Chapter 1: CLINICAL AND THERAPEUTIC NUTRITION

***Learning Objectives*:**

After reading this unit, the students will be able to:

1. define the terms dietetics, clinical nutrition, therapeutic diet and explain the concept of diet planning in disease,
2. enumerate the scope of dietetics and the role of dietitian in health care,
3. explain the relationship between nutrition and infection,
4. discuss the adaptation of normal diet to therapeutic diets, and
5. describe the types of therapeutic modifications with respect to consistency, frequency of meals, methods of cooking etc,.

Welcome to the study of clinical and therapeutic nutrition. Earlier you were introduced to public health nutrition which you learnt focuses on health promotion and disease prevention in the general population. *Clinical nutrition*, on the other hand, as a study focuses on the nutritional management of individuals or group of individuals with established disease condition. Clinical nutrition deals with issues such as altered nutritional requirements associated with the disease, disease severity and malnutrition and many such issues about which we will learn in this unit and other units in this course. Nutrition is an integral part of the medical therapy as adequate nutrition support can go a long way in improving quality of care and improving patient's medical outcome. The importance of nutrition in the prevention of illness and disease has been long recognized. Do you recall your grandma's homemade remedies for common illnesses such as fevers, cough/cold, stomach ache, and indigestion or heart burn? Yes, nutritional care in terms of providing hot cups of soup or porridge ensured that you were adequately and appropriately nourished which helped improve medical outcome. There is certainly more to clinical nutrition than this. So let us get to know about clinical and therapeutic nutrition.

DIETETICS AND ROLE OF DIETITIAN IN HEALTH CARE

As a student of nutrition it must be evident to you by now that the diet and the food we eat have a direct and significant impact on our health. Eating a healthy balanced diet improves the quality of our life,

whereas a poor diet may lead to morbidity and disease. The branch of medicine concerned with how food and nutrition affects human health comprising the rules to be followed for preventing, relieving or curing disease by diet is called *Dietetics*. Dietetics deals with feeding individuals based on the principles of nutrition. In fact, dietetics is the science and art of human nutritional care.

Clinical Dietetics is the application of dietetics in a hospital or health care institutional setting. Clinical dietetics focuses on individual nutrition support and symptom management. You may come across the terms diet therapy, therapeutic diets while studying about clinical dietetics. Let us get to understand these terminologies used in the context of dietetics.

Diet therapy is a branch of dietetics concerned with the use of food for therapeutic purpose. Diet therapy is a broad term used for the practical application of nutrition as a preventive or corrective treatment of a disease. It concerns with recovery from illness by giving good diet and prevention of disease. It may involve the modification of the existing dietary lifestyle to promote optimum health. For example a dietitian or a nutrition counselor may prescribe a diet therapy to an obese person to improve health. The therapy may involve including foods that improve the health condition while avoiding foods (such as fats, sugars etc.) that may make the condition worse. Basically the therapy promotes a balanced selection of foods vital for good health. The principles of diet therapy are to:

- maintain good nutritional status,
- correct deficiencies or disease, if any,
- provide rest to the body,
- help metabolize the nutrients, and
- make changes in body weight, when necessary.

Diet therapy may include prescribing specialized dietary regimes or meal plans. These specialized diet regimens or meal plans are called therapeutic diets. *Therapeutic diet* refers to a meal plan that controls the intake of certain foods or nutrients. They are adaptation of the normal, regular diet. Some common examples of therapeutic diets

include clear liquid diet, diabetic diet, renal diet, gluten free diet, low fat diet, high fibre diet etc. Therapeutic diets are usually prescribed by dietitians, nutritionists or physicians. We will learn about the types of therapeutic diets later in this unit.

Depending on the nature of the problem, a health care team might include physician/doctor, nurses, nutritionists, dietitians, counselors etc. But dietitian/nutritionists are at the forefront of nutritional care. A nutrition professional can advice, counsel, coordinates, educate, guide, inform, suggest and support. Nutrition professional works with individuals/patients to help them understand that good nutrition and good health go hand-in-hand. The various tasks and the role of dietitian in health care are enumerated next.

