Uttar Pradesh Rajarshi Tandon Open University

UGHN 106- Normal and Therapeutic Nutrition

UNIT-I: CONCEPTS IN DIET THERAPY

Structure

1.1. INTRODUCTION

Diet therapy refers to not merely the application of diet for diseased person, although used in anticipation of disease and for upholding good health. In most of the medical and surgical treatments patient's diet plays a complementary role. Recovery rate of patient depends upon the acceptance and intake of prescribed diet. In certain diseases modified diet is the primary ailment technique like as in diabetes mellitus and obesity.

1.2. GROWTH AND SCOPE OF DIETETICS

Nutrition is a science that deals with health and development by digesting, absorbing and metabolizing food in our body. It focuses on balanced diet that is necessary for good health. Impact of diet on the health is very powerful but complex.

According to many research studies food has an important impact on our health and well being. Modification in diet can help in controlling or preventing multiple health issues. Dietetics is a specialized field of nutrition which is concerned with study of diets and its effects on health and disease. The focus of dietetics is mainly on management of food through the accurate plan, monitoring and supervising diet of patients. In contrast, nutrition is associated with overall encouragement of good health by suggesting people healthy food choices. Diet in diseases is also called as Diet therapy, Dietotherapy, Clinical nutrition or Therapeutic nutrition.

Dietician nutritionists use nutrition and food science to help people improve their health. Nutrition and dietetic technicians work with dietician nutritionists to provide care and consultation to patients. Both dietician nutritionists and nutrition and dietetic technicians may also provide general nutrition education. Both are nationally credentialed and are an integral part of health care and food service management teams. Specific efforts for specific populations by dietetics professional include:

- Designing nutritional therapies for eliminating specific adverse health issue of an individual.
- Emerging nutritional programs for educational, health care and many other organizations.
- Improving public awareness about healthy nutritional practices.
- Ensuring the safety of food supply.
- Investigating the possible changes in diet to combat the diseased condition.
- Functioning with food manufacturers to improve the nutritional quality of prepared food.

In the sector of health management, experts of dietetics known as dieticians play very crucial role by the application of advanced knowledge gained during academic course of dietetics to alleviate or prevent diseased condition. In India, public and private sectors both provide extensive opportunities in the profession of dietician at multi places like community health

centres, NGOs, hospitals, health clubs, fitness and sports centres, nursing homes, pharmaceutical firms, hotels, etc.

Bureau of Labour Statistics (BLS) suggested an expected rate of employment growth upto 7% till 2031 opening a wide range of job opportunity. According to BLS, Dietetics and nutrition rank 21 among the healthcare domain and expansion of this industry would provide 21,000 more jobs. Dieticians and nutritionists who are endorsing in this industry are creating more successful environment in today's world of inclined health issues and chronic diseases. Registered dietician, sport nutritionist, public health nutritionists, food safety auditor, dietician, nutritionists and food processing managers are the top career opportunities in the field of dietetics and nutrition. Nestle, Cadbury, Unilever, GSK, Eli Lily, Novartis, Food & Nutrition Board (FNB), Ministry of women and Child Development comes under the top lists of recruiters for dietetics and nutrition graduates. For gaining advanced knowledge and creating best career in dietetics and nutrition there are many top placement opportunity colleges in India. Few of them are enlisted as Jamia Hamdard University; Christian Medical College, Vellore; Amity University, Noida; Lovely Professional University; School of Health Sciences, UPES, Dehradun, and; Mount Carmel College, Bangalore.

1.3 PURPOSES AND PRINCIPLES OF THERAPEUTIC DIET

Therapeutic diet is defined as an alteration or modification to the normal diet as required for the severity, nutritional status and metabolic changes of the patient for the particular disease. The basis of therapeutic diet is always a normal diet for healthy person.

Aim of therapeutic diet-

1. To sustain high-quality nutritional status.
2. To maintain acceptable level of all the nutrients in the body those are undersupplied.
3. To furnish rest to specific organs or whole body exaggerated with disease.
4. To regulate consumption of food according to ability of body to digest, absorb and metabolize nutrients during disease.
5. To introduce required changes in the composition and weight of body.

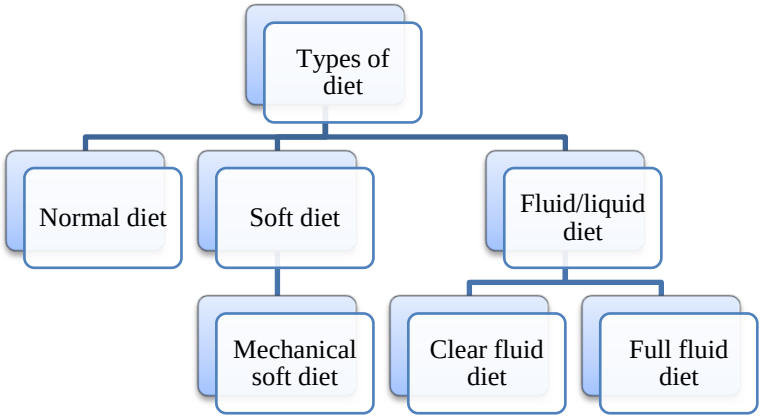
1.4 MODIFICATIONS OF NORMAL DIET AS THERAPEUTIC NUTRITION

1. *Alteration in consistency*- normal, soft or liquid diet is recommended for different type of diseases.
2. *Adjustment in the energy intake*-high or low energy diet is suggested on the basis of metabolic changes, body weight and activity level.
3. *Modified intake of one or more nutrients*- this alteration in picky nutrients is done on the basis of beneficial effect of increasing or decreasing certain nutrients on disease. Such as high protein, low protein, low sodium, potassium diet.
4. *Altered quantity of fibre*- most preferably high or low fibre diet is recommended in gastro-intestinal diseases but are also helpful in managing non-communicable diseases (NCD) like coronary heart diseases, diabetes, hypertension etc.
5. *Bland diet*- mechanically, chemically and thermally bland diets are advised in the diseases that affects alimentary canal, to avoid irritation. It must be free from strongly flavoured fruits and vegetables, spices and should be served at room temperature.
6. *Prohibition of several food items*- prescribed in malabsorption syndrome and allergic conditions by completely excluding particular food item from diet which is responsible for certain type of allergic symptoms or cannot be metabolized by body.
7. *Rescheduling feeding frequency*- rearrangement in the frequency of feeding is suggested in conditions where the individual cannot take heavy meal at a time. Small and frequent meals are suggested to avoid ill effects.
8. *Customized mode of feeding*- special feeding methods, enteral and parenteral nutrition, are recommended in conditions when patient is unable to consume food orally.

1.5 CLASSIFICATION OF THERAPEUTIC DIET

Regular Hospital Diet- these diets are derived from RDA and normal diet for an individual which also make sure to the satisfactoriness, availability and suitable for the disease specific nutrition in the present menu.

Figure 1.1: Illustrate the classification of therapeutic diet



Normal Diet- the term normal diet includes each and every food consumed in normal health condition consisting of all the basic five food groups in adequate amount that supplies all the recommended nutrients to the body in optimum quantity. It is also known as regular, full and general diet, used by the majority of patients who are allowed to eat without any limitations in the quantity and type of food. A little change in consistency of food is done according to the tolerability of individual as soft or fluid diet.

- Energy- 10% reduced due to decreased activity level.
- Protein- 10% increased to work against negative nitrogen balance.
- Total- 1600-2000kcal and 60-80g protein with adequate amount of all the other nutrients.
- Advantages- balanced diet, better acceptability, easy to plan and prepare, and ease in modification and evaluation when needed.
- Foods allowed- all the foods that are safe to consume in normal health.
- Foods restricted- fatty foods (cake, pastries), fried foods, spices rich food, pickles and strongly flavoured vegetables (capsicum, radish).

Soft Diet- it works as transition between normal and liquid diet. It is characterized by soft consistency, easily chewable, prepared with simple and effortlessly digestible foods; it should be restricted in highly flavoured foods and moderate quantity of connective tissue and fibres. It is recommended most preferably in gastro-intestinal tract diseases, acute infections and post-operative conditions because of its nutritional adequacy, easily digestible and low residue generation characteristics.

- All the macro and micro nutrients are altered on the basis of physical and pathological condition of the individual.
- Frequent meals and supplements are recommended if the individual is on soft diet for long time.
- Total- 1800-2000kcal and 55-65g protein is supplied.
- *Foods allowed*- refined cereals (bread, biscuits, semolina, rice etc.); washed pulses; milk and products (curd, buttermilk, yoghurt, cottage and processed cheese); lean meat and eggs; low fibre and starchy vegetables like potato, bottlegourd etc.; soft fruits like papaya, banana, mango etc in the form of juice, soup or purees; butter, cream, vegetable oil, salt and sugar in moderate amount.
- *Foods restricted or avoided*- raw and high fibre vegetables and fruits except above mentioned list; whole grain cereals and its product; whole and split pulses with husk; nuts and dry fruits; fried and fatty foods; tough meats; foods rich in spices; pickles; cakes; pastries etc.
- ***Mechanical soft diet***-in this type only texture of diet is altered because it is recommended only for individuals with poor dentine. It only requires chopped or diced vegetables before cooking; powdered or chopped form of dry fruits and nuts; finely minced or ground meats; soft bread and chapattis; and hard fruits and vegetables.

Fluid or Liquid Diets- it is recommended in many febrile conditions, after surgery and when it's difficult to accept solid food for the individual because of it is free from mechanical and chemical irritants. It is sub-categorized into two- clear and full fluid diet.

I. **Clear fluid diet**- to prevent dehydration and to regulate water and electrolyte balance in acute illnesses and post-operative conditions, clear liquid diet is suggested because patients show aversion to solid or semi-solid food. Hence, the symptoms of anorexia, nausea, diarrhoea and vomiting could be seen. After surgery, this diet work as bridge between intravenous and soft or full fluid diet. At frequent time intervals a little amount (30-60ml) of fluid is supplied to replenish the fluid and electrolyte balance to maintain body's mechanism. It constitutes some electrolytes, carbohydrates and water.
    - Total- 400-500kcal, 100-120g carbohydrate, 5g protein and negligible fat in a day.

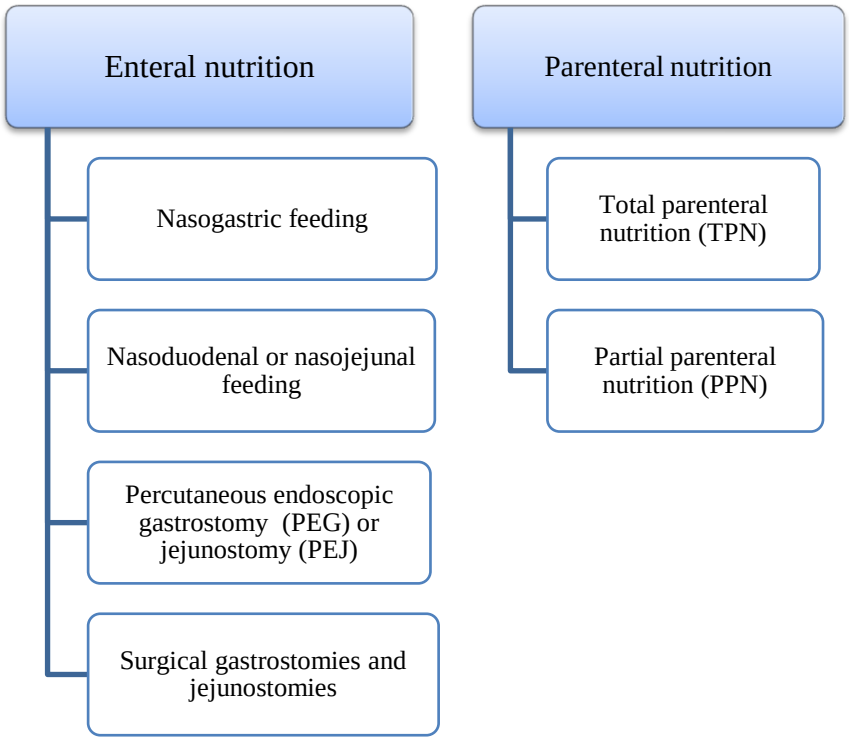
- This diet cannot be continued more than 3days due to its nutritional inadequacy but if for some reason it has to be continued for longer time then supplements of several nutrients must be given.
- *Foods allowed*- strained fruit juices, whey water, coconut water, barley water, glucose water, lime water, honey, carbonated beverages, weak tea or coffee without milk, clear soups, broths and gelatin.

II. **Full fluid diet-** it works as transition between clear fluid and soft diet. In post-operative condition and some of gastro-intestinal illnesses full fluid diet is suggested. Mechanically and chemically it is free from irritants. All the fluids, that are liquid at room temperature, are included in this category. Frequently at 2 to 4 hours of time interval can be given.

- Total- 1500-2000 kcal, 55-65g protein, except fibre all the nutrients in recommended amounts are supplied.
- It could be continued for a longer time period in comparison to clear fluid diet due to its nutritional adequacy.
- Multivitamin, multimineral and protein supplements can be added for better results.
- *Foods allowed*- strained gruels of pulses and cereals; vegetables and fruit in strained juice and pureed form; all the milk based beverages; cream soups and broths; plain ice-cream, soft custards, plain gelatine based desserts, puddings; butter, oil, cream; simple sugar, honey, salt; carbonated beverages, tea and coffee.

Special Feeding Methods- for critically ill patients, who cannot be fed orally, there are mainly two modes of feeding other than oral route that are enteral and parenteral nutrition. The main goal of this method is to maintain and recover the nutritional losses during disease condition.

Figure 1.2: Depict the types of enteral and parenteral nutrition



I. **Enteral nutrition-** the word 'tube feeding' also defines the term 'enteral nutrition' as supplying nutrients to the body through feeding tube accessed in the gut or by gastro-intestinal tract.

There are four ways of administration:

a. *Nasogastric feeding:* this route is appropriate for the patients suffering from the diseases of oral cavity or oesophagus because a soft and flexible tube, prepared with polyurethane or silicone is fixed from nose to the stomach that bypasses the oral and oesophagus area. Bolus injection, intermittent or continuous infusions are the ways of administrating the feed for a 3 to 4 weeks short-term.

b. *Nasoduodenal or nasojejunal feeding:* with the help of endoscopy and radiology the tube is inserted through the nose and placed in the small intestine of the individuals suffering with disorder of gastric motility, oesophageal reflux and continuous nausea and vomiting. This nasoenteric tube is placed only for short duration of 3 to 4weeks.

c. *Percutaneous endoscopic gastrostomy (PEG) or jejunostomy (PEJ):* this feeding method is advised for the patients who need enteral nutrition for long-term. In this

method tube is inserted directly to the stomach or jejunum with the help of endoscopy and exposed out from abdominal wall for giving feed. This is a non-surgical technique with minimal anaesthesia, insertion procedures and complications.

d. *Surgical gastrostomies and jejunostomies:* in this method, with the support of needle-catheter or surgery the tube is directly placed in the jejunum or stomach. This is recommended for the patients who are going through surgical procedures or endoscopic and radiological techniques are not possible to carry out.

- Composition of enteral formula:
  - *Energy:* usually 1kcal/ml is provided that can be accepted by majority of patients.
  - *Protein:* total protein content varies between 4-32% of total calories provided. High protein solutions are categorized as the formulas that provide 18-32% of protein. Caseinate, soy and lactalbumin protein isolates that are considered as biologically complete and intact proteins are constituted in polymeric formulas. Whereas, several formulas contain amino acids or peptide fragments extracted from the hydrolysis of soy, whey, casein and lactalbumin.
  - *Fat:* sunflower, safflower, corn and soya oils are basic sources of lipid in enteral formulas that varies from 1.5 to 55% of total calories in a feed.
  - *Carbohydrate:* corn syrup solids, corn starch hydrolysates, maltodextrins, sucrose, fructose, glucose and purees of vegetable and fruits are common sources of carbohydrate in enteral formulas that varies between 40-90% of total calories. Due to lactose intolerance and deficiency of lactase in acutely ill patients, addition of lactose is avoided in this formula.
  - *Micronutrients:* vitamins and minerals are added in the formula as per the requirement. For adults 1ml of water/kcal or 30-35ml of water/kg actual body weight is recommended and that for infant 1.5ml water/kcal or 150ml/kg body weight is recommended. Water intake is determined by

including the water from all the sources that could be medicational, IV fluids etc.

- Osmolality of a general enteral solution varies from 300 to 500 mOsm which is equal to osmolality of body fluid. It is defined as number and size of nutrient particles in a solution.
- Methods of administration-
  - *Bolus feeding:* with the help of 60ml syringe, per day three or four bolus feeding fulfils the daily nutritional requirement of majority of patients.
  - *Intermittent drip:* a pump or gravity is used to administer drip and four to six times in a day beginning with 100-150ml/feed for 20-60 minutes is adequate for most patients. Increment in feed is done on the basis of tolerance level of the patient.
  - *Continuous drip:* infusion of drip through pump is required for the patients suffering with compromised gastro-intestinal function.
- Complications-
  - *Access problems:* ulceration (pressure necrosis); migration (tube displacement); obstruction in tube; stoma site leakage.
  - *Administration problems:* microbial contamination; regurgitation; aspiration.
  - *Gastro-intestinal problem:* nausea and vomiting; bloating, cramping and abdominal distension; diarrhoea; constipation.
  - *Metabolism problems:* hypo or hyperglycemia; dehydration or overhydration; hypo or hyperkalemia; hyponatremia; hypo or hyperphosphatemia; deficiency of other micronutrients.

II. **Parenteral nutrition-** patients who suffer with the problem of impaired functions of gastro-intestinal tract are advised for parenteral nutrition to meet the nutritional requirement of body. In this method nutrients are delivered intravenously. This is prescribed for the patients with severe trauma or burns, malabsorption syndromes, obstruction in intestine, persistent vomiting, pancreatitis or hepatitis, after gastro-intestinal surgery and coma conditions etc.

- Total parenteral nutrition (TPN): in this method all the macro and micro nutrients are delivered intravenously.
- Partial parenteral nutrition (PPN): when only dextrose or saline solution is delivered intravenously.
- Composition of parenteral nutrition:
    - *Carbohydrate:* dextrose monohydrate 5-7% is delivered which supplies 3.4kcal/g. To prevent from hyperglycemia and hepatic abnormalities it should not be given more than 5mg/kg/min.
    - *Proteins:* concentration of amino acids varies from 3-15% in a commercial solution which yields 4kcal/g. Amino acid content is adjusted on the basis of requirement in some disease conditions like for renal or liver disorders.
    - *Lipids:* in a solution lipid content ranges between 10-20% and supply 1-2kcal/ml. It must not be exceeded than 2g/kg body weight daily.
    - *Fluid:* 30-50ml/kg body weight/day is required for an adult.
    - *Vitamins and minerals:* as these micronutrients do not follow digestion and absorption procedures when given intravenously, hence it is recommended less than RDA.
- Complications:
    - *Mechanical:* subclavian artery injury; subcutaneous emphysema; thoracic duct injury; misplacement of catheter; cardiac perforation; central vein thrombophlebitis; endocarditis.
    - *Sepsis and infection:* contamination of solution; entrance site catheter; contamination at the time of insertion; placement of catheter for long time duration.
    - *Gastrointestinal complication:* hepatic disorder; gastrointestinal villous atrophy; cholestasis.
    - *Metabolic complications:* dehydration; hyperlipidemia; hyperammonemia; hyperchloremic metabolic acidosis; hypo and hyperphosphatemia, hypo and hypercalcemia; hyperosmolar, nonketotic, hyperglycaemic coma; hypoglycaemia; hypomagnesemia; uremia; electrolytic imbalance; deficiency of fatty acids and trace elements.

1.6 ROLE OF DIETICIANS

Dieticians are qualified health professionals who examine and diagnose nutritional and health problems and treat them through dietary and lifestyle modification for an individuals and populations.

According to International Standard Classification of Occupation, 2008 (ISCO-08), dieticians are categorized as Professional Medical Worker, and are classified according to their occupation such as:

1. Clinical dietician
2. Food service dietician
3. Nutritionist / Public health nutritionist
4. Sports nutritionists

Clinical dietician

Clinical dieticians are one who is specialized in working in healthcare sectors including clinics, hospitals etc. and are also known as registered dietician. They are qualified enough to provide personalized medical nutrition therapy (MNT) based on the condition of the patients and are closely working with other medical professionals such as doctors, nurses, pharmacists, social workers etc. which helps to perform their duties like preparing diet plains by assessing the medical history of the patients more efficiently. They are also capable of designing and carrying out health and nutrition programmes. Clinical dieticians are also specialized in the preparation of various types of feeding namely intravenous feeding (IVF) and its types such as peripheral parental nutrition (PPN) and total parental nutrition (TPN) together with tube feeding (enteral nutrition).

Food service dietician

These dieticians are employed in a school canteen, company cafes, jails, restaurants and other large-scale meal planning and feeding organizations.They are in charge of all aspect of food service, including menu planning, coordinating with the kitchen workers to ensure appropriate preparation, and assessing the quality of the food. They create fresh meals, start wellness initiatives to guarantee that the nutritional needs of the consumers they serve are addressed, and

conduct routine audits to uphold quality assurance standards. Additionally, they can instruct and oversee the work of the kitchen crew, dietary assistants or technicians, and food delivery staff.

