NUTRITION AND DIETETICS

HIGHER SECONDARY - SECOND YEAR

Untouchability is a sin

Untouchability is a crime

Untouchability is inhuman

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1. RECOMMENDED DIETARY ALLOWANCES

1.1. DIETARY ALLOWANCES RECOMMENDED BY INDIAN COUNCIL OF MEDICAL RESEARCH (ICMR) FOR INDIAN POPULATION

Recommended Dietary Allowances (RDA) are estimates of intakes of nutrients which individuals in a population group need to consume to ensure that the physiological needs of all subjects in that population are met.

Following the recommendations of the League of nations in 1937, an attempt to recommend dietary allowances for energy, protein, iron, calcium, vitamin A, thiamine, ascorbic acid and vitamin D for Indians was made in 1944 by the Nutrition Advisory Committee of the Indian Research Fund Association, now called Indian Council of Medical Research (ICMR).

Between 1950 and 1968, in the wake of recommendations for energy and protein requirements by the Food and Agricultural Organization (FAO) and based on the international data provided by the FAO/WHO expert groups and those available in India, the recommendations for dietary requirements were revised.

Few years later, newer set of data generated by various researches and surveys conducted by renowned institutions like Avinashilingam Institute for Home science and Higher Education for Women – Deemed University, Coimbatore, National Institute of Nutrition, Hyderabad, ICMR and National Nutrition Monitoring Bureau (NNMB), created a necessity to revise RDAs further.

In 1988 an expert committee constituted by ICMR modified the reference body weight for Indian adults and RDAs in respect of energy,

fat, vitamin D and vitamin A. Recommendations on safe intake of fat in terms of both visible and invisible dietary fats were made. For the first time, recommendations for certain trace elements, electrolytes (sodium and potassium), magnesium and phosphorus, vitamin K and vitamin E and dietary fibre were considered.

A number of approaches such as

- dietary intake of nutrients
- growth
- nutrient balance
- minimal loss of nutrients and
- nutrient turnover

were utilized in arriving at the RDAs.

The RDA of an individual depends upon various factors which are as follows:

1. **Age :** Adults require more total calories than a child, whereas a growing child requires more calories per kg of body weight than an adult.

2. **Sex :** Males with high Basal Metabolic Rate (BMR) require more calories than females.

3. **Activity :** The type of activity also determines the energy requirements. The activities are classified as sedentary, moderate and heavy based on the occupation of an individual. Table 1.1 gives the ICMR classification of activities based on occupation.

Table 1.1 : Classification of activities based on occupation

Sex	Activity		
	Sedentary	**Moderate**	**Heavy**
Male	Teacher, Tailor, Barber, Executive, Peon, Postman, retired personnel, priest	Fisher man, Basket maker, potter, Goldsmith, Agricultural labourer, carpenter, mason, rickshaw puller electrician, fitter, turner, cooli, weaver, driver	Stone Cutter, Mine Worker, Wood cutter, Blacksmith
Female	Teacher, Tailor, Executive	House wife, Nurse, Servant maid, cooli, Basket maker, weaver, Agricultural labourer, Beedimaker	Wood Cutter

4. **Physiological Stress :** Nutrient requirements are increased in conditions of physiological stress such as pregnancy and lactation.

The RDAs are given for various age groups such as adult man and adult woman (for various activities), pregnant and lactating women, infants, children (1-9 years), boys and girls (10-12 yrs) and adolescents.

Table 1.2 gives the RDAs suggested by ICMR for the different age groups.

Table 1.2. : Recommended Dietary Allowances for Indians

Group	Particulars	Body wt	Net energy	Protein	Fat	Cal-cium	Iron	Vit. A. μg/d		Thia-min	Ribo-flavin	Nico-tinic acid	Pyri-doxin	Ascor-bic acid	Folic acid	Vit. B-12
								Reti-nol	β-caro-tene							
		kg	Kcal/d	g/d	g/d	mg/d	mg/d			mg/d	mg/d	mg/d	mg/d	mg/d	μg/d	μg/d
Man	Sedentary work		2425							1.2	1.4	16				
	Moderate work	60	2875	60	20	400	28	600	2400	1.4	1.6	18	2.0	40	100	1
	Heavy work		3800							1.6	1.9	21				
Woman	Sedentary work		1875							0.9	1.1	12				
	Moderate work	50	2225	50	20	400	30	600	2400	1.1	1.3	14	2.0	40	100	1
	Heavy work		2925							1.2	1.5	16				
	Pregnant woman	50	+300	+15	30	1000	38	600	2400	+0.2	+0.2	+2	2.5	40	400	1
	Lactation															
	0-6 months	50	+550	+25	45	1000	30	950	3800	+0.3	+0.3	+4	2.5	80	150	1.5
	6-12 months		+400	+18						+0.2	+0.2	+3				
Infants	0-6 months	5.4	108/kg	2.05/kg		500		350	1200	55μg/kg	65μg/kg	710μg/kg	0.1	25	25	0.2
	6-12 months	8.6	98/kg	1.65/kg						50μg/kg	60μg/kg	650μg/kg	0.4			
Children	1-3 years	12.2	1240	22			12	400	1600	0.6	0.7	8	0.9		30	
	4-6 years	19.0	1690	30	25	400	18	400	1600	0.9	1.0	11		40	40	0.2-1.0
	7-9 years	26.9	1950	41			26	600	2400	1.0	1.2	13	1.6		60	
Boys	10-12 years	35.4	2190	54			34			1.1	1.3	15				
Girls	10-12 years	31.5	1970	57	22	600	19	600	2400	1.0	1.2	13	1.6	40	70	0.2-1.0
Boys	13-15 years	47.8	2450	70			41			1.2	1.5	16				
Girls	13-15 years	46.7	2060	65	22	600	28	600	2400	1.0	1.2	14	2.0	40	100	0.2-1.0
Boys	16-18 years	57.1	2640	78			50			1.3	1.6	17				
Girls	16-18 years	49.9	2060	63	22	500	30	600	2400	1.0	1.2	14	2.0	40	100	0.2-1.0

1.2. PLANNING BALANCED DIETS

Balanced diet

A balanced diet is one which contains different types of foods such as cereals, pulses and vegetables in such quantities and proportion that the nutritional requirements are adequately met and a small provision is made for extra nutrients to withstand short duration of leanness.

- A balanced diet should provide 60-70 percent of calories from carbohydrate, 10-20 percent from protein and 20-25 percent from fat.
- Calorie allowance can be $\pm$ 50, while for all other nutrients minimum RDA must be met.
- Energy from cereals should not be more than 75 percent.
- Include two cereals in one meal eg:- rice and wheat.
- To improve protein quality the ratio of cereal protein to pulse protein should be 4:1.
- Two to three serving of pulses should be taken a day.
- Include atleast one medium size fruit. The fruit can be given raw without much cooking.
- Five servings of fruits and vegetables should be included in a day
- The diet should include minimum 100ml milk per day.
- Foods rich in fibre should be included.
- One third of the nutritional requirements, at least calorie and protein should be met by lunch or dinner.

Essentials of meal planning

A major objective of planning meals is to achieve nutritional adequacy along with consideration of other factors such as food cost

and economy, food habits, food preferences, acceptability of prepared foods and other factors.

1. Nutritional adequacy

The planned diet should meet the nutritional needs of the individual and the family as a whole. No single food can meet all the nutritional requirements. Therefore, to achieve a balance of nutrients a combination of different foods need to be included in the diet. The diet can be planned by including foods from the five food groups.

Although all nutrients are important, the requirement for certain nutrients are proportionately higher in certain age groups. e.g:- Iron in adolescent girl and pregnant woman. Therefore identifying rich sources of various nutrients within the same food group is required. e.g:- whole cereals and rice flakes are rich in iron among cereals, milk and fish have high calcium content among animal foods.

2. Food cost and economy

The expenditure on food is an important part of a family's budget and it is influenced by

1. family size
2. number of children
3. age group
4. activity and
5. special needs of pregnancy, lactation and diseased condition.

The proportionate expenditure on food depends upon the income levels i.e. it increases with decrease in total income. Moreover in case of low income level, a higher proportion is spent on buying staples rather than protective foods like milk, vegetables and fruits. Therefore the aim should be to achieve maximum nutritional benefit at minimum cost. For example, pulse can be used as a source of protein instead of animal foods; less expensive cuts of meat can be used; families can

have a small kitchen garden and grow vegetables and fruits to cut down their expenses on this food group and thus exercise economy in meal planning.

For achieving economy in meal planning, the following considerations are important.

- Knowledge of prevailing prices of food items.
- Knowledge of proportion of edible portion of different food stuffs as they vary widely. It may be high as 100 percent in foods like milk or low as 35-40 percent in leafy vegetables. This helps to decide the quantity of food to be purchased.
- Buying foods from fair price shops and retail outlets.
- Bulk purchase of nonperishables.
- Using seasonal foods as they are not only economical but also nutritious.
- Minimising nutrient losses during preparation and cooking.
- Making proper use of left overs and the commonly discarded foods eg: green leaves of vegetables like raddish leaves.

3. Acceptability of meals

Acceptability of meals is as important as meeting nutritional needs or planning within the budget. To make meals acceptable the following considerations are important.

a. Likes and dislikes

The likes and dislikes of all the family members should be kept in mind.

b. Variety

The meal should have variety in colour, texture, taste and flavour for better acceptability. Variety can be achieved by

i. selecting foods from each food group

ii. including a variety of vegetables to add colour

iii. avoid repeating the same food in different meals as well in the same meal in a different form.

iv. use different methods of cooking such as baking, boiling, frying to bring variety in texture.

v. use alternative garnishes and accompaniments.

c. Food habits and religious beliefs

Religious and socio cultural beliefs influence the choice of food. Certain foods are prohibited by certain religions. Also, the socio cultural factors either promote or prohibit the intake of particular foods in different families and communities.

d. Food availability and seasonal variation

As far as possible, seasonal and locally available foods should be used. Vegetables and fruits in season are not only cheap but have the highest nutrient content and best flavour.

e. Food fads

Wrong notions and beliefs regarding consumption of food is prevalent in different communities many of which are baseless and may deprive an important nutrient source. For example, fad like milk and fish should not be included in the same meal. These food fads need to be discouraged.

f. Portion sizes

While planning and preparing a meal, it must be ensured that the quantity prepared be easily consumed by the person of the given age, sex and activity. At the same time the quantity must meet the nutritional needs. These quantities are referred to as "one serving portion" or "portion sizes".

The balanced diets are given as multiples of these portion sizes. Table 1.3. gives the standard portion sizes for the various food groups.

Table 1.3 : Portion sizes of foods and their nutrient content

Food groups	g/portion	Energy (k.cal)	Protein (g)	Carbo hydrate (g)	Fat (g)
Cereals and Millets	30	100	3.0	20	0.8
Pulses	30	100	6.0	15	0.7
Egg	50	85	7.0	-	7.0
Meat / chicken/fish	50	100	9.0	-	7.0
Milk (ml)*	100	70	3.0	5	3.0
Roots and Tubers	100	80	1.3	18	-
Green leafy vegetables	100	45	3.6	-	0.4
Other vegetables	100	30	1.7	-	0.2
Fruits	100	40	-	10	-
Sugar	5	20	-	5	-
Fats and Oils (Visible)	5	45	-	-	5.0

*Toned milk

Source : Dietary guidelines for Indians – a manual, NIN, ICMR, 1999.

Steps in meal planning

The following steps may be adopted in planning meals.

1. Recommended Dietary Allowances

To plan a balanced diet the first step is to know the recommended dietary allowances for different age groups.

2. Food list

The next step is to prepare a food list ie., a list of quantities of various food groups to be included in the diet so that it is balanced and can meet the RDA. This can be done by

i. selecting foods from all the five food groups.

ii. deciding the quantities of the selected foods as multiples of portion sizes.

The number of portion of various food groups to be included in planning a balanced diet for adults is given in Table 1.4. For example

Table 1.4 : Balanced Diet for Adults – Sedentary / Moderate / Heavy Activity (Number of portions)

Food Groups	g/ portion	Sedentary		Moderate		Heavy	
		Man	Woman	Man	Woman	Man	Woman
Cereals and millets	30	14	10	16	12	23	16
Pulses	30	2	2	3	2.5	3	3
Milk	100 ml	3	3	3	3	3	3
Roots and tubers	100	2	1	2	1	2	2
Green leafy Vegetables	100	1	1	1	1	1	1
Other Vegetables	100	1	1	1	1	1	1
Fruits	100	1	1	1	1	1	1
Sugar	5	5	4	8	5	11	9
Fats & Oils (visible)	5	4	4	7	6	11	8

For non-vegetarians substitute one pulse portion with one portion (50g) of egg/meat/ chicken/ fish.

Source : Dietary guidelines for Indians - a manual, NIN, ICMR, Hyderabad, 1999.

the quantity of cereals and pulses to be included for an adult man doing sedentary work is 420g and 60g respectively.

Table 1.5 : Sample Meal Plan for an Adult man (Sedentary)

Meal Time	Food group	Raw Amounts	Cooked	Servings
Breakfast	Milk	100 ml	Milk or	½ Cup
	Sugar	15g	Tea or Coffee	2 Cups 1 Cup
	Cereals	70g	Breakfast	
	Pulses	20g	item	
Lunch	Cereals	150g	Rice	2 Cups
			Pulkas	2 Nos
	Pulses	20g	Dhal	½ Cup
	Vegetables	150g	Veg-curry	¾ Cup
	Vegetables	50g	Veg-salad	7-8 slices
	Milk	100ml	Curd	½ Cup
Tea	Cereals	50g	Snack	
	Milk	50ml	Tea	1 Cup
	Sugar	10g		
Dinner	Cereals	150g	Rice	2 Cups
			Pulkas	2 Nos
	Pulses	20g	Dhal	½ Cup
	Vegetables	150g	Veg. Curry	¾ Cup
	Milk (Curd)	50ml	Veg. Raita	½ Cup
	Vegetables	50g		½ Cup
	Fruit	100g	Seasonal	1 Medium

1 Cup = 200 ml Use 20 g visible fat per day.

Note : For Non-Vegetarians - Substitute one pulse portion with one portion of egg/meat/chicken/ fish.

Source : Dietary guidelines for Indians - a manual, NIN, ICMR, Hyderabad, 1999.

3. Planning the menu

The foods that are listed are converted into recipes and distributed in various meals like breakfast, lunch and dinner. A sample menu for an adult man doing sedentary work is given in Table 1.5. In the given table breakfast items include idli – 4 nos. / dosa – 3 nos. / upma – 1-1/2 cup / bread – 4 slices/ porridge – 2 cups / corn flakes with milk – 2 cups. Snack items include poha (riceflakes upma) – 1 cup / toast – 2 slices / samosa-2 / sandwiches-2 / biscuits - 5.

- - -

QUESTION

Part A

1. Males require more calories than females because of high_____.
2. One third of the day's calorie and protein requirements should be met by _____.
3. The major objective of meal planning is to achieve _____.
4. The proportionate expenditure on food _____ with decrease in total income.
5. The quantity of prepared food consumed by a person is called _____.
6. 100 ml of milk provides _____ k.cal of energy.
7. 30g of pulses provide an average of _____g protein.
8. The energy requirement per day for a teacher is _____ k.cal.

Part B

1. List the factors which determine the RDA of an individual.
2. How can meal planning be economized?
3. Enumerate the steps in meal planning.
4. Write a short note on portion size.
5. Define a balanced diet. What are the requirements of a balanced diet.

Part C

1. Elaborate on the various factors to be considered in planning meals for a family.
2. What are recommended dietary allowances? How were they arrived at?

2. NUTRITION IN PREGNANCY AND LACTATION

Nutrition requirements increase tremendously during pregnancy and lactation owing to the physiological changes. Wholesome nourishment before pregnancy has a greater impact on long term health than at any other time. A woman who has been well nourished before conception enters pregnancy with a good reserve of nutrients so that the needs of the growing foetus can be met without affecting her health. A well nourished foetus enters life with good physical and mental health. Moreover the reserve of nutrients laid before and during pregnancy help towards successful lactation after parturition.

2.1. PHYSIOLOGICAL CHANGES IN PREGNANCY

Foetal development is accompanied by many physiological, biochemical and hormonal changes which influence the nutrient needs and the efficiency with which the body utilizes them. The changes include

1. Increased Basal Metabolic Rate (BMR)

Due to foetal growth the BMR increases by about 5 percent in the 1st trimester reaching a high level of 12 percent during later stages of pregnancy.

2. Gastro intestinal changes:

Gastro intestinal motility diminishes which may result in constipation. The acid and pepsin secretion in the stomach is less and additionally a relaxed lower oesophagal sphincter may cause regurgitation of stomach contents into the oesophagus leading to sensation of heartburn and vomiting. This becomes more pronounced with increasing pressure of the foetus.

In later half of pregnancy the efficiency of absorption of iron, calcium and B vitamins increases as a natural adaptation mechanism to meet the increased needs.

3. Hormonal changes:

During pregnancy there is increased secretion of the following hormones.

- Aldosterone by the adrenal gland.
- Progesterone which relaxes uterine muscles to expand to accommodate the growing foetus.
- Thyroxin.
- Parathormone.

4. Changes in body fluid

The blood volume expands by 50 percent and this increased amount of blood is required to carry nutrients to the foetus and remove metabolic wastes from the foetus.

With increase in blood volume the concentration of plasma proteins, haemoglobin, blood glucose and water soluble vitamins decrease. The decline in serum albumin level tends to accumulate extra cellular water during pregnancy.

Haemoglobin level drops to 11g / 100ml (normal range 12-13 g / 100 ml) despite an increase in total haemoglobin content ie., haemodilution occurs. Thus during pregnancy, women with haemoglobin levels less than 10 g / 100 ml are considered anaemic.

5. Altered renal function

Increased blood volume and increased production of waste products like creatinine, urea and other wastes due to foetal and maternal metabolism produces a high Glomerular Filtration Rate (GFR) and the renal tubules are unable to adjust completely to this load. Some percentage of nutrients which are normally completely reabsorbed are excreted. Compounds like glucose , aminoacids and water soluble vitamins may appear in trace amounts in urine.

2.2. WEIGHT GAIN DURING PREGNANCY

Less than half of total weight gain resides in the foetus, placenta and amniotic fluid. The remainder is found in maternal reproductive tissues, fluid, blood and maternal stores (largely composed of fat). Fig. 2A gives the components of weight gain. The increasing subcutaneous fat in abdomen and thighs serves as energy reserve during pregnancy and lactation.

By full term, average weight gain during pregnancy for a normal healthy woman with desirable body weight is 12.5kg ranging between 11 – 13 kg.

The pattern of weight gain is as important as total weight gain. During first trimester there is little increase in weight (0.7 to 1.4kg). Thereafter a steady gain of 0.4kg/ week is desirable.

Table 2.1 gives an analysis of weight gain during pregnancy

Table 2.1 : Analysis of weight gain (g) in Pregnancy

Component	Period of gestation			
	upto 10 weeks	upto 20 weeks	upto 30 weeks	upto 40 weeks
Foetus and placenta	55	720	2350	4750
Uterus and breast	170	765	1170	1300
Blood	100	600	1300	1350
Extracellular water	—	—	—	1200
Fat	325	1915	3500	4200
Total	**650**	**4000**	**8500**	**12600**

Source : Passmore, P. Eastwood, M.A., ***Human Nutrition and Dietetics,*** English Language Book Society/Churchill Living Stone, 1986.

Weight reduction should never be undertaken during pregnancy. Excessive weight gain places an extra strain on the organs and increases the incidence of toxaemia during pregnancy.

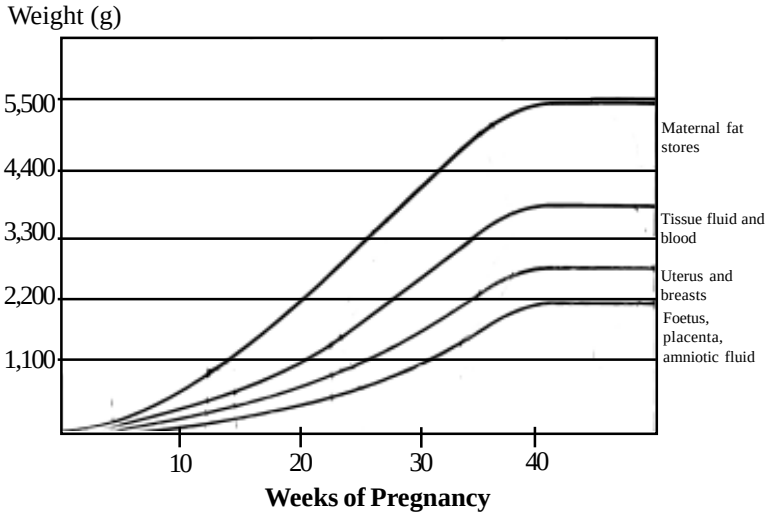


Fig. 2A : Components of weight gain in pregnancy

2.3. NEED FOR ADDITIONAL NUTRIENTS TO MEET THE DEMAND

A well nourished mother with a good reserve of nutrients can meet the demands of the foetus without affecting her health. Such a mother gives birth to a healthier baby with less complications.

1. Malnutrition and foetus:

Chronic moderate malnutrition and anaemia during pregnancy may result in still birth and Low Birth Weight (LBW) babies weighing less than 2500g. A large number of such babies are premature (<37 weeks of gestation) and rest suffer from Intra Uterine Growth Retardation (IUGR). IUGR results in babies which are Small For Date (SFD) ie, infants born after 40 weeks of gestation but small because of malnutrition during intrauterine growth.

The risk of Low Birth Weight babies and the related neonatal mortality is associated with one or more of the following factors.

- Low socioeconomic status.
- Poor maternal nutritional status.
- Small stature of the mother.
- Low prepregnancy weight for height.
- Biological immaturity (mothers less than 17 years).
- Low weight gain during pregnancy.
- Smoking, consumption of alcohol, use of drugs.
- Infectious diseases.
- Lack of education, poor knowledge on sound nutrition.
- Lack of motivation towards wanted pregnancy.

Fig. 2B explains the web of influence that can affect the outcome of pregnancy.

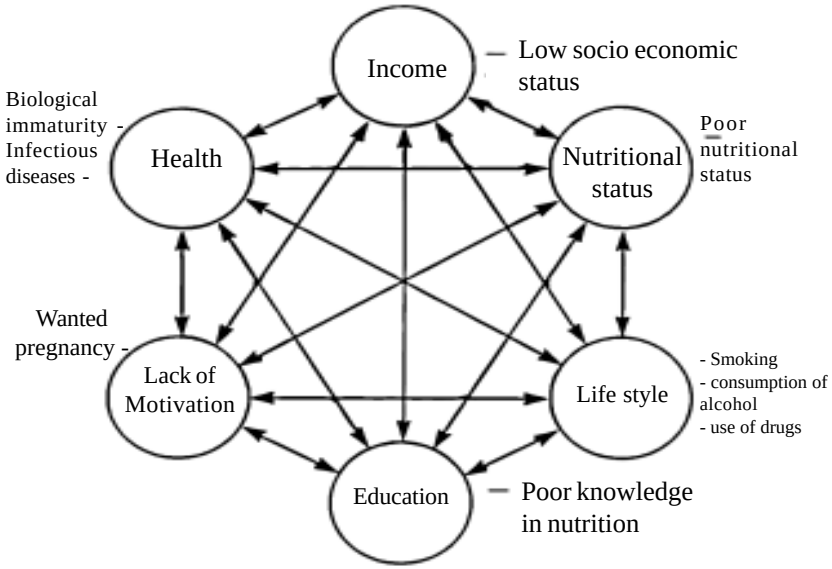


Fig. 2B : Web of influences that can affect the outcome of pregnancy

2. Effect of malnutrition on placenta

The placenta of malnourished mothers have fewer cells than well nourished mothers. The reduction in the number of cells reduces the ability of the placenta to

i. synthesize substances required by the foetus

ii. transfer nutrients

iii. inhibit the passage of potentially harmful substances to the growing foetus

3. Effect of malnutrition on maternal health:

A malnourished mother supplies nutrients to the foetus at the expense of her own tissues. Multiple micronutrient deficiencies during pregnancy like vitamin A, zinc, iron and folic acid are common and are associated with complications during pregnancy and labour. This may lead to abortion and even death of the mother.

4. Effect of malnutrition during infancy:

Inadequate nutrition during foetal life affects the health of the baby during infancy. Such infants develop nutritional deficiency diseases like rickets, anaemia or suffer from infectious diseases due to low resistance.

Hence it is essential to meet the increased nutritional needs of a pregnant mother.

2.4. NUTRITIONAL REQUIREMENTS DURING PREGNANCY

The RDA for an expectant mother is given in Table 2.2

Table 2.2

ICMR Recommended dietary allowances for an expectant mother

Nutrient	Normal Adult Woman	Pregnant Woman
Energy (k.cal)		
Sedentary	1875	2175
Moderate	2225	2525
Heavy	2925	3225
Protein (g)	50	65
Fat (g)	20	30
Calcium (mg)	400	1000
Iron (mg)	30	38
Vitamin A		
Retinol (µg)	600	600
(or)		
β carotene (µg)	2400	2400
Thiamine (mg)		
Sedentary	0.9	1.1
Moderate	1.1	1.3
Heavy	1.2	1.4
Riboflavin (mg)		
Sedentary	1.1	1.3
Moderate	1.3	1.5
Heavy	1.5	1.7
Niacin (mg)		
Sedentary	12	14
Moderate	14	16
Heavy	16	18
Pyridoxine (mg)	2.0	2.5
Ascorbic acid (mg)	40	40
Folic acid (µg)	100	400
Vitamin B_{12} (µg)	1	1

1. Energy:

Energy requirement during pregnancy is increased because of the additional energy required for

1. growth and activity of foetus
2. growth of placenta and maternal tissues
3. increase in maternal body size
4. steady rise in BMR

For a reference Indian woman (ICMR 1990) weighing 50kg, the total energy cost of pregnancy has been estimated to be 73000 k.cal. This includes the energy required for deposition of 4 kg of body fat (36000 k.cal) to be utilized later during lactation. Considering the increased energy demand during lactation and beneficial effect of increased energy intake on birth weight of infants and also protein sparing action, an additional intake of 300k.cal.per day during pregnancy is recommended.

2. Protein

An additional protein intake of 15g/day i.e. a total of 65g is recommended. The additional protein is essential for

1) growth of the foetus
2) development of placenta
3) enlargement of uterus,mammary gland
4) increased maternal blood volume
5) formation of amniotic fluid
6) preparation for labour, delivery, post partum period and lactation by maternal tissues.

3. Fat

ICMR expert committee has suggested an intake of 30g of visible fat/day during pregnancy. This is based on studies indicating that linoliec

acid requirements during this stage is 4.5 percentage of total energy. Of this, some of the essential fatty acid needs are met with by the invisible fat. Therefore an intake of 30g of visible fat has been suggested to meet the essential fatty acid needs.

4. Calcium:

The calcium requirement for an adult woman is 400mg/day. During pregnancy the need increases to 1000mg/day.

The additional calcium is needed for the growth and development of bones as well as teeth of the foetus and also for the protection of calcium resources of the mother to meet the high demand of calcium during lactation.

The amount of calcium deposited in the full grown foetus is around 30g. Therefore an intake of 1g calcium per day which meets the needs of the mother and the additional needs of pregnancy has been recommended by the ICMR. Inadequate intake of calcium results in the mobilization of calcium from mother bones resulting in demineralization of maternal bones and osteoporosis.

5. Iron:

The requirement of iron increases from 30mg/day to 38mg/day during pregnancy.

The increased requirement of 8mg/day is due to

i. expansion of maternal tissues including red cell mass, iron content of placenta and blood loss during parturition.

ii. to build the iron store in foetal liver to last for atleast 4-6 months after birth. This is because the baby's first food milk is deficient in iron. Generally infants are born with a high level of iron, 18-22g/ 100ml.

6. Iodine

Due to increase in BMR, iodine needs are also enhanced during pregnancy.

7. Zinc

Deficiency of zinc adversely affects the outcome of pregnancy. Apart from being a component of insulin and enzyme systems, it also participates in the synthesis of DNA and RNA, playing a significant role in reproduction. Hence zinc deficiency leads to foetal mortality, foetal, malformations and reduced intra uterine growth rate. The risk of LBW babies doubles and preterm delivery increases three times due to low zinc intake during pregnancy.

8. Sodium

The increase in extra cellular fluid increases sodium requirement. Hence restriction in diet may cause biochemical and hormonal changes.

When sodium level in blood drops (hyponatraemia), the kidney produces hormone renin which causes increased retention of sodium making it unavailable for normal body processes. When the system is overtaxed it results in sodium deficiency causing increased risk of eclempsia, prematurity and low birth weight infants. Normal sodium intake without restriction is advised during pregnancy.

Sodium is restricted when there is oedema or hypertension.

9. Vitamins

Vitamin A

Vitamin A requirements during pregnancy have been computed based on the vitamin A content of liver of the newborn. The additional intake works out to 25μg/day throughout pregnancy. Since this constitutes a very small fraction of the RDA for normal women, no additional allowance during pregnancy is suggested.

Vitamin D:

Vitamin D is essential as it enhances maternal calcium absorption. Its active form calcidiol and calcitriol can pass through placenta with ease and help in calcium metabolism of foetus. Since Vitamin D can be

synthesised in adequate amounts by simple exposure to UV rays no recommendation for vitamin D has been made.

Other fat soluble vitamins

Vitamin K is required for synthesis of prothrombin which is essential for normal coagulation of blood. A liberal vitamin K level in the mother's blood proves helpful in preventing neonatal haemorrhage. Hence it has become a routine to administer natural form of this vitamin by injection either to the mother before delivery or to the neonate soon after birth.

Thiamine, Riboflavin, Niacin

The RDA for thiamine, riboflavin and niacin is estimated on the same basis as for a normal adult woman ie., 0.5mg/1000 kcal, 0.6mg/1000k.cal and 6.6mg/1000k.cal respectively. As the energy requirement increases during pregnancy, the requirement of these vitamins also increases correspondingly.

Pyridoxine

Pyridoxine needs are increased during pregnancy. The ICMR committee has suggested an intake of 2.5mg of vitamin B6 during pregnancy, an increase of 0.5 mg per day.

Vitamin B_{12}

Based on the vitamin B_{12} content of foetus, the demand for this vitamin is estimated to be nearly 0.3μg / day. ICMR has suggested an additional allowance of 0.5 μg recommending a total daily intake of 1.5 μg of Vitamin B_{12} during pregnancy.

Folic acid

Normal adult woman requires 100 μg of folic acid per day. ICMR recommendations during pregnancy are 400 μg/day. Folic acid is essential for

1) increased blood formation i.e. haematopoiesis

2) synthesis of essential components of DNA/RNA which increase rapidly during growth

Supplementation of folic acid before conception and during first twelve weeks of pregnancy is recommended to reduce the primary and secondary neural tube defects among new born babies.

Vitamin C

The foetal requirement for vitamin C is too small to justify the additional intake of this vitamin during pregnancy. Moreover the recommendation for a normal adult woman, 40mg / day, includes a margin of safety. ICMR, therefore, has not recommended any additional intake of vitamin C during pregnancy.

The balanced diet providing the required nutrients as per the RDA for a pregnant woman doing sedentary work is given in Table 2.3

Table 2.3 : Balanced Diet for a pregnant woman (Sedentary work)

S.No.	Food Group	quantity in g
1.	Cereals and millets	300
2.	Pulses	60
3.	Milk (ml)	500
4.	Roots and Tubers	100
5.	Green leafy vegetables	150
6.	Other vegetables	100
7.	Fruits	200
8.	Sugar	20
9.	Fats and oils (visible)	30

For Nonvegetarians 30 g of pulses can be substituted with 50 g of meat / chicken / fish / egg.

Diet during pregnancy:

The basic principle of meal planning remains the same, but since the nutritional requirements increase during pregnancy, emphasis should be in including nutrient dense foods ie., foods that give more nutrients per calorie consumed.

During early months, the mother often suffers from morning sickness due to the hormonal and physiological changes, when she should be given small amounts of foods with increased frequency. Solid carbohydrate rich foods like bread, biscuit and fruit given in the morning or before meals helps to relieve nausea. Also fried, rich, strongly flavoured and spicy foods need to be avoided.

To meet increased requirements the mother should consume extra food. The mother can be given nutritious snacks in between meals rather than three meals a day thus increasing the frequency of feeding. Her feeding pattern should be 5-6 meals a day. Protein needs can be met by including good quality protein foods like meat, milk, egg, fish. Protein can also be obtained from pulses like soyabean and groundnut at a lower cost. To improve protein quality, a combination of plant proteins, as that in cereals and pulses, with small amount of animal protein should be used.

To meet additional iron needs foodstuffs like whole grain cereals, rice flakes, puffed rice, dried fruits, green leafy vegetables, eggs, enriched cereals and organ meats can be given.

Food rich in dietary fibre like fresh fruits, vegetables, whole grain cereals with plenty of fluids need to be included. This is to ward off constipation which is a common problem during pregnancy.

2.5. PROBLEMS DURING PREGNANCY

1. Nausea and vomiting

Generally it is mild and occurs during early pregnancy and is commonly called “morning sickness” as it tends to occur early in the

day but may occur at any time and can be improved by frequent small meals. If the condition develops to hyperemesis gravidarum, characterised by a severe prolonged persistent vomiting , then careful oral feeding and sometimes parenteral nutrition may be essential.

2. Constipation:

The pressure of the enlarging uterus on the lower portion of the intestine in addition to the muscle relaxant effect of placental hormones on the gastro intestinal tract and physical inactivity may make elimination difficult. Limited activity and exercise, insufficient fluid intake and insufficient bulk in diet may also be the causes of constipation.

Intake of plenty of fluids, foods rich in fibre helps to relieve constipation. Sometimes the weight of the foetus and downward pressure on veins leads to development of haemorrhoids.

3. Heart burn

Some pregnant women may complain of "feeling of fullness" or "heart burn" during later half of pregnancy. This is usually due to the pressure of the enlarging uterus crowding the stomach which in combination with the relaxation of the oesophagal sphincter may cause regurgitation of stomach contents into the oesophagus. This may cause a burning sensation due to gastric acid mixed with the food mass.

This feeling of fullness occuring due to gastric pressure, lack of space or gas formation can be avoided by taking small frequent meals and drinking fluids inbetween meals.

4. Oedema and leg cramps

Mild oedema due to physiological changes is usually present in the extremities in the third trimester. This may be caused by the pressure of the enlarging uterus on the veins returning fluid from the legs. This

oedema does not require sodium restriction or other dietary changes. Also the common occurance of cramps during night manifested by sudden contractions of the muscle is thought to be related to decline in the serum calcium levels, which is in turn related to calcium imbalance.

5. Pica

Pica refers to the compulsion for persistent ingestion of unsuitable substances that have little or no nutritional value like starch, clay and chalk.

6. Anaemia

A pregnant woman is labelled anaemic if the blood haemoglobin is less than 10g/100ml from the 28^{th} week onwards.

A significant fall in birth weight due to increase in prematurity rate and intrauterine growth retardation can occur if the haemoglobin level goes below 8 g / 100 ml. The demand for folate is increased due to increased cellular proliferation. Low folate levels are due to deficient intake. Megaloblastic anaemia due to folate deficiency results in intensified nausea, vomiting and anorexia.

7. Pregnancy Induced Hypertension (PIH)

PIH is a syndrome characterized by hypertension, proteinuria and oedema, convulsions or coma. The condition develops in the third trimester. Pre-eclempsia and eclempsia are the two stages which differ with the degree of symptoms, eclampsia denoting a severe stage. PIH is defined by systolic pressure of 140 mm Hg or diastolic pressure of 90 mmHg or both. A rise in systolic pressure by 20-30 mm Hg or diastolic pressure of 10-15 mmHg or both in two or more occasions six hours apart is diagnostic of PIH.

The extent of proteinuria varies with the degree of PIH. Oedema of pre-eclampsia may be associated with dizziness, headache, visual disturbances, facial oedema, anorexia, nausea and vomiting. In severe state of eclampsia convulsions occur near time of delivery. Optimal nutrition is the fundamental aspect of treatment.

9. Gestational diabetes mellitus:

Due to increased blood volume and corresponding metabolite load some glucose is excreted in urine. Most of these women revert to normal glucose tolerance after delivery. But they have a high chance of developing NIDDM after 40 years of age. The incidence of preclempsia is high in pregnant women with diabetes mellitus.

10. Ill effects of alcohol, caffiene, drugs and tobacco

Alcohol consumption during pregnancy leads to abnormal physical and mental development of foetus defined as Foetal Alcoholic Syndrome (FAS). Infants with FAS are premature and have low birth weight. They have distinct physical characteristics like small head, short eye slits which make the eyes looking far apart, flat mid face, thin upper lip and high evidence of central nervous system dysfunction.

Caffiene can cross the placenta and enter foetal circulation. Pregnant women who are heavy coffee drinkers are considered at risk for miscarriages, premature deliveries and may give birth to small for date infants.

Drugs used during pregnancy whether medicinal or recreational leads to numerous problems. Recreational drugs like heroin, LSD, marujuana lead to poor prenatal weight, short or prolonged labour and other perinatal problems. Self use of medicinal drugs especially during early stages of pregnancy may lead to malformation of the foetus.

Smoking during pregnancy results in placental abnormalities and foetal damage including prematurity and low birth weight. This is mainly due to reduced blood flow, which affects the oxygen and nutrient transport through the placenta.

Too early (teenage pregnancy) or too late (35 yrs and above) or too close (less than two years spacing) are not safe or conducive both to the health of the mother and infant.

LACTATION

Adequate nutrition for the mother during lactation is also of vital importance as the infant is dependant on mothers milk for its nutrition for the first few months of life. As the mother has to nourish the fully developed and rapidly growing infant, she needs extra nutrients to meet the baby's increasing needs in addition to her own requirements. A satisfactory diet during pregnancy will ensure a good store of nutrients for satisfactory breast feeding. Inadequate nutrition during lactation is reflected on both the quality and quantity of milk secreted.

2.6. PHYSIOLOGY OF LACTATION

Hormonal changes markedly increase breast areola and nipple size. During pregnancy estrogen secreted by the placenta bring about rapid development of glands in the breasts. Large quantities of progesterone change the glandular cells to actual secreting cells.

By the time the baby is born breasts reach a degree of development capable of producing milk. Yet, oestrogen and progesterone, despite their developmental effects on breast inhibit the actual formation of milk until after the baby is born. Thus during pregnancy the placental hormones inhibit the secretion of lactating hormones by the pituitary gland.

With the sudden expulsion of placenta during delivery the source of placental hormones is removed and secretion of lactogenic hormones is increased which bring about production and secretion of milk.

The process of milk production and secretion occurs in two distinct stages.

i. Prolactin reflex

When the baby sucks the breast, nerve impulses are passed up the spinal cord to the hypothalamus which stimulates anterior pituitary

leading to the secretion of prolactin. Prolactin is carried via the blood stream to the alveoli in the breasts where it stimulates milk production.

ii. Let down reflex

When the baby sucks, nerve impulses are passed to the posterior pituitary producing another hormone, oxytocin. Oxytocin contracts the muscle cells around the alveoli, squeezing out milk and propelling it down to the nipples.

The let down reflex is highly sensitive to emotional and psychological disturbances as well as physical contact. The mother's emotions, the baby's cry or even the baby's thought might initiate this reflex. On the other hand, anxiety, fear and tension may inhibit this reflex. Hence the mother should be comfortable and relaxed while feeding the baby.

These two reflexes operate simultaneously and release milk. Fig. 2C represents the process of stimulation of milk production.

As long as pituitary produces these lactogenic hormones, it cannot produce sufficient Follicle Stimulating Hormone (FSH) and Leutenizing Hormone (LH) which bring about ovulation. Thus lactation brings about natural contraception.

Table 2.4 gives the summary of hormonal control of lactation.

Composition of breast milk

Soon after delivery small quantities of thick, yellowish, viscous liquid called colostrum is secreted which is rich in antibodies and Vitamin A. This should be given to the baby and not discarded.