Role of Dietitian in Nutrition Care

Dietitian you know is an expert in dietetics, dealing with human nutritional care. A dietitian apply the science and principals of human nutrition to help people understand the relationship between food and health and make appropriate dietary choices to attain and maintain health and to prevent and treat illness and disease.

Dietitians work in a wide variety of roles in, for example, a clinical, public health or community, food service, administrative, freelance/consultancy, research or teaching capacity. However, you will find that majority of dietitians are clinical dietitians working in hospitals, nursing homes and other health care facilities or specialized institutes/units to provide nutritional care to patients with a variety of health conditions, and provide dietary consultations to patients and their families.

The activities most likely to be undertaken by the clinical dietitians would include:

- Collecting, organizing and assessing data relating to health and nutritional status of individuals, groups and communities,
- Review and analyze patients nutritional needs and goals to make appropriate dietary recommendations,
- Develop and implement nutrition care plans and monitor, follow up and evaluate these plans and take corrective measures wherever required,
- Calculate nutritional value of food/meals planned,
- Prescribe therapeutic diets and special nutrition support and feeding regimens,
- Oversee the preparation of special diets, special nutrition formulas for patients who are critically or terminally and require special feeding through oral, enteral or parenteral routes,
- Plan and prepare basic menus and assist in supervising food service personnel in preparing menus and serving of meals,
- Schedule work assignments in the dietary unit to facilitate the effective operation of the kitchen and other food preparation or dining areas,

Therapeutic Diets: A Review

Remember, a *therapeutic diet is a qualitative/quantitative modified version of a normal regular diet* which has been tailored to suit the changing nutritional needs of patient/individual and are used to improve specific health/disease condition. It is a planned diet used to supplement the medical or surgical treatment.

Here you may enquire what a normal regular d
Normal diet, here, refers to a basic, balanced d
meets the need of an individual.

Balanced diet is defined as one which contains a variety of foods in such quantities and proportions that the need for energy, proteins, vitamins, minerals, fats and other nutrients is adequately met for maintaining health and well being.

Refer to Figure 1.1 which illustrates routine hospital diets.

