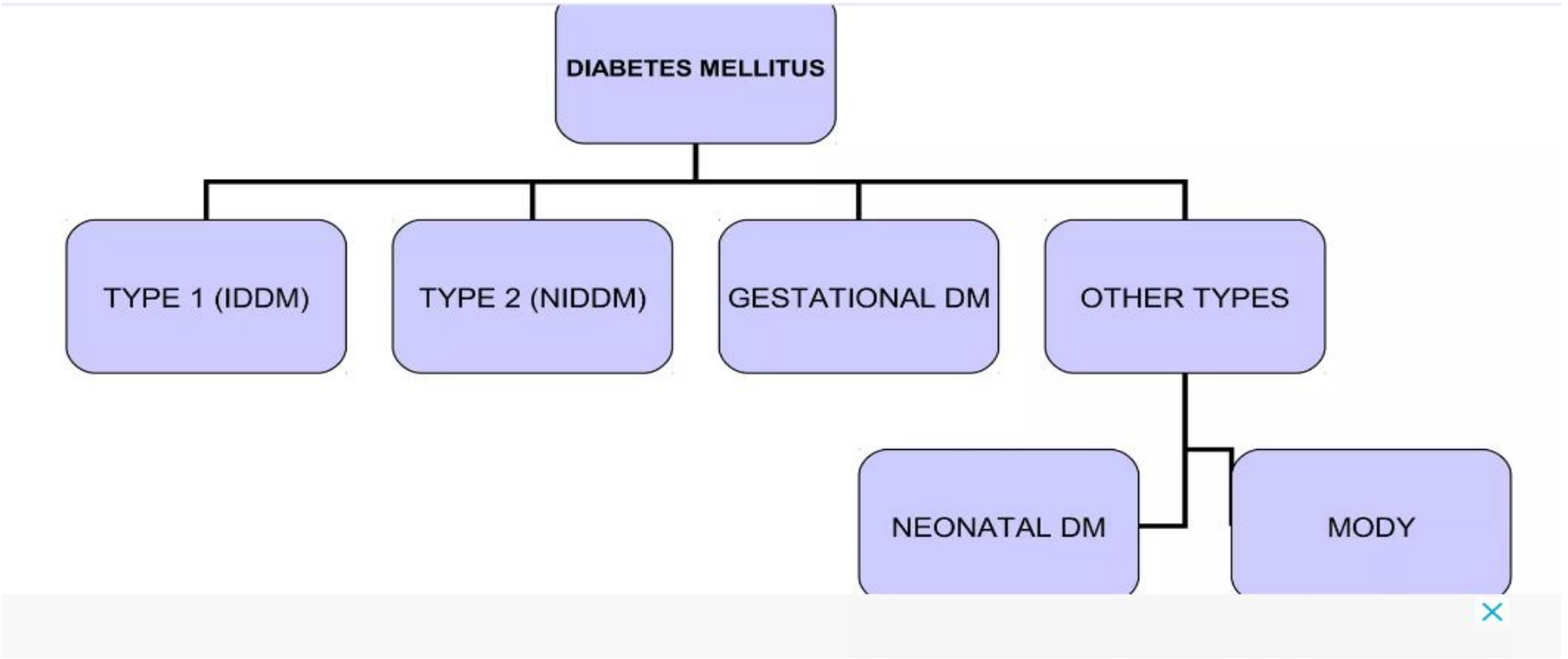
MEDICAL NUTRITIONAL THERAPY OF DIABETES MELLITUS

ASSISTANT PROF. MAYASAH A. SADIQ FIBMS-FM

What is a simple definition of diabetes?

- Diabetes is a chronic, metabolic disease characterized by elevated levels of blood glucose (or blood sugar), which leads over time to serious damage to the heart, blood vessels, eyes, kidneys and nerves.

TYPES OF DIABETES MELLITUS



PREVALENCE

- June 22, 2023 – More than half a billion people are living with diabetes worldwide, Iraq 14%.
- TYPE 2 DM(90-95%).
- TYPE 1 DM(5-10%).
- (2021) reported the global prevalence of GDM was 14.7% based on the International Association of Diabetes and Pregnancy Study Groups (IADPSG) .