Fig. 2C : Process of stimulation of milk production

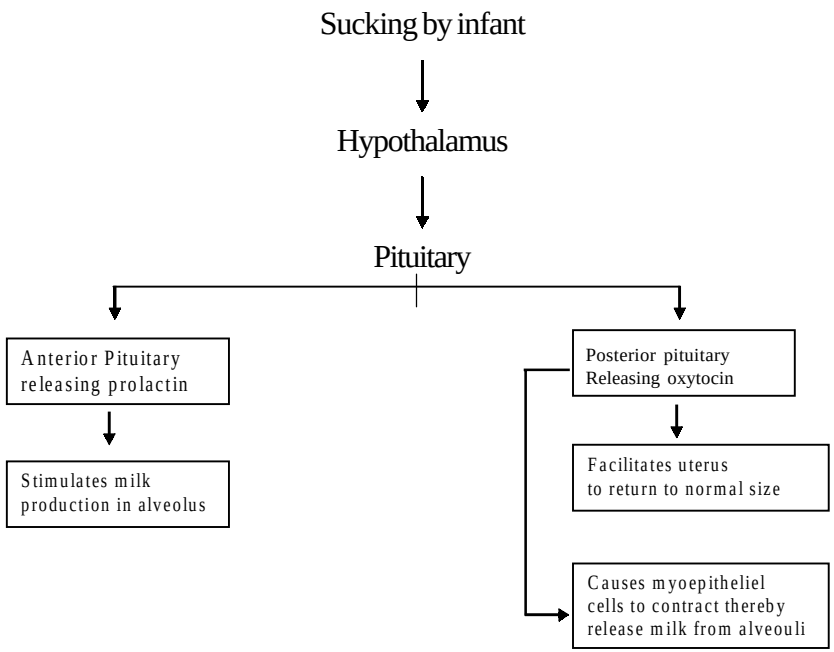


Table 2.4 : Summary of hormonal control of lactation

S.No.	Hormone	Source	Function
1	Estrogen	Ovary	Stimulates breast development
2	Progesterone	Placenta	Prepares breast for milk production by changing glandular cells to secreting cells
3	Prolactin	Anterior pituitary	Stimulates milk production
4	Oxytocin	Posterior pituitary	Facilitates release of milk from alveolus

After a few days of lactation the mother secretes larger amounts of less viscous and whitish milk known as "mature milk" which is more or less a complete food nutritionally. A healthy mother secretes 850ml of milk daily for which her nutritional needs are increased enormously.

Table 2.5 : gives the composition of mother's milk.

Table 2.5. : Composition of mother's milk

Nutrient	Quantity / 100 ml
Energy	65 k.cal
Protein	1.1g
Carbohydrate	7.4g
Fat	3.4g
Calcium	28mg
Iron	Negligible
Vitamin A (Retinol)	137 I.U.
Thiamine	0.02 µg
Riboflavin	0.02 µg
Vitamin C	3mg

Source : Gopalan C., Ramasastri B.V. and Balasubramanian S.C., (2000). ***Nutritive value of Indian Foods,*** NIN, ICMR, Hyderabad, India.

2.7. NUTRIENT NEEDS DURING LACTATION

ICMR nutrient recommendations for a lactating mother is based on the composition of breast milk and the fact that 850 ml of milk is produced daily. However the milk secretion continues to increase in the early periods of lactation upto six months and then gradually decreases. Therefore the nutrient requirements are given for the two periods in lactation ie., 0-6 months and 6-12 months. The RDA for a lactating mother is given in Table 2.6.

Table 2.6 : ICMR Recommended dietary allowances of a lactating mother

Period of Lactation

Nutrient	0 - 6 months			6 - 12 months		
	Sedentary activity	moderate activity	heavy activity	sedentary activity	moderate activity	heavy activity
Energy (k.cal)	1875 + 550	2225 +550	2925 +550	1875 +400	2225 +400	2925 +400
Protein (g)	75	75	75	68	68	68
Fat (g)	45	45	45	45	45	45
Calcium (mg)	1000	1000	1000	1000	1000	1000
Iron (mg)	30	30	30	30	30	30
Vitamin A						
Retinol (µg) or	950	950	950	950	950	950
β-carotene (µg)	3800	3800	3800	3800	3800	3800
Thiamin (mg)	0.9 +0.3	1.1 +0.3	1.2 +0.3	0.9 +0.2	1.1 +0.2	1.2 +0.2
Riboflavin (mg)	1.1 +0.3	1.3 +0.3	1.5 +0.3	1.1 +0.2	1.3 +0.2	1.5 +0.2
Niacin (mg)	12 +4	14 +4	16 +4	12 +3	14 +3	16 +3
Pyridoxine (mg)	2.5	2.5	2.5	2.5	2.5	2.5
Ascorbic acid (mg)	80	80	80	80	80	80
Folic acid (µg)	150	150	150	150	150	150
Vit. B_{12} (µg)	1.5	1.5	1.5	1.5	1.5	1.5

1. Energy

The lactating mother requires additional energy for the production of milk which is calculated from the volume of milk secreted, its energy content and the efficiency of conversion of food energy to milk energy. Based on the optimal output of 850 ml/day, energy content of 65 k.cal / 100 ml of breast milk and conversion efficiency of 80 percent, the additional allowance recommended during first six months of lactation is 550 k.cal / day. This is after taking into account the energy contribution from fat stores deposited during pregnancy. Most Indian mothers continue to lactate even after six months but the milk production is reduced. Hence ICMR has recommended an additional allowance of 400 k.cal / day for the period from 6 -12 months of lactation.

2. Protein

For production of milk, protein requirement also increases, as the produced milk contains 1.15g of proteins /100ml. The recommended additional protein intake during lactation is 25g per day for 0-6 months and 18g per day for 6-12 months.

3. Fat

ICMR has suggested an intake of 45g of visible fat per day. Although the total fat in breast milk is not influenced by the mothers diet, the composition of milk fat does. The fat also provides energy density to meet the higher energy requirement during lactation.

4. Calcium

Mothers milk contains 30-40 mg of calcium per 100 ml. Since about 850ml of milk is produced, around 300mg of calcium is secreted through milk per day. Therefore the additional intake of calcium is essential to enable the retention of 300mg of extra calcium daily. Since the dietary calcium retention in lactating women is 60 percent, ICMR has recommend 1000 mg of calcium per day for a lactating mother.

5. Iron

Since most mothers have lactational amenorrhea, it results in saving of nearly 1mg iron per day which otherwise would have been lost due to menstruation. This saving is more than sufficient to compensate for the negligible amount secreted in mother's milk and hence iron requirement during lactation is same as that of a normal adult woman ie, 30mg/day.

6. Vitamins

Vitamin A

The additional need of vitamin A during lactation is based on the amount secreted in mother's milk. On an average 300 µg of vitamin A is secreted per day. Hence ICMR has recommended an additional allowance of 350 µg of retinol ie.a total of 950 µg per day.

Thiamine, riboflavin and Niacin

As the calorie and protein requirements increase during lactation, the requirements of these vitamins also increase correspondingly. The amount of these vitamins computed on the basis of increased energy allowance would be sufficient to cover the amount secreted in breast milk. Hence the levels are computed on the same basis as that of adults i.e. 0.5mg/1000k.cal, 0.6mg / 1000k.cal and 6.6mg / 1000k.cal of thiamine, riboflavin and niacin respectively.

Pyridoxine

ICMR has recommended an additional intake of 0.5 µg i.e., total intake of 2.5 µg/day, same as that during pregnancy.

Folic acid

The folate content of breast milk is about 2.5 µg . Based on this, ICMR has recommended an additional allowance of 50µg/day of free folate ie., a total of 150µg free folate/day.

Vitamin C (Ascorbic acid)

Well nourished Indian mother secretes about 20mg of Vitamin C per day during lactation. Considering this and the cooking losses averaging to 50 percent, ICMR has recommended an additional intake of 40mg/day ie. a total of 80mg of ascorbic acid per day.

A balanced vegetarian diet for a nursing mother doing sedentary work is given in Table 2.7.

Diet during lactation:

A lactating mother requires not only large quantities of body building and protective foods but also additional energy yielding foods to facilitate copious formation and secretion of breast milk. Besides adhering to the basic principles of meal planning the following guidelines need to be considered.

- Large amount of fluids are essential for milk production. Therefore adequate fluids such as milk, fruit juice, milk based beverages and even water must be encouraged.
- The choice of food is wide during lactation. No food need to be restricted except spicy and strong flavoured foods which might impart flavour to milk that may be repulsive to the baby and that may cause gastric distress to the mother.
- Almost all medicines taken during lactation are absorbed into mothers blood and are secreted in the milk. Hence any medicine during lactation must be avoided or taken under strict medical supervision.
- Since the nutrient needs are enhanced, the meal pattern may be changed to 5-7 meals a day by introducing in between snack between the meals.

When a mothers diet is inadequate, her milk yield is usually well maintained by drawing on her own reserve of nutrients and evidence of malnutrition is likely to appear in the mother before it does in her child. Many women in poor communities have a remarkable ability to breast feed their infants for long periods. This is probably due to repeated stimulation of the neurohumoral reflex by frequently putting the baby to the breast and letting it suckle at night.

Fig. 2D gives foods to be consumed daily by a pregnant and lactating mother.

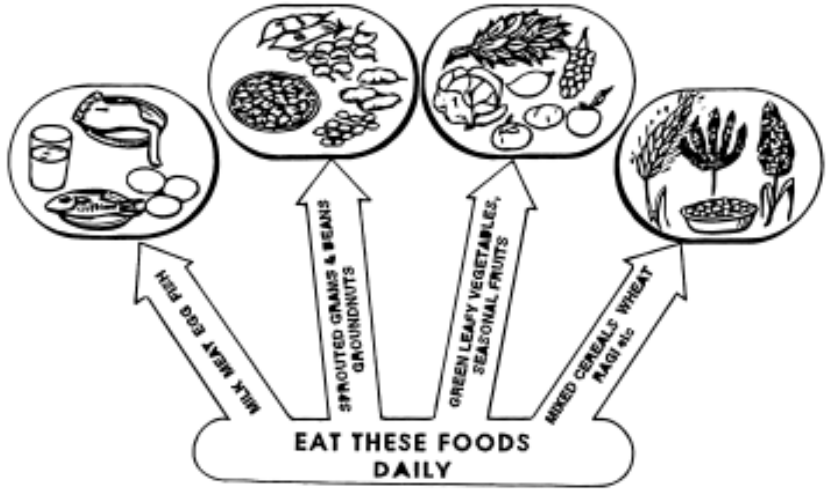


Fig. 2D : Foods for pregnant and nursing mothers

Source : Venkatachalam, P.S., and Rebello, L.M., ***Nutrition for Mother and Child,*** National Institute of Nutrition, ICMR Spl. Rep. Ser. No. 42, 2002.

Hence adequate diet during lactation will not only help the mother to maintain a sound nutritional status but also ensure good milk supply for a healthy infant.

Table 2.7 : A balanced vegetarian diet for a nursing mother doing sedentary work

S.No.	Food group	quantity in g
1.	Cereal and millets	330
2.	Pulses	90
3.	Milk (ml)	500
4.	Roots and Tubers	100
5.	Green leafy vegetables	150
6.	Other vegetables	100
7.	Fruits	200
8.	Sugar	20
9.	Fats and Oils	30

For Non-veg substitute 30 g of pulse with 50 g of meat / fish / chicken / egg.

Source : ***Dietary Guidelines for Indians - A manual,*** National Institute of Nutrition, ICMR, Hyderabad, India, 1999.

Galactogogues

Galactogogues are foods that help to produce more milk. Garlic, milk, almonds are considered to increase milk production. Studies carried out on nursing mothers have revealed that extra amounts of body building foods like fish and mutton increase the secretion of breast milk. Lactating mothers are also given special preparations containing ajwain, fenugreek seeds, which supply iron, protein, calcium and B-complex vitamins.

QUESTIONS

Part - A

1. The average weight gain during pregnancy is _____.
2. Low birth weight babies weigh less than _____.
3. The total energy cost of pregnancy is _____.
4. The growth and development of foetal bones and teeth demand an additional requirement of _____.
5. Iodine needs are enhanced due to increase in _____.
6. The compulsion for persistent ingestion of substances of least nutritional value like clay in called _____.
7. Severe prolonged persistent vomiting during pregnancy in called _____.
8. _____ hormone facilitates release of milk from alveoli.
9. The thick yellowish viscous liquid secreted by mother soon after delivery is called _____.
10. The additional energy requirement during 0 – 6 months of lactation is _____.
11. The calcium requirement of a lactating mother is _____ / day.
12. Foods that help to produce more milk are called _____.

Part - B

1. Write a short note on weight gain during pregnancy
2. What is the impact of malnutrition on the foetal and maternal health?
3. Explain any three problems during pregnancy.

4. List the dietary modifications for a pregnant woman.
5. Explain pre eclempsia and eclempsia.
6. List the guidelines to be followed in planning diet for a lactating mother.
7. State the reasons for the increased nutrient requirements during pregnancy and lactation .
8. Explain the role of hormones in lactation

Part - C

1. Explain the physiological changes in pregnancy .
2. Brief on the nutrient requirements during pregnancy .
3. Explain the physiology of lactation.
4. Elaborate on the nutrient requirement during lactation.

3. NUTRITION IN INFANCY

Infancy is a period of rapid growth. The development during infancy is rapid than any other period in the life time of an individual.

3.1. GROWTH AND DEVELOPMENT

The average birth weight of a newborn is 2.5 kg.

The growth and development is accompanied by a number of physiological changes which include

1. Change in body size

A healthy normal infant doubles its birth weight by six months and triples the birth weight by the end of one year. Similarly there is increase in body length of the infant from 50-55 cm at birth to about 75 cm during the first year. With increase in body length the body proportion also changes. By the time the child is two years old the head circumference achieves nearly 2/3rd of its final size and there is an increase in chest circumference.

2. Change in body composition

Weight gain comprises of growth in muscles, organ tissue, skeletal tissue and skeletal structure. At birth the infant has water content as high as 75 percent in its body,12-15 percent fat and poorly developed muscles. By the end of one year the water content decreases to 60 percent and fat content increases to 24 percent and there is a corresponding decrease in lean body mass. Mineralization of skeletal system takes place and continues during childhood and later during adolosence.

3. Changes in gastro intestinal system

A full term infant is able to digest simple proteins, emulsified fat and simple carbohydrates. During the first few months gastric acidity and salivary secretion is low. As the child grows the digestibility improves and by the end of first year the child is able to digest all types of food.

4. Changes in excretory system

Kidneys reach their full functioning capacity by the end of first year. During early months the glomerular filtration rate is low and hence excretion of high concentration of solutes is difficult.

5. Mental development

There is a rapid increase in the number of brain cells in the first 5-6 months after birth. Thereafter the rate of cell division declines though it continues till the second year.

6. Changes in circulatory system

The infants have a rapid heart rate of 120-140 per minute. At birth the level of haemoglobin is 18-22 g/100ml which provides sufficient reserve for expansion of blood volume and adequate oxygen carrying capacity to the growing tissues during the first 4-6 months.

7. Feeding behaviour

Maturation of nervous system especially that which controls muscular co-ordination brings about the change in feeding behaviour.

At birth the baby is able to co ordinate sucking, swallowing and breathing. Although the eyes cannot focus, the baby is able to find its nourishment by rooting reflex. Till about three months the baby sucks

by the up and down movement of the tongue which pushes out solid food if placed (extrusion reflex). By 3-4 months the tongue movements change and the child is able to swallow and by 6 months chewing movements also develop.

Growth monitoring

Though the above mentioned growth and developmental changes are significant, satisfactory growth in an infant can be accurately assessed by growth monitoring.

"Growth monitoring is a regular measurement of growth which enables to visualize growth, or lack of it and obtain specific, relevant and practical guidance to ensure continued regular growth and health of children."

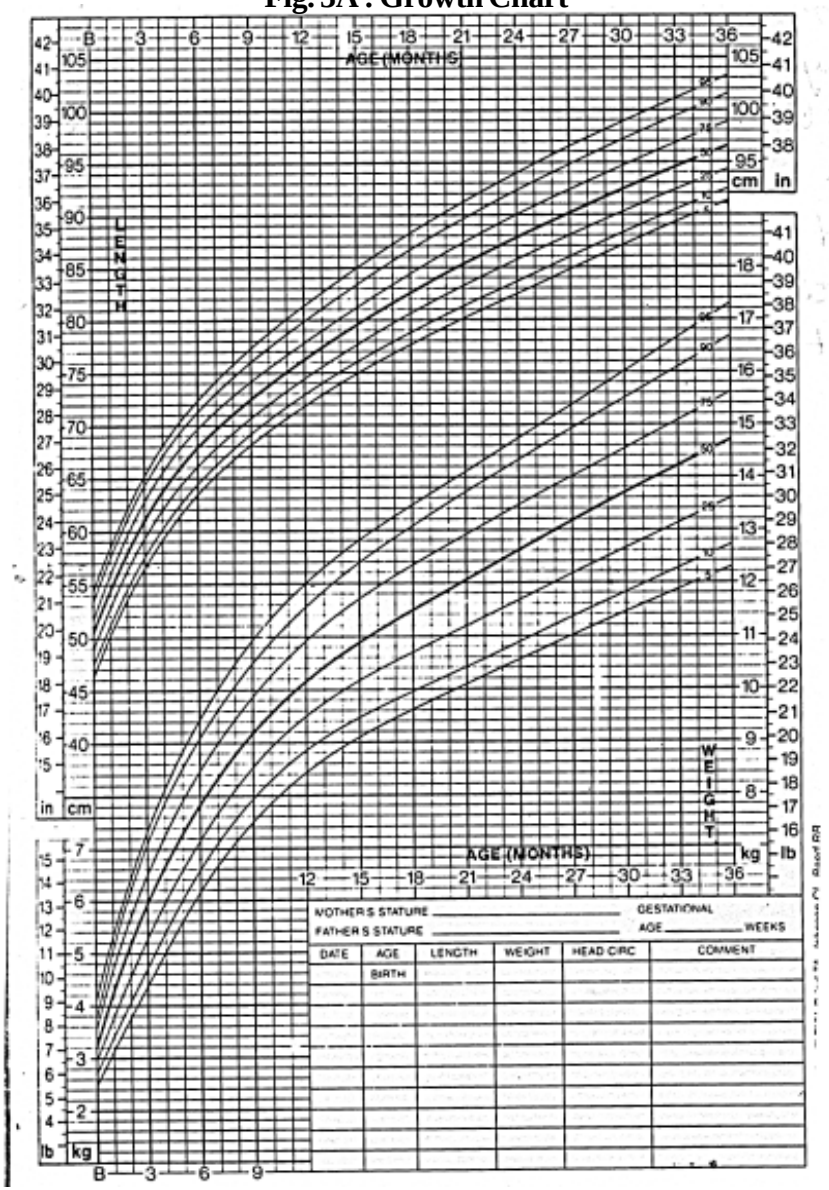
Though growth monitoring can be done in a number of ways the best way to do is by using a "Growth chart". (Fig. 3.A)

Immunization:

Malnutrition during infancy leads to higher incidence of infant mortality. Besides malnutrition there are certain other factors which compound with it causing mortality. Infectious diseases are one of them and hence it is important to protect the children against these disease through immunization.

Immunization is given at different ages during the first year of life which give life long immunity to the child against six dreadful diseases namely tuberculosis, polio, diphtheria, pertusis, tetanus and measles. So immunization is important not only for nutritionally deprived but for all children. Table 3.1 presents the immunization schedule.

Fig. 3A : Growth Chart



Source : Whitney E.N., and Rolfes S.R., (1999). ***Understanding Nutrition.*** 8th edition, West / Wadsworth.

Table 3.1 : Immunization Schedule

Age	Vaccine
Soon after birth	Hepatitus B 1st dose, OPV 1st dose, BCH
6 weeks	Hepatitis B 2nd dose DPT 1st dose OPV 2nd dose
10 weeks	DPT 2nd dose OPV 2nd dose
14 weeks	DPT 3rd dose OPV 4th dose
6 months	OPV 5th dose Hepatitis B 3rd dose
9 months	Measles
15 to 18 months	MMR
18 months	DPT, OPV 1st Booster
2 years	Typhoid vaccine
5 years	DPT, OPV 2nd Booster

Source : Primary Health Centre

3.2. NUTRITIONAL REQUIREMENTS

As growth during infancy is rapid, meeting the nutritional requirements is very important. Nutritional requirements for infants is based on the composition and intake of breast milk of well nourished population combined with the contributions from supplementary foods introduced around 4-5 months of age as mothers milk alone is inadequate after that. The RDA for infants is given in table 3.2.

Table 3.2 : ICMR recommended dietary allowances for Infants

Nutrients	0-6 months	6-12 months
Energy (k.cal)	108 / kg	98 / kg
Protein (gm)	2.05 / kg	1.65 / kg
Calcium (mg)	500	500
Vitamin A		
Retinol (µg) or	350	350
B carotene (µg)	1200	1200
Thiamine (µg)	55 / kg	50 / kg
Riboflavin (µg)	65 / kg	60 / kg
Niacin (µg)	710 / kg	650 / kg
Pyridoxine (mg)	0.1	0.4
Ascorbic acid (mg)	25	25
Folic acid (µg)	25	25
Vitamin B_{12} (µg)	0.2	0.2

1. Energy

The energy recommendations are based on the average secretion of 850 ml of milk per day by a well nourished mother. The infants require 108 k.cal/kg and 98 k.cal/kg during 0-6 months and 6-12 months of age respectively. Of the energy supplied 50 percent is used for basal energy, 25 percent for activity and 25 percent for growth.

Extremely active children may utilize more energy and hence there will not be weight gain unless additional calories are given. After six months 70 percent of energy requirement is met by breast milk and for the rest supplementary foods have to be given.

2. Protein

Protein requirements should not only meet the need for maintenance but also for the rapid skeletal and muscular growth. The human milk provides all the amino acids essential for proper growth. Protein intake of healthy infants during first 6 months of age is 2g/kg body weight. Protein requirement decreases after 6 months as do the energy requirement. After six months the protein requirement is 1.65 g/kg body weight, the contribution being equal from the mothers milk and vegetable protein supplements.

3. Fat

Adequately breast fed infants receive 30g of fat /day of which 10 percent is linoleic acid and 1 percent linolenic acid. Breast milk also meets the essential fatty acid requirements. Foods used as substitutes when breast milk is inadequate or not available should provide this proportion of fat and also ensure that 5-6 percent of energy is in the form of essential fatty acids. During weaning, the diet should provide 25 percent of energy from fat, which should be a blend of visible and invisible fat to reduce bulk.

4. Calcium

Upto 6 months when the infant is solely breast fed 300mg of calcium daily is adequate. Large per cent of calcium in breast milk is retained by infant. As the baby grows, rapid calcification of bones take place which is essential to support the weight of the body by the time the baby walks. To meet these requirements ICMR has recommended 500mg of calcium/day throughout infancy.

5. Iron

The infants require iron for growth, expansion of blood volume and for improving iron stores in the body. Considering the availability and absorption of iron an allowance of 1mg / kg body weight/day for an infant had been recommended. However, the ICMR has not suggested any RDA for iron due to the following reasons

a. The infant is born with good iron stores sufficient to last for four months. The haemoglobin level which is about 17g / 100ml at birth falls to 11g/100ml during second week. The released iron from the haemoglobin breakdown is stored in the infant to be used subsequently.

b. Though mothers milk contains negligible iron, the amount of bio available iron is sufficient to meet the needs of exclusively breast fed infants.

c. Loss of iron in infants is not known correctly and hence the amount to be replaced cannot be assessed.

6. Vitamins

Vitamin A

On the basis of vitamin A ingested by breast fed infants in well nourished communities the ICMR has suggested RDA for vitamin A as 350 µg per day throughout infancy.

Other fat soluble vitamins

ICMR has not recommended any allowance for vitamin D, vitamin E and Vitamin K. The vitamin D requirement placed between 200-400 I.U can be obtained by adequate exposure to sunlight.

B Complex vitamins

RDA for B complex vitamins is expressed in terms of weight of an infant which in reality is based on calorie consumption.

Completely breast fed infants derive the required thiamine and riboflavin requirements from breast milk. ICMR has recommended 55µg/kg body weight and 50 µg/kg body weight of thiamine and 65µg/kg body weight and 60µg/kg body weight of riboflavin during 0-6 months and 6-12 months of age respectively.

Niacin requirements are computed on the same basis as adults i.e., 6.6mg of niacin / 1000 k.cal which when expressed in terms of body weight will be 710 µg/kg and 650 µg/kg body weight for infants 0-6 months and 6-12 months respectively.

Folic acid requirements are based on the folic acid level in breast milk. Breast fed infants normally receive about 25 to 30 µg/kg of folic acid per day most of which is absorbed. Hence the ICMR has recommended folic acid intake of 25µg/day for infants.

It was observed that infants receiving 0.2 µg/kg of vitamin B12/day show normal haemopoiesis whereas those receiving less than 0.05 µg/day exhibit deficiency symptoms. Hence a daily allowance of 0.2 µg of vitamin B12 is recommended.

Vitamin C:

ICMR has recommended an intake of 25mg of vitamin C per day. This allowance is arrived after considering beneficial effect of Vitamin C on non-haem iron absorption.

3.3. BREAST FEEDING

Infants who are exclusively breast fed for the first 4-6 months of life grow well and breast feeding is beneficial not only during this period but also during later years of life. The infant is put on breast within half an hour after a normal delivery.

Colostrum:

During first two or three days colostrum is secreted in small quantities of about 10-40 ml. The composition of colostrum is as follows:

Nutrient	Quantity / 100 ml
Energy (k.cal)	58
Fat (g)	2.9
Calcium (mg)	31
Phosphorus (mg)	14
Iron (mg)	0.09
Protein (g)	2.7
Lactose (g)	5.3
Carotene (IU)	186
Vitamin A (IU)	296

Source : Guthrie A.H., ***Introductory Nutrition,*** Times Mirror/Mosby College Publishing

Colostrum contains interferon like substance which has strong antiviral activity. It contains B12 binding protein making it unavailable for growth of E-coli and other bacteria. It also contains antibodies against viral infection. Enzymes lysozyme and peroxidase which promote cell maturation are found to be more in colostrum.

Advantages of breast feeding

Breast feeding is the simple and best method of feeding and has the following advantages

1. Nutritional factors

The composition of human milk is best suitable for infants. Table 3.3 shows a comparison of human milk, cow's milk and Buffalo's milk.

It is observed that in human milk the protein content is lower but the content of carbohydrate, namely lactose is higher. The fat content

Table 3.3 : Comparison of Human milk with cow's and buffalo's milk

Nutrient Per 100 ml	Human milk	Cow's Milk	Buffalo's Milk
Water (g)	88	87.5	81
Energy (k.cal)	65	67	117
Protein (g)	1.1	3.2	4.3
Carbohydrate (g)	7.4	4.4	5
Fat (g)	3.4	4.1	6.5
Calcium (mg)	28	120	210
Phosphorus (mg)	11	90	130
Iron (mg)	--	0.2	0.2
Carotene (µg)	137	174	160
Thiamine (mg)	0.02	0.05	0.04
Riboflavin (mg)	0.02	0.19	0.1
Vitamin C (mg)	3	2	1
Caseinogen lactalbumin ratio	1:2	3:1	--

is comparatively less. This is advantageous to the infant as low protein reduces pressure on kidney to excrete extra nitrogen. Also the protein is present as lactalbumin which is better digested than protein in cow's milk.

Lactose provides natural sweetness and also helps in absorption of calcium and iron. Fat though less is highly emulsified and therefore better digested. Lipids in breast milk include unsaturated fatty acids, essential fatty acids, prostaglandin precursors, fat soluble vitamins, phospholipids and cholesterol.

When compared to animal milk, breast milk provides higher amount of vitamin C which is not destroyed by heating as it happens with cow's milk. The bioavailability of iron, in the presence of iron binding protein lactoferrin is higher. Similarly calcium in breast milk though less when compared to cow's milk is better absorbed by the infant.

2. Hormones and growth factors:

Breast milk is a rich source of hormones like Thyroid Stimulating Hormone (TSH), thyroxin, insulin and prolactin. It also contains growth regulating factors, growth promoters and growth modulators.

3. Immunological factors:

The following factors in breast milk provide passive immunity – that does not require the activation of the infants own immune defenses.

a. Macrophages: They can digest bacteria and also develop immunity against infectious diseases.

b. Lymphocytes: Lymphocytes produce antiviral substances like interferon. Lymphocytes also produce lymphokynes and other growth factors which stimulate proliferation and differentiation in the lymphoid tissue and its capacity to react to antigens.

c. Lactoferrin: It is an iron binding protein that inhibits the growth of E.Coli and other bacteria by binding the iron needed for their growth.

d. Lactobacillus bifidus factor: It is an amino sugar and contains N-acetyl neuraminic acid. It encourages the growth of the microorganism Lactobacillus bifidus and produces acetic acid or lactic acid from lactose and depresses the growth of pathogenic and disease causing organisms.

e. Enzymes: Breast milk also supplies enzymes like lipase, amylase and lactoperoxidase which increase digestibility and also destroy the harmful microorganisms.

f. Immunoglobulin: They are defensive proteins which include all types of antibodies. Immunoglobulin A is found in relatively high levels which offers protection against polio virus, streptococus and pneumococcus.

4. Economic factors

Breast milk is the most economical food for the baby. Even after accounting the extra food cost required by the mother, breast milk is cheaper than any other type of artificial feed.

5. Psychological factors

Breast feeding is essential for a healthy, happy and emotional relationship between the mother and the infant. While the mother gets a feeling of satisfaction, it gives a sense of security to the infant.

6. Natural contraceptive

During breast feeding there is a high level of protection, which prevents ovulation leading to lactational amenorrhea. This prevents the onset of another pregnancy due to suspension of menstruation and helps the uterus to return to its normal size. Breast feeding also prevents breast cancer.

7. Other advantages:

a. Infants jaw is more fully developed as he works harder to extract milk.

b. Breast milk is microbiologically sterile and hence less incidence of contamination and gastrointestinal problems.

c. Human milk is always fresh and at the right temperature.

d. It is convenient to administer at any time.

e. Low danger of incorrect formula or overfeeding.

f. Breast fed babies have better cognition and IQ later in life when compared to bottle fed babies.

In order to promote breast feeding and provide safe and adequate nutrition for the infant the Government of India has formulated the Indian National Code for protection and promotion of breast feeding. Subsequently the Infant Milk Substitute (IMS) act 1992 was passed to protect, promote and support breast feeding. According to this act there should be,

- no promotion of infant feeding products
- no display of artificial feeding products in health care facilitates
- the company personnel should not contact mothers for marketing and
- any brochures, booklets which advertise infant feeding products should not be permitted.

The World Alliance for Breast feeding Action (WABA) a network of organizations in collaboration with WHO and UNICEF, which also promote breast feeding, has declared August 1-7 as the world breast feeding week.

Artificial feeding

Though breast milk is the best milk and there can be no substitute for it, there are certain circumstances during which the infant need to be given artificial feeds.

Reasons related to mother

1. Illness of short duration like fever, cracked nipples or severe illness like tuberculosis, heart disease.
2. The mother is on steroids, anticoagulants or radioactive drugs.
3. Insufficient milk secretion.
4. Death of mother.

Reasons related to infant

1. Extreme prematurity.
2. Acute infections.
3. Congenital deformities like 'cleft palate' and gastrointestinal tract obstructions.

In the absence of breast milk, animal milk or toned milk is given as a substitute which need not be diluted but in cases when the infant is not able to digest, milk can be diluted using boiled water in the ratio of 3:1. When the baby is fed on animal milk, supplements of iron and vitamin C are essential.

Artificial milk formulae in dry form prepared from animal milk are available in the market which have been modified in nutrient content so as to resemble breast milk. These formulas are fortified with iron.

Whenever the infant is fed with an artificial food utmost care in handling and preparing the feed is essential. This includes cleanliness of utensils, bottles and nipples.

3.4. WEANING AND SUPPLEMENTARY FOODS

Weaning is the process of gradually introducing foods other than breast milk in the child's feeding schedule. The foods that are introduced in addition to breast milk are called supplementary foods. Introducing supplementary foods not only ensures the fulfillment of nutrient needs of the infant (which cannot be met by breast milk alone after 6 months) but also introduces the child gradually to the family eating pattern.

The nutrient density of the weaning foods should be 0.25k.cal to 0.4k.cal/g. Hence calorie dense foods should be given. Weaning food should provide atleast 10 percent of energy as protein.

Types of supplementary foods

I. Liquid supplements

1. Milk:

Initially milk can be given diluted with water in the ratio of 3:1, then the amount of water can be gradually reduced so that the infant consumes undiluted milk within a few weeks.

2. Fruit juices:

Fresh juices of tomato, grapes, oranges and sweet lime can be given. When this is introduced between 4-6 months a teaspoon of it can be diluted with little water and given. Gradually the quantity can be increased and undiluted juices (85ml of orange juice) can be given.

3. Soups:

Soups of green leafy vegetables can be given. The leafy vegetable is washed well with water and prepared in the form of soup by boiling it with a minimal amount of water and a little salt and onion. First the soups may be strained and later on unstrained soups can be given.

II. Semi solid supplements

Semi solid supplements may be given at 5 - 6 months. The first solid food commonly offered is a cereal or a starchy vegetable like potato, well cooked and mashed. In case of cereals small quantities of milk and sugar are added. Calorie dense foods can be prepared by using malted wheat or ragi.

Cooked mashed vegetables like potatoes, carrots, green leafy vegetables can be introduced starting with small quantities, which supply vitamins and add colour to the diet.

Fruits should be mashed and steamed except for banana until one year after which fruits can only be stewed.

Yolk of egg can be given at 6-7 months. Half a teaspoon of yolk can be started with and if tolerated, gradually increased to one yolk. Yolk can also be introduced as soft custard. Egg white because of its allergic manifestation is given only after 10 months. Thereafter whole egg can be given as poached or soft boiled.

Ground and cooked meat, boiled fish may be given with little flavouring and salt.

Pulses well cooked along with the cereals as kichidi or pongal can be given or can be made into porridge. Pulse and meat preparations can be given on alternate days, so that the baby receives each of them 3 or 4 times a week.

III. Solid supplements

When the baby starts cutting teeth solid supplements are given. Cooked cereals, pulses and vegetables can be given. Solids like idli, chappathi, rice and dhal can be given after the child gets used to semisolids. Meat may be minced fine instead of ground.

Vegetables chopped and boiled, leafy vegetables, soft and boiled raw carrots and fruit segments without skin and seeds can be given. When fed with solid supplements, plenty of water should be given to the child. Small amount of boiled, cooled water has to be given 2 to 3 times a day and more often during hot weather.

Table 3.4. presents the quantity of different foods to be included in the diet of 6-12 months old infant. Care should be taken in preparing the foods in a special way according to the age of the infant.

Table 3.4 : Balanced Diet for Infants (6-12 months)

S.No.	Food groups	quantity (gm)
1.	Cereals and millets	45
2.	Pulses	15
3.	Milk (ml)	500*
4.	Roots and tubers	50
5.	Green leafy vegetables	25
6.	Other vegetables	25
7.	Fruits	100
8.	Sugar	25
9.	Fats/oils (visible)	10

* Quantity indicates milk apart from breast milk. For breast fed infants 200 ml is required.

Source : ***Dietary Guidelines for Indians - A manual,*** National Institute of Nutrition, ICMR, Hyderabad, India, 1999.

Points to be considered in Weaning

1. Only one food should be introduced at a time.
2. Small quantities of food should be given at the beginning and the amount gradually increased as he develops a liking for it.
3. The child should never be fed by force. If the child shows dislike for a particular food, it should be removed from the diet and tried again after a week or two. If the dislike persists the food can be replaced by a substitute.
4. Food given should not be spicy. Fried foods should also be avoided.

5. Variety in child's diet is important to make it more appealing. As soon as the baby accepts a particular food well the next one may be started so that in time he / she learns to accept a good variety of foods. As the child grows the colour, flavour, texture and shape of food should be given special consideration so as to attract the child's attention.
6. To inculcate good eating habits and to encourage the child to eat all types of food, the parents should not show any personal dislike towards any food.

Low cost weaning foods

Several low cost weaning foods have been developed by the Institutes like Central Food Technology Research Institute (CFTRI), Mysore, National Institute of Nutrition (NIN) Hyderabad, Avinashilingam Deemed university (ADU), Coimbatore and Gandhigram Rural Institute. Indian multi purpose food, malt food, Balahar, Kuzhandhai Amudhu, win feed are a few of them. They are very nutritious and can be easily prepared at home. Table 3.5 gives a list of low cost supplementary foods with their composition.

3.5. FEEDING A PRETERM BABY

The preterm babies are those who are born before 37 weeks of gestation. Goal of feeding the preterm is to achieve a growth rate that approaches the normal growth rate of foetus in uterus.

The preterm is at a disadvantage in many aspects of nutrition. The problem facing the preterm are, poor sucking and swallowing reflexes, relatively high caloric requirement with small stomach capacity, and incompetent cardiooesophageal sphincter leading to aspiration, decreased absorption of essential nutrients.

The caloric need of non-growing preterm babies during the first week of life are 60 kcal / kg / day. After first one or two weeks of life most preterm babies require 120 - 150 kcal / kg / day to maintain satisfactory growth. High calories may be necessary in babies who are not gaining weight, post - operative patients and extreme preterms.

Table 3.5 : Low cost supplementary foods

Name	Composition
Indian Multi purpose Food (CFTRI)	Low fat groundnut flour and bengal gram flour (75:25) fortified with vitamins A, D, B1, B2, and calcium carbonate. Contains 42 percent protein.
Malt food (CFTRI)	Cereal malt, low fat groundnut flour, roasted bengal gram flour (40:40:20) fortified with vitamins and calcium salts. Contains 28 percent protein
Balahar (CFTRI)	Whole wheat flour, ground nut flour, and roasted bengal gram flour (70:20:10) fortified with calcium salts and vitamins Contains 20 percent protein
Supplementary food (NIN)	Roasted wheat flour, green gram flour, groundnut and sugar or Jaggery (30:20:8:20) contains 12.5 percent protein.
Kuzhandai Amuthu (ADU)	Roasted maize flour, green gram flour, roasted groundnut and Jaggery (30:20:10:20) contains 14.4 percent protein.
Win food (Gandhigram rural Institute)	Pear millet, green gram dhal, groundnut flour and jaggery (50:15:25:25). Contains 20 percent protein.
Amutham	Rice flour, ragi flour, bengal gram flour, sesame flour, groundnut flour and Jaggery (15:15:15:10:10:25). Contains 14 percent protein.
Poshak	Cereal (Wheat / maize / rice / jowar), pulse (Channa dal or green gram dhal) and oil seed (Ground nut) and jaggery (4:2:1:2)
Amirtham ADU	Wheat (roasted) - 37.5 g, roasted bengal gram - 18.8 g, soyaflour 6.2 g, groundnut 12.5 g, beet sugar 25 g.

Fluid needs of the preterm babies are relatively high during the first week of life. The intake of fluids varies from 90 - 100 ml / kg / day for 7 - 10 days. Additional fluids may be required when the baby is under the phototherapy or a radiant warmer.

Very low birth weight babies may have difficulty in tolerating the lactose the first few days. Glucose polymers are well tolerated.

Preterm babies require 3 - 4 g of protein per kilogram of body weight for rapid growth. Certain amino acids essential for the preterm such as cystine, taurine, alanine and arginine are present in breast milk.

Very low birth weight babies poorly digest and absorb saturated triglycerides. Vegetable oils containing unsaturated long chain fatty acids are better absorbed. Better still are medium chain triglycerides because their digestion and absorption are not dependent on bile salt level.

Calcium and phosphorus supplements may be needed to prevent rickets or osteopenia in preterms. Iron deficiency can occur by 6 - 12 weeks and hence 2.5 mg / kg / day of iron starting from 6 - 8 weeks of age may be given.

All low birth weight babies should receive vitamin supplementation in addition to the amount present in human milk.

The preterm babies are best fed with unprocessed human milk obtained from their mothers. It has been shown that milk of mothers delivering premature babies has higher caloric, fat, protein and sodium content which is suitable for the nutritional needs of low birth weight babies. Antimicrobial property of breast milk is of great importance to the preterm baby. If the baby does not gain weight satisfactorily with breast milk alone, dietary supplements like vegetable oils (corn oil, groundnut oil) may be used which increase the calorie value without increasing its volume.

