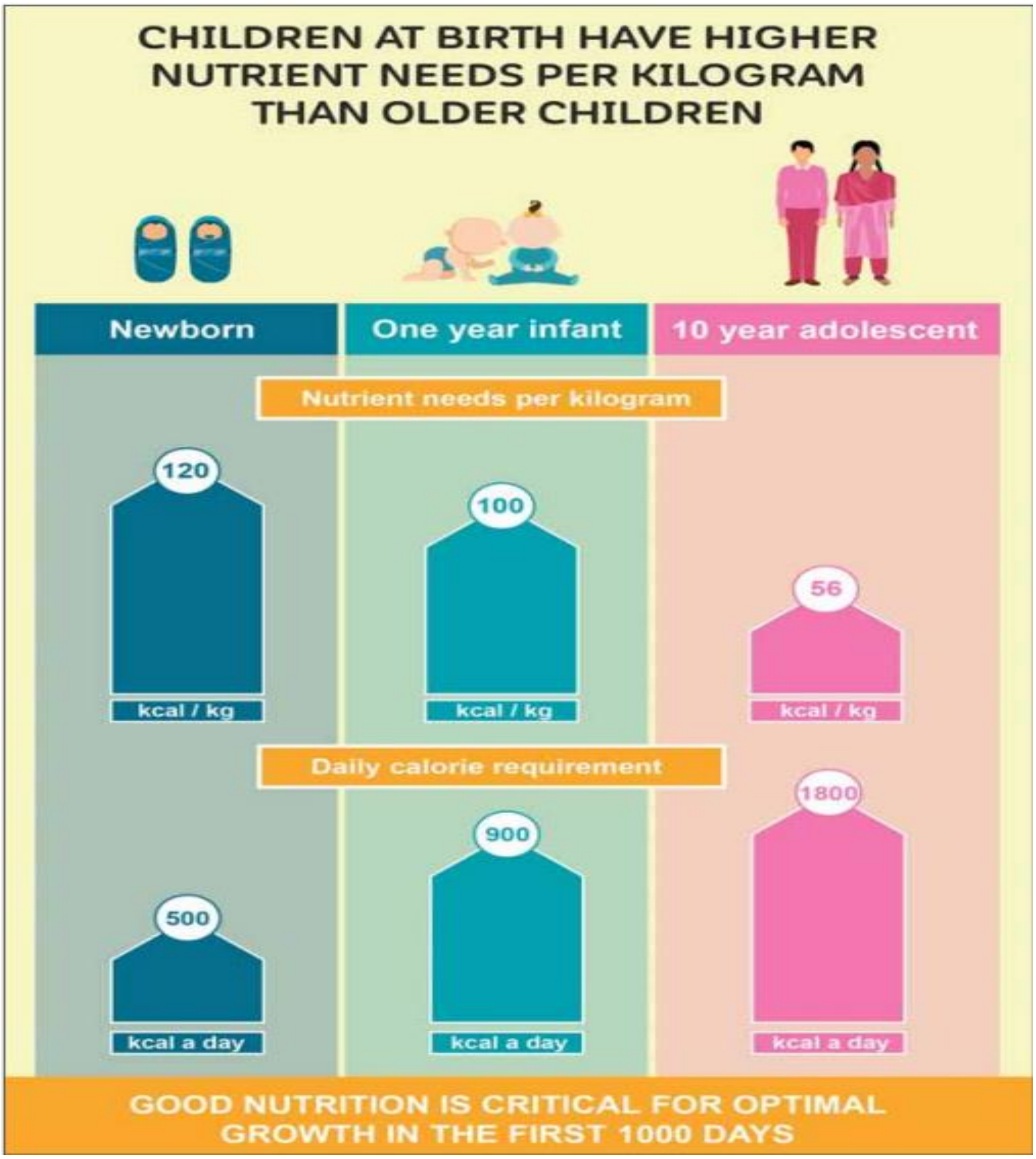
The first 1000 days of life are the most sensitive for the growth and development of the brain. The brain develops more quickly at this time than at any other, and it is also the time when neural connections and healthy cognitive function take place. To maintain optimal brain growth and development during this time, nutritional needs must be satisfied. In spite of eventual nutrient replacement, failing to give essential nutrients during this crucial phase may result in a lifelong shortfall (Schwarzenberg SJ, 2018).

Infant nutrition throughout the first two years of life is also associated to the prevention of childhood obesity. After birth, breastfeeding should start as soon as possible, and nourishing complementary foods should be provided when it is right. One of the best indicators of future obesity is weight growth during the first year of life (Ong KK, 2006).

In order to give newborns, the best start in life, it is crucial to ensure that the brain develops and is nurtured to its full potential throughout this era of rapid growth (Leadsom, 2014).

There is evidence that a range of prenatal factors, including maternal diet (total calorie intake, macronutrient, and micronutrient composition), maternal obesity, the microbiome, and environmental factors, might affect epigenomic regulation through changed gene and protein expression, increasing the likelihood of the child developing metabolic-syndrome-related disorders (Linares, et al., 2016);(Ganu, Harris, Collins, & Aagaard, 2012). The placenta, which serves as the interface between the mother and the foetus and delivers nutrients from the mother to the foetus, is also a vital organ during this particular window (Ouyang, et al., 2016); (Yampolsky, et al., 2008). Pregnancy obesity, excessive gestational weight gain, and gestational diabetes mellitus may be signs of maternal "overnutrition" and have been linked to greater placental size (Ouyang, et al., 2016);(Hindmarsh, Geary, Rodeck, Kingdom, & Cole, 2008). In fact, lower placental size has been noted in pregnancies with intrauterine growth restriction (Ouyang, et al., 2016); (Mayhew, et al., 2003). This is how the placenta controls the growth of the foetus.

Figure 2.3: Nutrient needs per kilogram for children



(Source: (comprehensive national nutrition survey, 2016-2018))

2.5 Complementary Feeding

After six months, a baby's nutritional and energy requirements start to outpace those of breast milk, necessitating the consumption of supplemental foods. At this age, a baby is also developmentally prepared to eat other foods. Complementary feeding is the term used to describe this shift (WHO, Complementary Feeding, 2021).

An infant's growth may stall if complementary foods are not offered at the age of 6 months or if they are introduced improperly (WHO, Complementary Feeding, 2021).

To ensure that infants' nutritional needs are met, complementary foods must be: **timely**, meaning that they are introduced when the need for energy and nutrients exceeds what can be provided by exclusive breastfeeding; **adequate,** meaning that they provide sufficient energy, protein, and micronutrients to meet the nutritional needs of a growing child; and **safe**, meaning that they are hygienically stored and prepared, and **properly fed** with clean hands using clean utensils and are not contaminated (WHO, Complementary Feeding, 2021).

According to WHO guidelines, supplementary foods should be introduced to infants at 6 months of age in addition to breast milk. Between the ages of 6 and 8 months, supplementary foods should be given to them 2-3 times per day. Between the ages of 9 and 11 months and 12 to 24 months, the frequency should increase to 3-4 times per day. For children between the ages of 12 and 24 months, additional wholesome snacks should be provided 1-2 times each day, as preferred (WHO, Complementary Feeding, 2021).

As the baby gets older, gradually increase food consistency and diversity while taking into account the baby's needs and skills. Beginning at 6 months, infants can consume pureed, mashed, and semi-solid meals. Most infants can also chew "finger foods" by the age of 8 months (snacks that can be eaten by children alone) (WHO, Complementary Feeding, 2021).

By the age of one year, the majority of kids are able to eat the same kinds of meals as the rest of the family, but they should still be given nutrient-dense foods, such as meat, poultry, fish, eggs, and dairy products that come from animals (WHO, Complementary Feeding, 2021).

Avoid giving children items like entire grapes or raw carrots that could choke them. Drinks having little nutritional value, like tea, coffee, and sugary soft drinks, should not be given. To prevent juice from replacing more nutrient-rich foods, keep the amount supplied to a minimum (WHO, Complementary Feeding, 2021).

Poor feeding habits include not feeding frequently enough, introducing complementary foods at the wrong time (either too early or too late), and using unhygienic or careless feeding techniques (World Health Organization (WHO) /United Nation Children’s fund (UNICEF), 2003).

In addition to these, the food is of poor nutritional quality, characterised by a lack of variety, an inappropriate consistency (food is either too thin or too thick), a deficiency in essential vitamins and minerals, particularly vitamin A, iron, zinc, and calcium, a deficiency in essential fatty acids, and a deficiency in calories among non-breastfed infants (Dewey KG, 2008).

Children's growth and nutritional status are negatively impacted by poor dietary quality and variety (Onyango AW, 2014). Micronutrients are crucial for young children's growth, development, and sickness prevention (WHO, Infant and Young Child Feeding, 2009).

Optimal health, growth, and development in infants and young children depend on adequate intakes of micronutrients like iron, zinc, and calcium (Rolfes SR, 2008).

To encourage the consumption of fruit and vegetables, a number of strategies are suggested, including (a) introducing fruit and vegetables early in the weaning process, (b) introducing a variety of fruit and vegetables, (c) repeating the presentation of a particular fruit or vegetable several times, (d) offering fruit and vegetables in an appropriate way, with a sweet, sour, or savoury taste, and (e) implementing responsive feeding practises (Woo Baidal, Cheng, Blake-Lamb, Perkins, & Taveras, Risk factors for childhood obesity in the first 1000 days: A systematic review. , 2016); (Waters, et al., 2011); (Ciampa, et al., 2010); (Mennella J. A., 2014);(Berni Canani, et al., 2011);

(WHO, Complementary Feeding: Report of the Global Consultation, 2002);(Pearce, Taylor, & Langley-Evans, 2013);(Faith, Dennison, Edmunds, & Stratton, 2006).

2.6 Factor Affecting Eating Habits of Children

Under the impact of biological, social, and environmental variables, food preferences change over the course of a person's lifetime (Ventura A.K., 2013). These preferences have a significant role in determining food preferences and the calibre of a diet (L.L., 1999);(Russell C.G., 2013).

According to the Ecological Systems Theory, human behaviour is influenced by the interaction of various environmental factors and individual traits like genetics, gender, and age (Bronfenbrenner, 1986).

Family and peers are part of the child's ecological niche, and both are impacted by the community, society, media, and food options. Throughout their lives, children's environments become more varied and complex. Parents give their kids access to food settings and eating experiences. Children take after their parents' eating habits, lifestyle, attitudes toward food, and happiness or discontent with their physical appearance (Cuellar J, 2015).

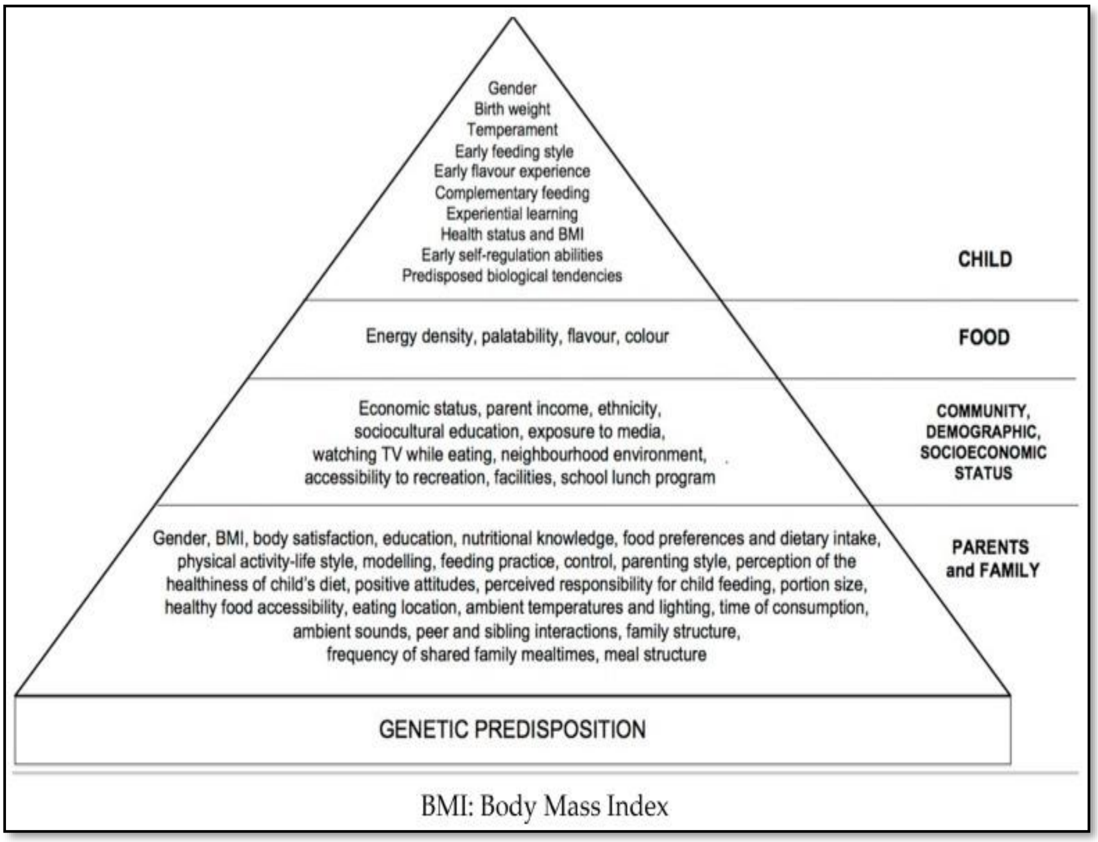
Early dietary habit formation and long-term tracking are key to maintaining healthy eating patterns (Montaño Z, 2015). Consequences of persistent eating habits from childhood include fussiness, a lack of variety in diet, heightened sensitivity to food cues, and an increased risk of obesity. Parental feeding practises are possibly a viable target for treatments to prevent unhealthy eating patterns and the development of excess weight in children. Eating behaviours and child weight are difficult to control directly (Finnane J.M, 2017).

The energy of meals for boys was higher than for girls, and this additional caloric difference came from the less healthful food category, as shown by Bouhlal et al., demonstrating that a child's gender may affect the mother's choice of foods (Bergmeier H, 2015).

The portion of food served to children is frequently decided by their mothers. However, little is known about the variables that affect a mother's choices on how much to feed her kids as well as her reasons and objectives for eating and drinking. Recent studies have shown that moms emotionally invest in their children's eating, and that mothers serve different portion sizes to "excellent" eaters and "picky" eaters (Johnson S.L, 2015).

Some contributing elements were child-centred (such as the child's preferences and past foods), while others had to do with adult expectations and worries, particularly those linked to nutrient content and waste. Mothers are emotionally invested in their children's eating habits and are aware of the "proper amounts" to serve to them. If interventions are geared at mothers' views of portion size, they may be more successful (Bouhlal S., 2015).

Figure 2.4: Factors influencing children's eating behaviors



Source: (E Cosmi V, 2017)

Khandpur et al. found that the majority of feeding practises were responsive, involved supporting or encouraging the child's independence and autonomy, and helped organise the feeding environment to increase the child's competency in selecting and consuming meals (Guerrero A.D., 2016).

In their investigation into the frequency of father-child out-of-home meals, Guerrero et al. found a correlation between these dining occasions and the kids' consumption of fast food and beverages with artificial sweeteners. Additionally, they discovered that fathers' consumption of sweetened beverages lowers when they share breakfast with their children (Vollmer R.L., 2015).

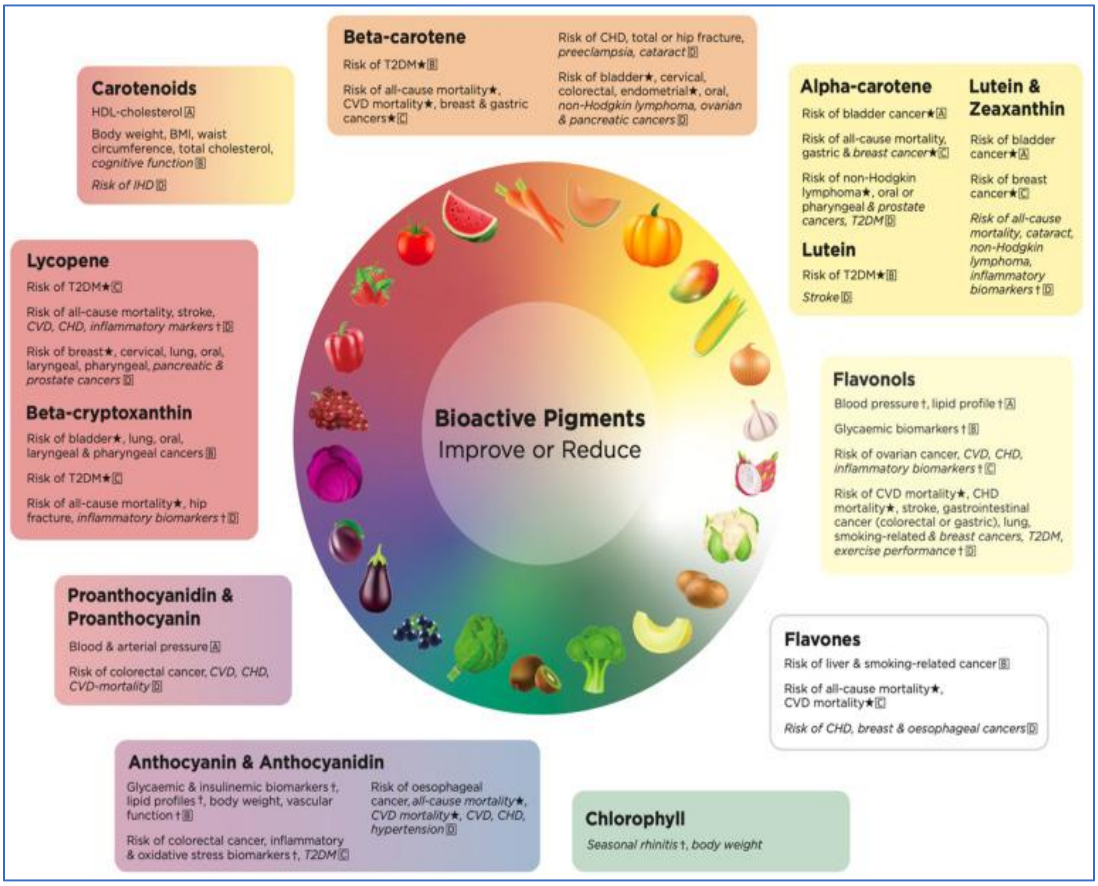
A greater incidence of emotional symptoms in youngsters is linked to increased consumption of high-sugar foods and a poorer diet (Kohlboeck, 2012).

Family interactions have an impact on the environment. Family dinners are the primary sociocultural context, whereas the accessibility and availability of various foodstuffs are physical elements of the home environment. By the way, mealtimes provide a naturalistic environment where parents may frequently supervise child behaviour, set limits and expectations, and engage in conversation with their kids. For these reasons, family meals and the social interactions that take place during them are significant life events for children (Le Heuzey M.F., 2015) and are connected to the development of their eating habits as well as their weight status. All age groups have relationships between the frequency of family meals and nutrient intake, food intake, obesity, disturbed or disordered eating practises, and psychosocial effects (Fayet-Moore F., 2016).

Practices including eating breakfast (Fink S.K., 2014), having family meals (Aworowska A., 2013), and consuming fast food (Suglia S.F., 2016) all affect dietary quality. The socioeconomic and demographic factors are related to both dietary quality and meal practises (Schrempft S., 2016); (Pearson N., 2017); (Khalsa A.S., 2017).

Young teens and children who attend fewer family meals eat more unhealthy foods. Frequent family dinners are associated with higher consumption of nutritious foods (such as fruits, vegetables, and calcium-rich foods) (McIntosh A., 2011).

Figure 2.5: The health promoting effects of bioactive pigments by colour in fruits and vegetables



Source: (Blumfield, 2022)

The foods offered at family meals affect the amount of nutrients and calories consumed, and serving fast food and takeout may counteract the nutritional advantages of home-cooked family meals (Lipsky L.M., 2015).

Family meals are also seen by parents as a chance to improve communication with their children and impart values related to food and eating. The advantages of frequently eating together as a family seem to be countered by watching television during meal (Fulkerson J.A., 2014).

A prominent dietary risk factor for mortality that can be modified is an inadequate intake of fruits and vegetables (FV), which also contributes to the rising incidence of both communicable and non-communicable diseases ((GBD, 2019); (Iddir, et al., 2020).

Poor fruits and vegetables intake was one of the leading dietary risk factors impacting disability-adjusted life years globally (GBD, 2019) and was responsible for 3.9 million deaths in 2017 (WHO, Increasing Fruit and Vegetable Consumption to Reduce the Risk of Noncommunicable Diseases, 2022).

A higher variety in the types of fruits and vegetables (FV) consumed has been independently linked to a lower incidence of diabetes (Cooper, et al., 2012), cancer (Büchner, et al., 2010); (Tang, Lee, Su, & Binns, 2014); (Jeurnink, et al., 2012), mortality (Tao, Xie, & Huang, 2020); (Blekkenhorst, et al., 2020), and improved cognitive function (Ye, Bhupathiraju, & Tucker, 2013); (Yeung, Kwok, & Woo, 2022). Meeting recommended servings of FV is also crucial.

In order to enhance growth and development in children and to form healthy eating habits that will last into adulthood, increasing the variety of fruits and vegetables (FV) is especially crucial during this period (Dalwood, Marshall, Burrows, McIntosh, & Collins, 2020).

The availability of food at home, parental eating habits, and family dining customs all appear to have a significant impact on children's nutrition quality. Children's diet quality and general health may benefit from interventions aimed at educating families about healthy eating practises at home (Santiago-Torres, 2014).

Food settings that encourage dietary habits high in nutrient-poor, energy-dense foods typically result in a positive energy imbalance, which then causes excessive weight gain (Campbell KJ, 2006).

Obesity, diabetes, and overall mortality risk are all known to rise with poor nutrition quality (Guo X, 2004); (McNaughton SA, 2012).

Utilizing the Healthy Eating Index (HEI), which rates adherence to the Dietary Guidelines for Americans, is one way to evaluate the quality of a diet. With children's diet quality scoring an average of only 55.9 out of 100 points, the HEI was used to evaluate the quality of their diets in the United States. This revealed indications of low to modest compliance with dietary recommendations (Guenther PM, 2008); (Fungwe T, 2009).

Given that they set an example for eating behaviour and affect the availability of foods at home, the home food environment and family eating habits are important factors in children's diets (Gillman MW, 2000).

For instance, a large body of research has shown a beneficial relationship between children's intakes of fruits and vegetables and their accessibility at home, and it is suggested that the frequency of family meals affects children's diets (Neumark-Sztainer D, 2003); (Larson NI, 2007) .

However, as kids become older, their eating patterns show that parental influences have less of an impact. Older kids are reported to consume fewer fruits and vegetables and more meals and drinks that are high in energy (Hendrie GA, 2012).

Dietary intervention is a key component of fighting the obesity pandemic. Whole grains, fruit, nuts, legumes, and fish were discovered to be linked to a decreased risk of obesity, whereas refined grains, red meat, and beverages sweetened with sugar were found to be linked to an increased risk (Schlesinger S., 2019).

Diet quality ratings are created to direct dietary practises and evaluate the general dietary quality of a community. The relationship between diet quality scores and body mass index (BMI) and other obesity indicators was examined in studies as part of a systematic review by Ashgari et al. They discovered that whereas outcomes were generally inversely correlated with BMI in rich nations, they were significantly more variable in underdeveloped countries.

Good health and maximum functionality across the lifespan are attainable goals, but they necessitate a lifestyle approach that includes regular physical activity and exercise, which help to balance out energy intake, regulate body weight, and a variety of physiological functions. This lifestyle approach must also include a total diet that is energy balanced and nutrient dense (Gil A R.-L. M.-G., 2014).

Julie A. Mennella recently proposed that changing parents' eating habits could be one way to improve baby food quality and lower the incidence of childhood obesity (Mennella J. , 2014).

Children's capacity to control intake is impaired as a result of parental use of food as a reward, which then causes an increase in emotional overeating. This implies the necessity of helping kids learn how to self-regulate when there is food present. Avoid forceful "clear your plate" feeding techniques in addition to the use of food as a reward by parents. Instead of utilising food as a form of reinforcement for good behaviour, it is crucial to modify meal portions and provide children with food when they are hungry (Faith, et al., 2003); (Faith, Rose, Matz, Pietrobelli, & Epstein, 2006); (Powell, Frankel, & Hernandez, 2017).

Vegetables are being advised more frequently, and failing to expose children to them up to eight times in a young age may result in a later inability to taste a variety of flavours, which in turn encourages selective eating (Mennella, Reiter, & Daniles, Vegetable and fruit acceptance during infancy: Impact of ontogeny, genetics, and early experiences. , 2016); (Powell, Frankel, & Hernandez, 2017).

Children who have trouble controlling their food have a higher chance of becoming obese. While the majority of kids seem to have the innate ability to control their food intake based on the energy level of the foods they consume, some kids have trouble self-regulating ((Faith, Rose, Matz, Pietrobelli, & Epstein, 2006); (Powell, Frankel, & Hernandez, 2017)).

An excessively low-fat, high-protein diet throughout early development might lead to nutrient imbalance. This is because subjects need a lot of energy to grow and because the myelination of the nervous system is at its highest during this time. At older ages, the amount of fat is higher than what is advised, while the intake of protein is still high. Reduced protein and saturated fat intake as well as a reduction in metabolic risk factors could result from a diet high in plant-based foods rather than animal products. A higher protein intake was linked to greater height, weight, and BMI in children up to the age of nine, notably at one year of age (Braun, et al., 2016).

Growing-up milk, also known as young-child formula (Eussen, Pean, Oliver, Delaere, & Lluch, 2015), should be chosen over cow's milk to satisfy the child's nutritional needs beyond the age of one year, limiting protein consumption and supplying important fatty acids and iron (Luque, Closa-monasterolo, Escribano, & Ferrè, 2015).

As children "learn to eat," it is vital to instill preferences for fruit and vegetables. Why is a concentration on fruits and vegetables so crucial? Increased consumption of these foods can lower the chances of several chronic diseases, particularly cardiovascular disorders, as they are key providers of many essential micronutrients (Mennella J. A., 2014); (Berni Canani, et al., 2011); (WHO, Complementary Feeding: Report of the Global Consultation, 2002); (Pearce, Taylor, & Langley-Evans, 2013)).

There are effective ways to promote acceptance of foods that were not initially accepted, including daily variation, diversity in meals, and repeated exposure up to eight times. It is crucial to encourage the consumption of healthful foods during complementary feeding because childhood eating habits are likely to persist into adulthood. Juices should be avoided during complementary feeding and moving forward, and neither sugar nor salt should be added to foods or sugar-sweetened beverages (juice drinks, soda) (Mennella, Reiter, & Daniles, Vegetable and fruit acceptance during infancy: Impact of ontogeny, genetics, and early experiences., 2016);(Faith, Dennison, Edmunds, & Stratton, 2006) . Fruit juice consumption was positively connected with an increase in body fat, per Faith et al. In particular, low-income families can attest to this (Faith, Dennison, Edmunds, & Stratton, 2006).

Early years of life are when dietary habits are formed. Children share their dietary environment with their parents, siblings, and other family members during the second year of life. This common "family food environment" affects kids' dietary intake and serves as a key benchmark for enhancing kids' eating habits (Johnson, et al., 2017).

Studies have shown that dining at a table is linked to younger children's increased consumption of fruits and vegetables, proper portion size, social engagement between parents and children, and limited access to TV viewing during meals (Faith, et al., Maternal-child feeding patterns and child body weight: Finding from a population-based sample. , 2003); (Ashman, Collins, Hure, Jensen, & Oldmeadow, 2016). Sometimes kids will eat while driving or playing and roaming about the house.

Even at a young age, screen usage has been found to be positively associated with obesity, sleep issues, melancholy, and anxiety while adversely associated with the growth of physical and cognitive capacities (Domingues-Montanari, 2017).

For kids, the context of eating is just as important as the actual place of the meal. Children who frequently watch TV during meals or snacks tend to eat more unhealthy foods and consume less fruits and vegetables (Johnson, et al., 2017); (Faith, et al., Maternal-child feeding patterns and child body weight: Finding from a population-based sample. , 2003); (Ashman, Collins, Hure, Jensen, & Oldmeadow, 2016) .

2.7 Quality of Diet

For children and adolescents to grow and develop in a healthy way, they need to eat a balanced diet. Seven food groups—grains, roots, tubers, legumes, nuts, dairy products, fresh foods, eggs, vitamin-A-rich fruits and vegetables, and other fruits and vegetables—were consumed the day before to gauge how diverse a child's diet was for those between the ages of 2 and 4 years (CNNS, 2019).

Children aged 2 to 4 years ingested 96% of cereals, roots, and tubers, 62% of dairy products, and 5% of fruits and vegetables high in vitamin A the day before the survey. The least frequent things consumed were eggs (16%) and fresh foods (1%). eaten food types in toddlers between the ages of two and four. Child food consumption habits vary depending on the mother's educational level and household income. With the mother's education level and family wealth position, the percentage of children aged 2 to 4 years who consumed dairy products, eggs, and other fruits and vegetables the day before increased (CNNS, 2019).

Children between the ages of 2-4 years rarely ate eggs and flesh-based items. The number of dairy products was highest in Punjab at around 92% and lowest in

Chhattisgarh at about 23%. Egg consumption ranged from 3 percent in Haryana to 71 percent in Meghalaya. The least amount of meat food was consumed in Haryana, and the most was consumed in Meghalaya. Meghalaya had the highest consumption of vitamin-rich fruits and vegetables (94%), while Andhra Pradesh had the lowest (29%). Kerala (77%) had the highest consumption of other fruits and vegetables, while Rajasthan (30%) had the lowest (CNNS, 2019).

Legumes and nuts (40%), dairy (92%), fruits and vegetables high in vitamin A (68%) and other fruits and vegetables (66%), were all consumed in the highest amounts among Sikh youngsters. Egg consumption (33%) and fresh food consumption (46%) were higher among Christian children. Children who lived in urban areas consumed more dairy products (74% vs. 58%), eggs (22% vs. 14%), and other fruits and vegetables (50% vs. 38%) than children who lived in rural regions (CNNS, 2019).

2.8 Healthy Diet and Children

A healthy diet is consumed throughout the life course and aids in preventing a number of noncommunicable diseases (NCDs) and disorders as well as malnutrition in all of its manifestations. However, there has been a change in dietary patterns as a result of increased production of processed foods, growing urbanization, and changing lifestyles. In addition to eating fewer fruits, vegetables, and other dietary fiber-rich foods like whole grains, consumers are increasingly consuming more items that are heavy in calories, fats, free sugars, salt, or sodium (WHO, healthy diet, 2020).

The two biggest threats to global health are an unhealthy diet and insufficient exercise. Healthy eating habits should be formed at a young age. Breastfeeding encourages normal development, improves cognitive function, and may have long-term health advantages by lowering the chance of acquiring NCDs later in life and being overweight or obese (WHO, healthy diet, 2020).

An important principle in the prevention of many chronic diseases is eating a healthy diet. Children should be encouraged to acquire good eating habits because this is a crucial time for their growth and development. Additionally, eating habits are formed at a young age, with many of them starting even before the age of five years (Skinner JD, 2002).

Meanwhile, modern food systems struggle to give everyone access to the nutritious food that is produced safely and responsibly. We must thus concentrate on the most vulnerable people, encourage a healthy and varied diet, and switch to sustainable food production systems if we want to ensure a nutritious diet now and, in the future (WHO, A healthy diet sustainably produced, 2020).

Infants and children receive similar suggestions for a healthy diet to adults. However, youngsters under the age of two also need to have these components. During the first six months of life, infants should only be breastfed. Up to age 2 and beyond, infants should only be breastfed. Breast milk should be supplemented with a variety of appropriate, secure, and nutrient-rich foods starting at 6 months of age. Complementary foods shouldn't have salt or sugar added (WHO, healthy diet, 2020).

The risk of dental caries rises when free sugars are consumed (tooth decay). The intake of too many calories from meals and beverages with a lot of free sugars also causes unhealthy weight growth, which can result in overweight and obesity. Recent research indicates that free sugars affect blood pressure and serum lipid levels and that reducing free sugar intake lowers cardiovascular disease risk factors (Te Morenga LA, 2014).

But there are many ways that a nutritious diet can be out of reach, especially in low- and middle-income nations and in circumstances when there is a lot of food insecurity, like armed conflict. An estimated 2 billion people worldwide lack access to sufficient, healthy, and safe food. More individuals are consuming unhealthy diets rich in calories, fats, free sugars, and salt as a result of the spread of highly processed food, fast unplanned urbanization, and changing lifestyles (WHO, healthy diet, 2020).

A diet rich in fruits, vegetables, legumes, nuts, and grains but low in salt, free sugars, and fats, especially saturated and trans fats, has been shown to have several health benefits. Breastfeeding and educational programs for young children and their parents help develop a balanced diet early in life. Higher educational outcomes, productivity, and lifetime health are results of these advantages (WHO, healthy diet, 2020).

Depending on individual characteristics (such as age, gender, lifestyle, and level of physical activity), cultural context, regionally accessible foods, and dietary habits, a diversified, balanced, and healthy diet will take on different compositions. But the fundamental ideas of what makes up a healthy diet stay the same (WHO, healthy diet, 2020).

Too many children are introduced to the wrong kind of diet as they start moving from liquid to soft or solid foods around the six-month mark, the survey claims. Nearly 45% of young toddlers between the ages of six months and two years are not given any fruits or vegetables worldwide. Almost 60% of people don't eat any dairy, fish, eggs, or meat (UNICEF, The State of the World’s Children, October 2019).

As children become older, their exposure to unhealthy food rises alarmingly, partly due to inappropriate marketing and promotion, the prevalence of ultra-processed foods in urban and rural regions alike, and the expanding availability of fast food and beverages with added sugar (UNICEF, The State of the World’s Children, October 2019).

2.9 Dietary Diversity

Increasing variety in one's diet is advised in the majority of dietary guidelines around the world because it is linked to consuming enough energy and key nutrients (Ruel, Nov 2003). Nutritionists have long recognized dietary diversity (DD) as an important determinant of high-quality diets (Society, 1990).

The variety of foods or food groups ingested over a specific time frame is referred to as dietary diversity. Here, the phrase "dietary variety"—which is frequently used in the literature—is used interchangeably with "dietary diversity" (Ruel, Nov 2003). By adding up the number of foods or food groups ingested throughout a reference period, dietary variety is often calculated ((Krebs-Smith, 1987); (Löwik, 1999)).