RISK FACTORS FOR TYPE 2 DM

- **Obesity:-** The number one risk factor for type 2 diabetes is obesity. Greater weight means a higher risk of insulin resistance because fat interferes with the body's ability to use insulin. The number of children being diagnosed with type 2 diabetes has also risen.[8]

- **Sedentary lifestyle:-** A sedentary lifestyle is damaging to health and bears responsibility for the growing obesity problems." Inactivity and being overweight go hand in hand towards a diagnosis of type 2.[9] Muscle cells have more insulin receptors than fat cells, so a person can decrease insulin resistance by exercising. Being more active also lowers blood sugar levels by helping insulin to be more effective.

RISK FACTORS OF TYPE 2 DM(CONT.)

- **Unhealthy eating habit**:- People who have been diagnosed with type 2 diabetes are overweight. Unhealthy eating contributes largely to obesity. Too much fat, not enough fiber and too many simple carbohydrates all contribute to a diagnosis of diabetes.[10] Eating right is can turn the diagnosis around and reverse or prevent Type 2.

- **Family history and genetics:-** If you have a relative who has/had diabetes your risk might be greater. The risk increases if the relative is a close one - if your father or mother has/had diabetes your risk might be greater than if your uncle has/had it

GESTATIONAL DIABETES(during pregnancy)

- **Risk factors for gestational diabetes mellitus**
- **Age:-** Women older than age 25 are at increased risk.
- **Family or Personal History**:- Your risk increases if you have prediabetes -a precursor to type 2 diabetes — or if a close family member, such as a parent or sibling, has type 2 diabetes. You're also at greater risk if you had gestational diabetes during a previous pregnancy, if you delivered a very large baby or if you had an unexplained stillbirth.
- **Weight: -**Being overweight before pregnancy increases your risk.
- **Race:-** For reasons that aren't clear, women who are black, Hispanic, American Indian or Asian are more likely to develop gestational diabetes.

OTHER TYPES OF DM

- **Maturity onset diabetes of the young (MODY) :-** MODY is a rare form of diabetes which is different from both Type 1 and Type 2 diabetes, and runs strongly in families. MODY is caused by a mutation (or change) in a single gene. If a parent has this gene mutation, any child they have, has a 50 per cent chance of inheriting it from them.[13] If a child does inherit the mutation they will generally go on to develop MODY before they're 25, whatever their weight, lifestyle, ethnic group etc.

MODY is the most common form of monogenic diabetes. Prevalence is estimated to be about 1/10,000 in adults and 1/23,000 in children

Neonatal diabetes mellitus (DM)

- is characterized by the onset of persistent hyperglycemia within the first six months of life due to impaired insulin function and is frequently caused by a mutation in a single gene affecting pancreatic beta cell function.(MONOGENIC)
- a rare cause of neonatal and infantile hyperglycemia with reported incidence ranging from 1 in 90,000 to 160,000 live births