Nutritionist/ Public health nutritionist

Nutritionist or public health nutritionist are a type of registered dietician who focuses on educating people about developing healthy eating habits, particularly in a group or community context. They concentrate on overall dietary trends before figuring out how to inform the public about better dietary options. They concentrate on assisting with the implementation of policies for a community or a sizable organization that will enhance population nutrition and hence increase the people's health and well-being.

Sports dietician

Sports dieticians are one who works on sports professionals and athletes. Their area of expertise is sports nutrition, which examines how food and nutrition affect the performance of athletes. Sports dieticians are working in sport club, gyms, and fitness centers as well as they are also appointing by a sports team to provide diet and nutrition guidance to the players. The main objective of sport dietician is to ensure that the diet followed by athlete help them to give their best in the performance.

1.7 CHARACTERISTICS OF DIETICIANS

Dietetic professionals have voluntarily developed a code of ethics to represent the moral tenets that govern the field and to set forth their commitments and duties to themselves, their clients, society, and the profession. Some of the characteristics of a good dietician are as follows:

- In terms of ethnicity, creed, religion, sex, age, and national origin, the dietician abstains from discriminating against other people.
- Dieticians and nutritionist honestly uphold their professional obligations.
- They protect the privacy of all information.
- They use scientific theories and the most recent knowledge when practicing dietetics.
- They never make incorrect or deceptive claims in their advertisements.
- They acknowledge that there are valid differences of opinion and offer facts and analyze controversial information without bias.

- They adhere to all relevant laws and rules pertaining to their profession.

1.8 DIET COUNSELLING

A combinational advice of psychological skills and nutrition expertise given by skilled dietician is known as diet counselling. Dieticians work not only on the dispenser as an advisor but also work on the changing food behavioural practices to get the healthy body and fulfil the body's requirement.

A dietician focuses on disease prevention rather than cure. Education of preventive measures includes exercising, prohibiting cigarette smoking, and healthy diet pattern. This can only be best advised and educated by a diet counselor.

Dieticians can also dispel the myths and misconception about food especially advertised and reported by media. Dietician at hospital can address the large group of population by OPDs on the importance of nutrition in an individual's day-to-day life.

The main objective of diet counseling must be to educate the patient about nature, hazards, sign and symptoms of disease and most important advice should be given regarding the preventive measures, personal hygiene, specific therapy and individual need on diet. Team approach is an effective tool for the successful diet therapy. Patient must be made aware of the role of diet in the prognosis of disease and he should be stuck on his diet therapy for a sound health.

1.9 TEAM APPROACH TO NUTRITIONAL CARE

In the US, first nutritional support team (NST) was established in 1973. NST was defined by Simon Allison in 1992, as "a team of different disciplines with good communication which enables nutritional support to be given in the best manner for each patient. Such a team improves the quality of treatment and reduces costs by avoiding unnecessary treatments and simplifying the treatments used; reducing complications; monitoring use of nutrients and outcomes of treatment; reducing waste; and standardising nutrients and equipment to enable bulk purchase and negotiation of competitive rates". It is a multidisciplinary approach that provides nutritional care more effectively than the individuals acting independently.

Senior physician, dietician, nurse and pharmacist are the core members of a nutrition care team. To accomplish this team approach other executive members are also involved in NST like finance manager, nurse staff member, general manager, catering officer, clinical therapist, senior doctor, supplies member, pathology representative, and clinical therapist.

Goals of a NST

- Prevention and treatment of hospital based malnutrition
- Avoiding metabolic complications
- Diminishing nutritional complication
- Reducing mechanical complication
- Creating guidelines for clinical nutritional
- Supervision of nutritional therapy
- Evaluation and collection of data on the effectiveness of artificial nutrition
- Allocating knowledge with others

Functions of nutrition care

- Nutritional assessment
- Assessment of malnutrition severity
- Determining the nutritional requirement
- Appropriate indication of special feeding methods
- Assessment of adequate access of nutrition therapy
- Management and initiation of parenteral and enteral utrition

1.10 PRINCIPLES OF FOOD PRESCRIPTION INDIAN DIETETIC ASSOCIATION (IDA)

In 1963, a large group of medical scientists, nutritionist and dietician thought to create a scientific body to work on the problems related to the science and technology of nutrition and dietetics for the treatment and prevention of any diseased condition. Hence, they felt like to promote the teaching, nutrition education and research along with training in the field of dietetics and nutrition.

Finally, under the Societies Registration Act, 1961, Indian Dietetic Association is registered with C. Gopalan as president and Prof. Kalyan Bagchi as secretary. In 1975, IDA was affiliated to the International Congress of Dietetics and Kolkata is the headquarter of IDA. Since the time it is founded, it's major activities include organizing lectures and seminars in the presence of eminent group of scientists from Indian as well as from abroad.

Other major objectives of IDA include:

- Encouraging the spirit of active pursuit of knowledge and original scientific research in the field of dietetics and nutrition.
- To provide scientific, cultural and social fellowship and promoting goodwill among its members.
- To promote close contact and interaction between persons following different branches and thus facilitate the development of a wider outlook and the integration and application of available scientific knowledge for the welfare of society.
- To safeguard the interests of scientists generally and its members in particular and work for their welfare.

1.11 COMPUTER ASSISTED INSTRUCTIONS (CAI) - DIET PLANNING USING COMPUTERS:

Computer is used as an important tool in the food service management and in the planning of menu. Arunmozhi Balaji formulated and standardized a computer software package named as computer aided learning in dietetics (CALID).

The actual instruction as the user sees is divided into two sections:

1. Master file which collects the information of patient like age, sex, address, height, weight and patient number and pathological condition.
2. Food site which collects information of food items with their calories, carbohydrate, protein and fat content. The food items are arranged alphabetically under the meal times. Serving size and amount of individual serving will be displayed. Provision for adding and deleting food items is built in.

In the first step of diet counseling system, patient's personal information is taken and further this counseling program is divided into 3 sections.

1. Analysis of the food intake

This assists the subject to sequentially list all the food items at meals and estimate quantities.

2. Summary

The summary would give the intake for the day for energy, carbohydrate, protein, fat along with the recommended dietary intake.

3. Printout

The printout would give the list of foods to be avoided and recommended along with the quantity per serving.

In this technologically rich era, all the population is dependent on the use of technology whether it is a phone, laptop or any other gadget. They want everything very quick and preference is in soft copy format rather than old hard copy format. Thus, use of computer assisted instructions is the best and easiest way for diet planning and counseling.

1.12 CHECK YOUR PROGRESS

Exercise 1:

1. What is the reason for changing normal diet?

2. What is special feeding method? Briefly describe the parental and enteral nutrition.

3. Describe the main role of nutrition care team (NST).

4. State whether the following statements are true or false.

a) Dietetics is a specialized field of nutrition which is concerned with study of diets and its effects on health and disease.
b) Patients suffering from impaired functions of gastro-intestinal tract are advised for parenteral nutrition.
c) Dietotherapy is basically a normal diet.

Exercise 2:

1. Fill in the blanks:

   a) Therapeutic diet is defined as _____ to the normal diet.
   b) _____ diet is recommended only for individuals with poor dentine.
   c) For critically ill patients there are two modes of feeding other than oral route that are _____ and _____ nutrition.
   d) Osmolality of a general enteral solution varies from _____ to _____ mOsm that is equal to osmolality of body fluid.

2. Write short notes on:

   a) Bolus feeding
   b) Objectives of NST
   c) Nasoduodenal feeding
   d) Sports nutritionist

UNIT-II MEDICAL NUTRITION THERAPY I

Structure

2.1 OBESITY

The WHO has identified overweight and obesity as one of the most significant public health issues of the present time due to the increased prevalence of these conditions and their negative health effects. Health is most favourably influenced by a healthy body weight. Variations of body weight that exceed specific limits are detrimental to health in general and can increase the risk of developing a variety of other illnesses.

Obesity occurs when the amount of calories consumed exceeds the amount of energy expenditure. It is a condition in which the body has a surplus of fat. In medical terminology, obesity is a condition characterised by excess body weight, which occurs when a person's weight is 20% or more over their ideal weight. When someone is 10–20% over their ideal weight, they are considered to be overweight. Therefore, the terms "overweight" and "obesity" are relative but not interchangeable. Age, sex, height, and body type affect a person's ideal body weight.

2.1.1 AETIOLOGY:

Obesity is a chronic multi-factorial disease with many contributing components, including both hereditary and environmental influences.

Genetic factor:

Obesity risk is influenced by a person's genetic inheritance. Therefore, obesity runs in families, and the likelihood is 80% if both parents are obese and 50% if only one parent is obese. Aside from obesity, there is growing evidence confirmed that fat distribution patterns are hereditary. Simultaneously, family socio-cultural practices instill specific eating habits and attitudes that may contribute to obesity.

Age and gender:

As long as the person is in a state of positive energy balance, it can happen to either gender at any age. Research conducted at the Nutrition Foundation of India have indicated that throughout all age groups, more women are overweight than men due to hormonal predisposition.

Physical inactivity:

People who lead sedentary lifestyles and put little value on physical activity are more likely to be obese. With TVs and computers dominating modern lifestyles, physical activity has decreased as a result of increased mechanization, better transportation, and working conditions, which have also promoted sedentary living. This is a direct cause of the rising rate of obesity, along with high energy intake.

Eating habits:

Snacking between meals, eating late at night due to insomnia, and consuming a lot of fatty and starchy foods all contribute to a high energy intake. Independent of overall calorie intake, the type and quantity of dietary fat may contribute to obesity, perhaps because this nutrient is more efficiently metabolized than other nutrient types.

Endocrine factor:

It is possible that hormonal factors play a role in the prevalence of obesity throughout puberty, pregnancy, and menopause. Hypothyroidism or myxoedema is linked to obesity. Juvenile obesity is thought to be caused by anterior pituitary gland dysfunction. Cushing's syndrome or over secretion of the adrenal gland causes obesity, where excess fat is typically stored in the torso rather than the limbs. Consuming oral contraceptives, which are hormonal in nature, may cause obesity. Less than 5% of all cases of obesity, however, are caused by endocrine variables.

Social factor:

The urge to frequently eat out and attend parties as a result of social pressure is a common reason why people consume too much food and energy. Quick access to fast food restaurants, high-impact advertising of junk food and other foods with large portions encourages overeating and obesity.

Drugs:

Some medications cause weight gain. A person's weight may increase as a result of taking medications such antidepressants, steroid hormones, contraceptives, diabetic medications, and antihistamines.

2.1.2 Obesity Assessment:

A patient's degree of obesity can be determined by visual examination in a subjective but largely accurate manner.

Body weight: There are two methods for determining ideal body weight first is tables of ideal weight for height and second is tables of average weight by height and age. An adult who weighs 10% more than their ideal weight is considered overweight, while 20% more is considered obese.

Table 2.1: Relationship between body weight and obesity

Degree of obesity	% body weight above to normal
Mild	25
Moderate	50
Severe	75
Very severe	100

Body Mass Index:

An individual's body mass index is used to determine whether or not they are overweight or underweight. BMI is generally regarded as a more accurate measure of body fatness and health risk than body weight. It is also known as the quetlet index. This index does not necessitate any standard tables.

$$\text{BMI} = \frac{\textit{Weight (kg)}}{\text{Height } (\text{m}^2)}$$

Table 2.2: ICMR approved the classification scheme for BMI

Underweight	<18
Normal	18.0-22.9
Overweight	23.24.9
Obese	>25

Waist Circumference:

It is the most practical technique a practitioner may use to assess a patient's abdominal fat before and during weight loss treatment.

High risk waist circumference according to International standards:
Men: >40 inches (>120 cm), Women: >35 inches (>88 cm)

High risk waist circumference according to Asian standards:

Men: >36 inches (>90 cm), Women: >32 inches (>80 cm)

Skinfold thickness:

It is a method for determining the body's fat distribution. A tool called a calliper is used to delicately pinch the skin and underlying fat in various locations. Biceps, triceps, subscapular, and suprailiac are common areas to measure skinfold thickness. With weight gain, the percentage of fat deposits under the skin increases.

Waist to hip ratio:

As a measure of regional abdominal adiposity, the waist-hip ratio (WHR) is used to forecast the risk of diseases linked to obesity. *A healthy waist to hip ratio is* <0.9 in men and <0.85 in women.

$$\textbf{WHR} = \frac{\textbf{\textit{Waist circumference}}}{\textbf{\textit{Hip circumference}}}$$

Broka's index:

This is the simplest and most reliable way to determine ideal body weight. The formula for broka's index is:

Height (cm) – 100 = ***ideal weight (kg)***

2.1.3 DIETARY MODIFICATION FOR OBESITY:

In order to effectively treat obesity, dietary changes should not only aim to reduce body weight but also to maintain it in the healthiest way possible. It's not always feasible to reach your target weight. The use of body fat stores is aided by maintaining a constant weight over time, which also reduces protein loss and the dramatic drop in BMR that accompany fast weight loss. For obese patient, low calorie, restricted carbohydrate and fat, normal protein, vitamins and minerals (apart from sodium), moderate fluid and high fibre diet are prescribed.

Energy:

In order to lose weight, one must exert more energy than they take in, or they must have a negative energy balance. A reduction of 1,000 kcal per day is needed to lose roughly 1 kg of body weight per week, and a reduction of 500 kcal per day results in a weight loss of over half a kg.

Table 2.3: Shows the daily energy requirements depending on ideal body weight (IBW) and activities

Activity	Energy requirement (per kg IBW)		
	Underweight	**Normal**	**Obese**
Sedentary	35	30	25
Moderate	40	35	30
Heavy	50	40	35

Protein:

Normal protein should be consumed because it makes people feel satisfied and helps them stay in good nutritional condition. It is advised to consume 0.8–1 g of protein per kg of body weight for tissue repair and specialized dynamic action.

Fat:

Reduce the calorie value of foods by following a low-fat or no-fat diet. Saturated and trans fats should be avoided, while consumption of substances like nuts and oilseeds should be limited. Around 15–25% of total energy should be provided by fat. Use of unsaturated fat must be emphasized in order to lower the risk of cardiac issues.

Carbohydrates:

About 55-60% of the total energy should come from carbohydrates, mostly in the form of complex carbohydrates like starch and dietary fibre, whereas simple carbohydrates like sugar which contains empty calories should completely avoided. For bulk and fullness, dietary fibre or indigestible carbohydrates are prescribed.

Vitamins and minerals:

Long-term fat restriction is likely to result in a deficiency in fat-soluble vitamins A and D, which necessitates supplementation. Sodium limitation as common salt is beneficial in a weight-loss diet because excess sodium predisposes to fluid retention. Fruits and vegetables should be included in the meal because they are low in energy, a rich source of vitamins and minerals, and they provide roughage that helps improve bulk and reduce constipation.

2.1.4 DIETARY GUIDELINES:

- Whole grain, millets, brown rice, oats should be included in the diet as well as refined cereals and polished rice should be avoided.
- Whole pulses and legumes should be included in the diet.
- Full fat milk, butter, cream, ice-cream should be avoided. Full fat milk should be replaced by skimmed milk.
- Red meat, fatty portion of meat, egg yolk should be avoided whereas chicken or fish should be included by using little oil in the preparation.
- Colorful fruit and vegetables should be included in the diet to fulfill the requirement of antioxidants.
- Unprocessed food, natural food and sprouts should be included in the diet.
- Fried and junk food should be avoided because it contains saturated and trans fat.
- Cake, pastries, chocolates should be strictly avoided in the diet.

2.1.5 BARIATRIC SURGERY:

Weight loss surgery, often known as Bariatric surgery, aims to change or disrupt the digestive process so that food is not absorbed and broken down as usual. Patients can lose weight and lower their risk of obesity-related health hazards or diseases by consuming less calories and nutrients. Patients with a BMI of greater than 40% might consider having bariatric surgery. People with a BMI between 35- 40 and additionally have concomitant conditions like diabetes are also considered candidates for surgery.

Types of bariatric surgery:

The bariatric surgeon will evaluate the patient's health and consult with them to choose which procedure is ideal.

Gastric balloon: In order to do this, a flexible scope known as an endoscope is used to introduce a deflated balloon via the mouth and into the stomach. After being placed, the balloon is inflated to constrict the stomach's volume. The balloon is later removed (often after six months) and this is only a temporary treatment.

Adjustable gastric banding (lap band): Gastric banding entails wrapping a permanent silicone band around the stomach. The band decreases the size of the stomach without removing any part of it. This surgery is typically done laparoscopically. A tiny port right beneath the skin is used to modify the band.

Sleeve gastrectomy: A section of the stomach is removed during gastric sleeve surgery, which reduces the size of the stomach. After this treatment, which is often carried out laparoscopically, the remaining stomach is shaped like a sleeve.

Gastric bypass: The small intestine's aperture is separated from the stomach's lower portion during gastric bypass surgery, and it is then joined to the stomach's upper portion. The stomach can contain less food as a result, and more significantly, the food spends less time in the small intestine, which limits the quantity that is absorbed. The most frequent gastric bypass operation, known as the Roux-en-Y bypass, is typically carried out laparoscopically and entails the removal of a piece of the stomach in addition to the bypass.

2.2 UNDERWEIGHT

Half of the Indian rural population is underweight most of them are from deprived communities. Due to inadequate food supplies in this area chronic food deficiency occurs which leads to chronic energy deficiency. When the body weighs below 10-20% of expected average weight for individual’s sex, age and height, and BMI is less than 18.5, this condition is characterized as underweight. It is the most common problem of underdeveloped countries due to poor living conditions, poverty, long lasting diseases etc. Beside this, many other causes also lie behind this situation of underweight.

2.2.1 Aetiology

Following are the major causes of underweight:

1. Inadequate food intake- if body's nutritional requirement is not fulfilled in the terms of quality and quantity due to poverty, psychological problem or irregular eating habits can turn into a poor condition characterized as underweight.
2. Increased physical activity- a deficient diet along with increased physical activity may leads to underweight.
3. Malabsorption- disrupted absorption of nutrients in the body due to gastrointestinal disturbance causes malabsorption of nutrients resulting in underweight.
4. Pathological conditions- one and any pathological condition like fever or cancer reduces the appetite but body demands increased energy needs because of increased metabolic rate thus causing reduced weight of the individual.
5. Hormonal imbalance- energy needs of the body are increased due to increased metabolic rate in hyperthyroidism which is if not met leads to loss of weight.
6. Eating disorders- frequently seen in young women due to obsession with thinness. A condition of self-starvation known as anorexia nervosa and bulimia nervosa characterized by binging and purging, by induced vomiting, cycle are the two major eating disorders.

2.2.2 Nutritional management

As in underweight condition the body is nutritionally deficit, it is recommended to take a diet rich in calorie, protein and fat along with liberal intake of vitamins. But in the preliminary step it is suggested to determine the cause of undernutrition then a balanced diet planning should be done accordingly.

Energy: an additional 500kcals per day is required for weight gain in addition to energy required for specific activity level, age, group and sex. To avoid the digestive disturbances gradual increase over one or two weeks is suggested.

Protein: 1.2g/kg body weight of high biological value protein is recommended for tissue building. Thus, good sources of protein should be included in the diet.

Fat: high calorie fatty food should be included in the diet such as butter, cream, oil and margarine rather than fried food. But it should be always taken with meal instead of before meal to avoid reduced appetite and gastric upset causing diarrhoea.

Carbohydrate: easily digestible foods with high carbohydrate and energy content should be preferred in the diet like potato, yam, dried fruits, sweets, nuts, jam, jelly, desserts, cereals and nonvegetarian food. Meal frequency must be increased by incorporating one minor meal in between two major meals.

Vitamins and minerals: supplements of vitamin and minerals are not required due to liberal consumption of diet.

Fluids: to avoid constipation enough fluid is required but it should be taken only after meal to avoid reduced dietary intake.

2.2.3 Dietary guidelines

- Positive energy balance should be maintained means higher energy consumption than the energy expenditure.
- Energy dense sources should be consumed to gain weight.
- Regular meal pattern must be maintained on priority basis with three major and three minor meals.
- Serving size should be increased gradually.
- Dietary supplements can be included.
- Appetizers may be included like soup, juices.
- Variations in the food can be tried out.

2.3 DIABETES MELLITUS

With the combination of two Greek words, the word Diabetes Mellitus was originated. Diabetes is denoted for Siphon and mellitus is denoted for sweet, which ultimately refers to “flowing of sweet liquid”. It is named as *Madhumeham* in native Indian language. The term ‘Honeyed urine’ was used by Susruta (an Ayurvedic physician) in about 400 B.C. in Ayurveda. Another contemporary physician named Charak was also well aware about this disease.

International diabetic federation (IDF) in 2020 reported that around 463 million people around the world having diabetes and many more may not be aware of their problem. Of this 463 million, 88 million people belong to Southeast Asia region, from which 77 million belong to

India. It is also stated that prevalence of diabetes is 8.9% and its incidence is increasing alarmingly in India. World diabetes day is celebrated on 14th November of every year focusing on primary global awareness campaign for general population.

It is a metabolic disorder distinguished by increased level of blood glucose because of diminished or negligible ability of tissues to utilize carbohydrate at the same time some major changes in the metabolism of protein, fat, electrolytes and water. These changes are the result of decreased or deficient effectiveness of a hormone named insulin that is secreted from the β-cells of the Islets of Langerhans of pancreas. If this metabolic derangement persist for long duration then ultimately shows some irreversible and permanent, structural and functional changes in the body's vascular system mainly the nervous system, kidney and eye.