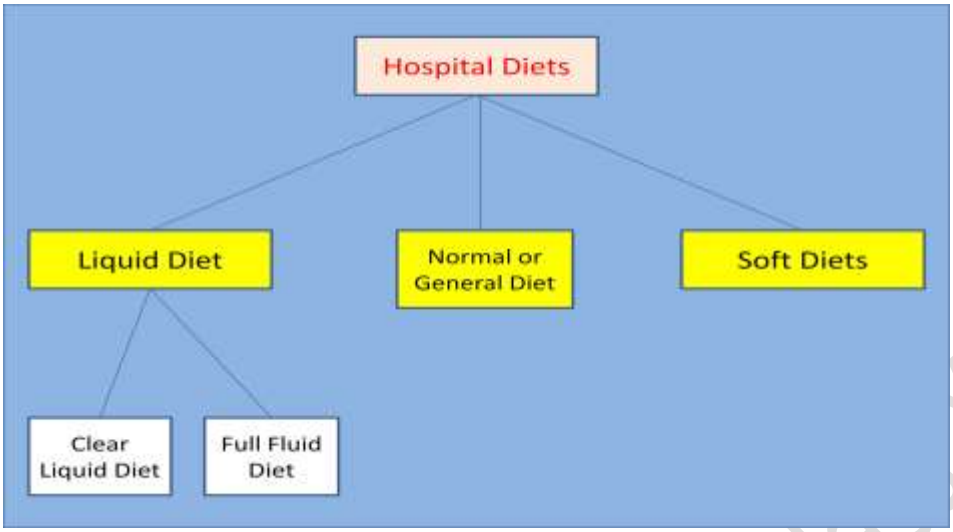

Figure 1.1: Routine hospital diets

Normal or *general diet* in a hospital setting is a balanced diet which meets the nutritional needs of an individual/patient. It is given when the individual's medical condition does not warrant any specific modification. Most hospitals follow simple dietary recommendations (given by ICMR for Indian population) while planning the general diet. It is planned keeping the basic food groups in mind so that optimum amount of all nutrients is provided. Further, since the patient is hospitalized or on bed rest, reduction of 10% in energy intake should be made. The diet provides approximately 1600 to 2200Kcal, and contain around 180 to 300g carbohydrates, 60 to 80g of fat and 40 to 70 g of protein.

Figure 1.1 also illustrates the soft diet and the liquid diets which are examples of therapeutic diet. In addition to these there may be other modified diets which individuals may require as part of their therapeutic needs. The reasons for modifying the diets may include:

- For *essential or life saving treatment*: For example in celiac disease, providing gluten free diet,
- To *replete patients who are malnourished* because of disease such as cancer and intestinal diseases by providing a greater amount of a nutrient such as protein,
- To *correct deficiencies* and *maintain or restore optimum nutritional status*,

- To *provide rest* or relieve an affected organ such as in gastritis,
- To *adjust to the body's ability to digest, absorb, metabolize or excrete*: For example a low fat diet provided in fat malabsorption,
- To *adjust to tolerance of food intake*. For example in case of patients with cancer of esophagus tube feeding is recommended when patients cannot tolerate food by mouth,
- To *exclude foods due to food allergies* or food intolerance,
- To *adjust to mechanical difficulties*, for example for elderly patients with denture problems, changing the texture/consistency of food recommended due to problems with chewing and/or swallowing,
- To *increase or decrease body weight/body composition* when required, for example as in the case of obesity or underweight,
- As *helpful treatment, alternative or complementary* to drugs, as in diabetes or in hypertension

The significance of modified or therapeutic diet is that it is useful in managing the disease condition; it promotes resistance to disease condition and is preventive or supplemental treatment. To help you understand, consider this aspect. When an individual suffers from a disease, the disease process may cause the patient to lose appetite and therefore eat less or in some other circumstances feel more hungry and eat more. Some individuals may have problems with digestion or absorption of food or specific nutrient leading to changes in the type of food which can be tolerated as also the frequency of feeding may need to be altered. Dietary modification than becomes a part of the therapeutic demand. There are many types of dietary modifications. A checklist of some common modifications is presented in the next sub section.

Types of Dietary Adaptations for Therapeutic Needs

A diet may need to be altered and adjusted in many ways before it meets the therapeutic needs of an individual patient. These adaptations may include:

- Change in consistency of foods, such as liquid diet, soft diet, low fibre diet, high fibre diet.
- Increase or decrease in energy value of the diet such as low calorie diet for weight reduction, high calorie diet for burns.
- Increase or decrease in specific nutrients or type of food consumed, such as sodium restricted diet, lactose restricted diet, high fibre diet, high potassium diet.
- Elimination of spices and condiments, such as bland diets.
- Omission of specific foods such as allergy diets, gluten free diet.
- Adjustment in the ratio and balance of proteins, fats and carbohydrate such as diabetic diet, renal diet and cholesterol-lowering diets.
- Test diets: These are single meals or diets lasting one or few days that are given to patients in connection with certain tests e.g. the fat absorption test used to determine if steatorrhoea is present.
- Change in frequency of meals, feeding intervals, re-arrangement of the number and frequency of the meals such as diabetic diet, diet for peptic ulcer disease.

Remember, *normal nutrition is the foundation upon which the therapeutic modifications* are made. The various dietary adaptations for therapeutic needs are briefly highlighted here.

A. Diets of Altered Consistency

Therapeutic diets are modified for consistency, texture to fit the nutritional needs. Some individuals may require a clear liquid diet, while others a fully liquid diet or soft diet based on their medical condition. Figure 1.2 illustrates the modified diets based on consistency.