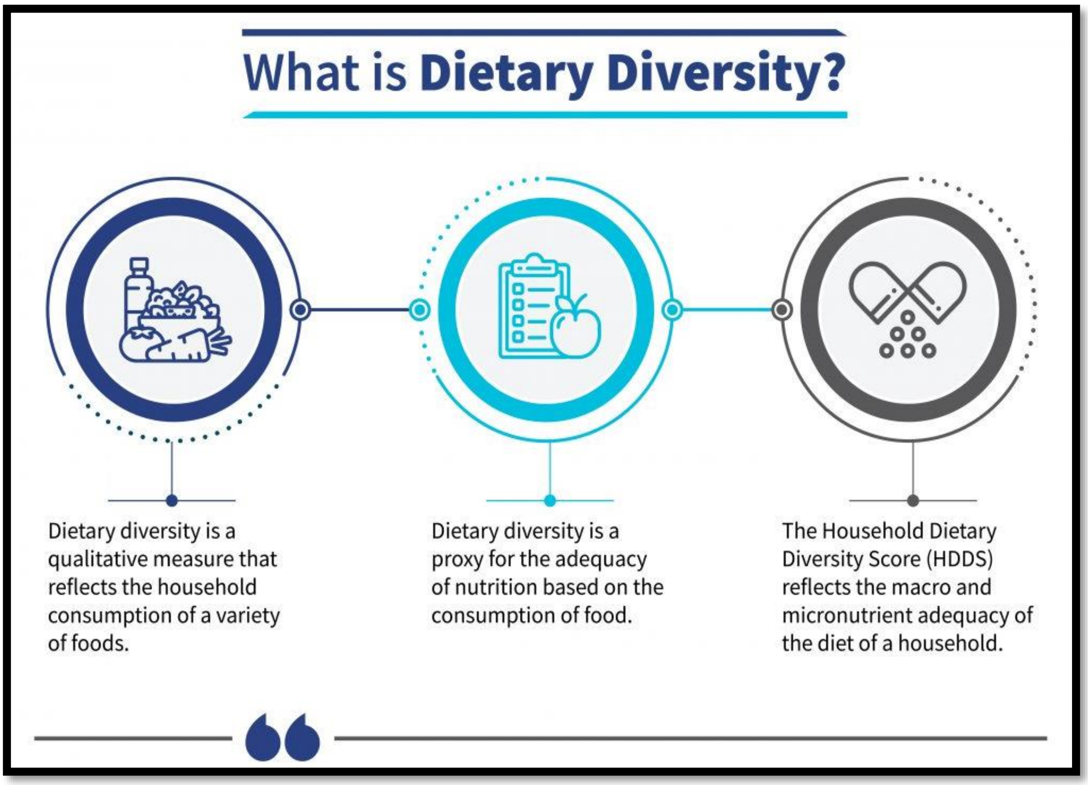
Dietary diversity has also been linked to better nutritional status in young children ((Society, 1990); (Arimond, 2002)), which suggests that variety may truly indicate superior dietary quality and a higher possibility of achieving daily energy and nutrient requirements.

The fundamentals of what makes up a healthy diet stay the same even though a diversified, balanced, and nutritious diet differs based on individual factors (such as age, gender, lifestyle, and level of physical activity), cultural context, regionally accessible foods, and dietary preferences (Swindale, 2006).

One factor affecting the quality of a diet is dietary diversity. Diverse diets may nevertheless fall short in other areas of food quality, such as macronutrient balance and/or moderation. When the amount of fat, protein, or carbs in a diet is either too high or too low, it lacks balance. When diets include excessive amounts of energy (calories), salt, or free sugars, moderation is lacking. Diverse food groups do not guarantee moderation or balance. Additionally, consuming a variety of food groups does not guarantee that the consumed proteins, carbs, and fats are of excellent quality. On the other side, dietary diversification is linked to higher micronutrient sufficiency and micronutrient density (micronutrients per 100 calories) (Stacy, 2016).

Pregnant women who are overweight or acquire too much weight are more likely to develop gestational diabetes and give birth to children who are heavier than average, increasing the likelihood that they will become obese as adults. A higher body mass index and obesity later in life are also linked to early-life rapid weight gain (Bruce KD, 2010); (Godfrey KM, 2016);(Schellong K, 2012). The physical and psychological development of children is negatively impacted by malnutrition (Black RE, 2013).

Figure 2.6: Dietary diversity



Source: (Swindale, 2006)

Children who are severely malnourished have lower infection resistance, which increases their risk of death. Those who do survive may later experience poor development and growth, failing to thrive (Fed to Fail? The Crisis of Children's Diets in Early Life, Child Nutrition Report 2021).

In order to ensure that everyone's dietary demands are met, dietary diversity is essential. Increased energy and nutrient intake can result from improved feeding practises, such as giving food that is suitably varied, which can enhance nutritional status (Ruel, Nov 2003).

Diet quality is often understood as a dietary pattern or a measure of variation among important food groups in comparison to those advised by dietary guidelines (Wirt, 2009). To prevent malnutrition, kids need nourishment that is appropriate for their age and is both sufficient and of acceptable quality (WHO, 2017). Consequently, a high-quality diet reflects achieving more appropriate nutrient intake profiles and a lower risk of NCDs linked to food (Dalwood, 2020).

Dietary inadequacy is a direct and significant sign of malnutrition in infants and young children under the age of two, and it is associated with illness, ill health, and mortality (Bhutta, 2008).

According to research (FANTA W. G., Aug 2006), a child's diet's diversity has a positive relationship with how adequate it is on average in terms of micronutrients. As a result, the MDD can be helpful in gathering data at the population level about the nutritional quality of infant and young child diets as well as the best complementary feeding practices (FANTA, 2014). To prevent malnutrition, children need diet that is appropriate for their age and is of acceptable quality and quantity (WHO, Guidance on ending the inappropriate promotion of foods for infants and young children : implementation manual, 2017).

Given that the majority of treatments to promote infant growth concentrate on food quality and quantity, understanding the distribution of dietary diversity and food deprivation among demographic groups is crucial. Dietary diversity and anthropometric deficits are connected (Sutapa Agrawal, 2019).

According to several research, dietary diversity is linked favorably to overall diet quality, micronutrient consumption, better early children's nutrition, and household food security (Sawadogo PS, 2006).

According to a new study with extensive data from India, children varied dietary intake is influenced by both personal and broader socioeconomic circumstances (Gausman J, 2018).

Additionally, in low- and middle-income nations, a high socioeconomic status (SES), as determined by maternal education and employment, may be linked to healthier overall food patterns, nutritional quality, and sufficient dietary diversity (Codjoe SNA, 2016); (Mayén A-L, 2014).

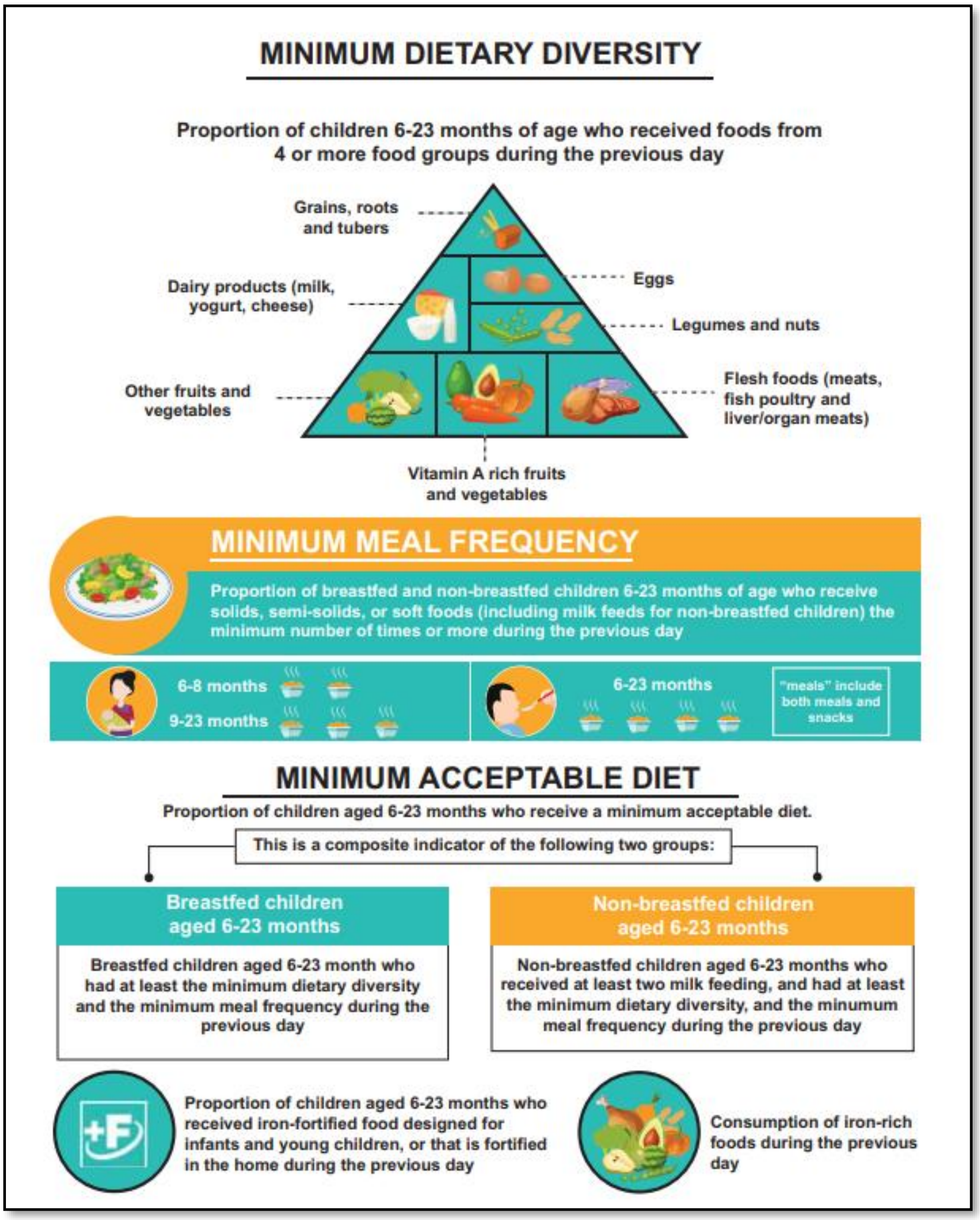
In comparison to poorer homes, wealthier households should have the means to buy more food and maintain a variety of diets. Higher parental education levels are linked to more favorable career prospects and salaries, which may translate into more disposable income and better dietary understanding (Codjoe SNA, 2016). It's essential for children's growth, development, and long-term health to have a diet that is sufficiently varied in both quantity and composition (Charmarbagwala R, 2004).

Following the recommendations of the WHO IYCF, these foods were divided into seven food groups: (1) "grains, roots, and tubers" (comprised of soup/clear broth OR bread, noodles, other grains OR fortified baby food OR potatoes, cassava, tubers); (2) "legumes and nuts" (comprised of beans, peas, or lentils); (3) "dairy products" (comprised of formula milk OR tinned powdered/fresh milk; OR cheese, yogurt, other milk products OR yogurt); (4) "flesh foods" (comprised of liver, heart, other organ meat OR fish, shellfish OR chicken, duck, or other birds); (5) "eggs" (comprised of eggs); (6) "vitamin A rich fruits and vegetables" (comprised of pumpkin, carrots, squash OR dark green leafy vegetables OR mangoes, papayas, Vit A fruits); and (7) "other fruits and vegetables" (comprised of any other fruits) (World Health Organization, 2007).

Minimum dietary diversity is the percentage of children aged 6 to 23 months who eat from four or more of the seven food groups (grains, roots, and tubers; legumes and nuts; dairy products; meat, fish, and poultry; eggs; vitamin-A-rich fruits and vegetables; and other fruits and vegetables) (FANTA, 2014).

The proportion of breastfed and non-breastfed children aged 6 to 23 months who consume solid, semi-solid, or soft foods at least twice a day or more (two times for breastfed infants aged 6 to 8 months, three times for breastfed children aged 9 to 23 months, and four times for non-breastfed children aged 6 to 23 months) is the minimum meal frequency (FANTA, 2014).The percentage of children aged 6-23 months who receive a minimum acceptable diet (other than breast milk) is known as the minimum acceptable diet. The indicator is a sum of the minimal meal frequency and minimum dietary diversity (FANTA, 2014).

Figure 2.7: Complementary feeding indicators for children aged 6-23 months



Source: (comprehensive national nutrition survey, 2016-2018)

During the first two years of life, a child's growth, health, and development must be supported by a diet that is nutritionally adequate. Dietary diversity serves as a stand-in for the diet's adequacy in nutrients. Nutritional deficits in newborns and young children are largely caused by a lack of dietary variety and frequent meals, which raises the risk of childhood illness and mortality (Black R. E., 2008).

The WHO advises using the three primary indicators of minimum dietary diversity, minimum meal frequency, and minimum acceptable diet to evaluate the effectiveness of complementary feeding practises for infants between the ages of 6 and 23 months (World Health Organization, Indicators for assessing infant and young child feedingpractices. Part II: measurement, 2010).

Only 21% of toddlers aged 6 to 23 months were given an acceptable variety of foods from four or more food categories, even though 42% of children this age was fed the recommended minimum number of times daily for their age. Dietary diversity varied between breastfed and bottle-fed infants, with bottle-fed infants (18%) obtaining a more appropriately diverse diet than non-breastfed infants (36%), who were aged 6 to 23 months. For the minimum meal frequency, a different pattern was seen: more breastfed children than bottle-fed children (50% vs. 42%) were fed the minimal number of times for their age (CNNS, 2019).

In contrast, among breastfed children, dietary diversity increased with age while meal frequency decreased. Among non-breastfed children, there were strong tendencies toward growing dietary diversity and rising meal frequency with age (CNNS, 2019).

The mother's eating habits unsurprisingly had an impact on the child's diet. Compared to children whose mothers ate non-vegetarian foods, children of vegetarian mothers had less variety in their diets. In comparison to children living in rural regions (19%), a higher percentage of breastfed and non-breastfed children (26.7%) were fed an appropriately diverse diet. Contrary to the minimal meal frequency, only 44% of children in rural areas and 37% of those in urban areas, respectively, received the requisite number of meals. In contrast to minimal meal frequency, the prevalence of minimum dietary diversity increased with the mother's degree of education (CNNS, 2019).

Similar trends were seen for household wealth, with higher-rich households consistently seeing an increase in the percentage of kids eating an acceptable variety of foods and a decline in meal frequency. While a greater percentage of Sikh (39%) and Christian (35% each) youngsters were fed a minimum Hindu children (43%) eat a more varied diet than children of other religions (relative to other children). and Muslim (42%) youngsters received the least amount of food for their age compared to members of other religions (CNNS, 2019).

The variety of food patterns and meal frequency varied by state. Meghalaya (62%) had the largest percentage of children aged 6 to 23 months who consumed a minimum diversified diet or greater, while Jharkhand (12%) and Rajasthan (12%) had the lowest percentage. Children receiving the minimum number of meals per day ranged from 22% to 28% of the population in Andhra Pradesh to 67% in Sikkim (CNNS, 2019).

Only 9% of kids between the ages of 6 and 23 months consumed meals high in iron overall. Children of vegetarian moms ingested these foods, which are consumed by 4% of children as a result of their mothers' diet. Christian children (30%) consumed far more iron-rich foods than Muslims (16%), who came in second (CNNS, 2019).

The intake of foods heavy in iron varied greatly by state, with Meghalaya (54%) having the highest consumption and Haryana (1%) having the lowest. Less than 5% of children aged 6 to 23 months ate foods high in iron in 7 out of 30 states (CNNS, 2019).

Only 6% of all kids between the ages of 6 and 23 months were given a diet that was at least satisfactory. The percentage slightly increased as mother education and household wealth grew. Compared to 10% of children born to moms with 12 or more years of education, only 4% of children born to unschooled mothers obtained an education and a minimum acceptable diet (CNNS, 2019).

In a similar vein, only 3% of kids from the lowest quintile of household wealth obtained a minimum tolerable diet, compared to 9% of kids from the top quintile. State-by-state, the prevalence of minimum recommended diet ranged from 1% in Andhra Pradesh to 36% in Sikkim. 5% of children aged 6 to 23 months obtained a minimum suitable diet in 10 out of 30 states (CNNS, 2019).

Additionally, because dietary diversity is a key predictor of stunting, interventions focused at enhancing it can be extremely effective in lowering the long-term burden of stunting in newborns and young children (Ahmad I, 2018).

2.10 Diet Quality Assessment Tools

Diet Quality Indices (DQIs) are evaluation techniques that can be used to quantify the overall quality of a person's dietary intake by rating food and/or nutrient intakes, as well as occasionally lifestyle characteristics, based on how well they adhere to dietary recommendations (Wirt A, 2009).

Diet quality is generally understood to be a dietary pattern or a measure of variation among important food groups in comparison to those advised by dietary guidelines (Wirt A, 2009).

Accurate measurement of the paediatric diet quality is essential for understanding current intakes and assessing the impact of treatments due to the association between childhood dietary consumption and NCDs in both childhood and adulthood (Al-Khudairy L, 2017).

A category of combination indexes, which frequently includes a measure of diet variation, includes the great majority of DQIs (such as the original DQI, HEI), and HDI (McCullough ML, 2002). Within and between food groups, a measure of adequacy, i.e., nutrients (compared to requirements), or food groups (quantities or servings), a measure of nutrients or foods to consume in moderation, and an overall balance of macronutrients.

Nutritionists that specialise in public health have always advocated diversity or variety in dietary patterns as a way to promote a healthy diet. The basic idea was that variety in dietary sources was required to achieve a "balanced" diet because no single meal could possibly contain all of the nutrients that the body required (Fung TT, 2005).

There were 80 distinct DQIs used in paediatric population samples, according to a systematic review of paediatric DQIs that included papers published up to October 2013; some of these identified cross-sectional associations with growth and health outcomes like body weight, early puberty, and blood pressure (Marshall S, 2014).

The Children's Index of Diet Quality (CIDQ), which measures dietary intakes of foods and nutrients linked to a healthy diet overall, has shown to be a useful tool for assessing the quality of young children's meals. The CIDQ may be a useful and independent instrument in nutritional research where the overall health of the diet, as opposed to specific nutrients, is of importance. It could be necessary to utilise another technique if a complete investigation of fat quality is required because the current index does not effectively distinguish between the fatty acid composition of various diets. The CIDQ can be completed quickly and is free of difficult computations or time-consuming dietary records (Röytiö, 2015).

The index provides a tool that divides children into three categories depending on the quality of their food and adherence to the Nordic nutrition recommendations, making it particularly effective and a simple tool for clinical practise in the nutritional advice of children. It might give medical practitioners a tool to pinpoint kids who would benefit from nutritional counselling in order to enhance the quality of their food and, perhaps as a result, lower their risk of developing non-communicable diseases later in adolescence and adulthood (Röytiö, 2015).

Although there are certain hereditary predispositions ((Rozin, 1990); (Birch, 1996)), eating preferences are mostly acquired via culinary experiences (e.g., an aversion to bitterness) (Steiner, 1979). Food exposure, associative conditioning, flavor-flavor learning, peer and parent modelling, exposure to food advertising, parental feeding habits, and cues concerning post-ingestive repercussions are all significant food learning experiences (Gibson, 2003). Biological preferences for specific flavours and minerals also exist in youngsters. Children's preferences for sweet tastes, fat, salt, and energy density, as well as their dislike of bitter tastes, have been better understood thanks to the study in this area, which is mostly experimental in design. There have been other reviews on this (Mennella, 1996); (Mela, 2000); (Birch L. , 1999).

The synergistic nature of micro- and macronutrients (Gerber, 2001) and the link between healthy diet patterns and lowered risk for diet-related disease and illness (KANT, August 1996) make diet quality a crucial factor in understanding food security.

One sort of food quality index that incorporates additional indications, such as the Healthy Eating Index (HEI)., is the Diet Quality Index - International (DQI-I) (INDDEX, 2018).

A composite diet quality indicator at the individual level is the DQI-I. It was developed in 2003 to make it possible to compare food quality across cultures, which was not possible before using diet quality composite indicators (Soowon Kim, November 2003).

The DQI-I was developed to take into account the numerous facets of a diet that contribute to quality, such as diversity, adequacy, moderation, and balance. It is based on existing indicators, such as the HEI and the Diet Quality Index (DQI) (INDDEX, 2018).

The DQI-I is used to evaluate a person's diet quality and may be applied in a number of cross-cultural contexts, making it valuable for comparing diets between geographical areas. This indicator is especially helpful in analysing changing diet quality related to the nutrition transition because it also covers specific nutrients linked to chronic, diet-related disorders and specific food groups, like empty calorie items (Soowon Kim, November 2003).

The purpose of a DQI is to offer a concise assessment of the general quality of the diet. It is an accumulation of ratings given to particular dietary elements that are thought to be typical of healthy eating, adding up to a final DQI score. The benefit of this strategy is that it considers dietary synergy, or the significance of the complete diet to health, rather than simply particular foods, food groups, or nutrients (LM, 2003); (Hu, 2002).

DQIs come in a wide variety of forms. Nutrient-based indicators fall under one major group and call for the conversion of food weights to nutrient weights. Using food-nutrient conversion tables (FCTs), comparison to requirements, adequacy ratios, etc., for example, revised DQI, content can be created. Another set of indicators is based on food and food groups; these use simple food group counts or dietary recommendations for suggested quantities and frequencies. The only items included in the Food-Based Quality Index (FBQI), Healthy Food Index (HFI), and Food Pyramid Index (FPI) are food groupings or individual foods. The MDS primarily consists of food groups, with alcohol and a ratio reflecting the diet's fatty acid composition as supplements, whereas the MDS merely consists of two modified Mediterranean diet score foods (revised by Waijers et al.) (Waijers PM1, 2007).

Data for the DQI are primarily derived from individual dietary data. instruments for gathering data, such as food frequency questionnaires (FFQs), dietary records, and 24-hour quantitative intake recalls. While 24-hour recalls gather information on entire intake—all items consumed and their quantities—FFQs focus on specific foods and minerals (Gil, 2015).

The primary goal of gathering comprehensive quantitative data on food intake was—and still is—to look into the relationships between certain nutrients, foods, or other diet components and health consequences. DQIs have been applied quite a bit. validated in relation to results. Surveys of dietary intake are also conducted to determine the nutritional status of the country. Vehicle identification is one of the more recent uses of dietary intake surveys on individuals. food fortification and a risk assessment of potential food dangers (Gil, 2015).

The DQI-I employs weights to proportionally evaluate meals according to their presumed nutritional significance, which is both a strength and a weakness, as researchers have discovered that standardised weights may not always be applicable (Tur, 2005).

Table 2.1: Strength and Weakness of Diet Quality Index

STRENGTH	WEAKNESS
Compared to existing composite diet quality indices, the DQI-I provides a richer definition and assessment of diet quality (INDDEX, 2018).	**However, distinct DQ ratings are often country-specific and cannot be compared (Gil, 2015).**
DQIs are crucial instruments for assessing the calibre of a diet for particular populations, not only in terms of nutrient intake but also in terms of dietary variety and moderation (Gil, 2015).	**Additionally, due to resource limitations, it is often impractical to obtain many days' worth of diet recall data from each responder due to the significant quantity of data needed to calculate this indicator (INDDEX, 2018).**

The healthy eating index (HEI) was created by Kennedy et al. (1995) as a gauge of the general quality of diet. The HEI is determined by taking into account the recommended serving sizes for the five food groups (grains, vegetables, fruits, milk, and meat), as well as the appropriate amounts of fat, saturated fat, cholesterol, sodium, and other nutrients. A FFQ with serving sizes was used to create the HEI. The degree to which the HEI associated with other diet quality indicators, especially the recommended dietary allowances (RDAs) for energy and important nutrients, was used to determine the HEI's significance (Kennedy ET, 1995).

The HEI is an index with a zero to 100 range that is based on ten distinct components, with scores for each component ranging from zero to ten. The first five HEI components are based on the US Food Guide Pyramid's five primary food groups, whereas components six through 10 are based on elements of the US Dietary Guidelines. One of the ten elements of the HEI is variety. The body mass index (BMI, kg/m2) of study participants, their "self-evaluation" of their diets, and the majority of dietary components have all been demonstrated to positively and significantly correlate with the HEI (Kennedy ET, 1995).

In an effort to enhance the original HEI, McCullough et al. (2002) created the 9-component Alternate Healthy Eating Index (AHEI) (McCullough ML, 2002).

Based on dietary recommendations and the food guide, this index was created to target food selections and macronutrient sources linked to a lower risk of chronic disease. The United States Department of Agriculture (USDA) came up with the pyramid, which places a focus on eating plant-based meals and unsaturated fats. Higher AHEI scores were associated with lower levels of biomarkers for endothelial dysfunction and inflammation, indicating that they may be utilised to lessen the risk of illnesses involving these biological pathways (Fung TT, 2005).

The importance of fruits and vegetables is attributed to the link between consumption and disease risk (Lock K, 2005). It has been demonstrated that the milk score is a reliable surrogate for saturated fat and fat intake (Rutishauser IHE, 2001).

The DQI-key I's advantage is that it provides a richer definition and assessment of diet quality than other composite diet quality indices. For instance, the HEI is purely based on food group consumption, but the DQI, the indicator on which the DQI-I is based, touches upon the same four diet quality components but uses fewer measurements and quantifies fewer micronutrients (Newby, 2003).

An epidemiological study that examined the diets of 5484 individuals in the United States served as the foundation for Patterson's first Diet Quality Index, which was published in 1994. Eight elements made up her score, six of which focused on certain nutrients (total fat, saturated fatty acids (SFA), cholesterol, protein, sodium, and calcium), while the other two solely evaluated the consumption of food types (fruit and vegetables, grains, and legumes). She discovered that low index scores were adversely connected with fat intake and positively correlated with vitamin and mineral intake (Patterson RE, 1994).

The concept of food quality depended on the features chosen by the investigators, as noted by Kant, who was the first to analyse worldwide diet quality indexes (KANT, August 1996). She examined the literature on dietary patterns in connection to health outcomes in a second review that was released eight years after the first (Kant, 2004).

Later, Waijers et al. analysed 20 DQIs and discovered that while they may be beneficial for gauging how closely people adhere to dietary recommendations, current indices did not significantly outperform specific dietary components at predicting disease or mortality (Waijers PM, 2007).

Additionally, Arvaniti and Panagiotakos examined 23 DQIs, the majority of which were similar to those described by Waijers (Arvaniti F, 2008). According to the Mediterranean diet and its link with health outcomes, Bach et al. revised a number of DQIs created for the general adult population (Bach A, 2006).

More recently, Alkerwi brought attention to the difficulties in defining and quantifying the idea of diet quality and suggested an integrated strategy that incorporates not only nutritional traits but also other aspects of diet quality, such as food safety, organoleptic, and sociocultural aspects for which there are currently no established thresholds or criteria, in an effort to clear up the confusion brought on by various DQIs (Alkerwi, 2014).

Similar to this, Gil praised DQIs as a crucial tool for evaluating diet quality in particular populations, not only in terms of nutrient intake but also in terms of diversity and moderation, even though he favoured a more comprehensive idea that accounts for factors like specific sociocultural practises, physical activity, sedentariness, and rest in addition to food groups and nutrients to create healthy lifestyle indicators (HLIs) (Gil A, 2015).

The 24-hour Dietary Recall (24HR) approach asks respondents about the kind and amount of every food and beverages they ate over the preceding 24-hour period, providing detailed, quantitative information on individual diets (Gilbson, 2008).

24 HRs are frequently used in low- and middle-income countries because they are rapid, culturally sensitive, and provide quantitative data on both foods and nutrients. They are enumerator-administered as opposed to self-administered (Gibson R. S., 2017).

With 40 million children under the age of five being overweight or obese, childhood overweight and obesity is a global health issue (WHO, Obesity and overweight. , 2011). Given the negative effects of obesity and how it persists throughout adulthood (Craigie AM, 2010).

Childhood obesity is crucial to deal with obesity at a young age. Dietary indices provide a means of comprehending the impact of early life food intake to obesity risk since recommendations for overweight prevention and treatment are consistent with food-based dietary guidelines (NHMRC, 2003); (NHMRC, Clinical Practice Guidelines for the Management of Overweight and Obesity in Children and Adolescents. Canberra, Australia: National Health and Medical Research Council (NHMRC) , 2003).

By comparing food consumption to specified criteria, typically reflecting current nutritional recommendations, dietary indices, for instance, evaluate the quality of diets (Newby PK, 2004).

Since they are linked with less participant effort, data handling and processing, and financial load, straightforward dietary assessment instruments are a desirable alternative to gather data from which to build a diet quality score. As a result, they are appropriate for survey or epidemiological research (Flood V, 2005).

NCDs have a negative impact on children and adolescent growth, development, and maturity (Michaud PA, 2007), which compromises adult health and shortens life expectancy (WHO, New global estimates of child and adolescent obesity released on World Obesity Day, 2017). The prevention of NCDs in children is therefore a global priority and calls for a multifaceted strategy to target the main NCD risk factors (NCD, 2018).

These risk factors include poor nutrition quality, lack of access to healthcare, and substance misuse, all of which have an impact on a person's ability to grow physically and mentally (NCDs, 2011), with poor diet quality being one of the main causes of NCDs worldwide (Green R, 2016).

Eating risk refers to "any inappropriate dietary pattern" that could harm one's health (Stallings, 2002). As toddlers become more independent in their food choices and display finicky eating habits (Cowbrough, 2010); (Dovey, 2008), they are more susceptible to dietary risk. Early risk identification is crucial since dietary risk behaviours may last over time (Craigie, 2011) and affect both short- and long-term health (Owen, 2005).

Toddler Dietary Questionnaire was found by Lucinda K. bell in 2014. When it came to authenticity, the TDQ performed admirably. Compared to a larger, 54-item FFQ, the nineteen-item TDQ accurately calculates dietary risk scores and places children in risk groups. There was no appreciable difference between the total dietary risk scores obtained from the TDQ_{ave} and the FFQ, which were closely associated (Bell, 2014).

However, the current brief food- or food-group-based questionnaires often attempt to measure a particular feature of diet (for example, fat intake) or a small number of food groups (e.g., only fruit and vegetables). In support of this, a recent evaluation discovered a dearth of quick tools (50 items) for assessing 5-year-olds' whole meals (Bell, 2014).

The reference tool used to judge validity of TDQ was the 54-item FFQ created by Huybrechts et al. This FFQ was found to be the best available validation tool since there is no gold standard to measure food consumption. It gives a reasonable measure when compared to the TDQ, capturing the intake data of important foods of interest over a comparable time period. It has been demonstrated to be reliable and valid in terms of food and nutrient intake evaluation compared with the estimated diet records

(Huybrechts, 2009); (Huybrechts I. D., 2006). a recently created 17-item FFQ for Australian children aged 2 to 5 (Flood, 2013).

Dietary intake needs to be assessed promptly, precisely, and affordably. Recalls and records, which are common traditional dietary assessment techniques, are time-consuming, expensive, and onerous (Collins, 2010). Furthermore, adopting these techniques can make it challenging to efficiently collect data on food intake for meaningful comparison with food-group-based dietary recommendations (Magarey, 2009). FFQ (Cade, 2002), on the other hand, measures food or food group intakes quickly and is less expensive, time-consuming, and labour-intensive, making it simple to compare results to dietary recommendations based on specific food groups (Magarey, 2009). However, a longer questionnaire is linked to a heavier workload, which is likely to lead to less cooperation and completion (Sinkowitz-Cochran, 2013).

Identification of dietary risks necessitates evaluation of entire diets. In contrast to the assessment of individual dietary components, the assessment of whole diets involves gathering information on the consumption of all five "core" food groups, including fruit, vegetables, grains (such as bread, rice, pasta, and noodles), meat and alternatives (such as fish, eggs, nuts, and dairy products), as well as "non-core" food groups (energy-dense, nutrient-poor items) (NHMRC, Eat for Health: Australian Dietary Guidelines; Providing the Scientific Evidence for Healthier Australian Diets., 2013); (NHMRC, Australian Guide to Healthy Eating., 2013).

Multiple adequacy and moderation factors make up the Healthy Eating Index, the majority of which are stated relative to calorie intake (i.e., as densities) and then rated in accordance with standards (Krebs-Smith SM, 2018).

Since they are related with lessened participant burden, data handling and processing, and cost, short, simple dietary assessment instruments are an appealing alternative to gathering data from which to build a diet quality score. As a result, they are appropriate for survey or epidemiological research (V. Flood, 2005).

Additionally, because they provide information fast, they are helpful in therapeutic settings for the immediate comparison of patients' dietary recommendations to food intake. Simple techniques that evaluate early-life obesogenic eating behaviours are essential in light of the rising rates of childhood obesity around the world. Given their benefits, quick techniques are needed to enable comparison of young children's nutritional intake to food-based dietary recommendations using a dietary index (V. Flood, 2005).

Dietary diversity is favourably correlated with overall diet quality, micronutrient consumption, early children's nutritional status, and household food security, according to a number of studies (Sawadogo PS M.-P. Y., 2006); (Steyn N, 2006); (Kennedy GL, 2007).

Additionally, in low- and middle-income nations, high socioeconomic status (SES), as determined by maternal education and employment, may be linked to healthier overall eating patterns, nutritional quality, and sufficient dietary diversity (Nguyen PH, 2013); (Codjoe SNA, Urban household characteristics and dietary diversity: an analysis of food security in Accra, Ghana, 2016); (Mayén A-L M.-V. P., 2014); (Harris-Fry H, 2015).

According to a recent study with extensive data from India, children varied dietary intake is influenced by both personal and broader socioeconomic factors (Gausman J, Ecological and social patterns of child dietary diversity in India: a population-based study, 2018).

By compiling data on food consumption, a nutritional diversity score for each child was created, which was an integer ranging from zero to seven (i.e., zero indicated that the child did not consume any of the 21 items, and a value of seven indicated that the child was fed at least one food item from each of the seven food groups).

To determine if the child's food during the previous 24 hours was sufficiently diverse, a binary variable was created from the overall score for dietary diversity. A score of three or less was deemed inadequate, while consuming food from at least four of the seven food groups was considered to constitute an appropriately diverse daily intake (ADDI) for children ((WHO, Indicators for assessing infant and young child feeding practices, Part 2: measurement, 2010); (WHO, Indicators for assessing infant and young child feeding practices part 1 definitions, 2007)).

In the vast majority of underdeveloped third world nations, nutritional issues are mostly quantified; nevertheless, the issue of dietary diversity or food variety is also crucial (Allen LH, 1991).

Indicators of dietary diversity have gained popularity during the past few years as a result of the recognised significance of dietary diversity for health and nutrition (Martin-Prevel Y, 2012).

The gold standard for determining dietary diversity is to count the number of different foods a person eats, or better yet, the number of calories they consume (Arimond M, 2011).

The Food Consumption Score is a common method, but it has certain drawbacks, including being a more complete process that takes time and requires technical knowledge (IDDEP, 2017).

The Individual Dietary Diversity Score (IDDS) is a proxy measure that has been approved for use in various age groups, sexes, and regions of the world. It tries to reflect dietary sufficiency, nutrient quality, and likelihood of ingesting micronutrients (Kennedy G, 2013).

Only a few studies employing IDDS that focus on dietary diversity have been conducted in India. The IDDS questionnaire is a technique for measuring changes in dietary quality at the individual level that is quicker, easier to use, and less expensive.

The diversity of foods adds a number of aspects to human health. It promotes biodiversity and sustainability, permits adequate nutrition, lessens the negative effects of food on health, sparks an interest in food, and, in the end, lowers the prevalence of chronic diseases (Mirmiran P, 2004).

The cornerstone of long-term and sustainable methods for combating global hunger is ensuring adequate diets while minimising infectious disease (Tontisirin K, 2002) ; (Ruel MT, 2013); (Pinstrup-Andersen, 2013).

Nevertheless the way we eat is influenced by a complex interplay of biology, information, skills, social-cultural elements (including identity and beliefs), psychological factors (emotion, motivation, goals, memory, and attention), environmental context, and resources (Francis J, 2012); (Contento IR, 2002); (EP., 2009).