When human milk feeding is not possible one must resort to animal milk or formula feeds.

QUESTION

Part A

1. A healthy normal infant _____ its birth weight by six months.
2. The body water content of infants _____ by end of one year.
3. World's breast feeding week is_____.
4. The reflex by which an infant pushes out solid food if placed is _____.
5. Growth monitoring is best done using _____.
6. The energy requirement of infants during 0-6 months is _____ k.cal / kg of body weight.
7. The ICMR allowance for vitamin C per day for an infant is _____.
8. The nutrient density of weaning foods should be _____.
9. Yolk of egg can be given at _____ months of age during infancy.

Part B

1. Give the immunization schedule for an infant.
2. Explain how breast milk provides immunity to the infant.
3. Enumerate the important points to be considered in weaning.
4. Brief on the liquid supplements that can be given for an infant.

Part C

1. Explain growth and development during infancy.
2. What are the advantages of breast feeding?
3. Explain the nutrient requirements during infancy.

4. NUTRITION DURING PRESCHOOL AGE (1-6 YEARS)

The rapid growth during infancy is followed by a generally slow growth between one to six years. The child becomes more active and the social and environmental influences have a great impact on his food behaviour and eating pattern. Development of full dentition by the end of two years increase the range of foods that can safely be eaten. The need for nutrients is increased as growth and development continues.

4.1. Growth pattern

During the second year, the increase in height is about 10cm and weight gain is 2 to 2.5 kg. After two years annual gain in height and weight is only six to seven cm and 1.5 to 2 kg respectively. However there is a wide variance in the physical development of children.

As growth proceeds, changes occur in proportion of water, muscle tissue, fat deposits and skeletal structure. The body water gradually decreases and there is addition of adipose tissue and that of minerals to the bones.

Psychosocial changes also take place. As he steps into the second year he develops a sense of individuality which is distinct and is reflected in his food behaviour. With advancing age there is an increasing sense of independence, initiative, imagination and curiosity.

Preschool age is also a period of imitation and sex identification, with boys imitating their fathers and girls their mothers. Such behaviour is reflected at meal times and therefore the parents play an important role in inculcating healthy and positive attitude towards food.

Table 4.1 : ICMR Recommended dietary Allowance of Preschool Children

Nutrient	Age (in years)	
	1 – 3	4 - 6
Energy (k.cal)	1240	1690
Protein (g)	22	30
Fat (g)	25	25
Calcium (mg)	400	400
Iron (mg)	12	18
Vitamin A:		
Retinol (µg) or	400	400
β carotene (µg)	1600	1600
Thiamine (mg)	0.6	0.9
Riboflavin (mg)	0.7	1.0
Niacin (mg)	8	11
Vitamin C (mg)	40	40
Pyridoxine (mg)	0.9	0.9
Folic acid (µg)	30	40
Vitamin B_{12} (µg)	0.2 – 1	0.2 - 1

4.2. NUTRITIONAL ALLOWANCES

1. Energy

Energy is required for growth and activity. The rate of growth fluctuates with age. Upto 10 years, there is no difference in sex for dietary allowance. The energy requirements are 1240 k.cal for 1-3

years and 1690 k.cal for 4-6 years. Improper weaning may lead to protein and energy malnutrition.

2. Protein

The increasing muscle mass requires a positive nitrogen balance. The basal losses and the additional requirement for growth have been considered in determining the allowances for protein. The protein requirement is 22g and 30g for age groups 1-3 years and 4 – 6 years respectively.

3. Fat

Adequate fat is required to provide the extra calories as well as to add calorie density and reduce bulk in the diet. The linoleic acid requirement is 3 percent of energy. To provide sufficient energy density and improve palatability of the diet 25g of visible fat per day has been suggested.

4. Calcium

Calcium requirements are assessed based on the calcium accretion in the body during period of growth. This deposition is not uniform throughout the growing period but is relatively higher during early childhood and during adolescence. Moreover all dietary calcium is not absorbed. Hence to ensure a positive balance, 400mg of calcium per day is recommended.

5. Iron

Iron requirements during childhood need to cover the basal loss of iron from the body, amount needed for growth and for increase in the haemoglobin concentration by about 1g/ dl. Based on this the requirements are given as 12 mg/day and 18 mg/day for 1 – 3 years and 4 – 6 years respectively.

6. Vitamins

Vitamin A

It has been observed that the incidence of vitamin A deficiency is high and serum vitamin A levels are low in Indian children whose intake of Vitamin A is less than 100µg/day. However, when food supplements providing a total of 300µg/day are given over a period of six months the deficiency symptoms disappear. Based on this observation and including a safety allowance, ICMR has suggested an intake 400 µg of vitamin A/day.

B complex vitamins

The recommended intake for B vitamins is based on the energy intake and is calculated as for adults i.e., 0.5mg/1000k.cal, 0.6mg/1000k.cal and 6.6mg/1000k.cal for thiamine, riboflavin and niacin respectively.

Folic acid and pyridoxine requirements are computed from interpolation of values for infants and adults. The requirement for children is slightly higher than that of infants.

Vitamin C

ICMR has suggested the same level of vitamin C as for adults i.e, 40 mg/day for preschool children.

The RDA for preschool children is given in Table 4.1.

The quantities of various food groups to be included in a balanced diet for preschool children is given in Table 4.2.

Table 4.2 : Balanced diet for Preschool Children

S.No.	Food groups	quantity (g)	
		1 - 3 years	4 - 6 years
1.	Cereals and Millets	120	210
2.	Pulses	30	45
3.	Milk (ml)	500	500
4.	Roots and tubers	50	100
5.	Green leafy vegetables	50	50
6.	Other vegetables	50	50
7.	Fruits	100	100
8.	Sugar	25	30
9.	Fats / oils (visible)	20	25

Source : ***Dietary Guidelines for Indians - A manual,*** National Institute of Nutrition, ICMR, Hyderabad, India, 1999.

4.3. Need for developing good food habits

The preschool years are ones that create a number of concerns about food intake. Nearly two out of three preschool children in India are malnourished. The different household factors affecting the child's nutrition are

- The economic status which determines the food available and thus the energy density of food.
- The mother's experience and knowledge which influences the food preparation and food intake by the child.
- Demand on mother's time to prepare the food
- Poor sanitation and water supply
- Poor living conditions

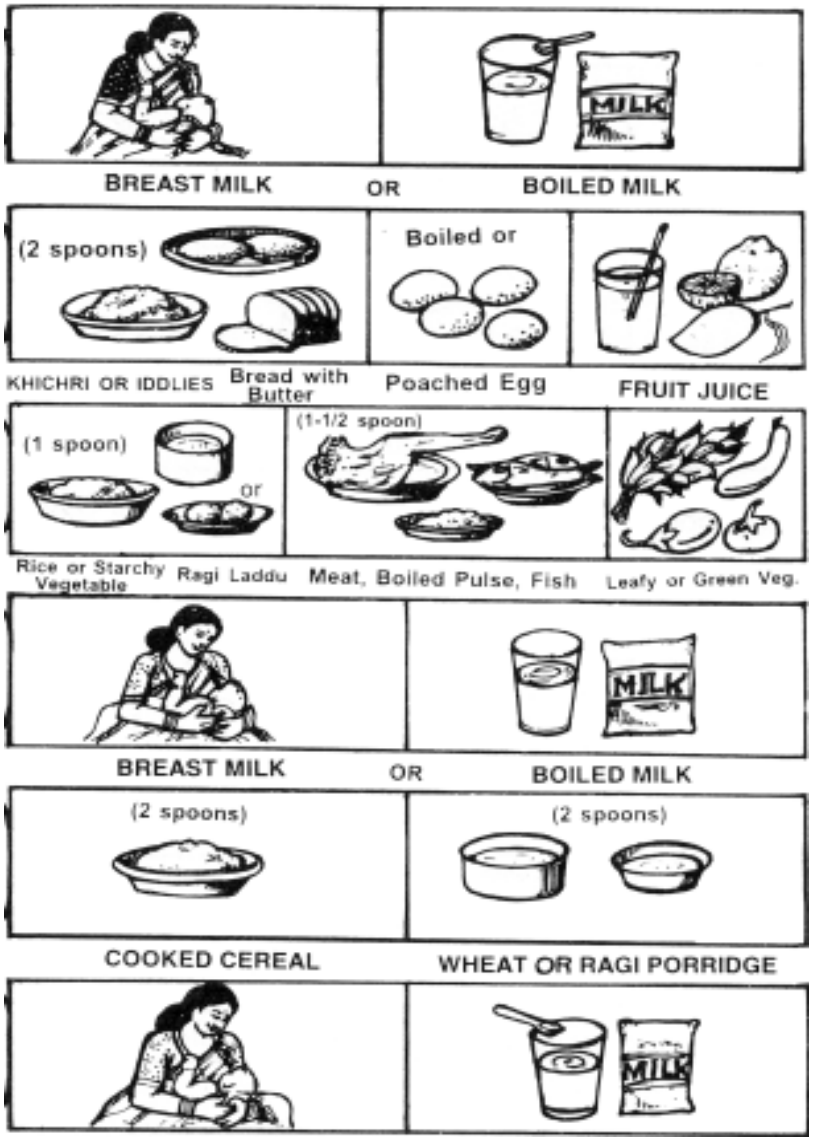


Fig. 4A : Meal - plan for Children (1 - 3 years old)

Source : Venkatachalam, P.S., and Rebello, L.M., ***Nutrition for Mother and Child,*** National Institute of Nutrition, ICMR Spl. Rep. Ser. No. 42, 2002.

- Contamination of food leading to infectious diseases
- Parental influence in showing dislike for a particular food.

These factors in turn affect the food intake leading to severe malnutrition and this has a profound impact on the growth and performance during later years.

In addition to these the preschoolers may show certain likes and dislikes which when not properly interpreted may lead to undernutrition. They may show interest in certain foods that may last from few months to few years. Food preferences may change from time to time. Also certain foods are liked by them only when cooked in a particular way.

Appetite is also erratic, with the result that the child may eat one meal well refusing the next. So there must be no hurrying at meal times, the atmosphere should be pleasant, peaceful and lacking distraction.

There should be regularity of meal times. The child should be taught to eat everything on his plate.

Proper evacuation of faeces shall be maintained by daily diet of fruits, vegetables and whole grains. They prefer simple unmixed dishes that are neither too cold nor too hot. Familiar foods are better liked and hence new foods should be given in small portions along with well accepted ones.

A balance should be maintained between hard and soft foods. Colourful foods add variety and stimulate interest. Finger foods such as cutlets, hard boiled eggs, small sandwiches, rolls and whole fruits are handy.

At the table, physical comfort while sitting, unbreakable bowls and cutlery with blunt edges will help the child in his/her efforts to feed himself.

Hence it is essential that good food habits are inculcated during childhood considering their food preferences.

4.4. PREVALENCE OF PROTEIN ENERGY MALNUTRITION (PEM), VITAMIN A DEFICIENCY AND ANAEMIA

Protein energy malnutrition, micronutrient deficiencies such as vitamin A deficiency and iron deficiency anaemia are common among preschool children.

The primary cause of malnutrition is a faulty and inadequate diet. Besides diet and socio economic factors various environmental factors aggravate the dietary deficiencies. These include

- chronic infection
- poor environmental sanitation
- poor insanitary living conditions and
- poor personal hygiene.

Protein Energy Malnutrition

PEM is defined as a range of pathological conditions arising from coincident lack of varying proportions of protein and calorie, occurring most frequently in infants and young children and often associated with infection.

The symptoms vary with the degree of malnutrition. Symptoms of different types of PEM is as follows.

1. Kwashiorkor : Oedema of face and lower limbs, failure to thrive, anorexia, diarrhoea, dermatitis, apathy, sparse, soft and thin hair, angular stomatitis, cheilosis and anaemia.
2. Marasmus : Failure to thrive, irritability and apathy, diarrhoea, dehydration. The child is shrunk and there is little or no subcutaneous fat.

3. Marasmic kwashiorkor : These children exhibit symptoms of both marasmus and kwashiorkor.
4. Nutritional dwarfing : Characterised by a marked retardation of growth.

The peak prevalence of protein energy malnutrition is observed in the age group of 2-3 years and marasmus between 1-2 years. Over 80 percent of under five are estimated to be malnourished and 1-2 percent suffer from severe malnutrition. Also, more than 50 percent of deaths in children is attributed to malnutrition either directly or indirectly.

The NNMB survey (1988 - 1990) of rural children reveals that only 10 percent are normal with weights above 90 percent of the standard weights. A majority of the children exhibit mild or moderate malnutrition while 7-8 percent are severely malnourished.

About 1-2 percent of preschool children suffer from severe forms of PEM namely kwashiorkor and marasmus and more than half of the Indian preschool children suffer from sub clinical undernutrition manisfested by low weight for age. About 65 percent of them are stunted which indicates undernutrition of long duration.

Vitamin A deficiency

Inadequate dietary intake of vitamin A or its precursor (β - carotene) is the most contributory factor for vitamin A deficiency.

Blindness due to xerophthalmia is an important public health problem among children in India. The term xerophthalmia includes all ocular manifestations of vitamin A deficiency like Night blindness, conjunctival xerosis, Bitot's spot and corneal xerosis.

Vitamin A deficiency is exhibited as Bitot's spots in 3 percent of preschool children and 30-40 thousand children become blind every year. Vitamin A deficiency increases the risk of disease and death.

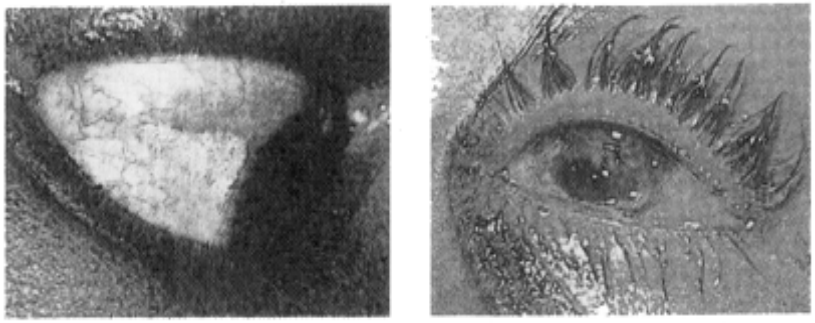
Iron deficiency anaemia

This is caused by the dietary lack of iron or inadequate absorption and utilization of iron. The symptoms include

- skin appears pale
- fingernails become thin and flat and eventually results in koilonychia (spoon – shaped nails)
- atrophy of papillae of tongue, glossitis
- angular stomatitis and dysphagia
- gastritis resulting in achlorohydria

Long term deficiency symptoms result in malfunctioning of various systems. The general symptom are lassitude, fatigue, breathlessness on exertion, palpitation, dizziness, headache, dimness of vision, insomnia and angina.

More than 50 percent of preschool children suffer from iron deficiency anaemia.



Bitot's Spot Keratomalacia

Fig. 4B : Symptoms of Vitamin A deficiency

Source : Srilakshmi B. (2002). Dietetics. 4th ed. New age International Publishers.

The prevalence of malnutrition in preschool children is shown in Table 4.3.

Table 4.3 : Prevalence of malnutrition among preschoolers in India

Aspects	Prevalence (%)
Low birth weight	30
Kwashiorkor / marasmus	1 - 2
Bitot's spots	3
Iron deficiency anaemia	50
Underweight (weight for age)	53
Stunting (height for age)	65

Source : ***Dietary Guidelines for Indians - A manual,*** National Institute of Nutrition, ICMR, Hyderabad, India, 1999.

The high prevalence of these nutrient deficiency diseases stress the need for a balanced, nutritious diet during preschool years.

QUESTION

Part A

1. Annual weight gain of children during second year is _____ kg.
2. The Iron requirement of children 1-3 years of age is _____ per day.
3. The protein requirement of children in the age group of 4-6 years is _____ per day.
4. The primary cause of malnutrition among preschoolers is _____.

Part B

1. Explain growth pattern during preschool age?
2. What is the need for developing good food habits during preschool age?
3. Brief on the various deficiency diseases prevalent among preschoolers?

Part C

1. Explain the nutrient allowances during preschool age?

5. NUTRITION DURING SCHOOL AGE (6-12 YEARS)

The school age, six to twelve years, is a latent period of growth. During this stage growth is slow and body changes occur gradually. The nutritional requirement is the same for boys and girls upto nine years after which girls out do boys and there is a change in some of the nutrient requirements for boys and girls.

5.1. GROWTH PATTERN

Though rate of growth is slow during school years, adequate reserves are laid down during this period for the rapid growth during adolescence. Hence the age from 6-12 years is being called the "lull before the storm".

Usually girls have a higher deposition of body fat as compared to boys of the same age but have less percentage of muscle tissues. During childhood boys are taller and heavier at each stage than girls but at the age of 11 to12 years girls become heavier and taller.

As the child enters school he/she develops ability to work out problems and participate in group activities. This is a period of emotional stress, competitive behaviour and dreaming which brings a drastic change in the previous learning and personality pattern. There is a change from dependence of parental standards towards those set by peer group.

5.2. NUTRITIONAL ALLOWANCE

1. Energy and protein

The requirements for calories and proteins increase during school age. The calorie requirements remain almost the same for girls throughout. Boys 10-12 years of age require more calories as adequate reserves are being laid for growth spurt during adolescence. The protein

requirements are slightly higher for girls than boys between 10-12 years for the approaching menarche.

2. Fat

In terms of visible fat the ICMR has recommended an intake of 5-6 percentage of total energy from linoliec acid. Considering this the minimum visible fat required has been estimated to be 12g / day but ICMR has suggested the desirable visible intake for school going children as 22g/day.

3. Minerals

The 10-12 year old children require more calcium than adults to meet the demand for skeletal growth.

The iron requirements are increased as blood volume increases. Also the mean increase in body weight from second year to the twelth year in boys and tenth year in girls is 2.5 to 2.7 kg per year which is equivalent to iron requirement of 0.3mg/day. The iron requirement is further increased by the gradual rise in the haemoglobin concentration and losses. The requirement for iron in girls 10-12 years is lower than 7-9 years because the iron absorption during 10-12 yrs is more which is 5 percent whereas it is only 3 percent in 7-9 years.

4. Vitamins

Vitamin A requirements of children have been computed from the requirement figures for infants (50µg/kg) and adults (93µg/kg) taking into account the growth rate at different ages. The RDA of vitamins A and C are same as adult RDA. The requirement for B vitamins are in proportion with the calorie requirements.

Table 5.1 gives the recommended dietary allowances of school going children.

Table 5.1.

ICMR Recommended dietary allowances of school going children

Nutrients	Age (in years)		
	7-9	10-12	
		Boys	Girls
Energy k.cal	1950	2190	1970
Protein (g)	41	54	57
Fat (g)	25	22	22
Calcium (mg)	400	600	600
Iron (mg)	26	34	19
Vitamin A			
Retinol (µg) or	600	600	600
β Carotene (µg)	2400	2400	2400
Thiamine (mg)	1.0	1.1	1.0
Riboflavin (mg)	1.2	1.3	1.2
Niacin (mg)	13	15	13
Pyridoxine (mg)	1.6	1.6	1.6
Ascorbic acid (mg)	40	40	40
Folic acid (µg)	60	70	70
Vitamin B_{12} (mg)	0.2-1	0.2-1	0.2-1

Diet

By school age the children establish a particular pattern of food intake. This may slightly differ from what is followed at home due to

peer influence. The child may try new foods which they normally do not consume. Breakfast is a very important meal. Children are generally restless and spent very little time at the table. Skipping breakfast affects their performance level and the calorie and nutrients lost cannot be made up at any other time during the day. Menus must include dishes that are quick to eat yet nutritionally adequate. Also there should be variety in colour, texture and taste. Table 5.2 presents the recommended quantities of food to be consumed by the school going children.

Table 5.2

Balanced diet for school going children

S.No.	Food groups	Quantity gms		
			10 - 12 yrs	
		7-9 yrs	Boys	Girls
1.	Cereals and millets	270	330	270
2.	Pulses	60	60	60
3.	Milk (ml)	500	500	500
4.	Roots and tubers	100	100	100
5.	Green leafy vegetables	100	100	100
6.	Other vegetables	100	100	100
7.	Fruits	100	100	100
8.	Sugar	30	35	30
9.	Fats / oils (visible)	25	25	25

For Non veg 30g of pulse can be exchanged with 50 gm of Egs/ Meat / Chicken / Fish.

5.3. PACKED LUNCH

Packed lunch have become a necessity for school children as it is not possible to have lunch at home. Packed lunch is a lunch in a tiffin box to be eaten by the child while away from home. Points to be considered while planning packed lunches are

1. It should meet one third of the day's nutritional requirements.
2. It should include food from all the five food groups though the number of dishes may be less.
3. At least one serving of green leafy vegetables should be included.
4. Food stuffs providing good quality protein like egg, milk or milk product like paneer or curd would improve overall protein quality in combination with vegetable protein.
5. Variety should be present.
6. Preferably the food packed should be different from that prepared for breakfast.
7. The dishes should be packed at right consistency so as to avoid leakage or food becoming dry during lunch which may not be appetising to the child.

One fruit or vegetable salad may be included every day.

Following are two examples of a packed lunch.

1. Vegetable pulao, onion raita, boiled egg, orange.
2. Sambar rice, amaranath porial, vegetable salad and butter milk.

5.4. SCHOOL LUNCH PROGRAMMES

Increasing urbanization and number of working mothers have made school days longer. Improper and hurried meals at home have become a routine. Whereas among rural population, young children are sent for work to earn a living and the drop out rate is higher in children at primary and secondary school level. These factors have created a necessity to provide lunch at schools which will provide nutritious food to children and also reduce the dropout rate.

The school lunch programmes operate with the following objectives To

1. provide food to the undernourished child and improve the nutritional status.
2. increase school enrolment and attendance.
3. inculcate good food habits.
4. incorporate nutrition education as part of the curriculum.
5. improve the educational performance of the students.
6. encourage use of locally available nutritious foods.
7. encourage community participation in the feeding programmes.

The two major nutrition intervention programmes currently in operation for the population below poverty line in Tamil Nadu are Nutritious Noon Meal Programme of the Government of Tamil Nadu and the Integrated Child Development Services (ICDS) sponsored by the ministry of social welfare, Government of India. The operational details of the two programmes is presented in Table 5.3.

Table 5.3 : School Lunch Programmes

Programme	Year started	Beneficiaries	Foods given	Nutrient contribution
ICDS	2nd October 1975	i) Children – 6 months to 4 years of age	1) 6months – 2 years : 80 g sathumavu* (Normal, I and II grade malnutrition)	1) 300 k.cal and 9 g protein
		ii) Pregnant and lactating mothers	2) III grade malnutrition : 160 g sathumavu	2) 600 k.cal and 18g protein
			3) 2-4 years: Rice – 80g, oil – 2gm, dhal – 5g	3) 350 k.cal and 7g protein
			4) Pregnant and lactating mothers : 120g sathumavu	4) 500 k.cal and 15g protein
Nutritious Noon meal programme	1st July 1982.	i) Children 2 to 15 years	1) 6 months – 2 years – 80g sathumavu	one third of daily requirement of calorie and protein
		ii) Pregnant and lactating mothers	2) upto 15 years : 80 g rice, 10g dhal and 2g oil	
			In addition to this each child gets 0.18 paise towards vegetable and grocery every day, 20g potato / greem gram / bengal gram once a week instead of egg.	
			3) Pregant and lactating mother – 720g sathumavu / week.	

* Composition of sathumavu per 100 gm – wheat 35 gm, Ragi 21.5 gm, Roasted Bengal Gram 11 gm, Jaggery 32.5 gm.

5.5. DEVELOPING GOOD EATING HABITS AND PREVENTION OF DENTAL CARIES

The adequacy of food in terms of nutrients not only depends on food available to the children but also on the food environment and models set for them by their peers, siblings, parents and other elders in the family.

Use of convenience foods by mothers and entry of fast foods have had a great impact on the food preferences of children. Hence nutrition knowledge of parents incorporated into meal planning is important in imparting positive attitudes towards food. The environment at the eating place also affects the nutrient intake while a comfortable and pleasant atmosphere is conducive to good eating. Arguments and family fights while eating affects the food intake adversely.

Advertising and television have a very strong influence on type of food chosen by children. Exposure to these and catchy slogans like 'chocolate', 'yummy', 'rich' tempt children to go in for processed foods and distort their liking and curiousity for natural flavour and colour of foods.

Tooth decay can be caused by caries. This can occur in children who are susceptible to and whose integrity of tooth structure may be affected by nutritional deficiency. Vitamin A is necessary for enamel and Vitamin C is essential for dentine. Calcium, phosphorus and vitamin D are needed for calcification. Fluorine decreases susceptibility of caries. Fermentable carbohydrate which adheres to the tooth is the major cause of tooth decay. The stickier the food and longer it stays in the mouth the greater is the effect. Thorough cleaning of mouth after each meal and developing the habit of brushing twice a day, early morning and before bed, might prevent dental caries. Fig 5A. presents a picture of dental caries.

Fig. 5A : Dental Caries

Source : Whitney E.N., and Rolfes S.R., (1999). ***Understanding Nutrition.*** 8th edition, West / Wadsworth.

QUESTION

Part A

1. The requirement of _____ increases as blood volume increases.

2. Packed lunch should meet _____ of the day's nutritional requirements.

3. The iron requirement per day for 11 year old girl is _____.

4. Tooth decay is caused by _____.

Part B

1. What are the factors to be considered in planning packed lunch for school going children?

2. List the general objectives of school lunch programmes.

3. How can good eating habits cultivated among school going children?

Part C

1. Explain the nutrient requirements during school going age?

6. NUTRITION DURING ADOLESCENCE

The transition from childhood to adulthood is called adolescence. This period (13-18 years) is characterized by rapid growth and development at all levels i.e., physical, physiological, psychological and social as described below.

6.1. GROWTH SPURT

The second and final growth spurt occurs during this period. The process of physical development from a child to an adult is called puberty. The growth spurt occurs in girls at approximately 11-14 years and in boys 13-16 years. Growth in girls in terms of height and weight is maximum prior to menarche. It is very rare that girls gain height after menarche, which is hardly 2-3 cm. In boys growth continues till late teens. They tend to gain weight at a faster rate and by 18-20 years, they have achieved their full height.

6.2. PHYSICAL, PHYSIOLOGICAL AND PSYCHOLOGICAL CHANGES

Body composition

Body composition changes during the period of maturation. The changes occur due to hormonal influence which regulate the development of sex characteristics.

The skeletal growth continues for a longer period of time for boys than girls. Usually the skeleton reaches its full maturity by 17 years for girls and by 20 years for boys. As mineralization increases the water content decreases.

Girls tend to deposit more fat whereas boys add more muscle mass. The result of pubertal changes is that boys have more lean body mass, skeletal weight and less adipose tissue as a ratio of total body mass. This difference in body composition for boys and girls is reflected in their nutrient requirements.

Sexual maturity

The growth spurt is accompanied by sexual maturity. In girls there is development of breasts, auxiliary and pubic hair and menarche. In boys the pubertal changes include deepening of voice, broadening of shoulders, development of auxiliary and pubic hair, growth of penis and testicles.

Psycho social changes

As this period is a transition to adulthood, they try to develop self identity. The desire to be accepted in their peer group changes their food habits, dressing and group conduct. This in turn brings psychological, emotional and social stress.

6.3. RECOMMENDED NUTRIENT ALLOWANCES

The recommended dietary allowances for adolescents is presented in Table 6.1.

1. Energy

The metabolic demands of growth and energy expenditure increases the calorie needs. The ICMR committee has suggested that energy should be provided on the basis of ideal weight for age. The energy requirements for boys is more than that of girls which is 2450 k.cal. and 2640 k.cal for boys 13-15 years and 16-18 years respectively and 2060 k.cal for girls of 13 to 18 years. The difference in energy requirements can be attributed to the rapid increase in weight for boys.

2. Protein

The protein requirements are computed in the same way as for adults. The protein needs represent 12-14 percent of the total energy requirements. This meets the need for growth, for pubertal changes in both sexes and for developing lean body mass in boys.

Table 6.1 : ICMR recommended dietary allowances for Adolescents

	Boys		Girls	
Nutrients	**13-15 yrs**	**16-18 yrs**	**13-15 yrs**	**16-18 yrs**
Energy (k.cal)	2450	2640	2060	2060
Protein (g)	70	78	65	63
Fat (g)	22	22	22	22
Calcium (mg)	600	500	600	500
Iron (mg)	41	50	28	30
Vitamin A				
Retinol (µg) or	600	600	600	600
β Carotene (µg)	2400	2400	2400	2400
Thiamine (mg)	1.2	1.3	1.0	1.0
Riboflavin (mg)	1.5	1.6	1.2	1.2
Niacin (mg)	16	17	14	14
Pyridoxine (mg)	2.0	2.0	2.0	2.0
Vitamin C (mg)	40	40	40	40
Folic acid (µg)	100	100	100	100
Vitamin B_{12} (µg)	0.2-1.0	0.2-1.0	0.2-1.0	0.2-1.0

3. Calcium

Bone growth requires calcium. Calcium requirements are based on calcium accretion during the period of growth. About 150 mg of calcium should be retained for increasing bone mass. Hence the allowance for boys is more than girls because of their increased skeletal growth.

4. Iron

The increase in body mass during adolescence correspond to 4.3 kg/year in boys and 4 kg/year in girls. The haemoglobin concentration increases by 2g /dl in boys and 1g/dl in girls. Therefore the iron required for growth alone is 0.7 mg / day in boys and 0.45 mg/day in girls. Moreover there is additional loss of iron in girls during menstruation which is significant from 13 years onwards which amounts to 0.45 to 0.5 mg/day. Hence considering the additional requirement for

- growth spurt
- expansion of blood volume
- increase in haemoglobin concentration
- additional iron to compensate menstrual losses in girls and
- adding the basal loss of iron,

the requirements for iron have been arrived at 41 mg/day and 28 mg/day for boys and girls 13 – 15 years of age, and 50 mg /day and 30 mg / day for boys and girls 16-18 years of age respectively. The higher requirement of iron for boys than girls may be attributed to the low percentage of iron absorption in adolescent boys (3 percent) than adolescent girls (5 percent).

5. Vitamins

The requirement for B vitamins namely thiamine, riboflavin and niacin increases in direct proportion with increase in calorie intake. Folic acid and vitamin B_{12} requirements also increase when there is rapid tissue synthesis as they participate in synthesis of DNA and RNA.

Transamination to synthesize non-essential amino acids requires more vitamin B_6. The structural and functional integrity of newly formed cells depends on the availability of vitamins A, C and E.

Table 6.2 gives the balanced diet for adolescents.

Table 6.2 : Balanced diet for adolescents (13 – 18 years)

S.No.	Food Groups	Quantity (g)	
		Boys	Girls
1.	Cereals and Millets	420	300
2.	Pulses	60	60
3.	Milk (ml)	500	500
4.	Roots and Tuber	200	100
5.	Green leafy vegetables	100	100
6.	Other vegetables	100	100
7.	Fruits	100	100
8.	Sugar	35	30
9.	Fats / oils (visible)	25	25

For Non-Veg 30 g of pulse can be exchanged with 50 g of meat / chicken /fish/ egg.

Source : ***Dietary Guidelines for Indians - A manual,*** National Institute of Nutrition, ICMR, Hyderabad, India, 1999.

6.4. CHANGE IN EATING HABITS

Psychological pressures on adolescents influence their eating habits. Boys generally tend to have a better appetite than girls and this helps them to meet their nutritional demands. The adolescent girls are at a disadvantage due to the following reasons.

1. with considerable amount of fat deposits and less physical activity than boys, girls may gain weight.
2. figure consciousness due to social pressure may force her into a self imposed crash diet for weight loss or self starvation leading to eating disorders like bulimia and anorexia nervosa.

The adolescents also develop a liking for fast foods which are nutritionally inadequate and rich in saturated fats and may skip meals at times.

Hence adolescents should be educated to consume a balanced nutritional diet including iron rich, calcium rich, protein rich foods and avoiding junk foods providing empty calories.

The adolescents should be advised not to miss meals and that, emotions should not dominate during meal times.

EATING DISORDERS

1. Binge eating

Binge eating is a eating disorder characterized by the consumption of a large amount of food in a small amount of time and may start at any age often not recognized till adulthood. The individual suffering from this is either overweight or obese and suffer from consequent disorders like high blood pressure, hypercholesterolemia and type II diabetes.

Food habits of binge eating:

a. Frequent dieting with erratic increase and decrease in weight.

b. Eating only when hungry or eating to the point of extreme discomfort or consuming large amount during a short time.

c. Avoiding eating at a social gathering or eating only small amounts in front of others.

d. Either avoiding physical activity or anything that may invite attention or increased awareness about one's own body.

They show psychological changes and the signs include

a. Depression, loneliness, guilt or shame and having a low self esteem.

b. Not able to control when eating and unable to stop binges.

c. Being preoccupied with dieting, body weight or food.

Both psychological and nutritional counseling is extremely important for binge eaters.

2. Anorexia nervosa

Anorexia nervosa is an eating disorder characterized by refusal to eat and loss of body weight. This is more common among adolescent girls when they try to avoid eating food due to over consciousness of their figure and social stress.

They appear extremely thin or emaciated due to rapid weight loss and complaint of nausea, vomiting or bloating after consuming normal food. Girls suffer from loss of mensturation.

They refuse to eat, deny hunger or eat tiny portions of food. They rigidly avoid specific foods like meat and milk.

They exercise heavily and show a different behaviour while eating such as using special utensils while eating or cutting food into fine pieces or eating very small spoons at a time.

3. Bulimia nervosa

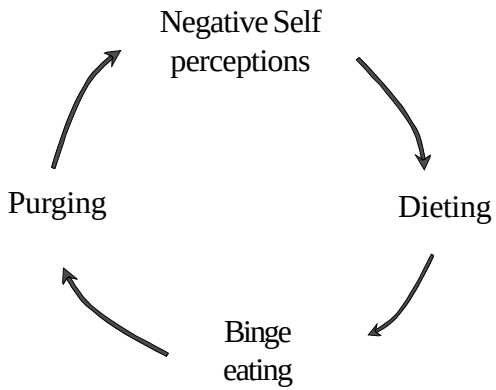
This is in quite contrast with anorexia nervosa. Bulimia nervosa is a eating disorder characterized by periods of bingeing and purging and developing unrealistic ideas about food.

The bulimic adolescents eat large quantities of food and then binge. The consequences are

- dental enamel erosion
- dental cavities
- swollen cheeks
- callus on back of hands
- fatigue and weakness due to malnutrition
- irregular menstrual period.

Figure 6A gives the viscious cycle of eating disorders

Figure 6A : Viscious Cycle of Eating Disorders



6.5. NUTRITION RELATED PROBLEMS

1. Anaemia

There is an increasing trend towards a decrease in age of menarche both in upper affluent class and rural communities making adolescent girls susceptible to anaemia. About 20-25 percent of adolescent girls suffer from anaemia irrespective of their social class. The impact is more profound in rural girls because of non-availability of healthy foods. Likes and dislikes and eating disorders also lead to anaemia.

2. Obesity

It affects 10-20 percent of adolescent population. Lack of exercise rather than excess calorie consumption is the cause. Concern about personal appearance may make adolescents more reluctant to participate in activities like sports. Obesity may also be due to hormonal imbalance, emotional stress or family habits.

3. Acne Vulgaris

Acne is a common concern among adolescents and about 80 percent of teens experience it. Scientific studies have been unable to show a strong link between any dietary factor and acne. But adolescents are warned to avoid junk foods like nuts, chocolates, pizzas, chips, candies and ice creams assuming that planning a well balanced diet without these is possible. The main culprit of acne is over activity of sebaceous glands in the skin. Blockage in a duct in the gland can lead to infection and localized pressure resulting in an acne lesion.

4. Malnutrition due to teenage pregnancy

Teenage mothers are considered to be at high risk as maternal death and infant mortality rates are higher among them. The biological immaturity has a greater impact on pregnancy. Malnutrition sets in when the pregnant adolesent girl fails to meet the demands of not only her growth but also that of the foetus. This has a direct bearing on the outcome of pregnancy. Lactation failure is also common. Teenage mothers fail to breast feed their infants adequately resulting in high infant morbidity rate.

Good nutrition and fostering healthy eating habits during adolescence paves way for a healthy adulthood.

QUESTION

Part A

1. Transition from childhood to adulthood is called _____.
2. Adolescence is a period of second _____.
3. As a result of pubertal changes boys have more _____ and less _____.
4. The energy requirement per day for adolescent girls is _____ k.cal.
5. The percentage of Iron absorption is more in adolescent _____.
6. Frequent dieting with erratic increase and decrease in weight is characteristic of _____.
7. An eating disorder in which the adolescents consume large quantities of food and the binge is _____.

Part B

1. Brief on the physical, physiological and psychosocial changes during adolescence?
2. What are the common nutrient related problems among adolescents?
3. Explain the eating disorders common among adolescents

Part C

1. Explain the nutrient requirements of adolescents?

7. NUTRITION FOR ADULTS

By the time an individual reaches adulthood, body growth especially in terms of height and body status stop to a certain extent, but tissue breakdown and repair of body tissues continues even among adults. Therefore adequate amount of essential nutrients need to be provided for maintenance of physical and mental health in adults.

7.1. ADULTS – THE PRODUCTIVE AGE GROUP

Though adulthood does not feature psychological and social stress as in school age or adolescence, the family and social responsibilities of the individual increases. This is when they tend to lead an independent living and many, both men and women, are breadwinners for their family. Entry into married life adds to their responsibilities, especially women who should be prepared to bear the physiological stress during pregnancy and lactation.

There may also be changes in lifestyle pattern based on their occupation, which may change their eating habits. The physical and mental stress due to their job, family and social pressure make adequate nutrition a necessity to safeguard the health of this highly productive age group.

7.2. RECOMMENDED DIETARY ALLOWANCES

As discussed in chapter 1, the age, sex, activity and body weight of the individual largely determine the nutrient requirements.

Since individual variations are high, the ICMR has suggested the recommended allowances based on reference Indian man and woman.

Reference Indian man has been defined as “an adult man between 20 – 39 years of age, weighing 60 kg. He is free from diseases and physically fit for active work. On each working day he is employed for eight hours in occupation that usually involves moderate activity. While not at work he spends eight hours in bed, four to six hours in sitting and

moving about and two hours in walking, active recreation or house hold duties". For such a reference man the ICMR has taken an average height of 163 cm.

Reference Indian woman is defined as "an adult woman between 20 – 39 years of age, weighing 50 kg. She may be engaged for eight hours in general house hold work, in light industry or in any other moderately active work. Apart from eight hours in bed, she spends four to six hours in sitting and moving around (light activity) and two hours in walking, active recreation or household duties". For such as reference woman the ICMR has taken a height of 151 cm.

The RDA for an adult man and woman engaged in different activities is tabulated in Table 7.1.

1. Energy

The energy requirement of an individual has been defined as "the level of energy intake from food that will balance energy expenditure when the individual has body size and composition and level of physical activity, consistent with long term good health and that will allow for maintenance of economically necessary and socially desirable activity".

The components of energy expenditure include

a. Basal Metabolic Rate (BMR)

b. Regulatory thermogenesis which includes the metabolic response to food ingested and stimuli such as cold, stimulants and drugs.

c. Nature and duration of activity. The allowances for those engaged in heavy work should be higher than those doing either sedentary or moderate work.

2. Protein

Studies on Indian adults have revealed that the minimum intake of dietary protein to maintain nitrogen equilibrium, on an average, is 0.58 g/kg body weight. After allowing for sweat losses the intake works out

Table 7.1 : ICMR Recommended Dietary Allowances for adults

Sex	Activity	Energy K.cal	Protein g	Fat g	Calcium mg	Iron mg	VITAMINA Retinol µg	VITAMINA βcarotene µg	Thiamine mg	Riboflavin mg	Niacin mg	Pyridoxin mg	Vit.C mg	Vit. B_{12} µg
Males	Sedentary	2425	60	20	400	28	600	2400	1.2	1.4	16	2.0	40	1
	Moderate	2845	60	20	400	28	600	2400	1.4	1.6	18	2.0	40	1
	Heavy	3800	60	20	400	28	600	2400	1.6	1.9	21	2.0	40	1
Females	Sedentary	1875	50	20	400	30	600	2400	0.9	1.1	12	2.0	40	1
	Moderate	2225	50	20	400	30	600	2400	1.1	1.3	14	2.0	40	1
	Heavy	2925	50	20	400	30	600	2400	1.2	1.5	16	2.0	40	1

to 0.7 g/kg. The corresponding safe level of intake has been computed to be 0.88 g/kg body weight. Hence the ICMR has recommended 1.0 g protein per kg body weight for both men and women. Since protein needs are not affected by activity the RDA for an protein is 60 g/day and 50 g/day for adult man and adult woman respectively.