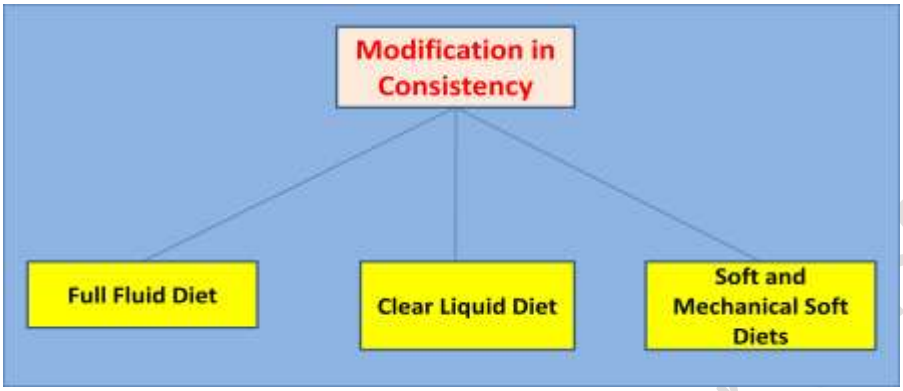

Figure 1.2: Modifications in consistency

a) ***Liquid Diet*** consists of foods that can be served in liquid or strained form in room temperature. They are usually prescribed in febrile states, postoperatively i.e. after surgery when the patient is unable to tolerate solid foods. It is also used for individuals with acute infections or digestive problems, to replace fluids lost by vomiting, diarrhoea. The two major types of liquid diets include - Clear liquid diet and full liquid/fluid diet.

i) Clear liquid diet provides foods and fluids that are clear and liquid at room temperature. The purpose of the clear liquid diet is to provide fluids and electrolytes to prevent dehydration. It provides some amount of energy but very little amount of other nutrients. It is also deficient in fibre. Hence it is nutritionally inadequate and should be used only for short periods i.e. 1-2 days. An average clear liquid diet contains 600 to 900Kcal, 120 to 200g carbohydrate, minimal fat 5 to 10g protein and small amount of sodium and potassium (electrolytes). The clear liquid diet is usually useful in situations when the gastrointestinal tract has to be kept functionally at rest. It is also prescribed before and after certain types of surgery involving the mouth or gastrointestinal tract. Also may be used in acute vomiting or diarrhoea.

Examples of clear liquid diet: Water, strained fruit juices, coconut water, lime juice (nimbu pani), whey water, barley/arrowroot water,

rice kanji, clear dal soup, strained vegetable or meat soup, tea or coffee without milk or cream, carbonated beverages, ice pops, plain gelatin are some examples of clear liquid diet.

ii) Full liquid diet provides food and fluids that are liquid or semi liquid at room temperature. It is used as a step between a clear liquid diet and a regular diet. The purpose of the full liquid diet is to provide an oral (by mouth) source of fluid for individuals who are incapable of chewing, swallowing or digesting solid food. It provides more calories than the clear liquid diet and gives adequate nourishment, except that it is deficient in fibre. It is indicated for post operative patients and for gastrointestinal illness. An average full liquid diet can provide approximately 1000 to 1800 calories and 50 to 65g of protein and adequate minerals and vitamins. The nutritive content of the full liquid diet can be increased by using protein, vitamin and fibre supplements.
Examples of full liquid diet: Foods allowed or included in a full liquid diet include beverages, cream soups, vegetable soups, daal soups, strained food juices, lassi/butter milk, yougurt, hot cocoa, coffee/tea with milk, carbonated beverages, cereal porridges (refined cereals) custard, sherbet, gelatin, puddings, ice cream, eggnog, margarine, butter, cream (added to foods), poached, half boiled egg etc.