The significance of structural, environmental, cultural, social, and psychological elements in diet behaviour is becoming more widely acknowledged (Marteau TM, 2012). According to Krumeich et al., changing unhealthy behaviours requires more than persuading people to behave more logically. They point out that many times, health decisions are influenced by social and cultural contexts that are outside of an individual's control (Krumeich A, 2001).

Despite the fact that traditional diets are typically extremely healthy (Kuhnlein H. In: Kuhnlein HV, 2009), social, cultural, and economic change has led to nutritional changes that have been linked to decreased diet quality in many regions (Popkin, 2004).

From one meal to the next, from one day to the next, and from season to season, the value of a diverse diet for boosted appetite is constant. The significance of dietary diversity applied to all food groups, including fruit, vegetables, and staples high in carbohydrates, as well as to the diet as a whole. Variety within a single crop also played a significant role in appetite and adequate intake, suggesting that locals believed dietary diversity to be closely related to agrobiodiversity (Powell, 2017).

Early-life experiences combine with genetic predisposition, natural food reactions and preferences, and, more crucially, environmental influences to produce eating behaviours. Through interactions that determine the growth of eating practises, parents have an impact on their child's weight. The control of a child's appetite is favourably correlated with serving practises that support maternal autonomy (Faith, et al., 2003); (Silva Garcia, Power, Fisher, O'Connor, & Hughes, 2016).

The HEI score can be used to rank individuals by their diet quality. Although this index has extensively been used to evaluate overall diet quality among adults, only few data are available among children (Angelopoulos, 2009).

The HEI 2015 rates densities of consumed food groups and nutrients rather than absolute amounts to evaluate dietary quality rather than dietary quantity (Jun, 2019).

One of the studies conducted on dietary diversity showed positive association between dietary diversity and intake of variety of nutrient (Ruel, Nov 2003) while another study showed weak and even in some cases negative association between diversity and certain nutrients (Elaine L. Ferguson, 2010).

Increased dietary diversity was associated with greater intake of energy and nutrients but did not enhance the nutritional quality of diet (Dalwood, Marshall, Burrows, McIntosh, & Collins, 2020); (Wirt A, 2009).

2.11 Limitations and weaknesses of dietary diversity

- **No Minimum amount for individual food group:** Instead of a food group count applying a minimum amount improves the performance of the indicator, as the dietary diversity score with a 15-g minimum requirement performed consistently better than ones with a 1-g minimum requirement (Togo, 2001).

- **More types of foods may not help:** Dietary diversity score developed using 24-hour diet recall can be used as a proxy for nutrient adequacy (Sealey-Potts C, 2014).

- **Number of food groups to be included may differ among countries:** Increasing the number of food groups in the score would likely improve the performance of the indicator, but results are not consistent across different studies (Togo, 2001).

- **Minimum dietary diversity score is a good proxy** for nutrient adequacy, but the dichotomous indicator based on the consumption of 4 food groups or more is a poor indicator of prevalence of acceptable nutrient adequacy (Ruel, Nov 2003).

Worldwide, there are not many studies related to diet quality of children below 5 years of age. Furthermore, they are more focused on frequency of food intake and diversity of diet but fail to assess quality of diets in terms of quantity, which children eat.

METHODS AND MATERIALS

METHODS AND MATERIALS

The purpose of this research study was to modify the Dietary Quality Assessment Tool (DQAT-2022) and conduct a psychometric evaluation in order to assess the nutritional status and dietary habits of young children (6 to 59 months) in urban Vadodara.

3.1 Methodology

The location of the current cross-sectional study was urban Vadodara. Aanganwadi centres (AWCs) in four zones of urban Vadodara were chosen randomly. The study included all AWC-registered children under the age of five.

There were 116, 112, 111, and 113 participants from the north, east, west, and south zones respectively. This study included four aaganwadis from the north, five aaganwadis from the east, four aaganwadis from the west, and five aaganwadis from the south zone **(Figure 3.1).**

A total of 452 children from four zones were enrolled based on sample size calculation as shown in **Figure 3.2**. In all 233 of them were female and 219 were male.

Data on socioeconomic status, infant and young child feeding practices, immunisation status, nutritional status were all collected using a semi-structured questionnaire from mothers of children under the age of 5 years using Epicollect5 software.

Figure 3.1: Sample Selection

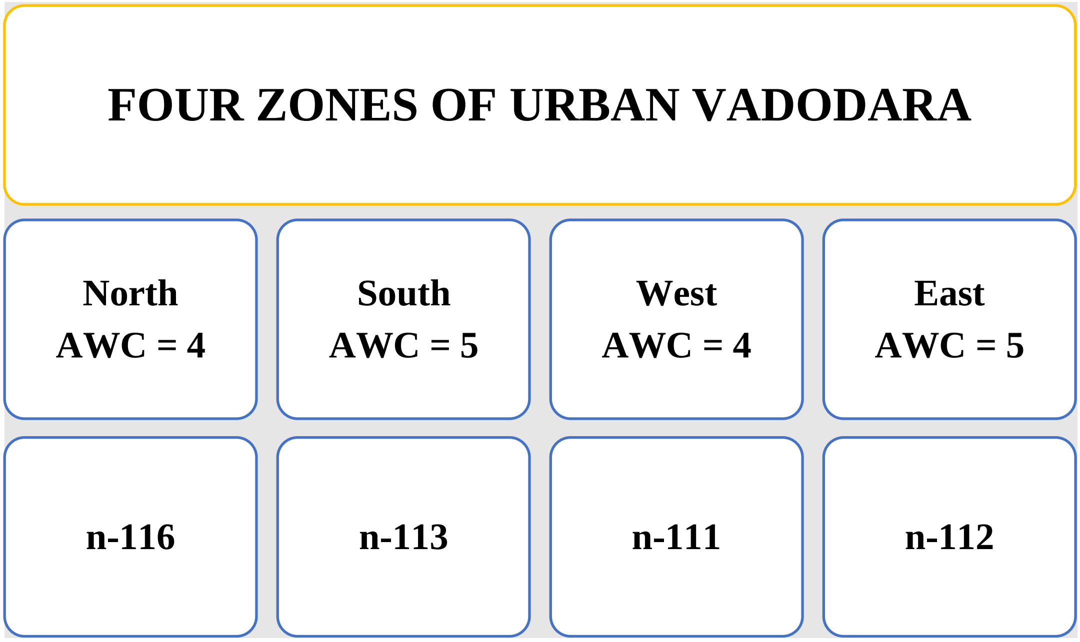


Figure 3.2: Sample Size Calculation

$N = 4pq/L^2$

p = prevalence/proportion

Using minimum dietary diversity data from Sengar and karud, 2022: p = 46.7%

q = 100 – p = 100 – 46.7 = 53.3%

L = allowable error or precision = 5%

$$N = \frac{4pq}{L^2} = \frac{4 \times 46.7 \times 53.3}{5^2} = 398.3$$

Attrition/Denial – 10% = 39

Final sample size: 398.3 + 39 = **437.3 ≈ 450**

3.2 Inclusion and Exclusion criteria

Inclusion criteria: All children less than 5 years of age registered at AWC with the consent of their mother were included.

Exclusion criteria: Severely malnourished children and mothers of children who were unwilling to be a part of the study were excluded and referred to the health facility nearby **(Figure: 3.3)**.

3.3: Objectives of the study

Broad objective of the study

- To modify and evaluate Dietary Quality Assessment Tool 2022 for children below 5 years of age.

Specific objectives of the study

- To modify the existing Dietary Quality Assessment Tool 2022.
- To assess the socio-economic status, nutritional status and dietary intakes of children and assess the quality of diets using DQAT 2023.
- To conduct psychometric evaluation of Dietary Quality Assessment Tool 2023.
- To develop manual on assessing and improving diet quality in children

3.4: Ethical approval

The study was approved by the Institutional Ethical Committee for Human Research of the faculty of family and community sciences, The Maharaja Sayajirao University of Baroda. The ethical approval number of the study is **IECHR/FCSc/MSc/2022/39**.

For conducting the study, permission was obtained from the Vadodara Municipal Corporation **(Appendix III)**, and informed consent was obtained from the mothers whose children were enrolled in the study **(Appendix IV).**

3.5: Study Design

Dietary diversity is an absolutely promising tool for assessing diet quality. However, it requires more research on it to improve and systematize the measurement approaches and indicators.

Dietary diversity is a qualitative tool and it is more focused on numbers of food groups but it does not give any information regarding the quantity of food.

Previous year, a dietary quality assessment tool was developed for children below 5 years (Sengar and Karud,2022) which can be used to assess healthy dietary pattern at early age of life however, due to paucity of time it could not be evaluated.

As was evident from the review of literature most of the dietary quality assessment tools were not tested for validity and reliability. Therefore, the present study dealt with modification of DQAT 2022 as per latest guidelines and norms as well as psychometric evaluation of the same.

The present study was cross sectional study and it was conducted in the two phases (**Figure 3.5).**

Phase I The Phase I was subdivided in two phases

Phase I A: Modification of Dietary Quality Assessment Tool (DQAT 2022)

The modification of DQAT 2022 **(Table 3.1)** was done based on the latest recommendation and guidelines.

Modification of Dietary Quality Assessment Tool (DQAT 2022) for children aged 6 to 59 months was carried out for the present research. According to guidelines from the ICMR-NIN 2020 and FANTA/FAO/WHO 2007; IAP guidelines 2019, a DQAT 2023 was developed to assess the diet quality of children under the age of five (ICMR, 2011; FANTA, 2007; IAP, 2019).

DQAT 2023 had two categories according to age (Table 3.2)

1. **DQAT2023-K scoring for children between 6-24 months**

DQAT 2023 was composed of **15 components** for children between 6-24 months. Except for breastfeeding, which had a score range of 0 to 20, every component had a range of either 0 to 10 or 0 to 5. A component's most desirable intake received the highest score, and its least desirable intake received the lowest score.

Figure 3.3: Inclusion and Exclusion criteria

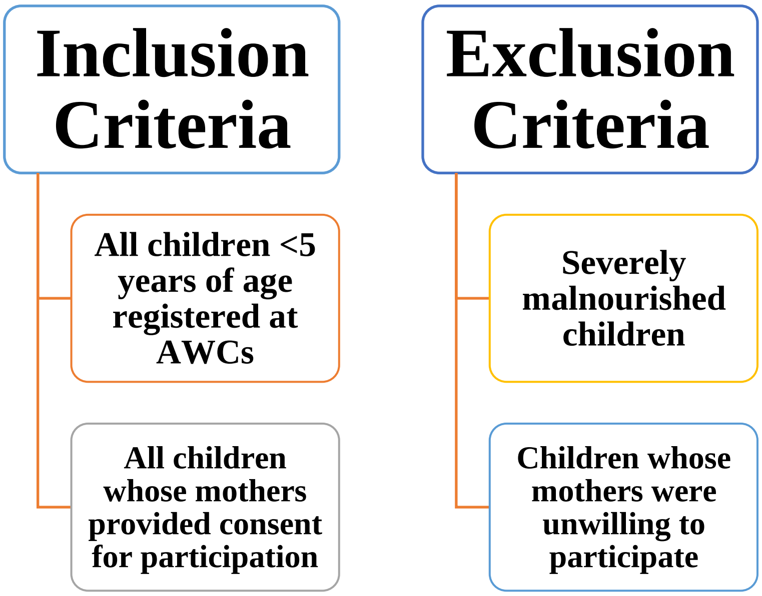
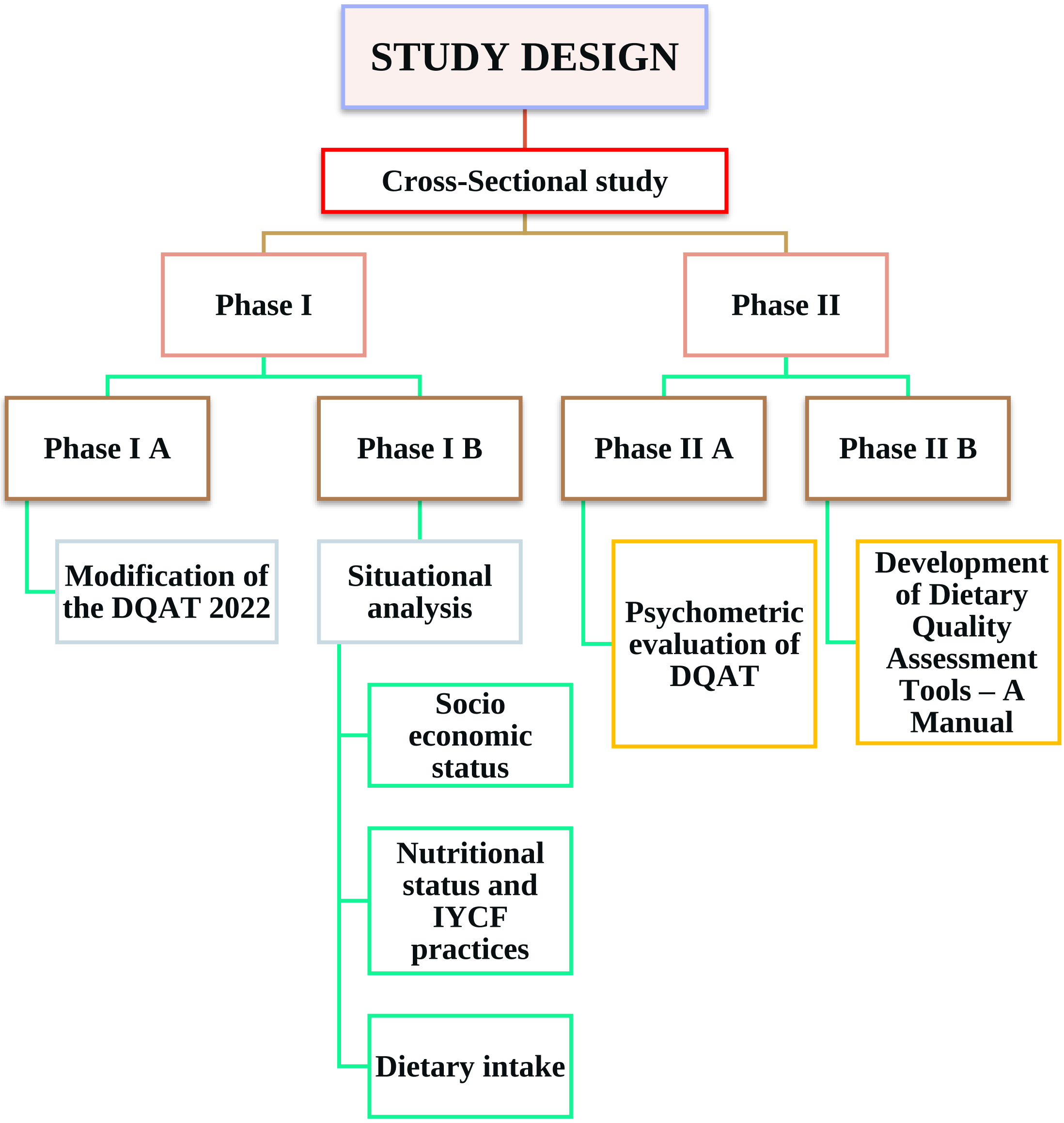


Figure 3.4: Study Design


STUDY DESIGN
Cross-Sectional study
Phase I
Phase II
Phase I A
Phase I B
Phase II A
Phase II B
Modification of the DQAT 2022
Situational analysis
Psychometric evaluation of DQAT
Development of Dietary Quality Assessment Tools – A Manual
Socio economic status
Nutritional status and IYCF practices
Dietary intake

A simple sum of all the components scores would give the overall DQAT score. A total score is 120. The DQAT score was further divided into three categories. If the score is greater than or equal to 96, the diet is considered to be of **“Good”** quality. If the score is between 61 and 95, it indicates “**Upgrading required**”, and if the score is less than or equal to 60, the child falls into the **“poor”** category **(Figure 3.5).**

2. DQAT2023-P scoring for children between 25-59 months

DQAT 2023 was composed of **14 components** for children between 25-59 months. Every component had a range of either 0 to 10 or 0 to 5. A component's most desirable intake received the highest score, and its least desirable intake received the lowest score.

A simple sum of all the components scores would give the overall DQAT score. A total score is 100. The DQAT score was further divided into three categories. If the score is greater than or equal to 80, the diet is considered to be of **“Good”** quality. If the score is between 51 and 79, it indicates “**Upgrading required**”, and if the score is less than or equal to 50, the child falls into the **“poor”** category **(Figure 3.6)**.

Figure 3.5: DQAT2023-K Score

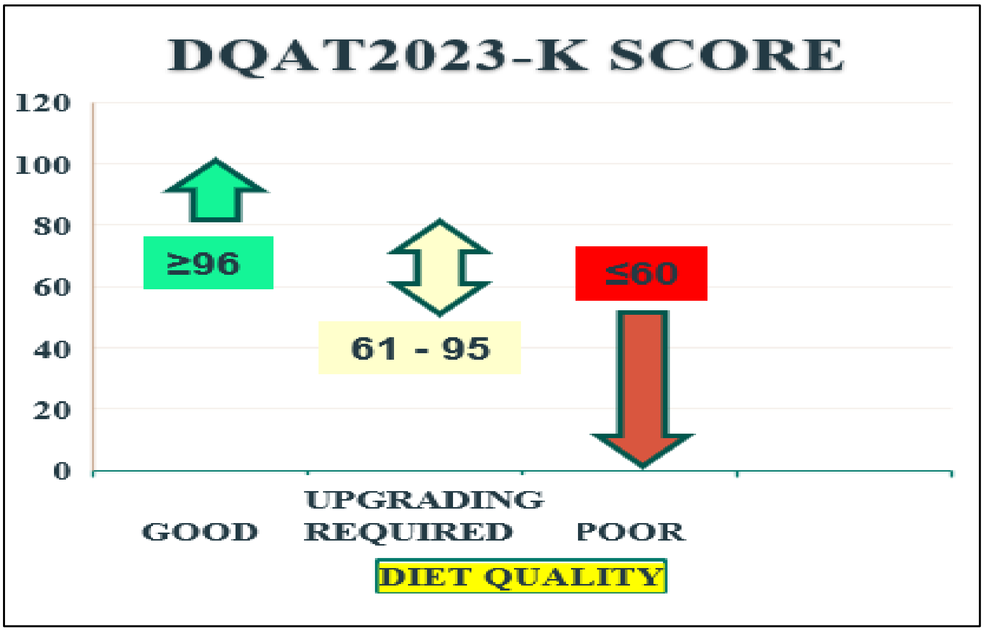


Figure 3.6: DQAT2023-P Score

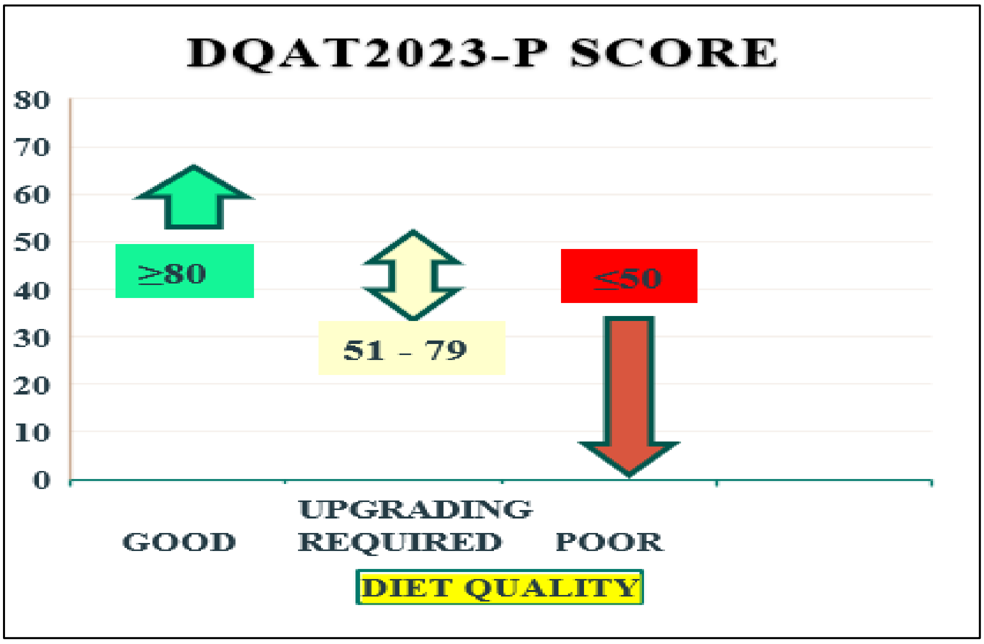


Table 3.1: Dietary Quality Assessment Tool (DQAT 2022)

Sr. no.	Individual component	Age	Cut off value	Max score	Min. score
1.	Breast milk	6-12 months	>600 ml/ 7-8 times per day	20	0
		13-24 months	>550 ml /3-4 times per day		
2.	Grains	6-12 months	≥ 15 g	5	0
		13-24 months	≥ 60 g		
		25-36 months	≥ 60 g		
		37-48 months	≥ 60 g		
		49-59 months	≥ 120 g		
3.	Roots and tubers	6-12 months	≥ 50 g	5	0
		13-24 months	≥ 50 g		
		25-36 months	≥ 50 g		
		37-48 months	≥ 50 g		
		49-59 months	≥ 100 g		
4.	Legumes	6-12 months	≥ 3.7 g	5	0
		13-24 months	≥ 15 g		
		25-36 months	≥ 15 g		
		37-48 months	≥ 15 g		
		49-59 months	≥ 15 g		
5.	Nuts	6-12 months	≥ 3.7g	5	0
		13-24 months	≥ 15 g		
		25-36 months	≥ 15 g		
		37-48 months	≥ 15 g		
		49-59 months	≥ 15 g		
6.	Dairy products	6-12 months	≥ 200 ml	10	0
		13-24 months	≥ 300 ml with BF or else 500 ml		
		25-36 months	≥ 500 ml		
		37-48 months	≥ 500 ml		
		49-59 months	≥ 500 ml		
7.	Flesh foods	6-12 months	≥ 12 g*	10	0
		13-24 months	≥ 50 g		
		25-36 months	≥ 50 g		

Sr. no.	Individual component	Age	Cut off value	Max score	Min. score
		37-48 months	≥ 50 g		
		49-59 months	≥ 50 g		
8.	Eggs	6-12 months	≥ 12 g*	10	0
		13-24 months	≥ 50 g		
		25-36 months	≥ 50 g		
		37-48 months	≥ 50 g		
		49-59 months	≥ 50 g		
9.	Vitamin A rich fruits	6-12 months	≥ 50 g	5	0
		13-24 months	≥ 75 g		
		25-36 months	≥ 75 g		
		37-48 months	≥ 125 g		
		49-59 months	≥ 125 g		
10.	Vitamin A rich vegetables	6-12 months	≥ 50 g	5	0
		13-24 months	≥ 75 g		
		25-36 months	≥ 75 g		
		37-48 months	≥ 125 g		
		49-59 months	≥ 125 g		
11.	Other fruits	6-12 months	≥ 50 g	5	0
		13-24 months	≥ 75 g		
		25-36 months	≥ 125 g		
		37-48 months	≥ 125 g		
		49-59 months	≥ 125 g		
12.	Other vegetables	6-12 months	≥ 50 g	5	0
		13-24 months	≥ 75 g		
		25-36 months	≥ 125 g		
		37-48 months	≥ 125 g		
		49-59 months	≥ 125 g		
13.	HFSS foods	6-12 months	0**	10	0
		13-24 months	0**		
		25-36 months	<5 % of total energy		
		37-48 months	<5 % of total energy		
		49-59 months	<5 % of total energy		

Table 3.2: Dietary Quality Assessment Tools (DQAT2023-K and DQAT2023-P) - Individual components with scoring

Sr. no.	Individual component	Age	Cut off	Max score	Min score
1	Breast milk	6 -12 months	>600 ml / 7-8 times per day	20	0
		13-24 months	>550 ml / 3-4 times per day	20	0
2	Grains	6 -12 months	≥15 gm	5	0
		13-24 months	≥60 gm	5	0
		25-36 months	≥60 gm	5	0
		36-48 months	≥60 gm	5	0
		49-59 months	≥120 gm	5	0
3	Roots and Tubers	6 -12 months	≥50 gm	5	0
		13-24 months	≥50 gm	5	0
		25-36 months	≥50 gm	5	0
		36-48 months	≥50 gm	5	0
		49-59 months	≥100 gm	5	0
4	Legumes and Pulses	6 -12 months	≥3.75 gm	5	0
		13-24 months	≥15 gm	5	0
		25-36 months	≥15 gm	5	0
		36-48 months	≥15 gm	5	0
		49-59 months	≥15 gm	5	0
5	Nuts	6 -12 months	≥3.75 gm	5	0
		13-24 months	≥15 gm	5	0
		25-36 months	≥15 gm	5	0
		36-48 months	≥15 gm	5	0
		49-59 months	≥15 gm	5	0
6	Dairy products	6 -12 months	≥ 200 ml	10	0
		13-24 months	≥300 ml with BF or else 500 ml	10	0

Sr. no.	Individual component	Age	Cut off	Max score	Min score
		25-36 months	≥500 ml	10	0
		36-48 months	≥500 ml	10	0
		49-59 months	≥500 ml	10	0
7	Flesh Foods	6 -12 months	≤12 g*(above 9 months allowed)	10	0
		13-24 months	≥50 gm	10	0
		25-36 months	≥50 gm	10	0
		36-48 months	≥50 gm	10	0
		49-59 months	≥50 gm	10	0
8	Eggs	6 -12 months	≤12 g*(above 9 months allowed)	10	0
		13-24 months	≥50 gm	10	0
		25-36 months	≥50 gm	10	0
		36-48 months	≥50 gm	10	0
		49-59 months	≥50 gm	10	0
9	Vitamin A rich Fruits	6 -12 months	≥50 gm	5	0
		13-24 months	≥50 gm	5	0
		25-36 months	≥50 gm	5	0
		36-48 months	≥50 gm	5	0
		49-59 months	≥50 gm	5	0
10	Vitamin A rich Vegetables	6 -12 months	≥25 gm	5	0
		13-24 months	≥50 gm	5	0
		25-36 months	≥50 gm	5	0
		36-48 months	≥50 gm	5	0
		49-59 months	≥50 gm	5	0

Sr. no.	Individual component	Age	Cut off	Max score	Min score
11	Other Fruits	6 -12 months	≥50 gm	5	0
		13-24 months	≥50 gm	5	0
		25-36 months	≥50 gm	5	0
		36-48 months	≥50 gm	5	0
		49-59 months	≥50 gm	5	0
12	Other Vegetables	6 -12 months	≥25 gm	5	0
		13-24 months	≥50 gm	5	0
		25-36 months	≥50 gm	5	0
		36-48 months	≥50 gm	5	0
		49-59 months	≥100 gm	5	0
13	HFSS Foods	6 -12 months	0*	10	0
		13-24 months	0*	10	0
		25-36 months	< 5 % of total energy	10	0
		36-48 months	< 5 % of total energy	10	0
		49-59 months	< 5 % of total energy	10	0
14	Total Fat	6 -12 months	≤25 gm	10	0
		13-24 months	≤25 gm	10	0
		25-36 months	≤25 gm	10	0
		36-48 months	≤25 gm	10	0
		49-59 months	≤25 gm	10	0
15	Added Sugar	6-12 months	0**	10	0
		13-24 months	0**	10	0
		25-36 months	< 5 % of total energy	10	0
		36-48 months	< 5 % of total energy	10	0
		49-59 months	< 5 % of total energy	10	0

*Introduce Eggs/ Chicken/ Meat/ Fish around 9 months (ICMR-NIN,2011) **No HFSS foods to be offered to children below 2 years-IAP JUNCS guidelines, 2019

Phase I B: Situational Analysis

Phase I-B included situational analysis, in which the subject's socioeconomic status and nutritional status were assessed. Using a semi-structured questionnaire, data on socioeconomic status, infant and young child feeding practices, immunisation status, and knowledge of IYCF practises among mothers were all collected. Software named Epicollect 5 was used to collect the data. A 24-hour dietary recall was used to obtain children's dietary patterns, and calculations were performed using the Ntuitive application based on IFCT, 2017 values.

3.6 Tools and Parameters

The following tools were used for evaluating the various parameters as shown below (Table 3.6):

Socio economic status

Using a semi-structured questionnaire, mothers of children provided information about their socioeconomic status, including their age, sex, education level, occupation, per capita income, religion, caste, type of family, type of home, amenities, and resources available in the household **(Appendix V).**

Infant and young child feeding (IYCF) Practices

Information on infant and young child feeding practices (IYCF) was collected using a semi-structured questionnaire. This information included the initiation and duration of breastfeeding, the frequency of breastfeeding and complementary feeding per day, the child's birth weight, the variety of complementary feeding, dietary patterns, hygienic practices, immunisation status, etc.

Anthropometric measurements

Anthropometric measures of the children weight and height were conducted.

Weight

An important anthropometric measure of body mass is weight. It can be used to diagnose acute protein-calorie malnutrition in children of all age groups since it is a sensitive indicator of malnutrition.

Weights were taken using an infant weighing scale for infants up to 24 months old. The child was positioned lying on their back, and the weight was recorded. All of the subjects had their weight measured using a calibrated digital weighing scale. It is convenient to use in the field and portable. On the scale, the subject was instructed to stand upright without touching anything, without wearing bulky clothing or shoes, and to look straight ahead. The children were watched to make sure they weren't wearing heavy jewellery.

Height

Using a flexible, non-stretchable fibreglass tape, the height measurements of all participants were collected. The even texture of the floor was ensured by fixing the tape vertically and straight to the ground on a smooth wall. The participant was instructed to stand upright and look straight ahead, with the subject's shoulders, hips, and heels contacting the wall. The arms hung loosely by the sides, and the head was held pleasantly upright. The subject's height was measured to the nearest 0.1 cm from the lower edge of a thin, smooth scale held on top of the subject's head in the centre, crushing the hair at an angle to the tape.

Children under the age of two were placed on their backs with their legs extended and their heads against the Infantometer. The length was determined while the infant's knees and feet were flexed against the Infantometer.

WHO growth standards for children 0 – 59 months of age

Using WHO growth criteria, the prevalence of malnutrition was evaluated.

1) Height/Length for Age Z-Score (Stunting)

Stunting is characterised by low height for age. It is the outcome of persistent or ongoing undernutrition, which is frequently accompanied by low socioeconomic circumstances, poor maternal health and nutrition, frequent illness, and/or unsuitable baby and young child feeding and care in the early years of life. Stunting prevents children from developing their complete physical and intellectual potential (WHO, 2021) **Table 3.3.**

2) Weight for Height/Length Z-Score (Wasting)

Wasting is a low weight-to-height ratio. It typically denotes recent and significant weight loss as a result of a person not eating enough or having an infectious ailment like diarrhoea that caused them to lose weight. Although there are treatments available, a small child who is moderately or severely wasted has a higher risk of dying (WHO, 2021) **Table 3.4**.

3) Weight for Age Z-Score (Underweight)

Underweight children are those that have low weights for their age. An underweight child could become wasted or stunted, or even both (WHO, 2021) **Table 3.5**.

24-hour Dietary Recall

The purpose of the diet surveys was to estimate the subjects' daily consumption of energy, protein, fat, calcium, and iron. Information on dietary intake was obtained over 3 days (1 holiday and 2 working days) using a structured interview.

The 24-hour dietary recall (24HR) approach involved asking participants about the kind and quantity of each food and drinks they ingested during the previous 24-hour period in order to provide comprehensive, quantitative data on specific diets (Gilbson, 2008).

The foods consumed for various meals as well as the amount of food consumed were asked about by the respondents. Then, the mothers were questioned about the raw materials needed to prepare each food item for the entire household and asked to demonstrate how much raw material was utilised in terms of home measurements, which were subsequently documented in terms of the standard volumetric measurements. Later, this was changed to grams. Additionally, the amount of prepared food was measured. Additionally, this was done using domestic measurements before being transformed to utilise standard measurements. After that, the amount of cooked food consumed by the participant was measured in standard metric units using household measurements. This information was used to determine the subject's intake of raw components **(Appendix VI).** Based on the values listed in the food intake tables of the Indian Food Composition tables, the nutritional value of the foods consumed by children was determined (IFCT 2017).

Dietary Diversity

Information on the children's eating patterns was obtained for the dietary diversity using standard checklist (FANTA, 2007). There was a checklist created with typical patterns like:

1. Grains, roots, and tubers
2. Dairy products
3. Vitamin A fruits and vegetables
4. Other vegetables and fruits
5. Legumes and nuts
6. Eggs
7. Flesh foods (chicken, meat, fish, organ meat)

Table 3.3: Z-Score Cut Off Points for Stunting

Degree of undernutrition Z-Score cut off points	Height/Length for age Z-Score (Stunting)
Normal	-1SD and above
Mild	-1SD to -2SD
Moderate	-2SD to -3SD
Severe	< -3SD

Table 3.4: Z-Score Cut Off Points for Wasting

Degree of undernutrition Z-Score cut off points	Weight for Height/Length Z-Score (Wasting)
Normal	-1SD and above
Mild	-1SD to -2SD
Moderate	-2SD to -3SD
Severe	< -3SD

Table 3.5: Z-Score Cut Off Points for Underweight

Degree of undernutrition Z-Score cut off points	Weight for age Z-Score (Underweight)
Normal	-1SD and above
Mild	-1SD to -2SD
Moderate	-2SD to -3SD
Severe	< -3SD

Table 3.6: Tools and Parameters

Parameters	Tools
1. Socio-economic status 2. Infant and young children feeding practices	• Semi – structured questionnaire Data will collect using Epicollect 5 software.
3. Nutritional status Anthropometric measurement • Weight • Height	• Infant weighing scale and bathroom scale • Infantometer and flexible fiberglass tape
4. Dietary patterns 5. Dietary Diversity 6. Diet Quality	• 24 – hours dietary recall Calculation was done using Nutritive application based on IFCT, 2017 values. • Semi – structured questionnaire • DQAT 2023 (Sengar & Patel)

Phase: II

The phase II was divided in two subdivided phases.

Phase II A: Psychometric evaluation of Dietary Quality Assessment Tool (DQAT)

In this Phase II A, psychometric evaluation was done. Assessment for validity, reliability, and internal consistency were included as part of the psychometric evaluation.

Data from 452 subjects were collected for the analysis. Each respondent was prompted to provide a 24-hour recollection of their 3-day intake. The National Institute of Nutrition's Dietary Guidelines for Indians: A Manual included sample menus from which validity was evaluated.

Validity

Content Validity

It evaluates qualitatively how well an index captures the range of factors that define the standard of diet as outlined in the "Dietary Guidelines for Indians, 2010."Whether the index is able to capture the numerous important aspects of diet quality in the "Dietary Guidelines for Indians, 2010" is the fundamental concern when evaluating content validity. The set of components was compared to the Dietary Guidelines for Americans and Indians-2010's main guidelines for this purpose.

Construct and criterion Validity

It assesses how accurately the index captures the value of a diet. There were three methods used.

First and foremost, it is crucial to determine whether the index offers the highest ratings to menus created by nutritionists to demonstrate good diet quality in order to assess construct validity. Expert curated menus were employed for this sample diet.

