Section 3: Eat Healthy

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Chapter 12: Poor Diet and its Consequences

‘Anam Aham’ or ‘I am what I eat’ is a realisation we have had since ancient Vedic times. This is because the food, along with all the nutrients and other bioactive substances present in food which we eat, literally governs our health and nutritional status. Food is also known to affect our moods, our cognitive abilities and our intelligence quotient. Nutrients and the other bioactive substances play a big role in preventing communicable and non-communicable diseases. Even if a single nutrient is missing from our diet it can lead to adverse health symptoms. If we eat too much of a nutrient it can result in an imbalance in the body with a negative impact on health. Hence the focus is always on a balanced diet. This chapter explains the relationship between the food we eat, the nutrition it provides to our body and the effect on health and disease. It examines the effect of under and overnutrition on health as well as the economy. Initiatives to tackle the problem of malnutrition, that have been and need to be intensified, are discussed.

Relationship between agriculture, nutrition and health

The definition of ‘health’ as adopted by the World Health Organization in 1948 is as follows:

‘A state of complete physical, mental and social well-being and not merely the absence of disease and infirmity’

Unhealthy diets are closely linked with poor health status. In turn, dietary patterns and food choices are determined by a multitude of factors such as availability of foods, pricing, knowledge and awareness, taste preferences, social and cultural norms amongst others. Food, therefore, becomes a common point between agriculture, nutrition and health. It serves as the output of agricultural activities and subsequently plays a major role as a carrier of nutrients thereby resulting in either positive or negative health outcomes depending on how it is consumed.

Food is more than a sum of its nutrients or individual components. Synergism and interaction between different food components often requires a balancing act. This forms the rationale behind the concept of a ‘balanced diet’ as prescribed by the National Institute of Nutrition, Indian Council of Medical Research (ICMR) Dietary Guidelines for Indians. A balanced diet should provide around 50-60% calories from carbohydrates, preferably from complex carbohydrates, about 10-15% energy from proteins and 20-30% from both visible and invisible fats.

Absolute quantity of food components is equally important as the quality as well as relative proportions. For example, over the years, focus has shifted from total fat intake to intake of unhealthier fat fractions such as saturated fats. Likewise, carbohydrates are a major affordable energy source in Indian diets. Carbohydrates get preferentially used by the body for energy and thus have a protein sparing action, allowing the human body to utilize proteins for their critical role of tissue synthesis and maintenance. At the same time, in the absence of physical activity, excess carbohydrates in the diet may lead to weight gain and obesity. Qualitatively, complex carbohydrates such as those present in pulses, millets and whole grains (minimally processed with outer bran layer intact) are known for their positive attributes such as low glycemic index, satiety, cholesterol lowering properties etc.
The nutrition we derive from foods is deeply rooted in traditional practices of cooking, preserving and consuming seasonal foods as well as the ancient wisdom of some foods with medicinal benefits. For e.g., fruits and vegetables are known to be rich sources of vitamins, minerals, fibre as well as many non-nutritive yet protective substances such as flavonoids, antioxidants, etc. Including fruits and vegetables in the daily diet may reduce the risk of some non-communicable diseases and certain types of cancers. Swapping (exchanging) an unhealthy snack with a seasonal fruit is also a way to prevent weight gain and eventually reduce the risk of obesity. Some fruits and vegetables are known to boost the immune system. For e.g., Indian gooseberries (amla), oranges and other citrus fruits.

A diet consisting of foods from various food groups typically provides most of the daily requirement of nutrients. Food groups can be broadly classified as follows:

- Cereals and Millets
- Pulses
- Milk and animal derived foods such as meat, fish & poultry
- Fruits and Vegetables
- Nuts, oilseeds, Oils, Fats, and Sugars

Based on the degree of processing and/or cooking, intake quantity, degree and nature of interaction with other food components, the above-mentioned food groups provide us with the following nutrients:

- Macronutrients such as Carbohydrates, Proteins & Fats
- Micronutrients such as Vitamins and Minerals

The right food choices practiced consistently over a period of time lead to achievement of health goals specific to different stages of life. Age appropriate dietary guidelines as well as nutrient requirement values serve as guidance for nutrient intake at population level. For example, during the early years of life, optimal growth & development require sufficient proteins to support bone and tissue development. Similarly, adolescents in the age group of 10-15 years demand adequate protein-carbohydrates to sustain the second growth spurt. Physiological conditions such as pregnancy and lactation have higher requirements for most macro and micronutrients such as iron, folic acid and calcium. Whereas, as one grows older, energy requirements are reduced owing to a predominantly sedentary lifestyle with limited physical activity. However, vitamins, minerals and proteins remain critical to ensure healthy ageing.

Poor or unhealthy diets often lead to negative health outcomes:

- Undernutrition leads to physical and cognitive impairment, and increases susceptibility to infectious diseases.

- Micronutrient deficiencies or in other words possible insufficient intake of iron, iodine, vitamin A, folate etc. can cause severe illnesses and physical impairments, such as anaemia, mental retardation, visual impairment or birth defects respectively.

- Overweight and obesity increase the risk of non-communicable diseases (NCDs) such as type 2 diabetes, hypertension, heart disease, stroke and certain cancers.
Epidemiological shift from communicable to non-communicable diseases

India is in the middle of an epidemiological transition and is simultaneously battling the coexistence of undernutrition, overnutrition, and micronutrient deficiencies. While earlier the majority of deaths were due to communicable, infectious diseases, the death rates are now higher for diet related non-communicable diseases. The many facets of this transition include:

**Agricultural transformation:** With the advent of the green revolution in the late 1960s, India has moved from being food insecure to self-sufficient in grains. The focus has been on cereal grains especially staple crops such as wheat, rice and maize with relatively less attention towards other nutritious crops such as pulses, millets, coarse grains. This supply-demand equation has affected the share of plate in a typical Indian meal which tends to be cereal (carbohydrate) heavy.

**Urbanization:** Urbanization including migration to cities in search of work, has led to a change in dietary/consumption patterns. With more women entering the workforce, there’s less time to cook meals and hence a reliance on convenience foods and out-of-home consumption. Increase in disposable incomes is another factor resulting in changing consumer habits and preferences.

**Food environments/ecosystem:** The external as well as personal food environment/ecosystem has experienced a transformation with availability through formal/informal markets, price volatility, online delivery, promotion and marketing campaigns, regulatory ecosystem etc.

**Physical activity:** Factors such as rise of sedentary job profiles, time spent on gadgets/electronic devices, changing patterns of transportation, modern innovations that have automated some of the household tasks, cultural and safety considerations have led to a decrease in physical activity. As per a WHO statistic, globally, about 25% of adults and more than 80% of adolescents were insufficiently physically active in 2010. Physical inactivity is a leading risk factor for various non-communicable diseases, injuries and premature deaths worldwide.

**Healthcare infrastructure:** The revamped National Health Mission with a focus on disease control, prevention and surveillance has made a huge impact on healthcare system. Life expectancy at birth in India has risen to 69 years during 2013-17.

Undernutrition and micronutrient deficiencies

Human nutrition describes the processes whereby the body obtains and uses necessary substances obtained from foods (nutrients) to maintain structural and functional integrity. Optimum nutrition refers to an adequate intake of nutrients. Malnutrition is an imbalanced nutritional status resulting from deficiencies, excesses or imbalances in a person's intake of nutrients.

The term malnutrition covers 2 broad groups of conditions. One is 'undernutrition'—which includes stunting, wasting, underweight and micronutrient deficiencies. The other is
'overnutrition' which results from excessive intake of nutrients leading to overweight and obesity when there is excess intake of calories, or other symptoms of toxicity of excess intake of micronutrients.

As per the conceptual framework developed by UNICEF in 1990, the causes of malnutrition can be broadly classified as immediate, underlying and basic (Figure 1). Immediate causes act at individual levels. They include inappropriate diet and disease status. Inappropriate diet may be the result of unavailability of food, inappropriate dietary intake, poor feeding practices and personal food preferences. Diseases, particularly infectious ones such as diarrhoea, intestinal worms, respiratory infections, can both be a cause or result of undernutrition. Dietary transition, inadequate physical activity and lifestyle choices may be contributing factors to overnutrition.

Underlying causes act at a household and community level. These are primarily household food insecurity i.e. poor availability or access to food, inadequate health care, and unhealthy household environments. Family size and composition, gender inequalities and household income also affect household food security. Basic causes act at a national and international level. These include social, economic and political structures as well as environmental factors. Political instability, availability of health and social services, population size and growth rate, urban migration, natural resources, agricultural output, natural disasters, climate change, humanitarian crisis, international trade agreements and global food prices all affect the nutritional status of the population as a whole.

From the perspective of access, availability and affordability, some of the main causes of malnutrition include:

- Limited access to food and its affordability
- Limited access to adequate health care facilities
- Inadequate social environment at home and local community, especially for women and children
- Geographical segregation and poor accessibility to markets due to lack of roads
The indicators used to measure nutritional imbalance in undernutrition are defined as follows:

- **Underweight or low weight for age**
  Weight for age is a term used to describe weight appropriate for a particular age. In case the weight of a child is less than -2 standard deviations from the WHO child growth standards median, the child can be categorized as underweight. However, underweight is a composite indicator as it can reflect wasting, indicating acute weight loss, as well as stunting (long term or chronic growth failure). As per the Comprehensive National Nutrition Survey (CNNS 2016-18), 33% of children under five are underweight. The survey also indicates 10% school going children are underweight.

- **Wasting or low weight for height**
  Wasting is an acute form of malnutrition usually due to frequent and prolonged infections where the child loses weight resulting in low weight for height. Wasting may also result from sudden shock (food deficits) such as lack of food due to drought/famine and/ or severe and sudden illness. This type of malnutrition is reversible if proper measures are taken to feed the child frequently with nutrient dense foods. As per the Comprehensive National Nutrition Survey (2016-18), 17% of children under five are wasted. The survey also indicates 23% school going children are wasted.
are thin (BMI for age is less than -2 SD). Body mass index (BMI) is an indicator of weight status and is used to identify thin, overweight/obese individuals.

- **Stunting or low height for age**

  This is associated with long term (chronic) growth failure. In India, stunting is a major issue and is often linked to lack of timely nutritional interventions, caring practices, illness and chronic deficits in food intake. Stunted children not only have reduced physical growth, they also lag behind in academics, which may have negative consequences for their future. As per the Comprehensive National Nutrition Survey (2016-18), 35% of children under five are stunted. The survey also indicates 22% school going children are stunted.

  All anthropometric indices are compared to the WHO Child Growth Standards (2006).

- **Micronutrient deficiencies**

  Also known as hidden hunger, it is a consequence of inadequate intake of essential micronutrients like iron, vitamin A, vitamin B12, iodine and zinc in the diet. Micronutrient deficiencies in children are usually not seen in isolation. Children tend to have multiple micronutrient deficiencies due to low intake of food and lack of diversity in diets.

  Other assessment criteria include anthropometric measurements like MUAC (Mid-Upper Arm Circumference), presence of clinical signs and symptoms like oedema (swelling), skin changes (pallour, dryness, dermatitis, etc.), hair changes, night blindness, deformity of bones, etc.

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The **Poshan (Prime Minister’s Overarching Scheme for Holistic Nutrition) Abhiyaan** was launched by the Prime Minister on 8 March 2018. It is India’s flagship program of the Ministry of Women and Child Development to improve nutritional outcomes for children, adolescents, pregnant and lactating mothers by leveraging technology, a targeted approach and convergence.

For implementation of POSHAN Abhiyaan the four-point strategy/pillars of the mission are:

- Inter-sectoral convergence for better service delivery
- Use of technology (ICT) for real time growth monitoring and tracking of women and children
- Intensified health and nutrition services for the first 1000 days
- Jan Andolan

Read more about at:

- [https://icds-wcd.nic.in/nnm/home.htm](https://icds-wcd.nic.in/nnm/home.htm)
- [https://niti.gov.in/poshan-abhiyaan](https://niti.gov.in/poshan-abhiyaan)
Overnutrition and associated consequences

Over nutrition is a state where the nutritional intake exceeds the nutritional needs and then manifests itself as overweight and obesity in case of excess intake of energy. Overweight is a condition which is characterized by excess body fat. Obesity is a consequence of long-term positive energy balance i.e. having more calories than actually required. Based on the WHO guidelines for Asia Pacific (2004), Body Mass Index (BMI) between 23 to 24.9 kg/m² is a determinant of overweight whereas obesity is marked with a BMI of 25 or more (Table 1).

<table>
<thead>
<tr>
<th>Classification</th>
<th>BMI (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
</tr>
<tr>
<td>Normal</td>
<td>18.5 to 22.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>&gt;23</td>
</tr>
<tr>
<td>At risk</td>
<td>23 to 24.9</td>
</tr>
<tr>
<td>Obese I</td>
<td>25 to 29.9</td>
</tr>
<tr>
<td>Obese II</td>
<td>&gt;30</td>
</tr>
</tbody>
</table>

Source: Mishra, 2009

India ranks third, after US and China, in terms of obesity prevalence. As per the National Family Health Survey (NFHS-4) data, obesity amongst Indian adults has nearly doubled in the last decade. By 2030, 290 million Indians will be overweight while 52 million would be obese.

Globally, prevalence of childhood and adolescent obesity has increased tenfold in the last four decades. As per the Comprehensive National Nutrition Survey (2016-18), about 4% school going children (5-9 yrs. old) and 5% adolescents (10-19 yrs. old) are overweight or obese.

Let us examine the factors which can increase the risk of being overweight or obese:

**Birth weight:** Low birth weight is defined as weight (at birth) less than 2500g. Both low birth weight and high birth weight is linked to obesity in adult years. Infants born preterm or those small for gestational age are at risk of larger waist circumference and a higher BMI as adults. This is due to change in gene programming while the baby is still in the womb.

**Genetics and familial causes:** Genetics affects hormones involved in fat regulation and if both parents are obese the likelihood of obesity is more in children. Familial history can also be linked to the family’s eating pattern and parents’ own eating behaviours and child-feeding practices.

**Socio economic status:** Obesity was known to be common in prosperous countries and people from higher socio-economic status of developing countries, owing to the higher
accessibility and availability of food. Financial security may lead to indulgence in calorie dense fast foods and a lifestyle involving less of physical activity, use of labour-saving gadgets and increased screen time. However, recent evidence suggests that obesity prevalence cuts across socio-economic status and is gradually on the rise.

**Dietary pattern:** Over the past few decades, the food and the home environments have changed tremendously. Our modern eating environment has had an effect on the way the people eat. Fast food outlets and conveniently available food has led to availability of foods high in fats, sugar and energy. The portion sizes have increased, and people are making unhealthy food choices.

**Sleep:** Insufficient sleep is now linked to metabolic disorders. It has been observed that short sleepers may be obese and short sleeping adults/children may suffer from obesity related disorders (Horne, 2008).

**Physical inactivity:** Besides changes in the nutritional habits, daily physical activities and recreational activities have also changed dramatically over the past two generations. The ubiquity of modern technology and motorization in our life has greatly contributed to a decrease in physical activity and significantly reduced energy expenditure (Corzilius, 2007). Growing urbanization and use of personalized transportation have resulted in children going to school in automated means of transportation. Schoolwork and academic competitiveness have led to reduced physical activity and participation in sports is negligible.

Obesity is associated with diet-related non-communicable diseases (NCDs). Disease conditions like insulin resistance (impaired response of body to insulin), diabetes, dyslipidemias (abnormal amounts of lipids in blood), hypertension (high blood pressure), cardiovascular diseases and certain types of cancer are higher in obese individuals.

**Economics of malnutrition**

The adverse effect of malnutrition is poor health consequences for individuals - impairment of growth and development in children, poor cognitive development and as a result reduced chances of succeeding in life. Poor education usually results in poor job prospects and reduced earning capacity, thus perpetuating the vicious cycle of poverty and malnutrition. Let us discuss the economic impact of malnutrition in greater detail.

**Impact on individuals: Impaired physical growth and cognitive development**

Early-life undernutrition and its effects often persist life-long, leaving the individual susceptible to infectious diseases, impaired physical growth, impaired cognitive development, delayed maturation, lower muscle strength and reduced bone density. Many children are born undernourished because their mothers have poor nutritional status prior to and/or during pregnancy. The nutritional status of women and girls is poor due to limited availability and access to food, traditional and cultural practices - women eat the last and least, early marriage, repeated pregnancies and frequent infections along with poor access to health care and sanitation. This phenomenon is known as the 'Inter-generational' cycle of malnutrition.
Impaired physical growth reduces work capacity, labour productivity and increases absenteeism from work. This results in lower income levels, lower standards of living and an overall poorer quality of life. Poor educational performance leads to loss of employment opportunities. This in turn prevents reduction of poverty levels. Loss of productivity due to malnutrition is estimated to be more than 10% of an individual’s lifetime earnings.

Impact at a household, community and country level

Morbidity due to malnutrition has an economic impact at the household and national level. Cost of medical care and hospitalization as well as the resultant loss of earnings can be catastrophic for families living below poverty line. There is also a huge fiscal cost for the government. In terms of medical and social care needed, increased morbidities put a strain on national health care and welfare systems.

A study found that stunting resulting in 1% loss in adult height is associated with a 1.4% loss in productivity. The loss in adult income from being stunted may be up to 22%. Malnourished and weak adults have lower manual productivity particularly in the agricultural and other manual or labor-intensive sectors. Another study observed that elimination of anemia can lead to 5-17% increase in adult productivity.

According to another report by Save the Children (Crosby et al, 2013), economic cost of micro-nutrient malnutrition for India is between 0.8 per cent and 2.5 per cent of its GDP, which is equivalent to $15-46 billion.

India faces the human and economic threat posed by NCDs. NCDs account for about 40% of all hospital stays and roughly 35% of all recorded outpatient visits. NCDs not only affect health, but also productivity and economic growth. The probability of dying during the most productive years (ages 30-70) from one of the four main NCDs is a staggering 26%. India stands to lose $4.58 trillion before 2030 due to NCDs and mental health conditions. Cardiovascular diseases, accounting for $2.17 trillion, and mental health conditions ($1.03 trillion), will lead the way in economic loss (Bloom et al., 2014).

Initiatives for tackling malnutrition

Nutrition is a multisectoral problem. Solving the issue of malnutrition is a challenging but not insurmountable feat as the causative factors are interactive and complex.

In 2012, the World Health Assembly identified six global nutrition targets- reducing stunting and wasting in children under 5 years, halting the obesity epidemic, reducing anemia in reproductive age women, reducing low birth weight and increasing exclusive breastfeeding rates. In 2015, world leaders adopted the Sustainable Development Goals which included the goals to eradicate hunger and end all forms of malnutrition by 2030.

India has implemented several food security programs such as the Mid-Day Meal Program, Annapurna Scheme, Integrated Child Development Services scheme, Public Distribution System, National Food Security Act, National Horticultural Mission etc. However, despite a decline in rates of undernutrition, malnutrition continues to be a persistent problem in India. Hence a multisectoral solution is required. A holistic approach that allows for physical,
economic, social and ecological access to a macro and micronutrient replete diet is required. This approach should include a partnership between all stakeholders i.e. governments, UN agencies, NGOs, food industries, researchers, farmers and civil society. Malnutrition should be tackled at the farm, processing and consumption stages.

Social safety net schemes have an important role to play in promoting the ‘Eat Healthy’ philosophy. Table 2 outlines the beneficiaries and the provisions of three large scale food security programs.

**Table 12.2: Food Security Programs and Schemes in India**

<table>
<thead>
<tr>
<th>(A) INTEGRATED CHILD DEVELOPMENT SERVICES (ICDS): WHAT IS IT?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Flagship programme for early childhood care and development</td>
</tr>
<tr>
<td>• Launched on 2nd October 1975</td>
</tr>
<tr>
<td>• Now governed by provisions of National Food Security Act (2013)</td>
</tr>
<tr>
<td>• Target beneficiaries: Children between 6 months to 6 years, Pregnant women &amp; Lactating mothers</td>
</tr>
<tr>
<td>• Number of beneficiaries as of 31st March 2019:</td>
</tr>
<tr>
<td>a) Operational Anganwadi centres: 13,72,872 (13.72 lakhs)</td>
</tr>
<tr>
<td>b) Number of children between 6 months to 3 years: 39,58,4766</td>
</tr>
<tr>
<td>c) Number of children between 3 years to 6 years: 30,78,9356</td>
</tr>
<tr>
<td>d) Number of children between 6 months to 6 years: 70,37,4122</td>
</tr>
<tr>
<td>e) Number of Pregnant women and Lactating mothers: 17186549</td>
</tr>
<tr>
<td>f) Total beneficiaries: 87,56,0671</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTEGRATED CHILD DEVELOPMENT SERVICES (ICDS): WHY IS IT IMPORTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ICDS scheme offers a package of six services including supplementary nutrition and nutrition and health education</td>
</tr>
<tr>
<td>• The scheme is jointly administered by Ministry of Women and Child Development (three services) and the Ministry of Health &amp; Family Welfare (three services)</td>
</tr>
<tr>
<td>• Under the National Food Security Act (2013), the supplementary nutrition provisions are entitled for every pregnant woman and lactating mother till six months after child birth; and for every child in the age group of 6 months to 6 years (including those suffering from malnutrition) for three hundred days in a year</td>
</tr>
<tr>
<td>• Supplementary nutrition categories:</td>
</tr>
<tr>
<td><strong>Beneficiary</strong></td>
</tr>
<tr>
<td>Children between 6 months to 3 years</td>
</tr>
<tr>
<td>Malnourished children between 6 months to 3 years</td>
</tr>
<tr>
<td>Children between 3 years to 6 years</td>
</tr>
<tr>
<td>Malnourished children between 3 years to 6 years</td>
</tr>
<tr>
<td>Pregnant women and Lactating mothers</td>
</tr>
</tbody>
</table>
INTEGRATED CHILD DEVELOPMENT SERVICES (ICDS): TELL ME MORE

- The ICDS scheme addresses inter-generational cycle of malnutrition by improving nutritional and health status of pregnant women and lactating mothers. It also reduces the risk of malnutrition associated/linked morbidity and mortality amongst children between 6 months and 6 years of age.
- Nutrition education to promote the use of healthy balanced diets through dietary diversification is an important component of different Government programmes such as POSHAN Abhiyaan and Anganwadi Services.
- Ministry of Women and Child Development has advised all the States/UTs to ensure use of relevant fortified food articles (wherever supplied) in the administration of the Supplementary Nutrition Programme.
- Use of iodized salt is mandatory for cooking the food under supplementary nutrition programme.

(B) MID-DAY Meal (MDM) Scheme: WHAT IS IT?

- Largest school feeding programme launched with a view to enhance enrolment, retention, attendance and simultaneously improve nutrition levels amongst school going children.
- Launched as centrally sponsored scheme (National Programme of Nutritional Support to Primary Education) on 15th August 1995.
- Target beneficiaries: 9.12 crore primary and upper primary school children in the age group of 6-14 years.

MID-DAY Meal (MDM) Scheme: WHY IS IT IMPORTANT?

- The scheme is administered by Ministry of Human Resource Development.
- Food norms under the scheme are as follows:

<table>
<thead>
<tr>
<th>Primary students (class I to V)</th>
<th>Upper primary students (class VI to VIII)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100g food grains</td>
<td>150g food grains</td>
</tr>
<tr>
<td>20g Pulses</td>
<td>30g Pulses</td>
</tr>
<tr>
<td>50g Vegetables</td>
<td>75g Vegetables</td>
</tr>
<tr>
<td>5g Oil and Fat</td>
<td>7.5g Oil &amp; Fat</td>
</tr>
<tr>
<td>Salt &amp; Condiments (As needed)</td>
<td></td>
</tr>
</tbody>
</table>

- The MDM guidelines are designed in such a manner that children get sufficient amount of carbohydrates, proteins and micronutrients such as iron and folic acid.
- The primary school children are provided with 450 calories and 12g protein while children in upper primary classes get 700 calories with 20g protein.
- MDM scheme addresses the issue of hunger and protein-energy malnutrition amongst the age group of 6-14 years thereby positively impacting learning outcomes in school.
- Vegetables (sourced locally by schools) can be a good source of vitamins, minerals, phytochemicals and fiber in the meal. Vegetables with high Vitamin C content can also alleviate iron deficiency by boosting the absorption of iron from the meal.
- After infancy, children in school going age experience the second growth spurt up to late adolescence i.e. 19 years. This is a crucial phase for nutrition intervention to correct height deficits.
• The school health programme administered by National Health Mission (Ministry of Health and Family Welfare) compliments the MDM scheme through services such as Immunization, Micronutrient supplementation, De-worming, Health promotion, Capacity building of school teachers.

**MID-DAY Meal (MDM) Scheme: TELL ME MORE**

• Rice constitutes ~85% of the food grains consumed through MDM. Fortification of food items in a systematic manner through Food Corporation of India (FCI) (starting with rice) has been approved for MDM. Kitchen gardens are also being promoted in each school.

• As per guidelines on food safety and hygiene for school kitchens in MDM scheme issued by Ministry of Human Resource Development dated 13th Feb 2015, the States/UTs must consider engaging CSIR institutes/NABL accredited laboratories and FSSAI notified laboratories for testing of MDM food samples for microbiological and chemical parameters.

• The testing charges for protein and calories have been fixed as INR 1200 (excluding taxes) for MDM meals vide order number 15022/01/2019-QA dated 8th April 2019.

**(C) PUBLIC DISTRIBUTION SYSTEM (PDS): WHAT IS IT?**

• Launched as ‘Targeted’ public distribution system (TPDS) scheme in June 1997

• Operated under the joint responsibility of Central government and State/Union Territory governments

• Now governed by provisions of National Food Security Act (July 2013)

• Target beneficiaries: 75% rural and 50% urban population; coverage of almost two-thirds (80.5 Crore persons) of the total population at an all India level under two categories: Antodaya Anna Yojana (AAY) and Priority Households (PHH)

**PUBLIC DISTRIBUTION SYSTEM (PDS): WHY IS IT IMPORTANT?**

• TPDS is administered by Department of Food & Public Distribution (Ministry of consumer affairs, food and public distribution) with a vision to ensure food security for the citizens

• Subsidized food grains are provided to identified eligible households as per the following entitlement norms:

<table>
<thead>
<tr>
<th>Category of beneficiary</th>
<th>Number of Households</th>
<th>Foodgrains entitlement (per month)</th>
<th>Issue price (per kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAY</td>
<td>2.5 crores</td>
<td>35kg per family</td>
<td>Rice: Rs 3, Wheat: Rs 2, Coarse grains: Rs 1</td>
</tr>
<tr>
<td>Priority households</td>
<td>16.1 crores (approx.)</td>
<td>5kg per person</td>
<td>Rice: Rs 3, Wheat: Rs 2, Coarse grains: Rs 1</td>
</tr>
</tbody>
</table>

• In 2018, India ranked 103 (of the 119 countries) on the Global Hunger Index. The index includes measurement of ‘inadequate’ food supply which is an important indicator of hunger.