b) ***Soft diet*** as the name suggests provides soft whole food that is lightly seasoned and are similar to the regular diet . The term 'soft' refers to the fact that foods included in this type of diet are soft in consistency, easy to chew and made of simple, easily digestible foods. It does not contain harsh fibre or strong flavours. It is given during acute infections, certain gastrointestinal disorders and at the post operative stage to individuals who are in the early phase of recovery following a surgery. The soft diet provides a transition between a liquid and a normal diet i.e. during the period when a patient has to give up a full liquid diet but is yet not able to tolerate a normal diet. Soft diet can be nutritionally adequate (providing approximately 1800-2000 calories, 55-65g protein) provided the patient is able to consume adequate amount of food.

Examples of soft diet: A soft diet freely permits the use of cooked vegetables, soft raw fruits without seeds, broths and all soups, washed pulses in the form of soups and in combination of cereals and vegetables (like khichri, dalia), breads and ready-to-eat cereals (most preferable refined such as poha, upma, pasta, noodles etc.), milk and milk beverages, yogurt, light desserts (including kheer, halwa, custard, jelly, ice cream), Egg and tender and minced, ground, stewed meat and meat products, fat like butter, cream, vegetable oil and salt and sugar in moderation. Foods to be best avoided in the soft diet include coarse cereals, spicy highly seasoned and fried foods, dry fruits and nuts, rich desserts.

Among the soft diet is also the *mechanical soft diet* also known as the dental diet which is a normal diet that is modified only in texture for ease of mastication i.e. chewing. When an individual cannot chew or use facial muscles for a variety of dental, medical or surgical conditions mechanical soft diet is recommended. Elderly persons who have dental problems are prescribed mechanical soft diets. The food in mechanical soft diet is similar to the soft diet and may be full liquid, chopped, pureed or regular food with soft consistency. Simple salads, fruit salads and cottage cheese may be included. No food is restricted unlike in the case of the customary soft diet. Just removing the skin and seeds, cutting or chopping the food into small fine pieces are processes usually employed.

c. ***Bland Diet***: A bland diet is made of foods that are soft, not very spicy and low in fiber. It consists of foods which are mechanically, chemically and thermally non-irritating i.e. are least likely to irritate the gastrointestinal tract. Individuals suffering from gastric or duodenal ulcers, gastriris or ulcerative colitis are prescribed this diet.

Foods Included: Milk and milk products low in fat or fat free; Bread, pasta made from refined cereals, rice; cooked fruits and vegetables without peel and seeds; Eggs and lean tender meat such as fish, poultry that are steamed, baked or grilled; Cream, butter; Puddings and custards, clear soups.

Foods Avoided: Fried, fatty foods; Strong flavoured foods; Strong tea, coffee, alcoholic beverages, condiments and spices; High fiber foods; hot soups and beverages; whole grains rich in fiber; strong cheeses.

B. Modification in Quantity

Depending on the clinical condition some individuals may require a *restriction diet* such as sodium restricted diet (as in high blood pressure), purine restricted diet (as in gout) or low residue diet (prescribed and/or before abdominal surgery) designed to reduce the frequency and volume of fecal output. Sometimes a complete *elimination diet* may be recommended when there is food intolerances or complete insensitivity to a particular food such as a gluten free diet or a dairy free diet or nut free diet etc. Occasionally an *increase in the amount of a specific dietary constituent* may be prescribed such as a high potassium diet or a high fibre diet (as in constipation) or an iron-rich diet (as in anaemia) when the clinical condition demands.

C. Modification in Nutrient (Proteins, Fat, Carbohydrate) **Content**

The nutrient content of the diet is modified to treat deficiencies, change body weight or control diseases such as hypertension or diabetes. You may have come across patients with high blood sugar levels, being prescribed a diabetic diet which requires changes in the quantity and type of carbohydrates included in each meal. Refined carbohydrates (such as sugar, honey, refined flour, semolina etc.) are best avoided and use of complex carbohydrates (whole wheat flour, coarse cereals etc.) recommended. Patients with heart diseases require a fat controlled low cholesterol diet while patients with renal (kidney) failure and advanced liver diseases a low protein diet, patients with HIV disease, cancer or malnourished a high protein, high calorie diet. Others as in the case of overweight, obesity a weight reduction diet, low in fat and calories.