As determined by a diet's energy value, DQAT 2023 should be able to evaluate diet quality separately from diet quantity. A diet quality score may overrate high-calorie meals since nutrient intake is positively connected with energy intake. Pearson correlations between the DQAT 2023 component cores and energy intake were seen to assess this independence.

Third, principal component analysis was used to evaluate the index's underlying structure. (PCA). The PCA was employed to ascertain the number of independent factors that jeopardise the DQAT 2023 based on correlations among the components. PCA was used to determine whether one or more factors might be attributed to the data's systematic variation.

Reliability

Using the Cronbach's alpha coefficient, the DQAT 2023 was examined for one type of dependability, internal consistency, and the extent to which different index components measure the same underlying, latent, unidimensional concept. This statistic captures any systematic variation underlying the dietary components that are examined since it is theoretically identical to the average of the correlations among all possible split-half combinations of the 15 components of the DQAT.

Inter-Component correlations were seen in order to better comprehend the connections between the various components.

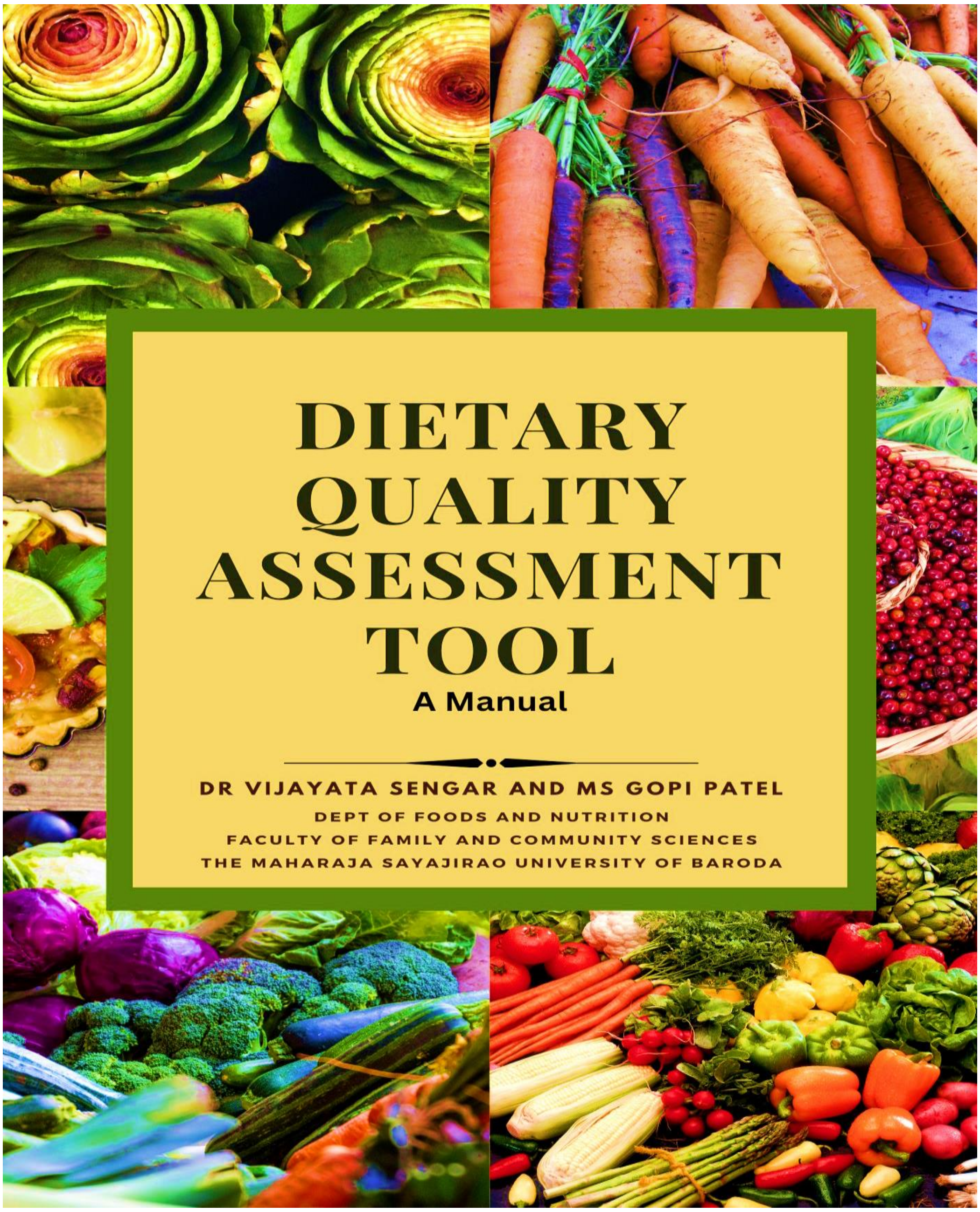
Phase II B: Development of Dietary Quality Assessment Tools – A Manual

A manual on enhancing nutrition quality in diet was created and given to mothers of young children between 6-59 months of age

The manual focused on the following content:

- Importance of healthy diet in early years of life
- Dietary quality assessment tool 2023 for children under 5 years of age
- How to measure your child's dietary quality?
- Suggestions for improving dietary quality
- Sample menus with high diet quality

Figure 3.7: Dietary Quality Assessment Tool – A manual



Statistical analysis

The data was entered through the software name Epicollect5 and was analysed using Microsoft excel (2010) and SPSS version 20 or above.

- Frequency distribution and percentage was calculated for all parameters that would be expressed in a rank order fashion. Chi square test was used for assessing significance between variables.

- Means and standard errors was calculated for all parameters that were expressed numerically. Independent T test and ANOVA tests were conducted to understand the variations in groups, if any.

- Correlation coefficients was computed between indicators of nutritional status and other parameters of interest.

- Principal component analysis was conducted for establishment of Construct and Criterion validity.

- Cronbach Alpha was computed for establishing internal consistency and reliability testing.

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

The present study was concerned with understanding the nutritional status of children and infant and young child feeding practices, along with the modification and psychometric evaluation of the Dietary Quality Assessment Tool (DQAT).

There were two phases to this investigation. Phase I dealt with modification of DQAT 2022. A situational analysis was carried out to investigate the current situation of the children's nutritional status, dietary patterns, the mother's knowledge of IYCF practices, and the socioeconomic profile of the households. The DQAT was modified in accordance with the most recent updates based on Indian nutritional requirements and dietary guidelines. In second phase, DQAT 2023 was tested for validity, reliability, and internal consistency and a guide for improving diet nutrition quality was also developed.

The following phases of the study were separated by their proximity:

Phase I was subdivided into two parts

Phase I A: Modification of Dietary Quality Assessment Tool (DQAT 2022)

Phase I B: Situational analysis which consisted of assessment of dietary intakes of children and assessing the quality of diets using DQAT 2023, socioeconomic status, IYCF practices, and nutritional status of children under 5 years of age

Phase II was subdivided into two parts.

Phase II A: Psychometric evaluation of Dietary Quality Assessment Tool (DQAT 2023)

Phase II B: Development of Dietary Quality Assessment Tool – A Manual

The study took place in Vadodara's urban area. Present study comprised of 452 children under the age of five years. Aanganwadi Centres (AWCs) from 4 zones of urban Vadodara were randomly selected. Children under five, who had AWC registrations, were enrolled for the study. Anthropometric measurements of the participants, including height and weight, were taken. All 452 children's mothers provided information on their socioeconomic situation, nutritional status, IYCF practices, and immunization status. Dietary intakes were also assessed over a period of three consecutive days.

PHASE I A

Modification of a dietary quality assessment tool (DQAT 2022) for children below 5 years of Age

Modification of Dietary Quality Assessment Tool (DQAT 2022) for children aged 6 to 59 months was dealt with for the present research. According to guidelines from the ICMR-NIN 2020 and FANTA/FAO/WHO 2007, Modified DQAT 2023 was developed to assess the dietary quality of children under the age of five (ICMR, 2011; FANTA, 2007). Two components were added namely total fat and added sugar to DQAT2023. Modifications were done in the amounts of fruits and vegetables components as per latest requirements.

DQAT 2023-K for children between 6-24 months

DQAT2023-K was composed of 15 components for children between 6-24 months which include:

1. Breast milk
2. Grains
3. Roots and Tubers
4. Legumes
5. Nuts
6. Dairy products
7. Flesh Foods
8. Eggs
9. **Vitamin A-rich fruits**
10. **Vitamin A-rich vegetables**
11. **Other fruits**
12. **Other vegetables**
13. High Fat, salt, and sugar foods (HFSS Foods)
14. **Total Fat**
15. **Added Sugar**

Components in **bold** were modified

Except for breastfeeding, which had a score range of 0 to 20, every component had a range of either 0 to 10 or 0 to 5. A component's most desirable intake received the highest score, and its least desirable intake received the lowest score.

A simple sum of all the individual component scores would give the overall DQAT score (Max score 120). A DQAT score equal to or above 96 implied a **"Good"** quality diet. Scores ranging from 61–95 indicated **"Upgrading required"** and scores equal to or below 60 indicated a **"Poor"** quality diet.

DQAT2023-P for children between 25-59 months:

DQAT2023-P was composed of 14 components for children between 25-59 months which include:

1. Grains
2. Roots and Tubers
3. Legumes
4. Nuts
5. Dairy products
6. Flesh Foods
7. Eggs
8. **Vitamin A-rich fruits**
9. **Vitamin A-rich vegetables**
10. **Other fruits**
11. **Other vegetables**
12. High Fat, salt, and sugar foods (HFSS Foods)
13. **Total Fat**
14. **Added Sugar**

Components in **bold** were modified

Every component had a range of either 0 to 10 or 0 to 5. A component's most desirable intake received the highest score, and its least desirable intake received the lowest score.

A simple sum of all the individual component scores would give the overall DQAT score (Max score 100). A DQAT score equal to or above 80 implied a **"Good"** quality diet. Scores ranging from 51–79 indicated **"Upgrading required"** and scores equal to or below 50 indicated a **"Poor"** quality diet.

Modified DQAT can be used to assess the quality of a diet not only in terms of diversity but also in terms of quantity and can serve as a useful tool for identifying gaps in the dietary quality of young children and thus rectifying them in their diets.

PHASE I B

Situational Analysis

The characteristics of the children in the study are displayed in **Table 4.1**. Mean age of mothers was 27 $\pm$ 4 years. Mean values for Age, weight, height, and weight at birth are shown in **Table 4.1**. Age and Gender-wise distribution of the subjects is shown in **Table 4.2**. Almost an equal representation from all age groups were observed in the study.

4.1 Socio–Economic Status

Socioeconomic status is a significant factor in determining individual's level of nutrition and health. The accessibility, affordability, and effective use of various available facilities are also influenced by socioeconomic status. Taking into account an array of factors, including income, education level, occupation, caste, religion, family structure, and facilities that are accessible, socio-economic status is a measurement of a person's or family's economic and social standing in comparison to others. where the three factors of income, education, and occupation together are the best indicators of socioeconomic level. The socioeconomic profile of the participants is displayed in **Table 4.3.**

Education qualification of the parents

The majority of mothers, at 33.8% of the total, had completed middle school or less in terms of educational attainment. Twenty-seven percent of mothers attended high school, compared to 20.4% of mothers who studied in primary school. While mothers who completed intermediate or diploma, graduation, and professional education were at 0.2, 6.6, and 3.1%, respectively.

The majority of the Father's educational attainment was at the middle school level. **Table 4.3** shows that 17.7% of people had only completed primary school, 21.7% had finished their high school education, 3.5% had taken an intermediate or diploma program, 8.8% had graduated, and 2.4% had accomplished a professional program. Mothers (8.4%) had a greater illiteracy rate than fathers (7.1%).

Occupation of parents

It was observed that over 90% of the mothers were unemployed. 6.6% of the total mothers worked in elementary occupations like house helping, street vending, and elementary work. The workforce was made up of 0.2% craft and associated trade employees, 0.2% plant and machine operators and assemblers, and 0.2% professionals. 1.1% of people held jobs as skilled workers and associate professionals.

Findings from fathers' occupations indicated that 43.4% of fathers worked in elementary-level jobs like food street vendors. 32.1% of the total were skilled employees and shop market vendors, while 8% of the fathers were categorized as technicians and associate professionals. 7.1% of the workforce worked as assemblers and operators of machinery. 4.9% of fathers worked as craft and related trade employees, whereas 1.8% of fathers were employed professionally. A competent worker in agriculture or fishing was taken up by 1.8% of fathers. Meanwhile, it was found that 1.1% of fathers were unemployed.

Household Income

The mean of the total family's monthly income was determined to be 16102 + 9947 INR. The majority of the households (83.2%) had an income between 5,001 and 20,000 INR. The percentage of those with incomes under 5,000 INR was found to be less than 1%. A range of incomes over 50,001 INR was earned by 1.2% of the population.

Ninety-five percent of the population in the majority had no other sources of income when other income was taken into account. 4.4%, however, had a different category that was not mentioned. Less than 1% of people used poultry as a secondary source of income.

Around 63.7% of families had only one wage earner. Two earning members of the household made up one-fourth of the total household.

Ration cards were used by 63.3% of all households, of which 25.7% have incomes below the poverty line and 37.2% have incomes above it. There were 36.7% of families without ration cards.

Residence and Religion

Around 68.6% of the population lived in homes that they owned, compared to 31% who rented houses. Only 1% of people lived in a different sort of home, which was not indicated.

Hindu families made up 61.1% of all households, followed by Muslim households at 38.1%, Christian families at 0.2%, and others at 0.2%.

Over half of the population fell into the general/open categories, such as Pathan, Patel, and Brahman households. Elsewhere, 27.89% of a household fell under the OBC category, and 13.72% of all households fell under the ST category. The SC category made for the lowest percentage of households, at roughly 6.38% **Table 4.3**.

Sources of drinking water

About 92.04% of the households had inside piped water services. whereas 2.88% of families used piped water that came from outside their homes. Nearly 3% of households got their drinking water from a public tap. Less than 1% of respondents drank water from bottles. No one drank water from a bore well or a tube well.

Over 81.6% of the population used water treatment to make it safe to drink. 18.4% of people were not treating their water in any way to make it safer to drink.

To make safer drinking water, the vast majority of people used the staining process through clean clothes. 5.96 % of houses utilized a water filter, while 1.89 % of all households utilized R.O. (reverse osmosis) water treatment methods like boiling. The household didn't utilize any treatments like chlorine or bleach.

Toilet facilities

Toilet facilities were present in 94.9% of the households, with 94.7% of those having private toilets and 0.2% using public toilets. Meanwhile, 5.1% of people did not have access to proper toilets.

Table 4.1: Mean Anthropometric measurements of the subjects (N =452)

Variables	Mean
Age (months)	13.69 ± 16.29
Weight (kg)	10.86 ± 2.54
Height (cm)	85.00 ± 12.05
Weight at the time of birth (gm)	2812.23 ± 1182.03

Table 4.2: Age and Gender - wise Distribution of the subjects (N =452)

Age group	Male (n=219) (%)	Female (n=233) (%)	Total n (%)
6-12 months	40 (18.26)	48 (20.60)	88(19.5)
13-24 months	51 (23.28)	40 (17.17)	91(20.1)
24-36 months	50 (22.83)	49 (21.03)	99(21.9)
36-48 months	35 (15.98)	50 (21.46)	85(18.8)
48-59 months	43 (19.53)	46 (19.74)	89(19.7)

Table 4.3: Socio-economic profile of the subjects (N =452)

Characteristics	n (%)
Religion	
Hindu	276 (61.1)
Muslim	172 (38.1)
Christian	2 (0.4)
Shikh	0 (0)
Other	2 (0.4)
Caste	
SC	30 (6.38)
ST	62 (13.72)
OBC	126 (27.89)
Other	234 (51.77)
Type of family	
Joint	254 (56.2)
Nuclear	198 (43.8)
Extended	0 (0)
Total number of family members (Mean ± SD)	5.98 ± 3.03
Total number of young children between 6 – 59 months of age (Mean ± SD)	1.41 ± 0.60
Education qualification of Mother	
Professional	14 (3.1)
Graduate	30 (6.6)
Intermediate or Diploma	1 (0.2)
High school	92 (20.4)
Middle school	153 (33.8)

Characteristics	n (%)
Primary school	124 (27.4)
Illiterate	38 (8.4)
Education qualification of Father	
Professional	11 (2.4)
Graduate	40 (8.8)
Intermediate or Diploma	16 (3.5)
High school	98 (21.7)
Middle school	175 (38.7)
Primary school	80 (17.7)
Illiterate	32 (7.1)
Occupation of Mother	
Legislators, Senior Officials & Managers	0 (0)
Professionals	1 (0.2)
Technicians & Associate Professionals	5 (1.1)
Clerks	0 (0)
Skilled Workers & Shop Market Sales Workers	5 (1.1)
Skilled Agricultural & Fishery Workers	0 (0)
Craft & Related Trade Workers	1 (0.2)
Plant & Machine Operators and Assemblers	1 (0.2)
Elementary Occupation	30 (6.6)
Unemployed	409 (90.5)
Occupation of Father	
Legislators, Senior Officials & Managers	0 (0)
Professionals	8 (1.8)
Technicians & Associate Professionals	36 (8.0)
Clerks	0 (0)
Skilled Workers & Shop Market Sales Workers	145 (32.1)
Skilled Agricultural & Fishery Workers	8 (1.8)
Craft & Related Trade Workers	22 (4.9)
Plant & Machine Operators and Assemblers	32 (7.1)
Elementary Occupation	196 (43.4)
Unemployed	5 (1.1)
Total Monthly Income	
≤5000	2 (0.4)
5001 – 20000	376 (83.2)
20001 - 35000	54 (11.9)
35001 - 50000	15 (3.3)
≥50001	5 (1.2)
Other Sources of Income	
Agriculture	0 (0)
Poultry	2 (0.4)
House / Shop rent	0 (0)
NA	430 (95.1)
Other	20 (4.4)
Total Number of Earning Members in Family	
1	288 (63.7)

Characteristics	n (%)
2	113 (25.0)
3	41 (9.1)
4-5	10 (2.2)
>5	0 (0)
Having a Ration Card	
Yes	286 (63.3)
No	166 (36.7)
The Economic Status of Household	
BPL	116 (25.7)
APL	168 (37.2)
AAY	2 (0.4)
The Main Source of Drinking Water of Household	
Piped water inside the house	416 (92.04)
Piped water outside of the house	13 (2.88)
Public tap	12 (2.65)
Bottled water	1 (0.02)
Tube well / Bore well	0 (0)
Treat Water to Make it Safer to Drink	
Yes	369 (81.6)
No	83 (18.4)
Don't know	0 (0)
Type of Water Treatment	
Boil	7 (1.89)
Add bleach / chlorine	0 (0)
Strain it through cloth	344 (93.22)
Use water filter / R. O	22 (5.96)
Other	0 (0)
Don't know	0 (0)
Toilet Facility Available in the Household	
Yes	429 (94.9)
No	23 (5.1)
Type of Toilet Facility Used by Household	
Private	428 (94.7)
Public	1 (0.2)
Outside	23 (5.1)
Type of house	
Own house	310 (68.6)
Rented house	140 (31.0)
Govt. house	0 (0)
Other	2 (0.4)

4.2 Nutritional status of the subjects

The nutritional status of the children under five was evaluated. The indicators used to assess the nutritional status were the height for age Z-score (HAZ), weight for age Z-score (WAZ), and weight for height Z-score (WHZ).

The rate of stunting in children under the age of five was measured using a height-for-age z-score. When stunting rates were evaluated, it was found that 37.4% of the children fell into the normal range. On the other hand, rates were comparable across genders, with mildly stunted children making up 28.8% of all children. Children were found to be moderately stunted in 17.5% of cases, and severely stunted in 16.4% of cases. Stunting rates were higher in females than in males. Nonetheless, there was a non-significant difference **(Table 4.4).**

Weight-for-height z-scores were used to assess the wasting rates of children under the age of five. About half of the children (55.5% of them) fell to the normal category when wasting rates were assessed. The rate of mild wasting was 31.1 % in male and 27.5 % in female. Children's Moderate wasting rates were determined to be 10.8%, and their severe wasting rates to be 4.4%. In comparison to females, males showed higher rates of wasting. In terms of wasting rates, there was a non-significant gender difference **(Table 4.5)**.

Weight-for-age Z-score as shown in **Table 4.6** displays the rates of underweight in children under the age of five. One-third of all participants belonged to the normal category, according to the analysis of the data that was gathered. 42.7% of children were found to be mild underweight. 17.3% of children were found to be moderately underweight, while 6.4% were found to be extremely underweight. In contrast, men were more inclined to be underweight than females. Overall, there was a non-significant gender disparity in underweight rates.

The prevalence of underweight was highest, followed by wasting and stunting, according to gender-wise analysis of nutrition status in participants. males were considered to experienced undernutrition at higher rates than females.

Table 4.4: Gender-wise Prevalence of Stunting (HAZ scores) (N= 452)

Degree of undernutrition Z-score cut off points		Height for age Z-score (Stunting) n (%)			Chi-square
		Male	**Female**	**Total**	
Normal	**-1SD and above**	79 (36.1)	90 (38.6)	169 (37.4)	0.944NS
Mild Stunting	**-1SD to -2SD**	61 (27.9)	69 (29.6)	130 (28.8)	
Moderate Stunting	**-2SD to -3SD**	41 (18.7)	38 (16.3)	79 (17.5)	
Severe Stunting	**<-3SD**	38 (17.4)	36 (15.5)	74 (16.4)	

Table 4.5: Gender-wise Prevalence of Wasting (WHZ scores) (N= 452)

Degree of undernutrition Z-score cut off points		Weight for height/length Z-score (Wasting) n (%)			Chi-square
		Male	**Female**	**Total**	
Normal	**-1SD and above**	109 (49.8)	142 (60.9)	251 (55.5)	7.303NS
Mild Wasting	**-1SD to -2SD**	68 (31.1)	64 (27.5)	132 (29.2)	
Moderate Wasting	**-2SD to -3SD**	30 (13.7)	19 (8.2)	49 (10.8)	
Severe Wasting	**<-3SD**	12 (5.5)	8 (3.4)	20 (4.4)	

Table 4.6: Gender-wise Prevalence of Underweight (WAZ scores) (N= 452)

Degree of undernutrition Z-score cut off points		Weight for age Z-score (Underweight) n (%)			Chi-square
		Male	**Female**	**Total**	
Normal	**-1SD and above**	64 (29.2)	88 (37.8)	152 (33.6)	5.000NS
Mild Underweight	**-1SD to -2SD**	95 (43.4)	98 (42.1)	193 (42.7)	
Moderate Underweight	**-2SD to -3SD**	44 (20.1)	34 (14.6)	78 (17.3)	
Severe Underweight	**<-3SD**	16 (7.3)	13 (5.6)	29 (6.4)	

In order to identify the age group with the highest burden of malnutrition among children under the age of five, nutritional status was also evaluated by age. Due to increased consumption of HFSS foods, the age range of 25 to 36 months saw the highest rates of severe stunting, whereas the age group of 13 to 24 months saw the highest rates of moderate stunting. The age range of 49–59 months showed the highest prevalence of mild stunting. A total of 37.4% subjects were found in the normal range. Sixteen percent of the total participants suffered from severe stunting age-wise which is displayed in the **Table 4.7**.

The age range of 49 to 59 months was found to have the highest prevalence of severe wasting, with reduced nutritious food consumption being the main contributing factor. The majority of the children—approximately half—were within the normal range. Mild wasting affected 29.2% of the entire population, with 37 to 48-month-old children showing the highest prevalence of mild wasting. Highest 14.6% of children between the ages of 49 to 59 months had moderate wasting it shown in the **Table 4.8**.

Table 4.9 displays the prevalence of underweight among children under the age of five according to age. The highest burden of severely underweight children was observed between the ages of 25 and 36 months. Majority of the individuals were mildly underweight, with those aged 49 to 59 months showing the highest incidence. Six percent of the population was severely underweight. The most underweight children belonged to age group of 49–59 months old, followed by those who were 6–12 months old, 37–48 months old, 13–24 months old, and 25–36 months old. At the ages of 25 and 36 months, one third of children were moderately underweight. Age showed to have a substantial impact on nutritional status.

Further analysis revealed that for the three variables WHZ, HAZ, and WAZ, a significant difference between children above and below 2 years (WHZ -f value of 12.073**; HAZ -f value of 17.365*; WAZ -f value of 0.267***) was seen as shown in **Table 4.10.**

Table 4.7: Age - wise Prevalence of Stunting (HAZ scores) (N= 452)

Degree of undernutrition Z-score cut off points		Height for age Z-score (Stunting) Age n (%)						Chi-square
		6-12 months	**13-24 months**	**25-36 months**	**37-48 months**	**49-59 months**	**Total n (%)**	
Normal Stunting	-1SD and above	47 (53.4)	24 (26.4)	34 (34.3)	36 (42.4)	28 (31.5)	169 (37.4)	25.17NS
Mild Stunting	-1SD to -2SD	22 (25.0)	27 (29.7)	25 (25.3)	26 (30.6)	30 (33.7)	130 (28.8)	
Moderate Stunting	-2SD to -3SD	6 (6.8)	23 (25.3)	19 (19.2)	13 (15.3)	18 (20.2)	79 (17.5)	
Severe Stunting	<-3SD	13 (14.8)	17 (18.7)	21 (21.2)	10 (11.8)	13 (14.6)	74 (16.4)	

Table 4.8: Age - wise Prevalence of Wasting (WHZ scores) (N= 452)

Degree of undernutrition Z-score cut off points		Weight for height/length Z-score (Wasting) Age n (%)						Chi-square
		6-12 months	**13-24 months**	**25-36 months**	**37-48 months**	**49-59 months**	**Total n (%)**	
Normal	-1SD and above	50 (56.8)	60 (65.9)	57 (57.6)	44 (51.8)	40 (44.9)	251 (55.5)	15.70NS
Mild Wasting	-1SD to -2SD	22 (25.0)	22 (24.2)	29 (29.3)	30 (35.3)	29 (32.6)	132 (29.2)	
Moderate Wasting	-2SD to -3SD	11 (12.5)	5 (5.5)	10 (10.1)	10 (11.8)	13 (14.6)	49 (10.8)	
Severe Wasting	<-3SD	5 (5.7)	4 (4.4)	3 (3.0)	1 (1.2)	7 (7.9)	20 (4.4)	

Table 4.9: Age-wise Prevalence of Underweight (WAZ scores) (N= 452)

Degree of undernutrition Z-score cut off points		Weight for age Z-score (Underweight) Age n (%)						Chi-square
		6-12 months	**13-24 months**	**25-36 months**	**37-48 months**	**49-59 months**	**Total n (%)**	
Normal	-1SD and above	38 (43.2)	41 (45.1)	34 (34.3)	28 (32.9)	11 (12.4)	152 (33.6)	40.598***
Mild Under-weight	-1SD to -2SD	39 (44.3)	35 (38.5)	32 (32.3)	37 (43.5)	50 (56.2)	193 (42.7)	
Moderate Under-weight	-2SD to -3SD	8 (9.1)	12 (13.2)	22 (22.2)	17 (20.0)	19 (21.3)	78 (17.3)	
Severe Under-weight	<-3SD	3 (3.4)	3 (3.5)	11 (11.1)	3 (3.5)	9 (10.1)	29 (6.4)	

***Significant at the 0.001 level (2-tailed)

Table 4.10: Mean Z-Scores for WHZ, HAZ and WAZ among subjects (N= 452)

INDICATOR	Age	Mean	T-test
WHZ	≤ 2 years	-0.62 ± 1.50	12.073**
	> 2 years	-1.00 ± 1.12	
HAZ	≤ 2 years	-1.20 ± 1.95	17.365*
	> 2 years	-1.55 ± 1.41	
WAZ	≤ 2 years	-1.12 ± 1.02	0.267***
	> 2 years	-1.57 ± 0.99	

***Significant at the 0.001 level (2-tailed)

4.3 Background information

Information was provided on children born with an illness or medical issue during the evaluation. About 92.3 % of the children were free of complications, whereas 7.7 % had illnesses like diarrhea, a cold, a cough, jaundice, a very low birth weight, body water retention, a small intestinal infection, etc.

When children who had ever been admitted to the NRC or a health center were analyzed, it was found that 97.3% of children had never been admitted to the NRC or a health center, while 2.7 % of children had **Figure 4.1**.

The statistics shown in **Table 4.11** that 67% of mothers experienced a natural delivery, while 33% underwent a c-section. whereby less than 1% of mothers had not given birth to a child beyond full term, while 99.3% of mothers had. In government hospitals, about half of the mothers had given birth to their children. 3.1% of infants were born in a primary health center, compared to 39.4% of all births taking place in private hospitals. 2% of all births take place at home. In other categories that weren't stated expressly, less than 1% had been accounted for.

Figure 4.1: Subjects ever admitted to NRC/Health Centre (N=452)

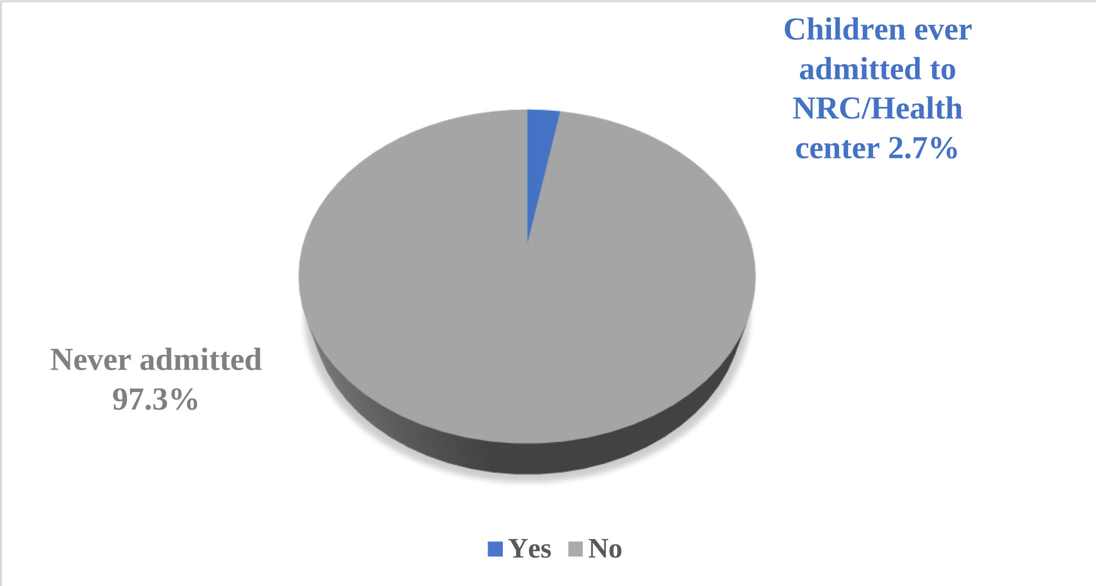


Table 4.11 Background information of the subjects (N=452)

Characteristics	n (%)
Any Medical Complication/ Disease at Birth	
Yes	35 (7.7)
No	417 (92.3)
Children Admitted to NRC/CMTC	
Yes	12 (2.7)
No	440 (97.3)
Type of Deliver of Your Child	
Normal	303 (67.0)
C-section	149 (33.0)
Other	0 (0)
Full Term Born Children	
Yes	3 (0.7)
No	449 (99.3)
Place of Child Born	
Government Hospital	250 (55.3)
Private Hospital	178 (39.4)
Primary Health Care (PHC)	14 (3.1)
Community Health Care (CHC)	0 (0)
At home	9 (2.0)
Other	1 (0.2)

4.4 IYCF Practices among children below 5 years of age

A semi-structured questionnaire was used to assess the frequency of IYCF practices followed in the population. Effective public health interventions to improve child survival, nutrition, and development include best practices for feeding infants and young children (IYCF). Malnutrition can have many root causes, including poor IYCF practices.

Malnutrition caused by inadequate feeding practices in infancy and early childhood affects cognitive and social development, school performance, and productivity later in life (Victora, 2008). Children who were exclusively breastfed were 14 times more likely to survive and have a lower risk of developing pneumonia and diarrhea (Arifeen, 2001).

For six months, the infant should only be breastfeed exclusively. The most important of benefit is developing defense against gastrointestinal illnesses, which is a common issue in both developed and poor nations. Within an hour of birth, nursing should be started to protect the baby from illnesses and newborn mortality. Infants who are either partially breastfed or not at all may be at an increased risk of death from diarrhea and other diseases (WHO, 2021).

Children from 6 to 23 months benefit greatly from the nutrients and energy found in breastmilk. Between the ages of 6 and 12 months, it can meet half or more of a child's energy demands, and between the ages of 12 and 24 months, it can meet one-third of those needs. Moreover, breast milk lowers death rates in malnourished children and provides vital nutrients and energy during illness. Babies who were breastfed as children and adolescents are less likely to be overweight or obese. They also score higher on Intelligence quotient and attend school more frequently (WHO, 2021).

Further results of the evaluation of infant and young child feeding practices among children under 5 years of age are shown in **Table 4.12.**

When the early initiation of breastfeeding in infants under the age of five was evaluated, 71.7% of mothers could initiate breastfeeding within one hour, whereas 28.3% of mothers did not. Caesarean births or delivery problems for the mother or infant were found to be the main cause of delay in early initiation of breastfeeding. Of the total children, 64.38 % were not being breastfed at the time. One third of the children were breastfed continuously whereas 2.87 % of the children weren't breastfed more than three times a day.

Around 16% of children received breast milk more than 6 times daily, compared to 17.04% who received it between 3 and 6 times daily. Almost 15% of the total children were given bottle milk or artificial milk. The vast majority of the young children did not receive artificial milk or bottle-feeding.

According to study, 90.9% of all children did not receive pre-lacteals from their mothers. 9.1% of all children received pre-lacteals while they were young. Around fifty five percent of all children were not breastfed at night, compared to 43.81% of all children who were breastfed at night. One quarter of the children received no additional food or drink, and 74.6% of them received it before they were six months old.

When their child was ill, 41.6% of mothers increased the number of times they breastfed them, compared to 20.1% of all mothers who did not. About 38.3% were unsure of the advantages of increasing breastfeeding frequency as well as whether they had been increased or not.

Complementary Feeding

When mothers' knowledge of complementary feeding was evaluated, it was found that 70.4% of mothers recognized that meals provided after 6 months were referred to as complementary foods, whereas 3.3% of mothers were not familiar with the concept. Only 26.1% of mothers informed that Balshakti that was administered on Annaprasan Day was regarded, as complementary feeding, however, for 0.2% of the total children the answer given by mothers was not specific. The initiation of complementary feeding was evaluated, and the results showed that 90.49% of mothers began it once their infants were 6 months old, compared to 9.51 % who had started it previously.

Children under the age of five were assessed for how often they received complementary feeding, and it was shown that 59.73% of them were fed between three and four times daily. Followed by 1.11% of children who were fed 5 to 6 times each day. On the other side, 39.16% of the children received complementary foods in response to their requests or when they asked for them.