3. Fat

The two factors that need to be considered while assessing fat requirements are

a. The invisible fat in the diet which supplies majority of the essential fatty acid requirements.

b. A certain amount of visible fat is required to meet requirements of two essential fatty acids i.e., linoliec and linolenic fatty acids.

The requirement of linoleic acid has been estimated to be 3 percent of total energy requirement, which can be met by 12 g of visible fat. To provide energy density and palatability to the diet the ICMR has suggested 20 g visible fat per day. The type of visible fat used is also important. Oils containing high amount of saturated fatty acids may increase the linoleic acid requirements and are detrimental to health. Hence combination of oils with equal proportion of saturated, monounsaturated and polyunsaturated fatty acids has been recommended.

4. Calcium and phosphorus

In adults calcium is required for replacing calcium lost from body through urine, faeces, sweat and bile. Of the dietary calcium only 20 to 30 percent is absorbed and this is facilitated by vitamin D. Long term balance studies have shown that a positive calcium balance can be achieved by an intake of 300 to 500 mg of calcium daily. ICMR has suggested 400 mg calcium / day for both men and women.

Along with this, a desirable intake of phosphorus is recommended as the functions of calcium and phosphorus is closely linked. The elemental Ca:P ratio in the diet should be maintained at 1:1.

5. Iron

The loss of iron through sweat, gastrointestinal tract and urine is estimated to be 14 μg/kg body weight. Apart from this women have additional loss due to menstruation which varies between 0.5 to 1mg per day (an addition of 16 μg/kg taken as the upper limit). Based on these the iron requirements are arrived at as 28 mg for men and 30 mg for women per day respectively.

6. VITAMINS

a. Vitamin A

Studies have revealed that 600 μg of retinol daily would be sufficient to maintain a normal serum vitamin A level at 20 μg / 100 ml. Hence the ICMR has suggested 600 μg of retinol for both men and women equivalent to 2400 μg of β carotene. Since Indian diets contain both retinol and β carotene it is advisable to express the Vitamin A content of diet in terms of retinol equivalents.

Retinol equivalent = μg of retinol + ¼ μg of β - carotene.

b. B Complex vitamins

The requirement for B Vitamins is based on calorie intake i.e. 0.5 mg / 1000 k.cal, 0.6mg / 1000 k.cal and 6.6 mg / 1000 k.cal for thiamine, riboflavin and niacin respectively. The RDA for pyridoxine is 2.0 mg/day for both adult man and woman.

The minimal daily requirement of folic acid among Indians is 75 μg of folate. In this view the safe level of intake has been suggested to be 100 μg of folate per day. Due to lack of precise data on bioavailability of food folates ICMR has recommended 100 μg of free folate per day for adults.

c. Vitamin C (Ascorbic acid)

The concentration of Vitamin C in circulating leukocytes reflects the tissue concentration. Based on this a daily intake of 20 mg vitamin C is sufficient to maintain satisfactory ascorbic acid status. Considering 50 percent loss of vitamin C during cooking ICMR has recommended RDA of 40 mg vitamin C per day for both men and women.

A balanced diet providing the various nutrients as per the RDA given in Table 7.2

Table 7.2 : Balanced diet for Adults

S. No.	Food Group	Activity					
		Sedentary		Moderate		Heavy	
		Man	Woman	Man	Woman	Man	Woman
1.	Cereals and Millets (g)	420	300	480	360	690	480
2.	Pulses (g)	60	60	90	75	90	90
3.	Milk (ml)	300	300	300	300	300	300
4.	Roots and Tubers (g)	200	100	200	100	200	200
5.	Green leafy vegetables (g)	100	100	100	100	100	100
6.	Other vegetables (g)	100	100	100	100	100	100
7.	Fruits (g)	100	100	100	100	100	100
8.	Sugar (g)	25	20	40	25	55	45
9.	Fats / oils (visible) (g)	20	20	35	30	55	40

For Non Veg. 30 g of pulse can be substituted with 50 g of Meat / Chicken / Fish / Egg.

Source : Dietary guidelines for Indians-A manual, NIN, ICMR, 1999.

A sample vegetarian menu for a adult woman doing sedentary work is given below.

Meal	Menu	Raw Amounts
Early morning	Milk /Coffee / Tea	Milk - 100 ml Sugar - 10 g
Break fast	Upma - 11/2 cup, fruit	Cereal - 75 g Fruit - 50 g
Lunch	Rice - 1 cup Phulkas - 2 No's	Cereal - 100g
	Dhal - 1/2 cup Amaranth poriyal 1cup Vegetable Raita Curd - 1/2 cup	Pulse - 20 g Green leafe vegetable-100 g Vegetable - 50 gm Milk - 100 ml
Tea	Samosa - 2 no Tea 1 cup	Cereal - 50 g Potato - 50 g Milk - 100 ml Sugar - 10 g
Dinner	Dosai 3 no Sambar 1/2 cup Vegetable salad Fruit	Cereal - 75 g Pulse - 40 g Vegetable - 100 g Fruit - 50 g
Bed time	Milk	Milk - 100 ml Sugar - 5 g

7.3. NUTRITION RELATED PROBLEMS AMONG ADULTS

Being a productive age group, adequate nutrition is important for adults to maintain their productivity. Inadequate nutrition, besides leading

to various nutrient related problems also results in subsequent physical and psychological disturbances leading to absenteeism from work, poor concentration, lethargy and emotional distress. All these affect not only the economy of the family but superimposes the same on other family members and the viscious cycle continues.

The viscious cycle caused by malnutrition is given in Fig. 7 A.

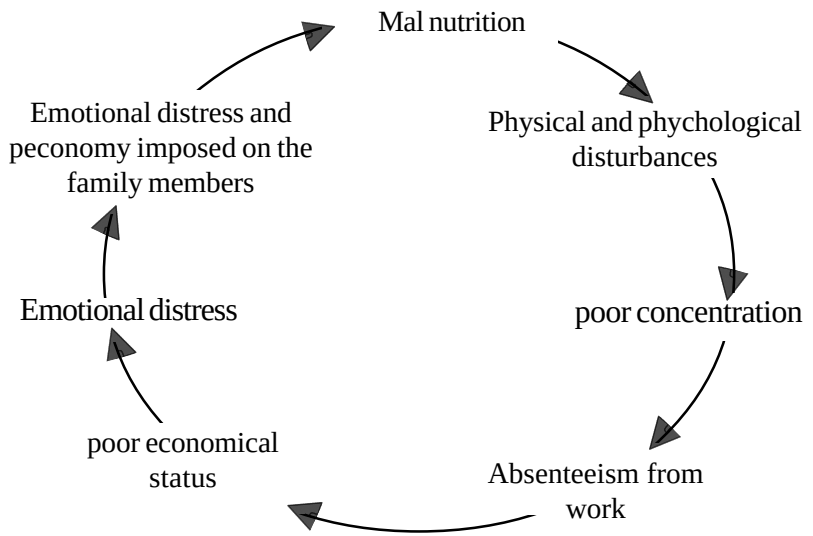


Fig. 7 . A. Malnutrition Visious Cycle

The various nutrient related problems that commonly occur among adults are as follows:

1. Anaemia

Anaemia is a common nutritional problem especially among Indian women. Women in the reproductive age group are the most affected. The causes of anaemia may be

- Inadequate diet in quality and quantity, deficient in folate, Iron, B Complex vitamins and vitamin C.

- Excessive menstruation
- Poverty
- Lack of awareness of food values
- Poor environmental hygiene and sanitation

2. Obesity

This can occur at any age and in either sex as long as the person is under positive energy balance. Besides genetic inheritance and physical inactivity, faulty eating habits contributes to obesity. These include nibbling between meals, eating more, eating fast with less chewing and housewives eating leftovers.

The concept of a balanced nutritious diet should be introduced even in the work place starting with the industrial canteens where more number of high calorie snack items are sold. These can be substituted with nutritious snacks prepared using green leafy vegetables and other vegetables and with limited frying.

3. Diabetes Mellitus

Type II diabetes is more prevalent among adults. Obese individuals are identified to be at risk. Malnutrition related diabetes occurs in young people between 15 to 30 years of age who are lean and undernourished. Acute stress more common among working women and executives is another cause.

4. Underweight

Adults with Body Mass Index (BMI) of less than 18.5 have reduced capacity for sustaining heavy work and therefore decreased productivity.

5. Coronary Heart Disease (CHD)

Those in the high socioeconomic group who adapt a sedentary life style and have a high intake of saturated fatty acids tend to develop CHD. The incidence is high in obese individuals.

QUESTION

Part A

1. The weight of an Indian reference man is _____.
2. The ICMR recommendation for protein per kg of body weight is _____.
3. The ca:p ratio in the diet should be maintained at _____.
4. Vitamin A content of the diet is expressed in terms of _____.
5. The RDA for Pyridoxine is _____ for both adult man and woman.

Part B

1. On what basis the energy, protein and fat requirements of adults arrived at?
2. Brief on the requirement of minerals for adults?
3. Explain the common nutrient related disorder in adults?
4. Plan a balanced for a adult woman doing sedentary work?

Part C

1. Explain the nutrient requirements of adults?

8. NUTRITION DURING OLD AGE

Individuals above the age of 60 years constitute the elderly. However the increasing number of healthy and active people among the elderly has led to the need for more defenitive age groupings. Thus the specific age groups of 65-75, 75-85 and older are often referred to as the young old, old and the oldest old respectively. Today the elderly constitute about seven percent of the total population and the projected figure is ten percent by 2016. Hence health and well being of the elderly is given more importance and has paved way for a specific field of study called 'Geriartric Nutrition".

8.1. AGING

Aging is a irreversible biochemical change that occurs throughout an individuals life cycle and continues until death. Genes are the major determinants of nature of aging. Health and good nutrition may delay the process of aging. Aging varies among individuals depending on their nutritional status and living environmental conditions.

In old age, the nutritional status is determined by the state of nutrition of an individual cell. Conditions like dietary deficiency, improper digestion and absorption, insufficient distribution of nutrients, accumulation of excess waste products lead to poor nourishment of cells.

With increasing age, cell functioning is slowed down and the response to harmones and synthesis of enzymes decreases. These changes are associated with a decrease in the number of functioning cells. Since the cells are interdependent, if one cell dies, others of the same or different organ lose their ability to function resulting in malfunctioning of the organ. This in turn gradually affects the total body function leading to death.

8.2. PHYSICAL, PHYSIOLOGICAL AND PSYCHOLOGICAL CHANGES

The process of aging is associated with various changes, which are as follows.

1. Physical changes

Old people develop physical changes due to the process of maturation like graying of hair, wrinkled skin, decline in height and a bowed posture. There may be loss of vision and decrease in sense of learning. Their physical strength and vigour also decreases.

2. Physiological changes

The physiological decline in body functions during aging is not uniform. It varies among different organs. The capacity of the system may not decline but their ability to respond to a challenge or to maintain homeostasis is lowered. The physiological changes that occur in various systems are as follows.

a. Taste and smell

There is a decrease in the number of taste buds and papillae on the tongue. The ability to taste salt is very much decreased whereas that to sugar in less altered. Besides there is a reduction in olfactory sensitivity which decreases the ability to detect the flavour. This decreases the palatability of the food resulting in poor intake. Diminished taste and smell decreases the sensory stimulation that may impair metabolic processes.

b. Salivary Glands

Decrease in salivary secretion or lack of salivation (xerostomia) causes a feeling of dry mouth, which makes chewing and swallowing difficult. Hence crunchy, dry and sticky foods are avoided by old people.

c. Teeth

They may lose teeth or have ill fitting dentures which makes chewing difficult. They may omit fresh vegetables and fruits. This may lead to

vitamin and mineral deficiency accompanied by decreased gastrointestinal motility and problems in elimination like constipation.

d. Gastrointestinal function

The secretion of digestive enzymes and digestive juices decline. This results in incomplete digestion, or food remaining longer in stomach for digestion. The secretion of hydrochloric acid, intrinsic factor and pepsin decreases which affects absorption of calcium, protein, iron and vitamin B_{12}.

Above 60 years of age the rate of emptying of liquids is rapid which again leads to decreased absorption of nutrients.

The p^H of proximal small bowel increases and there is bacterial over growth in the bowel.

In the small intestine there is decreased secretion of enzyme lactase, which can be a risk factor for developing osteoporosis. Thinning of gastrointestinal layer decreases gastric motility and prolonged transit through the colon leading to constipation.

e. Liver and biliary function

There is a decrease in blood flow to the liver. This may lead to minor structural and biochemical changes. Gall bladder becomes sluggish in releasing bile, which impairs fat metabolism and increases susceptibility to gall stones. The activity of drug metabolising enzymes decrease and therefore lower drug doses need to be prescribed during old age.

f. Metabolic Function

There is a decrease in metabolic rate and impaired glucose tolerance, which necessitate dietary modifications. The body protein levels also decrease.

g. Neurological Function

There is a decrease in neuromuscular coordination. They may develop a state of confusion. There is a decreased synthesis of seratonin. Carnitine derived from the aminoacids lysine and methionine may be effective in slowing down mental deterioration. Carotenoids play a protective role related to aging and cognitive function.

h. Cardiovascular function

Changes in blood vessels such as narrowing of the lumen, thickening of the arterial walls and replacement of elastic muscle fibres with non elastic fibres lead to increased rigidity of vessels (atherosclerotic changes) which reduces their capacity to carry nutrients to the cells. There is decreased myocardial contractibility and increased peripheral resistance, increasing the prevalence of hypertension.

i. Renal function

There is a decrease in Glomerular Filtration Rate (GFR) affecting the elimination of waste products and reabsorption of electrolytes. Moreover, the body's ability to regenerate nephrons ceases after 40 years of age. Hence increased solute load on each nephron may lead to necrosis and kidney damage.

j. Skeletal tissue

Demineralisation of bones is more rapid than mineralisation. The bones become increasingly vulnerable to fractures and the vertebrae may collapse. This results in decline in height and a stooped or bowed posture. This posture may affect respiratory function.

k. Pulmonary function

Pulmonary capacity declines by about 40 percent throughout life. Among elderly this may not have an impact on health but may impose restriction on energetic exercise.

l. Harmonal changes

Activity of various glands like thyroid, adrenal cortex, islets of langerhans is decreased resulting in changes in metabolism and metabolic functions. The hormonal imbalance affects the calcium metabolism leading to osteoporosis and bone loss. Menopause in women decreases their iron requirements.

3. Psychological change

a. Loneliness

With increasing urbanization and generation gap, nuclear family systems have emerged. The elderly are considered irrelevant and redundant by their own families and are left lonely. Loneliness leads to depression and in turn loss of appetite. They tend to follow irregular meal times leading to malnutrition.

b. Economic aspects

Among many elderly individuals financial constraints often limit their food intake.

c. Anxiety

Emotional stress and deprivation leads to alterations in food habits and attitude towards food. In addition, hormonal changes associated with anxiety depress the flow of digestive juices which may result in impaired digestion and absorption.

d. Loss of self esteem and independence

With retirement the elderly may experience a loss of self esteem. With decreasing physical strength, mobility and diminishing financial resources their dependence on others increase. They sometimes feel powerless leaving the task of decision making to youngsters. This may cause depression and frustration among elderly.

8.3. NUTRITIONAL NEEDS

1. Energy

The energy requirement decreases due to

a. decreased physical activity

b. reduction in lean body mass and increase in adipose tissue,

c decrease in resting metabolic rate by 15-20 percent due to changes in body composition and physical inactivity.

The calorie intake should be adjusted to maintain weight. The energy requirements for different age groups 60 years and above are given in table 8.1.

2. Protein

The protein requirement do not change during old age. It is the same as adults i.e. 1g / kg of body weight. Since the calories are reduced without decrease in proteins the diet should be protein rich when compared to a normal adult diet.

3. Carbohydrate

Since the calorie requirement is reduced the carbohydrate content should also be proportionately reduced. Due to impaired glucose tolerance and gastro intestinal disturbances like constipation, emphasis should be on taking complex carbohydrates.

4. Fat

The fat requirements are also reduced corresponding to the energy requirements. The intake of saturated fat should be less and that of unsaturated fat more.

Table 8.1 : Energy requirement (k.cal / 24 hrs) of male and female 60 years and above with different body weights

Sex	Body weight Kg	Energy requirement for sedentary activity k.cal
Male	60	1976
	65	2072
	70	2176
	75	2280
Females	60	1864
	65	1944
	70	2024

(Nutrient requirement and recommended Dietary allowance for Indians, ICMR, 2002)

5. Minerals

Calcium needs increases during old age due to increasing mobilization of calcium from bones and incidence of osteoporosis. During old age 1000mg of calcium is recommended per day because of the following reasons.

a. Limited availability of calcium from foods.

b. To compensate age related bone loss and to improve calcium balance.

c. To prevent fractures and tooth decay.

d. To compensate decreased efficiency in calcium absorption.

Aging does not affect iron needs. Hence iron needs are same as that for adults. Mild anaemia may affect the health of old people due to inefficient circulation. Therefore iron intake should be adequate during old age.

6. Vitamins

a. Vitamin A requirements remain the same i.e., 600 µg of retinol

b. Inadequate exposure to sunshine may affect vitamin D levels in which case supplementation may be required.

c. Vitamin C requirements increase due to stress and medications. The antioxidant vitamins such as vitamin E, carotenoids and vitamin C have been identified to promote health of the elderly.

d. Vitamin B_6 requirements are also increased due to atrophic gastritis which interferes with absorption. Liver dysfunction is an additional risk factor for Vit. B_6 deficiency.

Besides these various nutrients, water should be consumed in plenty as such or as fluids like buttermilk, fruit juice and soups. Intake of sufficient fluids reduce the load on kidneys and relieves from constipation by stimulating peristalisis.

The quantity of food stuffs to be included in a balanced diet for elderly is given in Table 8.2.

Table 8.2 : Balanced diet for an elderly person for a day

Food Stuff	Quantity (raw) g	
	Males	Females
Cereals	350	225
Pulses	50	40
Vegetables	200	150
Green Leafy vegetables	50	50
Roots and Tubers	100	100
Fruits	200	200
Milk and Milk Products	300	300
Sugar	20	20
Fats and oils	25	20

(Source : "Dietary tips for elderly", NIN, ICMR Hyderabad 2000)

8.4. NUTRITION RELATED PROBLEMS OF ELDERLY

The elderly are at risk of poor nutrition due to economic pressure, poor dentition, aging tissues and inadequate diet, which may be compounded with the incidence of chronic disease. The commonly prevalent nutrition related problems among the aged include;

1. Osteoporosis

Osteoporosis is characterized by decreasing bone mass and density. As a result the bones become porous, light and fragile becoming more vulnerable to fractures. The incidence of osteoporosis is more common in women after menopause.

2. Obesity

Many of the elderly are obese. They fail to make adjustments in their energy intake corresponding to decreased energy needs.

3. Anaemia

Anaemia characterized by feeling of fatigue, anxiety, lack of energy is common. Iron inadequacy is caused by low dietary intake, decreased absorption or lack of haem iron, vitamin C or blood loss.

Pernicious anaemia due to vitamin B_{12} deficiency is common among elderly women. The diet for elderly should include foods rich in haem iron and vitamin $B_{12.}$

4. Malnutrition

The causes of malnutrition during old age are

a) economic constraints

b) physical inactivity

c) cumulative effect of chronic disease and medication

d) social isolation

e) lack of knowledge in preparing meals adequate to meet their needs

5. Constipation

Aging disturbs the natural rythmic contraction of colon due to

a) loss of tone
b) stress
c) medications
d) lack of exercise
e) low fibre diet
f) insufficient fluid intake.

These result in constipation. Excess use of laxatives or enemas may also cause constipation.

6. Diabetes Mellitus

The incidence of Non Insulin Dependent Diabetes Mellitus (NIDDM) is increased due to impaired glucose tolerance and decreased sensitivity of cells to insulin.

7. Cardiovascular disease

The incidence of hypertension and other cardiovascular diseases like atherosclerosis, acute myocardial infarction, angina pectoris, and congestive heart failure is high due to changes in cardio vascular function. These may impose dietary restrictions, change in texture of diet and use of diuretics and hypotensives. These inturn may affect the dietary intake and health of the individual.

8.5. MODIFICATION OF DIET TO SUIT THE NEEDS

The various physical, physiological and psychological changes during oldage necessitate the following modifications in the diet.

1. The problems of dentition or loss of teeth create the need to include foods with soft texture and that are easily chewable.
2. Foods should be easily digestible as there is a decrease in production of digestive enzymes.

3. Fat should be restricted to prevent obesity and susceptibility to cardiovascular diseases. Foods rich in saturated fat should be avoided.
4. Energy rich foods like sweets, fried foods and starchy foods need to be avoided.
5. Foods rich in calcium like milk and milk products should be given to compensate bone loss and reduce osteoporosis.
6. Fresh fruits, vegetables and green leafy vegetables should be included liberally which supply vitamins, minerals and fibre and are rich in antioxidants. Fruits and vegetables may be given as fresh juices, purees, soups and salads.
7. Coffee, tea and carbonated beverages should be restricted as they may result in insomnia (lack of sleep) due to over stimulation.
8. Small frequent meals may be given instead of three large meals which will aid in complete digestion.
9. Plenty of fluids need to be included to prevent constipation and dehydration.
10. Salt intake should be reduced.

Good nutrition during old age is of immense significance and care should be taken to see that the diets are nutritionally adequate, well balanced and suitable for consumption.

First of October is celebrated as world elders day.

Recipes for the elderly

With changing socio economic environment sometimes the elderly people are forced to live on their own and cook their own food. Hence they need some simple but nutritious recipes to maintain good health.

The recipes should

- be nutritious
- be easy to cook
- involve minimum time for cooking or no cooking
- be ready to eat

A few easy to cook and ready to eat recipes have been formulated by National Institute of Nutrition, Hyderabad which are as follows.

Easy to cook	Ready to eat
1. Dalia (made from Broken wheat Green Gram dhal)	1. Coconut laddu
2. Ragi Ambli	2. Groundnut Chikki
3. Rava Upma	3. Black gram dhal laddu
4. Kichedi	4. Groundnut biscuits
5. Curd Salad	5. Cheera
6. Suji Kheer	
7. Rice	
8. Methi Paratha	
9. Pohe (Rice flakes upma)	

The preparation for a couple of recipes are given below

1. Dalia

Ingredients	**Quantity**
Broken Wheat	100 g
Green gram dhal	100 g
Cumin seeds	5 g
Grated Carrot	100 g
Black Pepper Powder	2 g

Oil	15 ml
Salt	to taste
Water	450 ml

Method

Heat oil in pressure Cooker. Add cumin seeds and fry till it turns brown. Add broken wheat and fry till golden brown. Add rest of the ingredients and pressure cook for two minutes.

Total weight of cooked dalia in 750g measuring seven katories (1 Katorie – 150 ml).

The Nutritive value of the recipe

Calories	-	900 k.cal
Protein	-	42 g
Fat	-	19g
Calcium	-	390 mg
Iron	-	17 mg

2. Cheera

Ingredients	**Quantity**
Pressed rice	100 g
Ground nuts	50 g
Sugar	120 g

Method

Roast pressed rice till crisp. Roast ground nuts till brown. Remove husk and powder coarsely. Melt sugar in a heavy vessel. Put off the flame and add pressed rice and ground nuts. Mix well and spread on a

greased wooden board. Cut into pieces with a greased knife before it gets cold.

Total weight of cooked cheera	325 g
Number of pieces	25

Nutritive Value

Calories 111 k.cal, Protein 19.3 g, Fat 21.6 g, Calcium 65 mg, Iron 21.4 mg.

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QUESTIONS

Part A

1. The branch of Nutrition related to the elderly population is _____.
2. Old age is defined as _____ years and above.
3. The protein requirement during old age is _____ per kg of body weight.
4. _____ mg of calcium is required per day during old age.

Part B

1. Brief on the process of aging?
2. Explain the psychological changes during old age?
3. Give the dietary modification for the elderly suggesting suitable recipe?
4. What are the nutrition related problems of the elderly explain?

Part C

1. Explain the physical and physiological changes during old age?
2. Discuss the nutrient requirements during old age?

9. INTRODUCTION TO DIETETICS

9.1. DIETETICS

Dietetics is concerned with planning of diets in maintaining health and in prevention and treatment of disease. It is a science as it uses the rudiments of principles of nutrition and it is an art as it is concerned with the aesthetics of food service.

Diet therapy

Diet therapy means use of diet (food and drink) not only in the care of the sick, but also in the prevention of disease and maintenance of health. It is concerned with the use of food as an agent in effecting recovery from illness.

9.2. PRINCIPLES OF THERAPEUTIC DIET

A well planned diet providing all the specific nutrients to the body helps to achieve nutritional homeostasis in a normal, healthy individual. However, in disease conditions, the body tissues either do not receive proper nutrients in sufficient amounts or cannot utilize the available nutrients owing to faulty digestion, absorption or transportation of food elements, thus affecting the nutritional homeostasis of the sick person. The diet, therefore needs to be suitably modified. However, it is imperative that the basis for planning such modified diets should be the normal diet.

Therefore diet therapy is concerned with the modification of normal diet to meet the requirements of the sick individual.

The general objectives of diet therapy are

- To maintain a good nutritional status.
- To correct nutrient deficiencies which may have occurred due to the disease.

- To afford rest to the whole body or to the specific organ affected by the disease.
- To adjust the food intake to the body's ability to metabolize the nutrients during the disease.
- To bring about changes in body weight whenever necessary.

The advantages of using normal diet as the basis for therapeutic diets are

- It emphasises the similarity of psychological and social needs of those who are well, even though there is quantitative and qualitative differences in requirements, thus ensuring better acceptability.
- Food preparation is simplified when the modified diet is based upon the family pattern and the number of items requiring special preparation is reduced to a minimum.
- The calculated values for the basic plan are useful in finding out the effects of addition or omission of certain foods. e.g; if vegetables are restricted, vitamin A or Vitamin C deficiency can occur.

Factors to consider in planning therapeutic diets

1. The underlying diseased condition which requires a change in the diet.
2. The possible duration of the disease.
3. The factors in the diet which must be altered to overcome these conditions.
4. The patients tolerance for food by mouth.

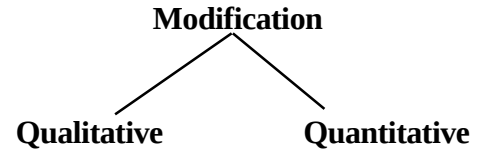
In planning meals for a patient his economic status, his food preferences, his occupation and time of meals should also be considered.

The four attributes of a therapeutic diet are;

- Adequacy
- Accuracy
- Economy
- Palatability

9.3. MODIFICATION OF THERAPEUTIC DIETS

Therapeutic diets can be modified in terms of quality and quantity.



- Restriction of a Nutrient eg.; Sodium in hypertension
- Excess of a nutrient eg.; Tuberculosis where increased protein and energy are required

- Change in consistency eg.; clear liquid diet
- Rearrangement of meals eg: Increasing frequency of meals
- Omission of foods eg: Allergy, which demands complete exclusion of the allergic food.

Routine Hospital Diets

1. Clear liquid Diet

Clear liquid diet is a temporary diet of clear liquids without residue and is non – stimulating, non-irritating and non-gas forming.

Small amounts of fluids (usually 30-60 ml) are served at frequent intervals (2 hrs) to replace fluid and electrolytes and also to relieve thirst. Being composed mainly of water, carbohydrates and some electrolytes, a clear fluid diet can normally provide only 400-500 k.cal, 5 g protein, negligible fat and 100-120 g of carbohydrates.

It is nutritionally inadequate and therefore used for a very short period of time (24-48 hrs).

Disease conditions for its use

1. Preoperative patients eg: preparation for bowel surgery.
2. Prior to colonoscopic examination.
3. Post operative patients eg: in the initial recovery phase after abdominal surgery or after a period of intravenous feeding.
4. Acute illness and infections as in acute Gastro Intestinal (GI) disturbances such as acute gastroenteritis, when fluid and electrolyte replacement is desired to compensate for losses from diarrhoea.
5. As the first step in oral alimentation of a nutritionally debilitated person.
6. Temporary food intolerance.
7. To relieve thirst.
8. To reduce colonic fecal matter.

2. Full fluid diet

A full fluid diet includes all foods which are liquid or can be liquefied at room and body temperature. It is free from cellulose and irritating condiments and spices.

This diet can be properly planned and made nutritionally adequate for maintenance requirements. If used for more than two days, then a high protein, high calorie supplement may be necessary.

This diet is given in between a clear liquid diet and soft diet. The average nutritional composition of this diet is 1200 k.cal and 35 g protein. This should be given at 2-4 hr interval.

Disease condition for its use

1. Most often used post operatively by patients progressing from clear liquids to solid foods.
2. Acute gastritis and infections.
3. Following oral surgery or plastic surgery of face or neck area.
4. In presence of chewing and swallowing dysfunction for acutely ill patients.
5. Patients with oesophagal or stomach disorder who cannot tolerate solid foods owing to anatomical irregularity.

3. Soft Diet

A soft diet is used as a transitional diet between full fluid and normal diet. It is nutritionally adequate. It is soft in consistency, easy to chew, made up of simple, easily digested foods, containing limited fibre and connecting tissues and does not contain rich or highly flavoured foods.

The average soft diet supplies around 1800 k.cal and 50 g protein. However the energy, protein and other nutrients are adjustable according to the individual's need, based on activity, height, weight, sex, age and disease condition.

It can be given as three meals a day with or without in between meal feedings.

Disease condition for its use

1. Patients progressing from full fluid diet to general diet.
2. Post operative patients unable to tolerate general diet.

3. Patients with mild GI problems.
4. Weak patients or patients with inadequate dentition to handle all foods in a general diet.
5. Diarrhoea convalescence.
6. Between acute illness and convalescence.
7. Acute infections.

A soft diet can be modified as mechanical soft diet.

Mechanical soft diet

Many people require a soft diet simply because they have no teeth and such a diet is known as mechanical or a dental soft diet. It is not desirable to restrict the patient to the food selection of the customary soft diet and the following modifications to the normal diet may suffice.

- Vegetables may be chopped or diced before cooking
- Hard raw fruits and vegetables are to be avoided; tough skins and seeds to be removed.
- Nuts and dried fruits may be used in chopped or powdered forms.
- Meat to be finely minced or ground.
- Soft breads and chapattis can be given.

Disease condition for its use

1. In cases of limited chewing or swallowing.
2. Patients who have undergone head and neck surgery.
3. Dental problems.
4. Anatomical oesophagal strictures.

Table 9.1 gives list of foods allowed in a soft, full liquid and clear liquid diet.

Table 9.1 : Foods allowed in Soft, Full liquid and Clear liquid diets

Types of food	Soft diet	Full liquid diet	Clear liquid diet
Cereals	Refined, finely ground whole grain, bread, biscuits, semolina, pastas.	Gruel, porridges, Kanji, ragimalt	Barley water
Pulses	All dhals	Dhal soups, dhal payasam	Dhal water
Fruits and vegetables	All fruit & Vegetable juices, soft fruits like mango, Papaya, banana, baked, pureed fruits & vegetables, low fibre vegetables,.	Strained juices, cooked and pureed fruits	Clear strained fruit juice
Milk	Milk & Milk products cheese, cream, curd.	Milk & milk beverages, milk shakes, lassi	Whey water
Fats & oils	Butter, oil, cream, margarine	Butter, oil, cream, margarine	--
Meat & Fish	Tender, minced, lean meat, poultry, fish, except pork.	--	--
Eggs	All except fried	only in beverages	Egg white well beaten in fruit juices.
Sugar & Jaggery	All	Sugar, jaggery, glucose, honey	Sugar or glucose
Nuts and oil seeds	None	None	None
Beverages	All	Tea, coffee, egg nog, non-carbonated Beverages	Clear tea, clear coffee. (without milk) carbonated bevrages
Soups & desserts	All, custards, kheer, puddings	Strained custards ice cream, plain gelatin	coconut water. Fat free broth plain gelatin, flavoured ice.

4. Normal diet

A normal diet is defined as one which consists of any and all foods eaten by a person in health. It is planned keeping the basic food groups in mind so that optimum amounts of all nutrients are provided. As there is no restriction of any kind of food, this diet is well balanced and nutritionally adequate.

Since the patient is hospitalized or is at bed rest, a reduction of 10% in energy intake should be made and too many fatty foods and fried foods be avoided as they are difficult to digest. The proteins are slightly increased (+10%) to counteract a negative nitrogen balance. All other nutrients are supplied in normal amounts.

5. Cold semi liquid diets

This diet is given following tonsillectomy or throat surgery until a soft or general diet may be swallowed without difficulty. It contains more of cold beverages and luke warm preparations.

6. Blenderized liquid diet

This is adopted in conditions of

i) inadequate oral control

ii) oral surgery with dysphagia

iii) wired jaws (blenderized foods can be consumed through small openings).

iv) Patients with reduced pharyngeal peristalisis.

Routine food is made into liquid pulp and can be prepared using a kitchen blender.

9.4. SPECIAL FEEDING METHODS

The special feeding methods depend on the type of disease, the patient's conditions and his tolerance to food. The different modes of feeding patients are

1. Enteral
2. Parenteral

Enteral

By definition enteral means "within or by the way of the gastrointestinal tract." As for as possible, the patient should be encouraged to ingest food through the oral route. Supplements may be added whenever necessary. The foods are administered via a tube and hence enteral feeding in also called tube feeding.

Tube feeding

Tube feeding may be advised where the patient is unable to eat but the digestive system is functioning normally. Full fluid diets or commercial formulas may be administered through this route.

The tube may be passed through the nose into the stomach (nasogastric), duodenum (nasoduodenal) or jejunum (nasojejunal).

When there is an obstruction in the oesphagus, enteral feeding is done by passing a tube surgically through an incision in the abdominal wall into the stomach (gastrostomy), duodenum (duodenostomy) or jejunum (jejunostomy).

Indications for tube feeding

i. Inability to swallow due to paralysis of muscles of swallowing (diptheria, poliomyelites)

ii. Unwillingness to eat.

iii. Persistent anorexia requiring forced feeding.

iv. Semiconcious or unconscious patients.

v. Severe malabsorption requiring administration of unpalatable formula.

vi. Short bowel syndrome.

vii. Babies of very low birth weight.

Tubes

For enteral feeding for a short period of time locally available thin bore nasogastric tubes are usually adequate. For prolonged use, specially prepared thin bore, soft, flexible tubes are desirable.

Procedure

The preparations to be administered are kept in bottles marked "For intragastric use". They are connected to the tube and allowed to drip into the stomach by gravity. Feeding is started as a continuous drip of 50 ml per hour, increased by 20 ml every 24 hours until the required rate is achieved (usually 100 to 120 ml per hour). There is evidence that giving intermittent boluses of feeds every two hours improves metabolism, compared to feeding by continuous drip.

Enteral feeds

The types of feeds that can be administered though a tube include:

1. Blenderized food

This is prepared for patients who cannot chew and swallow due to cancer of the oral cavity, larynx or oesophagus.

Ordinary food items which cannot be swallowed are cooked well and blenderized to make them liquid for feeding through a nasogastric tube.

2. Polymeric mixtures

Polymeric mixtures contain intact protein, fat and carbohydrate of high molecular weight and are thus lower in osmolarity and require normal digestive juices.

3. Elemental diets

Elemental diets are commercially predigested mixtures of amino acids, dextrins, sugars, electrolytes, vitamins and minerals with small amounts of fat. They are free of lactose and can be easily administered.

The main indication for elemental diets is short bowel syndrome, till functional regeneration occurs in the residual bowel. These diets are used as alternatives to intravenous feeding. The disadvantages of this diet are high cost and unpleasant taste and sometimes high osmolarity. Therefore, easily digestible and more palatable preparations of casein and egg albumin are preferred.

To prevent essential fatty acid deficiency enteral feeds should provide 4% of total calories as essential fatty acids.

Commercial enteral mixtures of varying osmolarity, digestibility, energy supply, lactose content, viscosity and fat content are available Eg: Ensure, Ensure plus, osmolite, Triosorbon, Isocal.

Methods of administration

The three common methods of tube feeding administration are

1. Continuous drip
2. Intermittent drip
3. Bolus

Continous drip

This is the most common form of administration. The drip rate is adjusted in increments to prevent cramping, nausea, diarrhoea or distention. Feedings are started at 30 to 50 ml/hr every 8 or 12 hrs until the final rate is attained

Intermittent drip

In this 4-6 feeds are given with regular periods of interruption example : 4 hours on and 4 hours off.

Bolus method

In this method large volumes are given in a short time. For example, 200 ml is administered in a minimum time of ten minutes.

Parenteral Nutrition

The delivery of nutrients directly into the circulation through the peripheral or central vein is termed as parenteral nutrition. This can be total or supplemental.

The total sustenance of increased nutritional requirements through intravenous feeding has been termed Total Parenteral Nutrition (TPN). When parenteral nutrition provides 30-50% of the total daily nutrients it is termed partial parentral nutrition. Intravenous feeding is best used in conditions when the patient cannot eat, will not eat, should not eat, cannot eat enough or cannot be fed adequately by tube feeding.

Conditions which necessitate parenteral feeding include

1. Cancer
2. Inflammatory bowel disease
3. Short-bowel syndrome
4. Preoperative patients
5. Gastrointestinal fistulae.

Parenteral feed solutions

The peripheral vein solution should be of less than 600 mOsm, as higher osmolarity results in thrombosis and inflammation of the vein. The parenteral feed solutions contain;

- glucose
- emulsified fat
- crystalline amino acids
- vitamins

- electrolyes – Sodium, chlorine, phosphorus, potassium, calcium and magnesium
- trace elements – zinc, copper, chromium, manganese and iodine
- water

Advantages of enteral feeding over intravenous feeding

- Convenient to administer.
- Inexpensive.
- No hospitalization.
- No sterlization of tubes or nutrient.
- Expert supervision not necessary.
- Easily tolerated.
- Avoids catheter related sepsis and infections.
- Avoids metabolic disturbances.
- Intestinal mucosa regenerates more rapidly as in case of short bowel syndrome.

9.5. FOOD EXCHANGE LIST

A food exchange list consists of similar foods grouped together so that specified amounts of each food listed in that group have approximately the same energy, carbohydrate, protein and fat content. So any one food in a particular exchange list can be exchanged for another in the same list. This facilitates a wider choice in selecting foods within every exchange, while controlling the total calorie, protein and fat in the daily diet.

Nine food exchange lists have been prescribed which are as follows:

1. Vegetable exchange A

Vegetable exchange A includes vegetables with less carbohydrate. 100 gm of vegetables make one exchange which has negligible fat and protein.

This includes leafy vegetables and gourd vegetables.

2. Vegetable exchange B

Vegetable exchange B includes vegetables with high carbohydrate contents i.e. with carbohydrate of 7 g and above. e.g : Beetroot, Cauliflower, Carrot are included in this exchange. This provides 10g carbohydrate, 2 g protein, negligible fat and 50 k.cal.

3. Fruit exchange

Each exchange of fruit on this list provides on an average about 10g of carbohydrate, negligible protein and fat and 50 k.cal.

4. Cereal exchange

Quantities of cereal / cereal products providing 20 g of carbohydrate is taken as one exchange. Each cereal exchange provides approximately 20 g Carbohydrate, 2 g protein, negligible fat and 100 k.cal.

5. Pulse exchange

The basis for this exchange is 30 g of raw pulse containing 6 g of protein. So the quantities of pulses providing 6 g of protein is taken as one pulse exchange. Each pulse exchange provides 6 g protein, negligible fat, 15 g carbohydrate and 100 k.cal.

6. Flesh food exchange

One meat exchange provides 10 g protein, negligible carbohydrate and 70 k.cal. The quantities in this exchange vary from 50 - 60 g, the basis being the protein content.