**PUBLIC DISTRIBUTION SYSTEM (PDS): TELL ME MORE**

• Rice forms >50% of the food grains distributed through PDS. Government of India has approved the centrally sponsored pilot scheme on ‘Fortification of Rice and distribution under Public Distribution System’ on 14th February 2019. The rice would be fortified with Iron, Folic acid and Vit B12. The pilot scheme has been approved for an initial period of three years beginning 2019-20 with a focus on 15 districts to begin with.
Policy level reforms

**Poverty reduction**: Increased purchasing power will allow people to consume a more diversified diet that incorporates foods rich in fruits, vegetables and protein. Effective implementation of employment programs such as the National Rural Employment Guarantee Act (NREGA) and increased investment in skill development programs will help reduce rates of unemployment and consequently lead to a reduction in household food insecurity.

Let us discuss how the existing programs can be implemented more effectively, the food environment improved as well as other efforts needed to tackle the problem of malnutrition in India.

**Restructuring of existing programs**: More effective implementation and monitoring of existing programs, particularly the Public Distribution System, is required. Decentralization of programs, increasing the diversity of foods provided by subsidy programs, increased funding, scaling up of successful pilot programs, and enabling vulnerable individuals to access their benefits is required. Existing health and nutrition programmes need to be reoriented to also target the challenges of rise in NCDs. Prevention and early detection of NCDs will help in more effective management. The infection-malnutrition cycle can be prevented by improving health infrastructure and sanitation services.

**Agricultural reforms**: India was able to attain self-sufficiency in food production by land reforms, irrigation programs, subsidies and incorporation of new technologies. While ensuring food production continues to keep pace, new issues like climate change, low crop diversity, indiscriminate use of chemical fertilisers and pesticides, improper use of available water, unavailability of water, loss of soil quality, fluctuating crop prices, and financial struggles of farmers, need to be addressed. Improving processing and storage methods to reduce wastage at the farm gate and investment in new farming technologies are other areas that need attention.

**Education**: Consumer behaviour patterns need to be modified. Educating the consumer about an adequate diversified diet, cooking and processing techniques to improve nutrient retention, infant child feeding practices, lifestyle, and sanitation is required. This can be provided by family counselling, local community campaigns, mass media campaigns and school-based interventions. Panchayats, NGOs and Self-Help Groups do play an important role in dissemination of information. In addition, people should also be educated regarding health and nutrition programs that they are eligible for to ensure proper utilization of the available schemes.

**Supplementation programs**: Supplementation programs such as the Mid-Day Meal (MDM) program and Integrated Child Development Services (ICDS) in vulnerable populations such as children, pregnant women, lactating women, and the elderly may help reduce nutrient gaps. Provision of fortified foods or food supplements such as fortified complementary foods, multiple micronutrient powders, iron fortified cereals, and lipid based nutrient supplements can be useful in combating micronutrient deficiencies such as iron deficiency anaemia. In recent years, the Food Safety and Standards Authority of India (FSSAI) has nudged various stakeholders to increase the development and use of fortified staples such as oil, salt, milk, wheat flour and rice. Fortified foods have now been incorporated into the Public Distribution System, MDM, and ICDS schemes by various state governments.
**Intersectoral coordination**: The nutritional policies and programs currently available often fall under the aegis of multiple government agencies such as Health and Family Welfare, Women and Child Welfare, Human Resource Development etc. Policies are formulated centrally but implementation is at the state level. Collaborations with environment, forests, agriculture, and public works sectors will help to appropriately tailor programs to the specific region. Such efforts have already been initiated. FSSAI has introduced initiatives such as the Eat Right movement which involves collaborations between Civil Society Organizations, Industry and Professional Associations, NGOs, national and international agencies, academia and corporates. Food safety and nutrition resources are being integrated into existing central and state programs.

India currently faces the triple burden of malnutrition. Access to an adequate, safe, and nutritious diet is a basic human right. Food security is vital to ensure optimal growth and development, maintenance of health, improved productivity and sustainable development of the nation. Malnutrition is a multifaceted problem which can only be combated by an integrated multi sectoral approach.

India contributes to 18% of the world population and is projected to surpass China as the world’s most populous country by 2027. Several strides have been made but there are miles to traverse and further actions are required to ensure that India and the global community meets the commitment to Sustainable Development Goals.

**Summary**

- Food is a common point between agriculture, nutrition and health. It serves as the output of agricultural activities and subsequently plays a major role as a carrier of nutrients thereby resulting in either positive or negative health outcomes depending on how it is consumed.
- A diet consisting of foods from various food groups (cereals, millets and pulses, fruits and vegetables, milk, egg and flesh foods, fats and sugars) typically provides most of the daily requirement of nutrients (carbohydrates, fats, protein, minerals and vitamins).
- The right food choices practiced consistently over a period of time lead to achievement of health goals specific to different stages of life.
- Poor or unhealthy diets often lead to negative health outcomes - undernutrition, overnutrition and micronutrient deficiencies.
- There has been an epidemiological shift in causes of mortality and morbidity - from communicable (infectious) diseases to non-communicable diseases. Diet-related non-communicable diseases include type 2 diabetes, hypertension, heart disease, stroke and certain cancers.
- The shift has been related to agricultural transformation, urbanization, changes in the food environment, physical activity levels and health care infrastructure.
- There are several causes of malnutrition.
• Indicators of undernutrition include underweight, stunting and wasting/thinness. BMI is a useful indicator of weight status.

• Malnutrition impairs physical growth and cognitive development in individuals.

• Morbidity due to malnutrition has an economic impact at the household and national level. Cost of medical care and hospitalization as well as the resultant loss of earnings can be catastrophic for families living below poverty line. There is also a huge fiscal cost for the government.

• In terms of medical and social care needed, increased morbidities put a strain on national health care and welfare systems.

• India has implemented several food security programs such as the Mid-Day Meal Program, Annapurna Scheme, Integrated Child Development Services scheme, Public Distribution System, National Food Security Act, National Horticultural Mission etc.

• Several measures are needed to transform the food ecosystem and existing programs to intensify the fight against malnutrition. These involve restructuring of existing programs, agricultural reforms, behaviour change communication, focussing on micronutrient malnutrition in the food supplementation programs and intersectoral coordination.

Key Words

**Anthropometry** – study of measurements of the human body

**BMI** – Body Mass Index, an indicator of weight status of the body

**Dyslipidemias** - elevated total or low-density lipoprotein (LDL) cholesterol levels, or low levels of high-density lipoprotein (HDL) cholesterol

**GDP** – Gross Domestic Product which measures the value of economic activity within a country

**Hypertension** - condition in which the blood pressure in the arteries is persistently elevated.

**Insulin resistance** - impaired response of body to insulin

**Low birth weight** – birth weight less than 2500g

**Morbidity** – the rate of disease in a population

**Mortality** - death

**NCD** - non-communicable diseases like cardiovascular diseases, diabetes, cancer, etc.

**Stunting** – low height for age

**Wasting** – low weight for height
Exercises

1. Describe the relationship between the food you eat and the status of your health.

2. Give reasons why we see a shift in causes of mortality and morbidity from communicable to non-communicable diseases.

3. Discuss the basic, underlying and immediate causes of undernutrition.

4. What are the best anthropometric indicators to study the prevalence of undernutrition among children in a community?

5. Discuss the economic cost of malnutrition on the individual and the nation.

6. Who are the beneficiaries and what are the provisions of the following food security schemes of the government?
   a. ICDS
   b. MDM
   c. TPDS

7. Discuss measures to intensify the efforts to reduce the prevalence of malnutrition in India.

References


16. WHO. Fact Sheets on Physical Activity. Available at https://www.who.int/news-room/fact-sheets/detail/physical-activity
Chapter 13: Healthy Diets for All

- **Basic concept of food and nutrition**
  - Nutrients, Food groups and Balanced diets
  - Food Based Dietary Guidelines
  - Nutrient Requirements

- **Macronutrients**
  - Water
  - Carbohydrate
  - Protein
  - Fat

- **Micronutrients**
  - Water soluble
  - Fat Soluble
  - Minerals

- **Other bioactive substances**

- **Enhancing the quality of diets**
  - Short term intervention - Supplementation
  - Medium term intervention - Food Fortification
  - Long term intervention - Dietary Diversification
  - Others
Chapter 13: Healthy Diets for All

Food is necessary for survival. All organisms consume food for the energy and nutrients it provides. However, the basic biology underlying food intake is also closely linked to pleasure. Hence, we continue to eat food even when satiated knowing well that most of the highly palatable foods may not be the most wholesome. Our desire to eat these foods is also dependent on several influences in our modern food environment, like cost, availability, convenience and social influences.

It is known that even though food is essential for survival, not all foods are created equal. An appropriate knowledge related to food and its constituent nutrients is necessary to ensure good health. Nutrients are those constituents of food that give nourishment essential for the maintenance of life, growth and development. Most foods contain nearly all nutrients, some being in higher proportions and some lesser. Some nutrients are needed in larger amounts by the body and are hence called macronutrients; while some, though being essential, are needed in smaller amounts, these are called micronutrients. It is important to obtain the right proportion of nutrients from the foods consumed. The following discussion will highlight the different nutrients and their role in health and well-being. This chapter will also help in understanding different concepts that could be used to enrich our diets.

Basic concept of food and nutrition

It is well known that for survival, the human organism needs to take in oxygen, water, and food. We can survive only about three minutes without air, three days without water, and three weeks without food (Towell, 2011). Food is the source of nutrients which are essential for growth, reproduction and good health.

Nutrients, Food groups and Balanced diets

Nutrients are the constituents of food that is required by the body in appropriate amounts. Broadly, nutrients can be classified as:

- **Macronutrients** – These are required by our body in large quantities (measured in grams) and include proteins, carbohydrates, fats and water.
- **Micronutrients** – These include vitamins and minerals and are required by our bodies in relatively smaller quantities (measured in milli or micrograms) but are essential for various body processes.

The requirement of these nutrients varies throughout the lifecycle depending on the need and nutritional status of an individual. Nutritional status is the condition of health which is influenced by the utilization of nutrients. The key to achieve a good nutritional status is to consume a balanced diet. A balanced diet is one that contains all types of food in such quantity and proportion that meets all needs of the body adequately. The quantities of foods needed to meet the nutrient requirements vary with age, gender, physiological status and physical activity. A balanced diet should provide around 55-60% of total calories from
carbohydrates, preferably from complex carbohydrates, about 10-15% from proteins and 20-30% from fat.

In addition, a balanced diet should provide other non-nutrients such as dietary fibre, antioxidants and phytochemicals which bestow positive health benefits. Antioxidants such as vitamins C and E, beta-carotene, riboflavin and selenium protect the human body from free radical damage. Other phytochemicals such as polyphenols, flavones, etc., also afford protection against oxidative damage. Spices like turmeric, ginger, garlic, cumin and cloves are rich in antioxidants. Foods are conventionally grouped as:

1. Cereals and Millets
2. Pulses
3. Milk and milk products, Egg, Meat and Fish
4. Vegetables and Fruits
5. Oils and Fats, Nuts and Oilseeds, and Sugars

However, foods may also be classified according to their functions - energy giving, body building and protective foods. Energy giving foods mainly include cereals, fats and sugars; body building food groups are pulses, milk and milk products, meat, fish, poultry and eggs; and, protective foods include mostly fruits and vegetables, though other food groups also contribute vitamins and minerals to the diet.

The relationship between food and health is complex. Everyone needs food to live, but too little food, too much food, or the wrong type of food has negative consequences for health. Improving eating habits is not just for an individual but for the whole population. ICMR-NIN has introduced the concept of ‘My Plate for the Day’ (figure 1) to fight hidden hunger. The plate is half filled with fruits and vegetables. A major portion of the remaining half is cereals, millets and pulses. Small amounts of fats, oils, nuts and oilseeds are also included along with one glass/cup of milk/curd.
While planning a diet the dietary goal should focus on maintenance of a state of positive health and optimal performance. It should ensure adequate nutritional status by achieving adequacy in all nutrients, prevention of deficiency diseases, prevention of chronic diet-related disorders and increasing the life expectancy.

**Food Based Dietary Guidelines**

Right nutritional behaviour and dietary choices are needed to achieve dietary goals. The following 15 dietary guidelines provide a broad framework for appropriate action (ICMR/NIN 2011):

1. Eat variety of foods to ensure a balanced diet.
2. Ensure provision of extra food and healthcare to pregnant and lactating women.
3. Promote exclusive breastfeeding for six months and encourage breastfeeding till two years or as long as one can.
4. Feed home based semi-solid foods to the infant after six months.
5. Ensure adequate and appropriate diets for children and adolescents, both in health and sickness.
6. Eat plenty of vegetables and fruits.
7. Ensure moderate use of edible oils and animal foods and very less use of ghee/ butter/ vanaspati.
8. Avoid overeating to prevent overweight and obesity.
9. Exercise regularly and be physically active to maintain ideal body weight.
10. Restrict salt intake to minimum.
11. Ensure the use of safe and clean foods.
12. Adopt right pre-cooking processes and appropriate cooking methods.
13. Drink plenty of water and take beverages in moderation.
14. Minimize the use of processed foods rich in salt, sugar and fats.
15. Include micronutrient-rich foods in the diets of elderly people to enable them to be fit and active.

**Nutrient Requirements**

Requirements are the quantities of nutrients that healthy individuals must obtain from food to meet their physiological needs. These have been defined at different levels - the Estimated Average Requirements (EAR), the Recommended Dietary Allowances (RDAs) and the Tolerable Upper Intake Levels (TUL).

<table>
<thead>
<tr>
<th>Terms used in the framework of nutrient requirements (ICMR-NIN, 2020)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimated Average Requirement (EAR)</strong> refers to the average daily nutrient intake level estimated to meet the requirements of half of the healthy individuals in a particular life stage and gender group.</td>
</tr>
<tr>
<td><strong>Recommended Dietary Allowances (RDAs)</strong> refer to the daily dietary nutrient intake level that is sufficient to meet the nutrient requirements of nearly all (97–98 percent) healthy individuals in a particular life stage and gender group.</td>
</tr>
<tr>
<td><strong>Tolerable Upper Level (TUL)</strong> refers to the highest average daily nutrient intake level that is likely to pose no risk of adverse health effects to almost all individuals in the general population. As intake increases above the TUL, the risk of adverse effects will increase.</td>
</tr>
</tbody>
</table>
Macronutrients

The macronutrients needed by our body in larger quantities and these include carbohydrates, protein and fats. In addition, water is also considered to be an important nutrient.

Water

Water is the largest component of the human body making up 50 to 70 % of body weight, depending on age and body composition. Water is the medium in which all metabolic processes of our body take place. Water itself participates in several metabolic reactions. It serves as a solvent for vitamins, minerals, amino acids, glucose and many other substances so that they can participate in reactions. It is the medium of all cell fluids, digestive juices, lymph, blood, urine and perspiration, and hence important for the process of digestion, absorption, transport and excretion of nutrients and waste products. Water helps in the regulation of normal body temperature.

Besides plain water, beverages like fruit and vegetable juices, milk, soft drinks and soups also contribute to the total water intake. Water is also present in fruits and vegetables making up most of their weight. Fruits which are juicy have higher water content like watermelon, muskmelon, oranges, etc. Vegetables with a high percentage of water by weight include cucumber, bottle gourd (ghia), green leafy vegetables, etc. Water needs vary with factors such as body size, physical activity and environmental conditions. Adults need at least 2 to 3 litres (8-12 glasses) of fluids per day to replace daily losses. This amount includes pure water and water present in foods and beverages.

Carbohydrates

Carbohydrates are essential for the body as they are a source of readily available energy for the body. These are organic compounds that consist of carbon, hydrogen and oxygen.

Classification

Carbohydrates are of two types - simple and complex. Simple carbohydrates are sugars, such as the ones found in candy, fruits and baked goods. They are called simple sugars because they are made up of one (mono) or two (di) units of sugars (saccharides).

Monosaccharides (simple sugar): These contain one sugar molecule. Glucose -- which is needed by the body for immediate energy is a simple sugar. It is also known as dextrose, grape sugar, and corn sugar. It is about half as sweet as table sugar. Other examples for monosaccharides are fructose (found in fruits and honey) and galactose.

Disaccharides (simple sugar): Disaccharides contain two sugar molecules. Table sugar, or sucrose is a disaccharide, as it consists of glucose and fructose. Other examples are lactose or milk sugar, composed of galactose and glucose; and Maltose made of two glucose molecules.
Cane sugar or sugar and other sweeteners like honey and jaggery are 95 per cent to 100 per cent carbohydrate. Although both honey and sugar provide the same amount of calories, unlike table sugar, honey contains a small amount of vitamins and minerals.

**Complex Carbohydrates** are the ones found in fruits and vegetables, whole grains and pulses. They are basically long chains of several (poly) sugar (saccharide) molecules attached together. Hence, they are called polysaccharides. Examples of complex carbohydrates are starch, glycogen and dietary fibre (pectin, gums, mucilages, cellulose, hemicellulose). **Starch** is a complex carbohydrate and is the storage form of carbohydrate found in plants. It is an important source of energy for animals and humans. Cereal and cereal products, pulses and legumes, roots and tubers are the main source of carbohydrate for Indians. It acts as an excellent source of fuel (energy) for the body. **Glycogen** is the form of carbohydrate stored in the body in animals.

**Dietary fibres** are complex carbohydrates that cannot be digested by human enzymes. Cellulose is the main structural component of plant cell walls and is referred to as insoluble dietary fibre. Pectin is also a complex carbohydrate found in ripe fruit and vegetables and is referred to as soluble dietary fibre. It helps to set jams and jellies. Both soluble and insoluble dietary fibre help in regulating many body processes, including body weight, bowel movement, blood sugar, blood pressure and blood cholesterol.

So, it can be said that carbohydrates are important components of the diet. While simple sugars and many refined foods like flour provide readily available energy/calories, many of these foods lack vitamins, minerals, and fibre. These "empty calories" and can lead to weight gain. In 2015, the World Health Organization (WHO) set upper limits by recommending that the intake of free sugars be less than 10% of the total energy intake (strong recommendation) and a further reduction to less than 5% of total energy intake (conditional recommendation) throughout the lifespan for preventing both dental caries and obesity. Thus, it is healthiest to get carbohydrates from as natural a form as possible -- for example, from fruit instead of table sugar, or from whole wheat flour instead of maida.

**Functions**

Some of the important functions of carbohydrates are listed below:

- The main function of the carbohydrate is to provide energy. One gram of carbohydrate yields 4 kcal (17 kJ) of energy. Some amount of carbohydrate is stored as glycogen in the liver and muscles for immediate conversion to glucose/energy. Brain and the central nervous system use only glucose as their source of energy.

- Fibre, or complex carbohydrates, can absorb water, prevent constipation and other bowel disorders, provide a feeling of fullness and control hunger. Fibre plays a role in prevention of diseases like cancer of colon i.e. the large intestine, diabetes (by...
lowering blood glucose levels) and heart disease (by lowering blood triglyceride and cholesterol levels).

- If taken in sufficient quantity, carbohydrates are preferentially used as a source of energy thus sparing proteins for their function of growth and maintenance.

**Food sources**

Milk, yogurt, and other milk products are a source of lactose; fruits, some vegetables and their juices are a source of fructose, glucose and sucrose; bread, rice, wheat and other cereals, legumes and pulses, starchy vegetables are a source of starch and fibre; processed food items like sweets, cookies, sweetened beverages and other desserts are a rich source of sucrose.

Carbohydrates are thus an important component of our diet and we must ensure that 55 to 60% of our daily calories are provided from an intake of healthy carbohydrates.

**Proteins**

The English word protein originated from the Greek word “proteios”, meaning prime or primary. This term is very appropriate in nutrition, because proteins are the primary structural and functional component of every living cell. Like carbohydrates, they are organic compounds, but are distinct from carbohydrates as they have nitrogen along with carbon, hydrogen and oxygen in their structure. A protein molecule is made up of tiny units called amino acids. Amino acids are linked together in chains by linkages called peptide linkages. All proteins are built up of just 20 kinds of amino acids.

The biological value of proteins is dependent upon combinations of amino acids that build up any particular protein. There are nine amino acids that are essential to human health and nutrition. They are essential because they cannot be synthesised in the body and must be supplied by the protein in the diet. The nine essential amino acids are: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. Thus, the content, digestibility coefficients, and relative proportions of amino acids in dietary protein are the determinants of its nutritional value.

**Classification**

The proteins can be classified on the basis of their amino acid content as:

**Complete protein**: Any food that has all the essential amino acids in the right proportions is called a complete protein food. These are high quality proteins which promote growth and maintain life. Animal proteins, such as eggs, cheese, milk, meat, and fish, are considered high-quality, or complete proteins because they provide sufficient amounts of the essential amino acids and hence are superior to plant protein foods. The protein content of soybean is exceptionally high.
**Partially complete protein:** Plant proteins are of lower-quality, or partially complete proteins because many plant proteins lack one or more of the essential amino acids. Partially complete proteins can, however, be combined with other foods to provide all the essential amino acids. For example, cereals and pulses are deficient in lysine and methionine, respectively. Rice and pulse when taken together improves the quality of protein by supplying these two amino acids and making up for the deficiency. This is called **mutual supplementation.**

**Incomplete protein:** They are completely lacking in one or more of essential amino acids and can neither promote growth nor maintain life, e.g. gelatin (found in bones, cartilage and collagen) and zein (found in corn). Nitrogen liberated by the breakdown of these proteins can be utilized for synthesis of other amino acids in the body.

**Functions**

- Proteins are vital to basic cellular and body functions, including cell regeneration and repair, tissue maintenance and regulation.
- Hormone and enzymes, which are vital for the regulation of metabolism, are protein in nature.
- Even antibodies which protect the body from illness are also proteins.
- Proteins like hemoglobin, lipoproteins perform important body functions.
- Protein can also provide energy if sufficient carbohydrate and fat are not supplied by the diet. Each gram of protein yields about 4 Kcal.

Deficiency of proteins leads to serious illnesses such as impaired mental health, oedema, shrinkage of muscle tissues, as well as weak immune system. Deficiency of both energy and proteins results in protein-energy malnutrition (PEM). It is characterized by a group of related disorders that include marasmus, kwashiorkor and intermediate states of marasmic-kwashiorkor.

Children with kwashiorkor have nutritional oedema, skin and hair changes, metabolic disturbances, including hypoalbuminemia (low protein in the blood) whereas marasmus is characterized by severe wasting.
Food sources

Protein is found in foods from both animal and plant sources. Good sources of protein include meat, poultry, fish, milk, egg, and cheese, as well as legumes and pulses. Protein content of some foods is given in Table 1.

Table 13. Protein content of some foods (g/100 g of foodstuff)

<table>
<thead>
<tr>
<th>Food from animal sources</th>
<th>Protein (g)</th>
<th>Food from plant sources</th>
<th>Protein (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken, leg</td>
<td>19.44</td>
<td>Peas (dry)</td>
<td>20.43</td>
</tr>
<tr>
<td>Goat chops</td>
<td>20.39</td>
<td>Lentils</td>
<td>24.35</td>
</tr>
<tr>
<td>Fish (Hilsa)</td>
<td>21.8</td>
<td>Cowpea</td>
<td>21.25</td>
</tr>
<tr>
<td>Eggs</td>
<td>13.28</td>
<td>Cashew Nut</td>
<td>18.78</td>
</tr>
<tr>
<td>Paneer</td>
<td>18.86</td>
<td>Groundnuts</td>
<td>23.65</td>
</tr>
<tr>
<td>Milk</td>
<td>3.26</td>
<td>Soybean</td>
<td>37.8</td>
</tr>
</tbody>
</table>


Fats or Lipids

Fats are organic compounds that are made up of carbon, hydrogen, and oxygen. A typical fat molecule is made of one molecule of glycerol and three molecules of fatty acids. It is also called triglyceride or triacylglycerol.

Classification

Fats or the fatty acids they are made of can be classified as:

- Essential and non-essential fatty acids
- Saturated and unsaturated fats
- Visible and invisible fats

Some fatty acids are called essential as they cannot be synthesised in our body and must be an essential part of our diet. Examples are linoleic acid (omega 6) and linolenic acid (omega 3); whereas fatty acids which can be synthesised in the body are termed as non-essential fatty acids like stearic acid, palmitic acid, etc.

Saturated fats have single bonds between their molecules and are "saturated" with hydrogen molecules. They tend to be solids at room temperature, such as ghee, butter, coconut oil.

Unsaturated fat: Unsaturated fats contain one or more double or triple bonds between the molecules. Most of these are found in vegetable oils. These fats are liquid at room temperature. They are also found in certain foods. This group is further classified into two
categories called monounsaturated fats (having one double bond) and polyunsaturated fats (having two or more double bonds).

Fat naturally present in foods and our body exists as the cis isomer. During the process of hydrogenation trans fats are formed. Hence partially hydrogenated oil (e.g. vanaspati, margarine, bakery fat) would have some trans fats. Some meats and dairy products contain small amounts of trans fats which have been formed due to microbial conversion, but mostly they are usually found in processed foods. Examples of food products that may contain trans fats include bakery products like cookies, doughnuts, and fried foods like namkeens, samosas etc. Trans fats should be completely avoided in the diet as they are harmful for health.

Fat is also present in almost all food stuffs. Cereals, pulses, nuts and oilseeds, meat, fish, poultry have fat in them. They are called invisible fats as we cannot see the fat. Visible fats are fats which are added to foods like butter, cooking oil, ghee, etc. and can be seen.

**Functions**

- Fat is a concentrated source of energy. Each gram of fat provides approximately 9 kcal.
- Fats provide satiety and palatability to the diet.
- Fat serves as a carrier of fat-soluble vitamins in the body and also helps in their absorption.
- Fat is stored under the skin and thus it checks the loss of heat from the body and keeps the body warm.
- It is also present around the vital organs of the body such as kidney and the heart and thus protects them from external injury.
- Fat serves as a source of essential fatty acids which have important functions in our body.