Minimum Dietary Diversity (four food groups out of seven food groups required) was evaluated to assess the dietary patterns of children under 5 years of age. The majority of respondents (almost 98%) included grains, roots, and tubers as complementary diets. Dairy products such as milk, curd, and buttermilk were included as complementary foods in 80.09 % of the total diets. About 16.81% of children under 5 years old ate fruits and vegetables high in vitamin A while child to the tune of 64.6% devoured other fruits and vegetables. The majority of the children consumed nuts and legumes as components of their meals. Among the children, 18.56% had consumed eggs, and 7.52% had had flesh meals such as meat, fish, poultry, and organ meat **Figure 4.2.**

When the data were further assessed, 67.5% of the mothers fed their children complementary foods in addition to breastfeeding, whereas 32.5% of the mothers did not do so. According to the mother's understanding, complementary feeding can begin as early as six months. Seventy percent of the mothers informed that this was what the AWC worker advised them to do. The mother answered that the body's needs rose as age increased in 41.81% of cases. About 2% of mothers believed that because children were too little therefore, they didn't feel hungry until they were 6 months old. Almost one tenth of mothers were unsure of the rationale behind complementary feeding beginning at 6 months of age.

Nearly one third of the participants consumed vegetarian meals meanwhile, 50.88 percent of all food intake was made up of non-vegetarian items while 11.73% of children also consumed eggs as eggetarian children.

When mothers first started feeding their children, most of them started with semisolid-consistency foods. Around 2% of all mothers started with liquid foods, compared to 16.15% of mothers who started with semi-solids. Less than 1% of mothers introduced solid foods, but after some processing, such as grinding, crushing, or mashing, their children had no trouble eating it.

Knowledge evaluation of mothers regarding child malnutrition

As seen in **Figure 4.3** below, it was observed that more than half (66.37%) of the mothers were not aware of the word "malnutrition," and 15.93% believed that malnutrition had a contributing role in the child's low weight. Fewer than 3% of respondents thought that an inactive child had been malnourished. Indicators of malnutrition, such as a decrease in appetite, were cited by 1.55% of mothers. About 16% of mothers indicated that malnutrition was to blame for their frequently ill children.

Mothers wash their hands before and after cooking, according to an evaluation of their handwashing habits 99.78% of all respondents reported of washing their hands after changing a baby's nappy, as well as before and after feeding the child.

The significant majority of mothers adhered to the guidelines that were crucial when feeding children, including drinking clean water, washing hands before and after feeding, using a clean bowl for serving, and properly covering foods.

While 40.49% of the children did not receive Balshakti because they were engaged in an early education and nutrition programme after three years, 59.51% of the children received Balshakti packages from Aaganwadi. Thirty-eight percent of the children who received Balshakti packages liked eating, whereas 21.46% did not like it. Around 6.9% of mothers were able to cook diverse recipes from Balshakti packets, the great majority of mothers were unable to do so as seen in **Table 4.12**.

Figure 4.2: Food groups included in complementary foods (N = 452)

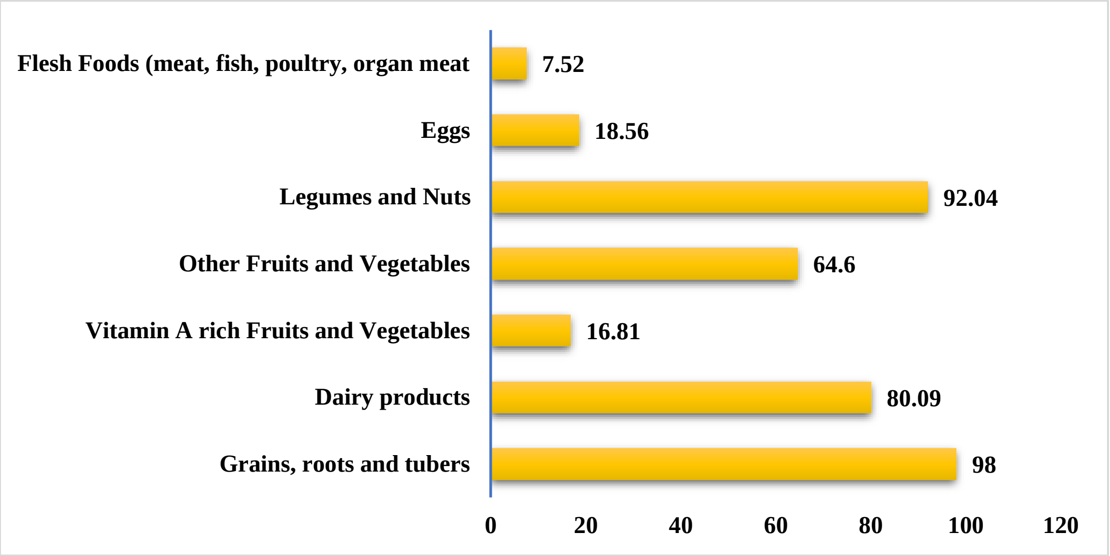


Figure 4.3: Knowledge of mothers regarding malnutrition

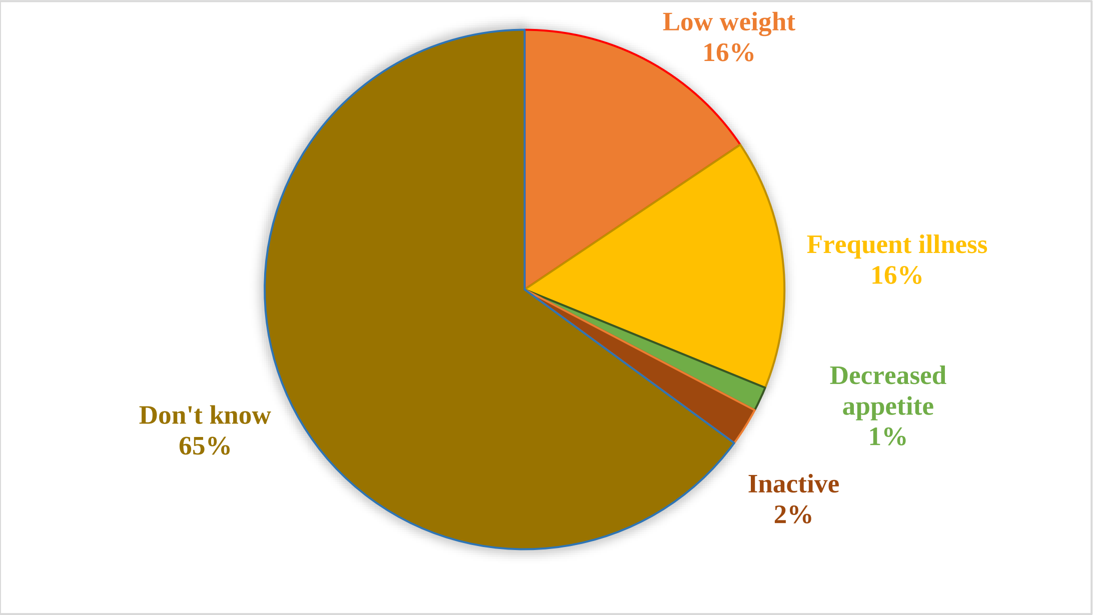


Table 4.12: Infant and young child feeding practices of Subjects (N = 452)

Characteristics	n (%)
For 0 to 6 months children	
Early Initiation of Breastfeeding	
Yes	324 (71.7)
No	128(28.3)
Feed a Colostrum to child	
Yes	40 (8.8)
No	88 (19.5)
Number of children	
Breastfeed children	161 (35.62)
Non-breastfeed children	291 (64.38)
Frequency of breastfeeding	
<3 times/day	13 (2.87)
3 to 6 times/day	77 (17.04)
>6 times/day	71 (15.71)
Not breastfeeding	291 (64.38)
Bottle Feed / Artificial Milk given to Children	
Yes	65 (14.4)
No	387 (85.6)
Pre-lacteals given to children	
Yes	41 (9.1)
No	411 (90.9)
Breastfeeding at night in children	
Yes	198 (43.81)
No	254 (56.19)
Other food/drink given to children	
Yes	115 (25.4)
No	337 (74.6)
Complementary feeding	
Complementary foods according to mothers	
Food given to children after 6 months	318 (70.4)
Balshakti given on annaprasan day	118 (26.1)
Don’t know	15 (3.3)
Any other	1 (0.2)
Initiation of Complementary Foods	
Before 6 months	43 (9.51)
After 6 months	409 (90.49)
Frequency of complementary foods	
3-4 times	270 (59.73)
5-6 times	5 (1.11)
When child asks	177 (39.16)
Food groups included in complementary foods	
Grains, roots and tubers	443 (98.0)
Dairy products	362 (80.09)
Vitamin A rich fruits and vegetables	76 (16.81)
Other fruits and vegetables	292 (64.60)
Legumes and nuts	416 (92.04)
Eggs	84 (18.56)
Flesh foods (meat, fish, poultry, organ meat)	34 (7.52)
Malnourished children according to mothers	
Low weight	72 (15.93)

Characteristics	n (%)
Frequent illness	72 (15.93)
Decreased appetite	7 (1.55)
Inactive	11 (2.43)
Don’t know	300 (66.37)
Other	0 (0)
Increase the frequency of breastfeeding when child is sick	
Yes	188 (41.6)
No	91 (20.1)
Don’t know	173 (38.3)
Handwashing practices of mothers	
Before cooking	452 (100)
After cooking	452 (100)
After cleaning baby’s diaper	451 (99.78)
Before feeding child	451 (99.78)
After feeding child	451 (99.78)
Breastfeed child along complementary feeding	
Yes	305 (67.5)
No	147 (32.5)
Reason behind complementary foods starts after 6 months according to mothers	
Increase nutrients requirement	189 (41.81)
AWC worker advised her	320 (70.79)
Child does not feel hungry before	8 (1.77)
I don’t know	40 (8.85)
Other	6 (1.33)
Type of children diets	
Vegetarian	169 (37.39)
Non-vegetarian	230 (50.88)
Eggetarian	53 (11.73)
Consistency of complementary feeds when begun to children	
Solid	2 (0.44)
Semi-solid	369 (81.64)
Semi-liquid	73 (16.15)
Liquid	8 (1.77)
Other	0 (0)
Point keeps in mind while feeding your child	
Wash hands before feeding child	452 (100)
Wash hands after feeding child	451 (99.78)
To use clean bowl for serving	451 (99.78)
Food should be covered	451 (99.78)
Clean water for drinking	451 (99.78)
All of above	451 (99.78)
Getting Balshakti packets from AWC	
Yes	269 (59.51)
No	183 (40.49)
Like to eat Balshakti packet by child	
Yes	172 (38.05)
No	97 (21.46)
Knowledge of making different recipes from Balshakti of mothers	
Yes	31 (6.9)
No	421 (93.1)

4.5 Nutrient Intake among children below 5 years of age

Table 4.13 illustrates the mean nutritional consumption for children under the age of five. The precise dietary consumption over the period of three consecutive days was recorded using a 24-hour dietary recall. Females consumed more overall nutrients than males did, with the exception of iron, according to a comparison of nutrient consumption by gender under the **Table 4.14.** However, each individual had individual dietary habits and consumption, **Table 4.15** shows that the mean nutrient intake was significantly different age-wise. **Table 4.16** displays the mean intake of nutrients by children aged 5 years, subdivided further by age and gender. Mean Calcium intakes were significantly different based on gender and age.

The statistical analysis of each nutrient consumption revealed significant differences among children who were older and younger than the age of 2 years in nutrient intakes, as shown in **Table 4.17**.

With the exception of protein and iron, a comparison of the % RDA of nutrient intakes by gender revealed that females had greater intakes of nutrients. The examination of the mean %RDA of intake of nutrients in children aged 5 years was non-significant within gender, with the exception of calcium (p- value: <0.05) **(Table 4.18).** Considering nutritional requirements vary with age, it was seen that the mean % RDA of nutrient intake was significantly different across all age groups (**Table 4.19)**.

Children's dietary data analysis revealed that no one met their energy needs; however, 2- to 3-year-olds fared well in comparison to other age groups. Nevertheless, children were consuming more protein than was recommended. The rest of the population, except infants aged 6 to 12 months, consumed enough fat. Only infants between the ages of 6 and 12 months could satisfy their iron needs. The majority of children in all age groups consumed 80% of their recommended calcium intake. Statistical analysis further revealed a significant disparity in the mean calcium levels based on gender across all age groups **(Table 4.20).**

Table 4.21 shows that, with the exception of the mean energy intake, children aged above and below 2 years differed significantly in their mean percent of the RDA for all nutrient intakes.

Table 4.13: Mean nutrient intake of subjects- Day-wise (N=452)

Nutrients	Day 1	Day 2	Day 3	Mean
Energy (kcal)	872.2 ± 352.3	713.8 ± 274.6	705.4 ± 269.6	763.8 ± 298.9
Protein (g)	27.6 ± 11.1	23.3 ± 9.2	22.6 ± 8.8	24.5 ± 9.7
Fat (g)	33.6 ± 18.1	27.9 ± 14.5	28.2 ± 14.0	29.9 ± 15.5
Iron (mg)	4.7 ± 3.1	3.7 ± 2.7	3.8 ± 2.6	4.1 ± 2.8
Calcium (mg)	419.2 ± 228.3	391.8 ± 209.0	392.1 ± 204.9	401.0 ± 214.1

Table 4.14: Mean nutrient intake of subjects- Gender-wise (N=452)

	Gender-Wise Mean		ANOVA
	Male	**Female**	
Energy (kcal)	760.8 ± 287.1	766.5± 262.0	0.048NS
Protein (g)	24.4 ± 9.0	24.6 ± 8.4	0.052NS
Fat (g)	29.6 ± 14.8	30.2 ± 13.1	0.192NS
Iron (mg)	4.1 ± 2.7	4.0 ± 2.6	0.233NS
Calcium (mg)	381.9 ± 194.5	419.1 ± 197.0	4.080*

*Significant at the 0.05 level (2-tailed)

Table 4.15: Mean nutrient intake of subjects- Age-wise (N=452)

Nutrients	Age					ANOVA
	6-12 months	**13-24 months**	**25-36 months**	**37-48 months**	**49-59 months**	
Energy (kcal)	417.4 ± 267.9	748.2 ± 246.4	809.9 ± 243.5	948.9 ± 158.0	885.3 ± 196.9	55.66***
Protein (g)	16.1 ± 8.8	23.6 ±7.6	26.3 ± 7.9	28.7 ± 5.9	27.6 ± 6.8	39.72***
Fat (g)	18.6 ±14.4	28.2 ± 13.0	32.4 ± 13.2	35.8 ± 10.0	34.3 ± 11.6	26.56***
Iron (mg)	2.2 ± 1.4	3.6 ± 2.2	4.5 ± 2.9	5.0 ± 85.0	5.1 ± 2.9	21.72***
Calcium (mg)	314.8 ± 246.1	412.1 ± 213.4	426.1 ± 198.1	435 ± 139.9	414.8 ± 139.1	5.69***

***Significant at the 0.001 level (2-tailed)

Table 4.16: Mean nutrient intakes of subjects- Age and Gender-wise (N=452)

Nutrients		Energy (kcal)	Protein (g)	Fat (g)	Iron (mg)	Calcium (mg)
6-12 months	**Male**	417.4 ±267.9	15.1 ± 9.1	16.9 ± 16.7	2.1 ± 1.5	275.1 ± 234.6
	Female	508.9 ± 255.9	16.9 ± 8.6	20.0 ± 12.2	2.2 ± 1.4	347.9 ± 252.9
13-24 months	**Male**	748.2 ± 246.4	23.7 ± 7.4	28.7 ± 12.8	3.5 ± 1.5	403.4 ± 211.7
	Female	706.1 ± 252.0	23.5 ± 8.0	27.6 ± 13.5	3.6 ± 2.8	423.1 ± 217.7
25-36 months	**Male**	809.9 ± 243.5	25.6 ± 8.0	31.7 ± 13.0	4.5 ± 3.0	400.2 ±186.6
	Female	851.7 ± 228.0	27.1 ± 7.9	33.2 ± 13.5	4.4 ± 2.7	452.5 ±207.8
37-48 months	**Male**	948.9 ± 158.0	29.2 ± 6.8	37.0 ± 10.8	5.3 ± 1.8	432.9 ± 149.3
	Female	886.8 ± 180.4	28.3 ± 5.2	35.0 ± 9.5	4.8 ± 2.8	436.5 ± 134.5
49-59 months	**Male**	885.3 ± 196.9	28.6 ± 6.8	34.0 ±13.1	5.3 ± 3.4	392.7 ± 138.0
	Female	886.3 ± 177.0	26.8 ± 6.7	34.6 ± 10.1	4.9 ± 2.4	435.3 ± 138.4
ANOVA		0.048NS	0.052NS	0.192NS	0.233NS	4.08*

***Significant at the 0.05 level (2-tailed)**

Table 4.17: Mean Nutrients intake of the subjects (N=452)

INDICATOR	Age	Mean ± SD	T-test
Energy	≤ 2 years	600.71±287.26	-11.68***
	> 2 years	870.69±204.04	
Protein	≤ 2 years	19.93±9.04	-9.97***
	> 2 years	27.49±7.02	
Fat	≤ 2 years	23.49±14.51	-8.51***
	> 2 years	34.08±11.81	
Iron	≤ 2 years	2.89±1.96	-8.16***
	> 2 years	4.83±2.75	
Calcium	≤ 2 years	364.25±234.51	-3.26**
	> 2 years	425.17±162.82	

*****Significant at the 0.001 level (2-tailed) **Significant at the 0.01 level (2-tailed)**

Table 4.18: Mean % RDA of nutrient intake of subjects- Gender-wise (N=452)

	Gender-Wise Mean		ANOVA
	Male	**Female**	
Energy	70.9 ± 25.6	72.0 ± 25.2	0.206NS
Protein	191.4 ± 69.9	190.8 ± 68.3	0.009NS
Fat	118.4 ± 59.3	120.7 ± 52.2	0192NS
Iron	53.2 ± 33.9	52.9 ± 35.5	0.009NS
Calcium	80.4 ± 45.8	90.1 ± 50.6	4.546*

*Significant at the 0.05 level (2-tailed)

Table 4.19: Mean % RDA nutrient intake of Subjects- Age-wise (N=452)

Nutrients	Age					ANOVA
	6-12 months	**13-24 months**	**25-36 months**	**37-48 months**	**49-59 months**	
Energy (kcal)	69.8 ± 39.4	72.2 ± 24.6	82.2 ± 23.3	67.1 ± 12.7	64.4 ± 13.7	7.3***
Protein (g)	153.5 ± 84.1	208.9 ± 67.6	232.8 ± 70.2	180.4 ± 37.0	173.8 ± 42.8	22.6***
Fat (g)	74.4 ± 57.6	112.9 ± 52.2	129.7 ± 52.8	143.1 ± 40.2	137.2 ± 46.4	26.6***
Iron (mg)	73.1 ± 47.7	44.7 ± 26.9	55.7 ± 35.7	45.5 ± 22.1	46.1 ± 26.4	11.7***
Calcium (mg)	104.9 ± 82.0	82.4 ± 42.7	85.2 ± 39.6	79.1 ± 25.4	75.4 ± 25.3	5.1***

***Significant at the 0.001 level (2-tailed)

Table 4.20: Mean %RDA of nutrient intakes - Age and Gender-wise (N=452)

Nutrients		Energy	Protein	Fat	Iron	Calcium
6-12 months	**Male**	62.3 ± 40.0	144.2 ± 86.3	67.5± 66.7	70.9 ± 49.0	91.7 ± 78.2
	Female	76.0 ± 38.2	161.3 ± 82.3	80.1 ± 48.7	74.9 ± 47.1	116.0 ± 84.3
13-24 months	**Male**	74.1 ± 24.4	209.4 ± 65.8	114.7 ± 51.2	44.2 ± 18.7	80.7 ± 42.3
	Female	69.9 ± 24.9	208.4 ± 70.7	110.6 ± 53.9	45.2 ± 35.0	84.6 ± 43.5
25-36 months	**Male**	80.2 ± 24.1	226.3 ± 70.6	126.8 ± 51.9	56.1 ± 37.9	80.0 ± 37.3
	Female	84.3 ± 22.6	239.5 ± 69.9	132.6 ± 54.2	55.3 ± 33.6	90.5 ± 41.6
37-48 months	**Male**	69.8 ± 11.6	183.9 ± 42.7	147.8 ± 43.4	48.0 ± 16.6	78.7 ± 27.1
	Female	65.2 ± 13.3	178.0 ± 32.8	139.9 ± 37.7	43.8 ± 25.3	79.4 ± 24.4
49-59 months	**Male**	65.1 ± 14.5	179.7 ± 42.9	136.2 ± 52.3	48.3 ± 30.9	71.4 ± 25.1
	Female	63.7 ± 13.0	168.4 ± 42.4	138.2 ± 40.6	44.1 ± 21.6	79.2 ± 25.2
ANOVA		0.21NS	0.01NS	0.19NS	0.01NS	4.55*

***Significant at the 0.05 level (2-tailed)**
Based on Recommended Dietary Allowance, ICMR-NIN 2020.

Table 4.21: Mean %RDA nutrients intake among subjects (N=452)

INDICATOR	Age	Mean ± SD	T-test
Energy	≤ 2 years	71.02±32.64	-0.28NS
	> 2 years	71.70±19.28	
Protein	≤ 2 years	181.69±80.87	-2.36*
	> 2 years	197.29±59.30	
Fat	≤ 2 years	93.96±58.04	-8.51***
	> 2 years	136.34±47.23	
Iron	≤ 2 years	58.64±41.04	2.78**
	> 2 years	49.42±29.29	
Calcium	≤ 2 years	93.48±65.86	2.89**
	> 2 years	80.11±31.45	

*****Significant at the 0.001 level (2-tailed) **Significant at the 0.01 level (2-tailed) *Significant at the 0.05 level (2-tailed)**

Association of Nutrient Intakes and Nutritional Status

The subjects' mean nutrient intakes are shown in Table 4.19 along with their nutritional status. To evaluate the association between the intake of nutrients and the individuals' nutritional status, data was analyzed. The mean nutrient intakes were found to be non-significantly correlated to HAZ and WHZ Score between the category of subjects had a z score above -2 SD and equal to or below -2 SD **(Table 4.22 and 4.23)**.

The highest nutritional intakes were seen in subjects with a WAZ Score of equal to or less than -2 SD, and significant differences were found in mean energy and fat intake between subjects with a WAZ Score of equal to or less than -2 SD and greater than -2 SD (**Table 4.24**).

T-tests showed that there was a significant relationship between HAZ scores, WHZ scores, and the mean percent of the RDA intake of calcium, which is displayed in **Tables 4.25** and **4.26** (p-value: <0.05). However, as shown in **Table 4.27**, the WAZ score had a significantly positive relationship with the mean percent of the RDA for fat.

Table 4.22: HAZ Score v/s Nutrients intake (N=452)

INDICATOR	HAZ score	Mean	T-test
Energy	≤ -2 SD	765.88±259.06	0.12NS
	> -2 SD	762.70±281.96	
Protein	≤ -2 SD	24.86±8.43	0.63NS
	> -2 SD	24.31±8.84	
Fat	≤ -2 SD	29.72±13.41	-0.19NS
	> -2 SD	29.98±14.21	
Iron	≤ -2 SD	4.11±2.60	0.24NS
	> -2 SD	4.04±2.67	
Calcium	≤ -2 SD	386.26±187.54	-1.14NS
	> -2 SD	408.61±200.71	

Table 4.23: WHZ Score v/s mean nutrient intakes (N=452)

INDICATOR	≤ -2 SD	Mean	T-test
Energy	> -2 SD	793.53±291.15	1.00NS
	≤ -2 SD	758.23±270.89	
Protein	> -2 SD	25.43±8.98	0.99NS
	≤ -2 SD	24.32±8.65	
Fat	> -2 SD	32.84±15.90	1.95NS
	≤ -2 SD	29.34±13.48	
Iron	> -2 SD	4.585±3.10	1.82NS
	≤ -2 SD	3.97±2.54	
Calcium	> -2 SD	436.53±199.07	1.66NS
	≤ -2 SD	394.43±195.48	

Table 4.24: WAZ Score v/s Nutrients intake (N=452)

INDICATOR	WAZ score	Mean	T-test
Energy	≤ -2 SD	813.38±222.39	2.18*
	> -2 SD	748.01±287.14	
Protein	≤ -2 SD	25.81±7.40	1.82NS
	> -2 SD	24.07±9.04	
Fat	≤ -2 SD	32.33±13.32	2.11*
	> -2 SD	29.11±14.05	
Iron	≤ -2 SD	4.32±2.33	1.18NS
	> -2 SD	3.98±2.73	
Calcium	≤ -2 SD	408.58±175.99	0.46NS
	> -2 SD	398.65±202.67	

***Significant at the 0.05 level (2-tailed)**

Table 4.25: HAZ Score v/s mean % RDA nutrient intake (N=452)

INDICATOR	HAZ score	Mean	T-test
Energy	≤ -2 SD	70.59±23.22	-0.50NS
	> -2 SD	71.86±26.46	
Protein	≤ -2 SD	195.07±66.23	0.87NS
	> -2 SD	189.09±70.39	
Fat	≤ -2 SD	118.87±53.66	-0.19NS
	> -2 SD	119.91±56.84	
Iron	≤ -2 SD	50.94±31.94	-0.94NS
	> -2 SD	54.16±36.00	
Calcium	≤ -2 SD	79.02±40.47	-2.01*
	> -2 SD	88.68±51.88	

***Significant at the 0.05 level (2-tailed)**

Table 4.26: WHZ Score v/s mean % RDA nutrient intake (N=452)

INDICATOR	WHZ score	Mean	T-test
Energy	≤ -2 SD	73.86±28.49	0.88NS
	> -2 SD	70.98±24.79	
Protein	≤ -2 SD	194.58±70.90	0.46NS
	> -2 SD	190.47±68.71	
Fat	≤ -2 SD	131.37±63.61	1.95NS
	> -2 SD	117.36±53.94	
Iron	≤ -2 SD	59.84±40.21	1.80NS
	> -2 SD	51.81±33.45	
Calcium	≤ -2 SD	96.03±59.49	2.02*
	> -2 SD	83.43±45.97	

***Significant at the 0.05 level (2-tailed)**

Table 4.27: WAZ Score v/s % RDA mean nutrient intake (N=452)

INDICATOR	WAZ score	Mean	T-test
Energy	≤ -2 SD	73.46±24.08	0.96NS
	> -2 SD	70.78±25.79	
Protein	≤ -2 SD	196.61±60.41	0.95NS
	> -2 SD	189.37±71.50	
Fat	≤ -2 SD	129.32±53.26	2.11*
	> -2 SD	116.45±56.21	
Iron	≤ -2 SD	52.55±36.93	-0.18NS
	> -2 SD	53.23±33.98	
Calcium	≤ -2 SD	83.60±43.27	-0.45NS
	> -2 SD	85.98±50.08	

***Significant at the 0.05 level (2-tailed)**

4.6 Dietary Diversity among children under 5 years of age

For a period of three days, the dietary diversity of children was assessed. **Table 4.28** illustrates the total food group consumption of children under the age of five. On days 1, 2, and 3, the children's means for dietary diversity were 4.055 + 1.11, 3.763 + 1.00, and 3.779 + 0.90, respectively shown in the **Table 4.29**.

Males showed greater dietary diversity than females, but neither group met the required minimum level **(Table 4.30)**. According to **Table 4.31**, children between the ages of 6 and 12 months had a poorer mean age-wise dietary diversity than other age groups. The children between the ages of 6 and 24 months had a significantly lower dietary diversity than required, which was even lower than the minimum amount that was needed **(Table 4.32).**

More than half of the children (67.93%) were found to have good dietary diversity, meaning that they consumed four or more food groups out of seven throughout the rest of the day, meeting the minimum requirement for dietary diversity. Around 32.07 % of children had poor dietary diversity, meaning that they consumed less than four food groups out of seven (**Table 4.33)**. When dietary diversity was compared between genders, females had higher rates than males. On days 2 and 3, there was no discernible difference in the dietary diversity across genders, however, on day 3, there was a significant different shown in the **Table 4.33**.

Dietary diversity among children between the ages of 25 and 36 months has been found to be good, meaning they consumed 4 or more food groups out of 7 per day which is shown in the **Table 4.34**. On day one, 49-39 months showed poor dietary diversity, but not on days 2 or 3. because the results show that on days 2 and 3, poor dietary diversity was seen in children aged 6 to 12 months. Dietary diversity and age in months have significant differences from one another.

Table 4.28: Dietary Diversity (out of 7 food groups) of the subjects (N=452)

Food Groups	Dietary Diversity n (%)					
	Yes			No		
	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3
Grains, Roots and Tubers	438 (96.9)	439 (97.1)	442 (97.8)	14 (3.1)	13 (2.9)	10 (2.2)
Dairy Products	411 (90.9)	419 (92.7)	421 (93.1)	41 (9.1)	33 (7.3)	31 (6.9)
Vit A rich fruits and vegetables	99 (21.9)	48 (10.6)	40 (8.8)	353 (78.1)	404 (89.4)	412 (91.2)
Other fruits and vegetables	334 (73.9)	314 (69.5)	333 (73.7)	118 (26.1)	138 (30.5)	119 (26.3)
Legumes and Nuts	389 (86.1)	346 (76.5)	352 (77.9)	63 (13.9)	106 (23.5)	100 (22.1)
Eggs	102 (22.6)	112 (24.8)	105 (23.2)	350 (77.5)	340 (75.2)	347 (76.8)
Flesh Foods (meat, fish and chicken)	60 (13.3)	23 (5.1)	15 (3.3)	392 (86.7)	429 (94.9)	437 (96.7)

Table 4.29: Mean dietary diversity scores of the subjects (N=452)

Dietary Diversity	Mean
Day 1	4.055 $\pm$ 1.11
Day 2	3.763 $\pm$ 1.00
Day 3	3.779 $\pm$ 0.90

Table 4.30: Mean dietary diversity scores of the subjects- Gender-wise (N=452)

Dietary Diversity	N	Mean	ANOVA
Female	233	3.85 ± 0.84	0.197NS
Male	219	3.88 ± 0.88	
Total	452	3.87 ± 0.86	

Table 4.31: Mean dietary diversity scores of the subjects- Age-wise (N=452)

Age-wise dietary diversity	N	Mean	ANOVA
6 – 12 months	88	3.11 ± 1.00	31.861***
13 -24 months	91	3.73 ± 0.80	
25 – 36 months	99	4.11 ± 0.73	
37 – 48 months	85	4.19 ± 0.65	
49 – 59 months	89	4.16 ± 0.57	
Total	452	3.87 ± 0.86	

***Significant at the 0.001 level (2-tailed)

Table 4.32: Mean dietary diversity scores -Age and Gender-wise (N=452)

Age and Gender-wise Dietary Diversity		Mean
6-12 months	**Male**	2.99 ± 0.90
	Female	3.22 ± 1.06
13-24 months	**Male**	3.80 ± 0.90
	Female	3.65 ± 0.65
25-36 months	**Male**	4.10 ± 0.71
	Female	4.13 ± 0.76
37-48 months	**Male**	4.23 ± 0.64
	Female	4.16 ± 0.66
49-59 months	**Male**	4.26 ± 0.51
	Female	4.07 ± 0.62
ANOVA		31.861***

***Significant at the 0.001 level (2-tailed

Table 4.33: Day-wise Dietary Diversity category (N=452)

Dietary Diversity categories	Day 1	Day 2	Day 3	Total
Good n (%)	334 (73.9)	291 (64.4)	296 (65.5)	307 (67.93)
Poor n (%)	118 (26.1)	161 (35.6)	156 (34.5)	145 (32.07)

Table 4.34: Dietary Diversity Category- Age and Gender-wise (N= 452)

Age and Gender-Wise Dietary Diversity	Dietary Diversity				Chi-square
	Good		Poor		
	Male	Female	Male	Female	
6 -12 months	7 (5.4)	19 (13.2)	33 (37.1)	29 (32.6)	19.765***
13 -24 months	27 (20.8)	20 (13.9)	24 (27.0)	20 (22.5)	
25 – 36 months	36 (27.7)	35 (24.3)	14 (15.7)	14 (15.7)	
37 – 48 months	25 (19.2)	38 (26.4)	10 (11.2)	12 (13.5)	
49 – 59 months	35 (26.9)	32 (22.2)	8 (9.0)	14 (15.7)	

***Significant at the 0.001 level (2-tailed

Dietary Diversity and Nutritional Status

The participants in the normal category were more dietary diverse. A statistical study of the HAZ, WHZ, and WAZ data, which are presented in **Tables 4.35, 4.36,** and **4.37,** respectively, revealed no statistically significant relationship between dietary diversity and nutritional status. There was a significant difference in the mean dietary diversity for children below and above 2 years shown in the **Table 4.38.**

According to **Tables 4.39, 4.40, and 4.41**, analysis of variance (ANOVA) results showed a significant difference in WHZ and WAZ between genders, with the exception of HAZ.

Table 4.35: HAZ v/s Dietary Diversity (N= 452)

Degree of undernutrition Z-score cut off points		Dietary Diversity		Chi-square
		Good (n=274)	Poor (n=178)	
Normal	**-1SD and above**	98 (35.8)	71 (39.9)	7.073NS
Mild Stunting	**-1SD to -2SD**	88 (32.1)	42 (23.6)	
Moderate Stunting	**-2SD to -3SD**	40 (14.6)	39 (21.9)	
Severe Stunting	**<-3SD**	48 (17.5)	26 (14.6)	

Table 4.36: WHZ v/s Dietary Diversity (N= 452)

Degree of undernutrition Z-score cut off points		Dietary Diversity		Chi-square
		Good (n=274)	Poor (n=178)	
Normal	**-1SD and above**	141 (51.5)	110 (61.8)	4.951NS
Mild Wasting	**-1SD to -2SD**	86 (31.4)	46 (25.8)	
Moderate Wasting	**-2SD to -3SD**	34 (12.4)	15 (8.4)	
Severe Wasting	**<-3SD**	13 (4.7)	7 (3.9)	

Table 4.37: WAZ v/s Dietary Diversity (N= 452)

Degree of undernutrition Z-score cut off points		Dietary Diversity		Chi-square
		Good (n=274)	Poor (n=178)	
Normal	**-1SD and above**	84 (30.7)	68 (38.2)	4.711NS
Mild Underweight	**-1SD to -2SD**	117 (42.7)	76 (42.7)	
Moderate Underweight	**-2SD to -3SD**	52 (19.0)	26 (14.6)	
Severe Underweight	**<-3SD**	21 (7.7)	8 (4.5)	

Table 4.38: Mean Dietary Diversity scores of subjects ≤2 and >2 years (N=452)

Age	Mean DDS	T-test
≤ 2 years	3.43±0.95	30.127***
> 2 years	4.15±0.65	

***Significant at the 0.001 level (2-tailed)

Table 4.39: Mean Dietary Diversity scores v/s WHZ scores- Gender wise (N=452)

Degree of undernutrition Z-score cut off points		Gender	Dietary Diversity
Normal	-1SD and above	Male	3.79 ± 0.98
		Female	3.79 ± 0.87
Mild Wasting	-1SD to -2SD	Male	4.06 ± 0.74
		Female	3.90 ± 0.76
Moderate Wasting	-2SD to -3SD	Male	3.98 ± 0.65
		Female	3.98 ± 0.91
Severe Wasting	<-3SD	Male	4.19 ± 1.01
		Female	4.13 ± 0.67
ANOVA			3.260*

*Significant at the 0.05 level (2-tailed)

Table 4.40: Mean Dietary Diversity scores v/s HAZ score - Gender wise (N=452)

Degree of undernutrition Z-score cut off points		Gender	Dietary Diversity
Normal	-1SD and above	Male	3.75 ± 1.03
		Female	3.85 ± 0.94
Mild Stunting	-1SD to -2SD	Male	4.01 ± 0.66
		Female	3.97 ± 0.76
Moderate Stunting	-2SD to -3SD	Male	3.84 ± 0.72
		Female	3.68 ± 0.74
Severe Stunting	<-3SD	Male	4.02 ± 1.01
		Female	3.80 ± 0.81
ANOVA			1.569NS

Table 4.41: Mean Dietary Diversity scores v/s WAZ score - Gender wise (N=452)

Degree of undernutrition Z-score cut off points		Gender	Dietary Diversity
Normal	-1SD and above	Male	3.56 ± 1.08
		Female	3.80 ± 0.96
Mild Underweight	-1SD to -2SD	Male	3.96 ± 0.80
		Female	3.81 ± 0.82
Moderate Underweight	-2SD to -3SD	Male	4.02 ± 0.65
		Female	3.98 ± 0.62
Severe Underweight	<-3SD	Male	4.31 ± 0.66
		Female	4.10 ± 0.55
ANOVA			4.321**

**Significant at the 0.01 level (2-tailed)

4.7 Dietary Quality of children among 5 years of age using Dietary Quality Assessment Tool (DQAT) (N=452)

Males performed better than females when mean DQAT scores were analyzed. There were, however, no significant differences between them **(Table 4.42).** According to statistical analysis, children between the ages of 25 and 36 months had the poorest mean DQAT scores. The DQAT results for all subjects overall were considered to be poor, as shown in **Table 4.43.** Age- and gender-wise mean DQAT scores fell into a poor category. There was a significant difference between the categories (p-value:0.001***), as seen in **Table 4.44.**

The diet quality of children under the age of five was evaluated according to gender using the diet quality assessment tool shown in **Table 4.45.** In comparison to boys, girls consumed poor-quality food. No one consumed a good-quality diet. The majority of children (93.4 %) consumed a diet of poor quality, while just 6.6% need to improve it. According to statistical analysis, there was no significant difference between the variables.