2.3.1 Classification of diabetes mellitus

Type 1 or Insulin Dependent Diabetes Mellitus (IDDM)

Even though it may occur at any age but probably seen before the age of 20 years. Therefore, it is also known as juvenile onset diabetes mellitus. Individuals suffering from this disease are dependent on insulin therapy because inadequate amount of insulin is secreted from the pancreas due to autoimmunity that is destruction of β-cells or infection of virus. Otherwise, fatal ketoacidosis may develop.

Type 2 or Non-insulin Dependent Diabetes Mellitus (NIDDM)

Development of NIDDM, adult onset diabetes, is usually a slow, mild and stable process. Pancreas may produce enough insulin but their actions are impaired. Almost all the patients are overweight but they lose weight very rapidly and giving diet therapy is utmost important. Acidosis is uncommon as in type 1 diabetes.

Gestational Diabetes Mellitus

Few women suffer from this during pregnancy. After delivery the blood glucose level returns to normal but glucose intolerance can be corrected by dietary modifications as prescribed in the type II diabetes.

2.3.2 Aetiology

On aetiology basis diabetes is classified under two groups: Primary or idiopathic and secondary diabetes.

I. Primary or idiopathic diabetes

Heredity: While, the accurate cause of this type of diabetes is unknown but most of the patients belong to this group. Heredity is the familial aetiology of primary diabetes mellitus, although its specific biochemical disturbance and mode of inheritance is not clear. It is believed to be inherited as a recessive gene characteristic according to the Mendelian theory.

Age: It is seen that 80% of the cases are from middle age group >50yrs and elderly. Thus, this disease is mainly of middle aged and elderly.

Sex: In younger age most commonly seen in males than females but in middle age, females are more affected with increasing chances of pregnancy and parity.

Obesity: strong association between obesity and diabetes are seen but it is uncertain, whether diabetes is the reason of obesity or diabetes is the result of obesity. It may be because obese people are physically less active or there is impaired insulin uptake, insulin resistance or hyperinsulinemia in target tissues.

Dietary factors: A high intake of refined food leads to increased consumption of sugar and reduced consumption fibre that may predispose to diabetes, hence high prevalence rate of diabetes have been reported.

Infections: insulin antagonistic hormones are produced in the infection of *Staphylococcus* that unmasks latent diabetes. Type I diabetes may be the result of viral infection which may brings about an autoimmune reaction and destroys β –cells of pancreas.

Stress: adrenocortical responses after any physical or emotional injury may unmask latent diabetes.

II. Secondary diabetes

A minor group of cases belong to this group as a result of impaired secretion of insulin in some diseases which destroy pancreas like pancreatitis, pancreatic cancer, pancreatectomy etc. or impaired level of insulin antagonistic hormones.

Growth hormone: in 30% of cases increased concentration of growth hormone have been observed.

Adrenocortical hormones: elevated level of glucose in blood results due to increased breakdown of protein that restrict from the utilisation of glucose by peripheral tissues reason behind this is increased secretion of cortisol and corticosteroid hormones.

Adrenaline: it suppresses the secretion of insulin and increases glycogenolysis that is responsible for the elevated blood sugar level.

Thyroid hormone: hyperthyroidism also predisposes diabetes.

2.3.3. Pathophysiological based symptoms of diabetes mellitus

Hyperglycaemia: Metabolism of protein, carbohydrates, fat and electrolytes are affected adversely as a consequence of deficient supply of functioning insulin. Impaired secretion of insulin leads to reduced utilization of glucose in peripheral tissues along with reduced glycogen formation which is followed by increased level of sugar in blood, a condition called hyperglycaemia.

Glycosuria: when the blood glucose level crosses the renal threshold level, i.e. 160–180mg/100ml, glycosuria occurs.

Fluid and electrolyte imbalance: elimination of water and sodium in the urine is elevated because increased level of sugar in urine represents major loss of energy.

Polyuria and nocturia: in this situation volume of urine is increased markedly due to increased osmolality of glomerular filtrate because of glycosuria that prevents the water from reabsorption and passes down to the renal tubules.

Polydipsia and polyphagia: polydipsia is increased thirst due to loss of water and electrolyte in polyuria and polyphagia is increased hunger due to loss of sugar in urine.

Dehydration: extracellular fluid becomes hypertonic and water leaves the cells as the level of glucose rises in blood.

Fatigue and loss of weight: carbohydrate utilization is impaired which may results into fatigue and to provide metabolic substrates, two compensatory mechanism works. Both results into loss of body tissue and wasting may occur.

Increased excretion of potassium, magnesium and phosphorus: increased excretion of electrolytes occurs as a result of glycogen and protein catabolism.

Effect of insulin deficiency on metabolism:

- **Hyperglycaemia:** decreased uptake of glucose by liver, muscle, adipose tissue; increased glucose production by liver due to glycogenolysis and gluconeogenesis; increased release of substrate by muscle; increased glycogenolysis; increased release of amino acid.
- **Hypertriglyceridemia:** increased triglyceride uptake by adipose tissue.
- **Ketonuria:** increased mobilisation of fatty acid by adipose tissue; increased fatty acids to ketone conversion by liver; decreased uptake of ketones in muscles.
- **Hyperaminoacidemia:** decreased uptake of branched chain amino acids by liver.

2.3.4. Assessment of diabetes

Random blood sugar: according to WHO, a random blood sugar level ranging above 200mg/dl and fasting blood sugar level above 140mg/dl almost certain to indicate diabetes.

Glucose tolerance test: this is the confirmatory test. WHO recommends 75g of glucose load for adults and 1.75g/kg body weight for children but not exceeding beyond 75g. At least three days before this test, all the medications should be discontinued.

- Sample is drawn at fasting condition.
- Then, 75g of glucose solution in 250–300ml of water should be given. To prevent nausea lemon juice could be added.
- After administration of glucose solution, blood and urine samples are taken every 30minutes for 2hours.
- Result is compared with the set criteria for diabetes given by expert committee of WHO and National Diabetes Data Group (NDDG) in United States, given in table below:

Table 2.4: Criteria of blood glucose level given by WHO

	Fasting	**2hrs after oral consumption of 75g glucose**

	Plasma mg%	Whole blood mg%	Plasma mg%	Whole blood mg%
Normal	<100	<80	<140	<120
Impaired glucose tolerance	100–140	80–120	140–200	120–180
Diabetes mellitus	>140	>120	>200	>180

Impaired glucose tolerance

When the glycaemic load lie between normal and diabetic after consumption of 75g glucose, then this situation is called as impaired glucose tolerance. Individuals with impaired glucose tolerance test positive are free from any symptoms but they are suggested to be more careful as they are prone to be diabetic at later stages.

2.3.5. Management of diabetes

Objectives

- Regulate the levels of blood glucose and lipid.
- To maintain weight for people with noninsulin dependent type diabetes and to uphold consistent day–to–day intake for people with insulin dependent diabetes.
- To promote healthy eating habits.

It can be treated with four modes:

- Diet
- Oral hypoglycaemic drugs
- Exercise
- Diabetes education

Food exchange lists

Food exchange list supports the patient:

- To prevent hyperglycaemia and hypoglycaemia by restricting the food intake according to the prescribed level of insulin.
- For increasing variety and palatability of food.
- Principles of diet are learnt more easily with the help of food exchange list.

Diet and Insulin

In a healthy child, secretion of insulin matches with the intake of food, whereas in juvenile diabetics the food intake has to be matched with the injected insulin. The table given below illustrates the types of insulin and their action.

Table. 2.5: Type of insulin and its action

Type	Onset hours	Peak action hours	Duration hours
Rapid action–short duration			
• Regular soluble crystalline	½	2 – 4	6 – 8
• Semilente	½	2 – 4	10 – 12
Intermediate action and duration			
• Lente	2	6 – 12	18 – 24
• NPH (Neutral Protamine Hagedorn)	2	6 – 12	18 – 24
Delayed action – Prolonged duration –			
• Protamine Zinc Insulin (PZI)	4 – 8	14 – 20	24 – 36
• Ultralente	4 – 8	16 – 18	18 – 24

Bovine and procrine pancreas are used for the preparation of conventionally available insulin. Peak absorption of carbohydrate and insulin action must be at the same time. Thus, according to the type of insulin as prescribed by the doctor the need of calories should be distributed in every meal. Also the dose of insulin is dependent on the quantity of calories. Table 2.6. Given below shows the distribution of calories in every meal with respect to type of insulin prescribed.

Table 2.6 : Distribution of calories according to the type of insulin

Type of Insulin	Breakfast	Noon	Mid–afternoon	Evening	Bedtime
1. None	1/3	1/3	–	1/3	–

2. Short acting (before breakfast and dinner)	2/5	1/5	–	2/5	–
3. Intermediate acting NPH	1/7	2/7	1/7	2/7	1/7
4. Long acting	1/5	2/5	–	2/5	80–160 kcal
5. Long acting with regular insulin at breakfast	1/3	1/3	–	1/3	–

2.3.6. Nutritional Management

Carbohydrate: Carbohydrate level is maintained to 60–65% of total required calories to avoid elevated serum triglyceride levels. This should be met in the form of polysaccharide and high fibre diet such as whole grains, millets etc. whereas, food sources of mono and disaccharide should be avoided such as chocolate, honey, sweets, sweetened drink etc.

Protein: 20% of total required calories should be fulfilled by protein sources to supply the essential amino acids to the body for tissue repairing. It also does not provide as much calories as fat and sugar does.

Fat: low fat diet is advised as it reduces the level of LDL and VLDL consequently reducing the risk of atherosclerosis and increasing the insulin binding potential. 15– 20% of total calories should be met from fat which must be high in polyunsaturated fatty acids and low in saturated fat.

Vitamins and minerals: supplements of vitamins and minerals could be included in the diet to overcome from the problem of oxidative stress. A diet rich in all the vitamins especially vitamin C and E for antioxidative potential is recommended along with adequate minerals particularly zinc and magnesium are prescribed. Thus, fruits and vegetables must be included in diet.

Dietary fibre: it is helpful in lowering requirement of insulin, serum cholesterol and triglyceride levels, controls blood pressure as well as increases insulin sensitivity at peripheral tissues, regulate the body weight. 20–30g of soluble fibre should be consumed daily because it delays gastric emptying time, increases transit time and slower down glucose absorption rate and serum cholesterol level. Pectin, gum, and hemicelluloses come under soluble fibre category. Lignin and celluloses are included in insoluble fibre category.

Glycaemic index (GI): it is defined as the ranking of foods according to the postprandial blood glucose response in comparison to a reference food. Low glycaemic index foods are advised to diabetics because it influences multiple parameters of lipid and glucose metabolism.

The consumption of low GI food will reduce the postprandial rise in blood glucose level and slows down the absorption of carbohydrate by reduced rise in gut hormones and insulin. However, a high GI form of carbohydrate produces raised postprandial response of blood glucose level and increases the demand of insulin which is a contributing factor for the higher risk of type II diabetes.

Foods to be avoided

Simple sugars such as honey, glucose, sweets, syrup, cake, candy, fried foods, nuts, jiggery, alcohol, sweetened juices etc.

Foods to be eaten in moderation

Cereals, fats, pulses, meats, egg, fruits, artificial sweetener, nuts root etc.

Foods to be taken liberally

Fruits except banana, lemon, clear soup, green leafy vegetables, mint, onion, spices, plain tea or coffee, skimmed and butter milk, salads.

2.3.7. Complications of diabetes

Short–term complications

- Hypoglycaemia or insulin shock (a condition where the blood glucose level is less than 45mg/dl).
- Ketoacidosis (smell of acetone may be felt in breath and finally leads to coma).

Long–term complications

- Infections (wound healing is delayed because of neuropathy, hyperglycaemia and ischaemia, thus prone to be infected with tuberculosis bacteria, infection of skin, urinary tract and foot)
- Cataract and retinopathy (yellow brown pigmentation in the eye lenses)
- Heart diseases (atherosclerosis, hyperlipidemia)
- Nephropathy (Progressive loss of kidney function)

2.4. CHECK YOUR PROGRESS

Exercise 1:

1. Fill in the blanks:

a) Excessive fatness of the body caused by abnormal increase of fat in the sub-cutaneous connective tissue is referred to as_____.
b) An adult who weighs _____ percent from ideal weight is considered overweight, while _____ percent is considered obese.
c) BMI is also known as_____.
d) A daily caloric reduction of _____ is required to lose around 1 kilogramme of body weight each week.
e) Roux-en-Y bypass is another name of _____ surgery.

2. What is bariatric surgery? Briefly describe the gastric balloon procedure.

3. What are the factors which determine the ideal body weight of an individual?

Exercise 2: Check your progress

1. Match the following:

a) Underweight	i) surgical removal of fat
b) Type 1 diabetes	ii) BMI less than 18.5
c) Type 2 diabetes	iii) Non-insulin dependent diabetes mellitus
d) Bariatric surgery	iv) Insulin dependent diabetes mellitus

2. State whether the following statements are true or false.

a) Positive energy balance means higher energy consumption than the energy expenditure.
a) Obesity is the condition in which the body is nutritionally deficit.
b) IDDM is known as juvenile onset diabetes mellitus because it may occur at any age.
c) World diabetes day is celebrated on 14th November.
d) Obesity is a condition in which the body has a surplus of fat.

UNIT-III: MEDICAL NUTRITION THERAPY IN GASTROINTESTINAL DISORDERS

Structure

3.1 INTRODUCTION

Gastro-intestinal tract is related to our digestion, absorption and utilization of food in the body. Functions of digestive tract may be affected by the disease of the tract itself and also by the organs which is closely attached to the gastro-intestinal tract such as gall bladder and pancreas. Gastro-intestinal diseases are the most common health care problem. Approximately 30-40% adults are suffering from digestive disorders because of the dietary habits and lifestyle.

The nature of Gastro-intestinal disorder are of two types or organic and functional. Organic disorders are those in which pathological changes occur such as ulcers and cancer whereas functional disorders do not change the pathological condition like constipation and diarrhoea.

3.2 DIARRHOEA

Diarrhoea is the defined as having three or more loose, liquid or watery stools per day. It occurs when the lining of the intestine is unable to absorb fluid, or it actively secretes fluid. Loss of fluid may contribute to the loss of electrolyte mainly sodium and potassium**.** There are many causes, including infection, inflammation, drugs, foods and diseases that may lead to the passage of unformed stools. Number of stools may vary from several per day to one every few minutes. Diarrhoea is not a disease itself, but a symptom of underlying functional and organic diseases.

Table 3.1: Illustrate the difference between functional and organic diarrhoea

Functional diarrhoea	Organic diarrhoea
Resulting in the increase neuromuscular activity which carried out by following reasons: • Disturbed emotional state like fear, tension, worry and anxiety. • Irritation and inflammation of mucous membrane due to physical, chemical and bacterial agents like in food poisoning. • Sensitivity to specific food (food	Many lesions and structural changes occur in the mucosal lining of the small and large intestine due to: • Bacterial infections (typhoid and bacillary dysentry). • Protozoal and parasitic infections (amoebiasis). • Malabsorption syndromes (lactose intolerance, celiac disease) • Intestinal cancer

allergy) • Nutritional deficiencies mainly vitamin B deficiencies like pellagra. • Achlorhydria also leads to improper digestion and absorption of foods.	• Other diseases such as viral hepatitis, liver cirrhosis, ulcerative colitis, tuberculosis etc.

3.2.1 Types of Diarrhea

Table 3.2: Difference between acute and chronic diarrhoea

Acute diarrhoea	Chronic diarrhoea
• It is defined as sudden onset and frequent passage of watery and unformed stools that may even pass several times in an hour. • Abdominal pain, cramps, weakness and sometimes fever and vomiting are the symptoms of acute diarrhoea. • Acute diarrhoea continues for only 24 to 48 hours.	• Chronic diarrhoea persists for longer period of time more than 2-4 weeks and patient may pass 4-5 unformed stools in a day. • Rapid passage of food through the intestine does not provide sufficient time to absorb nutrients in the body causing nutrient deficiency.

3.2.2 Common causes of diarrhoea:

Table 3.3 Depict the causes of acute and chronic diarrhoea

Acute diarrhoea	Chronic diarrhoea
• Gastrointestinal tract infection • Dietary factors such as food allergy or sensitivity and faulty feeding practices • Malnutrition • Other infections such as typhoid, cholera etc. • Some drugs and chemicals	• Malabsorption syndromes such as lactose intolerance, celiac disease etc. • Metabolic diseases • Chronic alcoholism • Liver cirrhosis • Colon cancer • Prolonged intake of laxatives

• Psychological factors such as tension, fear, anxiety etc.	

3.2.3 Management during acute diarrhea

Diarrhoea is a major cause of morbidity or mortality during infancy and childhood all around the globe. It is important to emphasis on the prevention of diarrhea by maintaining proper food and environmental hygiene.

During the short duration of acute diarrhea it leads to excessive loss of water and electrolyte leading to dehydration. To compensate these loss oral rehydration salt solution are given to the patients.

3.2.4 Composition of oral rehydration salt solution

Table 3.4: Composition of oral rehydration salt solution

Components	Amount g/liter
Sodium chloride	3.5 g
Sodium bicarbonate	2.5 g
Potassium chloride	1.5 g
Glucose	20 g

ORS therapy should start as soon as possible when the child passes even one stool; it is administrated in small sips or with a tea spoon to prevent the rapid passage of stools. The general rule of ORS therapy being one glass for every stool passes.

Other liquids like coconut water, barley water, weak tea, buttermilk, whey water, albumin water, cereal and pulses water etc. may be given along with ORS therapy.

3.2.5 .Management during chronic diarrhoea

Main objectives in the treatment of chronic diarrhoea are:

- To maintain the nutritional status
- To compensate the water, electrolyte and extra nutrients to recompense the loss
- To reduce the frequency of stool in minimum level

Some dietary modifications are necessary to achieve all of the above objectives:

Nutrients	Description
Energy	• Energy intake should be increased up to 10-20 percent to compensate the weakness and weight loss through diarrhoea.
Protein	• Protein intake should be increase as much as 50 percent to build up the body tissue and replace the tissue breakdown arisen by diarrhoea.
Carbohydrate	• Easily digestible fiber should be included to the diet to maintain the high energy requirement. • Intake of fiber should be minimal (1-2 g/day) to provide rest to the intestinal tract.
Fats	• Easily digestible emulsified fat like butter and whole milk may be given.
Vitamins	• Vitamin A and B group should be included in the diet to overcome the losses during diarrhoea.
Fibers	• To avoid irritation in the GI tract, insoluble fibers such as: structural plant materials, skins and seeds should be avoided in the diet. • Soluble fiber helps in the binding of stools so that it can be included in the diet. • Papaya and banana have astringent properties which are beneficial in diarrhoea.

3.2.6 Dietary pattern:

- Easily digestible, low fiber and low fat diet should be recommended.
- Soft and well cooked food should be included in the diet.
- Fluid intake should be liberal to reduce the risk of dehydration.

- Refined cereals and washed pulses, well-cooked vegetables, fruit which have low fiber content like banana and papaya, milk product like curd and paneer, egg and fish should be included in the diet.
- Whole cereals, raw fruits and vegetables, fried foods should be avoided.

3.3 CONSTIPATION:

Constipation is a condition of stasis in the large intestine in which faces retained in the colon beyond the normal length of emptying time this is the reason for the difficulty and infrequency of the passage of stool. It may be caused lifestyle factors such as inadequate intake of fiber, sedentary lifestyle and inadequate hydration and due to some other factors like medical conditions.

3.3.1 Types of constipation:

Table 3.5: Types of constipation

Atonic constipation	Spastic constipation
• It is the most common type of constipation also known as lazy bowel syndrome. • In this type of constipation intestinal wall loss the muscles tone along with reduced peristalsis movement. • Food takes longer time to move down to the tract as compared to normal rate.	• In this type of constipation muscle tone of the intestinal wall is increased that cause narrowing of the cavity and retarded the forward movement of feaces.

3.3.2 Symptoms of constipation:

- Bloated stomach
- Foul breath
- Headache
- Cramps

- Discomfort
- General malaise
- Headache
- Lack of apatite

3.3.3 Nutritional management

Nutritional management of constipation is basically depending on regularity of meal habits such as regular intake of meals, sufficient fiber and fluid intake along with regular exercise. Normal diet is prescribed with slight modification for the patient suffering from constipation.

Nutrients	Description
Fiber	• Normally 14 g for every 1000 kcal per day is recommended i.e. 25 g for women and 38 g for men. • In constipation, intake of high fiber food should be recommended such as whole grain cereals and pulses, fruits and vegetables and other fibrous foods. • Bran and psyllium husk are beneficial during constipation
Fluids	• Patients are advised to consume plenty of water because it helps to soften the stool. • 8-10 glasses or 2 liters of water is advised to consume in a day. • Hot water along with lemon in the morning helpful to initiate the peristalsis movement when taken before breakfast and ease to the patient suffering from constipation.

3.3.4 Dietary guidelines:

- Whole wheat chapatti should be included in the diet beside of white bread and polished rice.
- Include germinated pulses in the diet.
- Increase the intake of fruits and vegetable because it has high fiber content.

- Intake of laxatives like psyllium husk and agar agar relief from constipation because in the presence of water it swells up and increase the volume of feces.
- Adequate fluid intake should be included in the diet.
- Eat raw vegetables like carrot, cucumber, tomatoes, cabbage etc.
- Include at least two servings of fruits in the diet.
- Exercise regularly e.g. walking for about half to one an hour.