7. Milk exchange

On an average one milk exchange provides 5 g protein and 100 k.cal. The quantities of foods is this exchange is not constant and it varies with the CHO and fat content of foods. The basis for this exchange is protein content of foods.

8. Fat exchange

The exchange includes butter, edible fats and oils, cream, nuts and oilseeds. One exchange in this list is that quantity of food, which provides 11 g of fat. On an average one fat exchange provides 11 g fat and 100 k.cal and negligible protein.

9. Sugar exchange

This includes sugar, Jaggery, honey, jam, jellies and marmalades. Each exchange on this list provides on an average 5 g carbohydrate and 20 k.cal.

These exchange lists make planning of meals simple and quick and are as follows:

VEGETABLE EXCHANGE A

These vegetables may be used as desired. Carbohydrates and calories are negligible.

Leafy vegetables	Other vegetables
Amaranth	Ash gourd
Bathua	Bitter gourd
Brussels sprouts	Brinjal
Cabbage	Calabash cucumber
Celery	Cauliflower
Coriander leaves	Cho-Cho (Marrow)
Curry leaves	Cucumber

Fenugreek leaves	Drumstick
Lettuce	French beans
Mint	Knol-Khol
Rape leaves	Ladies-fingers
Spinach	Mango, green
Soya leaves	Onion stalks
	Parwar
	Plantain flower
	Pumpkin
	Raddish
	Rhubarb stalks
	Ridge gourd
	Snake gourd
	Tinda
	Tomato, green
	Turnip

VEGETABLE EXCHANGE B

Carbohydrates – 10 g **Calories – 50 k.cal**

Root Vegetables	**Quantity (g)**
Beetroot	75
Carrot	105
Colocasia	45
Onion (medium)	90
Potato	45
Sweet potato	30
Tapioca	30
Yam (elephant)	60
Yam	45
Other Vegetables	
Artichoke	60
Broad beans	90
Cluster beans	90
Double beans	50
Jack, tender	105
Jackfruit seeds	30
Leeks	60
Peas	45
Plantain, green	75
Singhara	45

FRUIT EXCHANGE

Carbohydrates – 10 g **Calories – 50 k.cal**

Fruit	**Quantity** g	**Approximate number of size**	
Amla	90	20	medium
Apple	75	1	Small
Banana	30	¼	medium

Cape gooseberry	150	40	small
Cashew fruit	90	2	medium
Custard apple	50	¼	
Dates	30	3	
Figs	135	6	medium
Grapes	105	20	
Grape fruit	150	½	big
Guava	100	1	medium
Jack fruit	60	3	medium pieces
Jambu fruit	50	10	big
Lemon	90	1	medium
Loquat	105	6	big
Mango	90	1	small
Mangosteen	75	2	medium
Melon	275	¼	medium
Orange	90	1	small
Papaya	120	2	medium
Peach	135	1	medium
Pear	90	1	medium
Pineapple	90	1 ½	slices (round)
Plum	120	4	medium
Pomegranate	75	1	small
Strawberry	105	40	
Sweet lime	150	1	medium
Tomato	240	4	medium
Water melon	175	¼	small

CEREAL EXCHANGE

30 g provide Calories : 100 k.cal

Carbohydrates : 20 g; Protein : 2 g

Bajra	Rice flakes
Barley	Rice puffed
Bread*	Sago**
Cholam (jower)	Samai
Corn flakes	Semolina
Maize, dry	Vermicelli (savian)
Oatmeal	Wheat flour
Ragi	Wheat, broken (dalia)
Rice	White flour

*To meet carbohydrates and calories add 5 g. sugar

**Requires supplementation with other high protein foods, when used

LEGUME AND PULSE EXCHANGE

30 g provide Calories : 100 k.cal

Carbohydrates : 15 g; Protein : 6 g

Bengal gram	Kabuli Channa (White gram)
Bengal gram, roasted	Lentils
Black gram	Peas, dried
Cow gram	Rajmah

Green gram	Rawan
Horse gram	Red gram

FLESH FOOD EXCHANGE

Calories - 70 k.cal; Protein 10 g

Food	Quantity (g)
Beef	60
Crab	120 g
Egg, duck*	2 Nos
Egg, hen*	2 Nos
Fish, big	60
Fish, small	60
Fish, Vajra	60
Fowl	60
Liver, Sheep	60
Mutton muscle*	60
Pigeon	50
Pork	60
Prawn	60

* Provides 100 calories

MILK EXCHANGE

Calories 100 k.cal; Protein 5 g.

Food	Quantity
Butter milk	750 ml
Cheese	30 g
Curd	210 g
Khoa	30 g
Milk, Buffalo	90 ml
Milk, Cow	180 ml
Milk, Skimmed *	260 ml
Milk, Skimmed, powder*	30 g

* Provides 10 g. protein

FAT EXCHANGE

Calories 100 k.cal; Fat 11 g.

Food	Quantity (g)
Almonds	15
Butter	15
Cashewnuts	20
Coconut	30
Ghee	11
Groundnuts	20
Hydrogenated fat (vanaspati)	11
Oil (coconut, mustard)	11
Pistachionut	15
Walnuts	15

QUESTIONS

Part A

1. Modification of a normal diet to suit the individual needs is called _____.
2. The liquid diet totally devoid of residue is called _____.
3. Which of the following can be included in a clear liquid diet.

   a) Milk b) Conjee c) Wheywater
4. A_____ diet is a transition between full liquid and normal diet.
5. Patients with poor dentition require a _____ diet.
6. Each pulse exchange provides _____ g of protein.

Part B

1. Explain a full liquid diet.
2. Define diet therapy. The basis for planning a therapeutic diet is a normal diet - comment.
3. What is a clear liquid diet? Give a list of foods that can be included in a clear liquid diet.
4. Write a short note on enteral feeds.
5. What are the advantages of enteral feeding over parenteral feeding.
6. Explain the food exchange lists.

Part C

1. Explain the dietary modifications in terms of consistency.
2. Explain enteral and parenteral nutrition.

10. DIET IN FEVER

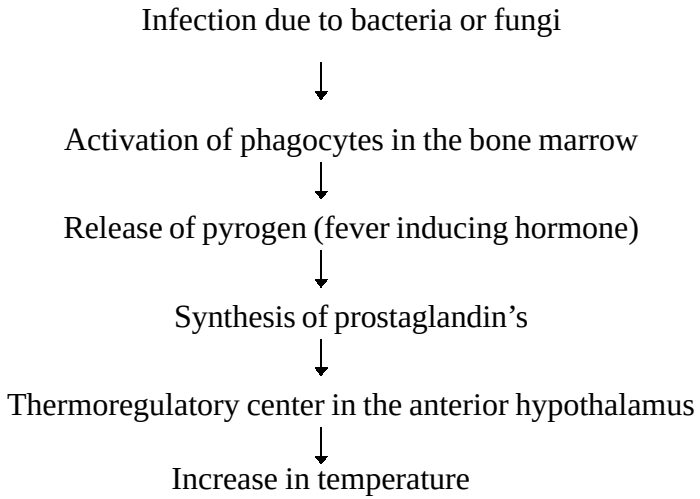
Fever is an elevation in body temperature above the normal of 98.4^{o} F, which may occur in response to infection, inflammation or unknown causes. The duration of fever may be 1) Short as in acute fevers of colds, influenza 2) Chronic as in tuberculosis or 3) intermittent as in malaria

10.1. CAUSES

Fever can be caused due to 1) exogenous agents such as bacteria or fungi or 2) endogenous factors such as antigen - antibody reactions, malignancy or graft rejection.

Development of fever due to exogenous agents is shown in fig 10A

Fig. 10A : Development of fever due to exogenous agent



Source : Srilakshmi, B. (2002) ***Dietetics.*** 4th ed. New age International Publishers.

10.2. METABOLISM IN FEVERS

The metabolic effects of fevers is proportional to the elevation of body temperature and the duration

1. An increase in the metabolic rate amounting to 13 percent for every degree celsius rise in the body temperature (7 percent for each degree farenheit); an increase is also due to restlessness and hence a greatly increased caloric need.
2. Decreased glycogen stores and decreased stores of adipose tissue.
3. Increased catabolism of proteins especially in typhoid fever and malaria places an additional burden upon the kidneys.
4. Accelerated loss of body water due to increased perspiration and excretion of body wastes.
5. Increased excretion of sodium and potassium.

10.3. DIETARY CONSIDERATIONS

The diet in fever depends on

1. The nature and severity of the pathologic conditions and
2. Length of convalescence.

It should meet the body's need for the following nutrients.

Energy

The caloric requirement may be increased as much as 50 percent if the temperature is high and tissue destruction is great. Restlessness also increases the caloric requirement.

Protein

About 100g of protein or more is prescribed for the adult when fever is prolonged. This will be efficiently utilized when the

caloric intake is liberal. High protein beverages may be used as supplements to the regular meals (eg. Milk)

Carbohydrates

Glycogen stores are replenished by a liberal intake of carbohydrates. Glucose – a simple sugar, which is less sweet and readily absorbed into the blood stream is preferred.

Fats

The energy intake may be rapidly increased through the judicious use of fats, (about 35 g of fat). Fried foods may retard digestion.

Minerals

A sufficient intake of sodium chloride is accomplished by the use of soups and liberal sprinkling of salt on food. Fruit juices a relatively good source of potassium should be included.

Vitamins

B complex vitamins are needed at increased levels proportionate to the increase in calories. Fevers increase the requirement for vitamin A and ascorbic acid.

Fluid

The fluid intake must be liberal to compensate for the losses from the skin and to permit adequate volume of urine for excreting the wastes. Daily 2500-5000 ml is necessary in the form of soups, fruit juices and water.

Ease of digestion

Blended, readily digestible foods (well cooked) should be used to facilitate digestion and rapid absorption. The food may be soft or of regular consistency.

Intervals of feeding

Small quantities of food at intervals of 2 to 3 hours will ensure adequate nutrition.

Diet in fevers of short duration - Typhoid

Typhoid is an infectious disease with an acute fever of short duration and occurs only in humans. *Salmonella typhi* causes typhoid. Faeces and urine of the patients or carriers of the disease are the source of infection. Infection is acquired by ingestion of food or water contaminated with faeces from patients or persons recovered from the disease. House flies help in the transfer of the bacteria from faeces to food.

Symptoms

The disease is characterized by:

- Continued, high inflammation of the intestine
- Formation of intestinal ulcers
- Haemorrhage and enlargement of spleen.
- Peyers patches of lymphatic tissue situated in the small intestine are a seat of infection in typhoid fever. The patient may complain of diarrhoea or constipation and severe stomach ache.

Principles of diet

A high calorie, high protein, high carbohydrate, high fluid, low fat, low fibre and bland diet is recommended for typhoid patients.

At first clear fluid diet is given followed by full fluid and soft diet. Liquid diets may not meet high calorie and high protein requirements. As the patient improves a soft diet can be given. Liquid diets are helpful in meeting water and electrolyte requirements. Because of intestinal inflammation, fiber and spices must be eliminated in the diet.

Table 10.1 : Foods to be included and avoided in typhoid fever

Foods to be Included	Foods to be avoided
Fruit juices with glucose, coconut water, milk if there is no diarrhoea, custards, thin dal, boiled egg, baked fish, cottage cheese, cereals, vegetable juices, bread, boiled potato, porridges.	Butter, ghee, chillies and spices, fried foods, and cream soups.

Diet in intermittent fevers – Malaria

Malaria is transmitted from human to human by the bite of the infected female *Anopheles* mosquitoe. Induced malaria occurs due to congenital transmission or blood transfusion.

Symptoms

Typical malarial attacks show sequentially.

- Over 4-6 hours shaking chills (the cold stage) fever to 41^{o}C or higher (the hot state) and the sweating stage. Associated symptoms include
- Fatigue
- Headache
- Dizziness
- Gastrointestinal symptoms, anorexia, nausea
- Slight diarrhoea
- Vomiting
- Abdominal cramps
- Backache and dry cough. When acute symptoms have continued for 4 or more days splenomegaly usually appears.

Dietary management - same as in fevers.

Diet in chronic fevers as in tuberculosis

Tuberculosis is an infectious disease caused by the bacillus *Mycobacterium* tuberculosis. It affects the lungs but may also be localized in other organs such as the lymph nodes or kidneys.

Symptoms

Pulmonary tuberculosis is accompanied by wasting of tissues, exhaustion, cough and fever. In the acute phase high fever and increased circulation and respiration are present. The chronic phase, is accompanied by low-grade fever. Because of the prolonged illness considerable wasting of tissues may be present.

As the disease progresses the patient begins to exhibit loss of appetite, pain in chest, fatigue, weight loss, sweat and a persistent worsening cough. If the blood vessel is eroded in the lungs, the sputum may be streamed in blood. Death ultimately results when sufficient damage has occured in the lungs and other vital organs.

There is increased catabolism of tissue proteins and increased loss of sodium chloride and potassium salt from the body.

Modification of nutrients

Energy

In order to achieve desirable body weight and meet the increased energy demands, a high calorie diet of 2500 - 3000 k.calories per day is recommended.

Protein

A protein intake of 80 to 120 g helps regenerate the serum albumin levels which are low.

Minerals

Calcium is needed to promote healing of the tuberculosis lesions. At least one litre of milk should be taken daily. Iron supplements may be needed if there has been hemorrhage. Calcium, iron and phosphorus help in regeneration of cells, blood and fluids.

Vitamins

Carotene is poorly converted to vitamin A hence the diet should provide vitamin A. Weekly inclusion of liver and dietary supplementation with vitamin A is essential. Ascorbic acid deficiency is present and additional amounts of citrus fruits and ascorbic acid supplementation is essential for regeneration purposes. Supplements of vitamin B-6 are also recommended.

Principles of diet

A high calorie, high protein, diet is prescribed. Fluid diet may be given at first progressing to the soft and regular diets when improvement occurs.

Dietary management / guidelines

- Food should be bland in flavour, non-stimulating and easily digested.
- Since patients have poor appetite, food must be appetizing
- During the acute stage a high calorie fluid and soft diet are prescribed followed by high calorie soft regular diet.
- Initially small quantities of fluid diet should be given once in three hours. When the fever decreases the interval can be increased to 4 hours.
- Good quality protein like eggs should be given.
- Fatty foods, highly fibrous foods and spicy foods, which are hard to digest should be avoided.
- 24th March is observed as world Tuberculosis day.

QUESTIONS

Part - A

I. Fill in the Blanks

1. Fever can be caused by _____ agents and _____ factors.
2. Fever is an elevation of body temperature above _____
3. Fever increases the requirements for_____and _____
4. Tuberculosis is an infectious disease caused by the bacillus _____ _____
5. _____ is needed to promote healing of the tuberculosis lesions.

Part - B

II. Write short answers

1. List the causes of fever.
2. State the metabolic effects of fever.
3. List the symptoms of typhoid.

Part - C

III. Write detailed answers

1. State the principles to be observed in planning diets for fevers.

2. Explain the dietary management for typhoid fever.

11. DIET IN OBESITY AND UNDERWEIGHT

11.1 OBESITY

Obesity can be defined as the generalized accumulation of excess adipose tissue in the body resulting in an increase of more than 20 percent of the desirable weight. Obesity is due to positive energy balance where the intake of calories (from the diet) is more than the expenditure of calories (physical activity)

Factors that contribute to obesity:

a. Genetic factors: Genetic inheritance influences 50-70 percent a person's chance of becoming obese. If both parents are obese the chance in children is 80 percent and 70 percent if neither parent is obese.

b. Age and sex: It can occur at any age and in either sex as long as the person is in a positive energy balance.

c. Eating habits: Nibbling between meals is a potential cause for obesity. Excessive consumption of relatively cheap carbohydrate rich foods such as rice and potato is another predisposing factor (rather than low calorie fruits and vegetables). It is the total intake of calories rather than the frequency of meals that causes obesity.

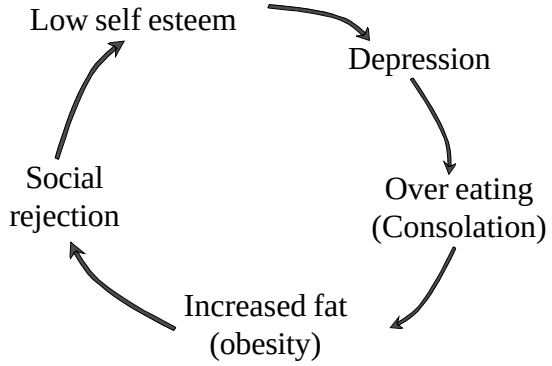
d. Physical activity: Obesity is more common after the age of 35 when physical activity decreases and food consumption either remains the same or may increase with improved economic status.

e. Endocrine factor: Dysfunction of the thyroid and pituitary may result in obesity.

f. Trauma: Obesity may follow due to damage to hypothalamus after head injury because it is not able to regulate appetite or satiety.

g. Psychological Factors: For people who are bored, lonely, discontented or depressed food becomes the focal point, leading to obesity as shown in fig.11A.

Fig. 11-A. VICIOUS CYCLE



11.2. ASSESSMENT

1. **Body weight:** An adult weighting 10 percent more than the standard weight is overweight and 20 percent more is obese.

2. **Body mass index**: Obesity is expressed in terms of BMI-Body Mass Index, and can be represented as

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

   Normal - 20 – 24.9
   Overweight - 25 – 29.9
   Obese - 30 – 39

3. **Waist circumference:** It is the most practical tool to evaluate a patients' abdominal fat.

   High risk waist circumference:

   Men > 40 in (>102 cm)

   Women > 35 in (>88 cm)

4. **Waist to Hip ratio (WHR)**

This is the most frequently used measure of adiposity. It is also called abdominal / gluteal ratio.

The normal ratio $\frac{\text{Waist}}{\text{Hip}} = 0.7$

A WHR of 1.0 or greater in men and 0.8 or greater in women is indicative of android obesity and increased risk for obesity related diseases.

5. **Broka's Index:** In order to calculate ideal body weight Broka's index is used. This measurement is easy to calculate and accurate.

   Brokas's Index = Height (cm) – 100 = ideal weight (Kg)

11.3 OBESITY - GRADES - I, 11 and 111

Grading can be done based on BMI

1) Normal - 20 - 25
2) Grade I obese - 25-29.9
3) Grade II obese - 30-40
4) Grade III obese - > 40

Grade I obesity: These people have body mass index more than 25 but less than 29.9. Overweight does not effect their health, they lead normal healthy lives and life expectancy is above normal.

Grade II obesity: They body mass index is between 30 - 39.9. These patients appear to be in good health but have reduced tolerance to exercise with shortness of breath. They are at an increased risk of diabetes, atherosclerosis, hypertension and fatty liver. Mortality rate increases with increasing body mass index.

Grade III obesity : The body mass index is above 40. They are susceptible to atherosclerosis and have serious psychological disturbances.

11.4. AREAS OF ADIPOSE FAT DISTRIBUTION

Fat mass is distributed differently in men and women. The android or 'apple' shape male pattern is characterized by fat distributed in the upper body above the waist, whereas gynoid or 'pear shape' female pattern is fat predominantly in the lower body, that is, lower abdomen, buttocks, hips and thighs.

Fat cells from the upper body seem to be functionally different from fat cells in the lower body. They are more sensitive to insulin. Abdominal or android fatness carries a greater risk for hypertension, cardiovascular disease, diabetes mellitus, gall bladder disease and stroke.

11.5. DIETARY MODIFICATION AND EXERCISE PATTERN

Prevention of obesity is most desirable and should start from infancy. Three essential principles to be remembered in diet therapy are

1. Adherence to the diet plan
2. Maintenance of the diet and
3. Maintenance of Energy balance

Principles of dietetic management

Low calorie - restricted carbohydrate, restricted fat but with normal protein, vitamins and minerals (except sodium) liberal intake of fluid and high in fibre is given.

Energy: 20 Kcal per Kg ideal body weight is prescribed for a sedentary worker and 25 Kcal for moderately active worker.

Proteins: 0.8 to 1g of protein / kg body weight is prescribed for tissue repair.

Carbohydrates: High carbohydrate content foods like potatoes and rice are restricted. Sugar which gives empty calories should be totally avoided. Fruits rich in carbohydrate like banana should be avoided. To produce a feeling of satiety and regular bowel movements, bulk-producing carbohydrates like green leafy vegetables and fruits are given.

Fat: Low fat or no fat should be given as calories are reduced. Foods rich in fat like nuts and oil seeds are avoided. Skim milk should be given.

Vitamins: With prolonged restriction of fats, there is likely to be a restriction of fat soluble vitamins A and D which may be supplemented.

Minerals: Sodium intake is to be restricted as excess sodium predisposes to retention of fluid.

Fluid: If salt is restricted then fluids can be taken liberally as extra fluids are excreted by the healthy kidneys. A glass of water taken before meals may help to cut down the intake of food.

High fibre: High fibre, low calorie food like green leafy vegetables, fruits, vegetable salads, whole grain cereals and pulses can be included in the diet. The advantages of using high fibre foods are.

- They are low in calorie.
- Foods like greens provide vitamins and minerals.
- High fibre diets give satiety.
- Help in regulating bowel movements.
- Reduce blood cholesterol.

Dietary Guidelines

1. Soups prepared from vegetables/pulses without the addition of fats or starch should be included in the diet.
2. Salads prepared using raw tomato, cucumber, cabbage, capsicum, radish, lettuce, carrots, sprouted green gram or bengal grams can be included.
3. Root vegetables, like potato, beetroot and carrot should be avoided.
4. High calorie fruits like mangoes, bananas and dry fruits should be avoided.
5. Lean mutton/chicken/fish should be steamed and not fried.
6. Cottage cheese to be used for processed cheese.
7. All fried foods like puries, parathas etc., should be avoided.
8. Avoid concentrated sweets like sugar, honey, ice cream, puddings, chocolate, candy etc.
9. Alcoholic beverages to be avoided.

Management after reduction: During weight reduction and after achieving normal weight, individuals are advised to follow the following instructions for the future control of obesity.

1. Avoid snacks between meals and restrict helping of

a) Cereal products

b) Fried foods and foods to which fat is added liberally for cooking

c) Milk products prepared from cream or butter

d) Nuts

e) Desserts

f) Decrease consumption of meat and fatty poultry

g) Coconut

2. Increase consumption of fruits and vegetables except tubers
3. Increase consumption of fish.
4. Check the weight at least every week on a reliable scale.
5. Daily exercise with the same zeal as during the reducing program.
6. Three regular meals should be taken.
7. Avoid skipping breakfast as it increases food intake during lunch.

Physical Exercise: A low calorie diet accompanied by moderate exercise is effective in causing weight loss. Aerobic exercises for 15-30 minutes in which speed and resistance is constant for eg. in walking, running and swimming can be performed as it directly increase the daily energy expenditure and is useful in long term weight maintenance. Further 50% of glucose and 50% of fat is metabolised to give energy when such exercise are performed. Exercise also preserves lean body mass and prevents the decrease in basal energy expenditure. Anaerobic exercise in which speed and resistance are not constant for eg. climbing stairs uses 100% glucose to give energy and does not use fat. Anaerobic form of exercise is not very effective in weight reduction. Passive exercise devices such as mechanical vibrators are ineffective methods of achieving loss of body fat. Some benefits of regular sustained exercise include

- Increased work capacity
- Cardiovascular efficiency
- Reduction in total fat stores
- Increased HDL-cholesterol and
- Improved muscle tone.

11.6. BEHAVIOR MODIFICATION

Behavior modification program must focus on three components: self monitoring, stimulus control and techniques for self-reward.

Self monitoring: A daily record of the place and time of food intake, as well as accompanying thoughts and feelings which stimulate food intake helps to identify physical and emotional settings in which eating occurs.

Stimulus control involves modification of

1) The settings of events that precede eating

2) The kinds of foods consumed and

3) The consequences of eating.

The last component is self-reward for eating control.

11.7. ILL EFFECTS OF OBESITY

The impact of obesity on health are

a. Physical disability: Since the feet have to carry extra load complications like flat feet, osteoarthritis of knee, hip and lumbar spine are common, Adipose tissues around chest and diaphragm interferes with respiration and predisposes to bronchitis.

b. Metabolic disorders:

i. There is a close association between obesity, diabetes mellitus and cardiovascular disease (fig. 11b). There is insulin resistance especially in muscle.

ii. Plasma cholesterol level is high and hence obese individuals are more prone to develop gall stones.

iii. Excess cholesterol and triglycerides with low levels of HDL

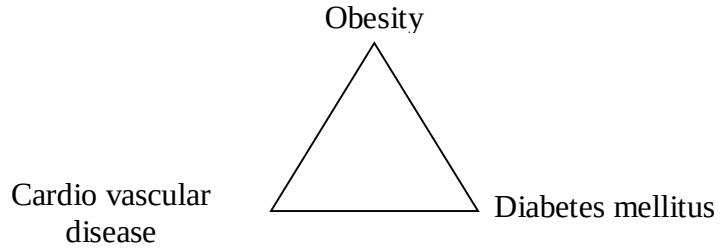


Fig. 11-B : Inter relationship of diabetes mellitus, obesity and cardiovascular disease

in plasma leads to atherosclerosis

iv. Obese people develop high blood pressure and there is an increased incidence of varicose veins.

c. Obsterical risk: Obese women when pregnant have greater obsterical risks because of hypertension, diabetes mellitus and post partum infection.

d. Cancer: Certain cancers (colon, rectum and prostrate in men, uterus, breast and ovary in women) are more prevalent in the obese.

e. Psychological Disturbances: Obese adolescents have personality characteristics of self blame, withdrawal and feeling of inferiority.

11.8. UNDERWEIGHT

People with BMI less than 18.5 are considered as under weight

Aetiology: Some of the causes of underweight are

1. Starvation due to famine
2. Diet inadequate in proteins
3. Debilitating diseases like tuberculosis, diabetes mellitus
4. Malabsorption syndrome or cancer

5. Psychological factors as in anorexia nervosa seen in girls in the age group 15 to 25 years

6. Pathological conditions such as fevers, gastro-intestinal disturbances where the digestion and absorption capacities are decreased.

Dietary Modification

A high energy, high protein, high fat diet with liberal vitamin intake is recommended. Before consuming such a diet the first step should be to determine and eliminate the cause for under eating.

Energy: The calorie requirements vary depending upon the activity. An additional 500 kcals per day to the recommended dietary allowances is recommended. The increase should be gradual over one or two weeks to prevent digestive disturbances.

Proteins: Instead of 1g of protein, over 1.2 g per kg body weight is recommended for tissue building. Good quality protein which is completely utilized by the body should be given.

Fats: Easily digestible fats are to be included. Excessive consumption of fried and fatty foods are not recommended as they may cause diarrhoea. Further, fatty foods taken at the beginning of a meal also reduces appetite. High calorie foods such as cream, butter, and oils increase weight and can be included.

Carbohydrates: High carbohydrate sources must form the basis of the diet. Dried fruits, sweets, nuts, jams, desserts, cereal and cereal products, potato chips and non vegetarian foods are a rich source of energy and should be included in the diet. Apart from the three meals, two feeds incorporating soups, juices or sweets in between main meals improve the nutritive value of the diet.

Vitamins and minerals: There is no need for extra vitamin and mineral supplements when the dietary intake is liberal.

Fluids: Fluids should not be taken before or with a meal, but only after a meal so that the food intake is not reduced.

Exercise: Regular outdoor exercise (light/moderate activity) should be performed as it helps to stimulate appetite and thereby increases foodintake.

QUESTIONS

Part - A

I. Fill in the blanks:

1. Obesity is the accumulation of adipose tissue in the body resulting in an increase of more than _____ percent of desirable weight.
2. Body mass index is called _____ Index.
3. The normal waist to hip ratio is_____
4. BMI of 30 – 40 is _____ obesity
5. People with BMI less than _____ are considered as underweight.

Part - B

II. Write short Answers

1. Explain Body mass index as a measure of assessment of obesity.
2. What is Broka's index? explain
3. Explain android and gynoid obesity
4. List the ill effects of obesity

Part - C

III. Write detailed Answers

1. What are the factors that contribute to obesity?
2. Explain the parameters used in the diagnosis of obesity.
3. What are the dietary modifications in the treatment of obesity?
4. List the causes and effects of underweight.
5. Explain the dietary modifications in the treatment of underweight.

12. DIET IN DISEASES OF THE GASTROINTESTINAL TRACT

12.1. FUNCTIONS OF THE GASTRO INTESTINAL TRACT

The gastrointestinal system includes the gastrointestinal tract (mouth, pharynx, oesophagus, stomach, small intestine, large intestine, including rectum) and the glandular organs (salivary glands, liver, gallbladder and pancreas) that are not part of the tract but secrete substances into it via ducts connecting these organs to the tract. The overall function of the gastrointestinal system is to process ingested foods into molecular forms that can be transferred, along with salts and water, from the external environment to the body's internal environment, where they can be distributed to cells by the circulatory system.

Figure 12.A depicts the anatomy of the gastrointestinal system. The liver overlies the gallbladder and a portion of the stomach, and the stomach overlies part of the pancreas.

The entire oesophagus functions as one tissue during swallowing. As the bolus of food is moved voluntarily from the mouth to the pharynx, the upper sphincter relaxes, the food moves into the oesophagus, and the lower esophageal sphincter relaxes to receive the food. Peristaltic waves move the bolus down the oesophagus and into the stomach.

The alimentary tract provides the body with a continual supply of water, electrolytes and nutrients. To achieve this requires

1. Movement of food through the alimentary tract.
2. Secretion of digestive juices and digestion of the food.
3. Absorption of the digestive products, water and the various electrolytes.

4. Circulation of blood through the gastro intestinal organs to carry away the absorbed substances and

5. Control of all these functions by the nervous and hormonal system.

The small and large intestines serve as organs of digestion,

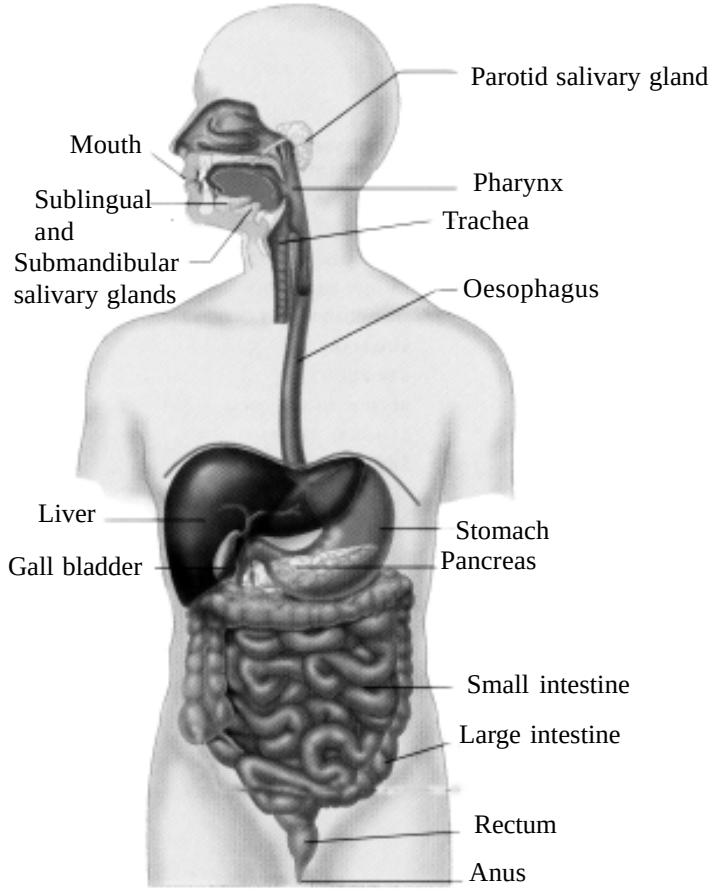


Fig 12-A : Anatomy of the gastrointestinal system

Source : Arthur J. Vander., James H. Sherman., Dorothy S. Luciano. (1994). ***Human Physiology.*** The Mechanisms of body function 6th ed. WCB/MC Graw Hill Inc.

absorption and excretion. Digestion is initiated in the mouth and stomach and is continued in the duodenum and jejunum with the aid of secretions from the liver, pancreas and small intestine. Absorption occurs primarily in the jejunum; the only substances absorbed in the terminal ileum are fats, bile salts and vitamin B_{12}. The large intestine or colon exists for the purpose of absorbing water and excreting the faecal mass.

12.2. CAUSES, SYMPTOMS AND DIETARY MODIFICATIONS OF DIARRHOEA

Diarrhoea is characterized by the frequent evacuation of liquid stools, accompanied by the excessive loss of fluid and electrolytes especially sodium and potassium.

Based on severity and duration diarrhoea can be classified as acute and chronic diarrhoea. Acute diarrhoea is the sudden onset of frequent stools of watery consistency, abdominal pain, cramping, weakness and sometimes fever and vomiting. This lasts for 24 to 48 hours. Nutritional losses are not a prime concern.

Diarrhoea is chronic when it persists for 2 weeks or longer. Nutritional deficiencies develop as the rapid passage of intestinal contents does not allow sufficient time for absorption.

Causes

Diarrhoea results from changes in the mucosa of the small and large intestines.

Diarrhoea may be due to many causes. The more common causes are:

- **Viral Infection :** e.g. 'intestinal' flu, a common term for infection of the bowels by the influenza virus and rota virus.
- **Bacterial Infection :** 50 percent of the cases are due to bacterial infections of the gut. Bacteria produce toxin in the gut e.g. *Vibrio cholerae, Shigella.*

- **Food poisoning :** Poor food hygiene and improperly handled food as a result of food being prepared with unwashed hands, food exposed to flies or cockroaches, or left at room temperature for a long time.
- **Allergy :** Allergy and food intolerance to certain foods or medicines.

Symptoms

Diarrhoea means passing loose or watery stools several times a day.

It is usually a symptom of an inflamed intestine or bowels. The inflammation results in food hurrying through the bowels. This leaves too little time for water to be absorbed from the bowel contents back into the body.

Diarrhoea can be uncomfortable especially when accompanied by abdominal pain, nausea, vomiting or fever. Diarrhoea can lead to dehydration.

Watch out for dehydration

Diarrhoea only becomes dangerous if you get dehydrated or lose too much body fluids. Vomiting and fever will both speed up the dehydration.

Babies below one year of age have a higher chance of getting dehydrated because they have so little body fluids to begin with. Adults and children who can drink freely to replace the salts and water lost are in no danger.

Signs of dehydration

- Inelastic skin
- Dry lips and mouth
- Furred tongue
- Sunken fontanelle (the soft spot on a baby's head)

Do the pinch test

Pinch up the skin on any part of your arm or abdomen and let go. Normal skin springs back into place at once. Inelastic skin sags back slowly.

Dietary modifications

Because diarrhoea is a symptom of a disease state, the aim of medical treatment is to remove the cause. The next priority is management of fluid and electrolyte replacement and finally attention to nutrition concerns.

Fluids

The loss of body fluids should be replaced by a liberal intake to prevent dehydration. Water, fruit juice, vegetable soups, rice kanji with salt, fresh lemon with sugar or honey can be given.

Electrolytes

Losses of sodium, potassium and other electrolytes cause weakness. Potassium is necessary for normal muscle tone of the gastrointestinal tract. Anorexia, vomiting and weakness occur unless losses are replaced.

Deficiencies of vitamin B_{12}, folic acid and niacin occur due to decreased intake of vitamins. Iron deficiency occurs due to the increased loss of iron in the faeces.

Energy

In acute diarrhoea over 1500 kcal daily and in chronic diarrhoea about 2500 kcal are given.

Proteins

Easily assimilable protein rich foods are given if tolerated.

Fats

Fats are restricted as they are not always absorbed and may aggravate diarrhoea.

Fibre

A low residue diet, i.e. diet low in fibre is recommended. A non – irritating diet consisting of soup, biscuits, rice, sago, arrow root, potato and skimmed milk can be included. Pectin from cooked apple helps in controlling diarhoea. Green leafy vegetables with a high residue should be restricted. When diarrhoea begins to lessen, fibre can be gradually incorporated in the diet to restore normal bowel motility.

Avoid

Spices, pulses, fried foods and fibrous vegetables are to be excluded.

Diet in Chronic diarrhoea

Low milk, then milk free and starch free diet can be given as represented in table 12.1.

Weanling Diarrhoea

Acute diarrhoea in weaning can be due to indigestion. When

Table 12.1 : Dietary Management of Chronic Diarrhoea

Type of Diet	Composition
• Diet A / Level I diet	Low milk diet (50 ml/kg/day) curd, rice with milk.
• Diet B / Level II diet	Milk free diet – cereal – pulse mix / amylase rich foods.
• Diet C / Level III diet	Lactose – Sucrose / starch free diet soya based or chicken based, and egg.

weaning food is introduced too early the infants' digestive system is not ready for digestive enzyme secretion and diarrhoea can result.

Strategies for lowering incidence of weanling diarrhoea.

- Encouragement of breast feeding
- Better food hygiene
- Improvement of nutritional status of children
- Clean food and
- Environmental sanitation are important strategies for lowering the incidence of diarrhoea.

The infant should continue to be breast fed during the attack of diarrhoea. Breast milk contains viable phagocytes and other protective substances which protect against most enteropathogens.

Milk should be diluted with equal volume of clean boiled water and fed along with Oral Rehydration Salt Solution (ORS) till the diarrhoea stops. Though there will be a temporary increase in the frequency of motions, recovery will be faster. Buttermilk whey can also be included as it has a beneficial effect. It discourages growth of pathogenic bacteria.

For older children cooked rice and lentil is usually well tolerated. Precooked ready to mix cereal pulse mixture prepared from roasted and powdered rice, wheat, black gram and powdered sugar in the ratio 1:1:1:2 can be given.

In adults, nutritional care includes replacement of lost fluids and electrolytes by increasing the oral intake of fluids high in sodium and potassium. Pectin from cooked apples helps to control diarrhoea. When the diarrhoea stops, starch foods like rice, potato can be given followed by protein foods. Fats need to be limited if the individual is healthy. In chronic diarrhoea, nutrients should be replaced parenterally and enterally. When diarrhoea begins to lessen, the addition

of normal amounts of fibre help to restore normal bowel motility.

Prophylaxis

1. Any food exposed to flies and dust must be strictly avoided.
2. When eating out avoid all uncooked foods, food touched by hands before serving or foods prepared under unhygienic conditions.
3. Food that is served hot as freshly made chapattis, toasted bread, idli and cooked vegetables, are safe to consume.
4. Cold foods served as meat, curd and butter milk are best avoided.
5. Fresh fruits must be peeled by the consumer.
6. Hot tea and water that has been boiled should be taken.
7. Tender Coconut water taken with a clean straw is the safest drink.

12.3 ORAL REHYDRATION THERAPY (ORT)

a. Home made solution : For one glass of boiled cooled water one pinch of salt and one teaspoon sugar can be added.

b. Oral rehydration salt solution : If the diarrhoea is prolonged and dehydration is evident, it is desirable to rehydrate the child orally by administering a solution approved by the World Health Organization (glucose 20g, sodium chloride 3.5g, trisodium citrate or kCl 2.9g or sodium bicarbonate 2.5g and potassium chloride 1.5g dissolved in one litre of safe drinking water). This solution provides 90 mEq/l of sodium, 20 mEq/l of potassium, 80 mEq/l of chloride and 30 mEq/l of bicarbonate. This must be given in small sips or with a teaspoon to prevent rapid passage of stools due to hyperactive gastro-colic reflex.

12.4. CONSTIPATION

Constipation is characterized by infrequent, incomplete evacuation of hard dried stools.

Types

There are three main types of constipation

1. Atonic 2. Spastic 3. Obstructive

1. Atonic constipation is due to

a. Lack of fluids. When there is excessive perspiration and an adequate amount of fluid is not taken. Water from the colon is completely absorbed and this leaves a small quantity of hard dry faeces which does not produce enough distension to initiate a reflex for its evacuation.

b. Lack of roughage. Faulty food habits which include irregular hours of meals, fasting or avoiding foods leaves little residue for evacuation.

c. Vitamin B Deficiency. Deficient intake of vitamin B produces loss of tone of the bowel wall.

d. Lack of potassium – deficient intake of potassium or excessive loss by use of purgatives may result in loss of bowel tone.

e. Irregular habits. Irregular bowel habits due to getting up late in the morning, or unhygienic condition prevailing may make a visit to the bathroom undesirable.