D. Changes in Meal Frequency

Individuals suffering with gastro-esophageal reflux disease (GERD) stand to benefit by consuming small but frequent meals. 5 to 6 small meals instead of three regular meals are recommended.

E. Changes in Method of Cooking

Leaching is indicated for cooking vegetables for people with chronic kidney diseases because the kidney's no longer maintain the ideal

level of potassium necessary for optimum health. Leaching (soaking in water) drains out excessive potassium and phosphorous from the vegetables. In elderly people food may be modified by mechanical processing such as mashing, blendrizing or chopping. For patients on bland diet foods steamed, baked or grilled are recommended. A review on the methods of cooking is presented for your understanding at the end of the book.

F. Modification in the Method of Feeding

To provide adequate nutrition, normally oral feeding (by mouth) is recommended. Sometimes oral feeding is not possible, under such circumstances special feeding methods such as *enteral* feeding (provision of liquid formula diet delivered via nasogastric feeding tube) and *parenteral* feeding (fluids containing water, glucose, amino acids, minerals, vitamins given through the peripheral and central veins) is recommended.

Here we have just introduced to you some common dietary modifications. A detail review on modified therapeutic diets in different disease conditions will be presented later in the units.

Chapter 2: NUTRITION AND INFECTION

***Learning Objectives*:**

After reading this unit, the students will be able to:

1. discuss the interaction between nutrition and infection,
2. describe the effect of infection on nutritional status,
3. discuss how malnutrition can lead to infection,

The role of nutrition in disease prevention and health management is well established. Also you are aware that poor nutrition can lead to ill health, disease and infections. Infections are caused by microorganisms which in turn can lead to malnutrition. Is there a link between these two conditions? In this section we shall discuss the interaction of infection and nutrition.

Infection and malnutrition have always been intricately linked. Evidence suggests that common childhood infections exert their influence in precipitating malnutrition. The relationship between malnutrition, impaired immunity and infection can be described as a vicious cycle. We will learn about this vicious cycle in this unit.

THE CYCLE OF MALNUTRITION AND INFECTION

Malnutrition, as you already know, is an impairment of health resulting from a deficiency or lack of food/nutrients or imbalance of nutrients in the diet. Almost any nutrient

deficiency, if sufficiently severe, will impair resistance to infection. Figure 1 illustrates this concept.

Let us understand this interaction between malnutrition and infection with the help of a case study. Raju, a 4 year old boy, is suffering from infectious diarrhoea, caused by the invasion of the body by harmful microorganisms. The infection caused loose motion, fever, dehydration and impaired absorption. On further investigation he was also found to be suffering from protein energy malnutrition reflecting as loss of weight. Now, when these two diseases exist in the same person (here Raju) concurrently, the interaction between the two diseases usually alters the nature, behaviour of the diseases. The overall clinical status of the child worsens often resulting in increased complications or increased duration of the disease and in some cases results in death. In case of Raju, infection is a common precipitating factor for malnutrition. Ironically, malnutrition is also a major factor in the occurrence of infection and the two interact, making each other worse. Figure 1 illustrates this interaction.