3.4 PEPTIC ULCER

Peptic ulcer is commonly known as stomach ulcer that is any localized lesion in the mucosal lining of the digestive tract that comes in contact with gastric juices (pepsin and stomach acids). The disintegration can result in necrosis of tissue. Ulcers that found in the stomach (jejunum) are called as gastric ulcer that occurs in the lesser curvature of the stomach caused by reflux of bile and factors that disrupt the mucosal barrier whereas the ulcers that are found in the upper part of the intestine are known as duodenal ulcer that occur in between the duodenal bulb in an area below the pylorus where the gastric juice are not neutralized.

3.4.1 Aetiology

- It can occur at any age but individual aged 45-55 years is more prone.
- Men are more prone to have peptic ulcer than of women.
- Hyper secretion of acid is the main cause of gastric ulcers that diminished the mucosal resistance to acid which cause ulcers.
- Bacterial infection (*Helicobacter pylori*) is leading cause of ulcers.
- Hereditary factor (family history of ulcer) is often contributed to ulcer.
- Doctors and high ranking executives are more prone to have ulcers because of irregular food habits and mental stress.
- Personality type like highly emotional, nervous and ambitious people are at high risk of ulcers.
- Excessive consumption of irritants foods such as spices, strong coffee, tea, tobacco and alcohol, steroidal drugs and analgesics can be a cause of ulcers.
- Gulping or improper mastication of food and missing meals are also a cause of ulcers.

3.4.2 Symptoms

- Pain, discomfort and flatulence in upper central part of abdomen.
- Burning and pressing pain occurs before meal in duodenal ulcer and after meal in gastric ulcer.
- Heart burn, vomiting and subsequent weight loss.
- Hemorrhages may also occur and appear as black stool (malaena) or blood in vomiting.
- Anemia is also caused by bleeding ulcers.
- Intestinal perforation and peritonitis (inflammation in the lining of the abdominal cavity) intestinal narrowing and obstruction also occur.

3.4.3 Management

The main objectives to manage peptic ulcer is to provide relief from the symptoms and allow ulcer healing. Treatment of peptic ulcer is basically based on drugs, rest and diet modification.

Drugs: mainly two types of drugs are used to treat ulcers-Antacids: (provide relief form symptoms. Aluminium hydroxide and magnesium hydroxide is a type of antacids) and inhibitors of gastric acid secretion (anti-histamine drugs are a type of inhibitors).

Rest: physical and mental both rests are essential for the relief from symptoms. Stress reduction techniques are also helpful life meditation and yoga.

3.4.4 Diet modification:

Main objective of diet modifications are:

- To provide adequate nutrition
- To provide rest to the digestive tract
- To maintain the neutralization of the body
- To reduce the acid secretion and also reduce the chemical, thermal and mechanical irritation to the gastric mucosa.

For achieving these entire objectives certain nutrient modifications are required:

Nutrients	Description

Energy	• Energy requirement is increased because the patients are undernourished due to active peptic ulcer. • The patient with acute cases and only confined to bed, then there is no need for extra calories. • Ambulant patient with peptic ulcers 10% increased calorie is recommended.
Protein	• Amino acids are essential for the tissue protein synthesis and also endorse healing and also important for their good buffering action. • Because of all these benefits protein recommendation is increased up to 25-50% in the patients of peptic ulcer.
Fat	• Fat delays the gastric emptying time because of this increase intake of fat is beneficial. • Mostly peptic ulcer patients are middle age individuals so fat intake should be moderately increased because the patients are more prone to atherosclerosis. • Approximately 20% of the calorie should be given from fat.
Carbohydrate	• Carbohydrate is basically included in the diet for meet the calorie need. • Around 50-65% of carbohydrates are recommended.
Vitamins	• Requirement of all the vitamins is remain normal except vitamin C because it helps in the ulcer healing.
Mineral	• Iron and vitamin C should be implemented with care because bland diet is poor in both nutrients, so medical supplementation must be given to the patient.

3.4.5 Dietary guidelines

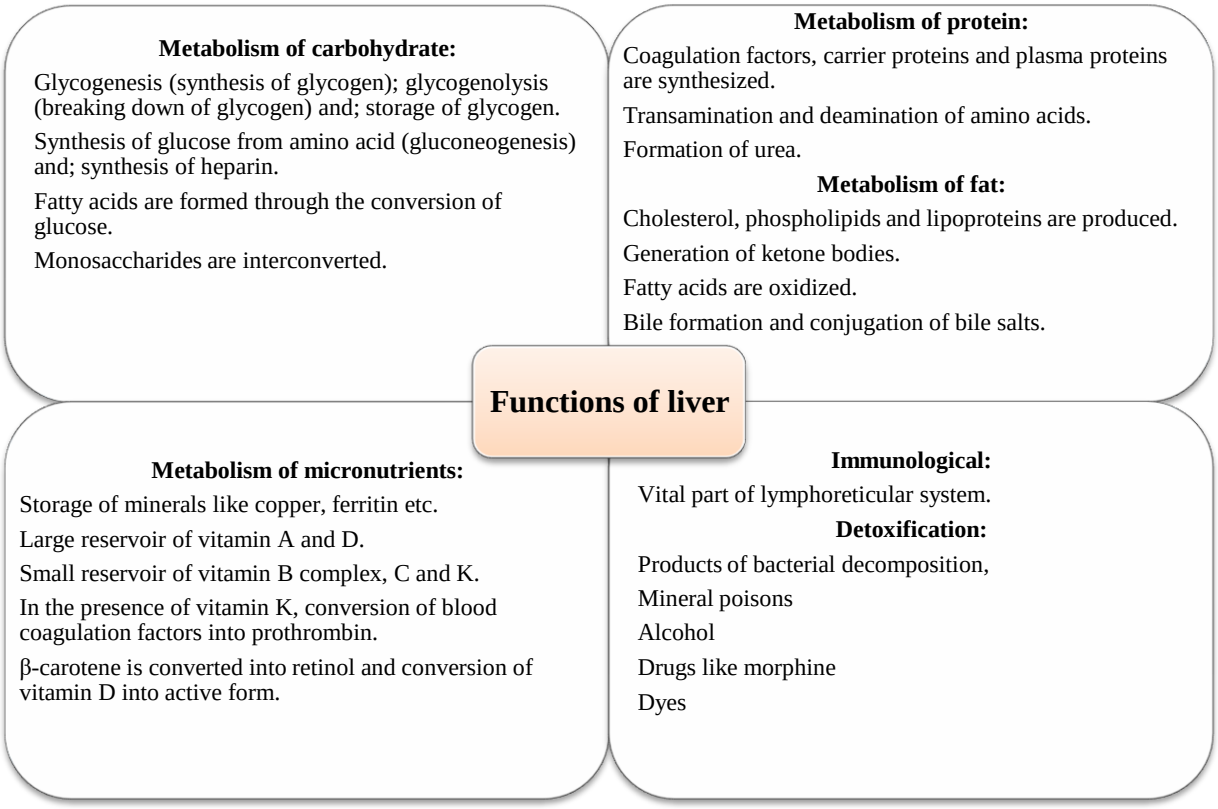
- Bland diet which is mechanically, chemically and thermally should be prescribed to the patients of peptic ulcers.
- Mechanically irritant food increased the peristaltic movement because it is fibrous in nature because of their coarse such as whole grain cereals, fruits and vegetables.

- Chemically irritant foods increase the production of gastric juice that can cause pain and discomfort to the patient. These foods are spices and condiments, fried foods, stimulating beverages (coffee, tea, alcohol, cocoa and carbonated beverages).
- Thermally irritant food like too hot and too cold food should be avoided.
- Emulsified and easily digestible fat should be included in the diet such as whole milk, cream, egg yolk and butter should be included moderately in the diet.
- Small and frequent meal should be prescribed to the patients.
- Meat protein should be avoided while egg, pulse and other protein food should be included.
- Gas former foods such as soyabean, pulses, cauliflower, peas, onion, watermelon and apple should be avoided.

3.5 MANAGEMENT OF LIVER DISORDERS THROUGH NUTRITION

With occupying 2.5-3% of total body weight, liver is considered as the largest organ of the body. Metabolism of fat, protein and carbohydrate takes place in this organ. A number of compounds are synthesized or stored in the liver and transported to the other organs when required. Majority of end products produced after the digestion of food and toxic substances entered in the body by food are transported to the liver and get detoxified here. As liver plays a vital role in metabolism and detoxification of food, it imparts a noticeable effect on health and nutritional status of an individual. Role of liver in various functioning are shown below in Fig 3.1.

Fig 3.1: Multiple functions of liver



Above and beyond the etiology of liver disorders, the pathological changes occur in liver in each and every disease conditions are same. These basic changes are as mentioned and defined below:

- *Atrophy:* hepatic cells degenerate.
- *Fatty infiltration:* droplets of fat get accumulated on the hepatic cells. This can be cured but sometimes may progress to cause necrosis or fibrosis.
- *Fibrosis:* in the last stage of all liver disorders connective tissues takes place of the functioning cells of liver. It leads to liver cirrhosis.
- *Necrosis:* hepatic cells are died.
- ***Jaundice:*** it is not a disease but a symptom that arises in all liver disorders. It could be characterized as increased level of plasma bilirubin beyond 2-8mg/litre or serum bilirubin level more than 0.1-0.25mg/dl. Clinical signs are seen when the level increases more than 20mg/ litre and subclinical jaundice is said when the level lies in between 8-20mg/litre. When red blood cells are broken down, bilirubin is produced as a byproduct and is excreted in stool in conjugated form with bile in normal health conditions which gives characteristic yellow colour to the stool. Whereas, if it is not excreted out then gets

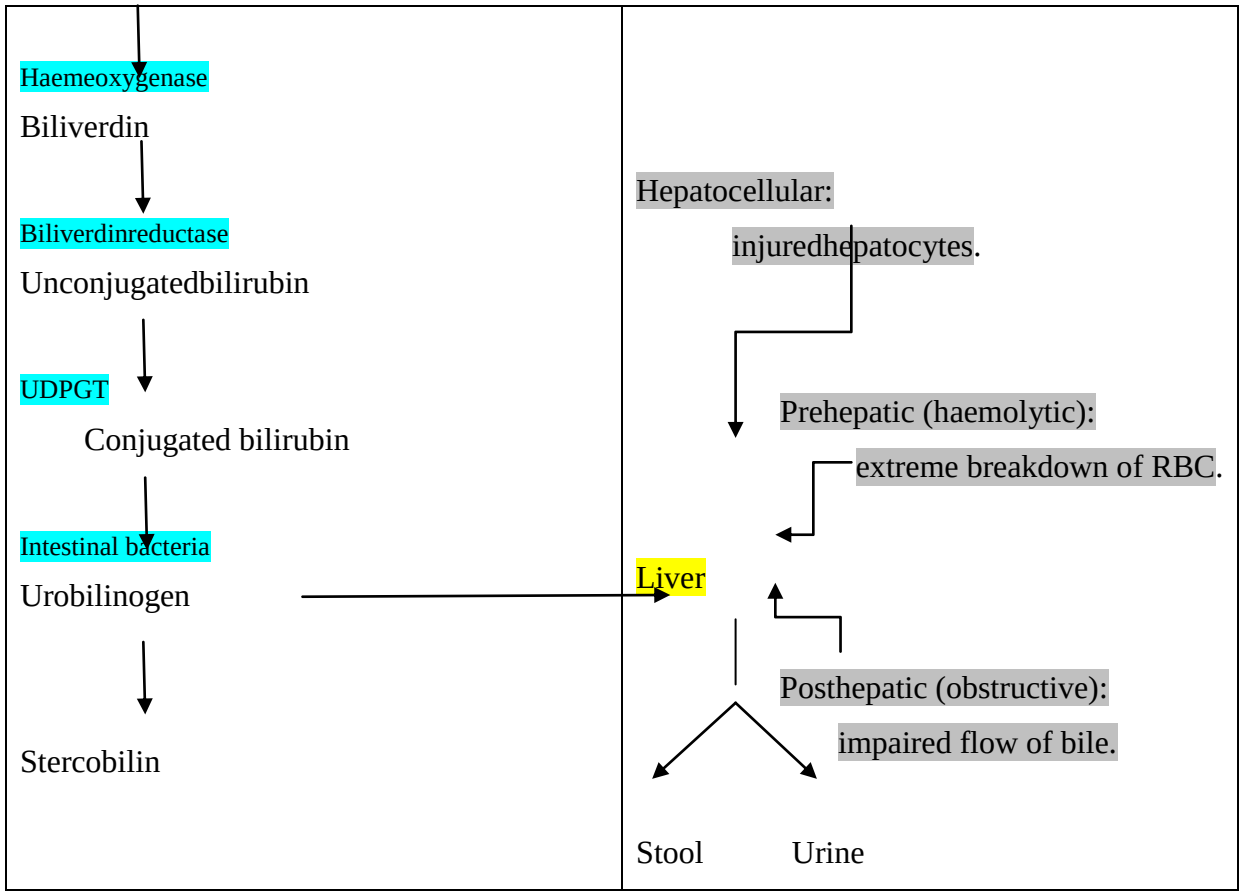
accumulated in blood which leads to yellow colour of the urine, skin and the sclera of eyes. Three types of jaundice are described below in table 1. Schematic diagram of normal metabolism of bilirubin and the causes behind liver disease which leads to various types of jaundice is shown in fig 1.

Table 3.6. Descriptionoftypes of jaundice

Types of jaundice	Description
Hepatocellular	• Causes: injured hepatic cells by toxins or infective agents or blocked bile canaliculi. • Due to its fat soluble property, it is not excreted out but gets accumulated in the skin and tissues
Prehepatic (haem olytic)	• Cause: extremely breaking down of red blood cells. • Newborns are mostly affected so it is also known as 'neonatal jaundice'. • Congenital defects like sickle cell anaemia, thalessaemia, mismatched transfusion of blood or ingestion of certain drugs etc. are also responsible for this type of jaundice.
Posthepatic (obstructive)	• Causes: impaired flow of bile from liver to the duodenum due to some obstacle in between the path like in the case of cholelithiasis or cancer of the liver or pancreas.

Fig 3.2. Schematic diagram representing normal metabolism of bilirubin and types with causes of jaundice.

Normal metabolism of bilirubin	Causes and types of jaundice
Red blood cells (destroyed after 120 days) Release HaemeGlobin	



Other general symptoms of liver disorder are enlisted as following:

- General fatigue and weakness
- Increased body temperature
- Loss of hunger
- Pain in abdomen
- Flatulence
- Nausea and vomiting etc.

3.5.1 ETIOLOGY OF LIVER DISORDER:

1. **Nutritional imbalances-** a diet low in protein but high in fat and carbohydrate has been proved as most evident risk factor for non-alcoholic fatty liver disease (NAFLD). This is a modifiable risk factor which can be improved by good food habits and increased physical activity. Hence, it does not lead to fibrosis or necrosis. Liver disorders due to

nutritional imbalances could be seen in diseases like kwashiorkor, diabetes, due to starvation etc.

2. **Infective agents-** a number of infective agents are there which is responsible for liver disorder. Some of them are as:
    - *Hepatitis A virus:* People get infected from this virus through faecal oral route, as it is excreted in stools of patient or carrier of this disease or; because of poor hygienic condition of the person and the environment.
    - *Hepatitis B virus:* it is transmitted through blood donation from a carrier donor. As well as through inappropriately sterilized needles as in case of drug addicts.
    - *Other agents:*hepatitis and liver abscesses are caused by the migration of Entamoeba from large intestine to portal veins. Malaria, a parasitic infection, also attacks to the liver.
3. **Toxic agents-** natural toxins, alcohol, some drugs and many more agents are enlisted under this term:
    - A large proportion of ethyl alcohol 90-95% is oxidized in the liver, since its direct association with liver this may lead to liver damage and cirrhosis of liver.
    - Natural toxins that thrive on food like Aflatoxin, a mould found in peanuts and many other foods, also leaves a damaging effect on liver.
    - Hepatic damage may also results from some commonly used drugs like paracetamol (analgesic), halothane (anaesthetic drug) and many more. Drugs that are used in treating diabetes may leads to jaundice like tolbutamide and chlorpropamide. Arsenic, carbon tetra chloride, organic hydrocarbons etc, industrial chemicals are also associated with jaundice and liver damage.
4. **Congenital diseases-** in many individuals due to hereditary defect in the conjugation and transportation of bilirubin, excessive stores of copper, iron, glucose and galactose are observed in the liver causing cirrhosis of liver.

3.5.2 LIVER FUNCTION TESTS (LFT):

The term liver function test is being used to do laboratory test on patient's blood for biochemically examining the status of liver disorder. (table 2)

Table3.7. Liver Function Tests

Test	Production in liver disease	Indication
Serum bilirubin (including total, conjugated and un conjugated serum bilirubin)	Elevated	Overproduction or fault in hepatic uptake or conjugation is being warned.
Serum alkaline phosphate	Elevated	Hints to cholestasis
Aminotransferases (transaminases) includes alanineaminotransferase (ALT or SGPT) aspartateaminotransferase (AST or SGOT)	Elevated	Liver cell injury
Prothrombin time (PT)	Elevated	Suggests for low level of vitamin K deficiency which leads to impaired synthesis of blood coagulation factor.
Serum albumin	Lowered	Dysfunction of liver
Serum globulin	Elevated	Chronic liver disorder
Ammonia	Elevated	Hepatic failure

3.5.3 HEPATITIS

Degeneration of hepatic cells and inflammation are two characteristics of hepatitis. This is an infectious disease. Viral and drug induced hepatitis are two types of hepatitis. Viral hepatitis is further divided into infective (Type A) and serum hepatitis (Type B). Type A is mild one whereas Type B may convert into severe liver damage.

Aetiology of viral hepatitis

- *Infective hepatitis or Hepatitis A Virus (HAV)* - it is the most preferable cause of viral hepatitis which is tremendously communicable through faecal-oral route via contaminated food and water.
- *Hepatitis B Virus (HBV) together with Hepatitis C Virus (HCV)* - which leads to chronic stage. Blood transfusion, improperly sterilized needles are its route of contamination. As well as sexual contact, open wounds, saliva and splashes of blood into the eyes or mouth of the infected person are some other route of infection.
- *Hepatitis D Virus (HDV)* -for dissemination and survival of HDV in humans it is dependent on HBV which causes serious chronic hepatitis.
- *Hepatitis E Virus (HEV)* - it is transmitted through faecal oral route. It is a rare acute form of hepatitis.

Aetiology of drug induced hepatitis

- Toxic effect of certain chemicals like heroin, marijuana, alcohol, carbontetrachloride and many more.
- Due to drug reaction like penicillin or sulfa.

Symptoms

- In the beginning stage only non-specific symptoms are noticed which includes-Fever, headache, weight loss, anorexia, loss of muscle tone, vomiting, nausea and abdominal discomfort.
- Later, specific symptoms of liver disorder are noticed which includes- jaundice and fatty liver. Jaundice is evident from the pale yellow colour of sclera and skin; dark yellow to brown colour of urine, and; stool with clay colour.

Note:

- ✓ *Preicteric stage:* it is defined as the prejaundice stage when specific symptoms are not visible, though virus is capable of infecting others by faecal-oral route of the patient.
- ✓ *Icteric stage:*in this stage specific symptoms of jaundice could be noticed.
- ✓ *Anicteric stage:*occurrence of jaundice in children could be manifested with biochemical test only as symptoms are not visible in them.

Nutritional management

Basically, the nutritional management for liver disorder is done to achieve three mandatory goals *viz* to lessen the symptoms; give support in the regeneration of hepatic tissues, and; in prevention of further damage. A high carbohydrate, high protein and fat in moderation are advised to accomplish this goal set.

Energy: An increased amount of energy is required for minimizing the total protein utilisation and maintaining standard body weight. About 20-30% of total energy is added with the RDA. This increased amount is supplied gradually as the patient feels anorexic. Beginning with 1500-2000kcal, the amount reaches up to 2000-2500kcal daily. But only 1000kcal is supplied in case of nasogastric feeding.

Protein: for the prevention of fatty infiltration of liver and for the promotion of regeneration of hepatic cells, intake of protein must be increased to conquer the negative nitrogen balance. However, requirement of protein varies in accordance to the severity of disease. 40g and 60-80g of protein is permitted in severe and mild jaundice, respectively.

Fats: only 20g and 20-30g of fat is permitted in severe and moderate jaundice, respectively. In other cases of jaundice, restriction in fat content is needed as it does not metabolize due to obstruction in bile flow and results in fatty diarrhoea.

Carbohydrates: to avoid the breakdown of protein and for compensating the need and enough supply of energy, a high carbohydrate diet is recommended. Intravenous glucose supply is adviced in fever, nausea and vomiting. As soon as these problems are resolved patient should be shifted to oral feeds like fruit juice, sugar, jaggery, honey etc.

Vitamins and minerals: vitamin supplements should be given through oral or intravenous route to maintain the adequate level of vitamins. For electrolyte balance, supplements of minerals must be included.

Foods included

Bread, biscuits, soft chapathis, cereal porridge, skimmed milk, potato, yam, tapioca, sugar, jaggery, honey, fruit, fruit juices, soft custards without butter and cream.

Foods avoided

Meat, fish, chicken, egg, ghee, butter, oil, pulses, beans, bakery products, dried fruits, spices, papads, pickles, fried preparations, alcoholic beverages, chutney, cream, whole milk etc.

3.5.4 HEPATIC ENCEPHALOPATHY

Neurological disturbances are developed as a complication of severe liver diseases. In this situation certain nitrogen containing substances such as ammonia are not metabolized by liver due to severe damage of hepatic cells and directly enter into the cerebral circulation.