2. Spastic constipation results from excessive tone of the colonic muscles.

3. Obstructive constipation is due to malignancy of the colon.

Causes

Temporary or chronic constipation can be due to

1. Failure to establish regular times for eating, inadequate rest and incomplete elimination.
2. Chronic use of laxatives.

3. Difficult or painful defecation due to hemorrhoids.
4. Poor muscle tone of the intestine due to lack of exercise.
5. Ingestion of drugs, large amounts of sedatives.

Symptoms

Infrequent or insufficient emptying of the bowel may lead to headache, coated tongue, foul breath and lack of appetite. These symptoms usually disappear after evacuation has taken place.

12.5. DIETARY MODIFICATIONS – HIGH FIBRE DIET

Energy : Normal calories according to age, sex and occupation are advised.

Proteins : About 60 – 80g protein is advised.

Fats : Fats stimulate the flow of bile and lubricate the bowel. Fried foods should be avoided.

Carbohydrates : Adequate bulk should be supplied in the form of vegetables and whole fruits which are rich in unabsorbable cellulose.

Vitamins : B group vitamins help individuals to regulate the bowel function.

Minerals : Acutely ill or bed ridden patients require potassium in the form of vegetable soup and fruit juice to prevent constipation.

Fluids : A liberal amount of fluids, about 10 glasses per day is advised. Warm fluid taken early morning on an empty stomach helps people to evacuate the bowel.

Fibre : The intake of dietary fibre should be increased by eating whole cereals and increasing consumption of fruits and vegetables. The most important factor is the water holding capacity of the fibre.

Bran may be taken in the first week. It is made more palatable by adding cooked fruits and vegetables. Oranges, carrots and cabbage

fibres hold water more effectively. Whole grain breads and cereals should be used instead of refined cereals e.g. whole wheat flour instead of maida.

Foods included are high fibre foods like bran, vegetables, fruits whole grain bread. Low fibre foods like refined cereals have to be avoided.

12.6. MEANING OF THE TERMS PEPTIC, GASTRIC AND DUODENAL ULCER

The term peptic ulcer is used to describe any localized erosion of the mucosal lining of those portions of the alimentary tract that come in contact with gastric juice. This disintegration of tissues can also result in necrosis. Majority of ulcers are found in the duodenum, although they also occur in the stomach and in the oesophagus. Similar symptoms are produced by the ulcer regardless of its location and response to treatment is the same.

Duodenal Ulcer

In this condition there is hypersecretion of acid although tissue resistance is normal. Acid hypersecretion is due to an increased number of parietal cells and impaired rapid gastric emptying with loss of buffering effect.

Gastric Ulcer

Patients with gastric ulcer have weakened mucosal resistance caused by poor nutrition, diminished mucosal blood flow and a defect in the inhibition of gastric acid and pepsin secretion.

In the development of gastric ulcers although the presence of acid is essential, the degree of tissue sensitivity is important. In patients with duodenal ulcer, excess production of acid and pepsin is the primary factor. Figure 12-b shows the location of duodenal ulcer and gastric ulcer.

12.7. AGGRESSIVE AND PROTECTIVE FACTORS FOR GASTRODUODENAL MUCOSA

Aggressive factors

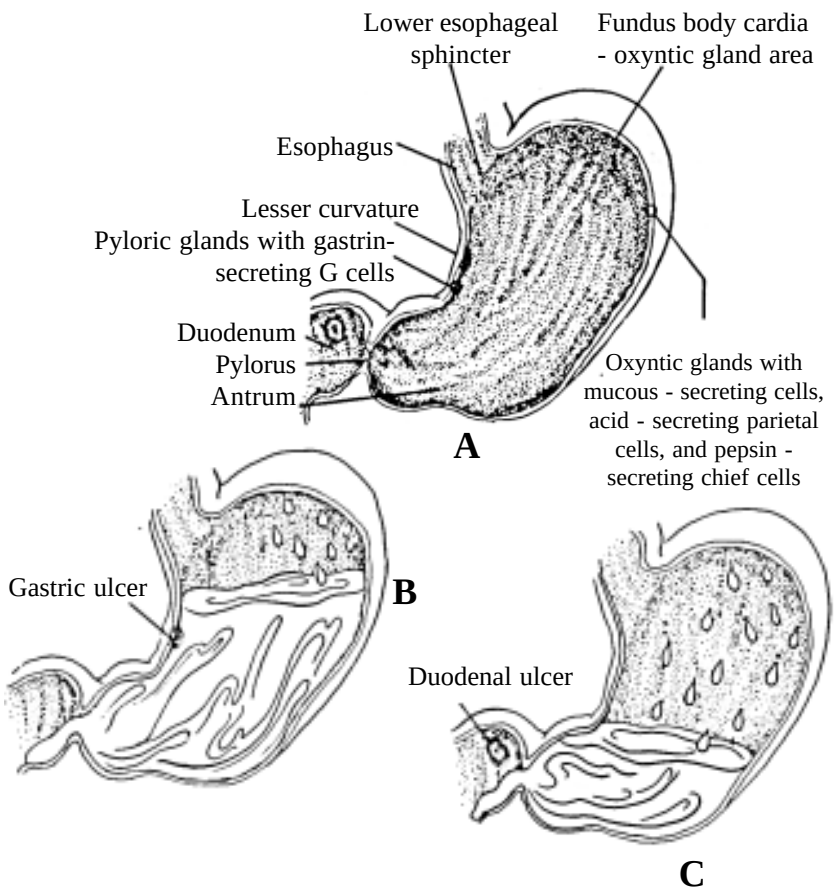


Fig. 12-B : Diagram showing (A) The stomach and duodenum with eroded lesions; (B) Gastric ulcer; and (C) Duodenal ulcer

Source : Mahan Kathleen L. Arlin M.T. Krauses' ***Nutrition and diet therapy.*** 8th ed. W.B. Saunder Company.

a. Bacterial infection : Helicobacter *pylori*, a spiral shaped, unipolar flagellate is associated with inflammation of gastric mucosa which could be a cause for peptic ulcer. This can be cleared by antibiotic treatment.

b. Genetic factors : It is more common in persons with blood group O. First degree relatives of patients with duodenal ulcer have an increased risk.

c. Sex : Men are affected two to three times more frequently than women.

d. Age : The incidence is high between 20 and 40 years during which time career and personal strivings are at a peak.

e. Stress : Highly nervous and emotional individuals are more susceptible as worry, fear and anxiety lead to hypersecretion of acid and hypermotility of the stomach.

f. Potentially irritant substances : Caffeine, aspirin and nicotine may delay healing the ulcer. Chillies, pepper, ginger, strong tea and coffee increase the secretion of hydrochloric acid and aggravate the condition.

g. Hydrochloric acid

h. Pepsin

i. Rapid gastric emptying

j. Smoking

k. Alcohol

Protective Factors

a. Prostaglandin

b. Bicarbonate secreted by stomach

c. Mucus

d. Mucosal blood flow.

Symptoms

- Epigastric pain
- Heart burn occurring as deep hunger contractions 1 to 3 hours after meals is the chief complaint.
- The pain is dull, piercing and burning and is usually relieved by taking food.
- Discomfort and flatulence in the upper part of the abdomen may be present.
- Low plasma protein levels delay rapid and complete healing of the ulcer.
- Weight loss and iron deficiency anemia are common.

Treatment : Therapeutic goals :

1. To relieve the symptoms
2. To allow healing of ulcer
3. To prevent complications like surgery

12.8. DIETARY MODIFICATIONS

Bland diet is given for ulcer patients. Bland diet is a diet which is mechanically, chemically and thermally non-irritating.

- Mechanically irritating foods include those with indigestible carbohydrate such as whole grains, raw fruits and vegetables.
- Foods that stimulate gastric secretion are chemically irritating foods and these include meat extractives, caffeine, alcohol, spices.

- Thermally irritating foods are those foods served either very hot or iced.

The diet must be nutritionally adequate in order to correct any preexisting deficiencies and to promote healing. This must be based on individual needs and food tolerances.

- Milk should be included as protein provides the necessary amino acids for synthesis of tissue protein to heal the ulcer.
- Moderate amounts of fat help to suppress gastric secretion.
- Fried foods are not advised as they are difficult to digest and aggravate the symptoms.
- Ascorbic acid helps in wound healing; hence citrus fruit juice and tomato juice can be given.

Dietary Guidelines

- Whether a patient is on bland or regular diet, a balanced diet should be taken.
- Regularity of meal times is essential. Small frequent meals are beneficial.
- Instead of heavy meals moderate amounts of foods should be eaten.
- In between meals, protein rich snacks should be taken.
- Meals should be eaten in a relaxed atmosphere. Personal and family problems should be forgotten while eating.
- Food should be eaten slowly and chewed well. Fast eating provokes gastric feeding reflex.

- Smoking, drinking coffee and alcohol should be avoided particularly on an empty stomach.
- Adequate physical and mental rest is basic.

Table 12.2 : Foods to be included and avoided in peptic ulcer

Foods to be Included	Foods to be Avoided
Milk, butter, cheese, eggs, steamed fish, rice, semolina custards, puffed rice, cornflakes, cooked pulses.	Alcohol, strong tea, coffee, cola beverages, pickles, chillies, spices and condiments, all fried foods, cakes, raw unripe fruits, raw vegetables, onion.

QUESTIONS

PART - A

I. Fill in the blanks

1. _____ and _____ virus can cause diarrhoea.
2. _____is necessary for normal muscle tone of the G.I. tract.
3. _____fibre foods should be restricted in diarrhoea.
4. The three types of constipation are _____, _____ and _____.
5. Bland diet is a diet which is mechanically, _____ and _____ non irritating.

PART – B

II. Write short answers

1. List the functions of the gastrointestinal tract.
2. Explain weanling diarrhoea.
3. Explain ORT.
4. List foods to be excluded from the diet of a peptic ulcer patient.

PART – C

III. Write detailed answers

1. Explain the dietary modifications for a person suffering from diarrhoea.
2. List the causes for peptic ulcer.
3. Explain dietary modifications for a patient suffering from peptic ulcer.

13. DIET IN DISEASES OF LIVER

The liver has the most varied and extensive function and is one of the most important organs involved in the metabolism of food. Most of the end products of digestion are transported directly to the liver where they are stored or resynthesized into other forms.

13.1. FUNCTIONS OF LIVER

1. Protein metabolism - synthesis of plasma proteins, deaminisation of amino acids, the resultant ammonia is detoxified by conversion to urea. Transamination of amino acids to maintain normal blood levels of non essential amino acids synthesis of prothrombin / fibrinogen.
2. Carbohydrate metabolism - synthesis, storage and release of glycogen. Glycogen is converted to glucose when needed (glycogenolysis). Liver cells convert protein to glucose to give energy (gluconeogenesis), synthesis of heparin.
3. Lipid metabolism - synthesis of lipoproteins, phospholipids, cholesterol, formation of bile, oxidation of fatty acids.
4. Mineral metabolism - Iron and copper, both essential to hemoglobin formation are stored in the liver.
5. Vitamin metabolism - All fat soluble vitamins A,D,E,K, as well as ascorbic acid and B-Complex vitamins are stored in the liver. Carotene is converted to vitamin A and vitamin K to prothrombin.
6. Drugs are metabolized and hormones are deactivated in the liver.
7. Liver detoxifies chemicals, poisons or drugs entering the body through foods.

13.2. AGENTS WHICH CAUSE DAMAGE TO THE LIVER

1. Dietary deficiencies

a. A low protein intake and reduced capacity to secrete beta lipoproteins as seen in kwashiorkor cause fatty changes in the liver.

b. Fatty changes in the liver are also common in uncontrolled diabetes, in starvation, and obesity. These changes are reversible.

2. Infective agents

a. Virus can cause infection and damage to the liver. Hepatitis A virus is excreted in the stools and spread by the faecal – oral route. The patient suffers from jaundice and the liver is enlarged and tender.

b. Improperly sterilized needles used in blood transfusion can transmit Hepatits B virus which causes homologous serum jaundice.

3. Toxic agents

1. Alcohol : Consumption of alcohol produces acute liver damage and jaundice.

2. Drugs and Chemicals : Drugs like paracetamol may damage the liver. Excess stores of iron, copper, galactose and glycogen may accumulate in the liver and lead to cirrhosis.

13.3. JAUNDICE – SYMPTOM OF LIVER DISORDERS

Jaundice is a symptom common to many diseases of the liver and biliary tract and consists of a yellow pigmentation of the skin and body tissues because of accumulation of bile pigments in the blood.

Jaundice may be produced due to the following factors / reasons

1. Obstructive jaundice results from the interference of the flow of bile by the formation of stone and tumors.

2. Hemolytic jaundice results from an abnormally large destruction of blood cells as in pernicious anemia.

3. Toxic jaundice originates from poisons, drugs or virus infection.

13.4. INFECTIVE HEPATITIS – SYMPTOMS AND DIETARY MANAGEMENT

Infective hepatitis is otherwise known as viral hepatitis.

Symptoms : Anorexia, fever, headache, rapid weight loss, loss of muscle tone and abdominal discomfort precede the development of jaundice. Neglected viral hepatitis leads to cirrhosis of liver. Treatment consists of adequate rest, nutritious diet and avoidance of further damage to the liver.

Dietary Management : The objectives of dietary treatment are to aid in the regeneration of liver tissue and prevent further liver damage.

A high protein, high carbohydrate, moderate fat is recommended. Small attractive meals at regular intervals are better tolerated. Over feeding should be avoided.

Energy : Sufficient calories should be given to maintain weight and reduce protein catabolism. A diet which supplies 1600 k cals to 2000 k cals is suggested.

Proteins : 1 g protein per kilogram of body weight daily is needed to overcome negative nitrogen balance, for liver cells to regenerate and prevent fatty infiltration of the liver. With severe jaundice 40 g and in mild jaundice 60 - 80 g of protein is permitted. In hepatic coma protein containing foods are avoided and high carbohydrate containing foods are given.

Fats : In severe jaundice 20 g and moderate jaundice 20-30 g is given. Fat needs to be restricted when there is obstruction to bile flow and in hepatic coma when fats are not metabolized by the liver.

Carbohydrates : High intake of carbohydrate is essential to supply enough calories so that tissue proteins are not broken down for energy. Fruits, fruit juices, vegetable juices, sugar, jaggery and honey are given to supply adequate electrolytes.

Vitamins : Vitamins are essential to regenerate liver cells. 500 mg of vitamin C, 10 mg of vitamin K, and B-complex vitamins are essential to meet the daily needs. If anorexia, nausea or vomiting are present, the vitamins may be given by injection.

Minerals : Oral feeds of fruit juice, vegetable and meat soups with added salt given orally or through a naso gastric tube help in maintaining the electrolyte balance.

Foods to be included and avoided are presented in table 13.1.

Table 13.1 : Foods that can be included and avoided in Infective Hepatitis

Foods to be included	Foods to be avoided
Cereal porridge, soft chapathis, bread, rice, skimmed milk, potato, yam, fruit, fruit juices, sugar, honey, soft biscuits, custards without butter, and cream.	Pulses, beans, meat, fish, chicken, egg, sweets with ghee, butter or oil, bakery products, dried nuts and fruits, alcoholic preparation, whole milk and cream.

13.5. DIETARY MANAGEMENT IN CIRRHOSIS OF LIVER

Cirrhosis is a condition in which there is destruction of the liver cell due to *necrosis*, fatty infiltration and *fibrosis*. (Fig. 13a) It is a serious and irreversible disease. It occurs after years of

excessive alcohol intake in individuals whose diets are deficient in nutrients. Malnutrition aggravates injury to the liver and can lead to child hood cirrhosis seen between the age of 1 to 3 years.

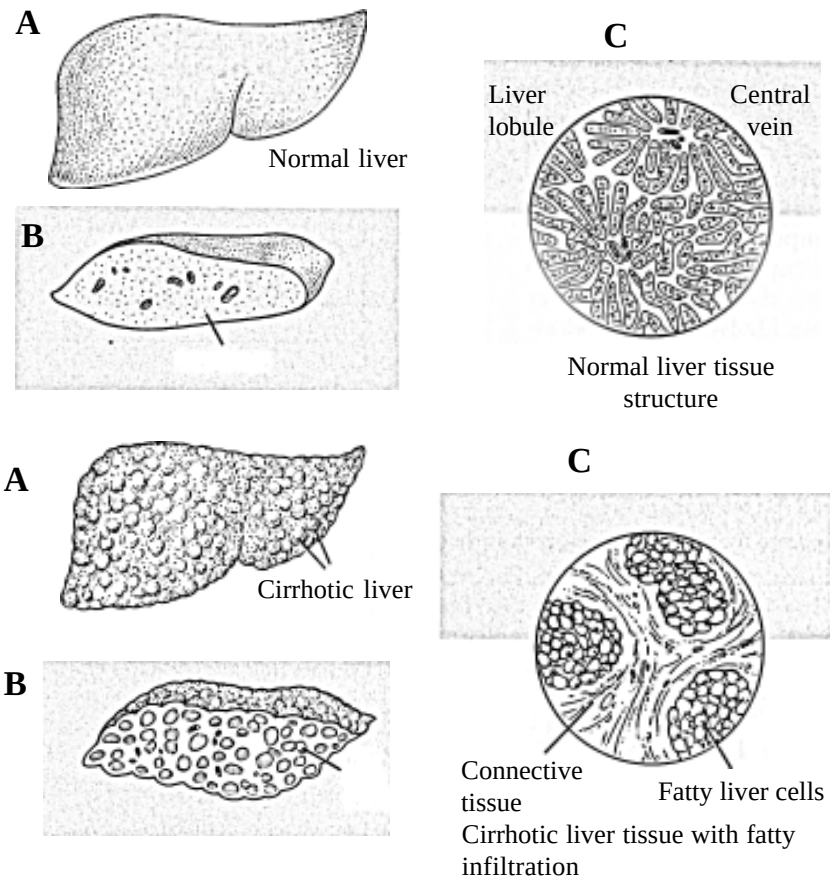


Fig. 13A : Comparison of normal liver and liver with cirrhotic tissue changes. (A) Anterior view of organ (B) Cross-section; (C) Tissue structure

Source : Williams S.R., (1994) 6th ed. ***Essentials of Nutrition and diet therapy,*** Mosbey year book.

Symptoms

The onset of cirrhosis may be gradual with gastrointestinal disturbances such as anorexia, nausea, vomiting and pain. The patient may suffer from weakness, muscle cramps, weight loss and fever. As the disease progresses jaundice occurs. Ascites which is the accumulation of abnormal amounts of fluid in the abdomen develops.

Principles of diet

A high calorie, high protein, high carbohydrate, moderate or restricted fat, high vitamin diet helps in the regeneration of liver and helps to prevent the formation of ascites. Low fat with supplementation of fat soluble vitamins and minerals should be given. Sodium should be restricted only when there is ascites. The diet should be attractive and palatable.

Dietary management

Energy : Since anorexia and ascites are present consumption of food is difficult. A highly nutritious high calorie diet is necessary because of prolonged undernourishment. The calorie requirement should be between 2000 - 2500 k cals.

Proteins : A high protein diet is helpful for regeneration of the liver. It also helps to compensate for the considerable loss of albumin in the ascitic Fluid. In the absence of hepatic coma, a high protein intake of 1.2 g/kg of body weight is recommended. The protein content of the diet varies according to the symptoms.

Fats : About 20 g of fat is given provided adequate amounts of protein is supplied.

Carbohydrates : Carbohydrates should be supplied liberally so that the liver may store glycogen. Liver function improves when an adequate store of glycogen is present.

Vitamins and Minerals : The liver is the major site of storage and conversion of vitamins into their metabolically active form. In cirrhosis the liver concentration of folate, riboflavin, nicotinamide, vitamin B_{12} and vitamin A are decreased.

Vitamin supplementation especially of B vitamins is required to prevent anaemia. Choline and methionine are useful if fatty infiltration is present.

Sodium is restricted to 400-800 mg/day in oedema and ascites. If there is no ascites very little salt is permitted to make the food more appetizing. Potassium salt is given for ascites and oedema to prevent hypokalemia.

Iron supplementation is essential as anaemia is common. A daily dose of 0.3 g of ferrous sulphate tablet 3 times after meals would also be beneficial. Folic acid 1 mg / day orally is given to treat macrocytic anaemia.

13.6. CHOLECYSTITIS AND CHOLELITHIASIS - DIETARY MANAGEMENT

Cholecystitis is an inflammation of the gall bladder and cholelithiasis is the formation of gall stones (Fig. 13b). Inflammation

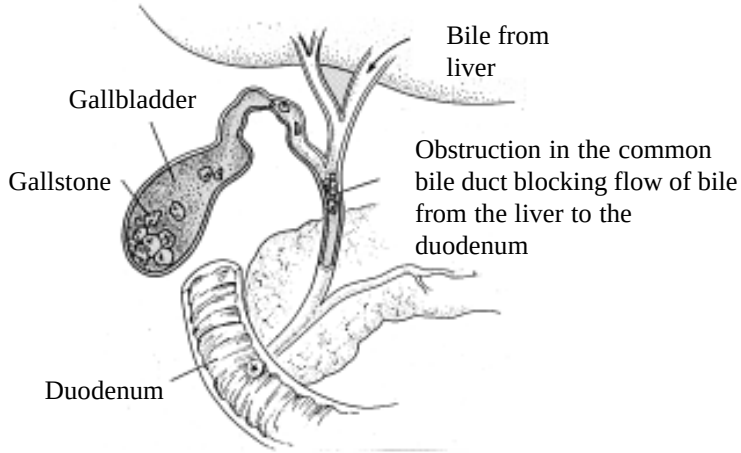


Fig. 13B : Cholelithiasis

Source : Krause's, ***Food Nutrition and Diet Therapy*** (2000). e.d. by Kathleen Mahan C and Escott - Stump S. 10th e.d. W.B. Saunders Company, Philadelphia.

of the gall bladder results from a low grade chronic infection and may occur with or without gall stones. Gall stones are of two main groups: Cholesterol and pigment stones.

When inflammation and / or stones are present in the gallbladder, fat in the diet is the main cause for contraction which causes pain. Surgical removal is usually indicated if the patient suffers from acute cholecystitis or cholelithiasis. Intake of fat should be greatly reduced to 20g day and energy should be derived from carbohydrate.

Cereals in a soft form, cooked rice, chapathi, bread and idli, milk pudding, curds, cooked vegetables, kichidi and porridge can be included in the diet. Pulses, beans, meat, fruit, fruit juices, fish, soft cooked eggs can also be given. These are high caloric, high protein foods which help in regeneration of liver cells.

- - -

QUESTIONS

Part - A

I. Fill in the blanks

1. Liver is involved in the _____ of food.
2. Conversion of glycogen to glucose is called _____
3. Gluconeogenesis is conversion of _____ to glucose.
4. Infective hepatitis is known as _____ hepatitis.
5. In cirrhosis there is destruction of liver cell due to _____, _____ and _____.

Part – B

II. Write short answers

1. List the functions of liver.
2. What are the symptoms of cirrhosis of liver?
3. What is Cholelithiasis?

Part – C

III. Write detailed answers

1. Explain symptoms and dietary management for infections Hepatitis.
2. Explain dietary management for cholelitheasis.

14. DIET IN DIABETES MELLITUS

Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by too much glucose in the blood and urine due to defective insulin action or deficiency in its secretion. Insulin, a hormone produced by the beta cells of the Islets of langerhans of the pancreas helps to utilize glucose for the production of energy by the body. Insulin helps in glucose uptake by the cells, prevents rise in blood sugar and maintains its level within normal limits.

In diabetes, glucose does not enter body cells, but accumulates in the blood. After it reaches a certain limit, it starts appearing in urine. It draws out more water with it and hence there is excessive urination.

14.1. PREVALENCE

It is generally believed that diabetes is more prevalent in affluent societies where obesity is a major health problem. However, it is observed that undernourished subjects are equally susceptible to diabetes. In India 2.5 percent of the population are affected with diabetes, and more than 90% of all diabetics belong to the non-insulin dependent type. Diabetes is prevalent in 8.2% of subjects in urban Chennai and in 2.4% subjects in rural Chennai.

14.2. TYPES

There are two main types of diabetes.

1. Insulin – dependent diabetes mellitus. (Type – I)

2. Non-insulin dependent diabetes mellitus. (Type – II)

1. Insulin – dependent diabetes (IDDM or Type – I)

This type of diabetes usually affects children or adolescents and is known as juvenile onset diabetes. There is little or no

production of insulin and as a result, such individuals require daily insulin injections. There is usually a sudden onset. The symptoms get severe, when insulin injections are discontinued. The diabetic develops a life – threatening metabolic complication referred to as ketoacidosis.

2. Non-insulin dependent diabetes. (NIDDM or Type II)

This usually affects overweight or obese adults and is known as adult onset diabetes. Non insulin dependent diabetes, develops slowly and is usually milder and more stable.

The insulin production may be normal or even high. However the insulin produced is not as effective as normal insulin. In subjects with this type of diabetes, diet, exercise or oral anti-diabetic drugs may be enough to control the raised blood sugar.

Other types :

3. Malnutrition related diabetes mellitus (MRDM)

This type of diabetes is mainly seen in some tropical countries like India and it occurs in young people between 15 – 30 years of age. Generally people with MRDM are lean and undernourished. In this type of diabetes, the pancreas fails to produce adequate insulin. As a result, these diabetics require insulin. In contrast to type 1 diabetics, these patients generally do not develop ketoacidosis, when insulin injections are discontinued.

4. Secondary diabetes may result from other hormonal disorders

5. Gestational Diabetes

Diabetes developed during pregnancy is described as gestational diabetes. It occurs in about 1% of pregnant women. Gestational diabetes increases the diabetes related complications during pregnancy, and also the subsequent development of diabetes after the delivery.

14.3. PREDISPOSING FACTORS AND SYMPTOMS

1. Heredity - The strongest predisposing factor is family history. Offspring of diabetics have insulin resistance and decreased insulin sensitivity.

Table 14.1 : Familial Risk of Developing Diabetes

	Your risk chance
If both parents are diabetics	99%
If one parent is a diabetic and the other from a family with a history of diabetes	70%
If only one parent is a diabetic	40%
If there is no history of diabetes in family	20%

2. Obesity - The chances of developing diabetes in obese individuals is 3 times higher than in non obese individuals.

Waist circumference is a reliable method of identifying people with a higher risk of developing diabetes. Waist circumference expands with increasing body waist. If waist circumference is greater than 94 cm in women and 80 cm in men, the person is twice as likely to have more than 2 risk factors. Diabetics have a higher waist to hip ratio (WHR). If the WHR is greater than 1.0 in men and greater than 0.8 in women, there is a greater risk to develop diabetes mellitus.

Fig. 14-A Illustrates the relationship of obesity and diabetes mellitus.

3. Age and sex - Individuals over 35 years of age have a 2 – 3 fold increase in developing diabetes especially if they are 50%

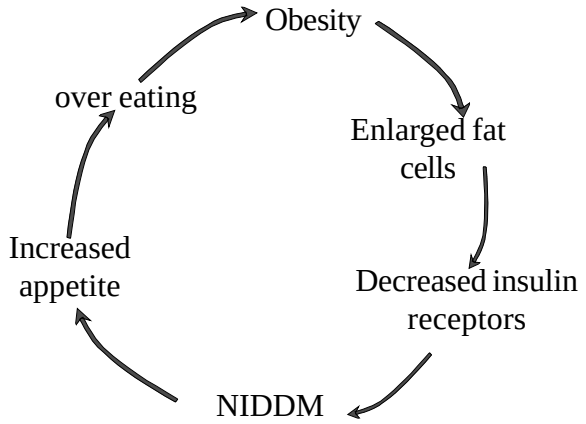


Fig. 14-A : Relationship between obesity and diabetes mellitus

above desirable weight. The prevalence of diabetes is more in men in India and more in females in western countries.

4. Physical Activity - Lack of physical activity increases the chance to develop obesity which increases the risk for developing diabetes. Physically inactive individuals have a 40% chance of developing diabetes mellitus.

5. Under nutrition - Under nutrition impairs β cell function by increasing the susceptibility of individuals to genetic and environmental influences.

6. Stress - Stress precipitates diabetes in susceptible individuals. In stress the body releases adrenaline, noradrenaline, cortisone that raise blood glucose levels and counteract available insulin.

7. Intake of simple sugars - A high intake of sugar is associated with a prevalence of obesity and hence diabetes mellitus. Sugar also depletes chromium which is essential for regulating blood sugar levels.

8. Alcohol - Short term risk of heavy or continuous alcohol intake include hypoglycaemia, glucose intolerance and ketone accumulation.

Symptoms :

Many diabetics are not aware that they have the disease. Following are the symptoms:

- Polydipsia (Excessive thirst)
- Polyphagia (Increased appetite especially for sweets)
- Polyuria (frequent urination) and nocturia
- Itching
- Easy tiring, weakness or irritability
- Drowsiness
- Slow healing of cuts and wounds
- Frequent infections of the skin, gums and vagina and pain in the legs, feet, urinary tract or fingers
- Blurred vision
- Hyperglycaemia (elevated blood sugar level) above 140 mg / 100 ml, the normal level being 80-100 mg/100 ml – A deficient supply of functioning insulin affects the metabolism of carbohydrates, fats and Proteins. As a consequence glucose enters the circulation and hyperglycaemia follows.
- Glycosuria (sugar in the urine)

14.4. ALTERED METABOLISM OF CARBOHYDRATE, PROTEIN AND FAT

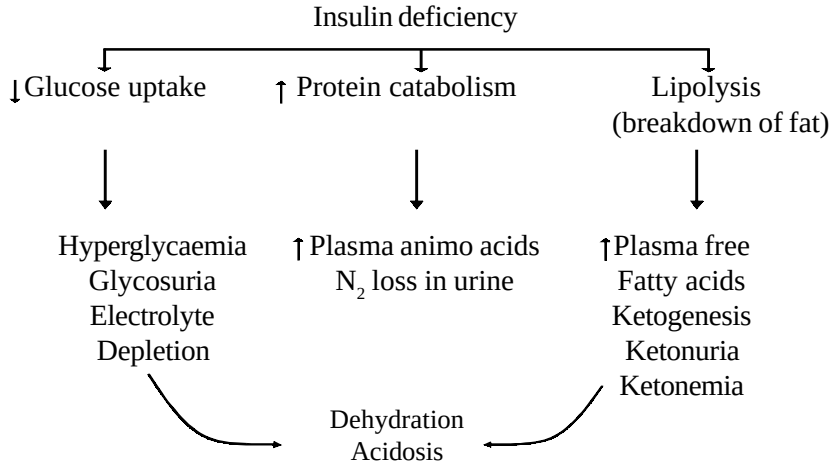


Fig. 14-B : Depicts the altered metabolism of carbohydrate protein and fat

Consequences of lack of Insulin

Lack of insulin produces four fundamental changes in carbohydrate metabolism which leads to hyperglycaemia.

1. Reduced entry and oxidation of glucose in muscle and other tissues.
2. Decreased formation of glycogen in the liver.
3. Decreased synthesis of fat from carbohydrate.
4. Release of glucose into the blood from the increased breakdown of glycogen in the liver.

14.5. DIAGNOSTIC TESTS

Diabetes may be present when sugar is present in the urine or when the blood sugar after fasting (12 hours after the last meal) or two hours after meals (post - prandial) is higher than 120 mg / 100 ml. Diagnosis of diabetes is confirmed after an oral glucose tolerance test.

Oral Glucose Tolerance Test (OGTT)

This test is carried out after 12 hours of over night fasting. Glucose – 75g in adults and 1.75g/kg of body weight in children is orally administered. Before the glucose load and two hours after it, blood samples are collected and glucose levels are estimated.

The diagnostic criteria for diabetes and impaired glucose tolerance test (IGT) are given below (Table – 14-B). In normal persons without diabetes the fasting sugar levels vary between 80 – 110 mg / 100 ml. The blood sugar levels increase after the glucose load and come down to basal level within two hours.

Table – 14.2 : Diagnostic Criteria for IGT and diabetes

	Blood sugar levels (mg/dl)	
	IGT	**Diabetes**
Fasting	< 120	>120
2 hours after 75g glucose load	120 – 180	> 180

< stands for 'less than'

≥ stands for 'equal to more than'

Urinary Sugar

Glucose is excreted into the urine when the blood glucose levels are elevated beyond 180 mg / 100 ml. Diabetics lose varying amounts of glucose depending on the severity of disease and the dietary intake of carbohydrates. The approximate amount of urinary sugar can be easily monitored by the available diagnostic strips (uristix). The changes in the colour of the reagent or strip indicate sugar levels in the urine.

Benedict's Test

Eight drops of urine and 5 ml of Benedicts solution are taken in a test tube and mixed. The test tube is kept in boiling water for 5 minutes and colour is noted. (Table 14-3).

Table – 14.3 : Interpretation of Benedicts Test

Colour	Approximate Sugar in		
	Report	Urine g%	Blood mg%
Green discolouration	0 to trace	--	<200
Green precipitate	+	0.25	200 – 250
Greenish-yellow precipitate		0.5	250 – 300
Yellowish – orange precipitate	+++	1.0	300 – 350
Brick-red precipitate	++++	>2.0	>350

Source : Raghuram T.C., Pasricha S. and Sharma R.D. (1993). ***Diet and Diabetes.*** National Institute of Nutrition – ICMR.

It is better to carry out this test on the second urine sample collected in the morning as urine sugar in this sample will more or less reflect blood sugar level.

Glycosylated hemoglobin - (Hb A_{1c})

As the concentration of glucose in blood rises, more glucose gets attached to hemoglobin (a pigment present in RBC) and the combined molecule is chemically estimated as glycosylated hemoglobin. It reflects the general trend of glucose levels in the blood during the previous 2 - 3 months. In normal individuals the glycosylated hemoglobin concentrations vary from 4 - 7% while in diabetics it is 8 - 18% of the total hemoglobin depending on the blood sugar level.

14.6. DIETARY MANAGEMENT

Diabetes can be treated by diet alone, or diet and hypoglycaemic drugs or diet plus insulin depending on the type and severity of the condition.

The main modes of treatment of diabetes are:

- Diet
- Exercise
- Drugs
- Education

Objectives in the management of diabetes are to:

- Reduce the sugar in blood and urine
- Maintain ideal body weight
- Treat the symptoms
- Reduce serum lipids
- Provide adequate nutrition
- Avoid acute complications
- Prevent vascular complications

Diabetic diet need not be a complete deviation from the normal diet. Indian diets are generally high in carbohydrate and low in fat, with carbohydrates providing 60 - 65% of total calories and fat providing 15 - 25% of total calories. The rest of the calories 15-20% is derived from proteins. The nutrient content of a diabetic diet has to be planned based on the age, sex, weight, height, physical activity and physiological needs of the patient. Diet for a diabetic can be planned using

1. Food exchange lists and
2. Glycaemic index of foods.

1. Food exchange lists

The diet for a diabetic patient is prescribed in terms of exchange lists. Food exchange lists are groups of measured foods of the same

caloric value and similar protein, fat, carbohydrate and can be substituted one for another in a meal plan. None of the exchange groups can itself supply all the nutrients needed for a balanced diet.

A balanced diet is one in which all the five food groups are included in required amounts in order to meet the recommended dietary allowances for individuals.

The food exchange lists help the patient to restrict the foods intake according to the insulin prescription so that hyperglycemia and hypoglycaemia can be prevented and to have variety in the diet.

2. Glycaemic Index

The glycaemic index indicates the extent of rise in blood sugar in response to a food in comparison with the response to an equivalent amount of glucose. The ability of the food item to raise the blood sugar is measured in terms of glycaemic index.

$$\text{Glycaemic Index} = \frac{\text{Blood glucose area of test food}}{\text{Blood glucose area of reference food}} \times 100$$

Factors that affect the glycaemic response to food are

1. Rate of ingestion of food
2. Food form
3. Food components – fat content, fibre content, protein content.
4. Method of cooking and processing food.

The glycaemic index is therefore useful in planning diet for diabetics. Cereals like wheat, rice, root vegetables like potato and carrot have a high glycaemic index (65 - 75%). Fruits have an intermediate glycaemic index (45 - 55%) and legumes have a low glycaemic index (30 - 40%) and are hence beneficial to diabetics. Table 14.4 presents the glycaemic index of common foods.

Table 14.4 : Glycaemic Index of Common Foods

Item	Glycaemic Index	Item	Glycaemic Index
Cereal Products		**Fruits**	
Bread	70	Apple	39
Millets	71	Banana	69
Rice (White)	72	Orange	40
Wheat (Paratha)	70	**Vegetables**	
Breakfast Snacks		Brown beans	79
Pongal	55	Frozen beans	51
Pesarattu	60	Potato	70
Upma	75	Sweet potato	48
Idli	80	Yam	51
Chole	65	Beetroot	64
Sprouted green gram	60	**Dried Legumes**	
Sundal	80	Soya beans	43
Dairy Products		Rajmah	29
Milk	33	Bengal gram	47
Ice-Cream	36	Green gram	48
Curds	36	Black gram	48
Miscellaneous		**Sugars**	
Groundnuts	13	Fructose	20
Potato Chips	51	Glucose	100
Tomato soup	38	Maltose	105
		Sucrose	59
		Honey	87

Source : Am. J. Clin. Nutr., 34 : 362, 1981. Raghuram et al., ***Diabetes Bull.,*** 7: 64,1987. Dilwari et al., ***Diet, Digestion & Diabetes,*** 1987.

The ability of the food item to raise the blood sugar is measured in terms of glycaemic index. Since the blood sugar level depends mainly on the intake of carbohydrate it is important to distribute the intake of carbohydrates. The total amount of carbohydrates is divided in to 4-5 equal parts. One third (33%) is served during lunch, one third (33%) during dinner. Of the remaining one third (33%), 25% is served during breakfast and 9% at tea or bed time.

Energy

The calculated calorie requirement should allow the patient to lose or gain weight as required and maintain body weight 10% lower than the ideal / desirable body weight. Dietary calories should be 60 - 70 per cent from carbohydrate 15 - 20 per cent from protein and 15 - 25 percent from fat.

The recommended calorie intake for a diabetic based on body weight is as follows : over weight individual - 20 kcal / kg.wt/day. ideal weight - 30 kcal / kg.wt./day. underweight - 40 kcal / kg.wt/ day.

Carbohydrate

High carbohydrate high fibre diet is given as it improves insulin binding. Complex carbohydrate found in cereals and pulses are given. These are then broken down into simple sugars before they are absorbed from the gut. Refined carbohydrates such as sugar, honey, jaggery and jam contain simple sugars which are directly absorbed are not recommended for diabetics, as they cause a rapid rise in blood sugar. Sugar present in fruits and milk raise the blood sugar at a slightly lower rate. Whole apple is better than apple juice because of its high fibre content and low glycaemic index.

Protein

It is recommended that 15 – 20% of total calories be derived from proteins. Proteins supply essential amino acids needed for

tissue repair. Proteins do not raise blood sugar during absorption and do not supply as many calories as fats.

In patients with NIDDM, consumption of protein along with carbohydrate will lower the blood glucose concentration. One gram of protein per kilogram body weight is adequate.

Fat

Low fat diet increases insulin binding and also reduces LDL and VLDL levels and reduces the incidence of atherosclerosis which is more common in diabetics. Fat content should be 15 - 25% of total calories and higher in polyunsaturated fatty acids.

Vitamins and Minerals

These are protective factors which are essential for the body. They are present in fruits, and vegetables.

Dietary fibre

Intake of 25g of dietary fibre per 1000 calories is considered optimum for a diabetic. High fibre foods have a low caloric value and low glycaemic index and therefore diabetics should consume such foods liberally. Fibre present in vegetables, fruits, legumes and fenugreek seed is soluble in nature and more effective in controlling blood sugar and serum lipid than insoluble fibre present in cereals.

High fibre diets

- Promote weight loss
- Lower insulin requirements
- Decrease serum cholesterol and triglyceride values and lower blood pressure.

The total fibre content of common foods g/100g is given in Table 14.5.