According to statistical analysis, the Dietary Quality Assessment Tool was used to evaluate the children's diet quality according to their age, as shown in **Table 4.46.** When compared to other age groups, children between the ages of 49 and 59 months displayed the poorest diet quality however, the difference was found to be non-significant. When dietary quality was assessed using DQAT no children came under good category. Highest number of children had poor DQAT scores according to **Table 4.46.**

Table 4.42: Mean DQAT Scores of the subjects- Gender-wise (N=452)

Gender	N	Mean	ANOVA
Female	233	42.29 ± 8.33	0.48NS
Male	219	42.86 ± 9.06	
Total	452	39.73 ± 8.57	

Table 4.43: Mean DQAT Scores of the subjects- Age-wise (N=452)

Age	N	Mean	ANOVA
6 – 12 months	88	45.82 ± 8.25	8.50***
13 -24 months	91	44.65 ± 12.18	
25 – 36 months	99	40.17 ± 7.38	
37 – 48 months	85	42.23 ± 6.93	
49 – 59 months	89	40.19 ± 5.79	
Total	452	42.57 ± 8.68	

***Significant at the 0.001 level (2-tailed)

Table 4.44: Mean DQAT Scores of the subjects- Age and Gender-wise (N=452)

Age and Gender-wise Dietary Quality		Mean
6-12 months	**Male**	44.69 ± 8.70
	Female	46.76 ± 7.83
13-24 months	**Male**	46.93 ± 11.93
	Female	41.75 ± 12.02
25-36 months	**Male**	40.07 ± 8.02
	Female	40.27 ± 6.75
37-48 months	**Male**	42.48 ± 7.17
	Female	42.06 ± 6.82
49-59 months	**Male**	39.89 ± 5.27
	Female	40.48 ± 6.29
ANOVA		8.50***

***Significant at the 0.001 level (2-tailed)

Table 4.45: Quality of Diet based on DQAT scores- Gender wise (N=452)

DQAT score	Male n (%)	Female n (%)	Total n (%)	Chi-square
Good	0 (0)	0 (0)	0 (0)	2.85NS
Upgrading required	19 (8.7)	11 (4.7)	30 (6.6)	
Poor	200 (91.3)	222 (95.3)	422 (93.4)	

Table 4.46: Quality of Diet based on DQAT scores- Age wise (N=452)

DQAT score	Age n (%)					Total n (%)	Chi-square
	6-12 months	13-24 months	25-36 months	37-48 months	49-59 months		
Good	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8.57NS
Upgrading required	3 (3.4)	8 (8.8)	7 (7.1)	10 (11.8)	2 (2.2)	30 (6.6)	
Poor	85 (96.6)	83 (91.2)	92 (92.9)	75 (88.2)	87 (97.8)	422 (93.4)	

Dietary Quality Using DQAT and Nutritional Status

The mean DQAT score shown in **tables 4.47, 4.48, and 4.49** within gender underwent an analysis of variance (ANOVA), which revealed no significant deviation from the WHZ, HAZ, and WAZ.

The HAZ, WHZ, and WAZ scores and DQAT scores did not significantly correlate when the nutritional status was compared. In terms of diet quality, more participants fell into the poor category; those cases of malnutrition were more prevalent.

According to **Table 4.50**, there was a significant difference between children under 2 years old and those above 2 years old in terms of the mean dietary quality using the DQAT score. However, the quality of the diet was poorer for children above 2 years than for those below 2 years, although the quality was poor for both age groups**.**

Table 4.47 Mean DQAT scores v/s WHZ scores- Gender-wise (N=452)

Degree of undernutrition Z-score cut off points		Gender	DQAT score
Normal	-1SD and above	Male	40.09 ± 8.64
		Female	40.06 ± 8.58
Mild Wasting	-1SD to -2SD	Male	39.10 ± 8.27
		Female	38.34 ± 7.87
Moderate Wasting	-2SD to -3SD	Male	40.89 ± 9.11
		Female	39.72 ± 7.56
Severe Wasting	<-3SD	Male	42.79 ± 13.98
		Female	36.48 ± 4.90
ANOVA			0.870NS

Table 4.48 Mean DQAT scores v/s HAZ scores- Gender-wise (N=452)

Degree of undernutrition Z-score cut off points		Gender	DQAT score
Normal	-1SD and above	Male	39.55 ± 9.34
		Female	39.07 ± 7.63
Mild Stunting	-1SD to -2SD	Male	40.52 ± 8.35
		Female	39.08 ± 8.84
Moderate Stunting	-2SD to -3SD	Male	40.64 ± 9.37
		Female	40.75 ± 8.28
Severe Stunting	<-3SD	Male	39.65 ± 8.73
		Female	39. 67 ± 8.55
ANOVA			0.478NS

Table 4.49 Mean DQAT scores v/s WAZ scores- Gender-wise (N=452)

Degree of undernutrition Z-score cut off points		Gender	DQAT score
Normal	-1SD and above	Male	41.73 ± 11.15
		Female	39.51 ± 8.02
Mild Underweight	-1SD to -2SD	Male	39.14 ± 6.97
		Female	40.48 ± 9.01
Moderate Underweight	-2SD to -3SD	Male	39.25 ± 8.75
		Female	36.57 ± 6.69
Severe Underweight	<-3SD	Male	40.83 ± 9.64
		Female	38.69 ± 5.34
ANOVA			1.325NS

Table 4.50: Mean DQAT scores of subjects ≤2and >2 years (N=452)

Age	Mean	T-test
≤ 2 years	45.23±10.43	5.439***
> 2 years	40.82±6.80	

***Significant at the 0.001 level (2-tailed)

Correlation of economic status and DQAT Score

When income level and DQAT Scores were associated, participants in the BPL category had considerably more poor-quality diets than those in the APL category (Almost 94% v/s 89%, p-value: < 0.05*) **(Table 4.51).** Around 37% subjects did not have a Ration Card.

Association of Individual components with DQAT Score

Gender was taken into consideration when comparing the DQAT scores with individual components. It was determined that there were substantial gender disparities in scores for dairy products and HFSS diets which shown in the **Table 4.52**. There was significant difference found in mean Breastmilk component gender wise for children under 2 years of age.

With the exception of Vegetables high in vitamin A, a t-test analysis showed that the means of the individual DQAT components were not significantly correlated with either age above or below 2 years. **(Table 4.53).** Analysis of variance (F-value) showed that nuts and other fruits were significantly correlated to age above and below 2 years.

4.51: Diet quality v/s economic status of the subjects (N=452)

	Dietary Quality n (%)			Chi-square
	Good	Upgrading Required	Poor	
BPL	0 (0)	7 (6.0)	109 (94.0)	8.24*
APL	0 (0)	18 (10.7)	150 (89.3)	
AAY	0 (0)	0 (0)	2 (100)	
NO	0 (0)	5 (3.0)	161 (97.0)	

*Significant at the 0.05 level (2-tailed)

4.52: Mean DQAT Individual components scores- Gender wise (N=452)

	Gender	Mean ± SD	Maximum score	T-test	F Value
Breastmilk (n=179)	Male	14.82 ± 7.05	20	2.18*	4.29*
	Female	12.39 ± 7.86			
Grains	Male	4.26±1.18	5	-0.16NS	0.46NS
	Female	4.28±1.1			
Roots and Tubers	Male	0.97±1.07	5	0.21NS	1.39NS
	Female	0.95±1.02			
Legumes	Male	3.85 ± 1.34	5	0.276NS	0.76NS
	Female	3.82 ± 1.39			
Nuts	Male	0.06 ± 0.38	5	0.464NS	0.215NS
	Female	0.05 ± 0.31			
Dairy products	Male	5.05 ± 3.10	10	-2.451*	6.01*
	Female	5.77 ± 3.20			
Flesh foods	Male	0.52 ± 1.17	10	0.999NS	0.99NS
	Female	0.41 ± 1.07			
Eggs	Male	2.55 ± 3.51	10	1.400NS	1.96NS
	Female	2.11 ± 3.16			
Vitamin A rich fruits	Male	0.28 ± 0.86	5	1.65NS	2.71NS
	Female	0.17 ± 0.62			
Vitamin A rich vegetables	Male	0.58 ± 0.77	5	-0.42NS	0.17NS
	Female	0.61 ± 0.88			
Other fruits	Male	1.91 ± 1.87	5	-1.07NS	1.15NS
	Female	2.10 ± 1.98			
Other vegetables	Male	1.24 ± 1.28	5	-0.47NS	0.23NS
	Female	1.29 ± 1.35			
HFSS foods	Male	4.14 ± 4.01	10	-2.326*	5.412*
	Female	5.01 ± 3.96			
Added sugar	Male	7.63 ± 3.29	10	-0.38NS	0142NS
	Female	7.74 ± 3.05			
Total fat	Male	3.91 ± 2.03	10	0.628NS	0.394NS
	Female	1.00 ± 1.76			

*Significant at the 0.05 level (2-tailed)

4.53: Mean DQAT Individual components scores- Age wise (N=452)

	Age	Mean ± SD	T-test	F Value
Breastmilk	< 2 years	5.09 ± 7.67	-0.34NS	2.27NS
	> 2 years	5.46 ± 8.28		
Grains	< 2 years	4.18±1.21	-0.72NS	1.52NS
	> 2 years	4.29±1.13		
Roots and Tubers	< 2 years	0.89± 1.05	-0.60NS	0.09NS
	> 2 years	0.97± 1.04		
Legumes	< 2 years	3.71±1.46	-0.81NS	0.47NS
	> 2 years	3.86±1.34		
Nuts	< 2 years	0.11±0.47	1.46NS	7.70**
	> 2 years	0.04±0.32		
Dairy products	< 2 years	5.71 ± 2.96	0.83NS	0.52NS
	> 2 years	5.37 ± 3.21		
Flesh foods	< 2 years	0.60 ± 1.29	1.10NS	3.71NS
	> 2 years	0.44 ± 1.09		
Eggs	< 2 years	2.60 ± 3.29	0.74NS	0.01NS
	> 2 years	2.28 ± 3.35		
Vitamin A rich fruits	< 2 years	0.23 ± 0.78	0.22NS	0.17NS
	> 2 years	0.22 ± 0.73		
Vitamin A rich vegetables	< 2 years	0.36 ± 0.82	-4.88***	3.65NS
	> 2 years	0.74 ± 0.79		
Other fruits	< 2 years	1.85 ± 1.84	-1.46NS	4.42*
	> 2 years	2.12 ± 1.97		
Other vegetables	< 2 years	0.71 ± 1.19	-7.83NS	2.87NS
	> 2 years	1.63 ± 1.26		
HFSS foods	< 2 years	4.45 ± 4.16	-0.30NS	1.06NS
	> 2 years	4.61 ± 3.97		
Added sugar	< 2 years	7.68 ± 3.40	-0.02NS	0.71NS
	> 2 years	7.69 ± 3.12		
Total fat	< 2 years	3.84 ± 1.95	-0.09NS	0.23NS
	> 2 years	3.86 ± 1.89		

***Significant at the 0.001 level (2-tailed) **Significant at the 0.01 level (2-tailed) *Significant at the 0.05 level (2-tailed)

Frequency of DQAT Score for Individual components

The scatter plot for Individual components and their DQAT scores is displayed in Figure 4.4. The DQAT Score Category for 6–12 months included breastmilk as an important component for children up to 2 years. A total of 179 children under the age of two were breastfed, with a maximum score of 20.

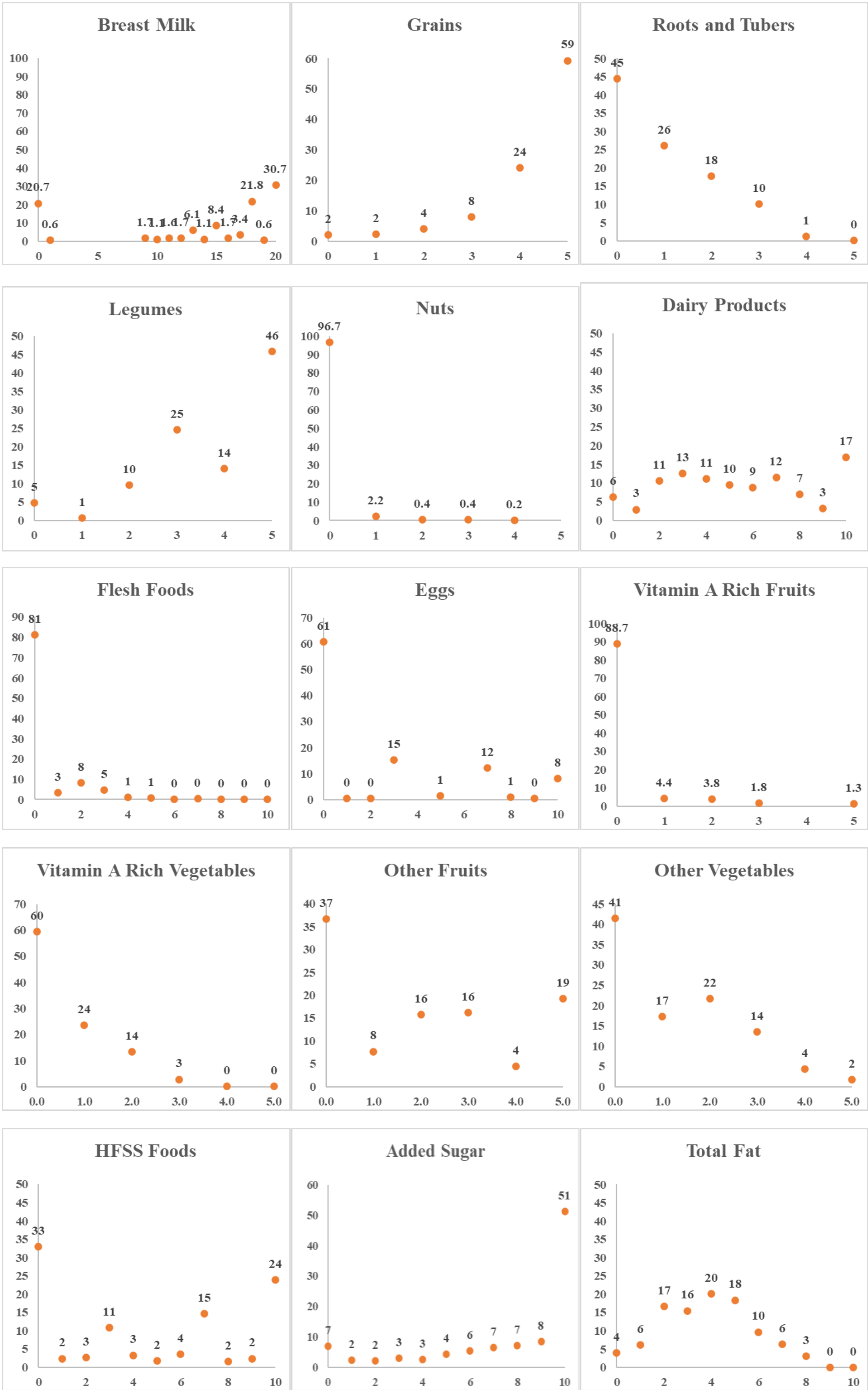
The majority (59%) of the individuals received a score of 5, meaning that almost 60% of children consumed the recommended daily allowance of grains. Nearly half of the children did not eat any roots or tubers during the survey period.

Nearly half of the total subjects were getting a 5, which indicates that 46% were fulfilling their recommended intake of legumes. The vast majority (97%) did not consume nuts at all. In terms of dairy product consumption, 48% of children scored 5 or higher, with 17% scoring 10—a good intake that complies with guidelines.

Eggs and flesh foods were not consumed by children, with 80% and 60%, respectively. Children ate other fruits more frequently than those high in vitamin A. Nearly half of the children did not consume vegetables in their diet.

Approximately one-third of children were consuming more than recommended amounts of high-fat, salty, and sugary foods. where one-fourth did not consume HFSS foods. A total of 50% of the children did not eat additional sugar. Twenty percent of children received a score of four, meaning they took 20 g of total fat per day **(Figure: 4.4)**.

Figure 4.4: Scatter plot showing DQAT scores for Individual Components



X-Axis: DQAT Scores **Y Axis: Percent Subjects**

4.8: Psychometric Properties of DQAT 2023 Evaluated

Validity

Content Validity

Content Validity examines qualitatively the extent to which an index represents the variety of attributes that make up diet quality in case of DQAT 2023.

The key recommendations applicable to children were used from 'Dietary guidelines for Indians- 2010'. These recommendations are linked to related components of DQAT 2023 and are shown in **Table 4.54.** All the components that relate to diet quality are reflected in DQAT. However, DQAT does not cover physical activity, water intake, food safety, cooking methods and healthy eating habits. DQAT covers additional calories consumed as extra sugar and fat. By design DQAT does not cover salt intake. DQAT does not measure energy intakes because it assesses quality rather than quantity.

Construct and Criterion Validity

Construct and criterion validity measure how well the index measures diet quality. This was done in three different ways for DQAT.

The DQAT scores for the Five sets of menus for children (6-59 months) were compared based on balanced diets according to 'Dietary guidelines for Indians' (ICMR, 2010) shown in **Table 4.55.** Menus developed by nutrition experts received maximum scores based on DQAT. All the sample menus were ranked to be of a good quality (DQAT score (6-24 months)> 96; DQAT score (25-59 months) >80).

Correlation analysis was done to see whether DQAT scores were independent of Diet quantity which done for both categories of DQAT in the **Table 4.56 and 4.57**. When it comes to children between the ages of 6 and 24 months, the component scores with the most positive correlations to energy were grains (0.65), total fat score (0.58) and dairy product (0.53), while the component scores with the highest negative correlations were the HFSS foods score (-0.54) and the added sugar score (-0.47). For children between the ages of 25 and 59 months, the component scores with the strongest positive correlations to energy were dairy products (0.48) and total fat (0.33) while components having highest negative correlations were added sugar (-0.31) and HFSS foods (-0.29).

The DQAT was effective in separating diet quality from diet quantity, as evident by the minimal correlations between the scores for each component and energy intake.

At least five components with an Eigenvalue larger than 1 were present in DQAT2023-K, as seen in **Figure 4.5**, which shows the scree plot. According to principal component analysis (PCA), the first 5 components and the first 10 components together explained around 57% and 85% of the variation, respectively.

At least six components with an Eigenvalue larger than one were found in DQAT2023-P, as seen in **Figure 4.6** in the scree plot. According to principal component analysis, the first six components and the first nine components together explained around 51% and 84% of the variation, respectively.

Table 4.54: DQAT Components mapped to Dietary Guidelines for Indians- Content Validity

Dietary Guidelines – **Key recommendations**	**DQAT Components**	**Comment**
Eat variety of foods to ensure a balanced diet	**DQAT components** Breast milk Grains Roots and Tubers Legumes Nuts Dairy products Flesh Foods Eggs Vitamin A-rich fruits Vitamin A-rich vegetables Other fruits Other vegetables High Fat, salt, and sugar foods (HFSS Foods) Total Fat Added Sugar	DQAT assesses intake of all the food groups and includes dietary diversity as well as breastfeeding (<2 y)
Eat plenty of vegetables and fruits	Vitamin A-rich fruits Vitamin A-rich vegetables Other fruits Other vegetables	DQAT covers recommended intakes of vegetables and fruits
Ensure moderate use of edible oils and animal foods and very less use of ghee/ butter/ vanaspati	Total fat HFSS	Higher intakes result in lower scores for total fat and HFSS components.
Overeating should be avoided to prevent overweight and obesity		DQAT does not measure energy intakes because it assesses quality rather than quantity.
Exercise regularly and be physically active to maintain ideal body weight **Ensure the use of safe and clean foods**		By design DQAT does not address physical activity or food safety.
Practice right cooking methods and healthy eating habits		DQAT does not include healthy eating habits and methods of cooking.
Drink plenty of water and take beverages in moderation		DQAT does not cover water intake.
Minimize the use of processed foods rich in salt, sugar and fats	Total Fat HFSS Added Sugars	DQAT covers additional calories consumed as extra sugar and fat. By design DQAT does not cover salt intake.

Table 4.55: Quality of sample diets as per DQAT- Construct and Criterion Validity

Components	6-12 Months	13-24 Months	25-36 Months	37-48 Months	49-59 Months
Breastmilk	20	20	-	-	-
Grains	5	5	5	5	5
Roots & tubers	5	5	5	5	5
Legumes	5	5	5	5	5
Nuts	0	0	0	0	0
Dairy products	10	10	10	10	10
Flesh foods	10	10	10	10	10
Eggs	10	10	10	10	10
Vitamin A-rich fruits	5	5	5	5	5
Vitamin A-rich veg.	5	5	5	5	5
Other fruits	5	5	5	5	5
Other vegetables	5	5	5	5	5
HFSS foods	0	0	0	0	0
Total fat	8	10	10	10	10
Added sugar	10	10	10	10	10
Total score	103/120	105/120	85/100	85/100	85/100

Table 4.56: Correlation of DQAT2023-K Component and Energy Intakes (N=179)- Construct and Criterion Validity

	Energy tot	Breast feeding	Legumes	Nuts	Dairy Products	Flesh Foods	Eggs	Vit A fruits	Vit A veg	Other Fruits	Other Veg	HFSS Foods	Added Sugar	Total Fat	Grains	Roots and Tubers
Energy intakes	1															
Breastfeeding	-.253**															
Legumes	.342**	-.081														
Nuts	.231**	-.067	.107													
Dairy Products	.535**	-.096	.099	.112												
Flesh Foods	-.006	.083	-.148*	-.043	-.190*											
Eggs	.224**	-.036	.029	.074	.007	.284**										
Vit A fruits	.116	-.040	.068	-.037	.130	.053	.117									
Vit A veg	.056	-.069	-.087	.071	-.085	-.020	.122	-.033								
Other Fruits	.138	-.072	-.003	.030	.181*	-.077	.102	.195**	.027							
Other Veg	.372**	-.190*	.161*	.197**	.087	.026	.200**	-.010	.245**	-.035						
HFSS Foods	-.539**	.147*	-.159*	-.020	-.149*	-.075	-.114	-.008	-.039	.031	-.284**					
Added Sugar	-.474**	.067	-.153*	.004	-.232**	.046	-.005	.061	-.022	.084	-.195**	.394**				
Total Fat	.583**	-.231**	.332**	.016	.108	.073	.133	.076	.070	.034	.327**	-.596**	-.366**			
Grains	.649**	-.200**	.362**	.027	.211**	.003	.129	.055	.008	.051	.250**	-.404**	-.281**	.651**		
Roots and Tubers	.444**	-.109	.121	.146	.093	.031	.233**	-.016	.213**	.035	.611**	-.371**	-.244**	.359**	.275**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.57: Correlation of DQAT2023-P Component and Energy Intakes (N=273)- Construct and Criterion Validity

	Energy tot	Legumes	Nuts	Dairy Products	Flesh Foods	Eggs	Vit A fruits	Vit A veg	Other Fruits	Other Veg	HFSS	Added Sugar	Total Fat	Grains	Roots and Tubers
Energy intakes	1														
Legumes	.253**														
Nuts	.027	-.083													
Dairy Products	.483**	-.022	.033												
Flesh Foods	.072	-.204**	-.051	-.049											
Eggs	.062	-.033	-.077	-.154*	.297**										
Vit A fruits	.077	-.050	-.011	.065	.018	-.031									
Vit A veg	-.016	.011	.024	-.116	.028	.140*	.000								
Other Fruits	.015	-.100	-.059	.046	-.065	.003	.010	.123*							
Other Veg	.162**	.022	.092	-.045	-.088	-.072	-.014	-.016	-.070						
HFSS	-.295**	-.096	.081	.137*	-.056	-.039	-.011	-.002	.105	-.011					
Added Sugar	-.314**	.046	.001	-.127*	.077	.017	.010	-.030	-.059	.073	.234**				
Total Fat	.327**	.155*	-.047	-.114	.008	.031	-.035	.051	-.022	.107	-.559**	-.204**			
Grains	.085	.067	-.128*	.134*	.047	-.018	.085	.098	.032	-.095	-.093	-.047	.042		
Roots and Tubers	.027	-.027	-.048	.063	.071	-.005	.027	-.033	-.036	-.048	-.094	-.049	.060	.322**	1

****. Correlation is significant at the 0.01 level (2-tailed).**

***. Correlation is significant at the 0.05 level (2-tailed).**

Figure 4.5: Scree plot – Principal Component Analysis of DQAT2023-K Components - Construct and Criterion Validity

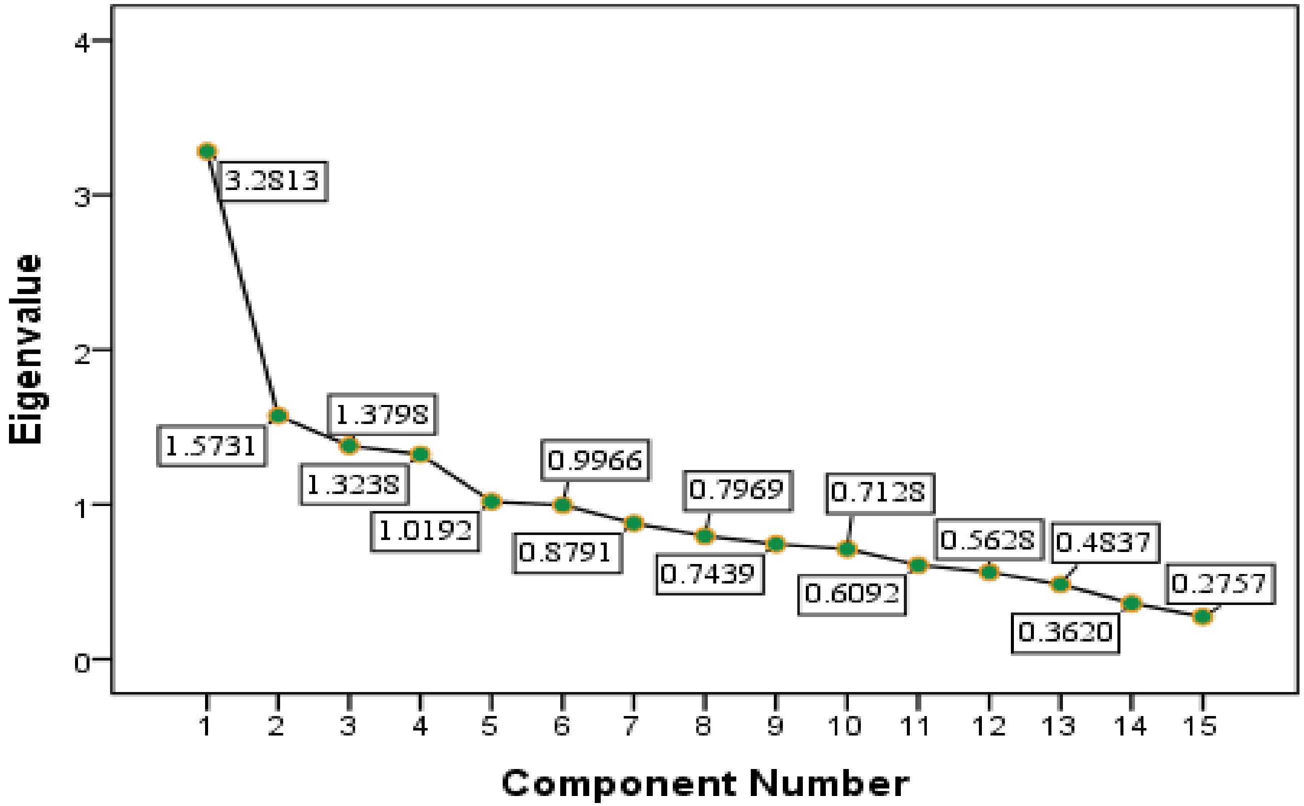
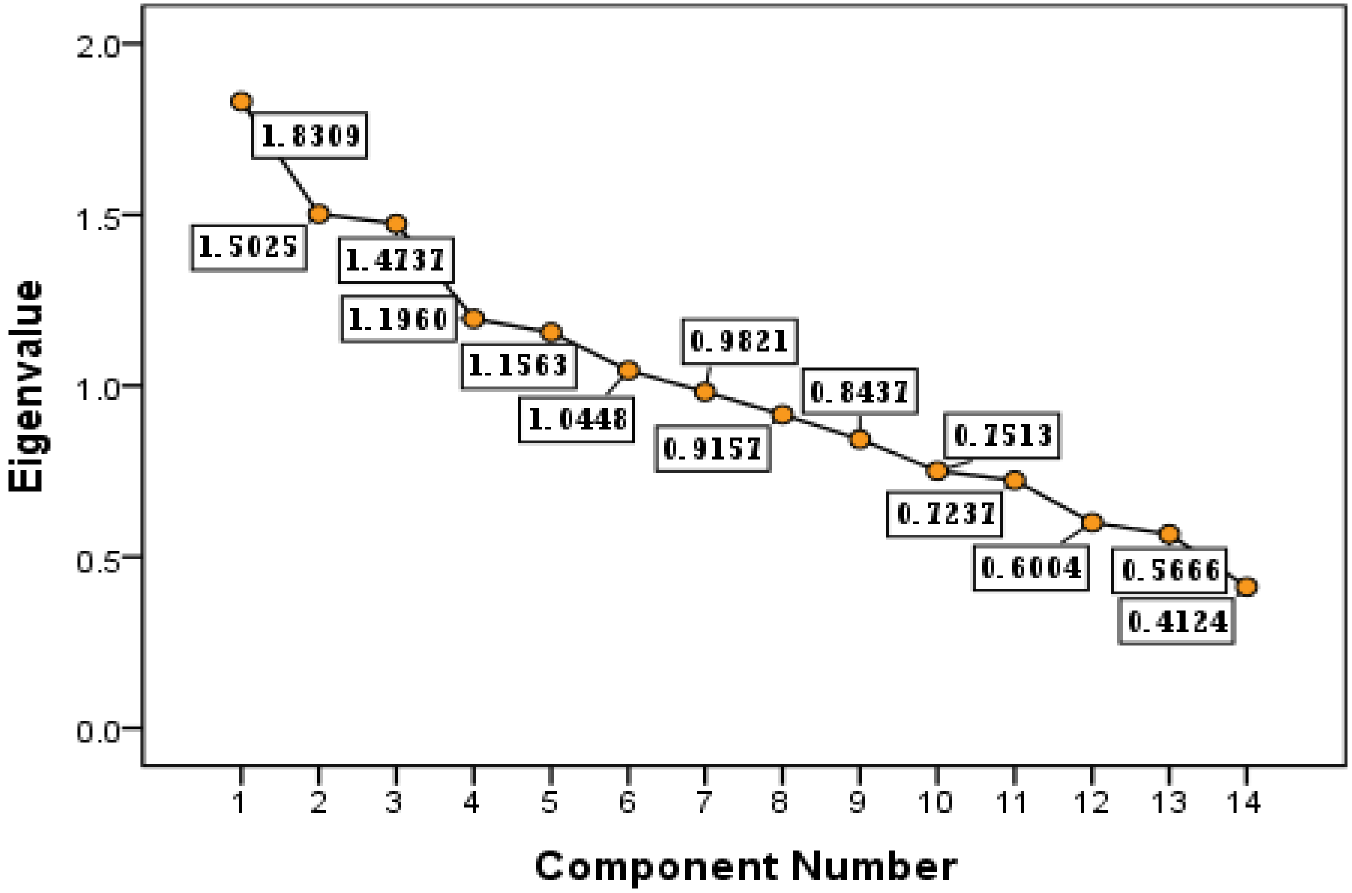


Figure 4.6: Scree plot – Principal Component Analysis of DQAT2023-P Components - Construct and Criterion Validity



Reliability

The most well-known types of reliability are test-retest and inter-rater reliability. DQAT was developed to be identical for identical diets or practices that are recalled, recorded and coded the same way. The respondent recall or data collection and processing may have contributed to the test-retest measurement error in this instance. Inter-observer dependability was not necessary because scoring required judgement. These two reliability tests were completely error-free.

The internal consistency of an index is measured by Cronbach's coefficient alpha. (Refer to Methods and Materials). The Cronbach's coefficient alpha for DQAT2023-K was -0.178, while for DQAT2023-P, it was -0.162. Because diet quality is known to be a complex and multidimensional entity, a low Cronbach's alpha was anticipated. In addition, not everyone consistently complies with the dietary criteria used to gauge diet quality. Internal consistency was therefore not a requirement for DQAT.