A huge reduction in the liver functional cells are seen which affects a number of reactions:

a. Disturbance in the conversion of ammonia to urea, which is toxic to the central nervous system.
b. Accumulation of aromatic amino acids (tyrosine, tryptophan and phenylalanine) in the blood due to decreased breakdown.
c. Decreased level of branched chain amino acids in the blood because these are broken down in peripheral muscles for energy requirement.

This disturbance in the neurological and neuromuscular system may results into coma and ultimately death, if get untreated.

Dietary management

Reduced intake of protein, minimising fat metabolism and tissue catabolism are the basic principles of dietary management for hepatic coma.

Energy: to get relieve from tissue breakdown adequate energy should be provided especially rich sources of carbohydrate to store glycogen in liver for quick recovery.

Protein: dietary protein is restricted upto 20g to 30g in accordance to the condition of patients and gradually increased as the recovery starts.

Fats: emulsified or medium chain triglycerides can be included in small amounts as the tolerance power of patient otherwise fat is restricted.

Vitamins and minerals: in the case of deficiency vitamin B complex, K and C could be administered through parenteral nutrition route. In minerals, restriction of sodium is advised if ascites is present.

Fluid: closely monitored for output then fluid intake is advised.

3.6 CHECK YOUR PROGRESS

Exercise 1:

1. Fill in the blanks:

a) Gastro-intestinal tract is related to _____, _____ and _____ of food in the body.
b) _____ is the types of constipation in which muscle tone of the intestinal wall is increased causing narrowing of the cavity.
c) Loss of fluid in diarrhoea may contribute to the loss of _____ and _____ in the body.
d) Ulcers found in the stomach are called _____.

2. What is the difference between functional and organic diarrhoea?

3. What are the contributing factors in the development peptic ulcer?

4. Briefly describe the etiology of liver disorder.

Exercise 2:

1. Match the following:

a) Glycogenesis	i) loss of brain function due to severe liver disease
b) Hepatic encephalopathy	ii) transmitted through faecal oral route
c) Anicteric stage	iii) synthesis of glycogen
d) Hepatitis E virus	iv) jaundice could be manifested with biochemical test

2. State whether the following statements are true or false.

a) Acute diarrhoea persists for longer period of time more than 2-4 weeks.
b) Hepatocellular jaundice is the condition in which breaking down of red blood cells occurs.
c) Increased intake of protein, maximizing fat metabolism and tissue catabolism are the basic principles of dietary management for hepatic coma.

UNIT-IV: MEDICAL NUTRITION THERAPY IN DISEASES OF THE CARDIOVASCULAR SYSTEM AND KIDNEY

Structure

4.1 INTRODUCTION

Cardiovascular disease (CVD) has been the major risk factor for morbidity and mortality around the globe, whose prevalence is predicted to be increase in both developed and developing countries. During the past few decades, the risk of CVD in India has been increased due to industrialization and life style pattern, and became a major cause of morbidity mainly in male population. All the diseases which are related to heart and blood vessels come under CVD like atherosclerosis, coronary heart disease (CHD), hypertension etc.

4.2 ATHEROSCLEROSIS:

The pathophysiology of atherosclerosis is involved in the coronary arteries, cerebral arteriesand aorta which are mostly affected by coronary heart disease and stroke.Atherosclerosis is a Greek word *athere* meaning gruel (yellow porridge like lesions are deposit in the arteries). Formation of atherosclerosis initiates during childhood, in which deposition of lipid (cholesterol and their esters, triglycerides, carotid,including calcium, iron, red blood cells and fibrous tissues like

macrophages and smooth muscle) in the large elastic muscular arteries, resulting in lesionsthatisknown as fatty streaks, it is the initial stage, which produces the minimal intimal thickening of the artery and does not affect the bloodflow during early childhood, but it rapidly become more complicated during adolescence.In early adulthood, lipid and necrotic debris convertby a cap of smooth muscles and fibrous tissue at some sites of the artery and forms more complex lesion called fibrous plaque in the lumen which begins to hinder the blood flow.These lesions is the major risk factors for the coronary heart disease, the most common indicator of atherosclerotic cardiovascular disease in adults of middle age.

4.2.1 Progression of Atherosclerosis

Endothelial cell injury: The initial process of the formation of plaque is mainly due to endothelial cell injury, in which endothelium is continuously exposed to circulation where any toxic substance can damage them, e.g. in case of tobacco use, diabetes and dyslipidemia. This constant force upon endothelium play a main role in the formation of atherosclerotic plaque that is mostly occurs in arterial bifurcation. Hypertension is one of the factors for the physical force of the blood circulation.

Lipoprotein deposition: When the endothelium of the artery is injured, lipoproteins have change to enter them and then modify itself through oxidation in the presence of free radicals or oxidizing enzymes. These modified lipoproteins or LDLs are inflammatory and are engulfed by macrophages that create foam cells and “fatty streaks” in the arterial wall.

Inflammatory reaction: The modified lipoproteins areantigenic in nature which attacks the inflammatory cells in the arterial wall and also released the inflammatory mediator which further increases the leukocyte recruitment after the endothelial injury.

Smooth muscle cell cap formation: Fibrous cap is formed when the smooth muscle cells (lipid filled cells) are emigrated to the surface of the plaque. When the cap is thick, the plaque is stable where as thin capped plaque is more susceptible to rupture or erosion which ultimately causing thrombosis.

4.2.2 Pathophysiology of atherosclerosis

There are 5 stages for the progression of atherosclerosis disease:

Stage 1: This stage is asymptomatic in which small fatty streaks are found that is non-obstructive. It is usually seen in younger age people around less than 30 years of age. Fatty streaks not all the time converted into advanced lesions.

Stage 2: In this stage plaque is formed with high lipid content which entered the endothelial wall when it is injured and more liable to rapture. At this point the lesions are unstable and move to the stage 3.

Stage 3: Acute, complicated lesions along with rapture and non-occlusive thrombus are found.

Stage 4: In this stage acute, complicated lesion along with occlusive thrombus are seen and patients are prone to have angina pain, myocardial infraction or sudden death.

Stage 5: This is the last stage in which supply of blood is cutting of due to the fibrotic or occlusive lesions.

4.2.3 Symptoms

- Excessive weight
- High level of cholesterol and triglyceride
- Hypertension

4.2.4 Aetiology

Table 4.1. Multiple risks factors associated for the development CVD

Group I	Group II	Group III	Group IV
Risk factor in which interventions have been proven to reduce the risk of CVD • Cigarette smoking • LDL cholesterol • High cholesterol diet	Risk factor in which interventions are expected to reduce the risk of CVD • Diabetes mellitus • Physical inactivity • HDL cholesterol • Triglycerides, small density LDL	Modifications in these can reduced the risk of CVD • Psychological factors • Lipoprotein A • Homocysteine • Oxidative stress	Risk factors which cannot be modified • Age • Male gender • Genetic factor

• Hypertension • Left ventricle hypertrophy • Thrombogenic factors	• Obesity • Postmenopausal state		

4.2.5 Nutritional management:

There are not such change in the diet patient are advised to take normal diet which in low in saturated fat and cholesterol and are known as "prudent diet". To achieve the low fat diet patient should have follow these recommendations:

Nutrients	Descriptions
Energy	• Most of the atherosclerotic patients are overweight so that hypocaloric diet (low in calorie) is given, till achieve the ideal body weight for height. • Reduction of 1000 kcal daily is required to lose around 1 kg in a weak and reduction of 500 kcal bring to lose weight around 1/2 kg.
Fat	• Both the quantity and quality of the fat are advised to modify. • For reducing the weight it is required to reduce the intake of fat. • Total fat in the diet should reduce to provide less than 30% of energy and the patients having higher serum cholesterol level should take only 20 % of energy. • Saturated fat (SFA) tends to increase the plasma cholesterol level while monounsaturated fat (MUFA) or polyunsaturated fat (PUFA) serum cholesterol level, so it is recommended to maintain the polyunsaturated/saturated fat (P/S) ratio up to 0.8-1.

Cholesterol	• Patients having high serum cholesterol level are advisable to reduce thedietarycholesterol, less than 300 mg/day or even 200 mg/day. • Food having high cholesterol content such as egg yolk, organ meats (liver, kidney and brain), fats of meat, whole cream milk, ice cream, butter and cheese should be avoided, because they contain high amount of cholesterol content.
Protein	• Protein intake is normal 1 g per kg body weight is advisable,butanimal protein should be avoided because it contains too much saturated fat.
Carbohydrates	• The diet is low in fat, so it is recommended to take calorie from carbohydrate. • It is advisable to include complex starches rather than simple sugar because they increase the intestinal transit time, delay gastric emptying and slow down the glucose absorption.
Mineral and vitamins	• Vitamin and minerals should be recommended in normal amount. • As all the animal fat, milk, cream, butter is restricted, the diet is tends to low in vitamin A content, so it is advisable to take yellow, orange and green vegetables and fruit to sustain the loss.
Sodium	• Sodium restriction is recommended because most of the patients are hypertension and have bad impact on the cardiovascular health. • Moderate reduction of dietary sodium between 1.5 to3 g per day is recommended to control cardiac oedema and it also reduce the risk of hypertension.

4.2.6 Diet and feeding pattern

Nutritionally well balanced and well planned diet should be taken. It is mandatory to have meal at proper time and develop good habits. Small and frequent meal having low fat and cholesterol should be recommended.

Food to be avoided

- Animal food that is high in saturated fat and cholesterol (eggs, organ meats)
- Fatty meats (mutton, pork and their products)
- Whole milk, cream, ghee, butter, khoa and cheese.
- Hydrogenated fats though from the vegetable source, contain high level of saturated fat.
- Food that contains high sugars (cakes, sweets, desserts, burfies, ladoos etc.)
- Consumption of alcohol.

Food to be included

- Green leafy vegetables, tomato, cucumber, raddish, lemon etc.
- Clear soup, lassi, vinegar.
- Low fat milk, low fat fishes, egg white.
- Fruit should be taken is plenty amount.
- Whole grain cereals, pulses, legumes, oats, beans etc.

4.3 HYPERLIPIDEMIA

Hyperlipidemia is a medical term which denotes high level of fat or lipid in the blood including cholesterol and triglyceride. Lipid disorders are functionally classified into 4 major groups.

1. Defects in the synthesis of apolipoprotein are proteins that bind lipid to form lipoprotein)
2. Deficiencies of the enzyme
3. Deficiency of the LDL receptor
4. Hyperlipidemias due to other genetic factors

4.3.1 Functional classification of lipid disorder

Lipid disorder	Unusual lipid pattern	Clinical features	Nutritional therapy

1. Defects in the synthesis of apolipoprotein			
Apolipoprotein A deficiency	↑Tissue cholesterol, serum triglyceride ↓HDL, serum cholesterol	Rare, inherited	Low cholesterol, low fat are recommended
Apolipoprotein B deficiency	↑Mucosal fat No lipoprotein synthesis	Rare, inherited, serious prognosis for child, steatorrhea, malabsorption	Very low fat
ApolipoproteinE deficiency	↑Chylomicron remnants, cholesterol, triglycerides ↓Serum LDL	Comparatively rare, inherited, xanthomas, atherosclerosis	Low cholesterol (less than 300 mg), low saturated fat, increased substation of PUFA. Weight reduction is advisable
2. Deficiency of enzyme			
Lipoprotein lipase deficiency	↑Chylomicrons	Rare, inherited pancreatitis is early childhood, lipemia, xanthomas	Fat (20 g), high carbohydrates, medium chain triglycerides (MCT)
Lecithin cholesterol acyltransferase (LCAT) deficiency	Complete unusual lipid pattern: all the lipoproteins have low amounts of cholesterol esters and high concentration of free cholesterols and lecithin. Accumulation of large LDL particles rich in	Rare, inherited, Abnormal cornea, Anemia, kidney damage	Low cholesterol, low fat

	unesterified cholesterol.		
3. Deficiency of LDL receptor			
Familiar hyper-cholesterolemia	↑LDL, VLDL and total cholesterol,	Common, inherited, increased atherosclerosis, all ages xanthomas	Low cholesterol (less than 300 mg), low saturated fat, substation of PUFA
4. Hyperlipidemia due to other genetic factors			
Familiar hypertri-glyceridemia	↑VLDL, TG, cholesterol and sometimes blood sugar	Common, inherited, glucose intolerance, possible NIDDM, obesity and accelerated atherosclerosis	Low and simple carbohydrates, low saturated fats and cholesterol along with this weight reduction is advisable
Familiar multiple hypelipoprotenemia	↑VLDL, LDL	Common, inherited, adult xanthomas, vascular disease	Low cholesterol (less than 300 mg), low saturated fat, substation of PUFA and weight reduction is advisable
Familiar type V hyperlipoprotenemia	↑Chylomicrones, VLDL, cholesterol and TG	Rare, glucose intolerance, obesity, pancreatitis, hepatosplenomegaly	Controlled carbohydrates, high protein and fat along with weigh reduction

4.3.2 Nutritional management

Nutrients	Description
Dietary fat	• Fat should recommended 25-35 % of total calories in which less than 7% of total calories comes from SFA.

	• It is advisable to include both PUFA (8-10% of total energy) and MUFA (10%) to replace SFA, because PUFA has great cholesterol lowering effect. • Sources of PUFA are sunflower oil, corn oil, soyabean oil, safflower oil etc. oils rich in MUFA are olive oil, canola oil, peanut oil, gingelly oil etc.
Dietary fibre	• Intake of 25-40 g per day of total dietary fat is recommended by for adults. • This recommendation is met by more than 6 servings of whole grains and more than 5 servings of fruits and vegetables.

Food included:

- Sea foods and nuts which contain omega-3 fatty acid should include in the diet.
- Insoluble fibers like skin of fruits, fiber of seeds, fruits, vegetables and whole grains should be included.
- Soluble fibers like pectin, gums and mucilages help in the reduction of serum cholesterol, which are present in lentil, legumes, oats, fruits and vegetables.
- Moderate caffeine consumption is advisable.

Foods avoided:

- Trans fatty acid (TFA) is composed by hydrogenation of vegetable oil and increase the serum cholesterol level, food that contains high TFA like fried foods, cookies, crackers, pakora, samosa should be avoided.
- Coconut oil and animal fat rise LDL so it should be avoided.
- Excessive consumption of alcohol increases the risk of hypertension and cardiomyopathy so it should be avoided.
- Canned and packed ready to fat food should be avoided.
- Use of tobacco should be avoided.

4.4 ISCHEMIC HEART DISEASE:

Ischemia is described as an insufficient blood flow (circulation) to a localized area caused by a blockage of the blood arteries supplying the region. Ischemic heart disease, commonly known as coronary heart disease (CHD) or coronary artery disease (CAD) is the term used to describe heart issues caused by narrowing the coronary arteries, which supply blood to the heart muscles. Despite the possibilities of blood clot or contraction of the blood vessels, atherosclerosis or the accumulation of plaque is the most common cause of CHD. Heart attacks, also known as myocardial infarctions (MI) are also occurring in this condition when the supply of blood is completely blocked to the heart muscle. Most individuals with early CHD (blood vessel narrowing less than 50%) do not have any symptoms or limitations in blood flow. But if the atherosclerosis aggravate, particularly if untreated, symptoms could appear.

4.4.1 Nutritional management:

The goal of dietary modifications is to provide sufficient nutrition while minimizing work effort and muscle strain to the heart. In order to accomplish the goal, a prudent diet is adjusted in the following ways:

Energy: For normal weight individuals, a level of calories sufficient to maintain their weight just slightly below the intended optimum weight level is indicated, whereas for overweight or obese patients, 1200 to 1500 kcal per day are typically advised.

Protein: For the maintenance of body tissue protein, it is recommended to consume normal amount of protein i.e. 0.8 g per kg of body weight every day is recommended.

Fat: The general prudent diet is appropriate for the patients because both the amount and type of fat must be modified. As part of a low-calorie diet, less than 20% of energy should derive from fat.

Carbohydrate: The remaining energy in the diet should be provided by carbohydrates. To minimize the work required of the heart, easily digestible carbohydrates should be included in the diet.

Sodium: Mild sodium restricted diet (2 to 3 g per day) is recommended.

Fluid: The fluid limitation is not too stringent. It is advised to drink 1.5 to 2 litres of liquids every day.

4.5 CONGESTIVE HEART FAILURE

Congestive heart failure (CHF) is a condition in which decreased cardiac output, impaired tissue perfusion and systematic and vascular congestion are manifested. Because of the declining of cardiac output all these problems became more serious. It simple words, CHF is a critical condition in which heart does not pump the blood normally. According to its name heart failure, it doesn't means that heart is actually fail or stop working properly, rather it means that heart muscles are not able to contract properly and has some problem that limiting the capacity to fill with blood. Constituently it cannot fulfill the demand of the body, and blood goes back to the heart faster than it pumps out and become congested. This pumping problem of the heart does not supply oxygenated blood in the body and the organs which cause severe problems.

CHF is developed by several reasons like myocardial infraction (MI), severe anemia, hypertension, ischemic heart disease, valvularstenosis or regurgitation, cardiomyopathy, beriberi, atrial fibrillation and pericardial diseases. Less common causes are bacterial, viral and fungal agent, rheumatic fever, electrolytes disorders, toxic agents, collagen vascular disorder, endocrine and metabolic diseases.

4.5.1 Symptoms

- Shortness of breath
- Weakness and fatigue
- Swelling of the legs, ankles and feet
- Irregular heartbeat
- Chest pain
- Abdominal swelling

4.5.2 Nutritional management

Dietary modification of the patients is based on the severity of the disease and overall nutritional status.

- Energy requirement is increased up to 20-30% than of basal requirement because of the increased cardiac and pulmonary workload.
- Protein is varying from patient to patient, 1.1g/kg is required for well-nourished patient and 1.4g/kg is required for the patient having undernutrition.
- Depending upon the severity of the disease sodium intake should be restricted to less than 2000 mg/day
- Patients on potassium-wasting diuretics should require high potassium diet.
- Fluid intake should be depending on the clinical symptoms up to 1.4 to1.9 liter per day.
- Intake of caffeine should be limited to prevent dysrhythmia and increased heart rate.
- Small and frequent meal should be advisable to meet the required nutrients.
- Depending upon the need and stage of the disease, consistency of the diet from normal to soft should be modified.
- 2 standard drinks of alcohol for men and 1 for women show no harmful effect but excess consumption should be avoided.

4.6 HYPERTENSION

Hypertension is a defined as an elevated blood pressure against the arterial wall which is measured by pump-up cuff and pressure monometer known as sphygmomanometer. Hypertension involve many other organs including heart like kidney, endocrine glands and central and autonomic nervous system which can increase the risk of having stroke, coronery heart disease, peripheral vascular disease, nephrosclerosis, congestive heart failure and peripheral vascular disease. Only 9% of the people having hypertension is due to ‘secondary’ sources such as renal, endocrine and neurological disorders which 95% of the population having ‘essential’, ‘primary’ or ‘idiopathic’ hypertension which is of unknown origin or having no identifiable cause of elevated blood pressure.

Blood pressure is a continuous phenomenon in which 2 blood pressure levels are involved: either systolic blood pressure (SBP) higher value recorded during the contraction of cardiac cycle or diastolic blood pressure (DBP) lower value found during the relaxation phase of the cardiac cycle. Patients whose SBP and DBP are in different category are diagnosed as hypertensive. Cut off for hypertension is demonstrated in the below table.

Table 4.2. Classification guideline according to American Heart Association (AHA), 2018

Category	Cut off value (in mm Hg)	
	SBP	**DBP**
Normal	<120	<80
Elevated	120-129	<80
Stage I hypertension	130-139	80-89
Stage II hypertension	140 and above	90 and above

4.6.1 Aetiology of hypertension

- Age
- Gender
- Heredity
- Psychosocial and sociocultural influences
- Obesity
- Physical inactivity
- Dietary factors like high consumption of fat and sodium and low consumption of dietary fibre etc.

4.6.2 Symptoms

Most of the patients having hypertension have no such symptoms and it can be detected by medical examination. Some common symptoms of hypertension are:

- Headache
- Impaired vision
- Dizziness
- Shortness of breathe
- Failing memory
- Pain and gastrointestinal disturbance

4.6.3 Medical nutritional management

Lifestyle modification plays an important role in the prevention of hypertension before starting on medications. **Dietary approach to stop hypertension** or DASH diet is used to prevent or control the risk of hypertension which focuses to increase fruits, vegetables and low fat dairy consumption and reduce the intake of fats, sweets and red meat consumption. DASH diet along with weight reduction has proven to reduce the SBP.

4.6.4 Nutritional management

Nutrient management of the hypertensive patients are based on weight reduction, sodium restriction along with general nutrient balance.

Nutrients	Description
Energy	• Most of the hypertensive patients are over-weight or obese so slight reduction in energy is recommended. • Even normal weight patients have also advised to take slightly reduced energy. • As described in atherosclerosis.
Protein	• Normal protein intake should be recommended. • Protein should contribute to about 15-20 % of energy in low energy diet. • Animal protein should be avoided because they are rich in fat as well as sodium. • Vegetable proteins like pulses and whole legumes should be included in the diet because they are low in fat and sodium.
Fats	• Low fat diet is recommended in which fat should be reduced to provide 20 % energy. • Type of fat in the diet should also be modified; saturated fats should be substituted with monounsaturated and polyunsaturated fats.
Carbohydrates	• 60-65 % of the energy comes from carbohydrates. • Complex carbohydrates like dietary fibres and starches should be included rather than simple sugars.
Sodium	• Sodium restriction helps to control the weight and blood pressure of

	the patients. • Sodium restricted diet should be recommended. • Sodium restriction is shown in table….
Potassium and calcium	• Potassium and calcium are the two main nutrients for the retention of hypertension. • Adequate amount of potassium should be recommended like milk, fruits and vegetables.