It is recommended that not more than 30% of a person's daily calories should come from fat; and less than 10% from saturated fats. Dietary cholesterol comes exclusively from animal sources. It is an important component of cell membranes and a precursor of bile acids, steroid hormones and vitamin D. A mix of different vegetable oils should be consumed to attain a good fatty acid profile. High fat diets lead to obesity and associated non-communicable diseases like cardiovascular diseases, diabetes and certain cancer.
Food Sources

Rich Sources of different types of fats are given in Table 2:

Table 13.2: Food Sources of Different Types of Fats

<table>
<thead>
<tr>
<th>Type of Fat</th>
<th>Food Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturated fat</td>
<td>Animal sources include meat and dairy products, such as: cheese, butter, cream, high-fat cuts of meat. Plant sources include coconut oil, palm oil.</td>
</tr>
<tr>
<td>Monounsaturated fat</td>
<td>Red palm, palmolein, groundnut, sesame, olive, rice bran and cottonseed oil</td>
</tr>
<tr>
<td>Polyunsaturated fat</td>
<td>All vegetable oils except for coconut oil, especially corn oil, safflower and sunflower oils, fish oil</td>
</tr>
<tr>
<td>Omega 3 fatty acids</td>
<td>Fatty cold water fish (salmon, tuna, sardines, mackerel) and fish oils, invisible fat of legumes like rajmah, cowpea, soyabean, black gram, cereals like wheat and bajra, mustard and fenugreek leaves and seeds, green leafy vegetables, canola, mustard and soyabean oils, flaxseed, walnuts.</td>
</tr>
<tr>
<td>Trans fat</td>
<td>Hydrogenated or partially hydrogenated vegetable oil, vanaspati, margarine, bakery shortening/fat</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>Egg yolk, organ meats (liver, kidney, brain, etc), milk fat, red meat, shrimp, prawn</td>
</tr>
</tbody>
</table>

Source: Ross et al, 2014; Mudambi and Rajagopal, 2012; Chadha and Mathur, 2015; Roday, 2018

Micronutrients

Nutrients which are required by the body in relatively lesser amounts are called micronutrients. Vitamins and minerals fall under this category. The requirements in terms of amounts may be small, but most vitamins and minerals have very important roles to play in health and well-being.

Vitamins

Vitamins are organic nutrients that are essential for carrying out several regulatory functions in the body. Vitamins are classified as water soluble and fat – soluble vitamins, based on their solubility in water and fats respectively.

Fat soluble vitamins: Vitamins which are soluble in fats are called fat soluble vitamins. There are four fat soluble vitamins – vitamin A, vitamin D, vitamin E and vitamin K. These vitamins can be stored in the body, hence excessive intake could be toxic. Table 3 gives in brief the main functions of each of these fat-soluble vitamins along with some examples of their food sources and deficiency signs and symptoms.
<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Function</th>
<th>Sources</th>
<th>Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>- Normal vision in dim light. - Maintains a healthy epithelium, especially the membranes that line the eyes, mouth, the gastrointestinal, respiratory and genitourinary tracts. This resists bacterial invasion and thus vitamin A gives protection against infection. - Essential for normal skeletal and tooth development. - Keeps the skin healthy. - Essential for the normal development of foetus.</td>
<td>Retinol (animal sources: fortified milk, cheese, cream, butter, eggs, liver, fish oil Beta-carotene (plant sources): Dark green leafy vegetables; yellow-orange fruits (apricots, papaya, mango) and vegetables (carrots, sweet potatoes, pumpkin)</td>
<td>- Xerophthalmia: Night blindness Conjunctival xerosis (dryness of the conjunctiva), Bitots spots (foamy spots on the conjunctiva) and keratomalacia which may lead to blindness. - Keratomalacia: degeneration and keratinization of the epithelium. - Follicular Hyperkeratosis: Skin changes, skin becomes rough, dry and scaly.</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>- Regulates the absorption and utilization of calcium and phosphorus from the intestinal tract. - Along with calcium and phosphorus forms bones and teeth makes them healthy and strong. - It regulates the amount of calcium and phosphorus in blood and promotes reabsorption of calcium and phosphorus in kidney.</td>
<td>Egg yolks, liver, fatty fish, fortified milk, fortified margarine. When exposed to sunlight, the skin can make vitamin D.</td>
<td>Rickets in Children: a condition in which the level of calcium and phosphorus is low causing knock knees, bow shaped legs and rachitic rosary (swelling or expansion of ends of ribs). Softening of the skull, and delayed closing of the fontanelles. Tetany: Low serum calcium level, causes trembling in hands and sometimes cramps and convulsions in children. Osteomalacia, in adults: bones become soft, fragile and susceptible to fracture. There is bone pain and difficulty in walking and climbing stairs.</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Polyunsaturated plant oils (soybean, corn, cottonseed, safflower); leafy green vegetables; wheat germ; whole-grain products; liver; egg yolks; nuts, legumes and seeds</td>
<td>Vitamin E deficiency is very rare. - Increased haemolysis (break down) of the red blood cells leading to anemia. - Repetitive abortions or premature births. - Weakening of muscles due to the excessiveoxidation of fats.</td>
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<td>-------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Vitamin K</td>
<td>Needed for proper blood clotting. It is also called an Anti-Haemorrhage vitamin.</td>
<td>Leafy green vegetables such as spinach; green vegetables such as broccoli, brussels sprouts, and asparagus; also produced in intestinal tract by bacteria</td>
<td>Usually seen in premature infants, but otherwise rare. May lead to excessive bleeding due to non-formation of blood clot</td>
</tr>
</tbody>
</table>

**Source:** Ross et al, 2014; Mudambi and Rajagopal, 2012; Chadha and Mathur, 2015; Roday, 2018

**Water soluble vitamins:** These vitamins are soluble in water. They cannot be stored in the body and excess are excreted mainly in urine. Vitamin B–complex and Vitamin C are examples of water-soluble vitamins.

**Vitamins of B complex group** include Thiamine, Riboflavin, Niacin, Pantothenic acid, Pyridoxine, Biotin, Folic acid, Folic acid, Cobalamin (B12). Table 4 gives, in brief, the main functions of important water-soluble vitamins along with some examples of their food sources and deficiency signs and symptoms.
Table 13.4: Water-soluble Vitamins- Functions, Sources and Deficiency

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Function</th>
<th>Sources</th>
<th>Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiamine also known as</td>
<td>- Acts as a co-enzyme for an enzyme carboxylase, needed for energy</td>
<td>Found in all foods in moderate amounts: whole-grain legumes, nuts and</td>
<td>Beriberi (dry beriberi mainly the nervous and muscular systems are</td>
</tr>
<tr>
<td>‘anti beri beri’ or</td>
<td>an enzyme carboxylase, needed for energy metabolism; important for nerve</td>
<td>seeds, dried yeast, pork, liver.</td>
<td>affected and wet beriberi affects the neurological and the cardiovascular</td>
</tr>
<tr>
<td>‘anti-neuritic vitamin’</td>
<td>function</td>
<td></td>
<td>systems and it is characterised by oedema)</td>
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<tr>
<td>Riboflavin</td>
<td>- Part of an enzyme needed for energy metabolism; important for vitamin</td>
<td>Dried yeast, milk, liver, meat eggs, kidney and green leafy vegetables.</td>
<td>Ariboflavinosis (inflammation of the tongue, scaling and cracks at the</td>
</tr>
<tr>
<td></td>
<td>and mineral metabolism as well - Some riboflavin dependent enzymes have</td>
<td></td>
<td>corners of the mouth, scaly lesions on the skin)</td>
</tr>
<tr>
<td></td>
<td>an antioxidant role in the body</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niacin</td>
<td>- Part of an enzyme needed for energy (carbohydrate and fat) metabolism</td>
<td>Yeast, poultry, meat, liver, fish, peanuts, whole grains, legumes and</td>
<td>Pellagra characterized by diarrhoea, dementia, dermatitis and ultimately</td>
</tr>
<tr>
<td></td>
<td>- essential for protein metabolism</td>
<td>some green leafy vegetable</td>
<td>death if condition is left untreated. The dermatitis is bilateral and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>worsens on exposure to sunlight.</td>
</tr>
<tr>
<td>Pantothenic acid</td>
<td>- Part of an enzyme needed for energy metabolism</td>
<td>Widespread in foods - Common sources include milk, meat and</td>
<td>Irritability, anorexia, postural hypotension (low blood pressure in</td>
</tr>
<tr>
<td></td>
<td>- It participates in several reactions of synthesis of lipids,</td>
<td>vegetables, peanuts, egg yolk, mushroom, potatoes, tomatoes,</td>
<td>standing position), impaired muscle coordination, numbness and tingling</td>
</tr>
<tr>
<td></td>
<td>neurotransmitters, steroid hormones</td>
<td>broccoli, yeast.</td>
<td>of hands and feet</td>
</tr>
<tr>
<td>Biotin</td>
<td>- Part of an enzyme needed for energy metabolism</td>
<td>Widespread in foods like egg, liver, green leafy vegetables and nuts;</td>
<td>Hair loss, dermatitis (redness and soreness of skin), conjunctivitis,</td>
</tr>
<tr>
<td></td>
<td>- role in regulating gene expression</td>
<td>also produced in intestinal tract by bacteria</td>
<td>lethargy, depression, hallucinations, prickling or tingling sensation of</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>extremities in adults and decreases tone of muscles.</td>
</tr>
<tr>
<td>Nutrient</td>
<td>Function</td>
<td>Sources</td>
<td>Deficiency</td>
</tr>
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<td>-----------------------</td>
<td>--------------------------------------------------------------------------</td>
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<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Pyridoxine (vitamin B6)</td>
<td>- Part of an enzyme needed for amino acid metabolism;</td>
<td>Meat, fish, poultry, nuts, pulses and whole grains, some vegetables, fruits</td>
<td>Inflammation of nerves, anaemia, neurological disorders</td>
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<tr>
<td></td>
<td>- Works with vitamin B12 and folic acid to lower homocysteine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Essential for the synthesis of heme, white blood cells and neurotransmitters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Folic acid</td>
<td>- Essential for maturation of RBCs</td>
<td>Organ meat (liver, kidney), deep green leafy vegetables, yeast, eggs, muscle meats and fish are good sources of this vitamin. Wheat and cereals provide a fair amount</td>
<td>- megaloblastic anaemia (large, immature RBCs) - Deficiency during pregnancy may cause neural tube defects in infants</td>
</tr>
<tr>
<td></td>
<td>- Formation of neurotransmitters.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Required for the synthesis of DNA.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Metabolism of amino acids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobalamin (vitamin B12)</td>
<td>- It helps in metabolizing fats.</td>
<td>Present only in the foods of animal origin.</td>
<td>pernicious anaemia - is associated with nerve degeneration that can result in eventual paralysis and death, megaloblastic anaemia (large, immature RBCs)</td>
</tr>
<tr>
<td>Absorbed in the body only in the presence of an intrinsic factor which is secreted in the stomach</td>
<td>- Essential for the maturation of red blood cells in bone marrow.</td>
<td>Liver, organ meat, muscle meat, fish, poultry, and milk and its products are good sources. It is not found in the foods of plant origin.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Important for nerve health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascorbic acid (vitamin C)</td>
<td>- Formation and maintenance of collagen the cementing material that holds the cells of the body together.</td>
<td>Citrus fruits (oranges, grapes, fruits, lemons and limes) berries, melons, pineapples, guavas, pears, banana, apple, leafy vegetables, capsicum, gooseberry, tomatoes are good source of ascorbic acid. Germination enhances the Vitamin C content of legumes.</td>
<td>Fleeting joint pains, irritability, retardation of growth in infants and children, anaemia, poor healing of wounds and increased susceptibility to infections Gross deficiency results in Scurvy (spongy bleeding gums)</td>
</tr>
<tr>
<td></td>
<td>- Healing of wounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Absorption of iron by the reduction of ferric iron to ferrous ion which is assimilated easily in the body.</td>
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<tr>
<td></td>
<td>- Acts as an antioxidant</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Provides Immunity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Formation of RBC's in bone marrow.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- It is helpful in the formation of hormones</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Chadha and Mathur, 2015; Ross et al, 2014; Mudambi and Rajagopal, 2012; Bamji et al, 2009; Srilakshmi, 2007; Roday, 2018
Minerals

Minerals are inorganic substances required by the body in small amounts and perform a variety of functions. Mainly, minerals are essential components of enzyme systems needed for several body functions. Some minerals are called **macrominerals** as they are needed in larger amounts than others, e.g. calcium, phosphorus, magnesium, sodium, potassium and chloride. Others are required in smaller quantities and are sometimes called **trace minerals**, e.g. iron, zinc, iodine, fluoride, selenium and copper. Despite being required in smaller amounts, trace minerals are no less important than other minerals. These minerals may be needed in very small quantities but having too much or too little can upset a delicate balance in the body. Table 5 and 6 list the functions and sources of important minerals in the body.

Table 13.5: Macrominerals: Function and sources

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Function</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>Maintains proper fluid balance, nerve transmission, and muscle contraction</td>
<td>Table salt, sauces, pickles, papads, chutneys, processed foods; small amounts in milk, breads, vegetables</td>
</tr>
<tr>
<td>Chloride</td>
<td>Maintains proper fluid balance</td>
<td>Table salt, sauces, pickles, papads, chutneys, processed foods; small amounts in milk, breads, vegetables</td>
</tr>
<tr>
<td>Potassium</td>
<td>Maintains fluid balance, muscle contractions and nerve signals, help reduce blood pressure and water retention</td>
<td>Bananas, oranges, grapefruit, prunes, raisins, and dates, broccoli, spinach, Potatoes, Sweet potatoes, Mushrooms, Peas, Cucumbers.</td>
</tr>
<tr>
<td>Calcium</td>
<td>Important for healthy bones and teeth; helps muscles relax and contract; important in nerve functioning, blood clotting, blood pressure regulation. Deficiency causes osteoporosis</td>
<td>Milk and milk products; green leafy vegetables, legumes, sesame seeds</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Important for healthy bones and teeth; phospholipids help in the transport of fat and are part of the cell membrane, constituent of nucleic acids, involved in energy production</td>
<td>Meat, fish, poultry, eggs, milk, beans, lentil, nuts, whole grains</td>
</tr>
<tr>
<td>Magnesium</td>
<td>It is a cofactor in more than 300 enzyme systems, regulates protein synthesis, energy production, muscle and nerve function, blood glucose control, and blood pressure regulation, good for bone health, immunity</td>
<td>Nuts and seeds; legumes; leafy green vegetables; seafood; bananas, apricots, cashew</td>
</tr>
</tbody>
</table>

*Source:* Chadha and Mathur, 2015; Ross et al, 2014; Mudambi and Rajagopal, 2012; Nix, 2009; Wardlaw et al, 2004
### Table 13.6: Trace minerals - functions and sources

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Function</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>Haemoglobin (iron containing compound) transports oxygen and carbon dioxide; myoglobin (iron containing compound in muscle) provides oxygen for muscle contraction; vital component of certain enzymes involved in metabolism of carbohydrates, fats and protein; helps in preventing infections, improves cognitive ability. Deficiency causes anaemia</td>
<td>Organ meats; red meats; fish; poultry; egg yolks; legumes; dried fruits; dark, leafy greens; and fortified cereals</td>
</tr>
<tr>
<td>Zinc</td>
<td>It is a constituent of many enzymes present in the body; is a cofactor in the synthesis of DNA and RNA, and thus proteins; immune reactions, insulin synthesis, taste perception, wound healing, the making of sperm, and the normal development of the fetus. Deficiency leads to delayed growth and sexual development</td>
<td>Meats, fish, poultry, nuts, whole grains, legumes</td>
</tr>
<tr>
<td>Iodine</td>
<td>Found in thyroid hormone, which helps regulate growth, development, and metabolism; needed for foetal brain development. Deficiency leads to goitre (swelling of thyroid gland), cretinism in infants born to deficient mothers, poor cognitive development in children</td>
<td>Seafood, foods grown in iodine-rich soil, iodized salt</td>
</tr>
<tr>
<td>Selenium</td>
<td>Proper functioning of thyroid gland, as an antioxidant, improves immunity</td>
<td>Meats, organ meats, seafood, grains</td>
</tr>
<tr>
<td>Copper</td>
<td>Part of many enzymes for energy metabolism, regulation of neurotransmitters and connective tissue formation; needed for iron metabolism</td>
<td>Legumes, nuts and seeds, whole grains, organ meats, seafoods, drinking water (where pipes are made of copper)</td>
</tr>
<tr>
<td>Manganese</td>
<td>Part of many enzymes especially in carbohydrate and lipid metabolism, formation of connective and skeletal tissues, part of the antioxidant defence system</td>
<td>Widespread in foods, especially plant foods - whole grain cereals (wheat, barley, rice bran), legumes, green leafy vegetables, nuts and tea, fruits and vegetables</td>
</tr>
<tr>
<td>Fluoride</td>
<td>Involved in formation of bones and teeth; helps prevent tooth decay. Excess can lead to fluorosis with mottling of teeth, joint pains, arthritis, stiffness of spine</td>
<td>Drinking water (either fluoridated or naturally containing fluoride), seafood, and most teas</td>
</tr>
</tbody>
</table>

**Source:** Chadha and Mathur, 2015; Ross et al, 2014; Mudambi and Rajagopal, 2012; Nix, 2009; Wardlaw et al, 2004
Besides nutrients, there are a few other constituents of food which one should be familiar with. These substances are bioactive and referred to as phytochemicals (plant chemicals) or zoochemicals (chemical substances obtained from animal sources e.g. omega-3 fatty acids obtained from fatty fish, probiotics obtained from fermented dairy products). They have numerous health benefits. There are several ways in which these chemicals exert their beneficial effect in the body. Some act as antioxidants and help to neutralize the damage-causing free radicals in the body. Others exert their influence by modulating the activity of enzymes which control metabolic processes. They may activate, deactivate, block or suppress certain enzymes or hormones. Some others work by reducing the inflammation levels in the body. An inflammatory condition has been linked to increased risk of cardiovascular diseases. Some phytochemicals work by improving immunity. They may have antibacterial and antiviral properties. Certain others may help to maintain DNA stability and ensure repair. Alteration of lipid and lipoprotein metabolism, regulation of blood sugar levels and blood pressure are some of the beneficial effects attributable to other phytochemicals. Fruits, vegetables, spices and condiments are a storehouse of different types of phytochemicals.

**Antioxidants:** They are natural compounds found in some foods that help in neutralising free radicals in our body. Fruits and vegetables are good source of antioxidants. Besides vitamins like β carotene, E, C and minerals like selenium, other phytochemicals like lycopene (present in tomatoes and watermelon), carotenoids (present in Green/yellow/orange fruits and vegetables), catechins (in tea), allium sulphur compounds (present in garlic, onion), anthocyanins (present in berries, beetroot), etc. act as antioxidants.

**Anti-inflammatory:** Some foods are rich in phytochemicals which reduce inflammation in the body. Curcumin present in turmeric is a powerful anti-inflammatory substance. Fatty fish are rich in omega 3 fatty acids which also reduce inflammation. Berries, broccoli, green tea, peppers, mushrooms, dark chocolate, cherries, tomatoes, etc. are considered as anti-inflammatory foods.

The role of antioxidants and other phytochemicals in health is increasingly becoming important, owing to our immense exposure to toxins, pollutants, pesticides and other harmful substances.

**Pre and Probiotics.** In recent years probiotic bacteria have increasingly been incorporated into foods and are ‘live microorganisms which when administered in adequate amounts confer a health benefit on the host’ (FAO/WHO 2002). In today’s fast pace life there are factors that negatively influence the interaction between intestinal microorganisms such as stress and diet, which lead to detrimental effects on health. Increasing evidence indicates that consumption of ‘probiotic’ microorganisms can help maintain a favourable microbiome which results in several therapeutic benefits. Commonly used bacterial probiotics include various species of *Lactobacillus, Bifidobacterium* and *Streptococcus* as well as *Lactobacillus lactis* and some *Enterococcus* species. Currently, the only probiotic yeast used is the non-pathogenic *Saccharomyces boulardii*.

The term prebiotic was coined by Gibson and Roberfroid in 1995. Dietary fibres which resist digestion by the human enzymes but are digestible by the gut microbes are referred to as prebiotics. These encourage the growth of good bacteria in our gut.
Oligosaccharides, which are relatively short chain carbohydrates, have now been acknowledged to have prebiotic properties. Various type of oligosaccharides are found in natural foods available abundantly in the Indian diets like fruits (watermelon, pomegranate, dates, figs), vegetables (onion, beetroot, green peas, sweet corn, garlic), legumes (chickpea, lentils, soyabeans) cereals (wheat, bran), milk and honey.

It can thus be concluded that almost all the nutrients and other substances which we derive from the diet have some essential role to play in the body. The lack or excess of any may prove to be harmful to the body. Eating a diversified, balanced diet with wholesome meals would meet the requirements of most of the nutrients. Awareness regarding the correct proportions of food and nutrients required, based on the physiologic needs, would help in promoting health.

**Enriching the quality of our diet**

‘Hidden Hunger’ or micronutrient deficiencies are majorly impacting the nutritional status of the Indian population. According to the CNNS Survey, nearly 80% of the adolescent population suffers from at least one micronutrient deficiency in India. Poor diet quality and faulty dietary patterns coupled with lack of nutrition awareness is the main cause of malnutrition. Enriching the diets of at-risk population through micronutrient fortification, supplementation and encouraging dietary diversification is the most cost-effective and sustainable method to tackle deficiencies. Strategies to combat malnutrition at a national level need to be cost-effective and feasible enough to reach remote areas. Enriching diets of masses with specific micronutrients and not focusing simply on caloric intake is a solution adopted by several nations around the globe. In India, various policies and programs have been implemented to ensure adequate supply of micronutrients. These include increasing content of protein and micronutrients contained in the Midday Meal Scheme and Integrated Child Development Scheme, development of efficient public distribution schemes and food fortification. It is not enough to just provide adequate amounts and quality of food, but also to improve awareness about nutrition and eating right.
Figure 13.2: Three main interventions to prevent and tackle malnutrition

Figure 1 depicts the short, medium and long term solutions to the problem of micronutrient malnutrition. These can be used either individually or in combination. These interventions are complementary rather than mutually exclusive and a multi-sectoral approach involving health, food security and agriculture is, therefore, of prime importance. Micronutrient supplementation provides the fastest improvement in the micronutrient status of targeted population, fortification has lesser but a wider and sustainable impact; increasing dietary diversity and utilizing local food resources takes the longest to create an impact, however, it is the most desirable and sustainable solution. The choice would depend on (1) level of nutritional deficiency (2) public health issues (3) existing government policies (4) availability of resources (5) awareness amongst populations and (6) cost-effectiveness.

**Short term intervention: Supplementation**

**What is supplementation?**

Supplementation is the term used to describe the provision of relatively large doses of micronutrients, usually in the form of pills, capsules or syrups.

**What is the need for supplementation?**

Timely supplementation of micronutrients in the correct doses can be lifesaving. Ensuring that women of reproductive age, pregnant women and children have sufficient essential micronutrients improves the health of expectant mothers, the growth and development of unborn children, and the survival and physical and mental development of children up to five years old.
• Micronutrient insufficiency is a direct cause of child mortality. Even very small doses of micronutrients such as iron, vitamin A, iodine and folic acid can be life saving for young children and pregnant women.

• The intake of foods rich in vitamin A, iron and zinc is low in India.

• In cases of severe deficiency, food-based approaches alone are not as effective, and supplementation is required to be implemented.

• The bioavailability of many micronutrients is low and require an ideal environment for absorption. For example, the rate of conversion of carotene to retinol is less than desired, limiting the use of dietary diversification as a strategy to combat vitamin A deficiency. (Retinol is the active form of vitamin A. Vegetarian sources such as yellow-orange fruits and green vegetables contain a precursor of retinol i.e. β carotene). Additionally, the absorption of iron from vegetarian food sources (also known as non-heme iron) is lower as compared to iron from meat, poultry and fish (also known as heme iron) due to the presence of anti-nutrient factors such as oxalates and phytates. This makes it difficult to raise levels through diet alone even after increasing food intake in case of a public health crisis.

• Certain medical conditions such as severe diarrhea in children and acute respiratory illness, pneumonia can prove to be life-threatening. Micronutrients such as zinc play a vital role in reducing the morbidity associated with the same.

• The requirements of micronutrients are altered throughout the life cycle. For example, demands of micronutrients such as iron, folic acid, vitamin B6 and vitamin B12 is increased during pregnancy. Supplementation of these during pregnancy has proven to reduce postnatal complications such as neural tube defects, low birth weight babies and anemia during pregnancy.

**Who is the target group for supplementation?**
- Women in reproductive age
- Pregnant women
- Lactating women
- Children under the age of 5

**How is it done?**

Supplementation is often done through government intervention programs.

**For how long is it done?**

Periodic supplementation should be combined with programs focussing on food fortification and dietary diversification. Supplementation should only be used as a short-term intervention in order to avoid risks of high dosages.
Which micronutrients are targeted?

Micronutrients that are identified to pose a public health challenge through intervention studies in a target population are often used for supplementation in at-risk population. These include vitamin A, iron, folic acid

What are the current programs in India?

National Vitamin A prophylaxis program

Deficiency of vitamin A is recognised as a public health problem. Dietary surveys indicate that intake of vitamin A is lower than Recommended Daily Allowance in young children, adolescent girls and pregnant women. Clinical and subclinical deficiency is highest in India. In the fifties and sixties many states reported blindness in children below five years of age due to vitamin A deficiency. A five-year long trial by National Institute of Nutrition indicated that mega doses of vitamin A once in six months in children aged one to three years can prevent xerophthalmia. These results suggested the need to administer massive doses of vitamin A in at-risk population groups.

The National Prophylaxis Program Against Nutritional Blindness was started in 1970, for children up to 3 years of age. In 2006, the age group was changed to children from 6 months to 5 years after reconsidering recommendations of the WHO, UNICEF and Ministry of Women and Child Development. The prophylaxis program has long term as well as short term strategies. The short-term strategy focuses on administration of mega doses on periodic bases, the long-term strategy focuses on the improvement of dietary quality.

National Iron Plus Initiative

Anaemia is one of the most challenging public health problems with more than 50% prevalence among the vulnerable groups such as pregnant women, infants, young children and adolescents. The most common causes of anaemia are nutritional with Iron Deficiency Anaemia (IDA) being the most prevalent nutritional cause of anaemia. Anaemia is known to have serious health outcomes and affects physical and cognitive health during all life stages. It is thus important that measures must be taken to prevent the onset of anaemia in vulnerable population groups.

The National Iron Plus Initiative (NIPI) is an attempt to look at the Iron Deficiency Anaemia comprehensively across all life stages including adolescents and women in reproductive age group who are not pregnant or lactating. The National Iron+ Initiative guidelines have been developed by the Adolescent Division of the Ministry of Health and Family Welfare (MoHFW), Government of India. The guidelines build on past and continuing work on the prevention and control of anemia in India and have been developed in the context of the existing policies and strategies of the health, nutrition and population sectors. Under an Intensified NIPI, the Anemia Mukt Bharat Campaign has been launched in 2018 to reduce the prevalence of anemia.
Calcium Supplementation during pregnancy and lactation

Eclampsia and pre-eclampsia during pregnancy is highly preventable with timely care and healthcare provision. WHO recommendations and global evidence suggests that provision of calcium supplementation during pregnancy and lactation, can prevent the onset of hypertensive disorders. This program has now been included in the Government of India’s ante-natal care (ANC) and post-natal care (PNC) package. For prevention of pre-eclampsia, WHO 2013 guidelines recommend inclusion of routine prenatal calcium supplementation in high doses (>1 gm/day), especially in areas where dietary calcium intake is low.

Protocol: Oral swallow able calcium tablets to be taken twice a day (total 1g calcium/day) starting from 14 weeks of pregnancy up to six months post-partum. It is not advisable to take both calcium tablets together as more than 800 mg calcium interferes with iron absorption. Calcium tablets should not be taken empty stomach since it causes gastritis. Calcium and Iron Folic Acid (IFA) tablets should not be taken together since calcium inhibits iron absorption. IFA tablets should be taken preferably two hours after a meal. Along with this, women are also counselled with regards to supplementation and calcium intake.