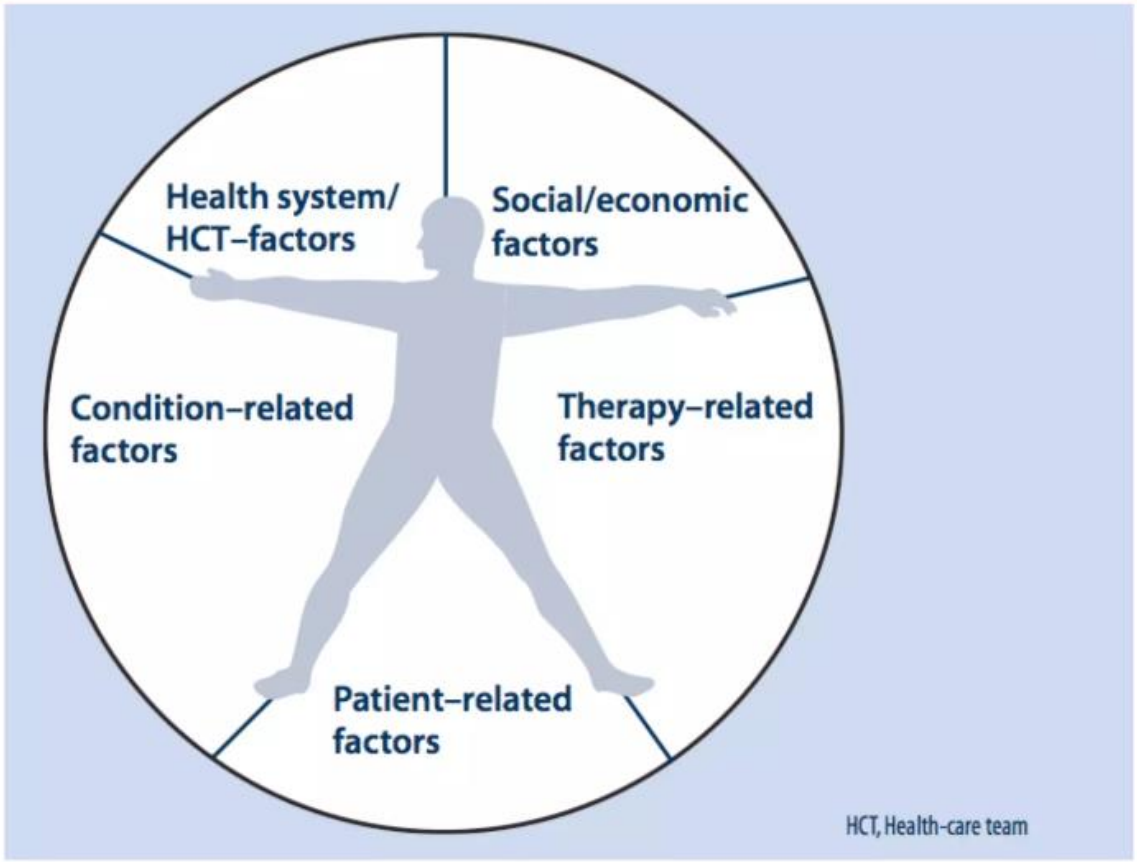
Diagnosis :

Any one of these is diagnostic

Any one of the following is diagnostic	
A.	Glucose
	1. Fasting plasma glucose ≥126 mg% or
	2. Symptoms of hyperglycemia and casual plasma glucose ≥200mg% or
	3. During an OGTT 2 hour plasma glucose ≥ 200mg%
B.	$HbA_{1c} \geq 6.5$ mg%

For proper management of DM, one should follow the following rules

- Dietary modifications
- Exercise
- Drug, if necessary
- Monitoring of blood glucose
- Education for every step
- Discipline



The Five Dimensions of Adherence

WHO (2003)

Adherence to Long-term Therapies: Evidence for Action

Basic Goals

- Maintain near-normal blood glucose levels
- Achieve and maintain a reasonable weight
- Achieve normal growth and development in children and adolescents
- Positive outcomes for pregnancy and lactation
- Prevent and treat acute complications such as hypoglycemia
- Prevent, slowing and treating co-morbidities such as hypertension, cardiovascular disease, and nephropathy

THE MAIN AIMS OF TREATING THE PATIENTS

- Making the patients symptom free
- Free from acute or chronic complications
- Providing basic diabetic education so that they can cover themselves in any emergency situation, diet and nutrition, sick day managements, foot care etc.

	TARGETS
Fasting (mmol/l)	<6.1
Post prandial (mmol/l)	<8.0
Bed time plasma glucose (mmol/l)	<7.0
HbA1C%	<7
Total cholesterol (mg/dl)	<200
Triglyceride (mg/dl)	<150
LDL (mg/dl)	<100
HDL (mg/dl) – Male - Female	➢40 ➢> 50
BMI (kg/m^2)	<25

LESS STRICT CONTROL OF BLOOD GLUCOSE

- Very young children
- Older people
- Persons with history of severe or repeated hypoglycemia
- Limited life expectancy
- Presence of comorbid conditions

GOALS OF DIETARY MODIFICATION

1. Eat a balanced meal
2. Take meals regularly
3. Attain & maintain desirable body weight
4. Maintain blood glucose, lipid profile in the normal range
5. Maintain blood pressure in target level
6. Produce adequate energy to ensure normal growth and development for children

GOALS OF DIETARY MODIFICATION

7. Change eating habits that will reduce insulin resistance in type 2DM
8. Provide adequate energy and nutrients for optimum outcome of pregnant and lactating mother
9. Provide nutritional support for older patients
10. Prevent hypoglycemia in individual treated with antidiabetic drugs
11. Prevent and treat chronic complications of diabetes

Dietary modification should not any word like **'diet control'**. All people should have 'healthy diet'. For a diabetic patient it is a **'balanced diet'**.