Table 4.3. Sodium restricted diet

Sodium restriction	Amount
Sodium in normal diet	3-4 g to as high as 10-12 g
Mild sodium restriction	2-3 g
Moderate sodium restriction	1000 mg
Strict sodium restriction	500 mg
Severe sodium restriction	200 mg

Food avoided:

- Table salt (light salt in the cooking is advisable).
- Salt preserved food like smoked fish, ham, bacon sausages, luncheon meat etc.
- Highly salted food such as potato chips, crackers, salted nuts, salted popcorns and salted snacks.
- Sodium preservative foods such as ketchup, chili sauce, soya sauce, garlic sauce, pickles and chutney.
- Canned vegetables in brine and canned vegetable juices.

4.7 BYPASS SURGERY:

Bypass surgery or heart bypass surgery is also referred to as coronary artery bypass graft. It is a procedure used to treat coronary heart disease; it is characterized by narrowing of the coronary artery due to the deposition of fatty material within the arterial wall that blocks the flow of

oxygen-rich blood to the heart muscles. This is the most common form of heart surgery among adults. In this procedure a blood vessel is removed from the chest, arms, or legs and used to create a diversion or bypass around the blockage in the coronary artery that supplies the heart. This enables blood to flow back to the heart.

NUTRITION IN RENAL DISEASE

4.8 NEPHROTIC SYNDROME

Progressive glomerulonephritis, diabetes mellitus, quartan malaria resulting due to drugs, amyloidosis, systemic lupus erythematosus, heavy metals and toxic venom are some of the reasons behind the occurrence of nephrotic syndrome. Diagnosis and management of underlying cause of proteinuria are the basics of medical treatment for nephritic syndrome. It is also known as ‘nephrosis’.

4.8.1 Clinical symptoms

It is clinically different from nephritis with the absence of haematuria, anaemia, consistent hypertension and nitrogen retention. But some common symptoms as in nephritis are also present like heavy proteinuria along with oedema.

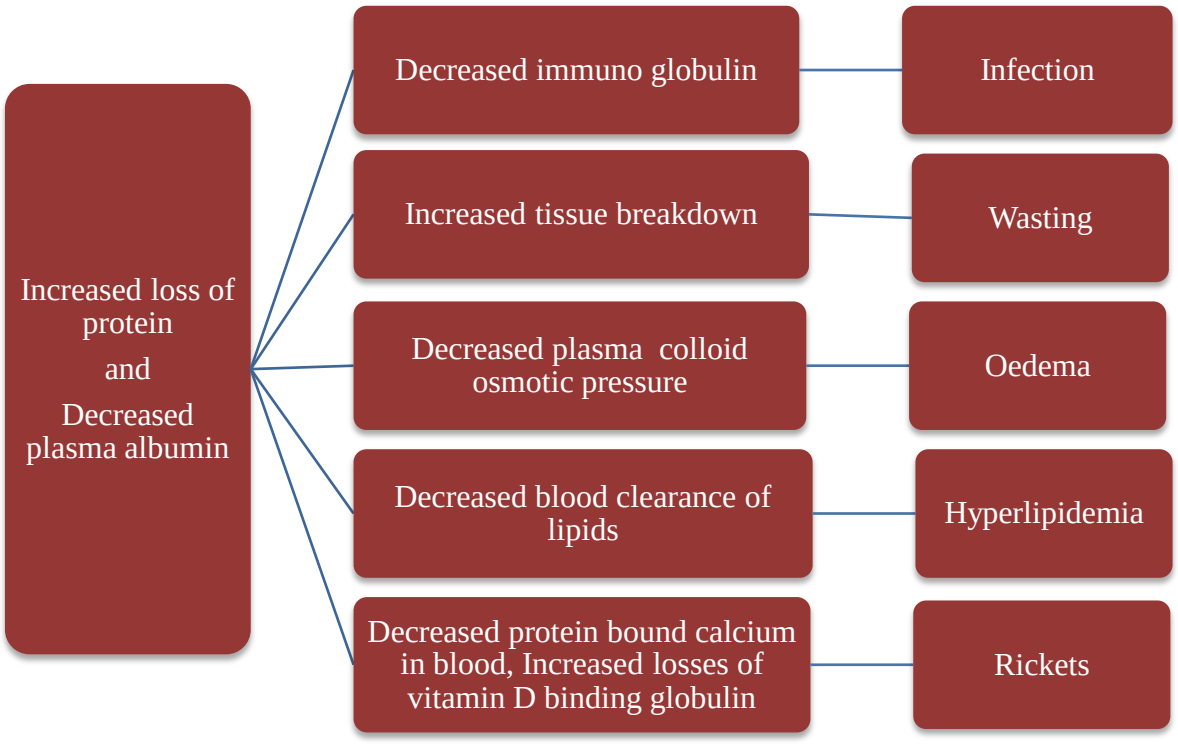
Main clinical symptoms include heavy proteinuria, hypoalbuminaemia and peripheral oedema. When the reabsorption capacity of renal tubules diminishes and the protein excretion increases then it turns to heavy proteinuria. If the daily losses are 5g/kg in adults and 0.1g/kg in children then it is said to be tolerated level. Plasma albumin molecules leakage to the glomerular membrane is very rapid due to their small molecular size. Plasma globulin molecules are present in smaller quantities in the urine due to their high molecular weight. This loss of protein in urine that is proteinuria results in the condition of oedematous tissues.

These situation opens a gateway for many more disorders like fatty liver, malnutrition, increased susceptibility of infection and tissue wastage due to loss of plasma albumin and other plasma proteins; coagulation factors like as fibrinogen, lipoproteins and other proteins are increased while antithrombin 3 is lost in urine which may results in the increased incidences of thrombosis, atherosclerosis and high level of plasma cholesterol level.

4.8.2 Principles of diet

A diet with high carbohydrate, moderate fat and restricted quantities of protein, salt and fluid is suggested for these patients. Supplementation of vitamins especially that of vitamin C is necessary. Maintenance of normal weight for height is mandatory for the patients with severe and persistent hyperlipidemia with low fat and cholesterol level.

Fig4.1: Impact of proteinuria in nephrotic syndrome



4.8.3 Dietary management

Energy: A minimum of 2000 kcals is recommended to ensure protein utilization for tissue synthesis. Food must be appetizing and appealing since poor appetite is noticed. Indication of the need for additional calories is weight loss or infection.

Protein: 0.8-1.0g/kg of body weight for protein restriction is employed. Adverse effect on renal function could be accounted for increased consumption of protein. Glomerulosclerosis and renal failure are the result of increased intake of protein in patients whose renal function is already

impaired and it exerts pressure on remaining nephrons causing hyperfiltration. If daily urinary protein loss exceeds 10g/day then it leads to negative nitrogen balance which should be replaced by taking adequate intake of protein.

Fat: Exceeding levels of blood lipid should be maintained by limiting the intake of saturated fat cholesterol and refined sugars.

Vitamins and minerals: Hypoalbuminaemia leads to a reduction in protein bound calcium that may cause hypocalcaemia in nephrotic syndrome. Sometimes, low ionized calcium levels are observed due to excretion of vitamin D binding globulin in urine and tetany due to loss of 25-hydroxy vitamin D_3 in urine. Optimum level of calcium intake should be maintained to reduce the symptoms of hypocalcaemia and if the symptoms are seen then vitamin D supplements should be included.

Supplementation of potassium is recommended in diuretic induced protein loss. These are also necessary for controlling oedema.

To prevent oedema and hypertension, sodium is restricted in the diet. Recurrence of oedema could be prevented by putting on modest sodium restriction in the diet. Potassium elimination may also be affected due to severe restriction of sodium so it should be opted very wisely. 2-3g/day of salt restriction is allowed. Liberal amount of low sodium foods are recommended.

Fluid: Fluid restriction is mandatory if oliguria is present, a situation in which $\leq$ 25ml/kg/24hours of urine output are measured and underlying impaired functions due to oedema.

4.9 GLOMERULONEPHRITIS

Inflammation of the blood vessels in the head of the nephrons, known as glomeruli, is called glomerulonephritis. Children of 3-10 years of age are more prone to acute form of this disease; however this can also affect the adults of age more than 50 years. Either it turns into chronic nephrotic syndrome or completely recovered within a short time period. The reason behind the onset of glomerulonephritis may be streptococcal infection, metallic poisoning, acute pyelonephritis and renal infarction as well as primary kidney diseases like as IgA nephropathy and heredity nephritis are other reasons of this disease.

4.9.1 Clinical Symptoms

Proteinuria and haematuria are the conventional symptoms of glomerulonephritis. Due to the retention of water and sodium and circulatory congestion, oedema and shortness of breath could be observed. Presence of high blood pressure and tachycardia may be noticed. Feeding problem is common because anorexia is seen generally in most of the patient. Progressive acute renal failure can be diagnosed as a result of uraemia, that is increased level of urea in urine and anuria or oliguria, which is decreased or diminished volume of urine output.

4.9.2 Principles of Dietary Management

Optimum dietary management is mandatory for acquiring nutritional support. Appropriate quantity of protein must be included in the diet ignoring the oliguric or anuric condition. However, salt is recommended in restricted amounts in oedema, hypertension and oliguric phases. Dietary modifications are not very crucial at acute and uncomplicated case and for children after post-streptococcal glomeulo-nephritis but antibiotic drug therapy and bed rest are utmost important. Intake of fluid should be calculated according to losses including in vomiting and diarrhea.

4.9.3 Dietary modifications

Energy: 80kcal/kg of body weight for children and calculated requirement for particular age group with 10% additional kcal in infectious condition is advised for all age groups. Liberal intake of simple carbohydrate and starchy food like honey, sugar, sago and fats replaces the need of protein for caloric intake which avoids the situation of protein starvation ketosis and catabolism. These foods are rich in carbohydrate but are poor in sodium and potassium.

Protein: restriction in protein intake is mandatory in case of increased level of blood urea nitrogen and oliguric condition. 0.5g/ kg of ideal body weight and 1-1.5g/ kg of ideal body weight of protein per day are suggested for older and younger children, respectively. Excess protein could be excluded from diet by taking low protein diet ultimately it gives rest to the kidneys. It is better to include complete proteins in the diet and zero protein diet is highly recommended if anuria develops. 20-40g of protein is considered as sufficient in the diet. Half of it that is 50% should be from animal sources as they are high quality protein with high sodium

content which should be kept in mind. Poor quality proteins should be avoided because they are intended to increase blood urea levels like as groundnuts and pulses. Fruits and vegetables are poor sources of protein, sodium and potassium, so they can be included in the diet. Rice is best to be included as compared to wheat because it has better quality of protein. Sago exhibits negligible protein so it could be taken liberally.

Sodium: sodium restriction is dependent on the varied degrees of hypertension and oliguria. Total sodium is restricted if oedema noticed. Only 500-1000mg/day of sodium is recommended in impaired renal function and gradually increased as soon as recovery starts. Foods that are rich in sodium are also suggested to be excluded from the diet. Following foods are high in sodium-

- Table salt or during cooking.
- Sodium bicarbonate and baking powder that is added in the pastries or cakes.
- Preservatives like potassium metabisulphite and sodium benzoate that is added in squashes, pickles, canned foods etc.
- Biscuits, papads, salted chips, nuts, popcorns, cheese, butter etc.
- Proprietary and commercial soft drinks in which sodium or potassium may be present.
- Fruits, fish and soup cubes like dried foods.

Restricted quantity of moderate sodium rich foods could be taken like curd, milk, coriander, cumin seeds, jaggery and vegetables like cauliflower, green mango, knolkhol, broadbeans, beetroot, radish, karamani, lettuce, carots, coriander and fenugreek leaves, spinach etc.

Potassium: impaired renal function may leads to suddenly stopped heart functioning due to increased level of potassium in blood which ultimately results in uneven heart beat. Adequate amount of potassium is necessary because too little of this mineral is also dangerous for the individual. Almost all the foods present in nature contains potassium in some amount majorly meats, vegetables and fruits. Cooking the vegetables in excess water and discarding the water may remove the potassium from vegetables. Condiments and spices are poor source of potassium so this could be included in the diet. However, if the presence of potassium in urine is noticed then it should be strictly restricted.

Instant coffee, chocolate, cocoa powder, jaggery and nuts are the good sources of potassium which should not be taken. Whereas, unsalted butter, honey, sago, sugar, arrow-root, vegetable oil, ghee and vegetable shortenings are low potassium sources with low protein and high calories.

Phosphorus: same as potassium, phosphorus is also present in almost all foods. Nuts, cheese, milk, peas and dried beans are good sources of phosphorus, which when taken in high quantity in the diet will raise the phosphorus level in blood which will imbalance calcium to phosphorus ratio that is maintained by kidneys and calcium would be pulled from bones resulting in weak and porous bones. Thus, phosphorus should be restricted in the diet.

Fluid: for the dispersal of oedema fluid, fluid intake should be restricted at the very first stage of treatment. After that in later stages fluid balance is maintained by allowance of fluid equal to the water excretion in any form with additional 500ml/day for insensible water loss. This allowed quantity is for total fluid intake in any form viz tea, coffee, milk, curd, fruit juices, in rasam, curry, sambar or anything else. Insensible water loss is-

- 10ml/kg body weight for adults.
- 20ml/kg body weight for older children.
- 30ml/kg body weight for infants.

Allowed amount of water should be kept in a container and taken by patient from that only. If it is limited and thirst controlling is a problem then it could be overcome by eating sour candy or chew gum or sucking on a lemon wedge for moistening the mouth. Yet, for diabetics sugar-free types should be opted and sugar level must be controlled. Restriction of salt is also good option for thirst control. Without swallowing, mouth could be rinsed with water or few chips of ice can be sucked for uncontrolled thirst.

Foods to be included: sugar, rice, excess water removed vegetables, honey and sago.

Foods to be restricted: jaggery, curd, pulses, milk, some fruits like banana, guava, pineapple, watermelon and papaya.

Foods to be avoided: bakery products, greens, pulses, salt, meat, chicken, egg, some fruits like sapota, amla, plums, lemon, peaches etc.

4.10 ACUTE RENAL FAILURE

When normal kidneys faces sudden shutdown of renal function after traumatic injury or metabolic insult, it is known as acute renal failure (ARF). Mortality rate due to ARF is really high and medical emergency is utmost important along with the role of nutritionist play a high impact in curing this condition.

4.10.1 Causes of Acute Renal Failure

- Plasmaloss in burns and crush injuries.
- Fluid loss in diarrhoea, diabetic coma, vomiting etc.
- Blood loss like in accidents, hemorrhages, ulcers and sometimes during delivery.
- Acute hemolytic disorders.
- Nephrotoxins like mushroom and paracetamol.
- Nephrosis and nephritis may also be responsible.
- Reduced renal flow post-anaesthesia or surgical operations.

4.10.2 Symptoms

- Anuria or oliguria, a minimum of 20-200ml/day of urine output is noted.
- Raised blood pressure and signs of uraemia are noticed. Anorexia, nausea, vomiting and lethargy are some common features of this disease. Thus, the oral intake for patient is very difficult.
- Potassium excretion is diminished. During the tissue protein breakdown to provide calories, potassium is released and this is the reason for increased serum potassium level.
- Increased level of serum urea and creatinine due to deposition of waste products of protein metabolism in the blood.
- Level of sodium, calcium and base bicarbonate decreases while the level of phosphate and sulphate increases.
- It may be fatal not because of raised blood urea nitrogen but because of potassium or water intoxication to treat with fluids for stimulating urine excretion.

4.10.3 Dietary management

Energy: high calorie diet from carbohydrate and fat sources are desired with a minimum of 600-1000kcal/day.

Proteins: if the continuous rise in blood urea nitrogen is observed and patient is under conservative treatment then protein sources are totally excluded from the diet. If the situation is under control then protein content is decided on the basis of urea content in blood. To prevent endogenous protein breakdown in patients under haemodialysis or peritoneal dialysis, only 40g/day of protein is allowed.

Carbohydrate: to get rid from tissue protein breakdown a minimum of 100g/day of carbohydrate is recommended. Two litres of 5% glucose meets this requirement. 700ml of 15% glucose feed is recommended for nasogastric feeding method and for oral administration 700ml glucose with lime juice is suitable.

Sodium: sodium loss in urine is measured and replaced through diet. Because of water retention dilutionalhyponatremia occurs.

Potassium: hyperkalemia or potassium intoxication that is rise in potassium level with a daily value of 0.7m Eq, is observed. It has toxic effect on heart. All the potassium rich food sources must be avoided like tomato, tea, coffee, cocoa and some vegetables.

Fluid: the allowed quantity of fluid depends on the total urinary and gastrointestinal losses with additional 500ml/day and extra 500ml must be included if visible perspiration is observed.

Foods allowed/restricted: salt free butter, low protein pudding and bread.

Foods avoided: pulses, protein concentrates and increased consumption of milk, meat and egg.

4.11 CHRONIC RENAL FAILURE

Level of urea exceeds excessively so it is also known as uraemia. At this point 90% functioning of renal tissues is destroyed. It is the end point for few of the conditions like glomerulonephritis, nephrotic syndrome and polynephritis.

4.11.1 Causes

- Progressive acute glomerulonephritis or nephrotic syndrome.

- Chronic urinary tract infection.
- Renal calculi.
- Elevated blood pressure.
- Polycystic kidneys.
- Diabetes mellitus type 1.
- Exposure to toxic substances.
- Gout.
- Surgical emergency especially abdominal.

4.11.2 Symptoms

- Reduced renal blood flow and glomerular filtration rate due to progressive loss in nephrons leads to the exposure of clinical symptoms.
- General manifestations include water intoxication or dehydration, hyponatremia, hyperkalemia, high susceptibility to infections and acidosis.
- High blood pressure, pericarditis, irregular heart beat and oedema could be seen when the GFR falls below 5ml/min.
- Loss of appetite, hiccups and vomiting could be observed in gastrointestinal symptoms.
- Coma, convulsions, twitching and peripheral neuropathy could be seen in neurological symptoms.
- Tiredness, breathlessness and tendency to bleed due to abnormal platelet function are the results of anaemia due to affected haemopoietic system are noticed.
- Pigmentation, purpura and itching are few of the changes seen in skin.
- Growth failure, rickets, dwarfism and renal osteodystrophy metastatic calcification are seen.

4.11.3 Objectives of treatment

- Prevention from the catabolism of protein hence minimizing uraemic toxicity.
- Avoiding water intoxication or dehydration.
- Get rid from acidosis carefully.
- To avoid electrolyte imbalances.

- Prevent losses of electrolyte and fluid from urine, vomiting and diarrhea.
- Maintaining optimum nutritional status.
- To minimize underlying complications of other bodily systems like nervous system abnormalities, bone pain etc.
- To postpone the necessity of dialysis by retarding the progression of renal failure.

4.11.4 Dietary management

Energy: to supply energy and to spare protein for tissue protein synthesis, adequate energy should be provided from carbohydrate and fat sources. It is advised to the patients that they should consume only to a limit since the catabolic products viz carbon dioxide and water, do not enforce burden on gradually increasing renal failure. Caloric requirement for all age groups is same as in the normal condition. Hence, not utilizing protein as caloric source and prevent from further aggravating existing uraemia.

Protein: protein intake must be reduced to 0.5g/kg body weight per day to avoid extra burden on kidneys. This will be supportive in controlling the rising level of urea in blood and eventually curing the anorexia and vomiting. 15-20g daily or 0.25g/kg body weight per day is recommended for older children and adolescents to prevent endogenous protein losses. In severe cases very lo quantity of protein is allowed in the diet.

Fluid and electrolytes: along with the protein restriction, further all steps must be followed so as to preserve water and electrolyte balance in case of 5% less functioning of normal kidneys. Oedematic diuresis is the secondary step to plasma hyper osmolarity. Excretion of urea gets increases as the intake of fluid is increased. Patient should be kept on diuretics if fluid retention is noticed and intake of sodium must be restricted if weight gain found in presence of hyponatremia. If no benefit is seen then none other than dialysis is the last option. Permitted volume allows only urinary losses plus 500ml extra.

Sodium: in chronic renal failure, sodium excretion is more or less constant. Ideal intake for infants lies between 1-2mMol/kg body weight and that for older children lies between 40-60mMol/kg body weights.

In case of oedema and hypertension, strict restriction is of sodium that is 0.2mMol/kg body weight/day is recommended along with the diuretics until the crisis is ended.

4.12 UROLITHIASIS

Nephrolithiasis, also referred to as kidney stones or renal calculi, describes the presence of stones inside the kidneys. It is one of the most prevalent kidney conditions in adults. When there are too many crystal-forming substances present in the urine that cannot be dissolved, stones can form. High urinary excretion of some substances, such as calcium, oxalate, uric acid, and cysteine, can promote the formation of stones, whereas the excretion of other substances, like citrate, has a protective effect. The formation of stones may be influenced by changes in urine pH, a lack of protective compounds that keep the crystals from sticking together, and low urine volume. Nephrolithiasis can also develop as a result of environmental factors like decreased fluid intake, hot climates, and dietary factors.

Different-sized stones develop and often travel in the direction of the ureter. Smooth stones flow into the ureter, but larger stones can obstruct the ureter's opening from a normal flow and produce excruciating discomfort. The pain may be accompanied by nausea, vomiting, even chills and fever. Only 10% of stones are big and elicit these effects.