What are some challenges for supplementation programs?

A lack of supplies and poor compliance are consistently reported by many Supplementation programme managers as being the main barriers to success. Iron supplements are not well tolerated by some as they produce symptoms of gastric distress.

Anemia Mukt Bharat

Anemia affects a large part of our population, all age groups and income categories. It affects physical growth, mental development and work capacity. Anemia Mukt Bharat campaign by the Ministry of Health and Family Welfare targets to reduce the prevalence of anemia by 3 percentage points per annum. It has a 6x6x6 strategy – 6 types of beneficiaries, 6 interventions and 6 institutional mechanisms. It specifically targets iron deficiency and folic acid deficiency related anemia by prophylactic supplementation. In addition, there is provision for biannual deworming as intestinal worm infestation has been identified as one of the causes of anemia. Besides testing and treating people for anemia, the important component of behaviour change communication has also been incorporated in the strategy for demand generation of supplements, to improve intake of iron rich foods as well as other measures.

Read more about it at: https://anemiamuktbharat.info/
Medium Term Intervention: Food Fortification

What is food fortification?

Food Fortification is the practice of deliberately increasing the content of an essential micronutrient, i.e. vitamins and minerals (including trace elements) in a food, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health. Food fortification can take several forms. It can either be for the general population or for a targeted population group; it can be mandated by the Government or can be a voluntary decision of manufacturers.

What is the need for fortification?

As mentioned earlier, the problem of hidden hunger is a serious concern in India which needs to be addressed in order to improve the health status of the nation. Often, there is considerable loss of nutrients during the processing of food as well. One of the food-based strategies to address this problem is fortification of food. This method complements other ways to improve nutrition such as diversification of diet and supplementation of food.

When did food fortification start in India?

Food fortification has been practiced in India since the 1950s and continues to be a part of policy programs to prevent several micronutrient deficiencies till date.

What are some key considerations for fortification?

The fortified food must be consumed in adequate amounts by a large proportion of the targeted population. It is also important that the targeted population has access to the foods which are going to be fortified. The form in which the nutrient (fortificant) is to be added, should be absorbed well by the body. The fortificant should not affect the sensory properties (taste, colour, appearance, texture) of the food to which it is added.

The general principles underlying the conditions for any fortification program given by the Food Safety and Standards Authority of India (Fortification of Food) Regulations, 2016 include the following:

Essential nutrients may be added to food for the purpose of contributing to any of the following:

I. Prevention or reduction of demonstrated deficiency of one or more micronutrients.
II. Reduction of the risk or correction of inadequate nutrition status of one or more essential nutrients
III. Meeting daily requirements of one or more essential nutrients
IV. Maintaining or improving health
V. Maintaining or improving nutritional quality of foods.
What are the health benefits seen with fortification?

The nutrients used in fortification of staple foods can prevent deficiencies, and hence improve immunity, productivity and cognitive development. Fortifying food with iodine, iron, vitamin A, and vitamin D has reduced the cases of iron deficiency anemia, night blindness and goiter. Evidence pertaining to fortifying staple foods with essential micronutrients is vast and thus the Government of India and FSSAI have set standards and regulations for fortification.

Which foods are used as staple vehicles for fortification in India and which micronutrients are targeted?

Single micronutrient or a combination may be used in order to fortify foods. Some processed foods are fortified. The Food Authority has drafted the standards for fortification of processed foods. The standards include fortification of cereal and cereal products like breakfast cereals, pasta and noodles, and bakery wares like bread, biscuits, rusks, buns with added iron, folic acid, and vitamin B 12 (in addition they may be fortified with zinc, vitamin A, riboflavin, niacin, and pyridoxine). In addition to these fruit juices shall be fortified with vitamin C. Fortification of processed foods will help in increasing the nutritional quality of these products as well as help in improving the nutritional status of the population at large.

How are allowances for fortification decided?

Generally, the extent of food fortification depends on the level of public health issues and those nutritional deficiencies that are most seen must be given priority. The level of micronutrient/s recommended for fortification of staple foods is country specific. It largely depends on the habitual diet of the population in a region. A database of micronutrient compositions of various foods and information on bioavailability are powerful tools to facilitate the process of arriving at the quantity of micronutrients required for fortification. It is also necessary to keep in mind the nutrient requirements and recommended dietary allowances of micronutrients for Indians.

How can a fortified food product be identified?

A logo (+F logo) has been notified for fortified food products as shown in figure 2.
Food fortification provides a medium-term food-based intervention and its benefits outweigh the limitations. Fortification must be encouraged, and nutrition awareness must be created regarding the use of fortified staples.

The intent of Food Fortification rests on micronutrient deficiencies which are a public health concern. Today we have iron deficiency, iodine deficiency and vitamin A and vitamin D deficiencies which are causing a serious concern in the population. The amount of the nutrient fortified is country and population specific and thus it is based on scientific recommendations made by expert bodies at national level. The quantities of nutrients fortified are safeguarded towards any toxicity as the dosages are in line with the normal recommendations needed by the population. The foods which are selected for fortification are the vehicles which are used by major section of the population on daily basis like wheat, rice, salt, oil. This is to cover the adequacy of these specific nutrients due to lack of diet diversity especially in the lower and middle socio-economic strata.

**Long term intervention: Dietary Diversification**

Increasing dietary diversity means increasing both the quantity and the variety of foods consumed (including a variety of food groups and a range of micronutrient-rich foods from each of the food groups). In practice, this requires the implementation of programs that improve the availability and consumption of, and access to, different types of micronutrient-rich foods (such as animal products, fruits and vegetables) in adequate quantities, especially among those who are at risk for, or vulnerable to micronutrient deficiencies. Increasing dietary diversity is the preferred way of improving the nutrition of a population because it has the potential to improve the intake of many food constituents – not just micronutrients – simultaneously. Micronutrient-rich foods also provide a range of antioxidants and prebiotic substances that are important for protection against non-communicable diseases and for enhancing immune function.

However, as a strategy for combating micronutrient malnutrition, increasing dietary diversity is not without its limitations, the main one being the need for behaviour change and for education about how certain foods provide essential micronutrients and other nutritive substances. A lack of resources for producing and purchasing higher quality foods can sometimes present a barrier to achieving greater dietary diversity, especially in the case of poorer populations. The importance of foods from animal sources for increasingly dietary quality is being recognized, and innovative approaches to increase their production and consumption in poorer regions of the world are currently being explored. Efforts are also underway to help poorer communities identify, domesticate and cultivate traditional and wild micronutrient-rich foods as a simple and affordable means of satisfying requirements. For infants, ensuring a diet of breast milk is an effective way of preventing micronutrient deficiencies. In much of the developing world, breast milk is the main source of micronutrients during the first year of life (with the exception of iron). Exclusive breastfeeding for the first 6 months of life and continuation into the second year should thus be promoted. Moreover, all lactating women should be encouraged to consume a healthful and varied diet so that adequate levels of micronutrients are secreted in their milk. After the age of 6 months, it is important that the complementary foods provided to breast-fed infants are as diverse and as rich in micronutrients as possible.
Others

Some of the other techniques that could be used easily at home scale are fermentation, germination and biofortification. **Fermented foods** are those foods that have been subjected to the action of microorganisms. Fermented foods have many advantages, besides enhancing the nutritional quality of food by increasing the bioavailability of certain vitamins and minerals; it also acts as nutraceutical agents to impart beneficial health effects. **Germination** refers to the process by which grains are sprouted. This is an effective processing method for improving nutritional quality, reducing anti-nutritive compounds, boosting the level and digestibility of free amino acids and available carbohydrates, increasing mineral bioavailability, increasing vitamins and improving the functional properties of cereal and pulses.

A very important aspect in enriching diet is communication and awareness. This is one of the most important issues if the message of nutrition has to spread to all sections of the society including, policy makers and planners, bureaucrats, professionals from the fields of agriculture, health and medicine, social sciences, education and others besides the community. For health and nutrition security there has to be awareness, and access to balanced diet at an affordable cost. Knowledge of right feeding practices, clean environment and safe drinking water, and health care outreach—primary and curative is important. Education, particularly of women is important for optimum utilisation of the available services and creating demand.

It is ironical that both ends of the spectrum of malnutrition have inherent hidden hunger which is related to the quality of food intake by the population. High intake of HFSS foods across all socioeconomic strata of Indian population adds to the baggage of malnutrition. In addition, a low diet diversity is an added aspect contributing to micronutrient malnutrition. Thus, a judicious combination of strategies—Food Fortification, Diet Diversification and Supplementation is the way forward to enrich the diets of the Indian population.

Summary

- Nutrients are those constituents of food that are essential for the maintenance of life, growth and development.
- Nutrients can be classified as macronutrients and micronutrients based on the requirement. They can also be classified as energy giving, body building and protective foods based on their functions.
- Macronutrients are nutrients required in larger quantities and include proteins, carbohydrates, lipids and also water.
- Micronutrients are nutrients required in small quantities and include all the vitamins and minerals.
- All nutrients have important functions to perform in our body. A deficiency of any of the nutrients results in clinical signs and symptoms.
• Phytochemicals and zoochemicals are bioactive substances present in plant and animal foods respectively. They confer us with health benefits.

• My plate of the day given by ICMR/NIN (2018) gives a good example of a balanced meal providing 2000kcal a day.

• The quantities of foods needed to meet the nutrient requirements vary with age, gender, physiological status and physical activity.

• To overcome malnutrition various simple techniques could be used to enrich our diet such as diet diversification, food fortification, food supplementation, fermentation and germination.

Key Words

Hidden hunger – another term for micronutrient deficiencies

Macronutrients – These are required in large quantities (in grams) and include proteins, carbohydrates, fats and water.

Micronutrients – These include vitamins and minerals – are required in relatively smaller quantities, but are essential for various body processes.

Prebiotics – substances (like oligosaccharides, fibre) which encourage the growth of good bacteria in our gut

Probiotics – live microorganisms which when administered in adequate amounts confer a health benefit on the host

Exercises

1. List the dietary guidelines for the Indian adult.

2. Why is water important for our body?

3. What are the different types of carbohydrates? Explain by giving examples.

4. What are the different types of fats found in our diet? Give at least two food sources for each.

5. Define the following terms briefly (2-3 lines):
   a. Pellagra
   b. Balanced Diet
   c. Essential Amino acids

6. Describe the functions of the following nutrients:
   a. Lipids
   b. Vitamin C
c. Calcium
d. Proteins

7. Explain the different methods which can be used at the household level for enriching our diet. Supplement your answer with suitable examples.

8. Discuss the merits and limitations of food fortification as a strategy to address micronutrient malnutrition.

References


Chapter 14: Healthy Diets Everywhere

- **Healthy Diets at School**
  - Nutrient requirements
  - Eating behaviour
  - Eating disorders
  - Promoting healthy eating habits
  - Healthy food at school
  - Promoting good hygiene practices in childhood

- **Healthy diets at Home**
  - Nutrient requirements
  - Meal Planning
  - Improving nutrient availability

- **Healthy diets at workplace**
  - Faulty eating habits at workplace
  - Steps to promote healthy eating behaviour

- **Healthy diets when eating out**
  - Buying ready-to-eat packaged food
  - Healthy food choices when eating out
Chapter 14: Healthy Diets Everywhere

The rapidly increasing prevalence of diet related non-communicable diseases (NCDs) in Indians has been largely linked to changes in lifestyle and dietary patterns. Rapid urbanization, hectic work schedules and high economic growth have resulted in greater access to commercially available processed and packaged foods. Scientific evidence indicates that regular consumption of foods high in simple carbohydrates (sugar), salt, fats, and industrial trans fats is one of the prime reasons for sudden increase in overweight/obesity and NCDs in India. It is therefore important to follow a healthy diet and lifestyle to lead a healthy life. Choosing foods wisely whether you eat at home or outside becomes important while trying to eat healthy.

In the previous chapters you learnt about the concept of ‘healthy diets’, macro and micronutrients, their requirements, and about ways of enriching the diet. In this chapter you would learn about how you can select and eat healthy meals whether you are at home, in school, in your workplace and even while eating out in a restaurant or any other food outlet. This chapter would also elaborate upon the concept of meal planning and other associated aspects including portion sizes and food exchanges, choosing wisely from the various food groups, impact of cooking on specific nutrients, household measures of improving diet quality, food labels and menu labelling.

A healthy diet is a solution to many of our health-care problems.
It’s the most important solution.
~John Mackey

A healthy diet can be described as a diet that helps to maintain or improve the overall health. It is one of the basic and most essential elements for maintaining good health, to prevent chronic diseases, and to provide an overall sense of wellbeing and vitality. It provides the body with essential nutrition: macronutrients, micronutrients, adequate calories and water. A healthy diet should maximize the consumption of whole grains, vegetables, fruit, and legumes and limit the consumption of red meats as well as refined and ultra-processed foods.

In the upcoming sections you would learn about the essentials of a healthy diet at home, at school, at workplace and when eating out.

Healthy diets at school

School is an educational institution which is designed to provide a learning space and environment to the students. In India a child remains in a formal schooling system for fourteen years. Apart from providing formal education, schools also nurture the overall development of the child including inculcation of good dietary and lifestyle habits. Healthy eating in childhood and adolescence is crucial for proper growth and development and to prevent various adverse health conditions. Poor dietary habits and nutrient inadequacy
Nutrient requirements

The school age includes a wide age group, from pre-schooler (3 to 4 years) to adolescence (17 years) spanning nearly 1.5 decades. During the school age the body grows, thus requirements of all the nutrients are high, however the specific requirement for each age group varies widely. As the child becomes older, peer influence and acceptance may become more important than family values thereby creating period of conflict between children and parents. Nutritional requirements vary among males and females after the age of 10 because of variations in growth rate, body composition, and physical activity level.

Micronutrient needs of youth are elevated during adolescence to support physical growth and development. Because of accelerated muscular, skeletal, and endocrine development calcium needs are greater during puberty and adolescence than during childhood or adult years. Iron requirements are increased during adolescence for the deposition of lean body mass, increase in red blood cell volume, and to support iron lost during menses among females. Other important nutrients are calcium, zinc and of course all vitamins during this period.

Eating behaviour

Eating behaviours evolve during the first few years of life. Most of the eating problems are behavioural in nature. Some of the most common eating issues include children being picky eaters, not eating enough or eating too much, eating the wrong foods, refusing to eat certain foods, or having erratic mealtimes. Most eating problems do not last long enough to interfere with a child's growth and development. However, difficult eating issues among children and adolescents may lead to serious changes in eating habits that can lead to health problems.

Food habits that are seen more frequently among adolescents than other age-groups include irregular consumption of meals, excessive snacking, eating away from home (especially fast-food venues), dieting, and meal skipping. Meal skipping increases throughout adolescence as they try to lose weight through calorie restriction, and as their lives become busier in general due to academic pressure. Breakfast is the most commonly skipped meal, especially among adolescent females. Adolescents who skip meals often snack in response to hunger instead of eating a meal. Snack foods consumed are often high in fats, sugar and sodium. Sugar containing aerated beverages are commonly consumed, accounting for high daily caloric intake. Many factors contribute to these behaviours, including decreasing influence of family and increasing influence of peers on food and health choices, increasing exposure to media, and increase in time spent outside home.

Most adolescents are aware of the importance of nutrition and the components of a healthy diet; however, there are many barriers to choosing healthy foods and beverage. They cite taste, time, and convenience as the key factors that affect their food and beverage choices. Many adolescents lack the ability to associate current eating habits with future disease risk and show little concern for their future health.
Eating disorders

Avoidant/restrictive food intake disorder (ARFID) is an eating disorder characterized by eating very little food or avoiding eating certain foods. It is a common eating disorder experienced by young children. Children with this disorder experience a disturbance in their eating which can include a lack of interest in food or a sensory aversion to certain foods. ARFID usually presents in infancy or during childhood and may persist into adulthood. It may initially resemble the picky eating that’s common during childhood. For example, a child might become averse to the texture of foods they once enjoyed. They might also fear experiencing abdominal pain or vomiting after consuming a certain food. These aversions and restrictions can lead to weight loss and nutritional deficiency among young children. Pica is a type of condition where a child might have the urge to eat non-food or non-nutritional substances like, soap, chalk, sand, ice, and hair.

High-risk dieting practices are used by many adolescents which may lead to risk of poor nutritional status and increased risk for eating disorders. Let us look at some of the eating disorders:

- Anorexia nervosa (AN) a disorder characterized by (1) refusal to maintain a normal body weight, (2) intense fear of gaining weight, (3) body image distortion. It may be one of two sub types restricting or binge eating/purging binge. A binge eating episode is marked by three particular features: (1) the amount of food eaten is larger than most persons would eat under similar circumstances (2) the excessive eating occurs in a discrete period, usually less than 2 hours; and (3) the eating is accompanied by a subjective sense of loss of control.

- Binge eating disorder (BED) is characterized by the occurrence of binge eating episodes at least twice a week for a 6-month period.

- Bulimia nervosa (BN) is characterized by repeated episodes of binge eating followed by inappropriate compensatory methods such as purging including self-induced vomiting or misuse of laxatives, diuretics, enemas, or non-purging, including fasting or engaging in excessive exercise.

Promoting healthy eating habits

School years shape the future of a child. Healthy eating habits during this phase help the child in imbibing them in their lifestyle. Children follow what they see, thus adults need to demonstrate the healthy eating habits themselves and be role models. This can help children maintain a healthy weight and normal growth. Some of the simple practices are listed here:

- Guide the family’s choices rather than dictate foods. Make a wide variety of healthful foods available in the house. This practice will help children learn how to make healthy food choices. Leave the unhealthy choices like chips, soda, and juice at the grocery store. Serve water with meals.
• Encourage children to chew the food properly and eat slowly. A child can detect hunger and fullness better when they eat slowly. Suggest the child to chew properly, this aids in digestion and gives time to the brain to register fullness.

• Eat meals together as a family as often as possible. Try to make mealtimes pleasant with conversation and sharing, not a time for scolding or arguing. If mealtimes are unpleasant, children may try to eat faster to leave the table as soon as possible. They then may learn to associate eating with stress.

• Involve children in food shopping and preparing meals. These activities can help parents understand children's food preferences and provides an opportunity to teach children about nutrition. In addition, children may be more willing to eat or try foods that they help prepare.

• Plan for snacks. Continuous snacking may lead to overeating, but snacks that are planned at specific times during the day can be part of a nutritious diet, without spoiling a child's appetite at mealtimes. Snacks should be as nutritious as possible and should be within reach and at eye level of the child.

• Discourage eating meals or snacks while watching television. Try to eat only in designated areas of home, such as the dining room or kitchen. Eating in front of the television may make it difficult to pay attention to feelings of fullness and may lead to overeating.

• Encourage children to drink more water and stay hydrated. Over consumption of sweetened drinks and sodas has been linked to increased rates of obesity in children.

• Try not to use food to punish or reward children. Withholding food as a punishment may lead children to worry that they will not get enough food. For example, sending children to bed without any dinner may cause them to worry that they will go hungry. As a result, children may try to eat whenever they get a chance. Similarly, when foods, such as sweets, are used as a reward, children may assume that these foods are better or more valuable than other foods. For example, telling children that they will get dessert if they eat all their vegetables sends the wrong message about vegetables.

• Make sure that children's meals outside the home are balanced. Also, select healthier items when dining at restaurants.

• Make sure that the child does not skip meals. Don't let the child skip or delay meals and ensure to schedule the snacks on time. Skipping or delaying meals can lead to eating too much or choosing an unhealthy snack.

• Pay attention to portion size and ingredients. Read food labels and limit foods with trans-fat, high fat, salt and/or sugar.
Nutrition education and counselling for children and adolescents should focus on short-term benefits, such as improving school performance, looking good, and having more energy. Messages should be positive, developmentally appropriate, and concrete, emphasizing skills to help them make healthy choices. Because snacking is prevalent among adolescents and snacks are often consumed in place of meals, teens should be encouraged to make healthy choices when choosing snack foods and beverages rather than to avoid snacking.

To prevent eating disorders, healthy eating habits should be developed and promoted from early childhood. To inculcate the habit of eating healthy foods among children and adolescents, it is important to change the food environment. Healthy food must be readily available to the children and access to unhealthy options should be limited.

**Healthy food at school**

Healthy food makes children feel better, grow better and learn better and right eating habits can be engrained in them from a young age. According to the United States (US) Centres for Disease Control and Prevention (CDC), children learn better eating habits when schools provide healthy foods. In India some private schools provide school meals to the younger children while in government schools mid-day meal service is provided.

Schools need to promote healthy eating behaviour. Schools should also ensure that the food available in the school cafeteria is healthy and hygienically prepared. With the aim to ensure safe and wholesome food for School children FSSAI has notified a regulation on Food Safety and Standards (Safe Food and Balanced Diets for Children in School) Regulations, 2020 (Box 1).

**Box 1: Ten-point Charter of healthy diets for School Children**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Charter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The School Authority itself/FBOs contracted by School Authority selling or catering school meals and FBOs contracted by Department of School Education for operation of the Mid-Day Meal scheme must obtain a registration or license as applicable and comply with the requirements of sanitary and hygienic practices to the food service establishments as specified under schedule 4 of the Food Safety and Standards (Licensing and Registration of Food Businesses) regulations, 2011.</td>
</tr>
<tr>
<td>2</td>
<td>Foods which are referred to as foods high in fat, salt and sugar (HFSS) cannot be sold to school children in school canteens/ mess premises/ hostel kitchens or within 50 meters of the school campus.</td>
</tr>
<tr>
<td>3</td>
<td>Encourage schools to adopt a comprehensive program for promoting Safe food and Healthy diets amongst school children, and to convert school campus into Eat Right School focusing safe and healthy food, local and seasonal food and no food waste as per the specified benchmarks.</td>
</tr>
<tr>
<td>4</td>
<td>Encourage School Authority to promote consumption of a safe and balanced diet in the school as per the guidelines issued by the National Institute of Nutrition (NIN)</td>
</tr>
<tr>
<td>5</td>
<td>The School Authority shall ensure that FBOs supplying prepared meals in the premises are on the basis of general guidance provided in the regulation and as per the direction issued by the Food Authority or the Commissioners of Food safety.</td>
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<tr>
<td>S. No</td>
<td>Charter</td>
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<tr>
<td>6</td>
<td>Nutritionists, dieticians may be engaged by the School authority to assist in the preparation of menu for the children, periodically.</td>
</tr>
<tr>
<td>7</td>
<td>FBOs manufacturing HFSS food products barred from advertising such foods to children in school premises or within 50 meters of the school campus.</td>
</tr>
<tr>
<td>8</td>
<td>FBOs to support healthy eating in schools and not market, sell, or give away low nutrition foods anywhere on school campus, including through logos, brand names, posters, textbook covers etc.</td>
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<tr>
<td>9</td>
<td>Regular inspection of premises to ensure that safe, healthy and hygienic food is served to students.</td>
</tr>
<tr>
<td>10</td>
<td>Creating a sub-committee by the State Level Advisory Committee to monitor the implementation of this regulations and to ensure availability of safe and wholesome food to school children.</td>
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</table>

It is also important for the parents and caregivers to understand the importance of providing healthy food in the tiffin. Box 2 presents some points to keep in mind to plan a healthy tiffin meal. Including all three food groups helps provide a balanced and healthy meal (Cereals for energy, pulses/flesh foods/eggs/milk products for body building and vegetables/fruits as protective foods).

**Box 2: Healthy tips for school tiffin**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Healthy tips for school tiffin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Choose healthy and wholesome recipes for tiffin. For example, roti wraps, rice preparations, stuffed parathas, steamed foods (idli, dhokla), and sandwiches stay best in tiffin lunch.</td>
</tr>
<tr>
<td>2</td>
<td>Include some protein (egg, paneer, pulses, sprouts, yoghurt) in the meal to keep your child satiated.</td>
</tr>
<tr>
<td>3</td>
<td>Pack vegetables or fruit with the school tiffin.</td>
</tr>
<tr>
<td>4</td>
<td>Do not fill up the meal box with creamy, cheesy, fatty or fried food.</td>
</tr>
<tr>
<td>5</td>
<td>Avoid using too much white sugar, biscuits or jams in the school meal.</td>
</tr>
<tr>
<td>6</td>
<td>Pack the meal box once the food has completely cooled. This helps keep the food fresh for longer periods.</td>
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<tr>
<td>7</td>
<td>Squeeze lemon over cut fruit (apple, pear, papaya, guava) to prevent discoulouration and keep them fresh.</td>
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**Promoting good hygiene practices in childhood**

It is important to maintain personal hygiene to keep away food borne illness and stay healthy. Repeated illness during childhood adversely affects the growth of children. It is important to build these habits in the child’s growing years. Some of these have been highlighted in box 3.
Box 3: Personal habits for maintaining good hygiene

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Hygienic habits</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Brushing teeth twice a day</td>
</tr>
<tr>
<td>2</td>
<td>Having regular baths and thoroughly cleansing the body during a bath</td>
</tr>
<tr>
<td>3</td>
<td>Regularly washing hair and trimming nails</td>
</tr>
<tr>
<td>4</td>
<td>Washing hands before and after eating, after using toilet</td>
</tr>
<tr>
<td>5</td>
<td>Washing hands after handling a pet or touching something that isn’t “clean”</td>
</tr>
<tr>
<td>6</td>
<td>Covering the mouth and nose with a tissue while sneezing/coughing</td>
</tr>
<tr>
<td>7</td>
<td>Changing into clean clothes after getting dirty</td>
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</tbody>
</table>

Healthy diets at home

What family members consume at home largely depends on the home food environment. What are the kinds of foods that are readily available at home? When hungry, do family members easily reach out to chips, savouries, biscuits, etc. or to fresh fruits, nuts, or other healthy preparations? It is also important to consider the composition of the family and keep in mind the nutrient requirements of each age group.

Nutrient requirements

The children in the family need good quality protein in every meal to supply essential amino acids for tissue synthesis all day long. Good quality protein sources include flesh foods (meat, poultry, fish), eggs, milk and milk products, or a combination of cereals and pulses. Pregnant and lactating women also need to have good quality proteins in every meal as they support the growth of the foetus and infant respectively. In another chapter you have learnt how requirements of nutrients increase at certain age groups and physiological stages of the lifecycle. As the individual ages, the energy needs decrease in response to decrease in activity levels. Adulthood is a critical period of life when any excess weight may predispose an individual to non-communicable diseases like diabetes, hypertension or heart disease.

Every member of the family may have different nutrient requirements however the principles of what constitutes a healthy, well balanced diet remain same for all age groups. Variations in texture and digestibility may have to be accounted for infants and elderly. These can easily be made in what is being cooked for the family. For example, a portion can be taken out for little children before putting in chillies, or a separated food portion can be mashed for infants and elderly having trouble chewing. It is important to keep the special nutritional needs of all family members in mind while planning and preparing meals for the family.