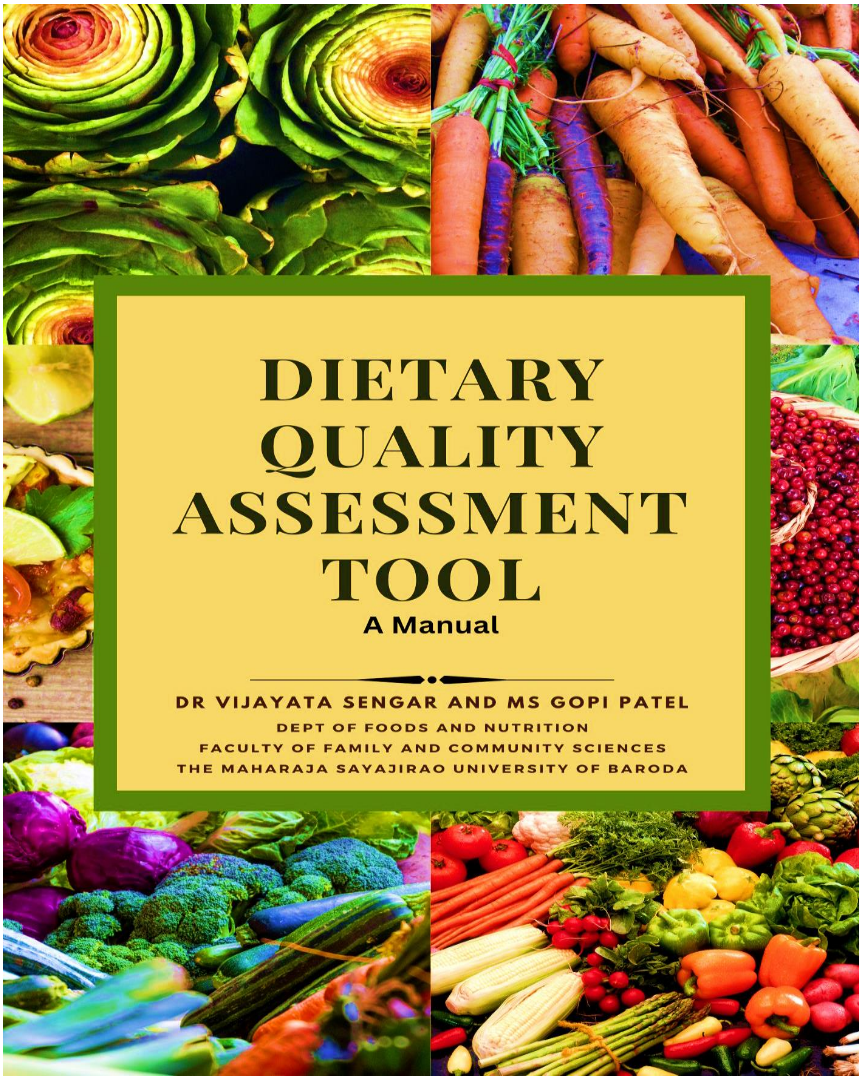
Phase II B – Development of a manual on Dietary Quality Assessment Tool

Based on the findings from study a manual on enhancing nutrition quality in diet was developed for mothers of young children between 6-59 months of age. The title of the manual was Dietary Quality Assessment Tool- A manual.

The manual focused on the following content:

- Importance of healthy diet in early years of life
- Dietary quality assessment tool 2023 for children under 5 years of age
- How to measure your child's dietary quality?
- Suggestions for improving dietary quality
- Sample menus with high diet quality

Figure 4.7: Dietary Quality Assessment Tool – A manual



DISCUSSION

UNICEF's conceptual framework of factors determining maternal and child nutrition listed an inadequate diet, frequent illnesses, poor breast-feeding techniques, delayed introduction of supplementary meals, and a lack of protein in the diet as the main causes of childhood malnutrition (UNICEF,2021).

The prevalence of severe stunting was 16.4 %, wasting 4.4%, and underweight 6.4% (<-3SD) in the present study which was similar to last year's study in urban Vadodara (Sengar and Karud,2022). The above findings were in line with the prevalence statistics shown in NFHS 5 (NFHS5, 2019-2020).

Around one third of the mothers were not aware of what malnutrition is. Several studies have shown a link between mothers knowledge and diet quality of children (Sengar and karud, 2022;Vereecken and Maes, 2010; Sunwoong et al, 2000). Majority of the mothers (74%) could initiate breastfeeding within one hour of birth in the present study. Similar finding have been reported in studies conducted in alike settings.

Dietary intakes data revealed that females had better nutrient intakes as compared to males. Dietary diversity was found to be poorest in the age group of 6-12 months indicating a strong need for early identification of poor diets and rectification of the same. A tool like DQAT 2023 can come handy in providing relevant diet related information. Several similar studies have also shown poor dietary diversity in this age group (Beckeman-Hsu et al,2020; Ahmed et al, 2018)

UNICEF (2019) reported that aound two thirds of the children do not receive adequate nourishment which is critical for their growth and brain development.

DQAT assessment also revealed that the diets of these children were of poor quality. None of the subjects had a good quality diet. A significant difference was observed across genders for DQAT breastmilk component in children under 2 years of age. This clearly shows that mothers had poor knowledge about the benefits of continued breastfeeding and frequency of breastfeeding in children upto 2 years of age.

Data also revealed that a low consumption of Vitamin A rich fruits and vegetables was observed which is indicative of the fact that these children lacked a diverse diet. A diverse diet helps in proper brain and body development which in turn will improve their performance, immunity and promote longevity (Sengar and Karud, 2022; UNICEF,2019).

Thus, there is a strong need to first assess the current status of diets using DQAT and then work upon improving individual components for providing best nourishment to children.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSIONS

The triple burden of malnutrition phrase "nutrition transition" describes the adjustments in dietary practices, consumption patterns, and energy use that come about over time as a result of economic development, typically in the context of globalization and urbanization (WHO, healthy diet, 2020).

An important principle in the prevention of many chronic diseases is eating a healthy diet. Children should be encouraged to acquire good eating habits because this is a crucial time for their growth and development. Additionally, eating habits are formed at a young age, with many of them starting even before the age of five years (Skinner JD, 2002). Children's growth and nutritional status are negatively impacted by poor dietary quality and variety (Onyango AW, 2014).

Diet quality assessment tool for children under 5 years of age could be used to simplify managing and accessing healthy dietary pattern at early age of life. It would also suggest the consumption of different food groups with quantity (Sengar and Karud, 2022).

Therefore, the present study was planned with the specific objectives of modifying existing DQAT 2022 and conducting psychometric evaluation of DQAT 2023 in context to India. As well as situational analysis was done to know nutritional status, IYCF Practises, Socio-economic status and dietary patterns of children under 5 using DQAT 2023 and developed dietary quality assessment tool -A manual.

Methodology

The study took place in Vadodara's urban area. This study comprised of 452 children under the age of five. Aanganwadi Centres (AWCs) from 4 zones of urban Vadodara were randomly selected. Children under five who had AWC registrations were enrolled for the study. Anthropometric measurements of the participants, including height and weight, were taken. All 452 children’s mothers provided information on their socioeconomic situation, nutritional status, IYCF practices, and immunization status. Dietary intakes were also assessed over a period of three consecutive days.

The data was entered through the software name Epicollect5 and was analysed using Microsoft excel (2010) and SPSS version 20 or above.

The present study was cross sectional study and it was conducted in the two phases.

Phase I The Phase I was subdivided in two phases

Phase I A: Modification of Dietary Quality Assessment Tool (DQAT 2022)

In Phase I A, a Dietary Quality Assessment Tool (DQAT 2022) for children below 5 years of age was modified. DQAT 2023 had two categories according to age. DQAT 2023 for children between 6-24 months composed with 15 components whereas for children between 25-59 months had 14 components.

A simple sum of all the components scores would give the overall DQAT score for children between 6-24 months. A total score is 120. The DQAT score was further divided into three categories. If the score is greater than or equal to 96, the diet is considered to be of "Good" quality. If the score is between 61 and 95, it indicates "Upgrading required", and if the score is less than or equal to 60, the child falls into the "poor" category.

A simple sum of all the components scores would give the overall DQAT score for children between 25-49 months. A total score is 100. The DQAT score was further divided into three categories. If the score is greater than or equal to 80, the diet is considered to be of "Good" quality. If the score is between 51 and 79, it indicates "Upgrading required", and if the score is less than or equal to 50, the child falls into the "poor" category.

Phase I B: Situational Analysis

Socio–Economic Status

Almost sixty percent of the subjects were Hindus and belonged to joint families (56.2%) with mean family members of 5.98 ± 3.03. Majority of subjects was per capita income between 5000 – 20000 INR. Nearly half of the subject's father had elementary occupation. One third of subjects lived in rented house.

Age and Sex profile of subjects and their mothers

The mean age of mothers was 27 ± 4 years. The mean age of children was 13.69 plus minus 16.29 months. The mean weight of children was 10.86 kg plus minus 2.54 kg. The mean height of children was 85 cm plus minus 12.05 cm. The mean weight of child at the time of birth was 2812.23 gram plus minus 1182.03 gram. The study population was consisted around 52% of female and 48% of male those age under 5 years.

Prevalence of malnutrition

The prevalence of stunting was 16.4 %, wasting 4.4%, and underweight 6.4% (<-3SD). Stunting and underweight were shown highest between 25 to 36 months of children. Wasting was found highest in between 4 - 5 years children due to inappropriate eating habits. There was a significant variation for HAZ, WHZ, and WAZ between both the age groups of below and above 2 years (WHZ f value of 12.073**, HAZ f value of 17.365*, and WAZ f value of 0.267***).

The prevalence of underweight was highest, followed by wasting and stunting, according to gender-wise analysis of nutrition status in participants. males were considered to experienced undernutrition at higher rates than females.

Infant and Young Feeding Children (IYCF) Practices

Around 72% of mothers provided early initiation of breast milk to children within 1 hour after birth. The majority of mothers did not give artificial milk or bottle-feed. According to the mother's knowledge, complementary feeding is defined as foods given after 6 months. One-third of the children were vegetarian, and nearly half were non-vegetarian. It was discovered that more than half (66.37%) of the mothers were not aware with the word "Malnutrition," and 15.93% believed that malnutrition was a contributing role in the child's low weight.

When mothers first started feeding their children, most of them started with semisolid-consistency foods. Minimum Dietary Diversity (seven food groups out of the minimum four food groups required) were categorized to assess the dietary patterns of children under 5 years of age. The majority of respondents (almost 98%) included grains, roots, and tubers as complementary diets. Dairy products such as milk, curd, and buttermilk were included as supplementary foods in 80.09 percent of the total. About 16.81% of children under 5 years old eat fruits and vegetables high in vitamin A. While other fruits and vegetables were devoured by children to the tune of 64.6%. The majority of the children consumed nuts and legumes as components of their meals. Among the children, 18.56% had consumed eggs, and 7.52% had had flesh meals such as meat, fish, poultry, and organ meat.

Dietary and Nutrient intake

With the exception of protein and iron, a comparison of the % RDA of nutrient intakes by gender revealed that females had greater intakes of nutrients. The examination of the mean %RDA of intake of nutrients in children aged 5 years was non-significant within gender, with the exception of calcium (p- value: <0.05). A statistical analysis revealed a significant disparity in the mean calcium levels by gender across all age groups.

The rest of the population, except infants aged 6 to 12 months, consumed enough fat. The majority of children in all age groups consumed 80% of their recommended calcium intake.

The mean nutrient intakes were found to be non-significantly correlated to HAZ and WHZ Score between the category of subjects had a z score above -2 SD and equal to or below -2 SD. The WAZ score had a significantly positive relationship with the mean percent of the RDA for fat among above and below 2 years.

Dietary Diversity

Dietary diversity was significantly lower among the children in the age group of 6 to 24 months which was even below Minimum dietary Diversity. Dietary diversity was shown to be poor among the children in the age group of 6 months to 12 months. Males showed greater dietary diversity than females relative to the mean sex, but neither group met the required minimum level.

According to analysis of variance (ANOVA) results showed a significant difference in WHZ and WAZ between genders, with the exception of HAZ.

Dietary Quality Using DQAT 2023

Age- and gender-wise mean DQAT scores fell into a poor category. There was a significant difference between the categories (p-value:0.001***). According to statistical research, children between the ages of 25 and 36 months had the poorest mean DQAT scores. In comparison to men, women consumed poor-quality food. No one of the total came from the good-quality diet that was consumed.

The quality of the diet was poorer for children above 2 than for those below 2, although the quality was poor for both age groups. Participants in the BPL category had significantly poor-quality diets than those in the APL category.

There was significant difference found in mean Breastmilk component gender wise children under 2 years of age with DQAT Score. With the exception of Vegetables high in vitamin A, a t-test showed that the means of the individual DQAT components were not significantly correlated with either age above or below 2 years.

Phase: II

The phase II was divided in two subdivided phases.

Phase II A: Psychometric evaluation of Dietary Quality Assessment Tool (DQAT)

Content Validity examines qualitatively the extent to which an index represents the variety of attributes that make up diet quality in case of DQAT 2023. Content validity of DQAT components were met the all-key recommendations of dietary guidelines. All the components that relate to diet quality are reflected in DQAT.

Construct and criterion validity measure how well the index measures diet quality. This was done in three different ways for DQAT. All the sample menus based on balanced diets according to 'Dietary guidelines for Indians' (ICMR, 2010) were ranked to be of a good quality (DQAT score (6-24 months)> 96; DQAT score (25-59 months) >80).

The DQAT was effective in separating diet quality from diet quantity, as evident by the minimal correlations between the scores for each component and energy intake. At least five components with an Eigenvalue larger than 1 were present in DQAT2023-K. According to principal component analysis (PCA), the first 5 components and the first 10 components together explained around 57% and 85% of the variation, respectively. At least six components with an Eigenvalue larger than one were found in DQAT2023-P. According to principal component analysis, the first six components and the first nine components together explained around 51% and 84% of the variation, respectively.

DQAT was developed to be identical for identical diets or practices that are recalled, recorded and coded the same way. Inter-observer dependability was not necessary because scoring required judgement. These two reliability tests were completely error-free.

The internal consistency of an index is measured by Cronbach's coefficient alpha. (Refer to Methods and Materials). The Cronbach's coefficient alpha for DQAT2023-K was -0.178, while for DQAT2023-P, it was -0.162. Diet quality is known to be a complex and multidimensional entity, a low Cronbach's alpha was anticipated. In addition, not everyone consistently complies with the dietary criteria used to gauge diet quality. Internal consistency was therefore not a requirement for DQAT.

Based on the findings from study a manual on enhancing nutrition quality in diet was developed for mothers of young children between 6-59 months of age in Phase II B. The title of the manual was Dietary Quality Assessment Tool- A manual.

Conclusion

The present study concluded that dietary diversity was significantly lower among the children in the age group of 6 to 24 months which was even below Minimum dietary Diversity indicating a strong need to improve complementary feeding practices.

Dietary quality assessment using DQAT revealed that no children came under good diet quality category. Highest number of children had poor DQAT scores.

DQAT 2023 was found to be a valid and reliable tool for assessing dietary quality of children between 6 months to 59 months. Thus, it can go a long away in identifying current diet related practices and also improving them.

Based on the findings from study a manual on enhancing nutrition quality in diet was developed for mothers of young children between 6-59 months of age.

Recommendations

Studies can be conducted using DQAT 2023 for identifying gaps in IYCN practices effectively.

Future studies can be planned on training and capacity building of mothers and caretakers to assess their child’s quality using DQAT 2023.

Additionally, they can be trained on how to improve low scores.

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APPENDICES

APPENDIX I

PERMISSION LETTER (Gujarati)

વડોદરા મહાનગરપાલિકા
સંકલિત બાળ વિકાસ સેવા યોજના,
બીજો માળ, વોર્ડ નંબર-૧૨ ની કચેરીમાં,
સહજાનંદ એપાર્ટમેન્ટ પાસે, અકોટા, વડોદરા-૨૦.
વેબસાઇટ: www.vmc.gov.in, ઇ-મેઇલ: icds@vmc.gov.in

જા.નં.:- VMC/ ICDS/ Home Science/ Permission/ ૨૫૮ /૨૨-૨૩, તા: ૨૭-૦૯-૨૦૨૨

પ્રતિ,
ડૉ. વિજયતા સેંગર,
આસિ. પ્રોફેસરશ્રી (CES),
ફુડ એન્ડ ન્યુટ્રીશન વિભાગ,
એમ.એસ. યુનિવર્સીટી,
વડોદરા.

વિષય: શ્રી ગોપી પટેલને અત્રેની આંગણવાડીઓના વિસ્તારમાં રીસર્ચ કરવાની મંજુરી આપવા બાબત

સંદર્ભ: આપનો પત્ર ક્રમાંક: No. F.C.Sc. / FND, Date:26/09/2022

જય ભારતસહ, ઉપરોક્ત વિષય અનુંસધાનમાં જણાવવાનુ કે વડોદરા મહાનગરપાલિકા સંચાલીત આઇ.સી.ડી.એસ. અર્બન પ્રોજેક્ટની આંગણવાડીઓમાં શ્રી ગોપી પટેલને "Modification and Evaluation of Dietary Quality Assessment Tool for Children under 5 Years of Age" પર અભ્યાસ/ રિસર્ચ કરવા માટે સંદર્ભના પત્રથી આપશ્રીના દ્વારા મંજુરી માંગવામાં આવેલ છે, જે નીચે મુજબની શરતે માહિતી મેળવવા/ અભ્યાસ/ રિસર્ચ કરવા માટેની મંજુરી આપવામાં આવે છે.

૦૧) આંગણવાડીના બાળકો, લાભાર્થીઓને અગવડતા ન થાય, તેમજ મકાન અને ઇન્ફ્રાસ્ટ્રકચરને કોઇ નુકશાન ન થાય તેવી રીતે સરકારશ્રીના ધારા ધોરણ મુજબ કામગીરી (અભ્યાસ) કરવા માટે આપશ્રીને મંજુરી આપવામાં આવે છે, જે દરમીયાન કોઇ અગમ્ય બનાવ કે ઘટનાની સંપૂર્ણ જવાબદારી આપશ્રીની રહેશે, તેમજ તેની ભરપાઇ પણ આપશ્રીને કરવાની રહેશે.
૦૨) અભ્યાસ/ રિસર્ચની કામગીરી પુર્ણ થયેથી અહેવાલની એક નકલ અત્રેની કચેરીને આપવાની રહેશે.
૦૩) કોરોના મહામારી અંગેની સરકારશ્રીની વખતો વખતની ગાઇડલાઇનનું પાલન કરવાનું રહેશે.
૦૪) આંગણવાડી ખાતેની તમામ કામગીરીઓ સબંધિત મુખ્ય સેવિકાશ્રી અને સિ.ડી.પી.ઓ.શ્રીની જાણમાં રહીને કરવાની રહેશે.

પ્રોગ્રામ ઓફિસર (શહેરી)
આઇ.સી.ડી.એસ
વડોદરા મહાનગરપાલિકા

બિડાણ: સંદર્ભનો પત્ર

નકલ રવાના (ઇ-મેઇલ દ્વારા):
૦૧) મુખ્ય આરોગ્ય અધિકારીશ્રી, આરોગ્ય વિભાગ, વડોદરા મહાનગરપાલિકા તરફ જાણ થવા સારૂ
૦૨) બાળ વિકાસ યોજના અધિકારીશ્રી, તમામ તરફ જાણ અને અમલ કરવા સારૂ
૦૩) મુખ્ય સેવિકાશ્રી,તમામ, તરફ જાણ અને અમલ કરવા સારૂ
૦૪) શ્રી ગોપી પટેલ તરફ જાણ અને અમલ કરવા સારૂ

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APPENDIX II

PERMISSION LETTER (English)

सत्यं शिवं सुन्दरम्
Estd. 1949

DEPARTMENT OF FOODS AND NUTRITION
FACULTY OF FAMILY AND COMMUNITY SCIENCES
THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA
VADODARA 390 002 – INDIA

No. F.C.Sc./FND Date: 26.09.22

To,
The Programme officer
ICDS
Vadodara Muncipal Seva Sadan
Vadodara

Subject: Permission for carrying out Masters Dissertation research work

Dear Sir/Madam

This is to request you to kindly grant permission to **Ms. Gopi Patel,** pursing Masters in Dietetics, Department of Foods and Nutrition at The Maharaja Sayajirao University of Baroda for carrying out her research work on children enrolled in AWC. She is working on **'Modification and Evaluation of Dietary Quality Assessment Tool for Children under 5 Years of Age"** under my guidance. She will be conducting anthropometric measurements and dietary intakes assessment for the children below 5 years of age. She will be collecting data from randomly selected aanganwadis under various zones of Vadodara. Kindly allow her to carry research work from October 2022 to February 2023.
In case, you need to contact Gopi or me for any clarification or verification, kindly contact on below mentioned numbers. Report of the work done will be submitted to your office.
Looking forward to a positive response from your side.

Thanking you.

Regards,
Vijayata

Dr. Vijayata Sengar
Asst professor (CES) (Research Guide)
Dept. of Foods and Nutrition
Faculty of Family and Community Sciences
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Mobile no.: 9879540227

Gopi Patel (Research Student): 9924756897

VADODARA MUNICIPAL CORPORATION

APPENDIX III

ETHICAL COMPLIANCE CERTIFICATE

सत्यं शिवं सुन्दरम्
Estd. 1949

Institutional Ethics
Committee for Human
Research
(IECHR)

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

Ethical Compliance Certificate 2022 – 2023

This is to certify that Ms. Gopi Patel's study titled, "**Modification and evaluation of dietary Quality assessment tool for children below 5 years of age**" from Department of Foods and Nutrition has been approved by the Institutional Ethics Committee for Human Research (IECHR), Faculty of Family and Community Science, The Maharaja Sayajirao University of Baroda. The study has been allotted the ethical approval number **IECHR/FCSc/MSc/2022/39.**

Prof Mini Sheth
Member Secretary
IECHR

Prof Shagufa Kapadia
Chairperson
IECHR

APPENDIX IV

CONSENT LETTER FOR MOTHERS IN LOCAL LANGUAGE

<u>માતાઓ માટે સંમતિ પત્ર</u>

ફૂડ એન્ડ ન્યુટ્રિશન વિભાગ,
ફેકલ્ટી ઓફ ફેમિલી એન્ડ કોમ્યુનિટી સાયન્સ,
ધ મહારાજા સયાજીરાવ યુનિવર્સિટી ઓફ બરોડા
વડોદરા 390 002- ભારત

<u>માહિતી પત્ર</u>

હું, ગોપી પટેલ ધ મહારાજા સયાજીરાવ યુનિવર્સિટી બરોડામાં ફૂડ્સ અને પોષણ વિભાગ માં ડાયેટિક્સમાં માસ્ટર્સ કરી રહી છું.

હું ડૉ. વિજયતા સેંગરના માર્ગદર્શન હેઠળ "પાંચ વર્ષથી ઓછી વયના બાળકો માટે આહાર ગુણવત્તા મૂલ્યાંકન સાધનમાં ફેરફાર અને મૂલ્યાંકન" શીર્ષક હેઠળ નિબંધ કાર્ય હાથ ધરું છું. વર્તમાન અભ્યાસ તમારા બાળકના પોષણની સ્થિતિ અને આહારના સેવન વિશે માહિતી એકત્રિત કરવાનો ઇરાદો ધરાવે છે. ઉપરોક્ત માહિતી ઇન્ટરવ્યુની મદદથી એકત્રિત કરવામાં આવશે જ્યાં તમને પ્રશ્નો પૂછવામાં આવશે અને તમારા જવાબો રેકોર્ડ કરવામાં આવશે.

પ્રશ્નો સામાજિક-આર્થિક સ્થિતિ, ખોરાક આપવાની પદ્ધતિઓ વિશે હશે. તમારા બાળકની ઊંચાઈ અને વજનનો ડેટા પણ રાખવામાં આવશે. તમારા દ્વારા આપવામાં આવેલી માહિતી ગોપનીય રહેશે અને તેનો ઉપયોગ ફક્ત અભ્યાસ હેતુ માટે જ કરવામાં આવશે. સંશોધનના અંતે, પરિણામ તમારી સાથે શેર કરવામાં આવશે.

આ સંશોધનમાં તમારી ઇચ્છા અને સહભાગિતા બદલ આભાર.

કોઈપણ પ્રશ્નના કિસ્સામાં, તમે અમારો સંપર્ક કરી શકો છો (વિગતો નીચે આપેલ છે).

ડૉ. વિજયતા સેંગર
સંશોધન માર્ગદર્શક
સંપર્ક નંબર: 9879540227

ગોપી પટેલ
સંશોધન વિદ્યાર્થી
સંપર્ક નંબર: 9924756897

વિષય સંમતિ ફોર્મ

નામ: ____________

ઉંમર: __________________

બાળકનું નામ: ______

બાળ ઉંમર અને જાતિ: ________

સરનામું: _________

મોબાઇલ નંબર: ____________

હું પુષ્ટિ કરું છું કે મેં ઉપરોક્ત માહિતી વાંચી અને સમજી લીધી છે અને પાસે પ્રશ્નો પૂછવાની તક મળી છે.

હું સમજું છું કે આ અભ્યાસમાં મારી સહભાગિતા સ્વૈચ્છિક છે અને હું કોઈપણ કારણ આપ્યા વિના અભ્યાસનો ભાગ નકારવા માટે સ્વતંત્ર છું. હું સમજું છું કે મારી ઓળખ અથવા મારા બાળકની ઓળખ તૃતીય પક્ષોને અથવા પ્રકાશિત કરવામાં આવેલી કોઈપણ માહિતીમાં જાહેર કરવામાં આવશે નહીં.

હું અભ્યાસમાં ભાગ લેવા માટે સંમત છું.

મને કહેવામાં આવ્યું છે કે અભ્યાસમાં ભાગ લેવા માટે મને કોઈ પૈસાની ઓફર કરવામાં આવશે નહીં.

હું સ્વેચ્છાએ ફૂડ એન્ડ ન્યુટ્રિશન વિભાગ, ફેકલ્ટી ઓફ ફેમિલી એન્ડ કોમ્યુનિટી સાયન્સ, મહારાજા સયાજીરાવ યુનિવર્સિટી ઓફ બરોડા તરફથી શ્રી ગોપી પટેલ દ્વારા હાથ ધરવામાં આવેલા અભ્યાસમાં ભાગ લેવા માટે સ્વેચ્છાએ સંમત છું.

તારીખ:

સહભાગીનું સંપૂર્ણ નામ:

સહભાગીની સહી

APPENDIX V

QUESTIONNAIRE

Date: **Area:**

AWC No.: **Contact no.:**

SOCIO-ECONOMIC STATUS		
1.	Name of a mother (code)	
2.	Age of mother	
3.	Religion	
4.	Caste	
5.	Type of family	1. Nuclear 2. Joint 3. Extended
6.	Total no. of family members	
7.	Total number of young children (6 – 59 months)	
8.	Head of family (HOF)	
9.	Educational qualification of Mother	1. Professional 2. Graduate 3. Intermediate or diploma 4. High school 5. Middle school 6. Primary school 7. Illiterate
10.	Educational qualification of Husband	1. Professional 2. Graduate 3. Intermediate or diploma 4. High school 5. Middle school 6. Primary school 7. Illiterate
11.	Occupation of Mother	1. Legislators, Senior Officials & Managers 2. Professionals 3. Technicians and Associate Professionals 4. Clerks 5. Skilled Workers and Shop Market Sales Workers 6. Skilled Agricultural & Fishery Workers 7. Craft & Related Trade Workers 8. Plant & Machine Operators and Assemblers 9. Elementary Occupation 10. Unemployed

12.	Occupation of Husband	1. Legislators, Senior Officials & Managers 2. Professionals 3. Technicians and Associate Professionals 4. Clerks 5. Skilled Workers and Shop Market Sales Workers 6. Skilled Agricultural & Fishery Workers 7. Craft & Related Trade Workers 8. Plant & Machine Operators and Assemblers 9. Elementary Occupation 10. Unemployed
13.	Other source of income	1. Agriculture 2. Poultry 3. House/ shop rent 4. Other (specify)_________________ 5. NA
14.	Total monthly income of family	
15.	No. of earning members in family	
16.	Economic status of household	1. Low income 2. Middle income 3. High income
17.	Do you have ration card?	1.Yes 2. No
18.	If yes, Which type of card?	1. BPL 2. APL 3.AAY
19.	What is the main source of drinking water of household?	1. Piped water inside the house 2. Piped water outside the house 3. Public tap 4. Bottled water 5. Tube well/bore well
20.	Do you treat water in any way to make it safer to drink	1. Yes 2. No 3. Don't know
21.	If yes, what do you do to water	1. Boil 2. Add bleach / chlorine 3. Strain it through cloth 4. Use water filter / R.O 5. Other 6. Don't know
22.	Is there toilet facility available?	1.Yes 2. No
23.	If yes, which type of toilet facility	1. Private 2. Public 3. Outside
NUTRITIONAL STATUS OF CHILD		
24.	Name of the child	
25.	Age (y)	1. 6 – 12 months 2. 13 – 24 months 3. 25 – 36 months 4. 37 – 48 months 5. 48 – 59 months
26.	Date of birth	
27.	Birth Order	

28.	Gender	1. Male 2. Female 3. Other
29.	Weight (in kgs)	
30.	Height (in cms)	
31.	Weight at the time of birth (kg)	
32.	Any medical complication/disease	1. Yes (specify: ____________________) 2. No
33.	Have your child ever admitted to NRC/ CMTC?	
34.	Delivery type of your child?	1. Normal 2. C-section 3. Other
35.	Was your child full term born?	1.Yes 2. No
36.	If no, in which month did you deliver your child?	
37.	Place of child?	1. Government Hospital 2. Private Hospital 3. Primary Health Care (PHC) 4. Community Health Care (CHC) 5. At home 6. Other ________
IMMUNIZATION STATUS OF CHILD		
38.	B.C.G. (1 ½ months)	1.Yes 2. No
39.	Polio-1(1 ½ months)	1.Yes 2. No
40.	DPT-1(1 ½ months)	1.Yes 2. No
41.	Hepatitis B-1(1 ½ months)	1.Yes 2. No
42.	Polio-2(2 ½ months)	1.Yes 2. No
43.	DPT-2(2 ½ months)	1.Yes 2. No
44.	Hepatitis B-2(2 ½ months)	1.Yes 2. No
45.	Polio-3(3 ½ months)	1.Yes 2. No
46.	DPT-3(3 ½ months)	1.Yes 2. No
47.	Hepatitis B-3(3 ½ months)	1.Yes 2. No
48.	Measles (9 months)	1.Yes 2. No
49.	Vitamin A (9 months)	1.Yes 2. No
50.	DPT (16 – 24 months)	1.Yes 2. No
51.	Polio (16 – 24 months)	1.Yes 2. No
52.	Vitamin A (16 months)	1.Yes 2. No
53.	Vitamin A (24 months)	1.Yes 2. No
54.	Vitamin A (30 months)	1.Yes 2. No
55.	Vitamin A (36 months)	1.Yes 2. No
56.	Immunization status of child	1. Fully immunized 2. Partially immunized 3. Non-immunized
IYCF PRACTICES		
FOR 0 TO 6 MONTHS		
57.	Early initiation of breastfeeding within 1 hour of birth?	1.Yes 2. No

58.	If no, then when did you initiate?	
59.	Did you feed thick yellowish milk (produced soon after birth) to your child?	1.Yes 2. No
60.	If yes, why?	1. Nurse/Doctor advised me 2. It is good for baby 3. Baby was crying therefore I gave her/him 4. Other
61.	If no, why?	
62.	Are you currently breastfeeding your child?	1.Yes 2. No
63.	If no, then why did you stop?	1. Starts complementary food 2. Child is growing 3. Insufficient breast milk 4. Mother is sick 5. Child is not well 6. Other
64.	If no, when did you stop?	
65.	How many times do you breastfeed your child?	1. <3 times/day 2. 3-6 times/day 3. >6 times/day
66.	Do you give your child bottle feed/artificial milk feed?	1.Yes 2. No
67.	Did you give any kind of liquid or pre-lacteals to your child soon after birth?	1.Yes 2. No
68.	If yes, what did you give?	1. Water 2. Water of patasa 3. Honey 4. Jaggery water 5. Other milk 6. Other
69.	If yes, why did you give?	1. Religion beliefs 2. Child is hungry 3. Breast milk is not coming 4. Other
70.	For how long did you exclusive breastfed your child?	
71.	Did you give any top milk to your child?	1.Yes 2. No
72.	When did you start giving water to your child?	
73.	Did you give any other food/liquid to your child before 6 months?	1.Yes 2. No
74.	If yes, what?	
75.	If yes, why?	
76.	Do you breastfeed your child at night?	1.Yes 2. No
77.	If yes, who advice you?	

78.	If no, why?	
COMPLEMENTARY FEEDING (6 YEARS AND ABOVE)		
79.	What is complementary food according to you?	1. Food given to child after 6 months 2. Bal shakti given on annaprasans day 3. Don't know 4. Any other
80.	When did you start complementary feeding for your child?	1.Before 6 months 2. After 6 months
81.	What food groups do you include in complementary feed?	1. Grains, roots and tubers 2. Dairy products 3. Vitamin A rich fruits and vegetables 4. Other fruits and vegetables 5. Legumes and nuts 6. Eggs 7. Flesh foods (meat, fish, poultry, organ meat)
82.	How many times you feed your child per day (complementary feed)?	1. 3-4 times 2. 5-6 times 3. when asks
83.	How do you know if your child is malnourished?	1. Low weight 2. Frequent illness 3. Decreased appetite 4. Inactive 5. Don't know 6. Other
84.	Do you increase the frequency of breastfeeding when your child a sick?	1. Yes 2. No 3. Don't know
85.	When do you wash your hands?	1. Before cooking 2. After cooking 3. After cleaning baby's diaper 4. Before feeding child 5. After feeding baby
86.	Do you breastfeed your child along complementary feeding? (6 months – 2 years)	1.Yes 2. No
87.	If yes, how many times in a day?	
88.	Do you know the reason, why complementary food starts after 6 months?	1. Increase nutrients requirement 2. AWC advised her 3. Child does not feel hungry 4. I don't know 5. Other
89.	What kind of food your child eats?	1. Vegetarian 2. Non-vegetarian 3. Eggetarian
90.	What should be the consistency of complementary feed when you began at 6 months?	1. Solid 2. Semi-solid 3. Semi-liquid 4. Liquid 5. Other

91.	What should be given to the child as complementary feed when began?	
92.	Does your child eat by himself/herself?	1.Yes 2. No
93.	If yes, do you supervise him/her?	1.Yes 2. No
94.	If no, why?	1. Too young 2. Makes a mess 3. Other
95.	If other, specify?	
96.	Do you avoid any kind of food in your child's diet?	1.Yes 2. No
97.	If yes, what is it?	
98.	If yes, why do you avoid?	
99.	What points do you keep in your mind while feeding your child?	1. Wash hands before feeding child 2. Wash hands after feeding child 3. To use clean bowl for serving 4. Check the temperature before feeding 5. Food should be covered 6. Clean water for drinking 7. All of above
100.	Does your child go to aaganwadi? (For 25-59 months)	1.Yes 2. No
101.	If yes, how many times?	1. Daily 2. Alternate days 3. Twice a week 4. Once a week 5. Once in 15 days 6. Never 7. Other
102.	Do you get Bal Shakti packets from AWC?	1.Yes 2. No
103.	If yes, does your child like to eat it?	1.Yes 2. No
104.	If no, why he/she doesn't like it?	
105.	If yes, how many packets in a month?	
106.	Do you know how to make different recipes from Bal Shakti packet?	1.Yes 2. No

APPENDIX VI

PROFORMA FOR 3 DAYS-24 HOUR DIETARY RECALL**

Name of the mother (Code): **Area:**

Contact number: **Date of survey:**

No of Breastfeeding: **HFSS foods:**

Sr. No.	Meal	Food item	Amount	Ingredients	Raw Amount
1.	Breakfast				
2.	Lunch				
3.	Snacks				
4.	Dinner				

** **(Included 2 weekdays and 1 holiday, excluded festivals and fests)**

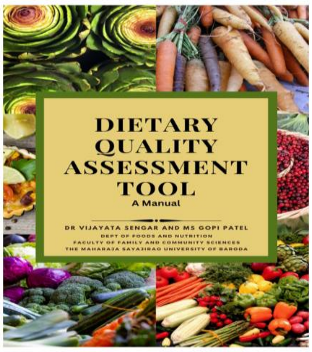
APPENDIX VII

DIETARY DIVERSITY CHECKLIST

Sr. no.	Food groups	Yes	No
1.	Grains, roots and tubers		
2.	Dairy products		
3.	Vitamin A rich fruits and vegetables		
4.	Other fruits and vegetables		
5.	Legumes and nuts		
6.	Eggs		
7.	Flesh foods (meat, fish, poultry, organ meat)		

APPENDIX VIII

DIETARY QUALITY ASSESSMENT TOOL – A MANUAL



All forms of malnutrition can be reduced with a high-quality diet. Diet quality is typically viewed as a dietary pattern or a measurement of the variance among important food groups in comparison to those suggested by dietary guidelines (Wirt A, 2009). Early life is like wet clay. Consequently, developing a healthy diet eating habit is easy.