4.12.1 Types of stones:

There are several different minerals that might cause kidney stones:

Calcium oxalate Stone: Calcium oxalate stones are the most prevalent form of kidney stone. These happen when the urine has high calcium, oxalate, or uric acid levels but low citrate levels. Foods high in oxalate, an element that occurs naturally in both plants and animals, are associated with calcium oxalate stones. These include spinach, black tea, almonds, potatoes, and beets.

Calcium phosphate stone: Kidney stones made of calcium phosphate are brought on by malfunctions in the urinary system. This form of stone frequently occurs concurrently with calcium oxalate stones. Several series of blood and urine tests are used to establish whether any urinary or renal issues could be causing this type of stone.

Struvite stone: This stones develop as a result of specific types of urinary tract infections, and they are more common in women. These stones tend to form rapidly, grow huge, and can take up the entire kidney. They can cause recurrent and sometimes severe urinary tract infections as well as kidney function loss if left untreated.

Uric acid stone: This type of stones is more common in men and is associated with a lack of hydration and a diet strong in animal protein. They are also more likely to occur in patients who have gout, a family history of this type of kidney stone, or who have received chemotherapy.

4.12.2 Dietary modification:

It is crucial to highlight that dietary changes cannot dissolve already-existing stones, but they can be beneficial in preventing the growth of new stones.

Fluids: The main objective of kidney stone treatment is to provide adequate water. Coconut and barley water, juice, and mild tea should ensure the passage of more than 2000 ml of urine every day. Diluted urine avoids solid concentration and also tends to make the urine neutral, preventing the strong acid or alkaline that predisposes the individual to crystal precipitation. Those who live in hot and dry climates, as well as those who exercise and perspire heavily, require more fluid consumption.

Foods: Depending on the type of stone developed, it is advised to limit foods high in calcium, oxalate, and uric acid. An individual who has passed a calcium oxalate stone should therefore refrain from eating a lot of calcium and oxalate.

According to research done at the National Institute of Nutrition in Hyderabad, wheat-based diets are thought to promote uric acid and calcium oxalate crystalluria, while L-tartaric acid, a component of tamarind, inhibits urolithiasis.

4.13 CHECK YOUR PROGRESS

Exercise 1:

1. Fill in the blanks:

a) _____ is a condition develops when a sticky substance called plaque builds up inside your arteries.
b) Blood pressure against the arterial wall which is measured by pump-up cuff and pressure monometer known as _____.
c) Inflammation of the blood vessels in the glomeruli is called _____.
d) _____ is the condition in which kidney suddenly stop to work due to traumatic injury or metabolic insult.

2. Illustrate the pathophysiology of atherosclerosis.

3. Describe the classification of blood pressure.

4. What is nephrotic syndrome? Briefly discuss the dietary management of nephrotic syndrome.

Exercise 2:

1. Match the following:

e) Hyperlipidemia	i) dietary approach to stop hypertension
f) DASH	ii) low urine output
g) Oliguria	iii) high level of cholesterol and triglyceride in the blood
h) Anuria	iv) kidney stop producing urine

2. State whether the following statements are true or false.

a) Congestive heart failure is a critical condition in which heart does not pump the blood normally.
b) Hypertension is described as reduced blood pressure against arterial wall.
c) DASH diet is used to prevent or control the risk of hypertension.
d) 2-3 g of sodium is considered under strict sodium restricted diet.

UNIT-V: MEDICAL NUTRITION THERAPY FOR FEVER, FOOD ALLERGY, CANCER AND FEBRILE CONDITIONS

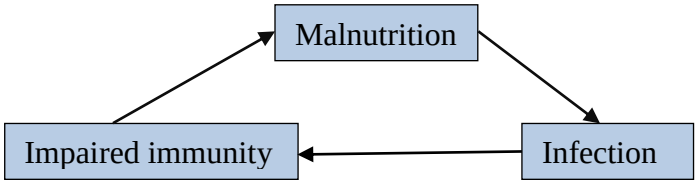
Structure

5.1 INTRODUCTION

Good nutritional status is very important for the human being to combat infection effectively.

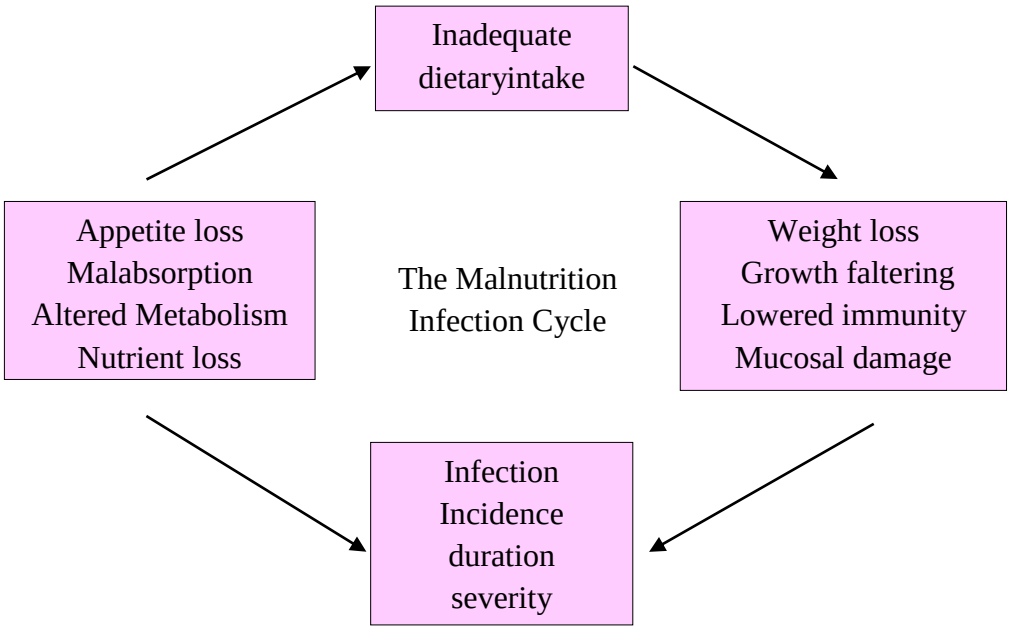
Malnutrition and infection are interconnected synergistically, i.e. a malnourished person can be more prone to infection and infection also contributes to malnutrition which causes a vicious cycle.

Figure 5.1: Depict the interconnection between malnutrition and infection



Inadequate nutrition leads to weight loss, lowered immunity, lowered resistance to infection, invasion by pathogens, mucosal damage and impaired growth and development in children.A sick person's nutrition is further aggravated by loss of appetite, malabsorbtion, diarrhea, alteration of nutrients for the immune response and nitrogen losses by urine; these are all the reasons of nutrient loss and promote damage to the defense mechanisms of the human body. These also consecutively contribute to reduce the dietary intake of a person.

Figure 5.2: Shows the complications related to malnutrition



5.2 NUTRIENTS AND IMMUNE RESPONSE

Nutrient	Description
Protein	• For adequate immune function protein is an important macronutrient. • Deficiency of protein reduced the immune response and increases the chances of infection because immune responses are dependent on the cell replication and production of protein with biological activities (e.g. cytokines, acute phase protein, immune-globulins). • Infection of the respiratory, gastro-intestinal and urinary tract is increases by protein energy deficiency because it affects the integrity of mucosal barrier.
Vitamin A	• It helps to maintain the epithelium layer of the respiratory and gastro-intestinal tract and also reduced the activity of phagocytes and lysozymes

	• Deficiency of vitamin A increases the risk of diarrhea, measles, malaria and overall mortality and also increases the risk of chronic gut infection and respiratory diseases.
Vitamin E	• It is an important fat-soluble vitamin that acts as an antioxidant and scavenges free radical. • B and T cell mediated immunity is impaired by the deficiency of vitamin E. • It is the only vitamin that when taken in higher amount then recommended dose can improve certain immune function temporarily.
Vitamin C	• It is a water soluble vitamin which helps in the function of phagocytes. • In vitamin C deficiency, phagocytes cannot function properly and contribute to the impairment of the response to infection and also reduce the resistance of tissue to infection by causing pathological alterations in the epithelial and other cells.
Zinc	• It is also a most vital nutrient to boost the immunity function. • Cells that are involves in the immune system needs zinc for proper functioning. • Deficiency of zinc decreases the non-specific immunity that contains neutrophils and natural killer cell function, reduces the number of T and B lymphocytes and suppresses hindered antibody production, cytotoxic activity and hypersensitivity.
Iron	• It is the most common trace element deficiency that is associated with impaired cell- mediated immunity and decreased the neutrophilaction, with the reduction of bacterial and myeloperoxidase activity.
Vitamin D	• It is an effective and cheap nutrient to boost immunity against tuberculosis.
Selenium	• Selenium is an important component of glutathione peroxide

	which is a vital antioxidant enzyme. • Therefore it may be important for cell that produce free radical and are exposed to substantial oxidative stress, such as macrophages and neutrophils.
Vitamin B_6	• It is essential for large number of reactions required for the synthesis and metabolism of amino acid. • Antibodies and cytokines as well as other protein are made up amino acid. • Deficiency of vitamin B_6impairs the growth and maturation of lymphocytes and impairs both antibody production and T cell activity.
Polyunsaturated fatty acids	• They are of two types: n-6 series (primary vegetable oil) n-3 series (fish oil and certain vegetable oils) • n-3 series of PUFA tend to inhibit macrophages and other cell functions and n-6 series of PUFA enhance the immunity function and also promote inflammatory response. • Therefore ratio of n-6 to n-3 series of PUFA has an important impact in the immune function.
In summary, it indicates that all the nutrients are required in adequate amount for the immune system. Deficiency of one of the nutrient leads to the risk of infectious diseases.	

5.3 METABOLIC CHANGES DURING INFECTION

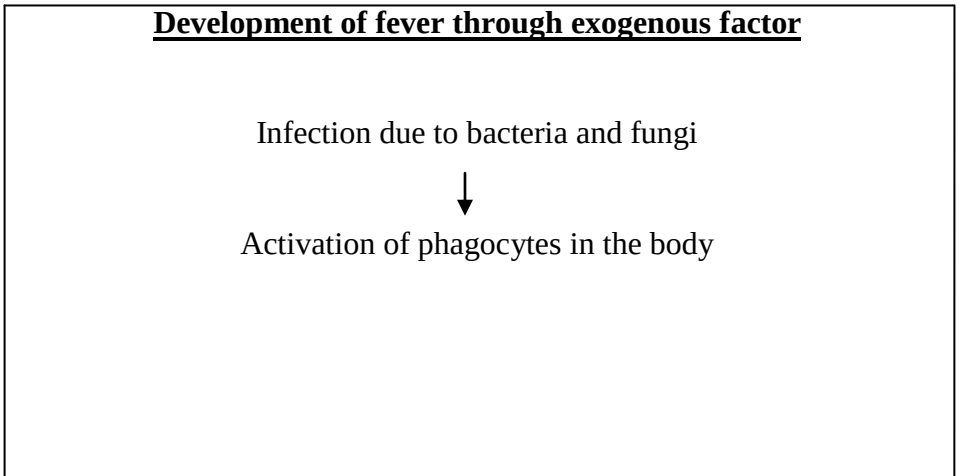
- With every 1^{O}Fincrease in body temperature the BMR is increases 7 percent.
- Losses of nutrient may be increased because of increased vomiting, diarrhea and perspiration. Mineral losses of sodium, potassium, magnesium, zinc and chloride occurs from the body.
- Catabolism occurs during infection and fever. Glycogenolysis(breakdown of glycogen) and gluconeogenesis (formation of glucose from non-carbohydrate source) is increased.
- Level of insulin increased and the resistance of insulin at cellular level decreases in addition, decrease the utilization of carbohydrate in the body.

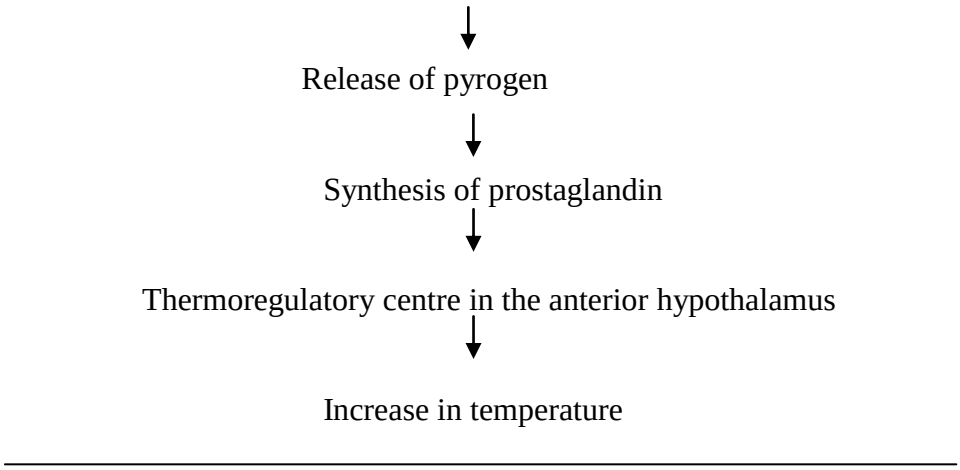
- Catabolism of protein increases according to the severity of infection and duration of fever.
- More nitrogen losses occur in long continuous fever than in short duration fever, leads to increase the nitrogen waste and place extra burden to the kidney.
- Anorexia and loss of food intake always accompanied with fever and infection, because of this the intake of macro and micro nutrient reduced and this leads to weight loss.
- Nutrient absorption like protein, mineral and vitamin is also decreased.
- Excessive loss of body fluid in the form of sweat and urination may be a form of severe infection with high fever.
- Sweating is a response of high fever although increased urination is because of elimination of nitrogen waste which is produced by catabolic activity.
- Due to the increase energy expenditure the storage of glycogen and adipose tissue significantly depleted.

5.3.1 Classification and aetiology of Fevers

Elevation of body temperature above normal that results from imbalance between heat produced and heat eliminated in the body is known as fever. It may be a reaction of infection, inflammation or unknown factors. There are two factors that may cause fever; one is endogenous factor (antigen-antibody reaction and malignancy or graft reactions) and the other is exogenous factor (bacteria, fungus and virus). In endogenous factor fever is an outcome of endogenous pyrogen (a fever causing hormone) produced by the activation of phagocytes in the bone marrow. These endogenous pyrogens initiate fever by increase the normal 'set point' for body temperature through the synthesis of prostaglandins which influence the hypothalamic thermoregulatory center in the anterior hypothalamus.

Table 5.1 Depicts the development of fever through flow chart





Fever is classified in two categories: acute and chronic fever

Acute fever: This time of fever is for short duration but the body temperature is rise above 104 ^{O}F. Fever associated infection are tonsillitis, chicken pox, influenza, typhoid, influenza and malaria are few types of acute fever. Malaria is a type of acute fever and also called as recurrent fever because repeated episode of high fever occur.

Chronic fever: This type of fever is for long duration. The temperature of the body remains low but the duration of fever is last long, even several months such as in tuberculosis. Therefore chronic fever has slow and gradual onset and also low in intensity.

5.4 TYPHOID

Typhoid is also known as enteric fever because infection or bacteria is found in the intestine and attaches itself to the epithelium of the intestinal wall where it multiplies and finally reaches the blood causing an increase in body temperature. The bacteria that involved in causing typhoid are *Salmonella typhosa.* This fever spread by food and water contaminated with intestinal content or faces. It may affect all age group but mainly occurs in children. Antibiotic treatment reduced the duration of typhoid fever to few days as compared to 2-3 weeks in the past.

5.4.1 Metabolic Changes during Typhoid Fever

- Tissue breakdown occur leads to loss of tissue protein.

- Because of the increased energy requirement the stored glycogen are rapidly depleted.
- Intestinal tract is highly inflamed and irritable.
- Water and electrolyte balance is disturbed because of diarrhea, vomiting, perspiration and also interferes in the nutrient absorption.
- Peyer's patches (ulceration in the intestine) are found that may be so serious to cause hemorrhage and perforation of intestine.

5.4.2 Symptoms of Typhoid Fever

- Graded fever which follows an upward ladder pattern
- Anorexia and vomiting
- Abdominal pain, cramps and diarrhea or constipation

5.4.3 Lifestyle Management

Treatment of typhoid contains:

- Bed rest
- Keep the patient warm
- Antibiotic therapy
- Diet modification

5.4.4 Nutritional Management

The diet should be planned by following objectives:

- To maintain the adequate nutrition
- To correct and maintain the water and electrolyte balance
- To restore the positive nitrogen balance
- To avoid irritation of intestinal tract
- To provide relief from symptoms

To achieve all these objectives, the intake of nutrients should be modified as follows:

Energy	• BMR is increased up to 50% along with body temperature, these are also increase the energy expenditure • It is necessary to increase the recommended energy intake by 10-20%.

	• At first, in the acute phase patient is not able to consume more than 600-1200 kcal/day, but the intake of calorie should be increased gradually according to the tolerance and recovery of the patient.
Protein	• Protein requirement is related to the severity and duration of the patient. • Excessive breakdown of tissue occur in the typhoid fever so the intake of protein should be increased up to 1.5 to 2 g/kg body weight. • Adequate energy intake is important for the effective utilization of protein. • High biological value protein that is easy to digest and absorbed like milk, eggs etc. should be included in the diet to reduce the tissue loss.
Carbohydrate	• Abundant amount of carbohydrate should be included to restore the exhausted glycogen store in the body. • Well-cooked and easily digestible carbohydrate should be included such as simple starch, glucose, cane sugar, jam and honey etc. because it necessitate less digestion and more absorption.
Dietary fiber	• Diarrhea and hemorrhage in the intestine is a symptom of typhoid, all type of irritant should be excluded from the diet. • All type of irritating and harsh fiber should be avoided from the diet because they are mechanical irritant.
Fats	• Fats are generally included in the diet to increase the energy intake without adding any bulk to the diet. • Emulsified fat such as whole milk, butter, cream, egg yolk should be included to the diet because it is easily digested and well tolerated by the patients.
Minerals	• Due to the increased perspiration extreme loss of electrolyte such as sodium, potassium and chloride occur. • To replenish the electrolyte loss, fruit juices, salty soup, broth, milk etc. should be included in the diet. • Iron supplementation is important in case of hemorrhage to prevent anemia.

Vitamins	• The requirement of some vitamin like vitamin A is increased because of resultant and increased fever; and vitamin C is increased because it is exhausted from the tissue stores. • Vitamin A and C are also important for the maintenance and stability of epithelial membrane (gut mucosa), boost the immunity and help in wound healing. • Vitamin B requirement is also increased with the increase in energy.
Fluid	• Adequate amount of fluid intake is very essential to compensate the loss through sweat and also ensure adequate volume of urine for excreting nitrogenous waste. • Daily intake of 2.5 to 5 liters fluid should be is desirable, it may be included in the form of soups, juices, beverages, plain water etc.

5.4.5 Diet and Feeding Pattern

- A high energy, high protein and full fluid diet are recommended to the patient in initial phase of high fiver.
- Small and frequent meal should be given for 2-3 hours interval.
- Sufficient amount of fluid and liquid are recommended to replenish the water and electrolyte losses.
- After the fever gets down a soft, low fiber and bland diet which is easy to digest and absorbed should be given to the patient.
- Whole grain cereal, whole pulses, raw fruits and vegetables, spices and strongly flavored food which are chemically irritating should be avoided.
- Well cooked, well mashed, blend, sieved, semisolid food like khichri, kheer, curd with rice, custard etc. should be given to the patient.
- Small quantity food at 2-3 hours interval provides adequate nutrition without causing any load to the digestive system.
- After improving the condition of the patient larger meal should be given, because proper nutrition diminishes the convalescence period.

Food Avoided

- High fiber food and their product should be avoided like whole wheat flour, cracked wheat, whole pulses with husk etc.
- All the raw vegetable and fruit are avoided except papaya and banana.
- Avoid fried food like samosa, pakoras, halwas and ladoo etc.
- Spices, pickles, relishes, chutney, and strongly flavoured vegetables such as cabbage, turnip, radish, onion, capsicum and garlic should be avoided.
- Excessive milk and milk products and dairy product fat like cream and butter should be highly restricted.

Food Included

- High amount of fluid like juices and soups.
- Milk based beverages
- Low fiber food such as refined cereals, dehusked pulses, well-cooked vegetables and fruits in soft and puree form.
- High biological value protein like tender meat, egg, fish, soft cheese, poultry etc.
- Sugar, honey, jam, plain gelatin based desserts.

5.5 TUBERCULOSIS

Tuberculosis is an infectious disease caused by *Mycobacterium tuberculosis* and is the major cause of illness and death in the globe. It generally affects the lungs, which is the primary cause of pulmonary tuberculosis. Tuberculosis also affects the other organ of the body like kidney, bone, lymphnodes and may generated. The most common form of tuberculosis in India is pulmonary tuberculosis.

Earlier the tuberculosis is restricted only in lower socio-economic group due to poor hygiene, sanitation and poor quality of food intake but current scenario shows that tuberculosis also occurs in high socio-economic group because of the strong genetic history in most of the cases. This disease present in both acute and chronic phase. The acute phase is quite similar to acute fever and the chronic phase is accompanied by low grade fever thus increased in metabolic rate is not so marked. The long duration illness leads to wasting of wasting of body tissue.

5.5.1 Metabolic Changes in Tuberculosis

- Wasting of tissue, exhaustion, cough, expectoration and fever.