Meal Planning

Eating a well-planned meal becomes important in today’s time when the population is struggling from the triple burden of malnutrition. Choosing a healthy diet for our own self and for others starts with comprehensive planning of each meal. With more people moving out for work, meal planning becomes critical in providing a combination of nutrition, taste and satisfying food preferences.
Meal planning may be defined as the science of when and how much to eat. It involves selection of each food group in adequate amounts to meet the nutritional need of the individual.

Meal planning comprises planning of balanced meals which are wholesome, nutritious, palatable, appetizing and well within the economic means of the family. It involves what, and how much to eat during each meal. The meals planned should not only ensure that nutrient requirements are adequately met but also be flexible enough to accommodate easily available seasonal foods. Further, it should also take care of the individual and family’s food preferences. A balanced diet should provide all nutrients in the amount and proportion required by the body according to individual’s age, gender and activity. Since adequate nutrition is important for physical, mental and emotional development of an individual, it therefore becomes essential that sufficient emphasis is laid on planning of proper meals. Main steps in meal planning include:

- Understanding the nutritional requirements
- Assessing acceptability of meals
- Procurement and storage of food

<table>
<thead>
<tr>
<th>Some points to remember</th>
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<tbody>
<tr>
<td>✓ Have regular family meals.</td>
</tr>
<tr>
<td>✓ Serve a variety of healthy foods and snacks.</td>
</tr>
<tr>
<td>✓ Be a role model by eating healthy yourself.</td>
</tr>
<tr>
<td>✓ Involve your child in meal planning and preparation.</td>
</tr>
<tr>
<td>✓ Keep mealtime calm and pleasant.</td>
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Acceptability of meals is an important aspect of meal planning. To make the meals acceptable consideration needs to be given to likes and dislikes of the family members, including variety in the meals, taking care of the food habits, seasonal food availability and palatability. Preference should be given to regional and seasonal foods as they are economical, nutritious add diversity to the diet and such diets are sustainable. It is important to plan meals in advance and procure them in advance to save time and resources.

**Improving nutrient availability**

Cooking food improves digestion and increases the absorption of many nutrients, for example, the protein in cooked dals is more digestible and β-carotene is better absorbed from cooked vegetables. However, some cooking methods reduce several key nutrients like vitamins B and C which are heat labile. The most common methods of cooking are sautéing, roasting, boiling, frying and steaming.

Water-soluble vitamins like vitamin C and the B vitamins namely — thiamine, riboflavin, niacin, pantothenic acid, pyridoxine (B6), folic acid, and cobalamin (B12); and water soluble forms of minerals are easily lost if soaking or cooking water is discarded and not consumed. Exposing food to high heat or prolonged cooking time also destroys heat labile vitamins, B
vitamins also get destroyed in alkaline medium when cooking soda is used for cooking pulses etc. Leaving cut fruits and vegetables exposed to air may also destroy vitamins. Additionally, vitamins like A and E may get destroyed by oxidation, if food is left exposed to air and light.

Loss of nutrients in vegetables begins from preparation onward and is greater during the cooking process.

1. When fruits and vegetables are peeled the vitamins present under the skin may be lost.
2. Nutrients are also lost when the edible leaves of carrot, beetroot and outer leaves of cabbage are discarded.
3. Vitamin B complex and Vitamin C are water soluble and are lost when the water in which vegetables are cooked is discarded. Sodium, potassium and chlorine are also lost when cooking water is discarded.
4. Vitamin C is lost by oxidation due to exposure of air.
5. During dehydration ascorbic acid and carotene are lost.
6. Addition of soda results in heavy loss of B – Vitamins during cooking.

When fruits and vegetables such as apple, banana, potato and brinjal are cut, there is a development of brown colour on the surface due to action of enzymes. This is known as enzymatic browning. When the tissue is injured or cut and the cut surface is exposed to air, phenol oxidase enzymes are released at the surface. These act with the polyphenols present in the fruits and oxidise them to orthoquinones, which gives the brown colour to cut tissues. Browning can be prevented by squeezing lemon on cut surfaces of fruits or keeping the cut vegetables soaked in water. However, it is best to use the cut vegetables soon after cutting to reduce nutrient losses.

Minimizing the nutrient loss during cooking

- When cooking vegetables, keep skins on when possible
- Do not wash vegetables after chopping/peeling
- Avoid repeated reheating of food
- Use a minimal amount of cooking liquid
- Choose steaming over boiling
- When boiling, retain the cooking liquid for a future use (like soups and stocks)
- Use a pressure cooker when possible to reduce cooking time
- Avoid using baking soda to hasten cooking or retain colour
- Cut vegetables into large chunks to reduce surface area and hence loss of nutrients
Healthy diets at workplace

A workplace is a place of employment or any location where an individual or group of individuals work. Such a place can range from a home office to a large office building or factory. The workplace is one of the most important social spaces other than the home. A working individual spends substantial part of each day at his/her workplace. It is therefore important that the meal/snacks consumed at workplace are healthy. The worksite is a central venue for influencing dietary behaviour.

Faulty eating habits at workplace

Faulty eating habits in the workplace contribute to poor health, reduced productivity and a negative working environment. Employees who have trouble in concentrating, suffer from irritability and lethargy may be making poor food choices. Talking to employees about bad eating habits is a delicate task best handled by addressing the workforce rather than targeting individuals. Small business owners should take a proactive and fun approach that encourages employees to make wise food choices. Some of the poor food habits include - consuming too much of tea/coffee, untimely snacks, unhealthy (high fat, sugar and salt) snacks during team meetings, poor meal timings, etc.

Benefits of healthy eating in the workplace

- Increased energy
- Increased productivity
- Decreased absenteeism
- Lower rates of chronic diseases
- Decreased medical claims, disability and insurance costs related to nutrition related chronic conditions

Steps to promote healthy eating behaviour

The dietary patterns of the employees/workers are also likely to be influenced by other factors in the work environment. Research studies have shown that workplace dietary interventions are generally effective, especially fruit and vegetable interventions. The following steps may help in improving eating behaviour of employees:

- Develop workplace policies that promote healthy eating
- Create an accessible area where information can be posted (such as a bulletin board), regarding healthy eating, nutritional information, and other resources
- Send out information regarding healthy eating and nutrition via emails or through workplace newsletters
- Organize health fairs that promote healthy eating, that include dietitians/ health and wellness experts to answer questions and provide consultations
- Provide access to a Registered Dietitian who can help counsel and provide support to those wishing to change their eating habits
- If selling food in the cafeteria, ensure that nutritional information is available
- Offer healthy foods in the cafeteria, vending machines, and during meetings
- Provide self-assessment tools for employees to assess their eating habits
- Offer workshops on topics such as preparing healthy meals, reading food labels etc.
- Provide a kitchenette, microwave, and refrigerator for employees to prepare, reheat and/or store healthy meals.

Table 1 provides suggestions for healthy workplace snacks and meals.

**Table 14.1: Healthy eating choices at workplace**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Meeting/ Cafeteria</th>
<th>Healthy food/ snack options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Meeting snacks</td>
<td>Roasted, unsalted chana, nuts, puffed rice, fox nuts, dates, steamed corns and peas, sprouts, steamed dhokla, fruits, low-fat sandwiches with whole wheat bread and vegetables, etc.</td>
</tr>
<tr>
<td></td>
<td>Beverage options</td>
<td>Unsweetened lemonade and butter milk, green tea, coconut water, unsweetened juice with pulp</td>
</tr>
<tr>
<td>2</td>
<td>Cafeteria Meals</td>
<td>Wholesome meals containing roti made from whole wheat or multigrain, millets, roti wraps, steamed idli, rice, Freshly cooked pulses and legumes, Dairy products such as plain yogurt/curd, buttermilk and milk, Fresh vegetables especially green leafy vegetables, Fresh and seasonal fruits and vegetables as salads</td>
</tr>
</tbody>
</table>

In addition to awareness about healthy diets, worksites should put in effort to reduce work-related stress and provide avenues for increasing physical activity especially among employees engaged in desk work.

**Healthy diets when eating out**

There has been a notable shift in the global eating culture in the past 40 years. Consumption of commercially available food/snacks outside the home has become an integral part of the busy modern lives. With fewer meals being consumed at home, the overall quantity of calories has increased while nutritional quality has declined. This has further contributed to the burden of diet related non communicable diseases. It is therefore important that due care is given to the type and amount of food consumed outside home. Commercially available food/snacks can be either packaged or unpackaged, ready to consume.
Buying ready-to-eat packaged foods

When buying packaged foods, it is important to read the nutrition labelling properly. “Labelling includes any written, printed or graphic matter that is present on the label, accompanies the food or is displayed near the food, including that for the purpose of promoting its sale or disposal.” Nutrition labelling is a combination of various mandatory (Nutrition Facts Panel (NFP) and ingredients) and voluntary information (symbols and logos, nutrient claims, health claims, allergen declaration) on food labels.

The Food Safety and Standards Act, (2006), and Food Safety and Standards (Packaging and Labelling) Regulations, 2011 have laid down the requirements for labelling of pre-packaged foods. It is mandatory that every package of food should carry a label that bears all the information required under the Act. Mandatory information is compulsory to be printed on food labels while voluntary information declaration is optional for the manufacturers. However, if any voluntary claim is being made then it should be substantiated by NFP. For example, nutrient claim “sugar free” should be substantiated by reporting the sugar value as zero/nil on NFP.

The label should not carry a false, misleading or deceptive description or presentation of the pre-packaged food and the labelling should not create a misleading impression regarding the character of food. To begin with, understanding of nutrition labelling is a must to make healthy food choices by the consumers. Nutrition labelling is the first and the most important source of information regarding the nutritional content of food purchased by the consumer. It is a tool for nutrition education and information about essential components of the food which has public health implications in preventing nutrition and diet related conditions such as obesity, cardiovascular disease and diabetes. Without nutrition labelling it is difficult for the consumers to identify the nutritional content of packaged food. Packaged foods which are usually high in fat, trans fat, sodium and sugar should be consumed judiciously.

To ensure that one is making healthy food choices, one should know how to read nutrition labels. One should be able to recognise foods which are high in fat, trans fat, sodium and sugar and consume these foods occasionally. Nutrition labelling is found on Front of Pack and Back of Pack. Usually the front of the label information is short and precise, in the form of nutrient and health claims while the back of the pack includes more detailed presentation of nutrients in the form of Ingredients list and Nutrition Facts Panel.

**Nutrient Claims**: Nutrient claim is usually related to the function, presence or absence of a nutrient in a food. For e.g. nutrient claims like “low in fat”, “good source of calcium”, “high in dietary fibre”, “zero cholesterol”, etc. Nutrient claims are not mandatory but if it is declared on the label then it becomes inevitable to have the nutrition value declared. For e.g. when a claim “rich in iron” is made on the label then it is mandatory to have iron values as percentage/mg on the panel and this is called substantiation of a claim.

**Health Claims**: “Health claim means any representation that states, suggests or implies that a relationship exists between a food or a constituent of that food and health and include nutrition claims which describe the physiological role of the nutrient in growth, development and normal functions of the body”. Other functional claims can concern specific beneficial effect of the consumption of food or its constituents, in the context of the total diet, on normal functions or biological activities of the body. Such claims can relate to a positive contribution to health or to the improvement of function or to modifying or
preserving health or disease. Risk reduction claim relates to the consumption of a food or food constituents, in the context of the total diet, to the reduced risk of developing a disease or health related condition.

**Nutrition Facts Panel:** Nutrition Facts Panel (figure 1) is a tabular presentation or declaration of the nutrients contained in a food package. Nutrition information is usually given as, “per 100g” or “per serving” or “% DV” or combination of “per 100g and per serving” or combination of “per serving and % DV” or combination of per 100g, per serving and % DV.” “%DV” stands for ‘Percent Daily Value’ which is the amount of nutrient needed by a person based on a 2000 Kcal diet. An individual’s Daily Value may be higher or lower depending on the calorie needs. A food is considered a rich source of a nutrient if 20% or more of the DV is present in that food; 10 – 19% is considered a good source and 5% or lower is considered a poor source.

This declaration should compulsorily comprise of the following information:

- Energy value in kcal
- Protein, fat and carbohydrate along with sugar quantity in grams
- Amount of any other nutrient for which a nutrition / health claim is made.
- The amount of vitamins and minerals should be in metric units.
- For nutrition declaration made per serving, the amount in one serving in grams or milliliter should be mentioned for reference beside the serving measure.
- When a claim is made on the amount or type of fatty acid or the amount of cholesterol, the amount of saturated fatty acids, monounsaturated fatty acids and polyunsaturated fatty acids in grams and cholesterol in milligrams should be declared. Along with this, the amount of trans fatty acids in grams should also be stated.

So, while selecting packaged foods for their nutritional value, the following can be kept in mind:

- Nutrients which are good for you include vitamins, minerals, fibre, protein and omega 3 fatty acids and it is a good idea to select foods rich in these nutrients.
- Select foods which have more than 15% DV of vitamins and minerals.
- Foods rich in fibre should have at least 6g fibre per 100g of food.
- There should be zero trans fat in the food as trans fats are bad for cardiovascular health.
- Healthy foods are low in total fat, saturated fat, sugar and salt/sodium.
- Low fat foods have no more than 3g fat/100g of food or 1.5 g fat/100 ml of beverage.
- Prefer foods with no added sugar.
- Foods with no more than 0.12 g of sodium or 0.3 g salt/100 g are considered to be low in sodium/salt.

Figure 14.1: Nutrition Facts Panel (Source: Pink Book, FSSAI)
The Food Safety and Standards Act, (2006), and Food Safety and Standards (Packaging and Labeling) Regulations, 2011 have laid down the requirements for labeling of pre-packaged foods. It is mandatory that every package of food should carry a label that bears all the information required under the Act. At the same time, it is also important that the label should not carry a false, misleading or deceptive description or presentation of the pre-packaged food and the labeling should not create a misleading impression regarding the character of food in any respect. Table 2 presents clarifications about certain claims which are seen on food packages or advertisements for food products. Box 4 lists the mandatory information each food label should have. In addition, there are certain mandatory declarations which manufacturers have to make on the label. These include:

- Addition of certain food additives like food colours, artificial sweeteners, Class II (chemical) preservatives, flavouring agents, monosodium glutamate, etc.
- For edible oils the kind of oil, names and proportions of oils in case of blends, and the declaration that the oil is not to be sold loose and that it is free of Argemone oil (an adulterant).
- For infant foods, it is mandatory to declare on the label that breast milk is the best for the baby.
- Presence of allergens in food.
A complete label gives the assurance that the food item has been manufactured by a reliable firm which is not trying to hide facts. In addition to checking whether the packets are well sealed and labelled and within the best before date, the list of ingredients should be checked for the presence of allergens. Products are also supposed to declare **allergy information** in case any of the known allergens like cereals with gluten, crustacean, peanut, tree nuts, egg, milk, fish, soy and sulphite in concentrations of 10 mg/kg or more have been used in the formulation of the product or the product has been processed in a plant where these ingredients are also processed.

There is very fine line between "**Best before**" and "**Expiry date**" of the food product. "Best before" date is the date after which the food product is not advisable to be marketed however it may still be safe to consume but its quality may have diminished. On the other hand, "Expiry" date of the product signifies the date after which the food product’s quality and safety attributes diminishes to a level that it cannot be consumed by the consumer. "Expiry date" is also termed as “**Use-by date**” or “**Recommended last consumption date**”

**Healthy food choices when eating out**

In today’s fast paced lifestyle, eating out has become inevitable. It is mainly due to lack of time, increased mobility of younger generation, more opportunities for social activities, and availability of a variety of regional and international cuisine. Hence it has become increasingly imperative to ensure that hygienic and healthy eating options are available to consumers of all income brackets. FSSAI is trying to improve the safety of street foods through its ‘Clean Street Food Hub’ initiative. Street foods provide cheap, nutritious and
traditional meals to a sizeable population in urban areas of our country. Maintaining hygiene is an integral part of keeping food borne diseases away. Food outlet and kitchens should maintain proper hygiene. Before selecting a food outlet, one should check the hygiene rating of the food outlet, if available.

**Menu labelling** refers to providing and displaying the calories and/or other nutritional information for each food item available at a food outlet. It is aimed at helping people make informed – and ideally healthier – food choices when eating out. To facilitate informed consumer choices, regulations on advertising and claims and mandatory menu labelling has been notified. FSSAI has issued draft packaging and labelling regulations making it mandatory for restaurant chains to declare on the menu cards, the calorie content of all the dishes served at their outlets. It also intends to bring online food-delivery platforms and food aggregators under the ambit of these regulations. Apart from menu labelling there are some other points to be considered when eating out for healthful and mindful eating, these have been outlined below:

- Avoid eating out when you are overly hungry. Eat a small healthy snack, such as carrots or a small apple, just before going out.
- Check the menu online so you can make healthy choices ahead of time
- The portion sizes at many restaurants are very large. The temptation for overeating can be hard to resist at these places. Think and plan ahead and order for smaller portion sizes or share your food.
- When ordering, ask about food items cooked in a healthier manner such as baked or steamed instead of fried.
- Prefer salads and other vegetable side dishes. Order salads or uncooked food items only if you are sure of the hygienic standards of the outlet.
- Prefer foods that are broiled, grilled, steamed, poached, roasted, or baked
- Avoid anything creamy, fried, crispy, breaded, battered, or au gratin
- Avoid sauces or soups with lots of butter, cream, or cheese
- Avoid thick or creamy salad dressings
- Limit fried foods, creamy curry sauces, cream sauces such as *Korma* or *Makhani*, and foods made with clarified butter or *ghee*.
- Prefer water or low-fat milk over beverages that have empty calories, such as sodas.
- Avoid ordering the value or combo meal unless the restaurant offers healthy sides such as salad.

Thus, whether we eat at home or at school, in the workplace or any food outlet, keeping some of these pointers in mind will help us select healthier food options which will increase the overall healthfulness of our diets.
Summary

- Eating a healthy diet is the basic step towards good health. Following a healthy diet at home, in school, at workplace and while eating out is possible and achievable.

- Healthy eating in childhood and adolescence is crucial for proper growth and development and to prevent various health conditions.

- Adequate nutrition is crucial during the school age, however there are several hindrances in achieving it, one such factor is ‘eating behaviour’ during the school age.

- Nutritional requirements vary greatly among males and females because of variations in growth rate, body composition, and physical activity level.

- It is also important for the parents and caregivers to understand the importance of providing healthy food in the tiffin. Choose healthy and wholesome recipes for tiffin. For example, roti wraps, rice preparations, stuffed parathas, steamed foods (idli, dhokla) etc. Combination of a cereal with pulse along with some vegetables/fruits provides a wholesome meal.

- How healthy the family diet is, is partly dependent upon the home food environment. It is therefore essential that healthy, well balanced meals are prepared, which cater to all family members of different age groups at home.

- Meal planning comprises planning of balanced meals which are wholesome, nutritious, palatable, appetizing and well within the economic means of families.

- Faulty eating habits in the workplace contribute to poor health, reduced productivity and a negative working environment. Employees who have trouble concentrating, irritability and lethargy may be making poor food choices. The workplace food environment should encourage and improve availability of healthy food options.

- Consumption of commercially available food/snacks outside the home has become an integral part of the busy modern lives. With fewer meals being consumed at home, the overall quantity of calories has increased while nutritional quality has declined.

- When buying packaged foods, it is difficult to check the food quality by looking at the food. In these cases, reading the food label helps in selecting more nutritious options of food.

- Before selecting a food outlet, one should check the hygiene rating of the food outlet, if available.
Key Words

Health claim - means any representation that states, suggests or implies that a relationship exists between a food or a constituent of that food and health.

Nutrition claim - is usually related to the function, presence or absence of a nutrient in a food.

Nutrition Facts Panel - is a tabular presentation or declaration of the nutrients contained in a food package.

Nutrition labelling - information on the label of packaged food regarding ingredients and nutrients present in food.

Percent Daily Value - which is the amount of nutrient needed by a person based on a 2000 Kcal diet.

Exercises

1. Discuss the things to be considered and the healthy food options when eating out.
2. Explain why meal planning is important.
3. What are some concerns regarding eating behaviour of children and adolescents?
4. Explain the things to be kept in mind when buying packed foods. Discuss importance of reading food labels.
5. What can be the best options for healthy tiffin?
6. Why is it important for employers to improve the food environment at the workplace? Discuss giving suggestions on how meals and snacks offered at workplaces can be improved.

Activity

1. Visit a college/school canteen or observe the service of a mid-day meal being served in a school. Make a note of the menu. Critically evaluate the nutritional quality of the meals served. (Hint: Look at the food groups included. Are any of the dishes high in fat, sugar or salt?)
2. Visit an office and check out the meals served in the cafeteria. How would you rate the healthfulness of the dishes? Use a nutrient profiling model to evaluate.
References

1. Food Safety and Standards (Safe Food and Balanced Diets for Children in School) Regulations, 2020 Available at: https://fssai.gov.in/eatrightschool/school-regulations.php


Chapter 15: Lifecycle Approach to Healthy Diets

- Importance of the first 1000 days
  - Nutritional care during pregnancy
  - Nutritional care during lactation
  - Nutritional care during infancy

- Childhood - the growing years
  - Importance of nutrition
  - Factors affecting dietary pattern
  - Inculcating healthy eating practices

- Adolescence – a critical period of development
  - Nutritional needs during Adolescence
  - Nutritional Issues and Dietary Challenges
  - Healthy diet during adolescence

- Adulthood and Healthy Ageing
  - Dietary needs and nutritional concerns
  - Healthy lifestyle
  - Eating mindfully
Chapter 15: Lifecycle Approach to Healthy Diets

Good nutrition is essential for survival, physical growth, mental development, performance, productivity, health and well-being across the entire life span: right from fetal development up to birth, childhood, adulthood and aging. Nutritional needs and concerns vary during different stages of life. Nutritional needs should be met at every stage of the life cycle because nutritional status at one stage influences health status at a later stage.

This chapter focuses on how the individual’s nutrient needs change through the lifecycle. If these needs are not met, they can adversely affect growth and development. For instance, iron deficiency experienced by young children can decrease intellectual capacity, and adequate vitamin D status during adolescence and early adulthood decreases the risk of breast cancer in older women. A focus is needed on meeting nutritional and other health needs of individuals during every stage of the life cycle in order to prevent diseases and promote good health.

Healthy individuals require the same nutrients throughout life, but amounts of nutrients needed vary based on age, growth, and development. Nutrient needs during each stage of the life cycle can be met through a variety of foods. There is no one best diet for everyone. Traditional diets defined by diverse cultures and regions provide the foundation for meeting individuals’ nutritional needs.

The amount of nutrients needed by individuals vary depending on:

● Age
● Illness
● Body size
● Lifestyle habits (e.g. smoking, alcohol intake)
● Physical Activity
● Genetic traits
● Medication use
● Growth
● Pregnancy and lactation

Importance of first thousand days

The “First 1000 days” begin from the day a woman conceives and continues till the child turns two years of age (Figure 1).
The first 1,000 days is a unique period of opportunity when the foundation of child’s optimum growth and development across the life span is established. This critical period of growth and development is largely affected by maternal and child nutrition. It is a period of great opportunity to provide adequate nutrition for the child without which the child becomes vulnerable to various birth defects and health problems. Inadequate nutrition before and during pregnancy may lead to low birth weight, poor mental development, greater chances of diseases such as overweight/obesity, diabetes, high blood pressure, heart diseases in later life and even death of the child. Therefore, it becomes critical to provide appropriate nutrition during the first 1,000 days of life. Let us now understand the entire 1,000 days in three stages with the focus on nutrition.

**STAGE 1**: Period between conception to birth of the child i.e. first 270 days.

**STAGE 2**: Period from birth of the child to 1 year i.e. 365 days.

- **Stage 2a**: Birth to 6 months.
- **Stage 2b**: Six months to 12 months.

**STAGE 3**: Period between 12 months to 24 months of child’s age.

The World Health Organisation identifies early childhood as the most important developmental phase throughout the lifespan, with lasting impacts that will affect the individual and the community. Essential nutrients are important for brain development, healthy growth and a strong immune system. Major public health problems such as obesity, diabetes, heart disease, cancer and mental health problems which were once regarded as adult issues, are largely shaped by how the baby is nourished in the womb and during the first 1,000 days’ period. Experiences in early childhood are also related to criminal behaviour, literacy level and employability.

**Alarming Facts**

Almost 21% of children under the age of 5 are stunted, as a result of chronic malnutrition. The effects of stunting last for the lifetime, beginning with lower IQ, weakened immune system and greater risk of diseases in later life. Children who are stunted, frequently earn up to 20 percent lower than average adults. (UNICEF/WHO/World Bank, 2020; UNICEF, 2012)
Nutritional care during pregnancy

The effects of poor nutrition in early life impact not only the child's health but also that of the child's offspring. In this way, the damaging effects caused by poor nutrition in early life have the potential to cascade down through generations. It is critical to break this cycle of malnutrition; otherwise undernourished girls will become undernourished women who give birth to low birth weight infants.

India has made groundbreaking progress in recent years in reducing maternal deaths during pregnancy. These have been possible because of the following schemes, initiatives and programs:

1. Institutional deliveries – Women are encouraged to deliver in hospitals and health care centres rather than at home. India has made a concerted push to increase access to quality maternal health services and hospital deliveries now stand at 79%.

2. State-subsidized schemes like the Janani Shishu Suraksha Karyakram – which allows all pregnant women delivering in public health institutions to free transport and no-expense delivery, including caesarian section.

3. Pradhan Mantri Surakshit Matritva Abhiyan, which allows women access to antenatal check-ups, gynecologists and to track high-risk pregnancies – exactly what is needed for healthier pregnancy outcomes.

Importance of healthy diet

During pregnancy, the quality of a mother’s diet and the rate of weight gain are two of the most crucial factors that influence a child’s future health. An inadequate diet will place the baby at risk for developmental delays, birth defects and poor brain development. When a woman lacks sufficient folic acid before becoming pregnant and in the early weeks of her pregnancy, it can lead to birth defects of the brain and spine (neural tube defects) that can cause death or lifelong disability. According to NFHS 4 data, more than half of the women in the reproductive age are anaemic. Although the pregnant woman needs to consume a balanced diet and the requirement for all nutrients increases, nutrients which are critical during pregnancy include:

According to UNICEF (2012), children who get the right nutrition during this time
- are 10 times more likely to overcome most of life threatening childhood diseases
- complete 4.6 more grades at school
- go on to earn 21% more in wages as adults
- are more likely as adults to have healthier families
- **Iodine** for foetal brain development and growth
- **Folic acid** to prevent birth defects and for better fetal development
- **Iron** to help in foetal brain development, expansion in blood volume and growth.
- **Vitamin B12** to prevent anemia and for nerve health.
- **Vitamin D** for calcium absorption and bone development.