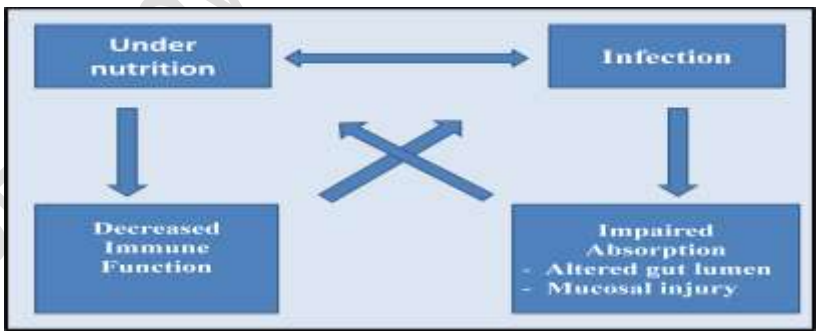

Figure 1: Interaction between infection and malnutrition

An inadequate dietary intake, in case of Raju, led to weight loss, lowered immunity, mucosal injury, invasion by pathogens, and impaired growth and development as highlighted in Figure 2. Raju's nutrition was further

aggravated by diarrhea, malabsorption, loss of appetite, diversion of nutrients for the immune response, and urinary nitrogen loss, all of which lead to nutrient losses and further damage to defense mechanisms making him more susceptible to infections. This in turn led to further reduced dietary intake causing a vicious cycle of malnutrition and infection as highlighted in Figure 1.

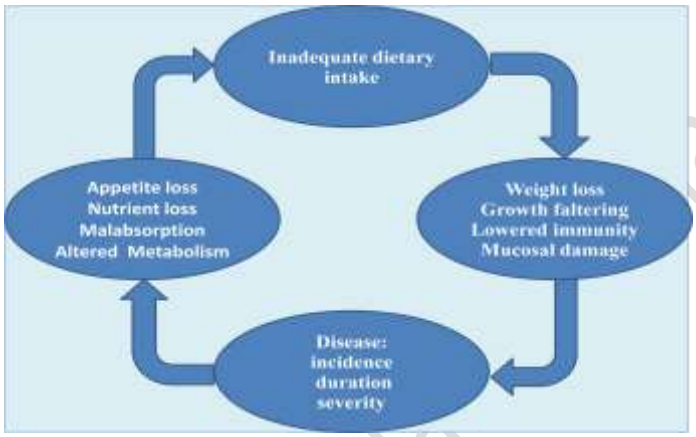

Figure 2: The vicious cycle of malnutrition and infection

So when infection aggravates malnutrition or malnutrition lowers resistance to infection, the relationship between the two can be described as *Synergism* i.e. the simultaneous presence of malnutrition and infection results in an interaction that is more serious for the individual than would be expected from the combined effect of the two working independently.

The synergistic effect of malnutrition and infection often leads to a high rate of child deaths in poor households/communities in India. What generally happens is that in a poor rural/slum household a child is as such born with low birth weight (that is less than 2.5kg) because of inadequate dietary intake of the mother during pregnancy. Subsequently the child is solely breast fed for long periods (2 or more years). Complementary feeding (i.e. introduction of additional foods other than breast

milk) is delayed beyond 6 months of age. This triggers growth faltering that is the child's growth and development slows down resulting in weight loss. In other terms malnutrition sets in. Moreover, in view of the poor environment and lack of hygiene so common in rural/slum areas, the children are further exposed to infections like diarrhoea and respiratory tract infections. There is reduction in food intake by the child due to loss of appetite due to these infections. As a result there is further slowing down of growth. The cumulative effect of dietary deficit and infection produces retardation of physical growth leading to *stunting* (short stature or low height/length for age as compared to normal child) in children. It is important to highlight here that the effects of stunting are long lasting. Children who are stunted grow up to be adults with reduced capacity to do physical work and are less economically productive.