A balanced diet is a combination of carbohydrates, fats, proteins and fibers appropriate for the individual.

DIET OF DM PATIENTS DEPENDS ON

- Age
- Gender
- Type of diabetes
- Patients present weight
- Physical activity
- Presence or absence of complications/ other diseases
- Pregnancy
- lactation

PROXIMATE PRINCIPLES OF FOOD

- Carbohydrate, such as rice, bread, etc
- Protein, such as fish, meat, milk, etc
- Fat, such as butter, oil etc

PLANNING OF DIET DEPENDS ON

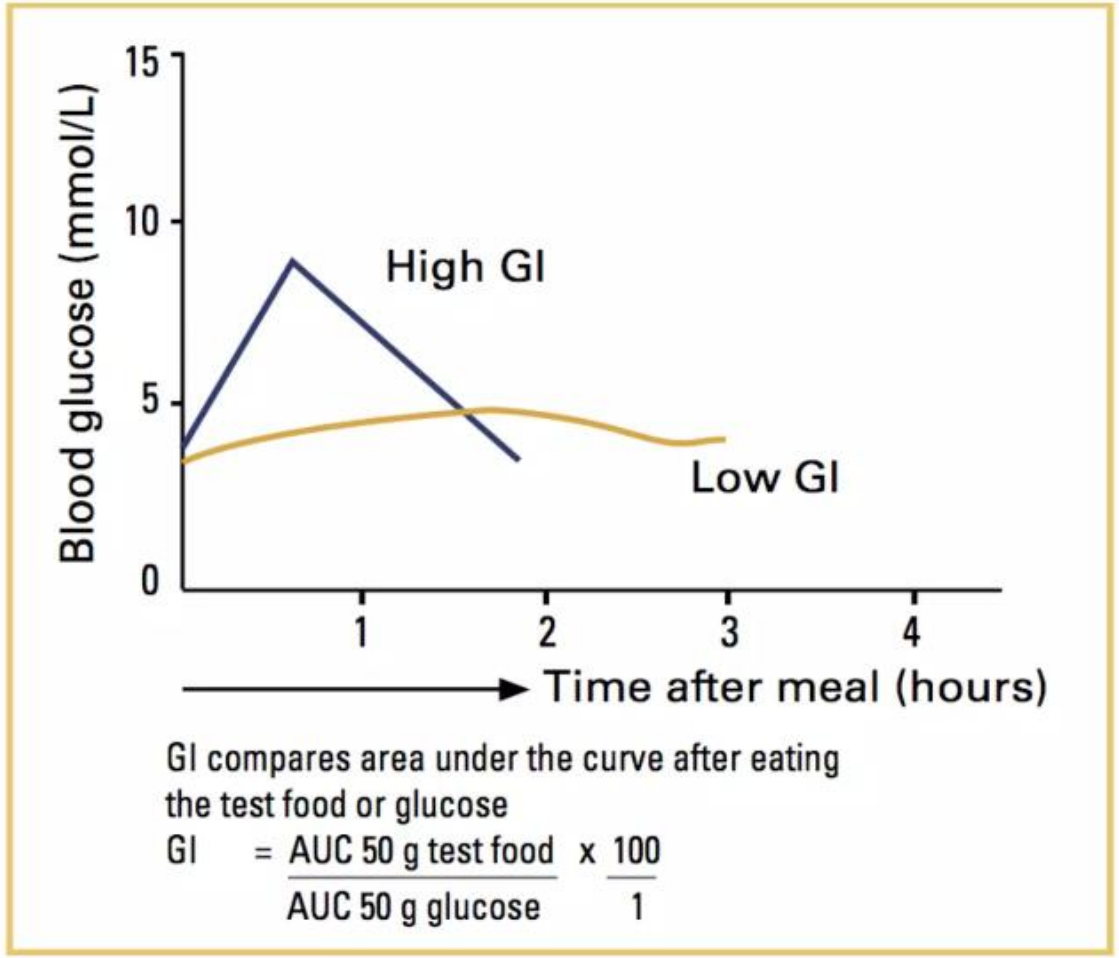
- ✓ Calorie values of food
- ✓ Glycaemic index

CALORIES

- It is the unit that represents the amount of energy provided by the food.
  - ✓ Carbohydrate and protein give 4 kcal/ gm
  - ✓ Fat give 9 kcal/ gm

GLYCAEMIC INDEX

- Glycaemic index (GI) is a numerical system of measuring how fast dietary carbohydrate triggers rise in glucose
- The GI depends largely on the rate of digestion and rapidity of absorption.
- All carbohydrate foods have a different glycaemic response. Some cause a low response; others cause a high response.
- portion size of the carbohydrate will also influence the glycaemic response; this is described as the '**glycaemic load**'.