In addition, the pregnant woman needs to take care about her meal timings and frequency, fluid intake, exercise and monitor weight gain. She should eat small and frequent meals as she will be unable to eat enough at a single meal. Foods rich in fats and spices should be avoided to prevent heartburn. She should avoid the foods or factors which trigger nausea such as smell of certain foods during initial months. Plenty of fluids should be taken to avoid dehydration and constipation. Gestational diabetes or hypertension need to be treated and appropriate medical nutrition therapy provided.

**How does mother’s weight gain affect the baby?**

The weight gained by the woman during her pregnancy has a powerful influence on her child’s lifelong health. Mothers’ nutritional status also affects the birth outcome. Underweight and overweight mothers both have an adverse effect on the growth of foetus. Obesity in pregnancy poses a threat to a baby’s future health. For example, it puts women at risk for gestational diabetes—a condition in which women exhibit high glucose levels during pregnancy. Gestational diabetes negatively impacts the baby’s development in the womb and makes him more susceptible to obesity and type 2 diabetes later in life. Excessive weight gain during pregnancy significantly increases the risk of childhood obesity. Moreover, women who are already overweight, before they become pregnant, will have children who are more likely to have problems maintaining a healthy weight later in their life.

**Nutritional care during lactation**

In order to support breast feeding, the mother’s body undergoes a number of physiological changes. Lactation is a period which puts great demands on maternal tissues as her breast milk has to meet the needs of a fully developed and rapidly growing infant. Adequate nutrition is very important to ensure good health of both mother and child. The effects of any nutritional inadequacies during this period can adversely affect the total quantity of milk produced. The nutrient content of the milk is usually maintained at the cost of maternal tissues, however the levels of certain nutrients in mother’s milk can reduce if the mother is severely under nourished.

Lactation therefore is an important period and care needs to be taken to ensure good maternal nutritional status. The energy and protein requirement of the nursing mother increases along with several micronutrients. The additional micronutrients which the nursing mother needs to include in her daily diet include:
• **Calcium:** to replenish calcium secreted in the milk and ensure good bone health for mother and child.

• **Vitamin A:** secreted in breast milk, important for growth and development of baby, immunity and its role in vision

• **Vitamin C:** secreted in breast milk, important for collagen synthesis, immunity

• **Folic acid:** prevents anemia, important for growth and development

• **Vitamin B12:** prevents anemia, important for growth, development, and nerve health

Successful lactation requires adequate nutrition and rest, in addition to family support and encouragement. The nursing mother should take a lot of fluids to support the secretion of nearly 800 ml of milk during the initial 6 months. Small and frequent meals are better accepted as the mother needs to consume additional food to meet the increased energy needs of the body. There are no food restrictions during lactation except strongly flavoured and spicy foods, smoking, alcohol and drug abuse as they may pass into breast milk. Also, any medications if required should be taken under strict medical supervision only as they may also pass into breast milk.

**Nutritional care during Infancy**

A child’s birth weight and whether the baby was born full-term or not are important markers of future health and development. Low birth weight is a leading cause of infant deaths in India. A baby is considered to be low birth weight when she weighs less than 2.5 kgs at birth. Intrauterine growth restriction due to poor maternal health and nutritional status may lead to low birth weight. **Premature babies** — that is babies born before 37 weeks of pregnancy also require additional care.

**Why exclusive breast feeding is very important for babies?**

• From birth through the first year, breastfeeding provides the healthiest start to the newborn. For the first 6 months the babies should be exclusively breast fed i.e. they shouldn’t be given any other fluid or food including water. Giving infants water, other liquids or other foods before six months, reduces the breast milk consumed, and may introduce germs leading to disease and malnutrition.

• It is very important that newborns get colostrum, the first thick yellowish milk from the breast which is the child’s ‘first vaccine’ and the best protection that she can have against illness, disease and death.
  a. Breastfeeding within one hour of life protects the child from infections and reduces the risk of death by nearly 22 % in the first month of life. Every mother should start breastfeeding within one hour of life to take advantage of the newborn’s intense suckling reflex and alert state to stimulate breast milk production.
b. Starting breastfeeding within one hour of life and learning to breastfeed properly (positioning and attachment), helps the mother produce more milk for her child.

- Skin-to-skin contact with the mother through breastfeeding keeps the child warm and fosters mother-infant bonding.

- Breastfeeding on demand should be encouraged.

Children who are exclusively breast fed are 14 times more likely to survive the first six months of life than non-breastfed children. Mother’s milk is all they need for survival and for optimal growth and development.

- Babies who are breastfed continue to be exposed to a wide range of flavours from their mothers’ diet through her breast milk. This plays a key role in determining what foods are familiar to and thus preferred by the baby.

- Breastfeeding is a natural birth control measure as it helps to increase the time between pregnancies, which naturally help to space births.

- Exclusive breastfeeding is also financially advantageous as families do not need to spend money on expensive infant foods.

- It is not just the babies who benefit from breastfeeding. A longer duration of breastfeeding is associated with lower risk of overweight, obesity, type 2 diabetes, ovarian cancer, breast cancer and heart disease for the mother.

Thus breastfeeding-friendly workplaces and public spaces should be created to improve support for mothers to breastfeed. Organisations should provide paid parental leave and family-friendly workplace policies to support parents to give their children the strongest start.

How long should breast feeding be continued and when should the baby be weaned?

Babies should be exclusively fed on breast milk for the first 6 months of their lives. All the possible support should be given to the young mother to pursue breastfeeding for the first six months. This should be followed by continued breastfeeding for up to 2 years, alongside the appropriate introduction of complementary foods at 6 months.

If mothers must return to work within first year, they should be encouraged to express and store breast milk, which can be given to the baby while the mother is at work. The reasons why women avoid or stop breastfeeding vary, but women who want to breastfeed need stronger support from their families, communities, healthcare providers and employers.

By the end of sixth month, breast milk alone is not enough to meet an infant’s nutrient requirements. Therefore, complementary feeding should begin at the seventh month. Babies who begin to eat solid foods before the age of 6 months are at greater risk for food
allergies. Age-appropriate complementary feeding adequate in quality, quantity and frequency should be available for children from 6-24 months. Young children have a very small stomach thus small frequent feeds are recommended. Infants should be fed slowly and patiently. Children should be presented with a variety of nutrient-dense foods to fuel their growth and development. A varied diet will also help shape their taste preferences for adulthood. Cow's milk as a drink should be avoided for the first 12 months (as babies can become allergic to it), though it can be used in the preparation of a dish such as porridge. Six monthly vitamin A supplementation is recommended.

Salt and sugar should not be introduced in the child's diet in the first year. Use natural fruits and vegetables to impart flavour. Mild flavours are preferred by infants. The temperature of the dishes should be neither hot nor cold. In fact, infancy is a golden window of opportunity to influence a child's preference for healthy foods. New foods should be introduced one at a time in small quantities, and tolerance to the food evaluated before presenting a larger serving to the infant. Introducing new foods at a time when the infant is hungry ensures better acceptance. The texture and consistency of the food also changes as the infant grows from strained gruels of flowing consistency to a semi-solid dish like mashed khicheri. By the age of one year the infant is ready to start the family meals albeit with less spices (texture to remain soft and mashed till teeth erupt for effective chewing).

What precautions should be taken during the weaning stage?

Infants aged 6 to 12 months old are more likely to suffer from diarrhoea than any other age group as this is the time period when they start eating complementary foods. If these foods are not handled in a safe and clean manner, it can lead to diarrhoea, illness and malnutrition. The following precautions need to be taken while preparing meals for infants:

- Boiled water should be given to infants and used for making their foods.
- Safe handling of foods and hygienic cooking and feeding practices are extremely important, as food contamination and subsequent diarrhoea contributes to 25% of undernutrition in infancy.
- Washing parents' and children's hands with soap before preparing and eating foods is one of the most important ways of preventing germs from getting into food and avoiding diarrhoea in young children. Hand washing with soap alone prevents up to 50% of childhood diarrhoea.
- Food served immediately after cooking and stored safely, reduces the risk of germs getting into food.
- Using clean utensils and crockery will stop germs from getting into food.
- Feeding bottles, which are difficult to keep clean, should be completely avoided. Instead cups and spoons should be used.
Improper disposal of stools and subsequent unclean hands lead to germs entering the body of young children, causing diarrhoea, other infections and leading to growth failure and poor development.

Childhood - the growing years

“A child’s body needs nutrition, not just food”
- Julie Webb Kelley

Growth and development are a continuous process whereby each year builds upon the preceding one. In the pre-school age, the child grows more in height. The body fat decreases but as the child enters middle childhood years, there is an adiposity rebound. The child gains about 5-7cms in height and about 2-3kg weight every year. In middle childhood along with gross muscles, fine muscles develop rapidly. By tracking the growth, children with growth deficiencies such as stunting, wasting or underweight or overweight/obesity can be identified at an early stage and intervened. So, before we start to offer nutrition counseling, nutritional assessment is of topmost priority.

Importance of nutrition

Good nutrition improves the child’s physical well-being as well as cognitive development, leading to better growth and academic performance. Counselling of care givers on nutrition and healthy eating for children is important. Both quality and quantity of food intake from each food group needs to be focused on.

Nutrient requirements are high during the growing years. Dietary energy must be sufficient to ensure growth and spare protein to be used for tissue synthesis. At the same time care has to be taken to not allow excess weight gain and obesity. As the child grows the energy requirements also tend to increase during periods of rapid growth. The brain needs energy to function properly and hence the supply of glucose is relevant and critical. Cognitively demanding tasks, such as schoolwork, require regular supplies of glucose to the brain in order to enhance cognitive functioning and improves memory and mood. The major sources for energy are fats and carbohydrates.

Carbohydrates is the main source of energy for school-age children. The recommended intake of carbohydrates is approximately 60% of the total energy intake. Complex carbohydrate sources such as whole grains, fruits, vegetables and legumes should be chosen instead of refined carbohydrates like refined grains (Maida, corn flour etc.), fruit juices with added sugars or other foods with high sugar content. Foods with high fat, sugar and/or salt such as chocolates, cookies, puffs, patties, samosa, burger, pizza, carbonated beverages should also be avoided as these may lead to obesity and associated health problems.

Suggested intake of fat is not more than 30% of total energy being contributed by fat, mainly from mono- and polyunsaturated fats. Sources of these healthy fats include vegetable oils, peanut butter, nuts and seeds. Essential fatty acids especially omega-3 fatty acids, are important for the child’s cognitive development. Food sources high in omega-3
fatty acids include green leafy vegetables, whole grains, fatty fish, walnuts, soybeans, flaxseeds and pumpkin seeds.

As proteins are essential for muscle strengthening, body growth, maintenance, and to enhance immunity, protein requirements gradually increase as the child grows. High-quality protein foods include eggs, dairy products, meat and seafoods. The other protein rich sources include processed soy products, legumes, nuts and oil seeds. Vitamins and minerals are an integral part of healthy nutrition since they perform several functions in body. Children of school age are more prone to developing micronutrient deficiencies that can have adverse influence on their overall performances. Some nutrients of concern are listed below:

- **Vitamin A** deficiency in children may lead to night blindness.
- **Vitamin D** is required for bone growth and calcium metabolism. Lack of vitamin D (Sunshine Vitamin) leads to Rickets in especially children not exposed to sunlight.
- **Calcium** is important to support bone growth
- **Iron** deficiency anemia can affect the cognitive performance of children
- **Vitamin C** enhances the absorption of iron from meals besides providing other benefits.

**Factors affecting dietary pattern**

Most young children need some structure and routine to their day. Generally, they prefer meals and snacks at regular times, as governed by the family’s lifestyle. They have a preference for simply prepared, mild tasting foods that they can easily handle. At this age children also tend to develop negative and positive associations with food. For example, sweets and chocolates which are given by parents as rewards for good behavior may be associated with positive emotions. On the other hand, foods which parents sometimes force their children to have like milk may get associated with negative emotions. It is important to know that early impressions associated with various uses of food, affect food-related attitudes and practices throughout life. When they grow up, they will be averse to consuming foods which evoke negative emotions. Food preferences can be influenced by parents and friends; as well as media advertisements may influence the child to select certain foods over others.

In contrast to the pre-school age where familial influence is higher, in the school- age, children are more influenced by their peer group. The food habits of school-age children are more scheduled due to specific school timings. However, many external influences may affect the child’s food choices. It is estimated that children are spending more time in front of a screen (television, computer and mobile) rather than in outdoor recreation. Ill effects of this include decreased physical activity and hence loss of appetite. Studies have shown that television advertising influences children’s food preferences and purchasing requests resulting in inclusion of unhealthy foods which increase the risk for obesity, dental caries, deficiency of micronutrients etc. Social events and parties often promote unhealthy eating habits.
The food served in school canteens or school lunch programs (Mid day meal programme in India) also influences the food choices of children. Availability of junk foods in or around the school acts as an enticement, and children land up making poor food choices. Hence it is very important to control the sale/service of unhealthy foods in the vicinity of schools. The Food Safety and Standards (Safe Food and Balanced Diets for Children in School) Regulation (2020) will regulate the sale of HFSS foods in schools and ensure that only healthy meals are served in schools.

Inculcating healthy eating practices

It is common among school children to skip breakfast. This makes the child feel inattentive and tired during class hours. Skipping breakfast affects both the nutritional status as well as the school performance of the students. Empirical evidence from research on the effects of breakfast on cognition shows that particularly for younger children, skipping breakfast can have adverse effects on both general energy levels and cognition of school children. The reason for skipping breakfast has to be identified and addressed.

As long as a child is at home the whole day, the mother can feed him meals. However, as soon as children enter school, they need to start eating a meal or two on their own. While packing tiffins the mothers need to make sure that it should be an item which is easy for the child to eat. The meal must be simple yet nutritious. For example, a vegetable-stuffed chapati or mixed vegetable rice or dal chawal cooked with vegetables can be chosen instead of too many items like chapati/rice, dal and sabzi separately.

Classroom lessons must include a subject on healthy eating habits. For small children the teacher may need to supervise the lunch ensuring that children inculcate good eating manners and finish their lunch.

Special effort needs to go into feeding a fussy eater. Active feeding rather than forced feeding should be done so that mealtimes do not become unpleasant for the child. Healthy foods of their choice must be packed, and variations must be considered. In a few cases, getting an attractive lunch box will also help to motivate the child into eating. For these children, mothers should involve them in the cooking process and teach them the benefits of each food. Family pot eating and family mealtime is important. Having meals together helps the child understand the importance of each meal. The whole family needs to eat healthy to inculcate healthy habits in the child.

Children who are underweight may need special care and attention. Children who are obese need to cut down unhealthy snacking especially on non-nutritive energy dense food. A study shows that for children of school going age, snacks may contribute up to one-third of the total calorie intake for the day. This is generally after-school snacks which are majorly influenced by peer pressure. Regular consumption of outside food increases the body weight and results in obesity. Children frequently consuming sweet foods such as sweets, chocolates, jellies, pastries, sugar sweetened beverages followed by poor oral hygiene tend to develop dental caries. Hence good oral hygiene is important.

Anaemia reduces the attention capacity of the child and brings down the academic performance. It may hinder the growth and development of the child. It is important to take care that iron rich foods are included in daily meals along with vitamin C rich foods for better
Absorption of iron. Inhibitors of iron absorption (e.g. tannin, oxalate, phytate and calcium) which reduce the bioavailability of iron from the food should not be consumed along with meals rich in iron. Tea, coffee, tamarind, cocoa are few beverages and foods which have these inhibitors.

Adolescence – a critical period of development

Adolescence is the period of transition from childhood to adulthood and a period of rapid growth and maturity both physiologically and psychologically. Adolescence has been referred to as a window of opportunity to prepare for a healthy productive and reproductive life and prevent the onset of nutrition related chronic disease in adult life. The three dimensions of growth during adolescence are physical growth, mental and emotional blooming and sexual development. Inadequate intake of nutrients can result in slow growth and delayed sexual maturation.

WHO (2010) defines adolescence as the segment of life between the ages of 10–19 years. Considering the major physical, cognitive and emotional changes that take place, this age group is further divided into 3 stages:

- Early Adolescence: Ages 10-15 years
- Middle Adolescence: 14-17 years
- Late Adolescence: 16-19 years

Nutritional needs during Adolescence

During adolescence, the linear growth of childhood is suddenly altered by an increase in the velocity of growth. Almost 80% of adolescent growth is completed during early adolescence. Post-puberty, the growth spurt decreases. Growth spurt in adolescence is associated with cognitive, emotional and hormonal changes. Nutritional needs vary during adolescence. They are different for males and females. This is mainly due to differences in growth spurts and sexual maturation. Puberty hits females between the age group 10-14, whereas for males it occurs between 12-16 years of age. Differences are seen not just in caloric and macronutrient requirements, but also in the requirements of micronutrients. Iron requirements are generally higher in females due to increased physiological demands and menstrual losses. It must also be noted that there are differences in body composition. Boys have greater muscle mass as compared to females. Approximately 45% of the skeletal mass is added during adolescence. Girls on the other hand tend to accumulate more fat than muscle tissues.

Energy and Protein requirements: The considerable increase in energy and protein requirements is attributed to the gain in weight and height along with increase in muscle mass in boys and fat mass in girls. Increment in requirements correlates with growth patterns, with the peak in requirements occurring at the peak growth period of adolescence. While considering protein requirements, it is important to consider the quality of proteins and not just quantity. Good quality protein should be provided daily by including
sources of good quality protein viz. milk and milk products, eggs, meat, fish and/or by using ideal food combinations of cereal and pulse (e.g. Dal-Roti/rice, khichdi, etc.). Most Indian diets lack protein and thus efforts must be made to include a serving of good quality protein in every meal of an adolescent.

**Minerals and Vitamins:** Minerals and vitamins play a critical role in the growth and development. The role of these micronutrients is considered to be very crucial due to the peak in growth velocity, increase in body size, body density and puberty changes. Micronutrients are involved in various physiological processes in the form of catalytic enzymes, hormones, structural components and protective agents. Thus, it is necessary to ensure the provision of a diet that supplies all essential micronutrients in required amounts. Iron and calcium are two minerals for which the requirement increases as the blood volume as well as skeletal mass is increasing. If adolescents in the age group of 13-17 years fail to meet calcium requirements they may not achieve their peak bone mass, thus increasing the risk of developing osteoporosis at a later age. Adolescent girls are at increased risk of anaemia due to rapid growth and development in adolescence and menstruation which increases the demand for iron. Zinc is important for growth and sexual maturation in adolescent.

**Nutritional Issues and Dietary Challenges**

Adolescent growth and development are linked to the quality of the diet they receive during childhood and adolescence. Adequate nutrition of any individual is determined by two factors: (1) adequate availability of food in terms of quantity as well as quality, which depends on socioeconomic status, food practices, cultural traditions, and intra-family allocation of the food, (2) the ability to digest, absorb, and utilize the food. This ability can be hampered by infection and metabolic disorders.

Food choices made by adolescents is a major factor that impacts the nutritional status and thus the health status of this age group. Factors that influence food choices of adolescents are:

- Taste
- Peer influence, food trends and fads
- Mood
- Body image
- Food habits as influenced by family, culture, religion
- Influence of media, celebrity endorsements, Influencers
- Convenience foods

Mass media as well as social media play a big role in influencing adolescents. Use of social media has now become an addiction to many and it greatly affects self-perception and body image. Besides the physical ill-effects of increased screen time, social media has a greater impact that influences choices, behaviour patterns, and mental health and lifestyle habits. This powerful form of media should be used in a positive manner to provide authentic health and nutritional messages.
Adolescent health problems include sexual health issues, teenage pregnancy, problems related to menstruation, drugs, tobacco and alcohol abuse, anaemia, eating disorders, obesity, behavioural problems and oral health. Many teens may describe themselves as being overweight despite being of normal weight, signifying a distorted body image. This leads to eating disorders like Anorexia Nervosa, Bulimia Nervosa and Binge eating. **Anorexia nervosa** is characterized by failure to maintain an adequate body weight, body image disturbance, and excessive dietary restriction and it may be accompanied by periodic binge eating and purging (e.g., self-induced vomiting, laxative use). The symptoms include muscle wasting, growth retardation, dry brittle hair, dry skin, and amenorrhea (absence of menses).

**Bulimia Nervosa** is characterized by recurrent binge eating (consuming large amounts of food while feeling out of control) accompanied by compensatory behaviors to prevent weight gain, and body image disturbances. Compensatory behaviors may be purging (self-induced vomiting, laxative, diuretic, or enema use) or non-purging (excessive exercise, fasting). Salivary gland enlargement, dental problems, heartburn, bloating and irregular menstrual periods are some common problems associated with bulimia nervosa.

Tendency to rely exclusively on junk food like potato chips or fries, burgers, pizzas, chocolates, etc. and consuming carbonated and, sweetened beverages on regular basis is on the rise among this age group. These snacks are easily available, convenient to be carried and inexpensive. Though most of these are energy dense due to their high fat/carbohydrate contents, they are devoid of important nutrients.

Skipping of meals is a common practice in this age group and this is more common in girls than boys. Girls generally miss meals in an effort to lose/maintain weight. Generally, breakfast, which is the most important meal of the day, is not consumed. When adolescents skip meals they tend to consume more snacks and fast foods which tend to be energy dense and low in other essential nutrients. Adolescent obesity is emerging as a major health problem, especially in urban populations. The reason is increased consumption of calorie dense foods and at the same time decreased physical activity. Obesity increases the risk for diabetes, heart disease, hypertension and polycystic ovary syndrome (PCOS) in girls.

Thus, it is important to promote not just good eating habits but also a good lifestyle which includes regular physical activity/exercise. Well-nourished adolescents ensure a healthier future of the nation.

**Healthy diet during adolescence**

Although dietary tips on food choices remain similar throughout the lifecycle, Figure 2 puts together foods to be encouraged and discouraged for the adolescents.
Besides these, it is also advisable to involve children in selecting and preparing foods. The home and the school food environment should be conducive for them to make healthy food choices. Poor food choices are often linked to non-availability of healthier food alternatives at home or in and around school.
Counseling related to excessive energy intakes among adolescents should focus on intake of discretionary calories, especially those from added sugars consumed through soft drinks and from solid fats consumed through snack foods and fried food. Tips should be provided for selecting nutrient-dense foods and beverages at all locations where teens spend their time. An ideal meal pattern for an adolescent age group is a three-meal pattern with two in between snacks – required to meet the multi nutrient requirements.

Adulthood and Healthy Ageing

Adulthood marks a long period which begins with the cessation of active growth. Population above 65 years is regarded as the geriatric age group. Aging is a normal process that begins at conception and ends at death. Once the body reaches physiologic maturity, the rate of catabolic or degenerative change may become greater than the anabolic regeneration. The resultant loss of cells can lead to varying degrees of decreased efficiency and impaired function. Lifestyle factors that seem to influence physiologic age are adequacy and regularity of sleep, frequency of consumption of well-balanced meals, sufficiency of physical activity, smoking status, extent of alcohol consumption, and body weight. Disease and disability are not always inevitable consequences of aging. The use of preventive service, elimination of risk factors, and adoption of healthy lifestyle behaviours are some of the major determinants of how well a person ages.

Dietary needs and nutritional concerns

Dietary needs of adults change with age due to the physiological changes which accompany aging. Some of these changes raise nutritional concerns and have to be managed by appropriate dietary interventions:

- The sense of taste, smell, sight, hearing, and touch often diminish at individual rates in the older adult. A reduction in taste and smell reduces appetite and hence overall food intake putting them at a risk of undernutrition. Impaired vision, and loss of functional abilities may prevent older adults from cooking and eating on their own. Improving the flavour of food by using a variety of spices and herbs may help increase appetite.

- Xerostomia (dry mouth) can cause difficulty with chewing and swallowing, which can result in the avoidance of certain foods. In such cases every meal needs to have a curry item to facilitate swallowing of the dry items. People who have missing teeth or who wear dentures often chew less efficiently, which can cause them to eat less hard-to-chew foods such as fruits, and raw vegetables. Modifications of food texture or consistency may make some foods easier to eat and therefore improve a person’s over all nutrient intake.

- Dysphagia, a weakening of the gag reflex that causes swallowing difficulties, can affect a person’s ability to safely consume foods. A person with dysphagia may need modifications in the texture or consistency of food, method of eating, or both.
• **Gastric atrophy**, alterations in gastric acidity, delayed gastric emptying, changes in bowel motility rates, decreased lactase activity, and medication usage can affect intake and availability of nutrients. These conditions can affect the bioavailability of nutrients, overall nutritional status, and the risk for developing chronic diseases such as osteoporosis.

• **Constipation**, which makes it difficult to pass stools or causes incomplete or infrequent passage of stools, is one of the most common digestive complaints in older adults. It can be caused by insufficient fluid intake, inadequate dietary fibre intake, limitations in mobility or activity, psychological factors, and medications. Constipation can often be resolved by increasing intake of dietary fibre, fluid, and increasing physical activity.

• During the aging process, blood vessels become less elastic and total peripheral resistance increases, leading to an increased risk for and prevalence of **hypertension** and cardiovascular diseases. Salt needs to be controlled in the diet as well as fats and simple carbohydrates, in order to keep blood pressure and lipid levels in check.

• **Renal function** and the glomerular filtration rate can diminish as much as 60% between the ages of 30 and 80 years, primarily because of a reduction in the number of nephrons, the functional unit of urine formation in the kidney, resulting in reduced blood flow. Consequently, older adults are often less able to respond to changes in fluid status and challenges to the acid-base balance. Excessive amounts of protein waste products and electrolytes may become increasingly difficult to metabolize, so dietary modifications may be needed.

• As people age, bone resorption becomes more than bone formation. The cause of **osteoporosis** may be age related changes such as decreased estrogen production associated with menopause. Decreased intestinal absorption of calcium and production of vitamin D, reduced physical activity and increased parathyroid hormone secretion may also cause osteoporosis. Many avoidable risk actors like sedentary lifestyle, emotional stress, inappropriate diet may contribute to osteoporosis.

• Every second woman of the reproductive age group in India is **anaemic**. Nearly one fourth of the men are also anaemic. Iron inadequacy can be caused by low dietary intake, impaired absorption possibly resulting from lack of heme iron or vitamin C or blood loss. Treatment may involve using iron supplements together with a diet providing iron sources of high bioavailability and vitamin C to enhance absorption.

• Both forms of **malnutrition** - undernutrition and overnutrition may plague both the adults and elderly.
Nutrition plays an important role in delaying the ageing process. While planning diets for adults and elderly the physiological conditions as well as any existing pathology should be kept in mind. Elderly may require food with special modifications in texture and consistency.

To maintain a healthy life, one should keep in mind quantity of nutrients of concern like saturated fat, trans fat, sodium and added sugar in the diet. Excess consumption of these may increase the risk of obesity, metabolic syndrome, Type-2 diabetes, hypertension and other cardiovascular diseases and, certain cancers. Saturated fat and simple sugars intake should each provide less than 10% of energy. For further risk reduction less than 5% energy from simple/free sugars is recommended. Salt intake should be less than 5g (1 teaspoon) in a day and trans fat intake should be less than 1 energy%.