A Vedic concept is "ANNAM AHAM," which translates to "I am what I eat."

As early as feasible in life, one should begin to develop healthy eating habits. Maintaining one's health, level of activity, and productivity requires a diet rich in nutrients. Unhealthy diets increase the risk of mortality and disability more than the sum of all other risk factors. Both the individual and societal levels need to address the problems of undernutrition (which causes underweight, stunting, wasting, and micronutrient deficiency) and overnutrition (which causes overweight or obesity, heart conditions, hypertension, diabetes, and some cancers)

1

After accounting for elements such as age, gender, physiological state, and physical activity, a balanced diet should offer enough calories and nutrients. These diets should include nutrients that promote all vital biological processes, including growth, cognition, bone, digestive system, and vision, as well as infection resistance.

A balanced diet offers a variety of natural foods and promotes long-term health and wellbeing. Two tenets of a balanced diet are diversity and moderation. Nearly all of the essential nutrients are included in the diet when meals from each food category are consumed in a variety of ways over the course of a week.

Serving sizes ought to be moderate. One must eat in order to "satisfy one's need and not greed." A fine line must be drawn when deciding what to eat and how much to eat. As a result, a balanced diet is one that contains all the nutrients that the body absolutely needs in ratios and amounts that not only meet those needs but also include a small amount of extra nutrients that can be kept on hand in case the body does not always get the nutrients it needs (1).

Each child must have adequate nutrition in the early years to reach their full potential, with the first two years of life being regarded as a crucial window of time for growth and development.

Dietary diversity is a qualitative tool and it is more focused on the number of food groups included but it does not give any information regarding the quantity of food.

Diet quality assessment tools for children under 5 years of age could be used to simplify managing and accessing healthy dietary patterns at an early age of life. It would also suggest the consumption of different food groups with quantity.

2

Dietary Quality Assessment Tool (DQAT) 2023

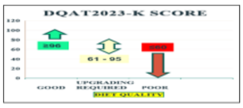
According to guidelines from the ICMR-NIN 2020 and FANTA/FAO/WHO 2007; IAP guidelines 2019, a DQAT 2023 was developed to assess the diet quality of children under the age of five (ICMR, 2011; FANTA, 2007; IAP, 2019).

DQAT 2023 had two categories according to age

1. DQAT2023-K scoring for children between 6-24 months

DQAT 2023 was composed of 15 components for children between 6-24 months. Except for breastfeeding, which had a score range of 0 to 20, every component had a range of either 0 to 10 or 0 to 5. A component's most desirable intake received the highest score, and its least desirable intake received the lowest score.

A simple sum of all the component's scores would give the overall DQAT score. The total score is 120. The DQAT score was further divided into three categories. If the score is greater than or equal to 96, the diet is considered to be of "Good" quality. If the score is between 61 and 95, it indicates "Upgrading required", and if the score is less than or equal to 60, the child falls into the "poor" category.



3

2. DQAT2023-P scoring for children between 25-59 months

DQAT 2023 was composed of 14 components for children between 25-59 months. Every component had a range of either 0 to 10 or 0 to 5. A component's most desirable intake received the highest score, and its least desirable intake received the lowest score.

A simple sum of all the component's scores would give the overall DQAT score. The total score is 100. The DQAT score was further divided into three categories. If the score is greater than or equal to 80, the diet is considered to be of "Good" quality. If the score is between 51 and 79, it indicates "Upgrading required", and if the score is less than or equal to 50, the child falls into the "poor" category.

4

Dietary Quality Assessment Tools (DQAT2023-K and DQAT2023-P) - Individual components with scoring

Sr. no.	Individual component	Age	Cut off	Max score	Min score
1	Breast milk	6 -12 months	>600 ml / 7-8 times per day	20	0
		13-24 months	>550 ml / 3-4 times per day	20	0
2	Grains	6 -12 months	≥15 gm	5	0
		13-24 months	≥60 gm	5	0
		25-36 months	≥60 gm	5	0
		36-48 months	≥60 gm	5	0
		49-59 months	≥120 gm	5	0
3	Roots and Tubers	6 -12 months	≥50 gm	5	0
		13-24 months	≥50 gm	5	0
		25-36 months	≥50 gm	5	0
		36-48 months	≥50 gm	5	0
		49-59 months	≥100 gm	5	0
4	Legumes and Pulses	6 -12 months	≥3.75 gm	5	0
		13-24 months	≥15 gm	5	0
		25-36 months	≥15 gm	5	0
		36-48 months	≥15 gm	5	0
		49-59 months	≥15 gm	5	0
5	Nuts	6 -12 months	≥3.75 gm	5	0
		13-24 months	≥15 gm	5	0
		25-36 months	≥15 gm	5	0
		36-48 months	≥15 gm	5	0
		49-59 months	≥15 gm	5	0
6	Dairy products	6 -12 months	≥ 200 ml	10	0
		13-24 months	≥300 ml with BF or else 500 ml	10	0

5

Dietary Quality Assessment Tools (DQAT2023-K and DQAT2023-P) - Individual components with scoring

Sr. no.	Individual component	Age	Cut off	Max score	Min score
		25-36 months	≥500 ml	10	0
		36-48 months	≥500 ml	10	0
		49-59 months	≥500 ml	10	0
7	Flesh Foods	6 -12 months	≤12 g*(above 9 months allowed)	10	0
		13-24 months	≥50 gm	10	0
		25-36 months	≥50 gm	10	0
		36-48 months	≥50 gm	10	0
		49-59 months	≥50 gm	10	0
8	Eggs	6 -12 months	≤12 g*(above 9 months allowed)	10	0
		13-24 months	≥50 gm	10	0
		25-36 months	≥50 gm	10	0
		36-48 months	≥50 gm	10	0
		49-59 months	≥50 gm	10	0
9	Vitamin A rich Fruits	6 -12 months	≥50 gm	5	0
		13-24 months	≥50 gm	5	0
		25-36 months	≥50 gm	5	0
		36-48 months	≥50 gm	5	0
		49-59 months	≥50 gm	5	0
10	Vitamin A rich Vegetables	6 -12 months	≥25 gm	5	0
		13-24 months	≥50 gm	5	0
		25-36 months	≥50 gm	5	0
		36-48 months	≥50 gm	5	0
		49-59 months	≥50 gm	5	0

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Dietary Quality Assessment Tools (DQAT2023-K and DQAT2023-P) - Individual components with scoring

Sr. no.	Individual component	Age	Cut off	Max score	Min score
11	Other Fruits	6 -12 months	≥50 gm	5	0
		13-24 months	≥50 gm	5	0
		25-36 months	≥50 gm	5	0
		36-48 months	≥50 gm	5	0
		49-59 months	≥50 gm	5	0
12	Other Vegetables	6 -12 months	≥25 gm	5	0
		13-24 months	≥50 gm	5	0
		25-36 months	≥50 gm	5	0
		36-48 months	≥50 gm	5	0
		49-59 months	≥100 gm	5	0
13	HFSS Foods	6 -12 months	0*	10	0
		13-24 months	0*	10	0
		25-36 months	< 5 % of total energy	10	0
		36-48 months	< 5 % of total energy	10	0
		49-59 months	< 5 % of total energy	10	0
14	Total Fat	6 -12 months	≤25 gm	10	0
		13-24 months	≤25 gm	10	0
		25-36 months	≤25 gm	10	0
		36-48 months	≤25 gm	10	0
		49-59 months	≤25 gm	10	0
15	Added Sugar	6-12 months	0**	10	0
		13-24 months	0**	10	0
		25-36 months	< 5 % of total energy	10	0
		36-48 months	< 5 % of total energy	10	0
		49-59 months	< 5 % of total energy	10	0

*Introduce Eggs/ Chicken/ Meat/ Fish around 9 months (ICMR-NIN,2011)
**No HFSS foods to be offered to children below 2 years IAP JUNCS guidelines, 2019

7

How to measure the quality of diet using DQAT?

Individual components with score

1. BREASTMILK

Sr. no.	Individual component	Age	Cut off	max score	min score	frequency / gms	score
1	Breast milk	6 -12 months	>600 ml / 7-8 times per day	20	0	8	20
						7	17.5
						6	15
						5	12.5
						4	10
						3	7.5
						2	5
						1	2.5
						0	0
		13-24 months	>550 ml / 3-4 times per day	20	0	4	20
						3	15
						2	10
						1	5
						0	0

For example: If your child is 9 months old and she/he took 7 breastfeeding's per day. DQAT Score: 17.5 / 20 (As highlighted in the table above). Breast milk is an individual component for only 6 months to 2 years and it has the highest score 20. Breastfeeding is regarded as a critical intervention for lowering early infant morbidity and death. Breastmilk is a substantial source of energy and essential nutrients.

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2. GRAINS

2	Grains	6 -12 months	≥15 gm	5	0	≥ 15.00	5
						12.00-14.99	4
						9.00-11.99	3
						6.00-8.99	2
						3.00-5.99	1
						0.00-2.99	0
		13-24 months	≥60 gm	5	0	≥ 60.00	5
						48.00-59.99	4
						36.00-47.99	3
						24.00-35.99	2
						12.00-23.99	1
						0.00-11.99	0
		25-36 months	≥60 gm	5	0	≥ 60.00	5
						48.00-59.99	4
						36.00-47.99	3
						24.00-35.99	2
						12.00-23.99	1
						0.00-11.99	0
		36-48 months	≥60 gm	5	0	≥ 60.00	5
						48.00-59.99	4
						36.00-47.99	3
						24.00-35.99	2
						12.00-23.99	1
						0.00-11.99	0
		49-59 months	≥120 gm	5	0	≥ 120.00	5
						96.00-119.99	4
						72.00-95.99	3
						48.00-71.99	2
						24.00-47.99	1
						0.00-23.99	0

For example: If your child is 9 months old and she/he consumed 20 gm of rice per day. DQAT Score: 5 / 5(As highlighted in the table above). They also include whole wheat, rice, rye, oats, maize, barley, sorghum/jowar, triticale, millets, and bajra (pearl millet), ragi (finger millet), among others. Whole pseudocereals like quinoa, buckwheat, amaranth, and wild rice are examples of grains

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3. ROOTS AND TUBERS

3	Roots and Tubers	6 -12 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		13-24 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		25-36 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		36-48 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		49-59 months	≥100 gm	5	0	≥ 100.00	5
						80.00-99.99	4
						60.00-79.99	3
						40.00-59.99	2
						20.00-39.99	1
						0.00-19.99	0

For example: If your child is 9 months old and she/he consumed 35 gm of Potato per day. DQAT Score: 3 / 5 (As highlighted in the table above). Vegetables with a high starch content, such as potatoes, sweet potatoes, yams, cassava, etc. it is called Roots and Tubers.

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4. LEGUMES

4	Legumes	6 -12 months	≥3.75 gm	5	0	≥ 3.75	5
						3.00-3.74	4
						2.25-2.99	3
						1.50-2.24	2
						0.75-1.49	1
						0.00-0.74	0
		13-24 months	≥15 gm	5	0	≥ 15.00	5
						12.00-14.99	4
						9.00-11.99	3
						6.00-8.99	2
						3.00-5.99	1
						0.00-2.99	0
		25-36 months	≥15 gm	5	0	≥ 15.00	5
						12.00-14.99	4
						9.00-11.99	3
						6.00-8.99	2
						3.00-5.99	1
						0.00-2.99	0
		36-48 months	≥15 gm	5	0	≥ 15.00	5
						12.00-14.99	4
						9.00-11.99	3
						6.00-8.99	2
						3.00-5.99	1
						0.00-2.99	0
		49-59 months	≥15 gm	5	0	≥ 15.00	5
						12.00-14.99	4
						9.00-11.99	3
						6.00-8.99	2
						3.00-5.99	1
						0.00-2.99	0

For example: If your child is 9 months old and she/he consumed 10 gm of boiled black grams (1 fist) per day. DQAT Score: 5 / 5 (As highlighted in the table above). Pulses (all dals, rajma, soybeans, chana, beans, peanuts, etc.) and other foods high in protein are among the foods that promote muscle growth. In comparison to pulses (known as dal) where the seed coat has been removed and the grain polished, whole pulses (also known as grams) which are consumed with the seed coat have higher levels of fibre, vitamins, and minerals.

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5. NUTS

5	Nuts	6 -12 months	≥3.75 gm	5	0	≥ 3.75	5
						3.00-3.74	4
						2.25-2.99	3
						1.50-2.24	2
						0.75-1.49	1
						0.00-0.74	0
		13-24 months	≥15 gm	5	0	≥ 15.00	5
						12.00-14.99	4
						9.00-11.99	3
						6.00-8.99	2
						3.00-5.99	1
						0.00-2.99	0
		25-36 months	≥15 gm	5	0	≥ 15.00	5
						12.00-14.99	4
						9.00-11.99	3
						6.00-8.99	2
						3.00-5.99	1
						0.00-2.99	0
		36-48 months	≥15 gm	5	0	≥ 15.00	5
						12.00-14.99	4
						9.00-11.99	3
						6.00-8.99	2
						3.00-5.99	1
						0.00-2.99	0
		49-59 months	≥15 gm	5	0	≥ 15.00	5
						12.00-14.99	4
						9.00-11.99	3
						6.00-8.99	2
						3.00-5.99	1
						0.00-2.99	0

For example: If your child is 9 months old and she/he consumed 10 gm of Almonds per day. DQAT Score: 5 / 5 (As highlighted in the table above). Nuts include almonds, walnuts, cashew, etc.

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6. DAIRY PRODUCTS

6	Dairy products	6 -12 months	≥ 200 ml	10	0	≥ 200.00		10
						180.00-199.99		9
						160.00-179.99		8
						140.00-159.99		7
						120.00-139.99		6
						100.00-119.99		5
						80.00-99.99		4
						60.00-79.99		3
						40.00-59.99		2
						20.00-39.99		1
						0.00-19.99		0
		13-24 months	≥300 ml with BF or else 500 ml	10	0	≥ 300.00	≥ 500.00	10
						270.00-299.99	450.00-499.99	9
						240.00-269.99	400.00-449.99	8
						210.00-239.99	350.00-399.99	7
						180.00-209.99	300.00-349.99	6
						150.00-179.99	250.00-299.99	5
						120.00-149.99	200.00-249.99	4
						90.00-119.99	150.00-199.99	3
						60.00-89.99	100.00-149.99	2
						30.00-59.99	50.00-99.99	1
						0.00-29.99	0.00-49.99	0
		25-36 months	≥500 ml	10	0	≥ 500		10
						450.00-499.99		9
						400.00-449.99		8
						350.00-399.99		7
						300.00-349.99		6
						250.00-299.99		5
						200.00-249.99		4
						150.00-199.99		3
						100.00-149.99		2
						50.00-99.99		1
						0.00-49.99		0

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		36-48 months	≥500 ml	10	0	≥ 500	10
						450.00-499.99	9
						400.00-449.99	8
						350.00-399.99	7
						300.00-349.99	6
						250.00-299.99	5
						200.00-249.99	4
						150.00-199.99	3
						100.00-149.99	2
						50.00-99.99	1
						0.00-49.99	0
		49-59 months	≥500 ml	10	0	≥ 500	10
						450.00-499.99	9
						400.00-449.99	8
						350.00-399.99	7
						300.00-349.99	6
						250.00-299.99	5
						200.00-249.99	4
						150.00-199.99	3
						100.00-149.99	2
						50.00-99.99	1
						0.00-49.99	0

For example: If your child is 9 months old and she/he consumed 250 ml of milk per day. DQAT Score: 10 / 10. (As highlighted in the table above). If children are between 13 -24 months old her/his requirement for milk is 300 or more ml along with breastmilk. Milk and milk products (paneer or cottage cheese, cheese, curd, etc).

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7. FLESH FOODS

7	Flesh Foods	6 -12 months	≤12 g*(above 9 months allowed)	10	0	≥12.00	10
						10.80-11.99	9
						9.60-10.79	8
						8.40-9.59	7
						7.20- 8.39	6
						6.00-7.19	5
						4.80-5.99	4
						3.60-4.79	3
						2.40-3.59	2
						1.20-2.39	1
						0.00-1.19	0
		13-24 months	≥50 gm	10	0	≥50.00	10
						45.00-49.99	9
						40.00-44.99	8
						35.00-39.99	7
						30.00-34.99	6
						25.00-29.99	5
						20.00-24.99	4
						15.00-19.99	3
						10.00-14.99	2
						5.00-9.99	1
						0.00-4.99	0
		25-36 months	≥50 gm	10	0	≥50.00	10
						45.00-49.99	9
						40.00-44.99	8
						35.00-39.99	7
						30.00-34.99	6
						25.00-29.99	5
						20.00-24.99	4
						15.00-19.99	3
						10.00-14.99	2
						5.00-9.99	1
						0.00-4.99	0

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		36-48 months	≥50 gm	10	0	≥50.00	10
						45.00-49.99	9
						40.00-44.99	8
						35.00-39.99	7
						30.00-34.99	6
						25.00-29.99	5
						20.00-24.99	4
						15.00-19.99	3
						10.00-14.99	2
						5.00-9.99	1
						0.00-4.99	0
		49-59 months	≥50 gm	10	0	≥50.00	10
						45.00-49.99	9
						40.00-44.99	8
						35.00-39.99	7
						30.00-34.99	6
						25.00-29.99	5
						20.00-24.99	4
						15.00-19.99	3
						10.00-14.99	2
						5.00-9.99	1
						0.00-4.99	0

For example: If your child is 9 months old and she/he consumed 11 grams of boiled fish per day. DQAT Score: 9/ 10 (As highlighted in the table above). Flesh foods are not allowed for children under 9 months of age. Animal-based foods contain high-quality proteins that support the development of our body's tissues. However, since animal products typically include a lot of saturated fat, we ought to proceed with caution and limit our consumption to lean or low-fat meat and poultry.

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8. EGGS

8	Eggs	6 -12 months	≤12 g*(above 9 months allowed)	10	0	≥12.00	10
						10.80-11.99	9
						9.60-10.79	8
						8.40-9.59	7
						7.20- 8.39	6
						6.00-7.19	5
						4.80-5.99	4
						3.60-4.79	3
						2.40-3.59	2
						1.20-2.39	1
						0.00-1.19	0
		13-24 months	≥50 gm	10	0	≥50.00	10
						45.00-49.99	9
						40.00-44.99	8
						35.00-39.99	7
						30.00-34.99	6
						25.00-29.99	5
						20.00-24.99	4
						15.00-19.99	3
						10.00-14.99	2
						5.00-9.99	1
						0.00-4.99	0
		25-36 months	≥50 gm	10	0	≥50.00	10
						45.00-49.99	9
						40.00-44.99	8
						35.00-39.99	7
						30.00-34.99	6
						25.00-29.99	5
						20.00-24.99	4
						15.00-19.99	3
						10.00-14.99	2
						5.00-9.99	1
						0.00-4.99	0

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		36-48 months	≥50 gm	10	0	≥50.00	10
						45.00-49.99	9
						40.00-44.99	8
						35.00-39.99	7
						30.00-34.99	6
						25.00-29.99	5
						20.00-24.99	4
						15.00-19.99	3
						10.00-14.99	2
						5.00-9.99	1
						0.00-4.99	0
		49-59 months	≥50 gm	10	0	≥50.00	10
						45.00-49.99	9
						40.00-44.99	8
						35.00-39.99	7
						30.00-34.99	6
						25.00-29.99	5
						20.00-24.99	4
						15.00-19.99	3
						10.00-14.99	2
						5.00-9.99	1
						0.00-4.99	0

For example: If your child is 9 months old and she/he consumed 10 grams of boiled egg per day. DQAT Score: 8/ 10 (As highlighted in the table above). Eggs are not allowed for children under 9 months of age.

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9. Vitamin A Rich Fruits

9	Vitamin A rich Fruits	6 -12 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		13-24 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		25-36 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		36-48 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		49-59 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0

For example: If your child is 9 months old and she/he consumed 50 grams of papaya per day. DQAT Score: 5/5 (As highlighted in the table above). Vitamin A Rich Fruits include orange, papaya, gooseberry, raspberry, mango etc.

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10. Vitamin A Rich Vegetables

10	Vitamin A rich Vegetables	6 -12 months	≥25 gm	5	0	≥ 25.00	5
						20.00-24.99	4
						15.00-19.99	3
						10.00-14.99	2
						5.00-9.99	1
						0.00-4.99	0
		13-24 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		25-36 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		36-48 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		49-59 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0

For example: If your child is 9 months old and she/he consumed 30 grams of carrots per day. DQAT Score: 5 / 5 (As highlighted in the table above). Vitamin A Rich Vegetables include spinach. carrot, Colocasia leaves, kale leaves, drumstick leaves, fenugreek leaves, amaranth leaves, curry leaves, mint leaves, celery leaves, cilantro, coriander leaves, etc.

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11. Other Fruits

11	Other Fruits	6 -12 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		13-24 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		25-36 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		36-48 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		49-59 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0

For example: If your child is 9 months old and she/he consumed 60 grams of apples per day. DQAT Score: 5 / 5 (As highlighted in the table above). Other fruit includes apple, sapota, banana, grapes, watermelon, guava, pineapple, blue berry etc.

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12. Other Vegetables

12	Other Vegetables	6 -12 months	≥25 gm	5	0	≥ 25.00	5
						20.00-24.99	4
						15.00-19.99	3
						10.00-14.99	2
						5.00-9.99	1
						0.00-4.99	0
		13-24 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		25-36 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		36-48 months	≥50 gm	5	0	≥ 50.00	5
						40.00-49.99	4
						30.00-39.99	3
						20.00-29.99	2
						10.00-19.99	1
						0.00-9.99	0
		49-59 months	≥100 gm	5	0	≥ 100.00	5
						80.00-99.99	4
						60.00-79.99	3
						40.00-59.99	2
						20.00-39.99	1
						0.00-19.99	0

For example: If your child is 9 months old and she/he consumed 60 grams of cucumber salad per day. DQAT Score: 5 / 5 (As highlighted in the table above). Other Vegetables includes cucumber, cabbage, brinjal, tomato, ladies' finger, bottle guard, bitter gourd, cluster beans, French beans, tinda, kakoda etc.

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13. HFSS Foods

13	HFSS Foods	6 -12 months	0**	10	0	≥33.5	0
						30.15 - 33.49	1
						26.80 - 30.14	2
						23.45 - 26.79	3
						20.10 - 23.44	4
						16.75 - 20.09	5
						13.40-16.74	6
						10.05-13.39	7
						6.70-10.04	8
						3.35-6.69	9
						No intake (0)- 3.34	10
		13-24 months	0**	10	0	≥50.50	0
						45.45 - 50.49	1
						40.40-45.44	2
						35.35-40.39	3
						30.30-35.34	4
						25.25-30.29	5
						20.20-25.24	6
						15.15-20.19	7
						10.10-15.14	8
						5.05-10.09	9
						No intake (0)-5.04	10
		25-36 months	< 5 % of total energy (kcal)	10	0	≥101.00	0
						95.95-100.99	1
						90.90-95.94	2
						85.85-90.89	3
						80.80-85.84	4
						75.75-80.79	5
						70.70-75.74	6
						65.65-70.69	7
						60.60-65.64	8
						50.51-55.55-60.59	9
						≤50.50	10

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		36-48 months	< 5 % of total energy (kcal)	10	0	≥136.00	0
						129.20-135.99	1
						122.40-129.19	2
						115.60-122.39	3
						108.80-115.59	4
						102.00-108.79	5
						95.20-101.99	6
						88.40-95.19	7
						81.60-88.39	8
						68.01-74.80-81.59	9
						≤68.00	10
		49-59 months	< 5 % of total energy (kcal)	10	0	≥136.00	0
						129.20-135.99	1
						122.40-129.19	2
						115.60-122.39	3
						108.80-115.59	4
						102.00-108.79	5
						95.20-101.99	6
						88.40-95.19	7
						81.60-88.39	8
						68.01-74.80-81.59	9
						≤68.00	10

For example: If your child is 9 months old and she/he has not consumed High Fat, Salt, and Sugar Foods in a day. DQAT Score: 10 / 10 (As highlighted in the table above). HFSS foods include Instant Foods (like soup), Fast Foods (like noodles, chips, pizza), Street Foods (vada pau, kabab, dabeli, vadas, pakodas), junk foods (like chocolate, ice cream, toffy, food packets (Gopal, Balaji, haldiram), flavoured drinks, French fries), etc.
For calculating energy, refer to online applications. For example, if your child between 49-59 months consumes a Vadapao then they approximately 290 kcal. The score for same is 0 (zero).

14. Total Fat

14	Total fat	6 -12 months	≤25 gm	10	0	25.00-27.50		10
						22.50-24.99	27.60-29.99	9
						20.00-22.49	30.00-32.49	8
						17.50-19.99	32.50-34.99	7
						15.00-17.49	35.00-37.49	6
						12.50-14.99	37.50-39.99	5
						10.00-12.49	40.00-42.49	4
						7.50-9.99	42.50-44.99	3
						5.00-7.49	45.00-47.49	2
						2.50-4.99	47.50-49.99	1
						0.00-2.49	≥50.00	0
		13-24 months	≤25 gm	10	0	25.00-27.50		10
						22.50-24.99	27.60-29.99	9
						20.00-22.49	30.00-32.49	8
						17.50-19.99	32.50-34.99	7
						15.00-17.49	35.00-37.49	6
						12.50-14.99	37.50-39.99	5
						10.00-12.49	40.00-42.49	4
						7.50-9.99	42.50-44.99	3
						5.00-7.49	45.00-47.49	2
						2.50-4.99	47.50-49.99	1
						0.00-2.49	≥50.00	0
		25-36 months	≤25 gm	10	0	25.00-27.50		10
						22.50-24.99	27.60-29.99	9
						20.00-22.49	30.00-32.49	8
						17.50-19.99	32.50-34.99	7
						15.00-17.49	35.00-37.49	6
						12.50-14.99	37.50-39.99	5
						10.00-12.49	40.00-42.49	4
						7.50-9.99	42.50-44.99	3
						5.00-7.49	45.00-47.49	2
						2.50-4.99	47.50-49.99	1
						0.00-2.49	≥50.00	0

		36-48 months	≤25 gm	10	0	25.00-27.50		10
						22.50-24.99	27.60-29.99	9
						20.00-22.49	30.00-32.49	8
						17.50-19.99	32.50-34.99	7
						15.00-17.49	35.00-37.49	6
						12.50-14.99	37.50-39.99	5
						10.00-12.49	40.00-42.49	4
						7.50-9.99	42.50-44.99	3
						5.00-7.49	45.00-47.49	2
						2.50-4.99	47.50-49.99	1
						0.00-2.49	≥50.00	0
		49-59 months	≤25 gm	10	0	25.00-27.50		10
						22.50-24.99	27.60-29.99	9
						20.00-22.49	30.00-32.49	8
						17.50-19.99	32.50-34.99	7
						15.00-17.49	35.00-37.49	6
						12.50-14.99	37.50-39.99	5
						10.00-12.49	40.00-42.49	4
						7.50-9.99	42.50-44.99	3
						5.00-7.49	45.00-47.49	2
						2.50-4.99	47.50-49.99	1
						0.00-2.49	≥50.00	0

For example: If your child is 9 months old and she/he has consumed 24 gm of oil from sabzi, dal, and extra foods per day. DQAT Score: 9 / 10 (As highlighted in the table above).
Total fat included visible and invisible fat consumption per day. Butter, Ghee (clarified butter), and cooking oils are fats and need to be consumed in moderation as they are energy dense. Fats from animal sources like milk, cream, butter, and ghee are high in saturated fats, which are not considered healthy fats. fat in bakery products like puff, biscuits, and pizza bases all have hidden fat.

15. Added Sugar

15	Added Sugar	6 -12 months	0**	10	0	≥33.5	0
						30.15 - 33.49	1
						26.80 - 30.14	2
						23.45 - 26.79	3
						20.10 - 23.44	4
						16.75 - 20.09	5
						13.40-16.74	6
						10.05-13.39	7
						6.70-10.04	8
						3.35-6.69	9
						No intake (0)-3.34	10
		13-24 months	0**	10	0	≥50.50	0
						45.45 - 50.49	1
						40.40-45.44	2
						35.35-40.39	3
						30.30-35.34	4
						25.25-30.29	5
						20.20-25.24	6
						15.15-20.19	7
						10.10-15.14	8
						5.05-10.09	9
						No intake(0)-5.04	10
		25-36 months	< 5 % of total energy (kcal)	10	0	≥101.00	0
						95.95-100.99	1
						90.90-95.94	2
						85.85-90.89	3
						80.80-85.84	4
						75.75-80.79	5
						70.70-75.74	6
						65.65-70.69	7
						60.60-65.64	8
						50.51-55.55-60.59	9
						≤50.50	10

		36-48 months	< 5 % of total energy (kcal)	10	0	≥136.00	0
						129.20-135.99	1
						122.40-129.19	2
						115.60-122.39	3
						108.80-115.59	4
						102.00-108.79	5
						95.20-101.99	6
						88.40-95.19	7
						81.60-88.39	8
						68.01-74.80-81.59	9
						≤68.00	10
		49-59 months	< 5 % of total energy (kcal)	10	0	≥136.00	0
						129.20-135.99	1
						122.40-129.19	2
						115.60-122.39	3
						108.80-115.59	4
						102.00-108.79	5
						95.20-101.99	6
						88.40-95.19	7
						81.60-88.39	8
						68.01-74.80-81.59	9
						≤68.00	10

For example: If your child is 9 months old and she/he has not consumed extra or added sugar in a day. DQAT Score: 10 / 10 (As highlighted in the table above). Added sugar means sugar that is added to food or food items. for example, sugar in packed fruit juices, milkshakes, cakes etc.
*1 g of added sugar = 4 kcal.

Example

For children 9 months old DQAT score:

DQAT Score = Sum of individual component score

= 17.5+5+3+5+5+10+9+8+5+5+5+5+10+9+10

= 111.5

DQAT Score = 111.5 / 120

DQAT Score shows that the child has a good quality diet according to the categories mentioned above.

Tips for Improving Diet Quality

- Eat a variety of foods to ensure a balanced diet.
- Encourage exclusive breastfeeding for six months and continue breastfeeding for two years or as long as you can.
- From 6 months of age, breast milk should be complemented with a variety of adequate, safe, and nutrient-dense foods. Salt and sugars should not be added to complementary foods.
- Feed home-based semisolid foods to the infant after six months.
- Ensure adequate and appropriate diets for children.
- or a source of high-quality protein, pulses should be consumed with cereal.
- Eat plenty of vegetables and fruit. eating fresh fruit and raw vegetables as snacks, and eating fresh fruit and vegetables that are in season.
- Don't skip breakfast.
- Ensure moderate use of edible oils and animal foods and very little use of ghee, butter, or vanaspati.
- Restrict salt intake to a minimum.
- Ensure the use of safe and clean foods.
- Adopt the right pre-cooking processes and appropriate cooking methods. methods.
- Drink plenty of water and take beverages in moderation.
- Minimize the use of processed foods rich in salt, sugar, and fat.
- Steaming or boiling instead of frying when cooking;
- Replacing butter, lard, and ghee with oils rich in polyunsaturated fats, such as soybean, canola (rapeseed), corn, safflower and sunflower oils;
- eating reduced-fat dairy foods and lean meats, or trimming visible fat from meat, and limiting the consumption of baked and fried foods, and pre-packaged snacks and foods (e.g doughnuts, cakes, pies, cookies, biscuits, and wafers) that contain industrially-produced trans-fats.
- MUFA, omega-3 fatty acids, protein, vitamins, and minerals are all present in nuts and seeds including walnut, almond, pumpkin seed, and flaxseed, among others. A handful of nuts daily is beneficial to your health ((2)

SAMPLE DIET PLAN

TIME	6-8 months	9-11 months	12 – 36 months	37 – 59 months
Early morning	Milk* + Almond powder (½ glass)	Milk* + Almond powder (½ glass)	Milk* + Almond powder (1 glass)	Milk* + Almond powder (1 ½ glass)
Break Fast	cucumber soup (½ catorie)	Vegetable upma (½ catorie) + egg white (1 no)	Vegetable pancake / egg omelette (½ no)	Vegetable pancake / egg omelette (1 no)
Mid-morning	Fruit pulp (3 table spoon)	Mashed fruit (½ catorie)	Pieces of fruit (4-5 slices)	Fruit (1 no.)
Lunch	Spinach dal + rice + boiled potato (mashed) (½ catorie + ½ catorie)	Spinach dal + rice + boiled potato (mashed) (1 catorie + ½ catorie)	Spinach dal + rice + boiled potato (1 ½ catorie + ½ catorie)	Spinach dal + rice (2 catorie)
Mid-evening	Mashed papaya (3 table spoon)	Mashed or dice papaya (½ catorie)	papaya (1 catorie)	papaya (1 catorie)
Dinner	Moong dal halwa (3 table spoon)	Mix vegetables + Roti (crushed) (½ catorie) / Chicken soup (1 catorie)	Mix vegetables / chicken sabji + Roti (crushed) (1 catorie)	Mix vegetables /chicken sabji + Roti (½ catorie + 1 no)
Bed-time	Milk (½ glass)	Milk (½ glass)	Milk (1 glass)	Milk (1 ½ glass)
DQAT Score	112	102	82	84

*1 glass = 200 ml, 1 catorie = 100 gm, ½ catorie = 50 gm

Options:
Spinach Dal (moong dal, red gram Dal, Bengal gram dal, lentil, mix dal)
Papaya (orange/ raspberry/peaches/ mango)
*Add nuts powder in milk (almonds, walnuts, pistachio, cashew nut)
Tomato soup (spinach, broccoli, carrots, sweet corn)
Moong dal kheer, besan Ladoo, savaiya, bottle gourd halwa, chikoo halwa, carrot halwa, ragi sheera)

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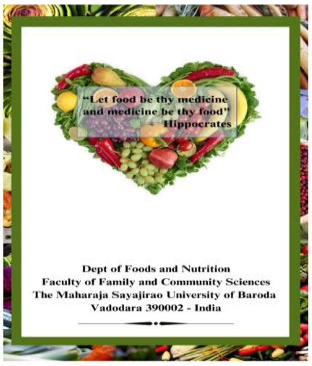

APPENDIX IX

PICTURE GALLERY