Table 14.5 : Total Fibre content of common foods (g / 100 g)

High (>10)	Medium (1 to 10)	Low (<1)	Nil
Wheat Jowar Bajra Ragi Maize Legumes Dhals Fenugreek	Rice Most vegetables Most fruits Coconut Sesame (til)	Refined and Processed foods	Sugar Fats/oils Milk All types of meat
Kamath and Belavady, 1980 : McCance & Widdowson, 1993.			

Source : Ghafoorunissa and Kamala Krishnaswamy (1995). ***Diet and heart disease,*** National Institute of Nutrition Hyderabad - India.

Table 14.6. Foods to be avoided and permitted for a diabetic

Foods to be avoided	Eaten in Moderation	Foods permitted
Simple sugars (glucose, honey, syrup, sweets, dried fruits, cake, candy, fried foods, alcohol, nuts Jaggery, sweetened juices.	Fats, cereals, pulses, meat, egg, nuts roots, fruits, artificial sweetener.	Green leafy vegetables, fruits except banana, lemon, clear soups, onion, mint, spices, salads plain coffee or tea, skimmed and butter milk, spices.

Source : Srilakshmi, B. (2002) ***Dietetics,*** 4th ed. New age International (P) Limited Publishers.

Other dietary guidelines to be remembered are.

- Timely intake of in between meal snacks should be stressed to avoid hypoglycaemia.
- Patients should avoid fasting and feasting.
- Alcohol , makes a person obese and stimulates appetite. The diabetic should avoid alcohol.

Diabetic Diet

This diet is as close to the normal diet as possible so as to meet the nutritional needs and the treatment of the individual patient. This diet is slightly low in carbohydrates, but adequate in other food principles. A sample diet is presented in Table 14.6.

Table 14.6 : Recommended allowances for a diabetic diet

Foodstuffs	Vegetarian (g)	Non-Vegetarian (g)
Cereals	200	250
Pulses	60	20
Green leafy vegetables	200	200
Other vegetables	200	200
Fruits	200	200
Milk (dairy)	400	200
Oil	20	20
Fish / Chicken without skin	--	100

This diet provides

Calories	-	1600
Protein	-	65 g
Fat	-	40 g
Carbohydrates	-	245 g

Table 14.7 : Sample Diabetic Diet

	Cooked measures	
	Vegetarian	**Non-vegetarian**
Bed Tea		
Oats Porridge	1 cup	1 cup
Break fast		
Whole cereal bread with little butter	2	2
vegetable stew	1 cup	1 cup
Lunch		
Rice	2 katories	2 katories
Sapathi	1	1
Green leafy vegetable	1 katori	1 katori
Curd	½ katori	½ katori
Chicken Roast	-	2 pieces
Tomato or citrus fruit	1	1
Pickle	a piece	1 piece
Tea		
Tea or Coffee with out suger	1 cup	1 cup
Whole gram sundal	1 katori	1 katori
Dinner		
Phulka (chapathi)	3	4
Dal	1 katori	—
Curd	½ katori	—
Roasted papad	1	1
Tomato or cucumber	1	1
Before going to bed		
Milk	1 cup	1 cup

Note : 5 tsp. of oil can be used in cooking

Sizes of Katori is given in Appedix - I.

Exercise

Regular exercise should be an integral part of the daily routine of the diabetic.

Benefits of exercise for Diabetics

1. Metabolic effects : Exercise Increase

a. Insulin sensitivity

b. Oxidative enzymes

c. Amino acid uptake

d. Storage of glycogen

e. Maximal oxygen uptake

2. Cardio vascular effects

a. Decrease in triglycerides

b. Increase in HDL – Cholesterol

c. Lower resting Blood pressure

d. Increase in oxygen transport (decreases blood viscosity)

e. Increases stroke volume and increases cardiac output

Drugs

In NIDDM, the body produces insulin, but this is less effective in controlling high blood sugar levels. When diet, exercise and weight reduction are not enough to control high blood sugar, oral hypoglycemic drugs are given. There are two groups of drugs used – sulphonylureas and biguamides. Since the action of these two drugs are different the doctor has to decide which is suitable.

14.7. COMPLICATIONS OF DIABETES MELLITUS

A. Acute complications

A diabetic is likely to develop acute complications as a result of sudden decrease or increase in blood sugar levels.

1. Hypoglycaemia

The rapid lowering of blood sugar (below 40 - 50 mg/dl) is known as hypoglycaemia. The person may experience increased appetite, weakness, sweating, restlessness, palpitation and giddiness. The diabetic who develops hypoglycaemia should immediately be given sugar or glucose.

2. Ketoacidosis

When the body cannot utilize carbohydrates to provide energy, it burns fats and certain amino acids. This results in increased formation of ketones, which accumulate in the blood resulting in ketoacidosis. This is a serious condition and the patient can go into a coma.

3. Infections

In diabetics, cuts and wounds heal slowly. They are prone to infections of the skin, urinary tract and foot.

B. Long term complications

Diabetics are predisposed to two types of complications of long duration.

a. Increased predisposition of the diabetic for atherosclerosis (hardening of blood vessels due to deposition of fatty substances) because they generally have high levels of blood lipids as cholesterol and triglycerides, which make them susceptible to heart disease and stroke.

b. Lesions that affect the small blood vessels (microangiopathy) of the eyes and kidneys. Lesions of the eye (retinopathy) results in rapid deterioration of eye sight. Lesions of the kidney (nephropathy) result in the excretion of protein in the urine. Neglect may lead to kidney failure. Diabetics can develop lesions of the peripheral nervous system (neuropathy).

Patients with neuropathy experience tingling, numbness and it is a degenerative condition of sensory nerves resulting in pain and absence of reflexes.

14.8. PATIENT EDUCATION

Environmental factors play a major role in the incidence of NIDDM in those with a family history. Since we have no control on the selection of our ancestors, care should be taken to delay the onset of diabetes mellitus by increasing physical activity and reduction in the intake of fatty foods which result in obesity which in turn can cause diabetes.

Diabetics should be educated on the nature of the disease and the possibility of acute and long term complications of the disease, if blood sugar is not kept under control. Adequate information enables the diabetic to improve the psychological acceptance of the disease. The importance of following the instructions of the doctor and the dietitian regarding diet, drugs and exercise should be explained.

A diabetic should monitor urine, blood sugar and serum lipids at regular intervals to ensure overall well-being. They should learn self monitoring of urinary sugar using commercially available strips. Patients who require insulin injections should know how to measure the insulin dose and give their own injections. Diabetics should be informed about the symptoms of hypoglycaemia and the immediate need for sugar. They should be aware of complications such as ketoacidosis and danger of infections which require immediate medical attention. Diabetic patients should maintain a diary to keep a record of their urinary and blood sugar results, body weight and alterations in their diet and drugs.

QUESTIONS

Part - A

I. Fill in the blanks

1. Insulin dependent diabetes is also known as _____ onset diabetes.
2. Non insulin dependent diabetes affects _____ adults.
3. Diabetes developed during pregnancy is described as _____ diabetes.
4. Polydipsia means _____ _____.
5. Frequent urination is known as _____.

Part - B

II. Write short answers

1. List the predisposing factors for diabetes mellitus.
2. What are the symptoms for diabetes mellitus?
3. List the types of diabetes mellitus.

Part - C

III. Write detailed answers

1. Explain the diagnostic tests to detect diabetes mellitus.
2. Explain dietary management for diabetes mellitus.
3. Explain – Glycaemic index and food exchange list.
4. Explain the benefits of exercise for a diabetic.
5. Write a note on the complications of diabetes.

15. DIET IN KIDNEY DISORDERS

15.1. FUNCTIONS OF KIDNEY

The basic anatomic and functional unit of the kidney is the nephron. Each kidney contains 1 million nephrons. As the body fluid flows through these finely structured units, the nephrons perform four significant functions to support life.

1. Filtering : The nephrons filter most constituents to prevent them from entering the blood, except red cells and proteins.
2. Resorbing : Needed substances are resorbed as the filtrate continues along the winding tubules.
3. Secreting : Additional ions are secreted to maintain acid base balance.
4. Excreting : Unneeded materials are excreted in a concentrated urine.

The primary function of the kidney is to maintain the constant composition and volume of the blood. This includes the regulation of

1. The osmotic pressure
2. The electrolyte and water balance and
3. The acid-base balance. The production of urine permits the elimination of excess water and solutes such as sodium, chloride and byproducts of metabolism such as urea, and ingested substances that may be toxic
4. Kidneys are the exclusive site for the production of 1,25 dihydroxy cholecalciferol the active form of vitamin D. Improper function can lead to bone disease
5. Kidneys produce erythropoietin – which is essential for the formation of RBC

6. Renin is released from the kidney in response to low blood pressure directly and stimulates the production of aldosterone.
7. Parathyroid hormone, calcitonin, insulin and gastrin are degraded by the kidneys.

Fig. 15-A. Depicts Longitudinal section of a kidney showing the location of a nephron.

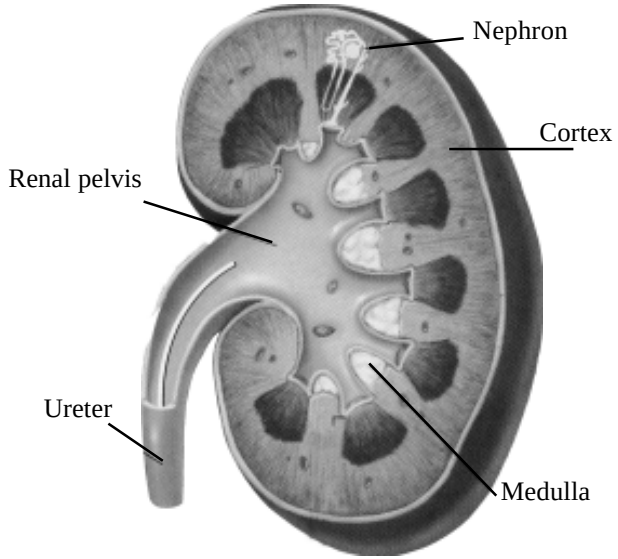


Fig. 15-A. Longitudinal section of a kidney

Source : William S.R. (1994) ***Essentials of Nutrition and Diet Therapy***, 6th edition Mosby year book.

15.2. GLOMERULONEPHRITIS – CLINICAL SYMPTOMS AND DIETARY MODIFICATION

Glomerulonephritis is an inflammatory process affecting the glomeruli, the small blood vessels in the head of the nephron. It occurs mostly in children and young adults. The most common cause is a previous streptococcal infection such as tonsillitis, pneumonia and respiratory infections.

Clinical Symptoms

In some patients there is swelling of the ankles and puffiness around the eyes. Some complain of headache, anorexia, nausea and vomiting. Hypertension and dimness of vision may occur. Classic symptoms include haematuria, proteinuria, oedema and shortness of breath as a result of sodium and water retention can occur. Tachycardia and elevated blood pressure may be present. The patient is generally anorexic which contributes to feeding problems. If the disease progress, oliguria or anuria occurs which signals the development of acute renal failure.

Dietary Management

During the acute phase of illness when nausea and vomiting are present, effort should be made to maintain fluid balance and to provide non-protein calories to minimize the catabolism of tissue proteins.

Salt is restricted if there is oedema, hypertension or oliguria. Bed rest and antibiotic therapy are the main treatment.

As the patient improves and appetite returns the following dietary modifications are done.

Energy

The recommended dietary allowances provide a general guide for the calorie requirements for the particular age and weight and 10% percent more for infection. For children 80 kcal / kg body weight is suggested. Sufficient calories is given without increasing the protein intake. High carbohydrate, low electrolyte supplements like fruit juices sweetened with glucose, honey, sago and cereals are given.

Protein

If the blood urea nitrogen is elevated and oliguria is present dietary protein is restricted. For older children the diet contains

0.5 g of protein / kg of ideal body weight and 1 to 1.5g / kg per day for younger children. A low protein diet is given to give rest to the kidneys. If anuria develops, proteins should be stopped. An intake of 20-40 g / day is sufficient, out of which 50 percent should be from animal protein. Pulses and groundnuts increase urea levels in the blood and should be restricted.

Sodium

If there is oedema or hypertension, sodium restriction to 500 or 1000 mg may be prescribed. In sodium restricted diets, the following foods are avoided.

a. Salt during cooking and on the table.

b. Baking powder and soda bicarbonate – added to cakes and biscuits.

c. Sodium benzoate added to soft drinks and canned foods.

d. Papads, cheese, nuts, popcorn, biscuits, salted chips

e. Bacon, Ham, Meat extracts, commercial sauces, soup cubes.

f. Monosodium Glutamate - Ajinomoto used in Chinese fried rice and Briyanis.

g. Proprietary drinks – Bournvita, Chocolate drinks

h. Dried fruits and Dried fish.

Food with Moderate sodium should be taken in restricted amounts.

a. Milk and Curds

b. Pulses and legumes – all varieties

c. Vegetables – radish, Carrot, Broad beans, cauliflower, field beans, knol khol, green mango, Beet root, Amaranth, parupukeerai, spinach, karamani

d. Miscellaneous foods which include

Coriander seeds, cumin seeds, Turmeric, Jaggery.

Potassium

When the kidneys don't function properly, potassium builds up in the body and causes the heart to beat unevenly and stop. Too little potassium is also dangerous.

All fruits and vegetables contain potassium. Apple, Guava, Papapa, pear and pine apple have the lowest amount of potassium and may be used once or twice a week.

Nuts, Jaggery, tender coconut water, instant coffee, chocolate and coco powder are very high in potassium content and should be avoided.

Potassium content can be reduced in vegetables by 'leaching' – cooking in excess water and then discarding the water. All spices and condiments contain potassium and should be used only in small quantities.

Free Foods

When proteins, sodium and potassium are restricted it is difficult to obtain sufficient energy. Foods low in protein, sodium & potassium but provide energy can be given. These include sugar, lollipop, sago, boiled sweets, sugar candy unsalted butter, unsalted margarine, dalda, oil and ghee.

15.3. NEPHROTIC SYNDROME – CLINICAL SYMPTOMS AND DIETARY MODIFICIATION

Nephrotic syndrome can be caused due to progressive glomerulonephritis, diabetes meltitus, drugs and toxic venom.

Symptoms

In Nephrosis, proteinuria along with oedema is present. Large urinary losses of albumin and other plasma proteins lead to tissue wastage, fatty liver, malnutrition and increased susceptibility to infection.

DIETARY TREATMENT

Principles of Diet

Restricted protein, high carbohydrate, salt restricted moderate fat with restricted fluid are recommended for a nephrotic patient. Vitamin supplements especially vitamin C should be given. Low quality proteins like pulses should be mixed with cereals and milk to improve quality of protein. High quality proteins like egg and meat are preferred.

Energy and protein

To ensure protein use for tissue synthesis, sufficient kilo calories must be provided 2000 kcals is suggested. Since appetite is poor, food must be appetizing and diet soft. Moderate protein restriction 0.5-0.6 g/kg is needed. When urinary protein losses are greater than 10 g / day, protein malnutrition occurs.

Sodium

Diuretics and sodium restriction are used to prevent further accumulation of fluid and prevent hypertension. The level of sodium permitted is usually less than 2g per day or even 500 mg / day. No salt is added while cooking or on the table.

Low sodium foods can be consumed. Sodium intake is liberalized when oedema is corrected. Potassium supplements are essential as calcium and potassium deficiency may accompany severe proteinuria.

15.4. RENAL FAILURE – ACUTE AND CHRONIC

Causes, symptoms and dietary management

Acute renal failure

There is sudden shutdown of renal function following injury to the normal kidney. This is a condition in which the kidneys are no longer able to maintain the normal composition of the blood.

Causes

- Loss of blood due to accidents and internal hemorrhage. Ulcers can cause acute renal failure as the blood flow to the kidneys decreases.
- Loss of plasma as in burns.
- Inhalation or ingestion of poisons such as carbon tetrachloride or mercury
- Shock from surgery
- Nephritis and Nephrosis can result in acute renal failure.

Symptoms

- Uremia - There is retention of urea and others urinary constituents in the kidney.
- Azotemia - accumulation of nitrogenous constituents in the blood.
- Oliguria - a scanty output of urine (less than 500 ml)
- Anuria - minimal production or absence of urine (less than 100 ml per day).
- Serum potassium levels are high when tissue proteins are broken down to provide calories.
- There is increased phosphate and sulphate with decreased sodium, calcium and base bicarbonate.
- Patients are lethargic, anorexic, have nausea and vomiting.

Dietary Management

Energy

A minimum of 600-1000 kcal is necessary. In the initial period when oral intake is less due to vomiting and diarrhoea, 100 g per 24 hours intravenous glucose is given to reduce protein catabolism.

Proteins

Initially a protein free diet is used in the non-dialysed patients. In the diuretic phase 20-40 g protein is given. The protein content of the diet varies depending on the urea content of the blood.

Carbohydrates

A minimum of 100g per day is essential to minimize tissue protein breakdown.

Fluid

Fluid allowance is regulated in accordance with urinary output. The total fluid permitted is 500 ml + losses through urine and gastro intestinal tract. With visible perspiration an additional 500 ml may be given.

Sodium

Sodium restriction is judged based on the sodium loss in the urine. For the non-dialysed patient 500 to 1000 mg per day is given. Patients on dialysis are permitted 1500 to 2000 mg per day.

Potassium

Potassium allowance is based on serum levels. Hyperkalemia (potassium intoxication) has deleterious effects on the heart. Potassium sources like tomato juice, coffee, tea, cocoa are avoided.

Chronic Renal failure

It is also known as uraemia as the level of urea in blood is very high. This occurs when 90 per cent of the functioning renal tissue is destroyed. It may be the end result of acute glomerulonephritis and nephrotic syndrome.

Causes

1. Progression of acute nephritis or nephrosis
2. Chronic infection of the urinary tract.

3. Kidney stones
4. High blood pressure
5. Exposure to toxic substances.

Once chronic renal failure occurs, the normal functions of the kidneys like regulation of body fluids, electrolytes, p^H and excretion of metabolites are disrupted.

Symptoms

In chronic renal failure symptoms appear when the glomerular filtration rate (GFR) is inadequate to excrete nitrogenous wastes. When the GFR is less than 10 ml per minute (normal 120 ml per minute) and the serum urea nitrogen (SUN) is more than 90 mg per day (normal 8 to 18 mg per day) dietary modification brings about improvement. As GFR falls, daily protein intake is restricted.

- The symptoms of the gastrointestinal tract are nausea or vomiting. The breath has an ammoniacal odour. Ulcerations of the mouth and hiccups interfere with food intake.
- The nervous system – Patients are drowsy, irritable and sink to coma.
- If there is hypertension, headache, dizziness, muscular twitchings and failing vision occur.
- The functioning of the heart is seriously disturbed
- Death results when hyperkalemia (elevated serum potassium) block the contraction of the heart.
- Dehydration, sodium depletion, high serum potassium, acidosis, increased susceptibility to infection are the most general manifestations.

Dietary Management

The objectives of treatment are

1. To maintain optimal nutritional status
2. To minimize uremic toxicity
3. To prevent protein catabolism
4. To improve the patients well-being
5. To delay the progression of renal failure
6. To delay the need for dialysis

Energy

Adequate kilocalories are essential to spare protein for tissue protein synthesis. Without adequate calorie intake body tissues will be rapidly catabolized thus increasing the blood urea and potassium levels. For adults calorie needs range from 35 - 45 kcal per kg of ideal body weight or 2000 to 3000 kcal per day.

Protein

Failing kidneys need to be given rest. Protein intake can be reduced to 0.5 g/kg body weight per day. Haemodialysis patients need 1.0g protein per kg body weight daily to compensate for losses of amino acids in the dialysate. The aim is to provide half of the protein allowance as high biological value protein.

Carbohydrate and Fat

Elevated serum triglycerides common in chronic renal disease can be lowered by controlling carbohydrate intake, dietary cholesterol and polyunsaturated fat.

Potassium

This is restricted to 1m mol / kg body weight. Potassium allowance is in accordance with the patients blood levels, urinary output and amount of potassium in the dialysate.

Sodium

Dietary sodium intake depends on the amount of sodium in serum and urine. Restriction is necessary if edema, hypertension and threat of congestive heart failure is present.

Vitamins

Losses of ascorbic acid and many B vitamins occur during dialysis. Intake is likely to be low as raw fruits and vegetables are restricted. Folic acid and pyridoxine requirements are increased. Due to impaired vitamin D metabolism supplements are needed.

Fluids

Intake of fluids needs to be monitored. 500 ml over the normal urinary output is allowed if there is no oedema and hypertension.

15.5. DIETARY MANAGEMENT IN URINARY CALCULI – UROLITHIASIS

Urinary calculi (kidney stones) may be found in the kidney, ureter, bladder or urethra as presented in Fig. 15-B. About 90% of

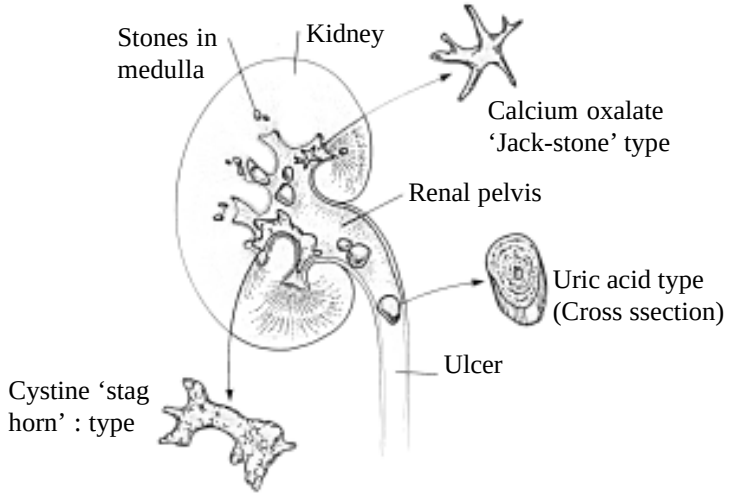


Fig. 15-B : Renal Calculi : Stones in kidney, pelvis and ureter

Source : Williams, S.R. 1985, ***Nutrition and DIet Therapy,*** Times Mirror/Mosby College Publishing St. Lousis, Toronto Santa Clara.

all stones contain calcium. The occurrence of kidney stones may be due to an outcome of different nutritional status, dietary habits and environmental factors such as temperature and humidity.

Table 15.1 : Foods rich in calcium, phosphates, oxalates and purines

Calcium	Phosphates	Oxalates	Purines
Leafy vegetables milk and milk products small fish with bones, prawns, crabs, ragi	Whole cereals, bran, legumes nuts, oil seeds, banana, carrot, meat, fish, egg, milk and milk products, cheese, organ meat, soft drinks	leafy vegetables, grapes, tea, chocolates, cocoa, coffee, cola drinks, beef, cashewnuts, beetroot, yam.	Meat, fish, animal tissues and organs as kidney, liver, brain, heart.

Source : Robinson, H.C. Marilyn. R. Lawler 1990, ***Normal and Therapeutic Nutrition,*** Oxford and IBH Publishing Company, New Delhi.

In warm climates, the urine volume is low and concentrated with urates, oxalates and calcium salts. Frequent urinary tract infection may contribute to the formation of stones. In India the most common type of calculi is calcium oxalate.

The diet should be low in oxalic acid and purine. Intake of calcium and phosphates should be reduced. Large amounts of fluid should be consumed to increase urine output. A dilute urine prevents the formation of stones. Foods rich in calcium, phosphates, oxalates and purines is given in table 15.1.

When stones are composed of calcium, magnesium phosphates and carbonates the urine is alkaline and acid – ash diet is used. The acid ash diet should maintain the urine pH between 4.5 and 5 and with an alkaline ash diet, a urinary pH of 7.6 to 8 is maintained.

a. Planning acid ash Diet

A liberal fluid intake is important. Salt is used in moderation. Fruits and vegetables should not contribute more than 25 ml of base daily.

b. Planning alkaline – ash diet

If stones of uric acid or cystine type occur, an alkaline - ash diet is given. Alkaline producing foods like fruits, vegetables and milk are given while acid producing foods like meat, eggs and cereals are restricted Table 15.2 gives the list of Acid producing, Alkali producing and neutral foods.

Table 15.2 : Acid producing, alkali producing and neutral foods

Acid producing	Alkali producing	Neutral foods
Bread, especially Whole wheat Cereals Cheese Corn Eggs Lentils Macaroni, spaghetti, Noodles Meat, fish, poultry Peanuts Rice Walnuts	Milk Fruits Vegetables Almonds Apricots dried Beans Beet greens Dates Figs, Peas dried, Raisins, Spinach Foods prepared with baking powder or baking soda.	Butter Coffee Fats Sugar Tapioca Tea

Source : Robinson, H.C. and Marilyn. R. Lawler, (1990). ***Normal and Therapeutic Nutrition,*** Oxford and IBH Publishing Company, New Delhi.

c. Low oxalate diets

In the case of oxalate stones, foods that are a good source such as beans, chocolate, cocoa, potatoes, spinach, tea and tomatoes should be omitted.

Foods to be included and excluded in renal calculi are presented in table 15.3.

Table 15.3 : Foods to be included and excluded in renal calculi

Diet	Type of stone	Foods to be included	Foods to be excluded
Acid ash diet	Ca and Mg phosphates and carbonates	Cereals, non-veg. foods, protein rich foods like nuts	Bakery products, milk, fruits and vegetables
Alkali ash diet	Uric acid and cysteine stones	Bakery products, milk, fruits and vegetables	Cereals, non-veg foods, protein rich foods like nuts.
Low oxalate diet	Calcium oxalate stones	Other than the foods excluded	Beets, greens, spinach, tea, tomatoes, potatoes, choco-lates, cocoa (concentrated calcium rich foods also to be restricted)

Source : Robinson, H.C. and Marilyn. R. Lawler 1990, ***Normal and Therapeutic Nutrition,*** Oxford and IBH Publishing Company, New Delhi.

Fluid

A liberal fluid intake of 3000 ml or more daily is essential to prevent the production of concentrated urine. Coconut and barely water, fruit juice and weak tea are given.

15.6. DIETARY GUIDELINES IN DIALYSIS AND KIDNEY TRANSPLANT

Dialysis is a procedure that replaces some of the kidneys normal functions. It is performed when a person has kidney failure. Dialysis helps to remove waste products including salt, excess fluids and maintain a safe level of blood chemicals such as potassium, sodium and chloride in the body and also controls blood pressure.

Haemodialysis

In haemodialysis the patients blood circulates outside the body through coils or sheets of semipermeable membranes that are constantly bathed by a hypotonic dialyzing fluid so that nitrogenous wastes are removed into the dialysate. The membranes do not permit bacteria to enter the blood nor can proteins escape from the blood. However some aminoacids are lost into the dialysate. As haemodialysis is performed 3 times a week for 3 - 4 hrs, it may be necessary to regulate the protein intake based on the level of nitrogen waste products. If diet is not controlled dialysis will need to be more frequent.

Peritoneal Dialysis

This consists of introducing 1 to 2 litres of dialysis fluid into the peritoneal cavity and 30 to 90 minutes later withdrawing the fluid. The process is repeated until the blood urea level drops to tolerable levels. Some blood proteins and amino acids are lost and compensation must be made. Fig. 15-C represents peritoneal dialysis.

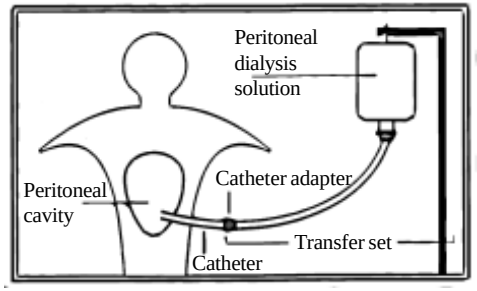


Fig. 15-C : Peritoneal dialysis

In continuous ambulatory peritoneal dialysis (CAPD), the dialysate is introduced into the abdominal cavity 3 - 5 times each day through a permanent indwelling catheter. The dialysate remains in the abdominal cavity for 4 - 8 hrs after which it is drained and fresh dialysate instilled. Protein losses occur but can be replaced by dietary protein (Fig. 15-D).

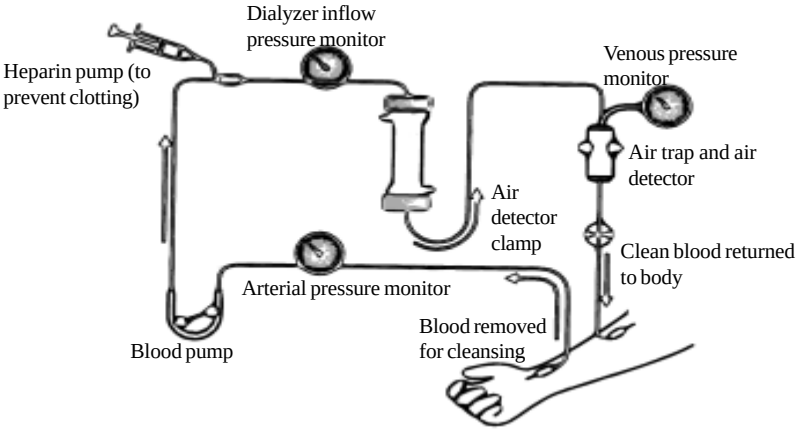


Fig. 15-D : Essential components of a dialysis delivery system

Source : Srilakshmi B., (2000). ***Dietetics.*** 4th ed. New Age International Publishers.

Dietary Management

The diet of a patient on kidney dialysis is important to maintain biochemical control. The objectives are to

1. Maintain protein and kilocalorie balance.
2. Prevent dehydration or fluid overload.
3. Maintain normal serum potassium and sodium blood levels and
4. Maintain acceptable phosphate and calcium levels.

Protein

For adults 1 g/kg body weight provides nutritional needs, maintains positive nitrogen balance and replaces amino acids lost during dialysis treatment. 75 percent of daily protein allowance should be protein of high biological value such as eggs, meat, fish and poultry. Milk is restricted as it has a high content of sodium, phosphate and potassium.

Energy

Carbohydrates are given to supply energy and prevent protein breakdown. The usual need is 40 kcal / kg lean body weight. Simple carbohydrate foods should be given.

Water balance

Fluid is limited to 400 to 500 ml / day plus an amount equal to urinary output.

Sodium

To control body fluid retention and hypertension, sodium is limited to 1000 to 2000 mg / day.

Potassium

Potassium accumulation can cause cardiac arrest and hence potassium restriction is necessary. A dietary allowance of 1500 to 2000 mg /d ay is given.

Vitamins

During dialysis water soluble vitamins from the blood are lost. A daily supplement of all water soluble vitamins is given. Fat soluble vitamins especially vitamin A and D may build up.

Diet for a person with kidney transplant

Initially after the kidney transplant, it is necessary to maintain dietary restrictions. Diet modification can help to keep the blood pressure, blood sugar and cholesterol levels within the normal limits. Optimal protein and energy intake with restriction of salt, simple sugars,

total fat, cholesterol and saturated fat is necessary. The healthy diet pyramid advocates eating more cereals, bread, legumes, vegetables and fruit, eating moderate amounts of milk, cheese, lean meat, poultry, fish and eggs and eating least quantities of sugar, oil and butter.

- - -

QUESTIONS

Part - A

I. Fill in the blanks

1. The basic functional unit of the kidney is the _____.
2. The four significant functions of the nephron are _____, _____, _____ and _____.
3. The primary function of the kidney is to maintain _____ and _____ of the blood.
4. The most common cause of glomerulonephritis is _____ infection.
5. Uremia is the _____ of urea in blood.

Part - B

II. Write short answers

1. What are free foods?
2. List the symptoms of chronic glomerulonephrits.
3. List the symptoms of nephrosis.
4. What are the types of dialysis?

Part - C

III. Write detailed answers

1. Explain the functions of kidney.
2. Explain the dietary management for nephritis.
3. Explain the causes for acute renal failure.
4. Explain dietary management in urinary calculi.

16. DIET IN DISEASES OF THE CARDIOVASCULAR SYSTEM

16.1. FUNCTIONS OF THE HEART

1. Heart possesses 4 chambers (2 atria and 2 ventricles) Blood enters the left atrium (LA) and left ventricle (LV) at a pressure near zero. The left ventricle pumps the blood into systemic circulation via the main distributing artery the aorta. Aorta divides into arteries which undergo successive divisions forming arterioles. These subdivide and lead to capillaries. Capillaries distribute the blood to the veins, which return the blood to the right atrium (RA) and right ventricle (RV) via great veins (inferior and superior vena cava) (fig – 16-A)

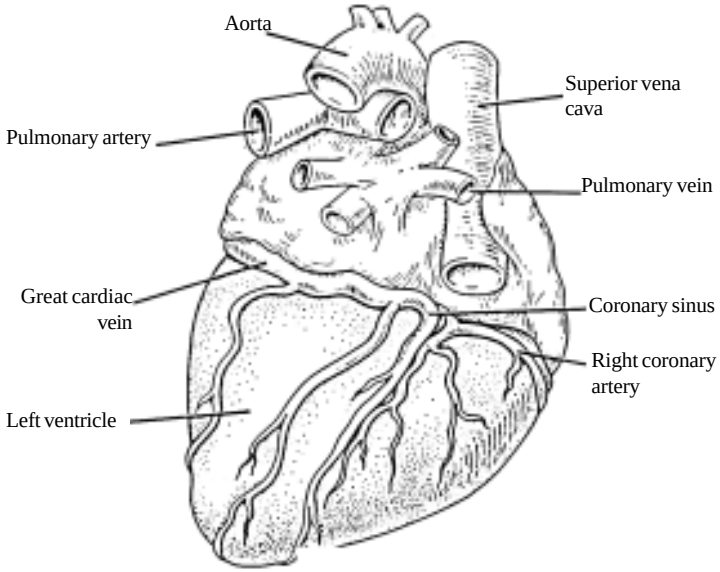


Fig. 16-A : Anatomy of Heart

Source : Williams, S.R., (1994). ***Essentials of Nutrition and Diet therapy.*** 6th ed. Mosby year book.

2. 'RA' and 'RV' receive blood which has returned from the tissues via the veins. The 'RV' pumps the blood into pulmonary circulation via the pulmonary artery. The aorta divides into arterioles and leads to pulmonary capillaries. Pulmonary capillaries facilitate exchange of gases across them. The oxygenated blood is then collected from the pulmonary capillaries by pulmonary venules and veins and transported to the 'LA' and 'LV'.

3. Heart provides the pressure for circulation.

Functions of cardiovascular system

1. Distribution of metabolites and oxygen to all the body cells.

2. Collection of waste products and CO_2 from different body cells and carry them to excretory organs.

3. Thermoregulation – carrying of heat from active metabolic sites (where heat is generated) to body surface where it is dissipated. Blood flow through skin varies to enhance or decrease the heat loss to the environment.

4. Distribution of hormones to the target tissues.

16.2. PREVALENCE AND RISK FACTORS

Heart disease affects people of all ages, but is most frequent in middle age and is often caused by atherosclerosis. No single factor is an absolute cause either of atherosclerosis or of coronary heart disease. The greater number of risk factors present always increases the risk of the disease. Major risk factors are elevated serum cholesterol, hypertension, cigarette smoking, diabetes mellitus and marked obesity. Other risk factors include family history of heart disease, lack of physical activity and stress.

The various risk factors have been classified into four categories.

Category I – modifiable

Risk factors for which intervention have been proved to lower cardiovascular risk.

1. Cigarette smoking – This increases heart rate and blood pressure, lowers high density lipoprotein cholesterol and promotes thrombus formation.

2. High intake of saturated fat like butter, ghee, egg yolk and coconut oil increase plasma cholesterol and promote atheroma formation.

3. Elevated low-density lipoprotein cholesterol increases development of atherosclerosis.

4. Hypertension – High blood pressure increases the incidence of stroke and heart failure.

5. Food habits - Excess fat, excess sugar, excess salt.

Category - II

Risk factors for which interventions are likely to lower cardiovascular disease risk.

1. Diabetes Mellitus - People with diabetes have metabolic alterations like insulin resistance. hypertension and central obesity which lead to coronary heart disease.

2. Physical inactivity - A sedcntary life style is associated with a two fold increase in coronary heart disease (CHD) risk. Regular aerobic exercise reduces blood pressure, lowers triglyceride concentration, increases HDL - Cholestrol and helps in weight control. Inactivity leads to obesity.

3. Obesity - Obesity is a risk factor for CHD as it is associated with hypertension and diabetes.

Category - III

Risk factors for which interventions may lower cardiovascular disease.

1. Psychological factors - Depression and social isolation are associated with CHD incidence.

2. Elevated triglycerides - Elevated triglycerides are often associated with obesity, diabetes, hypertension and low HDL - Cholestrol

Category IV – Non-Modifiable

1. Age – Incidence of CHD increases with age around 50-55 years.

2. Sex - Coronary Artery disease is twice as high in men than women. This difference may be due to the fact that in women the ovarian hormones play an important role. But after menopause the incidence is increased in women.

3. Heredity - If there is a history of heart attack before 55 in father and before 65 in mother the offspring are likely to get a heart attack at an early age.

Inter relationship between diet and other risk factors is presented in Fig. 16-B.

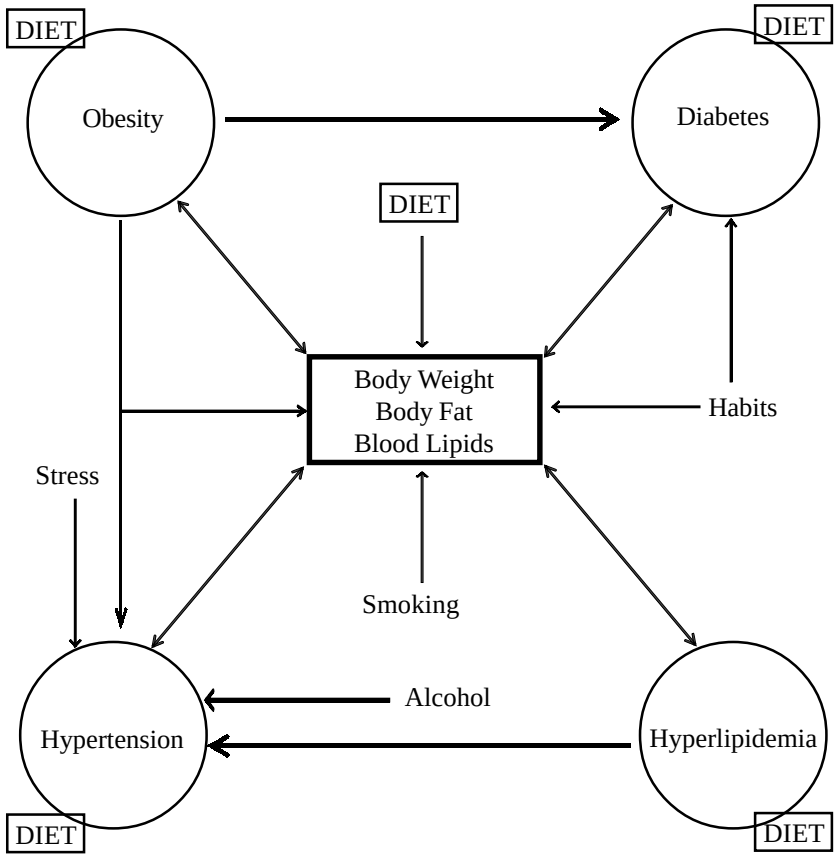


Figure 16-B : Inter-relationship between diet and other risk factors

Source: Ghafoorunissa and Kamala Krishnawamy, (1995). ***Diet and Heart Disease*** 2nd ed. National Institute of Nutrition Hyderabad, India.

16.3. BLOOD LIPIDS - UNDERSTANDING YOUR LIPID PROFILE

The Blood lipid levels in patients without coronary heart disease is classified as desirable, borderline - high and high risk. The blood lipid levels are presented in Table 16.1.