**Healthy lifestyle**

As we have discussed in earlier chapters, healthy eating is the key for healthy living. Besides our diet, we need to focus on other aspects also which would lead to a healthy life. These factors include physical activity, stress, consumption of tobacco, alcohol etc.

WHO defines a healthy lifestyle as a way of living that lowers the risk of being seriously ill- a way of living that helps you enjoy more aspects of your life. Health is not just about avoiding a disease or illness. It is about physical, mental and social well-being too. When adults adopt a healthy lifestyle, they become a more positive role model for other members of their family, particularly children.

**Healthy Eating – Eat Right Logo of FSSAI**

The logo (figure 3) represents a healthy *thali* or plate to ensure a balanced and wholesome diet comprising all food groups in right quantity for a healthy life. Each colour in the logo represents different food groups. The size of the colour depicts the quantity of the food to be consumed.
Physical activity and exercise is a major contributor to a healthy lifestyle. Physical activity is necessary to stimulate the body’s own natural maintenance and repair system. It is vital for the health of bones, joints, muscles, lungs and heart. Physical inactivity increases the risk of several diseases - coronary heart disease, stroke, high blood pressure, osteoporosis, etc. and in addition can contribute to poor posture, overweight, breathlessness, flabby body, low energy levels and stiff joints. Regular exercise can prevent and reverse age-related changes like decreases in muscle mass and strength, improve balance, flexibility, and endurance, and decrease the risk of falls in the elderly. Regular exercise can help prevent coronary heart disease, stroke, diabetes, obesity, and high blood pressure. Regular, weight-bearing exercise can also help prevent osteoporosis by building bone strength. It can help chronic arthritis sufferers improve their capacity to perform daily activities such as driving, climbing stairs etc. It also increases self-esteem and self-confidence, decreases stress and anxiety, enhances mood, and improves general mental health. Regular exercise can help control weight gain and, in some people, cause loss of fat. Box 1 outlines an action plan for increasing the physical activity level while Box 2 talks about the amount of sleep needed for different age-groups.
**Smoking** can cause respiratory illness, coronary heart disease and cancer. Use of tobacco causes cancers of the lung, mouth, lip, tongue, oesophagus, kidney, and bladder. It also further increases the risk of bladder cancer. Tobacco can cause atherosclerotic arterial disease (hardening and narrowing of the arteries) that can lead to heart attacks, strokes, and lack of blood flow to the lower extremities.

Drinking small amounts of **alcohol** may not be harmful for health however for many people it becomes difficult to draw the line. Raised blood pressure, which increases the risk of stroke; stomach disorders; depression and emotional disorders; cancers, particularly of the mouth, throat and gullet; hepatitis and cirrhosis of the liver; malnutrition; accidents at home, at work and on the roads; and suicides are some of the problems associated with alcohol consumption.

It is easy to become addicted to both tobacco and alcohol. Support and understanding from family members are often critical for sustained recovery. Medication can be useful for the prevention of relapses and for withdrawal symptoms.

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**Box 1: Action Plan for Increasing Physical Activity**

1. If you are not physically active identify when you could be more physically active and how (e.g. put more physical effort into housework; walk briskly, get off the bus or tram one stop earlier; choose to climb the stairs even if there is a lift, play sports).
2. Start slowly – don’t do too much too soon. Listen to your body: if you experience dizziness, nausea, pain and extreme tiredness you are doing too much too soon.
3. If you are comfortable with what you are doing increase the amount of exercise and build it up gradually.
4. Aim at half an hour of moderately intense physical activity five or more days a week. Exercise can be broken up into smaller 10-minute sessions.

Almost any type of exercise (resistance, water aerobics, walking, swimming, weights, yoga, and many others) is helpful for everybody.

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**Box 2: Get enough sleep daily**

It is recommended that newborns (0-3 months) get at least 14 to 17 hours of sleep, infants (4-11 months of age) need 12 to 15 hours, Toddlers (1-2 years of age) need 11-14 hours, Preschoolers (3-5 years of age) need 10-13 hours, school age children (6-13 years) need 9 to 11 hours, and teenagers (14-17 years) need 8-10 hours and those 18 years and above need 7-9 hours of sleep. Older adults (65+ years) need about 7-8 hours but do not sleep as deeply and may awaken at night or wake early, so naps allow them to make up the total of seven to nine hours of sleep.

Eating Mindfully

Nutrition researchers and practitioners have recently adopted the concept of “mindfulness” to better understand and modify dietary behaviour. Mindful eating, includes making conscious food choices, developing awareness of physical as opposed to psychological hunger; satiety cues, and eating healthfully in response to those cues. Mindfulness, even without specific training in mindful eating, may encourage people to better control portion sizes and choose less calorie-dense foods. Some simple tips which could be followed to ensure mindfulness while eating are:

- Stop eating when you are about 80% full even when eating something you love.
- Always judge the portion size before consuming any meal. When portion size of a dish is too large, share your dish.
- When you eat at “all you can eat” buffets, choose carefully and avoid tasting everything.
- Even if there are dishes on the menu that you love, don’t take a second helping (especially when you are full).
- Avoid getting the larger size food or drink regardless of how hungry you are and how cost effective it is.
- Don’t get attracted to food advertisements and freebies (buy one get one offers or free gifts)- stop, judge and think about the benefits or harmful effects of eating that product.
- Don’t eat if not hungry.
- Avoid eating in front of a screen like television, mobile phone, tablet, computer etc. as the person does not realise what and how much they have eaten.
- Avoid any distractions while eating. Concentrate on your food and what you are eating at every meal.
- Avoid binge eating as an emotional response to when you are sad or stressed.

Summary

- Balanced diet is important during all stages of life with special attention required during pregnancy, lactation and infancy.
- During the first 1,000 days, the brain grows more quickly than at any other time in a person’s life. While a newborn’s brain is only one-quarter of the size of an adult’s, it grows to about 80% by 2 years of age. During this time in particular, protein, iron, zinc and iodine are essential to the toddler’s rapidly developing brain.
• Iron plays a very important role throughout the first 1,000 days and the damage done by iron deficiency in pregnancy and the first 2 years of a child’s life can be irreversible. Iron deficiency in infants and toddlers can lead to impaired learning and social-emotional behaviour, including less alertness, increased irritability, less interest in play, contributing to poorer developmental outcomes. Early iron deficiency is also associated with higher levels of anxiety and depression later in life.

• Iron supplementation and deworming protect children from anaemia. Worms in children’s intestine result in loss of nutrients including iron, therefore regular deworming is very important.

• On the other end of the spectrum, rapid weight gain throughout the first two years of life is associated with childhood obesity and other serious negative health outcomes throughout life.

• Adolescence is a period of change from childhood to adulthood. This is the time for the second growth spurt and hence good nutrition is very important.

• Adults should ensure a balanced diet along with a moderate level of physical activity. This would prevent the occurrence of diet related non communicable diseases.

• Nutritional needs of elderly should be modified based on any specific conditions they are facing. Special attention should be given as they are vulnerable to both under and over-nutrition.

• Mindful eating is a habit that needs to be inculcated from childhood itself. Knowledge about right food choices will help an individual to train their mind towards healthy eating.

Important Terms

- **Gestational diabetes**: Diabetes which develops during pregnancy
- **Anorexia nervosa**: Eating disorder characterised by a failure to maintain adequate body weight, body image disturbance and excessive dietary restrictions.
- **Bulimia Nervosa**: Eating disorder characterised by recurrent binge eating accompanied by compensatory behaviours to prevent weight gain and body image disturbances.
- **Low birth weight**: Birth weight less than 2.5 kg.
- **Premature**: Born before 37 weeks of gestation.
- **Colostrum**: The milk secreted after childbirth for the first few days. It is yellowish in colour and rich in nutrients.
- **Physical Activity**: The state of being active or in energetic action or movement.
- **Malnutrition**: Refers to the under/over-nutrition or imbalances in the intake of energy, protein and/or other nutrients.

**Exercises**

1. What are the factors determining nutritional needs during the lifecycle?
2. List important vitamins and minerals required in increased quantity during pregnancy.
3. Why is it important for a pregnant woman to gain adequate weight during pregnancy?
4. What is colostrum? Why is exclusive breastfeeding important for the baby?
5. What is complementary feeding and explain the factors to be kept in mind during its initiation?
6. Explain the nutritional concerns of a school-going child.
7. Why is adolescence considered to be a critical period of development?
8. What are the common conditions that impact the nutritional status in elderly?
9. Discuss how lifestyle changes can help ensure healthy ageing in adults.
10. What do you understand by ‘mindful eating’?

**References**


Chapter 16: Influence of Taste and Other Sensory Perceptions on Food Choices

- Factors affecting food choices
- Role of senses in making food choices
  - Vision
  - Smell
  - Texture
  - Flavour = Taste + Aroma
- Taste Sensitivity: driving our food choices
Chapter 16: Influence of Taste and Other Sensory Perceptions on Food Choices

How do we choose what we eat? Our food choices are dependent on various intrinsic and extrinsic factors. The choice we make between a pack of chips or a fruit is not only based on our liking but there are several other factors involved. These factors include intrinsic properties of food like aroma and taste compounds, texture, colour, appearance, and temperature. Psychosocial and cognitive factors such as culture, education, mood, or conditioning also influence food choices. Understanding sensory perception of food is important for food producers. Food brings pleasure and conviviality to our lives and triggers multitude of emotions. The most nutritious food will not be willingly accepted and regularly consumed if it has poor sensory properties. The challenge to the food industry is to fit what consumers want with what they need, delivering nutritional value and health through products they prefer. This chapter addresses the questions- why we eat what we eat and how can we improve the choices we make?

Factors affecting food choices

The key driver for eating is of course hunger but what we choose to eat is not determined solely by physiological or nutritional needs. Some of the other factors that influence food choices include:

- Biological determinants such as hunger, appetite, and taste
- Economic determinants such as cost, income, availability
- Physical determinants such as access, education, skills (e.g. cooking) and time
- Social determinants such as culture, family, peers and meal patterns
- Psychological determinants such as mood, stress and guilt
- Attitudes, beliefs and knowledge about food

The complexity of making food choices is obvious from the list above, which is in itself not exhaustive. Factors affecting food choices also vary according to life stage and the power of one factor will vary from one individual or group of people to the next. Thus, one type of intervention to modify food choice behaviour will not suit all population groups. Rather, interventions need to be geared towards different groups of the population with consideration to the many factors influencing their decisions on choosing food. In this chapter we would focus on biological determinants of food choices.

Hunger and satiety: Our physiological needs provide the basic determinants of food choice. Humans need energy and nutrients in order to survive and will respond to the feelings of hunger and satiety (satisfaction of appetite). The central nervous system is involved in controlling the balance between hunger, appetite stimulation and food intake. The sensitivity of all basic tastes increases during hunger and declines post meal for about one hour. It has been observed to be the greatest at mid-morning. Depletion of body salt
content increases the sensitivity to salt without affecting the other taste thresholds. No significant influence of fasting has been observed in the sensitivity of various taste qualities.

The macro-nutrients i.e. carbohydrates, proteins and fats generate satiety signals of varying strengths. The balance of evidence suggests that fat has the lowest satiating power, carbohydrates have an intermediate effect and protein has been found to be the most satiating. The energy density of diets has been shown to exert potent effects on satiety; low energy density diets generate greater satiety than high energy density diets. The high energy density of high-fat and/or high-sugar foods can also lead to ‘passive overconsumption’, where excess energy is ingested unintentionally and without the consumption of additional bulk. An important satiety signal may be the volume of food or portion size consumed. Many people are unaware of what constitutes appropriate portion sizes and thus inadvertently consume excess energy.

**Palatability** is proportional to the pleasure someone experiences when eating a particular food. It is dependent on the sensory properties of the food such as taste, smell, texture and appearance. Sweet tasting and fat-rich foods have a greater sensory appeal. It is not surprising then that food is not solely regarded as a source of nourishment but is often consumed for the pleasure value it imparts.

The influence of palatability on appetite and food intake in humans has been investigated in several studies. There is an increase in food intake as palatability increases, but the effect of palatability on appetite in the period following consumption is unclear. Increasing food variety can also increase food and energy intake and in the short term alter energy balance. However, effects on long-term energy regulation are unknown.

**Sensory aspects**: ‘Taste’ is consistently reported as a major influence on food behaviour. ‘Taste’ is the sum of all sensory stimulation that is produced by the ingestion of a food. This includes not only taste per se but also smell (flavour), appearance and texture of food. These sensory aspects are thought to influence spontaneous food choice.

From an early age, taste and familiarity influence behaviour towards food. A liking for sweetness and a dislike for bitterness are considered innate human traits, present from birth. Taste preferences and food aversions develop through experiences and are influenced by our attitudes, beliefs and expectations. We still remember the foods which we consumed as children – special seasonal dishes like pickles, chutney and the traditional dishes grandma made. We search for that taste only.

Now we know that the process by which we accept or reject food is of a multi-dimensional nature. In complex food matrices, it is not always easy to establish relationships between the body’s response, physiological perception, and consumer reaction. Individual’s responses to food are not only based on the sensory characteristics of the product and on their physiological status but they are also related to other factors, such as previous information acquired about the product, their past experience, and their attitudes and beliefs.

Though there are several factors involved but sensory quality should be considered as a key factor in food acceptance because consumers seek food with certain sensory characteristics. The acceptance of a food will depend on whether it responds to consumer needs and on the degree of satisfaction that it is able to provide.
One of the proven theories on choice of food we make is that the acceptance of a food is basically the result of the interaction between food and man at a certain moment. The other theory of the influence of consumers’ decision to accept or reject a food depends on:

Food characteristics (chemical and nutritional composition, physical structure, and properties), consumer characteristics (genetic such as taste genetics, age group, gender, and physiological and psychological state) and those of the consumer’s environment (family and cultural habits, religion, education, fashion, price, or convenience). Now days the safety of the product also plays an important role in decision making. Extrinsic factors such as advertising, branding, packaging and labelling or price of the product also influence the food choices.

Familiarity is a powerful predictor of liking for food. Unfamiliar foods tend to be disliked. A memory of the flavour helps in identifying foods that significantly depart from what the visual and olfactory cues suggest it should taste like. We relate the place with the food and would not mind travelling the distance to experience that same taste again.

Individuals do not experience the same taste sensations. This variation comes from genetic differences as well as taste perceptions. When a food is placed in the mouth, it may taste pleasant to some if it is sweet (just as it might with mildly salty, fat-related and meaty tastes, although these have been less well explored), and unpleasant if it is bitter or excessively sour. This has been termed flavour–flavour learning.

Role of senses in making food choices

The simple act of putting food in our mouths and beginning to chew signals three different sets of glands to release enzyme-rich saliva, which lubricate the mouth and activate the “tastants”—that is, the chemicals that stimulate our taste receptors—contained within the masticated food. When you eat, the brain receives different sensory inputs. The eyes provide inputs about the appearance of the food, the nose detects the aroma, the taste buds on the tongue detect the flavour, the texture - and the information is integrated in the final sensory perception. For an individual, each perceived sensation would work together and help in choosing the food. In a study by Delwiche (2004) it was reviewed how the consumers make subjective judgments using one or more of the five senses every time they select or eat any food. For example, potato chips, celery, and some cereals have a crunchy sound when they are eaten; the taste and smell of foods can be highly appealing or unacceptable; and the appearance and feel of a food also are important in determining its acceptability.

Ayurveda correlates chemicals with taste. It insists that every meal we eat should have all tastes; the tastes are proof of the presence of certain categories of chemicals. It acknowledges that food should be tasty for it to be consumed willingly. Only tasty food can stimulate our senses. But at the same time, it insists on balancing tastes. Too much of any single taste is not advisable.

Figure 1 depicts the expectations of our different senses when selecting and evaluating a food product.
Food quality has both subjective and objective aspects. Appearance, texture, and flavour are largely subjective attributes, whereas nutritional and microbial qualities are not.

**Vision**

Eyes are the organs that capture the vision—transmit it to the brain where it mixes with memory. Thus, if you have seen it before then you may instantly recognise the food; even if you are not able to instantly remember the name you will at least remember when and where you saw it the last time. The appearance of a food includes its size, shape, colour, structure, transparency or turbidity, dullness or gloss, and degree of wholeness or damage.

The growing obesity crisis is but one of the signs that humankind is not doing such a great job in terms of optimizing the contemporary food landscape. While the blame here is often put on the global food companies—offering addictive foods, designed to hit ‘the bliss point’ in terms of the pleasurable ingredients (sugar, salt, fat, etc.), and the ease of access to calorie-rich foods—we wonder whether there aren’t other implicit cues in our environments that might be triggering hunger more often than is perhaps good for us. Here, we take a closer look at the potential role of vision. Specifically, we question the impact that our increasing exposure to images of desirable foods via digital interfaces might be having and
ask whether it might not inadvertently be exacerbating our desire for food (what we call ‘visual hunger’). For example, a decorated chocolate cake, a burger, a cheesy pizza which is visually tempting.

In society at large, there is a growing awareness of just how much people like to take pictures of the food that they have ordered in restaurants, and chefs wanting to design food in most pleasing manner. Increasingly, it would appear that people are spending more time looking at virtual images of appetizing foods, and paying less attention to the actual foods being consumed (see figure 2). Worse still, many of us eat while mindlessly watching screens (TV, or smartphone), failing to focus our attention on the flavour experience which might the very source of lower satiety, and higher-calorie food intake. The pleasure of seeing virtual food (the hunger for images, or ‘digital grazing’) while eating has in some sense superseded the pleasure of seeing the real thing. And while some might be tempted to see this as the fault of industry/marketers, it is important to remember, given the growing popularity of consumers taking pictures of food, that the problem here would appear to be, at least partly, self-inflicted. Excessive food photography and over exposure to pictures of food may also lead to satiation.

![Figure 16. 2: Growing craze for food photography](image)

Given the current obesity crisis, it would seem advisable to pay particular attention to any environmental factor that may influence our relation to food, and potentially sensitize the brain to food stimuli.
Smell

Foods especially when they are hot give out volatile vapours which we call aroma. Even before we eat, these vapours rise and enter our nostrils, then travel up and reach the end of the nose between the two eyes. Aromas are transmitted to a special part of the brain that houses emotions. Thus, two people - A and B may smell the same ‘samosa’ but A maybe transported to a time when he got scolded by the mother for finishing his own and his brother’s share and B maybe transported to a lovely roadside shack in the hills of Dalhousie where he had the best samosa 10 years ago. Some aromas may be instantly recognised while others may need effort and reference.

As per scientific concepts of tasting, aroma is strictly the odour/smell which we sense before eating that is when the food is still outside your mouth. Aromas have the power to make our mouth water in anticipation of eating very tasty food. Similarly, some aromas can completely put us off like rancid food’s smell and tell us that they have decomposed and thus, have become unfit for consumption.

We all know coffee has a wonderful aroma, but what do you think about cucumber? Most of us would say no or maybe. Please try this - take a normal bite of cucumber and while chewing pinch your nose for a few seconds and then release it. Most of the people would answer - yes cucumber has an aroma/odour but only inside the mouth. This is called aromatics. So, the sense of smell has 2 paths aroma from outside mouth and aromatics from the inside mouth; but they are captured by the same hair-like structure seated deep inside forehead in-between the eyes.

Food aroma/odour has been shown to influence food choices, portion selection, and can promote a specific desire to consume certain foods. Even when satiated, the sight or smell of a desirable food can stimulate appetite. People that exhibit a higher level of dietary restraint have been shown to be more responsive to food odour cues, resulting in a higher appetite and desire to consume the cued food item. Others have suggested exposure to a desirable savoury odour increases reactivity and attention to all food, leading to a general desire to eat. Frequently, these studies focus on responsiveness to energy dense, highly palatable foods such as pizza, or ice-cream. In this sense, responsiveness to energy-dense foods may be one important mechanism that promotes energy intake by stimulating appetite, by increasing the number of eating events, and types of foods selected. A similar phenomenon has been described as non-homeostatic hunger or “hedonic hunger,” where susceptible individuals are more sensitive to food cues and seek food spontaneously, eating for pleasure, irrespective of any underlying need. Individual differences in appetite responsiveness to rewarding properties of the food environment can be measured using the “power of food scale,” which also suggests that, for some people, food odour is a very powerful stimulus that can motivate eating in the absence of hunger, snacking, and promote positive energy balance.

Texture

This refers to those qualities of a food that can be felt with the fingers, tongue, palate, or teeth. Foods have different textures, such as crisp crackers or potato chips, crunchy celery, hard candy, tender steaks, chewy chocolate chip cookies, and creamy ice cream, to name but a few. Not only Indian food but chips are being added even to Burgers and Pizzas
to make them crunchy and crispy. This is one of the ways of introducing ‘sonic seasoning’.

Individuals have a preferred way to manipulate food in their mouths (i.e., mouth behaviour) and that this behaviour is a major driver of food choice, satisfaction, and the desire to repurchase. Texture, which is currently thought to be a major driver of product choice, is a secondary factor, and is important only in that it supports the primary driver — mouth behaviour. Currently there is a trend to include the textural properties of the product in the message, for example, crunchy, chewy, or creamy. Sometimes these words are used to connote more quality or emotional aspects such as freshness or mood, but at other times to connote texture preferences. However, with concepts that employ texture messaging, the underlying belief is that (1) these textural characteristics are of interest to most consumers; (2) these textural words are clearly understood by both marketers and product developers; and (3) products can be easily optimized using current product development and sensory tools.

Figure 16. 3: Food textures that people like

Figure 3 describes the different textures we like in food. Texture preferences changes during various stages, for instance older individuals who have experienced dental issues indicated that they could no longer enjoy many of the foods that were preferred when they were younger. While some studies have also concluded that taste sensitivity, and chewing behaviour differ by gender.
Flavour = Taste + Aroma

Flavour is a combination of taste and smell/aroma and is largely subjective. If a person has a cold, food usually seems to be tasteless. However, it is not the taste buds that are affected but the sense of smell. People vary in their sensitivity to different tastes. Sensitivity depends on the length of time allowed to taste a substance. Sweet and salt tastes are detected quickly (in less than a second), because they are detected by taste buds on the tip of the tongue; in addition, they are usually very soluble compounds. Bitter compounds, on the other hand, may take a full second to be detected because they are detected at the back of the tongue. The taste may linger, producing a bitter aftertaste.

Sensitivity to a particular taste also depends on the concentration of the substance responsible for the taste. The threshold concentration is defined as the concentration required for identification of a particular substance. The threshold concentration may vary from person to person; some people are more sensitive to a particular taste than others and therefore are able to detect it at a lower concentration.

Let’s understand this better with an example: There are 3 friends Nehmat, Ravi and Aryan. They are around 8 years old. One day they all had a glass of milk each at Nehmat’s house. All three glasses of milk had the same quantity of sugar - 1 teaspoon each. Ravi found the milk to be too sweet whereas Aryan found the milk less sweet, almost bland. Nehmat was the only one who enjoyed her milk. 3 kids - same sugar - but 3 different perceptions of sweetness.

Below the threshold concentration, a substance would not be identified but may affect the perception of another taste. For example, sub-threshold salt levels increase perceived sweetness and decrease perceived acidity, whereas sub-threshold sugar concentrations make a food taste less salty than it actually is. Another debatable topic is that the flavour enhancers such as MSG (monosodium glutamate) also affect taste sensitivity by intensifying a particular taste in a food though there are no specific studies to establish this as a fact.

Temperature of a food also affects its flavour. Warm foods generally taste stronger and sweeter than cold foods. For example, melted ice cream tastes much sweeter than frozen ice cream. There are two reasons for the effects of temperature on flavour. The volatility of substances is increased at higher temperatures, and so they smell stronger. Taste bud receptivity also is an important factor. Taste buds are most receptive in the temperature range between 20-30°C, and so tastes will be more intense in this temperature range.

Psychological factors also affect taste sensitivity and perception. Judgments about flavour are often influenced by preconceived ideas based on the appearance of the food or on previous experience with a similar food. For example, strawberry flavoured foods would be expected to be red. However, if coloured green, because of the association of green foods with flavours such as lime, it would be difficult to identify the flavour as strawberry unless it was very strong. Colour intensity also affects flavour perception. A stronger colour may cause perception of a stronger flavour in a product, even if the stronger colour is simply due to the addition of more food colouring. Texture also can be misleading. A thicker product may be perceived as tasting richer or stronger simply because it is thicker and not because the thickening agent affects the flavour of the food. Other psychological factors that may come into play when making judgments about the flavour of foods include time of
day (for example, certain tastes are preferred at breakfast time), general sense of well-being, health, and previous reactions to a particular food or taste.

Taste Sensitivity: driving our food choices

We already know that there are two types of taste - basic tastes and ayurvedic tastes. Now let us learn a little about them.

**Basic Tastes** include - Sweet, Salty, Sour, Bitter and Umami. Western contemporary science says only these 5 can be called tastes. Do you think it does justice to our Indian food? Using these 5 tastes can we describe all the elements of your 1 portion of vegetable e.g. aloo gobi? Only salt and oil/fat are covered what is left out is haldi (turmeric), garlic, ginger, different spices and chillies. In addition to this, what is left out is that special taste that we get when we eat jamuns, amlas, and roasted gram (chana).

Whatever has been left out has always been covered under Ayurveda as tastes. Jamuns, roasted gram (chana), tea, and coffee have a unique taste where you feel your entire mouth is kind of drying out. This is called **astringency** in English and **kashaya** in Ayurveda.

Now let us look at the term - 'Mirch Masala'. Some of us have started using just one word to describe this both - Spiciness. Do you think the sensations in your mouth when eating a single piece of clove is the same as when eating green chilli? The answer is yes to some extent. That’s why ‘mirchi’ and ‘masala’ both are ‘katu’ in Ayurveda and “pungent” in western science. Yet masalas and mirchis are not substitutable. We can distinguish between them when we are eating any cooked food.

Why can’t the Ayurvedic tastes astringency and pungency be included under basic tastes? Scientifically basic tastes are those that are captured on the tongue by our taste buds and Ayurvedic tastes are not captured on the tongue but instead on the nerves in the face. Tastes that are captured by the taste buds on the tongue are basic tastes. Astringency and pungency are not captured by the taste buds on the tongue hence they cannot be considered as basic tastes.

Taste is the most important deciding factor of choice we make in food. Taste is a complex sense. In addition to sensations arising in taste receptors, it is influenced by chemical, tactile, warm, and cold receptors in the mouth, and particularly by olfactory sensations. Our inclination towards one particular taste sensitivity could lead to various health effects. For instance, a “sweet tooth” leads to obesity through excess sugar consumption, is an overly narrow theory. There are multiple links between taste perceptions, taste preferences, food preferences, and food choices and the amount of food consumed. The impact of taste factors on food intake further depends on sex and age and is modulated by obesity, eating disorders, and other pathologies of eating behaviour.

Taste is a key factor that impacts food intake. Although much research has been devoted to the study of the peripheral gustatory system and taste quality, current understanding of the specific interplay of receptor activation, signalling, and hormonal modulation remains complex. Genotypic variation results in various phenotypes of food preference and nutrient intake. Additionally, the hormonal milieu impacts food hedonics and macronutrient intake. Increased knowledge of chemosensory variation will allow insight into individual’s
eating behaviour and potentially identify therapeutic targets for chronic health problems such as obesity.