From your understanding of the concept above now can you summarize the effect of malnutrition on infection and the reciprocal relation i.e. the effect of infection on nutritional status? Summarize the points in the space provided:

Now check your responses with the summarized list presented next. The basis of the effect is also described for your understanding

Effect of Malnutrition on Infection

With reference to Figure 1 and 2, it must be evident to you that inadequate nutrient intake lowers immunity. Also it leads to mucosal damage. Let us get to know more on this aspect.

a) *Lowered Immunity*: Immunity, in simple terms can be described as the state of being unsusceptible or being protected against a particular disease or illness by the presence of particular substance in the blood. These particular disease fighting substances are called *antibodies*. A healthy well nourished child/individual is at a lower risk of infection. They can fight the infection better. Why? Because of the ability of these well nourished individuals to produce these disease fighting substances called antibodies. But in case of malnourished individuals there is reduction in antibody production and therefore the disease fighting capacity is lowered making the individual more prone to infections. Hence you would notice that children who are suffering from specific nutrient deficiencies such as protein energy deficiency or iron deficiency anaemia or vitamin A deficiency are prone to infections

b) *Effect on the integrity of skin and mucous membrane*: Dietary inadequacy diminishes resistance to infection by reducing the integrity of various tissues. In a healthy well fed individual the skin, musosal membrane and other tissues are healthy and prevent the entry of infectious agents. They act as a barrier and prevent the infection from entering the body. In an individual suffering from malnutrition, the protective mechanism is absent. The mucous membrane becomes readily permeable and provides a favorable environment for the growth of the infectious agent. Consequently the individual will catch infection easily.

Next let us study about the effect of infection on the nutritional status.

Infection and Nutritional Status

Infection, no matter how mild, has adverse effects on nutritional status. Nutritional status, as you may recall, *refers to the condition of health of an individual as influenced by the utilization of the nutrients*. So how does infection influence the utilization of the nutrients which in turn influences nutritional status? Let us understand. There can be multiple ways but the first and foremost effect of infection is on loss of appetite.

a) *Loss of Appetite*: Do you recall the last time you were sick or down with some infection? What did you experience? Yes, you may not have been eager to consume food or were not able to tolerate food leading to loss of appetite. Further with use of medicines such as antibiotics to treat the infection your appetite may have been further affected leading to reduced food intake. Now if this condition would have been prolonged it would have led to consistent decrease in food intake leading to nutrient deficiency.

b) *Unfavorable cultural practices*: One of the common practices in our country is to restrict or withdraw food from individuals when suffering from infection, particularly diarrhoea or respiratory infections. It is believed that solid foods, milk etc. be best avoided instead bland, starchy gruels low in nutritive value be provided to rest the digestive system. Such a practice is deleterious; particularly when the individual due to infection is already having low food intake and further reduction in the quality of diet contributes to nutrient deficiencies and thus leading to poor nutritional status.

c) *Decreased intestinal absorption*: The main function of intestine is to digest, absorb and propel food along its length. During infection all these functions are affected. Infections

cause's changes to the epithelial membrane leading to malabsorption. Any decrease in the absorption of nutrients can lead to deficiency. For example in children suffering from infectious diarrhoea, protein absorption from intestine may reduce as much as 40%. Other evidence suggests that in children with acute diarrhoea and respiratory infections only 30 -70 per cent of ingested vitamin A is absorbed. Poor absorption thus leads to nutrient deficiency disorders influencing nutritional status.

d) *Worm/parasite infection*: Also there are documented reports implicating intestinal worm/parasitic infections with poor nutritional status. Hookworm, round worm infection, amoebiasis, giardiasis are among the most common intestinal parasitic infections worldwide. These infections are associated with decreased child growth, loss of weight, chronic blood loss, iron deficiency anaemia, diarrhoea and stunted growth.

e) *Protein loss*: In some infections and fevers, few nutrients, particularly proteins are excreted and lost from the body thus causing poor nutritional status. For example diseases associated with diarrhoea, dysentery produce an average loss of 0.9g protein per kg body weight per day. Higher losses are observed with typhoid fever and other acute infections, reaching 1.2g protein/kg body weight/day. Such losses therefore contribute to increased requirement of protein during infection and fevers.

From the discussion above it must be evident to you that the overall effect of the infections on the nutritional status is substantial. In the context of developing country like India, where large number of children, are already on a deficient diet and malnourished, the coexistence of infection in the same

child is producing the effect that is beyond the summed effect expected from the two conditions acting alone.