- Detected in early stage by a noticeable rise in body temperature, flushed face, increased circulation and respiration, constant fatigue, loss of weight, cough and general run down condition.
- Metabolic rate may increase 20-30 percent above normal, if the body temperature is rise above 39 ^{O}C.
- Chronic fever is accompanied by low grade fever.
- A noticeable loss of muscle tissues occur due to long duration illness and wasting of body tissue.
- The progression of the disease is slow with gradual worsening of cough this can leads to erosion of blood vessels of lungs.
- The bacteria of tuberculosis may get access to other body organs and establishing numerous secondary foci infection.
- When sufficient damage occurs in lungs and other organ it ultimately causes death.
- There is increased loss of sodium, potassium and chloride from the body, increased tissue protein catabolism and due to perspiration loss of water from the body also occur.

5.5.2 Lifestyle Management

- Bed rest
- Antibiotic therapy
- Fresh air
- Diet modification

5.5.3 Nutritional Management

Because of the increased tissue breakdown and malnutrition the objectives of nutritional management are:

- To reduce the mortality rate by providing nutrient required by body's immune system
- To prevent weakness and loss of weight
- To accelerate recovery.

To achieve the above objectives, the diet should be modified as follows:

Energy	• The patient is underweight and undernourished because of the chronic tuberculosis; energy requirement is increased to achieve the desirable weight. • Energy intake is increased by 300-500 kcal/day above the normal intake.
Protein	• In the case of tuberculosis; long duration of fever leads to wasting of body tissue, increased the nitrogen loss and the serum albumin level is often low, thus it is essential to increase the protein intake. • High biological protein should be included in the diet. • If the disease occurs in low economic group, more focus should be on cereal and pulse combination besides of animal food to improve their protein quality. • Recommended protein during tuberculosis is 1.2 to 1.5 g/kg body weight.
Carbohydrate	• Adequate amount of carbohydrate should be included in the diet to meet the increased energy requirement. • Sufficient amount of carbohydrate helps sparing proteins for tissue building.
Fat	• Too much fat should be avoided because of gastric upset and diarrhea. • Medium chain triglycerides and emulsified fat should be included in the diet because it is easily digestible.
Minerals	• The drugs that are given in tuberculosis interferes the metabolism of vitamin D that can reduce the absorption of calcium and phosphorus. • Calcium is an important mineral to heal the lesions so the intake should be increased. • Half liter to one liter milk is recommended in different forms which are well tolerated by the patient. • Calcium supplementation (500 mg/d) with active form of vitamin D can also be prescribed. • In the case of blood loss associated with expectoration and hemorrhage iron supplementation is necessary.

	• Other mineral like zinc and chromium is also important because it help in boosting the immunity.
Vitamins	• The diet should provide adequate amount of all the vitamins. • Conversion of β-carotene to retinol in the intestinal mucosa is adversely affected, thus the diet provide much retinol by giving some amount of milk and milk products, eggs and meats. • Vitamin C is helps in the synthesis of collagen and help to heal the tuberculosis lesions. • Adequate amount of Amla, cabbage, citrus fruit, guava and drumstick should be included in the diet because they are good source of vitamin C. • Chemotheraputic agent is used for the treatment of tuberculosis which has an adverse effect on the utilization of B-group vitamins, so the b-complex vitamin should be increased in the diet.

5.5.4 **Diet and Feeding pattern**

- A high protein, high energy full fluid diet is given in the acute phase of fever.
- With the improvement of the disease the diet progressed to soft and then normal.
- The diet should be made simple, easily digestible, well prepared and tempting to encourage the patient to eat.
- Too much fat should be avoided because it causes gastric upset and diarrhea.
- Six meal patterns are preferred if the patient has a poor appetite.
- All meal should contain cereal-pulse combination dishes with some amount of animal protein such as- sweet daliya with milk, khichri with curd paushticroti with curd etc.
- Plenty of fluid and electrolyte especially potassium should be included in the diet.
- Frequent feeding with nutrient dense food is recommended.
- Excess fat, fried food, organ meats and refined cereal should be restricted.

5.6 Human Immunodeficiency Virus (HIV) /Acquired Immunodeficiency syndrome (AIDS)

Human immunodeficiency virus attacks and weakened the body's natural defense system against disease and infection. Cells of immune system mainly helper T cells (CD4 T cells), macrophages, and dendritic cells are affected by HIV. Progression of HIV in advanced stage is known as acquired immune deficiency syndrome (AIDS). This is the last stage of HIV infection in which body's immune system is completely damaged and the CD4 count is below 200 cells/ mm.

5.6.1 Aetiology

Main routes of spread of HIV virus are:

- Though the exchange of body fluid, during an unprotected intercourse between an infected person and partner
- Through the exchange of infected blood during transfusion or skin piercing instruments, like sharing contaminated needle and syringe
- Through infected mother to her child before birth during pregnancy or after birth through breastfeeding.

5.6.2 WHO clinical classification of HIV associated disease (2007)

Primary HIV Infection • Asymptomatic
Clinical Stage 1 • Asymptomatic • Persistent generalized lymphadenopathy
Clinical Stage 2 • Moderate and unexplained weight loss (<10% of presumed or measured body weight) • Recurrent respiratory tract infection, herpes zoster, Recurrent oral ulcerations, Papularpruritic eruptions, Angular cheilitis, Seborrhoeic dermatitis, Fungal nail infections
Clinical Stage 3 Conditions where a presumption diagnosis can be made on the basis of clinical signs or simple investigations • Unexplained chronic diarrhoea for longer than one month

• Unexplained persistent fever (intermittent or constant for longer than one month) • Severe weight loss (>10% of presumed of measured body weight) • Oral candidiasis, Oral hairy leukoplakia • Pulmonary tuberculosis (TB) diagnosed in last two years • Severe presumed bacterial infection (e.g. pneumonia, meningitis, bacteremia, bone or joint infection), Acute ulcerative stomatitis, Gingivitis or periodontitis Conditions where confirmatory diagnostic test is necessary • Unexplained anemia and or neutropenia and thrombocytopenia for more than one month
Clinical Stage 4 Conditions where a presumption diagnosis can be made on the basis of clinical signs or simple investigations • HIV wasting syndrome • Recurrent severe or radiological bacterial pneumonia, chronic herpes simplex infection, Esophagealcandidiasis, Extrapulmonary tuberculosis, Kaposi's sarcoma, Central nervous system toxoplasmosis, HIV encephalopathy Conditions where confirmatory diagnostic test is necessary • Meningitis, Mycobacterium infection, Candidiasis, Herpes, Lymphoma, Carcinoma etc.

5.6.3 Influence of HIV/AIDS on the Nutritional Status

HIV infected patient are more prone to malnutrition due to various reasons such as reduced the food intake and nutrient absorption with increase the nutritional requirement.

- Reduced food intake because the patient are enable to eat or swallow because of opportunistic infection; appetite is reduced due to fatigue and depression and also because of side effect of medicine such as nausea, vomiting, abdominal pain and dirrhoea etc.
- Nutrient absorption is reduced because of poor integrity of gut mucosa that reduces the ability to digest and absorb nutrients.

- High energy expenditure is needed in the HIV infection that results in weight loss and after long period muscles wasting occur.
- Due to HIV/AIDS the ingested nutrients is converted in fat instead of lean muscles that leads to lipodystrophy.
- Impaired immune function which is associated with malnutrition is termed as nutritionally acquired immune deficiency syndrome (NAIDS). NAIDS mainly occur due to lack of essential micronutrients.

5.6.4 Nutritional management in HIV/AIDS

All the nutrients should be evaluated as per the requirement of the patient to reduce or delay the progression of disease and also maintain the quality life of the patients.

Nutrients	Description
Energy	• Energy requirement is prescribes to the patient accordingly as per the stage and severity of the patient. • Energy requirement is increased up to 10% in the asymptomatic stage to compensate body weight and physical activity in adult and for growth in children. • In the symptomatic stage 20 to 30% increased energy is prescribed to the adult patient to maintain the body weight.
Protein	• Protein requirement of the HIV/AIDS patient is same as the normal person that is 12-15% of the energy intake or 1g/kg body weight.
Fat	• Low fat diet is prescribed HIV infected patient suffering with malabsorption and diarrhea. • Otherwise fat requirement is also same as non-infected person around 20-30% of energy should be provided from fat. • Proportions of saturated, monounsaturated and polyunsaturated fatty acids are ≤7%, ≥10% and ≤10% of the total energy intake.
Micronutrients	• Micronutrients are important to maintain the immune system. Several studies reveals that need of β-carotene, vitamin C, vitamin E, vitamin B_{12}, vitamin B_6 and folic acid is increased in the HIV

	infected patients. • 70 mg/day of selenium is beneficial to the patients of HIV because selenium is a natural antioxidant. • Micronutrients are provided as per the days RDA of vitamin and minerals. Ensure that intake of micronutrients are at RDA level and encourage the people to consume healthy diets.
Fluid and Electrolyte	• Fluid intake of HIV infected patients are same as normal person but in case of vomiting and dirrhoea fluid intake should be increased for the replacement of sodium, potassium and chloride loss. • At least 2 liters of water is recommended and the water should be boiled or filtered before drinking.

5.7 FOOD ALLERGY

Food allergy is characterized as an unfavorable immunological reaction to a particular substance with recognizable symptoms that occur every time food is consumed. It can also be described as a changed tissue response to a foreign protein or antigen. The term "food hypersensitivity reaction" is sometimes used to describe food allergy.

5.7.1 Causes of food allergy:

Food allergies are caused by the immune system responding to specific foods. Although it is unclear why this occurs, certain foods are more likely to induce an allergic reaction in some individuals. Following are the most prevalent allergenic foods:

5.7.2 From animal sources:

- Cow’s milk contains two main allergens- casein and beta-lactoglobulin. When consumed, cow's milk may trigger allergic reactions such colic discomfort and passage of blood.
- Among animal foods, egg is a common allergen. The allergen in eggs is found in the egg white. Compared to other symptoms, cutaneous signs occur more commonly.
- Some fish species can cause allergic reactions. The most typical allergens are found in crustaceans (crabs, lobster, and prawns).

- Some people may develop an allergic reaction to any type of meat. The liver, pancreas, kidney, and brain of the same species can be consumed without consequence in cases of hypersensitivity to the flesh of particular animals.

5.7.3 From plant sources:

- In certain people, wheat flour has been linked to the acceleration of celiac disease symptoms. The discovery of antibiotics to wheat gluten in the blood of these patients suggests that this condition is caused by an allergic reaction to wheat gluten. All wheat-containing foods such as bran, bread rava, and samolina are avoided in this condition.
- Some people are allergic to peanuts, which causes gastrointestinal pain, skin rashes, and asthmatic paroxysms. Peanut oil that has been cold pressed, expelled, or extruded may produce an allergic reaction in people who are allergic to peanuts. Refined oil is completely safe.
- Consumption of edible mushrooms might occasionally result in an allergic reaction.

5.7.4 Symptoms of food allergy:

Symptoms of allergy can appear on any part of the body.

- Atopic dermatitis, edoema, fever, blisters, and urticarial (rashes), eczema, erythema, and lip pruritus are some of the cutaneous manifestations that might occur.
- Occult faecal blood loss, cheilitis, stomatitis, infantile colic, malabsorption, cramping and pain in the abdomen, occult abdominal distension, constipation, diarrhoea, dyspepsia, flatulence, nausea, and vomiting are some common gastrointestinal signs.
- Sneezing, allergic rhinitis, asthma, bronchitis, shortness of breath, running nose, and nasal polyps are among the respiratory symptoms.
- Tension fatigue syndrome (anxiety, exhaustion, irritation, discomfort in the muscles and joints, restlessness, and stomach pain), neuralgia, and migraine are among the neurological symptoms.
- Headache, cardiac arrhythmias, hypotension, and anaphylaxis are some examples of systemic symptoms.

5.8 CELIAC DISEASE:

Celiac disease is also known as celiac sprue or gluten-sensitive enteropathy. It is an autoimmune inflammatory disease of small intestine in which wheat protein gluten is not absorbed by the body because of the deficiency of enzyme which splits gluten accompanied by degeneration of jejunal mucosa that may also be a cause of celiac disease. It usually occurs in first three years of life or may even in adulthood.

5.8.1 Symptoms:

Symptoms of celiac disease are mostly occurring in children than in adults which include:

- abdominal pain
- bloating
- gas
- chronic diarrhea or constipation
- nausea
- vomiting
- pale stool with a foul smell
- fatty stool that floats

Other symptoms that are not related to digestion are:

- weight loss
- fatigue
- depression or anxiety
- joint pain
- mouth sores
- a rash called dermatitis herpetiformis
- nerve damage in the extremities, called peripheral neuropathy, which can cause tingling in the legs and feet

5.8.2 Dietary management:

- Provide gluten free diet that improves the symptoms, cure intestinal damage and hinder further damage. Gluten free diet contains no gluten, foods that contains gluten such as- wheat, rye, barley and oats are restricted.
- Foods like biscuit, bread, breakfast cereals (porridge, oats etc.), parathi, poori, chapatti, macaroni, noodles etc. should be avoided.
- Gluten free sources are coffee, tea, chocolate drink, wine, milk and milk products, meat, fish, poultry, eggs, cottage cheese, peanut butter, rice, potato and soya flour, corn, fruits and vegetable, milk based sweets without addition of cereals products.

5.9 LACTOSE INTOLERANCE

It is a digestive disorder that is caused by the inability of the lactase enzyme to digest 'lactose'. Main function of the lactase enzyme is to breakdown the carbohydrate mainly lactose present in the milk into glucose and galactose. When this enzyme is absent in the body then the lactose cannot be broken-down and passes into the large intestine and cause diarrhea.

5.9.1 Symptoms:

- Diarrhea
- Nausea sometimes vomiting
- Stomach cramps
- Bloating
- Gas and flatulence

5.9.2 Dietary management:

- Patient having lactose intolerance advised to follow lactose-free diet in which all the dairy products are avoided and can lead to the micronutrients deficiency such as calcium, phosphorus, chlorine, zinc, magnesium, riboflavin, Vitamin $B_{12}$and Vitamin A.
- Elimination of dairy product may lead to major risk associated with calcium deficiency and bone health therefore it is essential to provide adequate amount of calcium through non-dairy products such as: broccoli, collards, kale, turnip green and fortified soy products along with sesame seeds, almonds red and white beans etc.

5.10 NUTRITION IN CANCER

Cancer is defined as the abnormal division of the cells and spread throughout the body causing malignant tumor or neoplasm. Neoplasm means cells which proliferates or grow without the normal control. Malignant tumor spread to the adjacent tissue and impaired their function and providing undesirable systematic effect. Cancer may be caused by mutation and abnormal activation of cellular genes which is responsible for the control of cell growth and cell mitosis. These abnormal cellular genes are called as oncogenes, some genes are also exists in the body known as tumor suppression gene which works to prevent the transformation of malignant tumors. Some carcinogenic factors like tobacco use promote the growth of proto-oncogene which is then converted into oncogenes by mutation or carcinogens which ultimately increase the malignant transformation.

5.10.1 Carcinogenesis

Cancer development is a multistep process which includes 3 stages: initiation, progression and promotion.

Initiation- It is the first step that involves in the development of precancerous cells by exposure to some stress like oxidative stress or endogenous or exogenous carcinogens and become precancerous. Initiation alone is not enough cells must go through the progression stage.

Progression- In the second stage precancerous cells are stimulated through cell signaling and stats the replication and growth of the cells called as progression or promotion and initiates the carcinogenesis process.

Promotion- In the last stage that is progression these abnormal cells are cluster together and translocate into other parts of the body resulting in metastasis of cancer cells in other parts of the body.

5.10.2 Types of cancer

More than 100 types of cancer is recognized, most of cancer is named according to the organ or cells where they start like cancer is being in the breast is known as breast cancer; in colon is

colon cancer; being in basal cell of the skin is known as basal cell carcinoma. The main categories of cancers are:

Sarcoma: begins in bones, muscle, cartilage, fat, blood vessels and other connective and supportive tissue.

Carcinoma: begin in the skin or in the tissue that cover the internal organ.

Leukemia: begins in blood forming tissues like bone marrow which result in the production of large number of abnormal blood cells and enter the blood causing blood cancer.

Melanoma: begins from the growth of melanocytes that are skin cells produce the pigment melanin.

Lymphoma and myeloma: being in the cells of immune system.

Central nervous system cancers: being in the tissue of the brain and spinal cord.

5.10.3 Aetiology

Carcinogens: Physical carcinogens: ultraviolet and ionizing radiation.

Chemical carcinogens:asbestos, aflatoxin (food contamination), arsenic (drinking water contamination) and components of tobacco smoke.

Biological carcinogens:

- Viruses: Hepatitis B and liver cancer, human papilloma virus (HPV) and cervical cancer and human immunodeficiency virus (HIV) and Kaposi sarcoma.
- Bacteria: Helicobacter pylori and stomach cancer.
- Parasites: Schistosomiasis and bladder cancer.

5.10.4 Nutritional management:

Cancer therapy, recovery, and prevention all rely on proper nutrition. Radiation therapy, chemotherapy, hormone therapy, and surgery are all used to treat cancer, which can result in loss of appetite, energy, and malnutrition. Many patients experience weight loss as a result of side effects such nausea, altered tastes, and appetite loss as well as a catabolic condition brought on

by cancer. Others might gain weight as a result of their drugs, decreased activity, or emotional stress. The best dietary strategy is determined after identifying the kind of cancer and the course of therapy.

The main objective of nutritional management is to keep the weight stable during therapy. The food ingested must be nutrient-dense in order to regulate weight, promote healing, and preserve energy to deal with all of the additional obstacles that treatment may bring. The dietary modifications are as follows:

Energy: The total energy value of the food must be increased to prevent excessive weight loss and to satisfy higher metabolic demands. About 2,000 kcal will be enough to meet maintenance demands for an adult patient with good nutritional status. Depending on the severity of the malnutrition and any injuries to the body, a patient may need between 3000 and 4000 kcal.
The requirements of calories are:

- 20–25 kcal/kg is advised for sedentary patient.
- 30-35 kcal/kg is advised for patient with mild hypermetabolism and for weight gain/anabolism.
- 40–45 kcal/kg is advised for patients who are extremely malnourished, hypermetabolic, or stressed out.

Protein: Patients with cancer often suffer from protein energy malnutrition. To provide the essential amino acids and nitrogen which is required for tissue regeneration, healing, and treatment, more protein is needed. For patient having good nutritional status around 80-100 g protein is needed for maintenance and to promote anabolism. Nutritional requirement of protein are as follows:

- Minimum requirement of protein is 0.5 g/kg per day.
- Protein requirement for normal maintenance is 0.8–1.0 g/kg.
- If there is an increase in protein demand, 1.5 to 2.5 g/kg is advised, e.g. in case of protein-losing enteropathy, hypermetabolism, or in extreme wasting.

Micronutrients: Long-term general malnutrition can result in vitamin deficiencies. Progression of the disease may also change the metabolism of micronutrients Malabsorption and micronutrient deficiency may occur as a result of the lower gastrointestinal tract's reaction. Supplementation may be necessary in all these situations. For patients whose intake is restricted for a longer period of time, it may be advised to take a daily multivitamin and mineral supplement.

Fluid: The amount of fluids is increased to compensate losses brought on by gastrointestinal issues as well as any additional losses caused by illness and fever. Additionally, it's important to drink enough water to support the kidney's ability to eliminate the body's breakdown byproducts of cancer cells and drug-related toxins. The unified urinary tract is also shielded from irritation and inflammation by increased fluid intake.

5.10.5 Nutritional therapy for cancer:

Table 5.2: List of foods related to cancer prevention

Active ingredients	Food sources
Phytochemicals	Fruits, broccoli, cauliflower, etc.
Alpha lipoic acid (ALA)	Potatoes, spinach.
Anthaxanthin&Flavonoids	Fruits, vegetables, grains.
Lycopene	Fruits and vegetables (especially tomatoes).
Flavonoids	Garlic, carrots, onions, brinjal, red cabbage, tomatoes, grapefruit, orange and tea.
Glutathione	Asparagus and avocado.
Fibre	Whole wheat, brown rice, nuts, fruits and vegetables.
Vitamin A	Butter, dairy products, fish oils, carrot, egg yolk.
Vitamin E	Almonds, soybeans, spinach, sunflower seeds, sweet potatoes, walnuts, wheat gram, whole wheat flour.
Selenium	Seafoods.

5.11 CHECK YOUR PROGRESS

Exercise 1:

1. Fill in the blanks:

   a) Formation of glucose from non-carbohydrate source is known as_____.
   b) Typhoid fever is caused by the bacteria _____.
   c) _____ virus attacks and weakened the body's natural defense system against disease and infection.
   d) _____ is described as a changed tissue response to a foreign protein or antigen.

2. What are the metabolic changes occur during tuberculosis?

3. Describe the classification and etiology of fever.

4. What are the main routes for the spread of HIV?

Exercise 2:

1. Match the following:

a) Influenza	i) impaired immune function associated with malnutrition
b) Tuberculosis	ii) chronic fever
c) NAIDS	iii) gluten-sensitive enteropathy
d) Wheat allergy	iv) acute fever

2. State whether the following statements are true or false.

   a) Inadequate nutrition leads to weight loss, lowered immunity, lowered resistance to infection, invasion by pathogens, mucosal damage and impaired growth and development in children.
   b) With every $1^{O}F$ increase in body temperature the BMR is increases 10 percent respectively.
   c) Cells of immune system mainly helper T cells (CD4 T cells), macrophages, and dendritic cells are affected by HIV.