Thus, it is very important that habit of choosing balance in food should be inculcated from early life as it will influence later health. Food preferences are formed in infancy, and are tracked into childhood and beyond. Good food habits in childhood are important for preventing obesity later in life. Many studies show that children prefer high-energy, sugary, and salty foods. In pre-school age they tend to reject new foods. Thus, starting from the prenatal period, a varied exposure in utero and repeated experiences with novel flavours during breastfeeding and complementary feeding increase children’s willingness to try new foods and make balanced food choices.

Collectively, these data suggest that individuals with abnormal taste responsiveness (which leads to an altered perceived taste sensation evoked by foodstuffs, such as vegetables) may alter their intake of certain foods, thereby leaving them susceptible to perturbations in metabolic homeostasis. And this does indeed seem to be the case. For example, multiple investigators have shown sweet taste responsiveness to be correlated with body mass index (BMI). Moreover, the preference for consuming sugar-sweetened beverages was shown to be correlated with increased blood pressure. Bitter taste sensitivity/responsiveness has been associated with BMI, adiposity, and risk factors for cardiovascular diseases. Sensitivity to other taste qualities has also been associated with energy consumption and BMI. Thus, achieving a greater understanding of the factors that influence taste responsiveness could be potentially useful in our attempt at influencing nutritional intake and human susceptibility to diseases related to food intake patterns. Balance of all the tastes is the key to healthy diet.

It could also be noted that in some of the conditions the taste sense gets compromised and thereby affects the food choices. Abnormal taste function is present in healthy elderly people, and in patients with chronic renal failure and cancer. Smoking also decreases taste perception. In two separate population groups, a comparison of taste perception among samples of smokers and non-smokers revealed that the taste thresholds for bitter (using quinine hydrochloride) was significantly higher in smokers than in non-smokers. There was no significant difference in the taste thresholds for sweet, sour, or salt between smokers and non-smokers. Bitter is thus specifically affected. The age of the smoker, and thus presumably the duration of smoking, as well as the amount smoked, both adversely affected sensitivity to quinine solutions.

Humans use all of their senses to evaluate the sensory properties of a food. This evaluation begins before consumption and is based on how the food looks and smells; you would not choose green coloured fries or a grey coloured rice. The acceptance or rejection of a given food occurs when the human brain jointly processes: (a) information obtained from observing, handling, and consuming the food in question; (b) information acquired from the surrounding social and cultural context; (c) information gained from the physiological effects (pleasure, satiety, dislike, discomfort, etc.) experienced when eating and after eating a certain food; and (d) comparison with information stored in the memory of past experiences.

One of the primary functions, or challenges, faced by the brain is to find nutritious foods and to avoid ingesting those substances that may be poisonous or otherwise harmful. While the senses of taste (gustation), smell (olfaction), and texture (touch or oral somatosensory) provide the ultimate arbiters of a food’s palatability, it is the sense of vision that provides a
far more effective means of foraging, predicting which foods are likely to be safe and nutritious to consume, and generating those expectations that will constrain the consumption experience. Contemporary neuroscience demonstrates just what a powerful cue the sight of appealing food can be for the brain, especially the brain of a hungry person. Diets have changed and nutritional theories have come and gone. Human convictions about taste, however, have remained quite consistent over time; they are characterized by continuity rather than change. Thus, taste as a new science strategy could be adopted. Taste’s therapeutic significance helps in choosing the right food. Healthy eating habits should be inculcated right from childhood. Child should be encouraged to choose right food. The second concept by which we can improve our diets is eating and knowing. Educate people of the calorie intake and nutritive value of foods which would encourage them to make healthy food choices. However, the most important thing to do is to ensure that healthy foods are tasty and attractive to eat!

Summary

- The key driver for eating is hunger. Other factors also influence food choices.
- Biological, economic, physical, social and psychological determinants, as well as attitudes, beliefs and knowledge about food affect food choices.
- The central nervous system is involved in controlling the balance between hunger, appetite stimulation and food intake.
- The macro-nutrients i.e. carbohydrates, proteins and fats generate satiety signals of varying strengths. Many people are unaware of what constitutes appropriate portion sizes and thus inadvertently consume excess energy.
- Taste’ is consistently reported as a major influence on food behaviour. ‘Taste’ is the sum of all sensory stimulation that is produced by the ingestion of a food. This includes not only taste per se but also smell, appearance and texture of food.
- Familiarity is a powerful predictor of liking for food. Unfamiliar foods tend to be disliked.
- The sight, smell, texture and flavour of a food determine whether it will be selected for consumption.
- Sensitivity to a particular taste also depends on the concentration of the substance responsible for the taste. The threshold concentration is defined as the concentration required for identification of a particular substance.
- Flavour is a combination of taste and smell and is largely subjective. Temperature of a food may determine its flavour. Psychological factors also affect taste sensitivity and perception.
- Basic tastes include- Sweet, Salty, Sour, Bitter and Umami. In addition, there are taste sensations of astringency and pungency which are well documented even in Ayurveda.
Key words

Gustation – sense of taste
Kashaya – astringent
Katu – pungent
Olfaction – sense of smell
Oral-Somatosensory – sensation arising in the mouth providing information on the structure and state of object in mouth
Satiety - satisfaction of appetite
Sonic Seasoning – is a scientific field that uses sound to make food taste better

Exercises

1. List the factors that may influence food choices of individuals.
2. Discuss the pros and cons of food photography.
3. What is the difference between aroma and aromatics?
4. Explain how texture and flavour play a vital role in choosing foods.
5. What do you understand by the term 'sonic seasoning'? How will you use it to make food taste better?
6. What are basic tastes? Why are astringency and pungency not covered under these?
7. How will you use the knowledge about taste being a major determinant of food choices to encourage individuals to choose healthy foods?
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Chapter 17: Social and Behavioural Change for Improving Health Outcomes

- Theories and Approaches
- What is Social and Behavioural Change Communication?
- Theories of Behaviour Change and their Applications
  - At Individual Level
  - At Community Level
Chapter 17: Social and Behavioural Change for Improving Health Outcomes

Social and Behavioural Change refers to bringing about a positive transformation with a social system that includes changing behaviour of individuals and the society or social environment as a whole. This is often used in the context of improving public health outcomes, such as getting people to adopt vaccination to prevent polio or encouraging breastfeeding among new mothers. However, it finds application in a variety of settings for a broad range of activities such as higher enrolment of girls in schools, greater donation to charitable organizations and so on.

Behaviour change is an evidence-based process for changing knowledge, attitudes and practices of individuals or groups of individuals. This allows groups of individuals to define their needs, demand their rights, achieve their goals and sustain its benefits through a participatory and collaborative process that encourages both dialogue and action.

Individual behaviours are shaped and influenced by cultural practices, social norms and the economic and political landscape. Therefore, to bring about real and sustained change, it is important to consider the community as a whole.

Social change focuses on the community as the unit of change. It is geared towards changing behaviors on a large scale to eliminate harmful social and cultural practices, change social norms and structural inequalities within the community. This allows the community to transform their social system or organization through collaboration, partnerships, public-private dialogue and create joint ownership of the change process.

In this chapter, you will understand the concept of social and behaviour change, learn about key theories and approaches, and understand how these have been applied in practical settings around the globe. This chapter will largely focus on social and behaviour change in the context of public health. The key takeaway of this chapter is to not only understand how people and societies have been transformed but also be able to apply these to your own settings and environment to achieve goals relevant to your group, community and society as a whole. For example, you may feel that in your college or office, people have a culture of snacking on unhealthy food, particularly fried snacks and sweetened beverages. How would you mobilize people to take charge and transform their habits and environment and change the college/office culture? Let us learn by first understanding some basic theories and approaches to behaviour change.

Theories and Approaches

Bringing about social change is one of the most difficult tasks. Change is not only challenging at the individual level but also at the group and community level. Creating a national movement around behaviour change, that too regarding a complex set of behaviours surrounding habits that permeate every aspect of our lives, every single day, is a monumental task, to the say the least. The first step to creating behaviour change is to generate awareness among people about the particular behaviour to be adopted or discarded.
Traditionally, ‘Information, Education and Communication’ (IEC) has been used for this purpose. This involves working with individuals, communities and societies to develop communication strategies to promote positive behaviour that are appropriate to their settings. For example, informing people about eating fresh, seasonal and local fruits and vegetables is a positive behaviour that needs to be adopted as it is good for health and the environment. Merely providing people with information and teaching them how they should behave does not lead to desirable change in their response/behavior. However, when there is a supportive environment with information and communication (teaching) then there is likely to be a desirable change in the behavior of the target group.

What is Social and Behavioural Change Communication?

Behaviour Change Communication (BCC) is a step forward from IEC towards enabling action from individuals, communities and societies. It entails providing a supportive environment that will enable people to initiate and sustain positive behaviour, in addition to spreading awareness. For example, providing information and ‘nudges’ to shop at clean and safe fruit and vegetable markets encourages people to consume fresh, seasonal and local fruits and vegetables.

However, there is no single strategy that works for all individuals and behaviours. Interventions need to be context specific. The more complex the behaviour, the more well thought-out the interventions need to be. Thus, social and behaviour change communication (SBCC), often also only "BCC" or "Communication for Development (C4D)" is an interactive process with individuals, groups or communities which forms a two-way communication process. SBCC is a strategic use of communication to promote positive outcomes, based on proven theories and models of behaviour change.

SBCC is a systematic process starting with formative research and behaviour analysis, communication planning leading to implementation, followed by monitoring and evaluation. The target audience is carefully analyzed and segmented, messages and materials are prepared and pilot-tested, and delivery mechanisms such as mass media (which include radio, television, billboards, print material, internet), interpersonal channels (such as client-provider interaction, group presentations) and community mobilisation are used to achieve defined behaviour change objectives.

Theories of Behaviour Change and their Applications

There are several theories of behavioural change to draw from to design a large-scale social and behavioural change movement at the individual and community levels. Many of these relate to health specifically. We will explore each one of them one by one.

At the individual level are theories such as Health Belief Model, Theory of Reasoned Action and Planned Behaviour, Trans-theoretical model/Stages of change and Social Learning Theory. More recently, the ‘Nudge Theory’ has gained worldwide attention in influencing behaviour. At the community level are Diffusion of Innovations Theory and Community Mobilization. More recently, the ‘Systems Leadership Approach’ is gaining traction globally to bring about large-scale behaviour change.
At Individual Level

The Health Belief Model is one of the oldest theories on behaviour change (Rosenstock, 1974). Developed in the 1950s by social psychologists Irwin M. Rosenstock, Godfrey M. Hochbaum, S. Stephen Kegeles, and Howard Leventhal at the U.S. Public Health Service, suggests that people's beliefs about health problems, perceived benefits of action and barriers to action, and self-efficacy explain engagement (or lack of engagement) in health-promoting behaviour. This means that people will not adopt a positive health behaviour or change a negative one unless they believe they are at risk of a disease, understand the benefits of the behaviour change, are able to overcome barriers to adopting that health behaviour and have self-efficacy, i.e. they believe they have the ability to perform the health behaviour and have a sense of control on themselves and their environment.

Case Study: The Health Belief Model was applied to a nutrition education intervention for staff members of a university (Abood et al, 2003). An 8-week nutrition education programme was created to promote healthful dietary behaviours that reduce risks for cardiovascular disease and cancer. The intervention focused on specific health beliefs, nutrition knowledge, and dietary practices to demonstrate the effect of the intervention. The participants were divided into two groups. One group received the intervention and the other did not. As a result of this education programme, perceived benefits of healthy nutrition practices and nutrition knowledge related to cardiovascular disease and cancer significantly improved among the participants who received the intervention. These participants also significantly reduced total calories, fat, saturated fat, and cholesterol intake compared to those participants who were not part of the intervention. This experimental case-study suggests that targeting people’s beliefs, perceptions and improving their self-efficacy in adopting healthy behaviours leads to improved health outcomes. Therefore, if you were to design a health intervention, it would be useful to create and design education programmes accordingly.

Theory of Planned Behaviour and Reasoned Action Approach (ToRA or TRA) was developed by Martin Fishbein and Icek Ajzen in 1967. It posits that an individual's decision to engage in a particular behaviour is based on the outcomes the individual expects will come as a result of performing the behaviour. This theory was later revised and expanded to overcome any discrepancies in the Attitude-Behaviour relationship with the Theory of Planned Behaviour (TPB) and Reasoned Action Approach (RAA) (Fishbein & Ajzen, 2011). TRA states that a person's intention to perform behaviour is the main predictor of whether or not they actually perform that behaviour. This is further influenced by social norms. TPB also adds that perceived behavioural control in performing the behaviour plays a critical role in individuals actually performing that behaviour.

Case Study: In the context of improving health, it is a challenge to get people to exercise to reduce the incidence of obesity and its related health issues. How would we apply this theory to motivate people to exercise? In 1981, a study by Bentler and Speckart examined to what extent attitudes caused behaviour change. Their study revealed that the intent to exercise was determined by a person's attitude toward exercise, as predicted by the Theory of Reasoned Action (Bentler et al, 1981). Similarly, Mok WK, et al (2013) studied 486 students ranging in age from 11 to 18 years in Hong Kong. By means of self-administered questionnaire, demographic data, past physical activity and variables of theory of planned behaviour, such as attitude, subjective norm and perceived behavioural control were measured. Results of this study gave evidence that the theory of planned behaviour was a
useful framework for prediction of physical activity intention and behaviour of adolescents in Hong Kong. Among the variables, perceived behavioural control and past behaviour also played a significant role.

What does this mean in terms of bringing about behavioural change in people? It implies that we need to first examine people’s attitude towards that particular behaviour and see if they have any intention to perform it. This would likely predict if they actually perform it. So, for example, you would like to get people in your organization or college to exercise more, according to this theory, you would need to first examine their existing attitudes and intention to exercise. If their attitude towards exercise are negative, then you would have to work towards changing their attitude first and make sure they have the intention to exercise. This theory underlines the need to consider attitudes and intentions when designing any large-scale intervention.

Trans-theoretical Model of Behaviour Change (TTM) is an integrative theory of therapy that assesses an individual’s readiness to act on a new healthier behaviour and provides strategies or processes of change to guide the individual. The model is composed of constructs such as: stages of change, processes of change, levels of change, self-efficacy, and decisional balance (Prochaska, 2013). TTM integrates processes and principles of change from across leading theories, hence the name Trans-theoretical. According to TTM, health behaviour change involves progress through six stages of change: pre-contemplation (not ready for change), contemplation (getting ready for change), preparation (ready for change), action (creating change), maintenance (monitoring), and termination. Ten processes of change have been identified for producing progress along with decisional balance, self-efficacy, and temptations. The ten processes of change include, Consciousness-raising (Get the facts), Dramatic relief (Pay attention to feelings), Self-re-evaluation (Create a new self-image), Environmental re-evaluation (Notice your effect on others), Social liberation (Notice public support) — realizing that society is more supportive of the healthy behaviour, Self-liberation (Make a commitment), Helping relationships (Get support), Counterconditioning (Use substitutes), Reinforcement management (Use rewards) and Stimulus control (Manage your environment).

As per findings from basic research, any population at risk of a disease may be categorized into the following stages: 40% in pre-contemplation, 40% in contemplation, and 20% in preparation (Prochaska & Velicer, 1997). This approach highlights the need for targeted interventions based on the stage a particular population may be in. Therefore, this model suggests a more personalized approach to designing behaviour change intervention to help populations to reach the next stage of the desired behaviour change.

Case Study: Fifty-hundred-and-seventy-seven overweight or moderately obese adults (BMI 25-39.9) were recruited from large employers to be randomly assigned to receive stage-matched interventions as per the TTM Model (Johnson et al, 2008) or be in the control group that did not receive the TTM-based intervention. Those randomly assigned to the treatment group received a stage-matched multiple behaviour change guide and a series of tailored, individualized interventions for three health behaviours that are crucial to effective weight management: healthy eating (i.e., reducing calorie and dietary fat intake), moderate exercise, and managing emotional distress without eating. Assessments were conducted at four time points: baseline, 3, 6, and 9 months. All participants were followed up at 6, 12, and 24 months. The study revealed that at the end of the intervention, after 24 months, those participants who were classified to be in the pre-action stage for healthy eating at baseline and received treatment were significantly more likely to have reached
Protons or Maintenance stage than the comparison group. The intervention showed similar effects on managing emotional distress without eating, and consumption of fruits and vegetables. Those who were in a pre-action stage for both healthy eating and exercise at baseline and received the TTM-based treatment -30% lost 5% or more of their body weight vs.18.6% in the comparison group. This study demonstrates the ability of TTM-based tailored feedback to improve healthy eating, exercise, managing emotional distress, and weight on a population basis. The treatment produced the highest population impact to date on multiple health risk behaviours (Johnson et al, 2008). What does this study mean for designing population-based interventions? This underscores the importance of first identifying the readiness of a population to make a desired behaviour change such as exercising, healthy eating, stress-management and then designing targeted interventions based on their respective stages. This would generate the maximum likelihood to move them to the maintenance stage where the desired positive behaviour has been achieved and only needs to be maintained.

Social Learning Theory proposes that new behaviours can be acquired by observing and imitating others. This theory emphasizes that learning takes place in a social context and is a cognitive not a purely behavioural process (Bandura, 1977). The recent discovery of "mirror neurons" in primates provide support for a neurological basis for imitation. These are neurons which fire both if the animal does something itself, and if it observes the action being done by another (Rizzolatti et al, 2004). According to this theory, learning can take place even when there is no reproduction of the action or reinforcement of the behaviour, although learning may occur through observation of rewards and punishments. The learner is not a passive recipient of information. Cognitive processes, behaviour and environment all influence each other (Bandura, 1977). This theory has useful applications in bringing about large-scale behaviour change, particularly through the influence of media, celebrities or heroes that people are likely to emulate.

Case studies: Representations in the media are influential because people construct their views of society and desired behaviours based on what they see. If efforts to change beliefs are directed towards the sociocultural norms and practices at the social system level of a particular population, they can be highly effective in bringing about change in behaviour (Singhal et al, 1993). This lends credence to the entertainment-education approach or the infotainment approach to social and behavioural change.

This approach has been effectively used by Mexican creative writer-producer-director at Televisa, (the Mexican national television system). He has created a methodology to produce entertainment-education telenovelas. This methodology includes a formal, reproducible set of design and production techniques for the construction of persuasive mass media messages. It took Sabido eight years (from 1967 to 1975) to hone his methodology of producing entertainment-educational telenovelas. He created four historical-cultural soap operas for Televisa, each designed to promote and celebrate the rich cultural heritage of Mexico. The success of these historical-cultural soap operas convinced Sabido that telenovelas were ideally suited for educating Mexican viewers about various development topics since telenovelas were highly popular in Mexico. They achieved spectacular reach among the audience, ratings reaching millions of viewers for half-an-hour daily, five times a week, for about one year, representing massive exposure to an educational message. The melodrama in a telenovela represented a natural confrontation of 'good' role models against 'bad' ones, providing a unique opportunity to promote 'socially desirable' behaviours and dissuade 'socially undesirable' behaviours (Sabido, 1989). He subtly incorporated educational messages in entertainment content,
without making them too blatant, in order to produce a value-based, morally coherent, and a realistic telenovela, with believable characters and locales.

Based on Sabido’s method, a television drama called Hum Log was launched in India. Hum Log (‘We People’), a particularly popular television soap opera, was broadcast in India from 1984 to 1985. Hum Log featured educational messages about women’s status, family harmony, and smaller family size norms. It attracted a very large-sized audience, setting a record for television ratings in India (up to 95 percent), and getting through to the mass population of India as no television series had ever done before. The Hum Log broadcasts had particularly important impacts on certain audience segments (Singhal et all 1993). For example, many young women in the audience identified with Badki, a positive role model for female equality, who modelled her rejection of the traditional role for Indian young women by seeking a professional job outside the home, selecting her own husband, etc. (Singhal et all 1993). However, Hum Log delivered mixed results in terms of influencing the audience as Sabido’s methodology was not directly applied to this teleserial (Singhal et all 1993).

**Nudge Theory** has come into prominence, popularized by Richard Thaler and Cass Sunstein. Nudge is a concept in behavioral science, political theory and behavioral economics which proposes changing the ‘choice architecture’ to influence the behavior and decision making of groups or individuals in such a way that an individual or group is ‘nudged’ into performing the desired behaviour without taking away their freedom of choice (Thaler & Sunstein, 2009). A simple example of a nudge would be placing healthy foods in a school cafeteria at eye level while putting less-healthy junk food in harder-to-reach places. Individuals are not actually prevented from eating whatever they want but arranging the food choices that way causes people to eat less junk food and more healthy food (Thaler & Sunstein, 2009).

They argue that nudges can be used effectively to improve decisions about health, money and many other situations in life. They describe two systems of thinking, “The Reflective System” and the “Automatic System”. These have been further elaborated by Daniel Kahneman (Kahneman, 2011), the Nobel Prize winning behavioural economist who, along with Amos Tversky, first introduced the idea that humans are not rational decision makers through their ‘Prospect Theory’ that posits that systematic cognitive biases influence decision-making. The Nudge Theory draws from this idea.

According to the Two Systems of Thinking idea, The Automatic or Fast System is rapid, feels instinctive and does not involve any kind of deliberation. The actions that result from it are automatic, such as ducking when a ball is thrown at you. The Reflective or Slow System is deliberate and self-conscious and is engaged when people decide which college to attend, where to go on trips etc. (Thaler & Sustein, 2004; Kahneman, 2011). Since people often rely on the Automatic System for decision-making, their decisions are not always rational but are influenced by their cognitive biases. For example, the status quo bias can be seen when people are very likely to continue a course of action since it has been traditionally the one pursued, even though this course of action may clearly not be in their best interest. That is, people often lean towards the ‘default option’. This can be effectively used to nudge people towards a desirable decision by making it the default option such as serving salad with a burger instead of fries at restaurants. Nudge Theory has been widely applied in policy recommendations across health, economics, finance, environment, schools etc.
Case Study: The insights from behaviour economics and Nudge have been applied in the Indian setting (K. Subramanian, 2019). The Beti Bachao Beti Padhao (BBBP) scheme was launched on 22nd January 2015 to improve child sex ratio and empower girls and women. This campaign demonstrated the powerful use of the insight on ‘social norm’ in its ‘Selfie with Daughter’ initiative. Social norms dictate the way people behave. Changing people’s behaviour means changing social norms. By introducing a new norm and making people believe that this is the social norm, people can be nudged to adopt it. One of the aims of BBBP scheme was to stop parents from viewing girls as a burden and start celebrating them instead. The selfie campaign showcased examples of parents celebrating their daughters and taking a selfie to demonstrate it. This campaign became viral on social media encouraging people to act according to this new norm (K. Subramanian, 2019). Thus, Nudge can be applied effectively to change attitudes and behaviours.

Community Level

**Diffusion of Innovations Theory** is a theory that seeks to explain how, why, and at what rate new ideas and technology spread. Proposed by Everett Rogers in 1962, it proposes that four main elements influence the spread of a new idea: the innovation itself, communication channels, time, and a social system. The innovation must be widely adopted in order to self-sustain. The categories of adopters are innovators, early adopters, early majority, late majority, and laggards. Within the rate of adoption, there is a point at which an innovation reaches critical mass (Rogers 1962).

Case Study: One of the most prominent examples of the application of this theory is the spread of social media social networks such as Facebook. At first, when Facebook was started in 2004, it was limited to first Harvard University and then universities in the US only. These were the early adopters. As Facebook expanded its capacity to include more and more people, its base grew until the vast majority of people with access to internet are on Facebook.

In **Community Mobilization** action is stimulated by a community itself, or by others, that is planned, carried out, and evaluated by the community’s individuals, groups, and organizations on a participatory and sustained basis to improve the health, hygiene and education levels so as to enhance the overall standard of living in the community.

Case Study: A unique nine-year collaborative programme between Vietnamese and international medical scientists and an aid organization have established an innovative and successful community-based dengue vector control programme in Vietnam (Vu et al., 2004). The use of predacious copepods combined with new water management practices by nine communes in northern and central Vietnam helped eliminate the main dengue vector mosquito, Aedes aegypti. The model was enthusiastically taken up by communities with apparent ease and a high level of acceptability as demonstrated by post-project sustainability and expansion.

**Systems Leadership Approach** for sustainable development is an innovative and adaptive model that is a departure from the traditional hierarchical, top-down and linear approaches to implementing change. In this framework, complex systems such as environment, food and health are dealt with at three levels- Individual, Community and the
1. Convene and Commit - Key stakeholders engage in moderated dialogue to address a complex issue of mutual concern. They define shared interests and goals and commit to working together in new ways to create systemic change.

2. Look and Learn - Through system mapping, stakeholders jointly build a shared understanding of the components, actors, dynamics, and influences that create the system and its current outcomes, generating new insights and ideas.

3. Engage and Energize - Diverse stakeholders are engaged through continuous communication to build trust, commitment, innovation and collaboration. Inspiration, incentives and milestones help drive progress and maintain momentum.

4. Act with Accountability - Shared goals and principles set the direction of the initiative, while measurement frameworks help track progress. Coordination and governance structures can be developed as initiatives mature.

5. Review and Revise - Stakeholders review progress regularly and adapt the initiative strategy accordingly. Adopting an agile, flexible, innovative and learning-centered approach allows for evolution and experimentation.

Summary

- Social and Behavioural Change refers to bringing about a positive transformation with a social system that includes changing behaviour of individuals and the society or social environment as a whole.

- Individual behaviours are shaped and influenced by cultural practices, social norms and the economic and political landscape. Therefore, to bring about real and sustained change, it is important to consider the community as a whole.

- Bringing about social change is one of the most difficult tasks. Change is not only challenging at the individual level but also at the group and community level.

- Behaviour Change Communication (BCC) is a step forward from IEC towards enabling action from individuals, communities and societies. It entails providing a supportive environment that will enable people to initiate and sustain positive behaviour, in addition to spreading awareness.

- There are several theories of behavioural change to draw from to design a large-scale social and behavioural change movement.
Some of these theories are at the individual level such as Health Belief Model, Social Learning Theory, Nudge Theory and, some are at the community level such as Diffusion of Innovation Theory, Community Mobilization and Systems Leadership Approach.

**Key Words**

**Behaviour change** - is an evidence-based process for changing knowledge, attitudes and practices of individuals or groups of individuals.

**C4D** - Communication for Development

**SBCC** - Social and Behaviour Change Communication

**Exercises**

1. What do you understand by the term SBCC? How is it different from IEC?
2. Briefly describe the ‘Nudge theory’ of behaviour change.
3. List some theories of behaviour change that can be applied at the individual level. Explain any one in detail.
4. Giving suitable examples explain any two theories of behaviour change which are applicable at the community level.
5. What are the five key elements of the systems change process? Elaborate.

**References**

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