GI compares area under the curve after eating the test food or glucose

$$GI = \frac{\text{AUC 50 g test food}}{\text{AUC 50 g glucose}} \times \frac{100}{1}$$

Low GI
0-55

Intermediate
56-69

High GI
≥70

GLYCEMIC INDEX (GI)

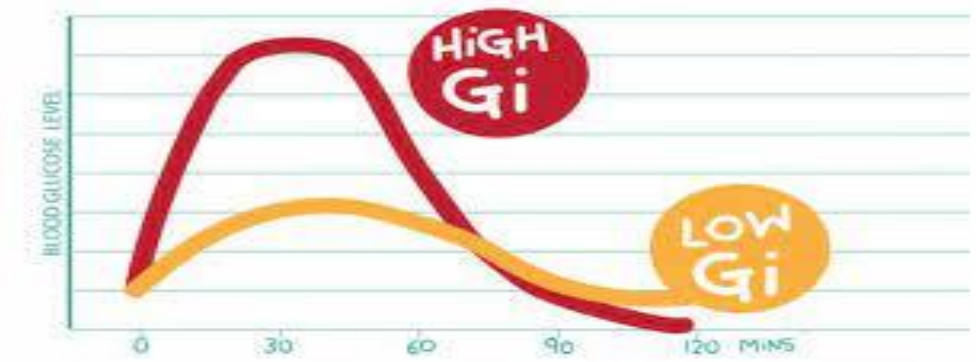
Increase in blood glucose (over fasting level) in 2 h following ingestion of 50 g CHO

GLYCAEMIC INDEX OF FOODS

Low glycaemic index	Intermediate glycaemic index	High glycaemic index
Lentil	Rye bread	glucose
Fruit & vegetables	Some rice (long grain)	Mashed & baked potatoes
yogurt	bananas	Processed breakfast cereal
milk	pasta	White bread
oats	grapes	White rice

Glycemic Index (GI)(CONT.)

- Factors that appear to have the most influence on blood glucose response include:
- - Form: liquids digest faster than solids
- - Meal composition: fat slows gastric emptying
- - Particle size: smaller particles digest faster
- - Fiber content: fiber doesn't digest (doesn't contribute glucose); increases satiety



DAILY DISTRIBUTION

- Carbohydrates: 50-60% of DCI
- Protein: 10-20% of DCI
- Fats: 30% of DCI
- Dietary fiber: 20 -35g/day
- Salt (Sodium): <6000 mg/day
- Vitamins and minerals

*DCI= daily calorie intake

CARBOHYDRATES

- Simple
- complex

- Refined & simple carbohydrates- sugar, glucose, soft drinks, jam, honey, marmalade, sweets, cakes, chocolate etc
- Complex carbohydrates- rice, wheat, bread, potatoes, and maize

Difference-

- ✓ Refined and simple sugars are quickly digested, absorbed and causes sudden rise in blood sugar. These types of food should be avoided.

- ✓Complex carbohydrates are more suitable, they have less glycaemic index. They are digested more slowly and cause less rapid rise in blood glucose level.

PROTEIN

Sources of protein

- Animal source – provides better quality protein. Egg, milk, meat, fish, poultry
- Plant source-provides less good quality protein. Pulses, cereals, nuts are the source of plant protein.

Functions of protein

- To build blood cells
- To build body tissues, hormones, muscle and other important substances

Protein

- •Protein requirements in children and young adults is same as the normal children or young adults (1.0 g/kg body wt.)
- •In patients with diabetic nephropathy – to control albuminuria, protein intake is lowered (0.6-0.8g/Kg body wt.) according to condition of the patient.

FAT

Sources of fat

- Saturated fat: **animal products**
- Unsaturated fat: **plants**

➢ Intake of saturated fat should be <7% of total energy

➢ Intake of Trans fat should be minimized

➢ Dietary cholesterol intake should be <200 mg/day

FAT

Trans fat

- Formed when liquid fats such as oils are chemically hydrogenated.
- Raises LDL cholesterol and lowers HDL cholesterol.