Table – 16.1 : Blood lipid levels

	Desirable	Border line high	High risk
Serum Cholesterol	<200 mg/dl	200-239 mg/dl	>240 mg/dl
LDL – Cholesterol	< 130 mg/dl	130-159 mg/dl	>160 mg / dl
HDL – Cholesterol	> 50 mg / dl (for men) > 35 mg/dl for women	--	< 35 mg / dl
VLDL – Cholesterol	< 40 mg / dl	--	--
Triglycerides	< 150 mg/dl	150-500 mg/dl	> 500 mg / dl

< stands for less than, > stands for greater than

The Cholesterol Ratio : Total Cholesterol / HDL – should be < 4.5

Source : (National Cholesterol Education programme – Arch. Intern Med., 148 : 30 : 1988)

LDL Cholesterol or "Bad" Cholesterol

Too much LDL cholesterol may lead to heart attack, stroke and circulation problems. If you do the following you may lower LDL level:

- Lose weight
- Eat less fat
- Eat less cholesterol containing foods as egg yolks

Triglycerides

High levels of triglyceride increases your risk to heart problems. If you do the following, you may lower your triglyceride level:

- eat less fat
- lose weight
- avoid alcohol
- lower your blood sugar levels
- eat less sugar / sweets

HDL Cholesterol or "Good" Cholesterol

If you do the following you may raise your HDL level

- exercise more
- stop smoking
- lose weight.

Eating to reduce blood cholesterol

- trim all visible fats from meats and remove skin from chicken
- avoid or limit organ meats such as liver and brain
- reduce intake of animal products (not more than 200 grams / day)
- use low fat dairy products and limit milk intake to 300 ml a day. (Vegetarians may go up to 500 ml)
- avoid high fat products such as butter and cream

- limit egg yolks to a maximum of two per week
- if you choose to fry, use a non-stick pan with no added fat. Do not deep fry
- limit or avoid commercially baked foods as they contain hidden fats, saturated fats and cholesterol

16.4. ROLE OF FAT IN THE DEVELOPMENT OF ATHEROSCLESOSIS

Cholesterol and triglycerides are the main forms of fat carried in the blood stream. These fats or lipids come partly from food, (exogenous) and partly from the body's own production in the liver (endogenous). Fats are not water soluble and hence cannot travel through the blood easily.

Cholesterol is an important substance for the functioning of the body. It is not fat but it is closely related to fat. It is a compound chemical that is an essential component in the structure of cells and is also involved in the formation of important hormones.

High levels of cholesterol can contribute to atherosclerosis, in which the blood vessels are narrowed by deposits of a fatty tissue called atheroma made up largely of cholesterol, esters and triglycerides (Fig 16-C).

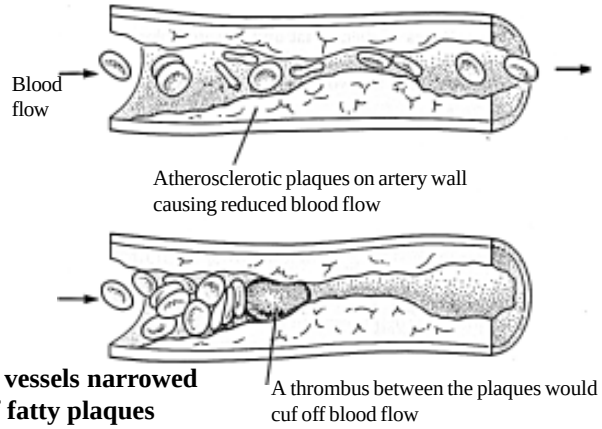


Fig. 16-C : Blood vessels narrowed by deposits of fatty plaques

These deposits of fatty tissue causes thickening of the arterial wall, loss of elasticity and narrowing of the lumen. (Fig. 16-D)

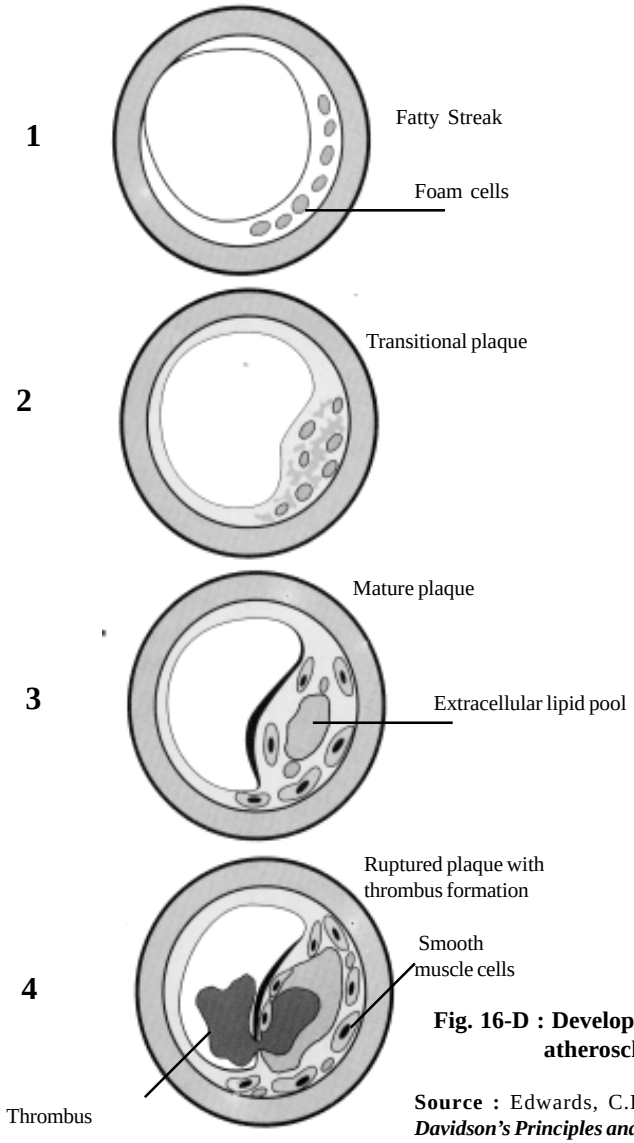


Fig. 16-D : Development of vascular atherosclerosis

Source : Edwards, C.R.W., et.al., (1995). ***Davidson's Principles and Practice of Medicine,*** ELBS with Churchill Livingstone.

Most myocardial infarctions are due to atherosclerosis. Myocardial infarction is a cardiac disability resulting from an inadequacy of the coronary arterial system to meet the needs of the heart muscle for oxygen and nutrients. It may be manifested as sudden death or as angina pectoris.

Angina pectoris refers to the tight, pressing burning and severe pain across the chest that follows exertion and is a result of inadequate oxygen to the myocardium.

High cholesterol levels in the blood stream lead to more cholesterol being deposited in patches of atheroma and a greater risk of severe atherosclerosis. The two major lipids, cholesterol (CHOL) and triglyceride (TG) circulate in the blood as lipid protein complexes known as lipo proteins. The major lipoprotein classes are chylomicrons (CH), very low-density lipoproteins (VLDL), low density lipoproteins (LDL) and high density lipoproteins (HDL)

LDL carries cholesterol from the liver to the periphery of the body and thus tends to promote the development of coronary heart disease.

HDL brings cholesterol from the tissues back to the liver for safe disposal. This is why HDL is referred to as good cholesterol and LDL as bad cholesterol.

Things that may prevent clogging

1. Increase HDL cholesterol by an increase in exercise.
2. Reduced intake of dietary fat and cholesterol will reduce chylomicron
3. Reduced total fat, saturated fat and trans fatty acid in the diet will reduce endogenous fat produced in the liver, as a result VLDL is reduced.

4. High intake of GLOP – water soluble fiber results in more cholesterol being lost in the intestine.

   GLOP Guar gum, Legumes, Oat bran and Pectin.

16.5. DIETARY MANAGEMENT - LOW FAT DIET

Objectives of dietary management include

1. Maximum rest for the heart
2. Maintenance of good nutrition

Principles of Diet

Low calorie, low fat diet particularly low in saturated fat, low in cholesterol, high in poly unsaturated fatty acids (PUFA), low carbohydrate and normal protein, minerals and vitamins are suggested. High fiber is recommended.

Energy

Increased body weight increases the workload of the heart. Reduction in body weight and blood lipids is accomplished by lowering calorie intake and substituting PUFA for saturated fats. Normal weight is maintained when energy intake and output are equal. Regular exercise is essential.

Fat

Dietary fat is the single most important factor requiring adjustment in prevention and control.

Dietary fat should be restricted to 30 percent of the total calories. Severe restriction results in mental and physical depression. The content of saturated fat should be less than 10 percent of calories and polyunsaturated fat should not exceed 10 percent of

calories. The proportion of saturated to monounsaturated to polyunsaturated fat should be 1:1:1. Saturated fatty acids appear to enhance the risk of CHD.

Mono unsaturated fatty acids reduce plasma cholesterol levels and increase HDL cholesterol levels. This is present in groundnut oil and olive oil.

Omega – 6 – PUFA found in seed oil and chicken fats lower plasma cholesterol levels and if necessary, small amount can be included.

Omega – 3 PUFA fatty acids found in fish, lower triglycerides and reduce risk of CHD. Consumption of 100 to 200 g of fish 2-3 times a week helps prevent heart disease. Trans fatty acids found in shortenings and spreads (due to hydrogenation of oil) produces an increase in LDL cholesterol (bad cholesterol) and decrease in HDL cholesterol (good cholesterol) and thus raises blood cholesterol levels.

Dietary cholesterol intake should be less than 300 mg / day. Fat calories should be replaced by complex carbohydrates like bread, cereals, legumes, vegetables and fruits. Diary products should not be eliminated since they are a rich source of calcium. Low fat or non fat dairy products should be eaten.

- A multivitamin pill with B-complex and several minerals, containing about 5 times the recommended dietary allowances should be taken once in a day on reducing diets.
- Tea/Coffee to be taken without sugar.
- Cooking oil not to exceed 15 g.

Sizes of teaspoons and katori is given in Appendix - 1

Table - 16.1 : Sample menu for 1000 Kcals Diet : Vegetarian

Early Morning	Tea/Coffee	One cup	
Breakfast	Phulkas	Two	
	Dhal curry	3 tbsp	300
	Tea/Coffee	One cup	k.cals
Mid morning	Any fruit	One	
Lunch	Rice	1 Katori	
	Dhal with any green Leafy vegetable	1 Katori	
	Rasam or Vegetable soup	1 Katori	400
	Buttermilk	1 Katori	k.cals
	Salad of tomato Onion, carrot	1 each	
Snack	Upma	1 Katori	
Tea	Tea / Coffee	1 Cup	
Dinner	Rice	1 Katori	
	Any vegetable curry	1 Katori	
	Rasam	1 Katori	
	Buttermilk	1 Katori	
	Salad of carrot, radish cucumber	1 each	300 k.cals
Bedtime	Any fruit	One	

Source : Ghafoorunissa and Kamala Krishnaswamy (1995) ***Diet and Heart Disease.*** National Institute of Nutrition. Hyderabad India.

Vegetarian diets have their own advantages. It is low in calories, fat and cholesterol. It has a high PUFA to saturated fat (P/S) ratio and provides adequate fiber. A ratio of 0.5 or over is satisfactory.

Carbohydrates : Carbohydrate intake is restricted as total caloric intake is restricted. Complex carbohydrate intake is recommended in place of sucrose. By reducing the sugar intake, the serum triglycerides decrease.

Protein, Vitamins and Minerals : Normal allowances are recommended.

Sodium : Sodium is restricted if there is hypertension.

Meal and Exercise : Three or four smaller meals are suggested instead of two big meals. Evening meals must be eaten two hours before bed. Regular exercise is necessary to reduce pressure.

Functional Foods : A functional food is any food that has a positive effect on a person's health, physical performance or state of mind. Foods rich in antioxidants, hypocholesterolenic agents and phytochemicals protect from CHD.

Vitamin C and β carotene are antioxidants. Citrus fruits are a good source of vitamin C. Green leafy vegetables and yellow orange coloured vegetables are a good source of carotenoids.

Garlic is hypocholesterolemic and one clove of garlic per day is sufficient to reduce cholesterol. High fibre also reduces cholesterol. Pectin in apples is effective in reducing cholesterol.

Guargum extracted from cluster beans, oats, turmeric, onion, garlic and fenugreek have hypocholesterolemic effect. Legumes and vegetables lower serum triglyceide levels.

16.6. HYPERTENSION

Hypertension or elevation of blood pressure above normal (120 mm Hg / 80 mm Hg) is a symptom that accompanies many cardiovascular and renal disease.

The causes of Hypertension are

- Genetic and environmental factors
- Emotional disturbances
- Stress
- Obesity
- Excessive smoking
- Renal diseases - eg. glomerulonephritis
- Adrenal tumors
- High viscosity of blood
- Narrowing of the blood vessels due to hormone secretions especially cortisone, aldosterone, adrenaline and nor adrenaline.

Table 16.2 : The Causes, Consequences and Control of Hypertension

1. Factors which increase blood pressure		
Causes	**Consequences Increase in:**	**Control Measures**
Increased intake		
(↑) of Calories	Body fat	Reduce food and fat intake
↑ Saturated fats	Body weight	Restrict processed foods
↑ Sodium	Serum lipids	Use minimum salt
↑ Alcohol	Serum insulin	Avoid alcohol
↑ Heavy Smoking	Catecholamines	Avoid smoking, take regular exercise
Stress and strain	Impaired glucose tolerance and platelet function	Adopt relaxation technique
2. Factors which decrease blood pressure		
Increased intake of:		
Fiber	Reduced calorie intake	Consume varied plant foods - vegetables, fruits and increase the intake of toned milk
Potassium	Increased sodium excretion	
Calcium	Alters vascular smooth muscle reactivity	
Magnesium	Stabilizes calcium, Channels	

Source : Nutrition : Vol 34. No. 4.

16.7. CLASSIFICATION OF HYPERTENSION

Hypertension is diagnosed when the diastolic pressure is consistently 90 mm Hg or more or the systolic pressure exceeds 140 mm Hg.

Mild Hypertension

Treatment is based on weight loss and sodium restriction.

Borderline Hypertension

Nutritional therapy is supported by drugs such as beta blockers.

Hypertension

Along with dietary treatment and beta blockers, peripheral vasodilators are given.

Table 16.3 : Classification of Blood Pressure

Classification of Blood Pressure according to WHO (1978) Criteria			
Normotension	SBP $\leq$ 140 mm Hg	and	DBP $\leq$ 90 mm Hg
Borderline hypertension	SBP 141-159 mm Hg	and	DBP 91-94 mmHg;
Hypertension	SBP $\geq$ 160 mm Hg	or	DBP $\geq$ 95 mm Hg

SBP - Systolic Blood Pressure; DBP - Diastolic Blood Pressure

Source : Nutrition, Vol. 34. No. 4.

16.8. DIETARY MANAGEMENT

Principles of diet : Low calorie, low fat, low sodium diet with normal protein intake is given.

Energy : Low calorie diet is given to obese patients to reduce weight to normal body weight. For a sedentary worker 20 Kcal / kg of ideal body weight and 25 Kcal / kg body weight for a moderately active worker is given.

Protein : About 60g protein per day is necessary to maintain proper nutrition.

Fats : About 20g partly as vegetable oil is permitted.

Carbohydrate : Complex carbohydrates are helpful in dietetic management.

Sodium : Increased intake of sodium in diet leads to increase in cardiac output and elevates blood pressure. Sodium restriction with weight reduction can effectively control mild or moderate hypertension. Salt should not be used in cooking or at the table. Preserved foods like pickles, canned foods and chips should be avoided.

16.9. SODIUM RESTRICTED DIETS

The normal diet contains about 3 to 6 g of sodium daily. The normal diet is modified for its sodium content.

1. Extreme sodium restriction (200 to 300 mg). No salt is used in cooking. Low sodium foods are selected. This diet is used in cirrhosis of the liver with ascites and congestive heart failure.
2. Severe sodium restriction (500 to 700 mg). No salt is used in cooking. Careful selection of foods is necessary. This level is used for severe congestive heart failure.
3. Moderate restriction (1000 to 1500 mg). No salt is used in cooking. Low sodium foods are selected. Measured amount of salt is used. This level is suggested for those with a strong family history of hypertension and patients with borderline hypertension.
4. Mild sodium restriction (2000 to 3000 mg). Some salt is used in cooking but no salty foods are permitted. No salt is used at the table. This level is used as a maintenance diet in cardiac and renal disease.

Sodium in Foods

Sodium content of animal foods is relatively high. Meat, fish, poultry, milk and cheese must be used in measured amounts.

Table 16.4 Sodium content of foods

Sl. No.	Foods with high sodium	Foods with moderate sodium	Foods with negligible amounts of sodium	Insignificant amounts of sodium
1.	Salt	Milk and Curd	Sugar	Fruits
2.	Baking powder	Pulses and Legumes	Oils	Cereals
3.	Canned foods	Vegetables	unsalted butter	Bitter gourd
4.	Cheese (commercial)	Broad beans		Brinjal
5.	Bacon, Ham Sausages	Cauliflower, field beans		Cabbage
6.	Meat, Poultry	Knol khol		Peas
7.	Fish, shell fish	Green tomato		Pumpkin
8.	Salted chips, pappads	Beet root		
9.	Pickles	Radish carrot		
10.	Sauces, soups	Amaranth		
11.	Dried fruits	Spinach		

A person suffering from hypertension should not use

1. Salt in cooking or at the table
2. Salt preserved foods – pickles – canned foods
3. Potato chips
4. Spices and condiments, sauces
5. Cheese, butter, salted butter
6. Frozen peas
7. Shell fish, dry fish
8. All processed and baked food

QUESTIONS

Part - A

I. Fill in the blanks

1. Heart possesses _____ chambers.
2. _____ and _____ are the main forms of fat carried in the blood stream.
3. LDL carries _____ from the liver to the periphery of the body.
4. _____ brings cholesterol from the tissues back to the liver for safe disposal.
5. Dietary cholesterol intake should be less than _____ mg / day.

Part - B

II. Write short answers

1. Explain the term

   a) Angina pectoris b) Atherosclerosis
2. List the causes for hypertension.
3. Explain the functions of heart.

Part - C

III. Write detailed answers

1. Explain sodium restricted diets.
2. Write a note on the dietary management for atherosclerosis.
3. What is the role of fat in the development of atheroclerosis?
4. Explain the risk factors for cardiovascular disease.

17. HOSPITAL DIETARY DEPARTMENTS

17.1. HOSPITAL DIETARIES IN PATIENT CARE

The common goal in feeding patients in hospitals is to provide quality food that meets nutritional standards at the most economical cost. Food service to patients requires imagination and ingenuity in planning for a variety of foods to meet the needs of the patients.

The dietary department is organized, equipped and staffed to provide food service to in-patients, employees and visitors. Service of food includes a number of functions – planning menus, purchase of raw materials and distribution of the finished product.

The end result depends on the physical arrangement and equipment for food service, number and type of personnel, type of food service set up and the budget.

The physical facilities of the dietary department have an important influence on the standard of food service, labour costs and morale of workers.

Adequate maintenance of records is also an important element for the smooth functioning of the department.

Apart from food service, the diet clinic of an outpatient service helps in wider use of dietary counselling and helps to clarify diet instructions.

Suitable equipment for efficient food production and service is an important factor in the successful operation of the dietary department. A model organization chart of the dietary department is presented in figure 17-A.

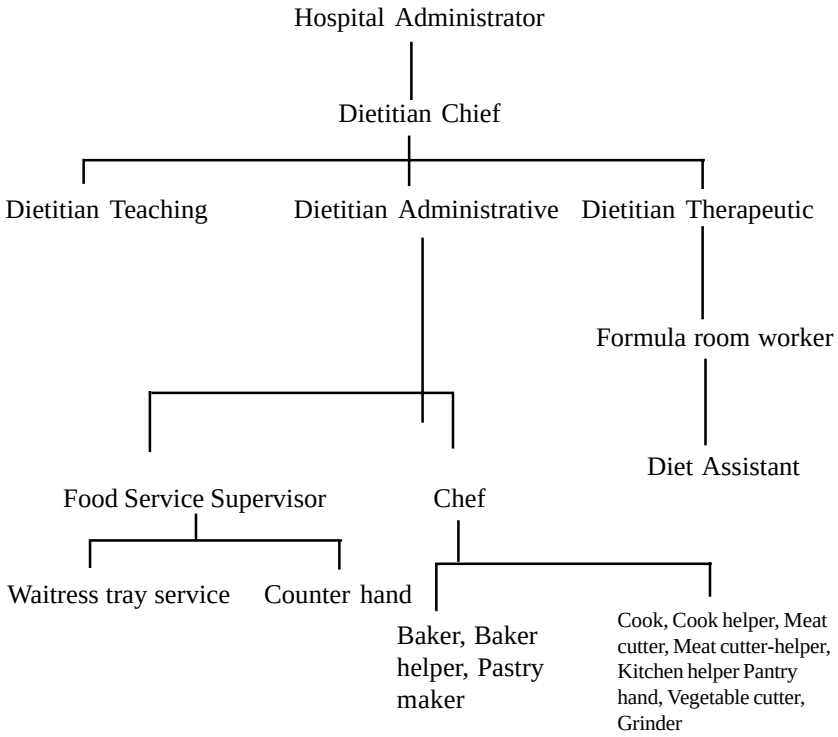


Figure 17-A Organisation Chart of a hospital dietary

Source : West B.B., Wood L., Harger U.F. and Shugart C.S. (1977). ***Food service in Institutions,*** 5th ed. John Wiley and Sons. New York.

17.2. DIETITIAN - DUTIES

A dietitian is a person with legally recognized qualification in nutrition and dietetics who applies the science of nutrition to the

feeding and education of groups of people and individuals in health and disease. The duties of a dietitian are as follows.

Dietitian (General)

1. Plans and supervises the preparation of therapeutic diets for individuals or groups in hospitals and institutions.
2. Gives instructions in selection and proper preparation of food according to dietetic principles.
3. Performs duties related to nutrition programmes.
4. Dietitian is responsible for food purchasing on behalf of the organization.

Public health nutritionist

1. Evaluates factors related to nutrition and food problems in the community.
2. Executes nutrition programmes.
3. Participates in nutrition programmes for the community.
4. Act as consultants to food processing and distributing firms or manufacturers of food processing equipment.

Administrative dietitian

1. Plans, develops, controls and evaluates food service systems.
2. Develops short and long range department plans and programmes.
3. Utilises human effort and facilitates resources efficiently and effectively.
4. Establishes and maintains standards of food production and service, sanitation, safety and security.

5. Maintains effective written and verbal communication.
6. Plans, conducts and evaluates orientation and in-service educational programmes.
7. Interprets, evaluates and utilizes current research relating to nutritional care.
8. Develops menu patterns and evaluates client acceptance.
9. Develops specifications for the procurement of food equipment and supplies.
10. Plans layout designs and determines equipment requirements for new food service facilities.

Consultant dietitian

With experience in administrative or clinical dietetic practice, He/She.

1. Evaluates and monitors food service systems to provide nutritionally adequate quality food.
2. Develops budget proposals and recommends procedures for cost control.
3. Plans, organizes and conducts orientation and in-service education programmes for food service.
4. Plans layout design and determines equipment requirements for new food service facilities.
5. Recommends and monitors standards for sanitation, safety and security in food service.
6. Develops menu patterns.
7. Assesses, develops, implements and evaluates nutritional care plans and provides follow up.
8. Develops, uses and evaluates education materials.

9. Provides guidance, and evaluation of the performance of dietetic personnel.
10. Maintains effective verbal and written communication and public relations.
11. Interprets, evaluates and utilises current research relating to nutritional care.

17.3. IMPORTANCE OF DIET COUNSELLING AND PATIENT EDUCATION

The major objective of dietary counselling is to educate the patient regarding the nature of the disease, its hazards, how a disease can be recognized and prevented. It is essential to advice the patient on personal hygiene, individual instructions on diet and any specific therapy needed.

Diet counselling makes the patient aware of the fact that diet plays an important role in the treatment of the disease. With today's emphasis on prevention of disease, diet counselling helps to reduce the risk of some illness by appropriate counselling.

Diet counselling is effective when the counsellor assists the patient in setting realistic goals and provides the necessary guidance in menu planning, food purchasing and preparation.

Table 17.1 : Steps in the counselling process

- Assessment	- Planning	- Implementation	- Evaluation
- Gathering and evaluating data	- set objectives	- client is able to plan her menus	- progress evaluated
- Food behaviour	- ways to achieve stated objectives	- prepare foods	
- Social, medical dietary history	- evaluate results	- consume the needed amounts	

Counselling Guidelines

1. Review medical record before counselling.
2. Provide a comfortable setting – undivided attention of the counsellor is essential.
3. Set a time in advance.
4. Counsellor should introduce herself and address the patient by name.
5. Listen effectively – eye to eye contact is necessary
   - note feelings and tone of voice
   - avoid criticism
   - Interrupt only when clarification is needed
6. Ask open ended questions.
7. Do not express approval or disapproval till data gathering is complete.
8. Avoid using medical terms and be prepared to explain.
9. Set Realistic objectives.
10. Prepare an individualized written dietary plan with the patient.
11. Give the patient opportunity to ask questions.
12. Bring the counselling session to a close. If follow up is needed set a time for next appointment.

17.4. THE INDIAN DIETETIC ASSOCIATION - ACTIVITIES

The Indian Dietetic Association (IDA) was founded with C. Gopalan as president and Kalyan Bagchi as secretary in 1963 with a band of nutritionists, dietitians and medical scientists who were resolved to deal with problems concerning nutrition and to highlight the importance of dietetics and nutrition in the maintenance of health and also in the prevention and treatment of disease. Their objectives were to –

1. Encourage nutrition education
2. Promote teaching, research and training in the field of dietetics and nutrition and
3. Safeguard the interests and welfare of the dietitians.

Aims and objectives of the Association

- Promote research, extension work and continuing education in the field of dietetics and nutrition.
- Publish a scientific journal titled 'Applied Nutrition'.
- Conduct Registration Examination, to prepare dietitians to start their own private practice.
- Conduct the annual convention of IDA.
- Safeguard the interests of the members of the Indian Dietetic Association.
- Promote interaction with dietetic associations abroad.

Activities of the Association

- To organize seminars and lectures in which eminent scientists from India and abroad participate.
- The annual conventions are a forum for the dissemination of knowledge.

Some of the seminars organized at this time are

- Widening frontiers in nutrition education.
- Combining malnutrition with subsidary foods.
- Nutrition education from the primary school to the postgraduate level.
- Curriculum construction – framing of core syllabus for dietetics.
- Dietary management of diseases.

QUESTIONS

Part - A

I. Fill in the blanks

1. The common goal in feeding patients in hospitals is to provide quality food to meet _____ requirements.

2. Adequate maintenance of _____ is an important element in the smooth functioning of dietary dept.

3. Administrative dietitian _____ _____ _____ and _____ food service systems.

4. The steps in the counselling process are _____, _____ implementation and evaluation.

5. The Indian Dietetics Association was founded with _____ as president.

Part - B

II. Write short answers

1. List 5 duties of a dietitian.

2. List the steps in the counselling process.

Part - C

III. Write detailed answers

1. What is the importance of diet counselling?

2. Draw the organization chart for a hospital dietary.

18. COMPUTER APPLICATIONS IN NUTRITION EDUCATION AND DIETETICS

18.1. COMPUTER USE IN DIET COUNSELLING

i. Interview Techniques

a. If the software is well written the computer can carry on a friendly informatic dialogue with the patient.

b. Utilization of branch functions in the program design ensures that no pertinent questions are unanswered.

c. Computerized interviewing saves professional time and obtains patient responses that are not biased.

d. Patients are honest about answering embarrassing questions by a computer than by a human interviewer.

e. Programs can collect information directly from the patients, summarize the relevant nutritional date and provide a printed summary before the patient is seen.

ii. Artificial Intelligence (A1)

Computers are programmed to make decisions within a limit. This is useful in assisting nurses and dietitians in diagnosing nutritional problems, interpreting diagnostic tests, detecting new genetic inborn erros and isolating drug-nutrient problems.

iii. Nutrition care plan

Once the interview is conducted and nutritional assessment analyzed a care plan must be devised.

a. Computers through their ability to quickly analyze diet information, plan diets that meet the patients' specific nutrient requirements.

b. The computer can teach patients about the background of their medical disorder, reinforce information on their therapeutic diet, help patients apply diet requirements to their life style and make necessary diet changes.

iv. Bedside Monitoring

Computer use possibilities include collecting patient data. ECG analysis, urine output measurements and drug doses at bedside.

v. Follow-up

Micro computers provide instant access to medical records, to schedule tests and retrieve laboratory data.

18.2. USE OF COMPUTERS IN NUTRITION EDUCATION

Computer assisted nutritional instructions educate individuals on the relationships of diet and disease, components of nutritional assessment, diet history methods and patient care studies.

Nutrition education is essential to one and all, since it can help prevent several diseases. For example, iodization of salt is a simple and effective way of preventing diseases arising due to iodine deficiency. To make learning about nutrition useful and interesting programs using multimedia and web would be useful.

Nutrition on Web

In a country like India, where a large population is below poverty line and malnourished, web is a very useful tool to supplement the efforts of nutritionists and to help remote health care centres. Multimedia and web help nutritionists to make nutritional information available in an attractive way.

There are several computer – based programmes on nutrition which are interactive, informative and interesting.

'Nutrition Discovery' for example, is a CD-ROM based programme which evaluates an individuals nutritional intake and quality of diet in an engaging and interesting way. Another CD based programme for children is 5 A Day adventures' designed to increase consumption of fruits and vegetables. It includes activities and information about nutrients in fruits and vegetables serving sizes, nutrition labelling and salad making. Short video clips show how plants grow and fruits are processed.

There are many sites on nutrition accessible to us. Some of these are:

www.dole5aday.com/menu/nutrition/menu.htm

www.kidsfood.org

www.leafygreens.org

www.education.world.com

www.healthyinformation.com

www.mediaawareness.ca/eng/med/class/teamedia/nutrie.

www.google.com

www.eatright.org

18.3. COMPUTER APPLICATIONS IN NUTRITION AND DIETETICS

Development and use of software package in nutrition education and diet counselling:

Computers can be used as a tool to teach menu planning and food service management. A computer software package - computer aided learning in dietetics (CALID) was formulated and standardized by Arunmozhi Balaji.

The actual instruction as the user sees is divided into:

1. Master file which stores patient information like age, sex, address, height, weight and patient number and condition.
2. Food site which stores information on food items with their calories, carbohydrates, protein and fat value. The food items are arranged alphabetically under the meal times. The quantity per serving and amount of individual serving will be displayed. Provision for adding and deleting food items is built in
3. The diet counselling system begins with patient personnal information. The counselling program is divided into 3 sections.

   i. Analysis of food intake for a day.

   ii. Summary

   iii. Printout

Analysis of the food intake

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

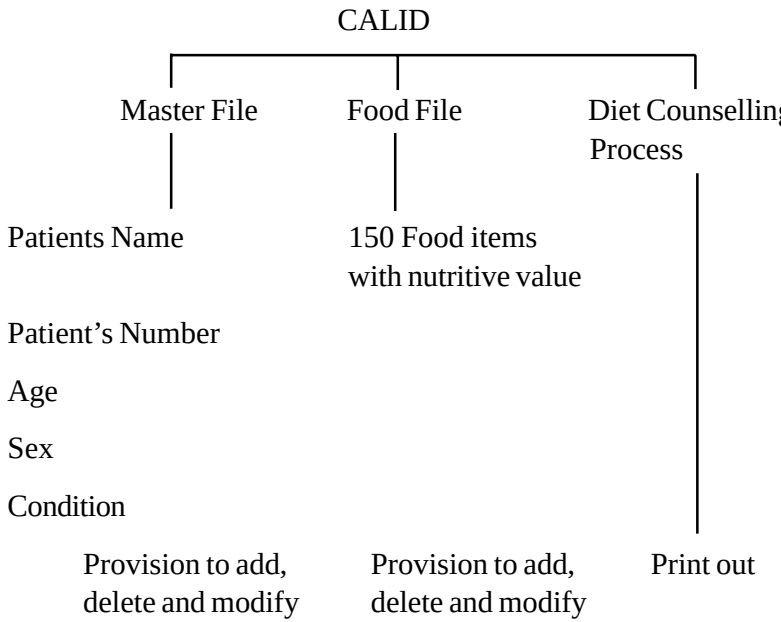
Summary

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

Printout

The printout would give the list of foods to be avoided and recommended along with the quantity per serving. The entire program is presented in Fig. 18A.

Figure 18A : Computer aided learning in dietetics – CALID



Balaji A.S., Muthayya. K. 1999

A Manual of second regional workshop on

"Planning Diet for Health"
- Computer Aided learning in Dietetics.

QUESTIONS

Part - A

I. Fill in the blanks

1. Computers can be used as a tool to teach _____ planning.
2. Diet counselling begins with patient _____information.
3. Print out lists of foods to be _____ & _____.

Part - B

II. Write short answers

1. Explain the 3 steps in a counselling program
2. What is Artificial Intelligence? Explain.

Part - C

III. Write detailed answers

1. Explain the use of Computer in diet counselling.
2. Explain the use of Computers in Nutrition Education.

PRACTICALS

Family Meal Management

No. of Periods

1. Plan a days diet for an anaemic pregnant woman doing moderate activity focusing on Iron rich items. Prepare, serve and evaluate a iron rich recipe for lunch. Calculate iron and Vitamin C content of the prepared item. 4
2. Identify foods rich in calcium and protein and prepare a recipe for a lactating mother. 4
3. Prepare a supplementary food for a pre-school child using locally available cereals and pulses. Calculate the energy and protein content of the prepared food item. 4
4. Give three nutritious and attractive recipes for a packed lunch for a 10 year old girl. 4
5. Prepare a nutritious snack for an adolescent using pulses and vegetables. Compare the energy, protein, iron and fat content of the prepared items with the given nutritive value of a baji. 4
6. Plan a days menu for an adult man doing heavy activity. Prepare an energy dense item for his dinner. 4
7. Prepare a vegetable salad rich in B-Carotene and Vitamin C. Calculate the B-Carotene and ascorbic acid content of the prepared item. 2

Related Experience

1. Observe the following aspects of a school lunch program in your school. 2

- Preparation and cooking
- Portioning
- Plate wastage

2. Visit to an old age home to assess the menu and compare it with the ICMR recommendations. 2

DIETETICS

1. Plan a days menu for a 60 year old man suffering from tuberculosis Prepare and serve one main item rich in calcium and protein. Calculate the calcium and protein content of the prepared item. 4
2. List four foods to be included and restricted for an obese person doing sedentary work. Suggest two ways to improve the fibre content of chapathis. Plan, prepare and evaluate a fibre rich lunch item for an obese person. 4
3. Plan a days menu for a sales executive convalescing from peptic ulcer. Prepare and serve an item for his dinner. Calculate the protein and vitamin C content of the prepared item. 4
4. Plan a whole days menu for a school teacher suffering from constipation. Identify four fibre rich foods. Prepare one fibre rich food and calculate the energy and fibre content of the prepared item. 4
5. Suggest two accompaniments for lunch for a diabetic college professor. List four foods to be included and restricted in diabetic diets. 2
6. Identify low, medium and high sodium foods. Plan a sodium restricted diet for a 6 year old boy suffering from nephritis. Prepare any one low sodium item for his lunch. 4
7. Plan a days menu for an executive suffering from atherosclerosis. Prepare and serve a low fat item for his dinner. Calculate the energy, protein and fat content of the item suggested for dinner. 4

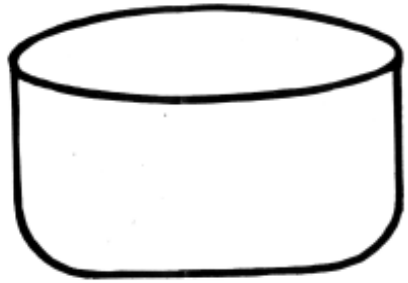
Related Experience

1. Visit to a well organized dietary department in hospital and observe in terms of

- Organization of the dietary department
- Planning, preparation service and evaluation of therapeutic diets. 4

APPENDIX - I

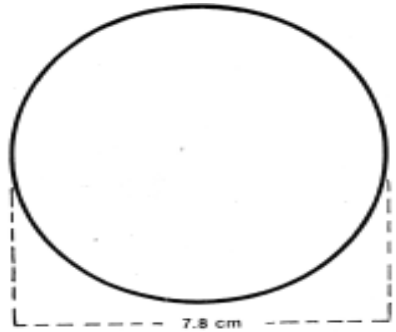
EQUIPMENT USED TO SERVE FOOD



15 ml

Tablespoon (15 ml) Teaspoon (5 ml)

ACTUAL SIZES OF SPOONS



ACTUAL SIZE OF KATORI

APPENDIX - II

Conversion Factor

I. To Convert mg to mmol

Mmol = mg / atomic weight

To Convert mmol to mg

mg = mmol x atomic weight

II. 1 milliequivalent (mEq) = atomic weight in mg divided by the valency.

To convert mg to mEq

$$Meq = \frac{mg \times valency}{Atomic\ weight}$$

To Convert mEq to mg

$$Mg = \frac{mEq \times atomic\ weight}{Valency}$$

Atomic weight of Sodium	-	23
Atomic weight of Potassium	-	39
Valency of Sodium	-	1
Valency of Potassium	-	1

APPENDIX - III

HEALTH CARE ON NET

1. TATA consultancy service - www.webhealthcentre.com
2. Nutrition foundation of India - www.nutrition foundation.in.org
3. Journal of American Dietetics Association - www.eatright.org
4. All India Institute of Medical Science - www.pugmarks.cons/aims
4. Institute of cardiovascular disease - www.pppindia.com/mmm
5. American Dietetic Association - www.eatright.org
6. Vegetarian Resource Group - www.vrg.org
7. National Institute of of Health - www.nih.gov./od/oar
8. World Health Organization - www.who.org/nut
9. UN World Food Programme - www.wfp.org

GLOSSARY OF TERMS

Ascites : accumulation of fluid in the abdominal cavity.

Basal energy expenditure : The amount of energy used in 24 hours by a person who is lying quietly, 12 hour after the last meal, in a comfortable temperature and environment.

Carnitine : an amino acid which forms an ester with fatty acyl COA to facilitate the transfer of long-chain fatty acids across mitochondrial membranes for oxidation.

Cirrhosis : inflammation and scarring of liver tissues resulting in impaired liver function.

Dietary fiber : plant fibers that include cellulose, hemicellulose, lignin, gums and pectin.

Essential fatty acids (EFA) : fatty acids which the body needs, but cannot be synthesized. The two main EFAs are linoleic acid and linolenic acids.

Fibrosis : formation of fibrous tissue in repair process.

Growth spurt : The period of growth when the growth rate is fastest.

Haemorrhoids : Commonly known as piles.

Haematuria : condition in which urine contains blood.

Infant mortality rate : number of infant deaths in the first years of life per 1000 live births.

Insulin : hormone secreted by beta cells of the islet of langerhans.

Invisible fats : Fat present as an integral component of plant and animal foods such as in cereals and legumes.

Ketogenesis : Synthesis of ketones.

Ketonemia : Presence of ketones in the blood.

Ketonuria : excretion of ketones when fatty acids are incompletely oxidized in the body.

Ketosis : condition resulting from incomplete oxidation of fatty acids, and the consequent accumulation of ketones like acetone, beta – hydroxybutyric acid and aceto acetic acid.

Kilocalorie : the amount of heat required to raise the temperature of 1 kg of water by $1^{o}C$.

Lactational amenorrhea : cessation of monthly menstrual period during the period of lactation.

Menarche : The onset of menses in females

Necrosis : death of a cell or portion of a tissue

Nephritis : inflammation of the nephrons

Nephrosis : degeneration of the nephrons.

Nocturia : Urination at night.

Nutrient balance : The balance between intake and output for a particular nutrient.

Oedema : abnormal accumulation of fluid in the intercellular tissue spaces or body cavities.

Oliguria : scanty secretion of urine.

Osmolarity : Is a measure of the osmotically active particles per litre of the solution. It is expressed as mOsm/l.

Osmotically : Is a measure of the osmatically active particles per kilogram of the solvent in which the particles are dispersed. It is expressed as mOsm/kg.

Osteopenia : A metabolic bone disease common in preterm infants, also called rickets of prematurity.

Plaque : any patch area : atherosclerotic plaque is a deposit of lipid material in the blood vessel.

Prophylaxis: prevention of disease

Proteinuria : excretion of protein in the urine

Purging : The use of self - induced vomiting, laxatives or diuretics to prevent weight gain.

Rooting reflex : If the baby's cheek is touched the baby will turn towards that side.

Transamination : the reversible transfer of an amino group from an amino acid to a keto acid, forming a new keto acid and a new amino acid without the appearance of ammonia.

Visible fats: Fats and oils that can be used directly or in cooking.

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