Fish oils

- Balance of omega 3 and omega 6 fatty acids
- Two or more serving of fish per week are recommended
- Fish oil supplements not recommended

Fat in prevention of diabetes

- Consumption of PUFA or biomarkers associated with lower risk of T2DM
- Supplementation with omega-3 FA in prediabetes has demonstrated some efficacy in surrogate outcomes beyond serum triglyceride levels

OTHERS

- Dietary fiber
- Vitamins and anti oxidants
- Minerals and trace elements
- Salt
- low calorie sweetener

Dietary fibers

- Minimum of 14 g of fiber per 1,000 kcal with at least half of grain consumption being whole intact grains
- Modest A1C reduction (0.2% to 0.3%) with excess of 50 g of fiber/day
- Regular intake of sufficient dietary fiber associated with lower all-cause mortality
- Very high intake may cause flatulence, bloating, and diarrhea

Sweeteners

- Sugar substitutes refers to high-intensity sweeteners, artificial sweeteners, nonnutritive sweeteners and low-calorie sweeteners
  - Neotame
  - Acesulfame-K
  - Aspartame
  - Sucralose
  - Advantame
  - Stevia
- Potentially benefit metabolic parameters
- Adversely altering feelings of hunger and fullness

Micronutrients

- Benefits of multivitamins or mineral supplements on glycemia not supported by evidence
- Routine use not recommended
- Annual assessment of vitamin B12 status in patients on Metformin; Supplement only if deficient

Vitamins and Micronutrients(CONT.)

- Populations that may benefit from a multivitamin/mineral supplement include :
- The elderly,
- Pregnant or lactating women,
- Strict vegetarians,
- Individuals with digestive and absorptive abnormalities,
- And people on caloric restriction for weight loss purposes.

Eating patterns

- Combinations of different foods or food groups acceptable
- Reducing overall carbohydrate intake demonstrated the most evidence
- Most robust evidence Mediterranean-style, low-fat, or low carbohydrate eating plans

Mediterranean-style

Foods	Evidences
Plant-based (vegetables, beans, nuts and seeds, fruits, and whole intact grains)	Reduced risk of diabetes
Olive oil as the principal source of dietary fat	A1C reduction
Fish and other seafood	Lowered triglycerides
Dairy products (mainly yogurt and cheese) in low to moderate amounts	Reduced risk of major CV event
Typically fewer than 4 eggs/week	
Red meat in low frequency and amounts	
Concentrated sugars or honey rarely	
Wine in low to moderate amounts	

Diabetes with CVD

- Replacing saturated fat with unsaturated fats (monosaturated)
- Consume less than 2,300 mg/day of sodium
- Recommendation to eat a serving of fish (particularly fatty fish) at least two times per week

Intermittent fasting

- Consuming all daily calories in set hours during the day

- Variety of approaches
  - ➢including restricting food intake for 18 to 20 h per day
  - ➢alternate day fasting
  - ➢severe calorie restriction for up to 8 consecutive days or longer

- Definite weight loss but without conclusive evidences of Hba1c reduction

Problems with Keto-diet

- Not suitable for some patients with T2DM
  - ➢ Pregnant or lactating
  - ➢ With or at risk for eating disorders
  - ➢ With renal disease
  - ➢ On SGLT2 inhibitors
- Sustainability

Short Report: Metabolism

The glycaemic benefits of a very-low-carbohydrate ketogenic diet in adults with Type 1 diabetes mellitus may be opposed by increased hypoglycaemia risk and dyslipidaemia

Vegetarian or vegan

Plant-based vegetarian eating devoid of all flesh foods	Reduced risk of diabetes
Can include egg (ovo) and/or dairy (lacto) products	HbA1c reduction
	Weight loss
	Lowered LDL-C and non–HDL-C

9.5 Is alcohol intake allowed?

Avoid alcohol intake. Advise caution as alcohol may cause hypoglycemia in those taking sulfonylureas or insulin, especially when taken without food.

MNT and anti-hyperglycemic therapy

- In T1DM, intensive insulin therapy using the carbohydrate counting approach can result in improved glycemia
- Consistent carbohydrate intake with respect to time and amount
- Insulin dosing should not be based solely on carbohydrate counting specially during a mixed meal (high fat/protein)

Gastroparesis

- Selection of small-particle-size foods may improve symptoms of diabetes related gastroparesis
- Correcting hyperglycemia is one strategy for the management of gastroparesis, as acute hyperglycemia delays gastric emptying

DIETARY EDUCATION TO YOUR PATIENT

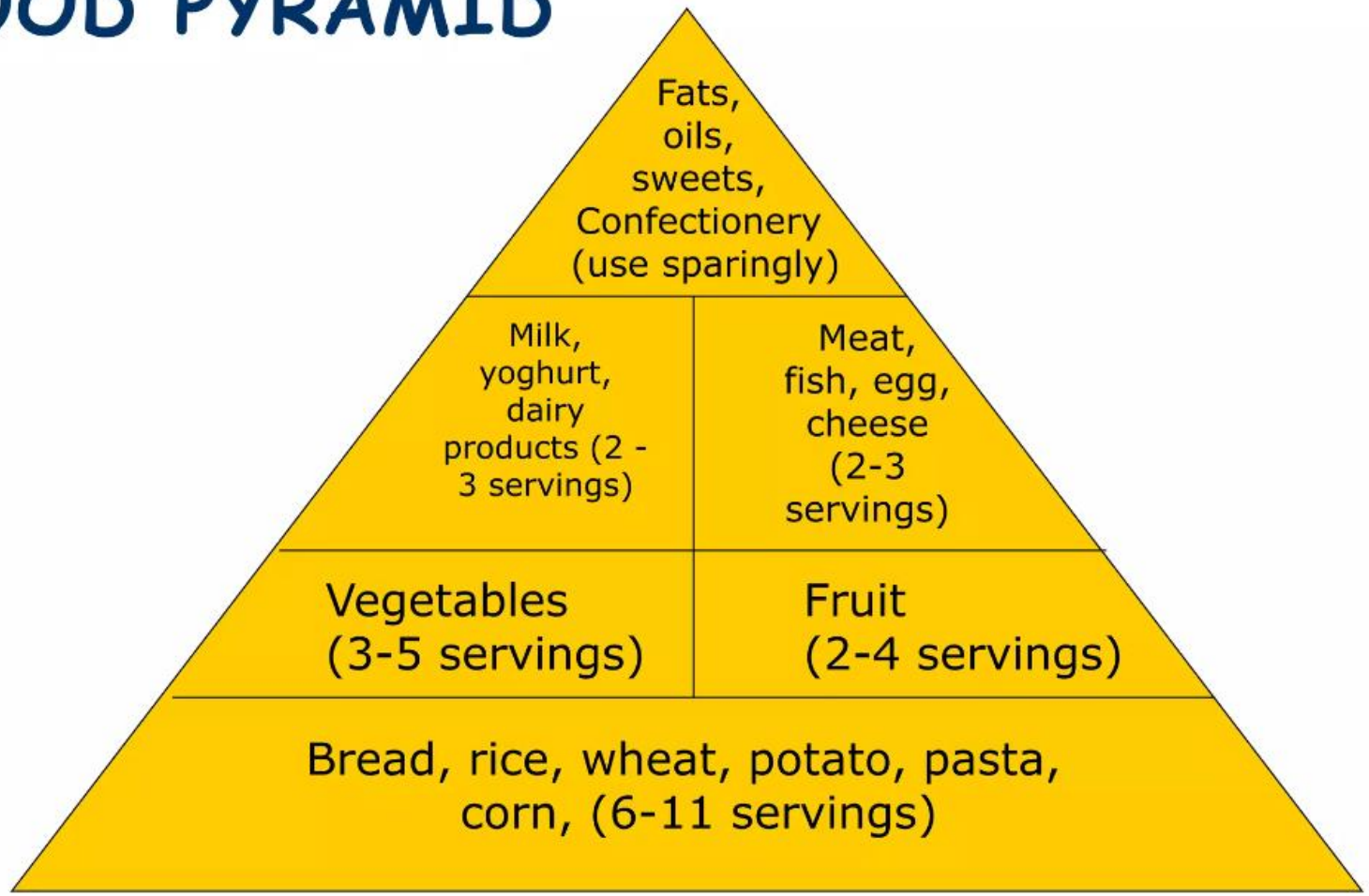
Before deciding a meal planning one must think

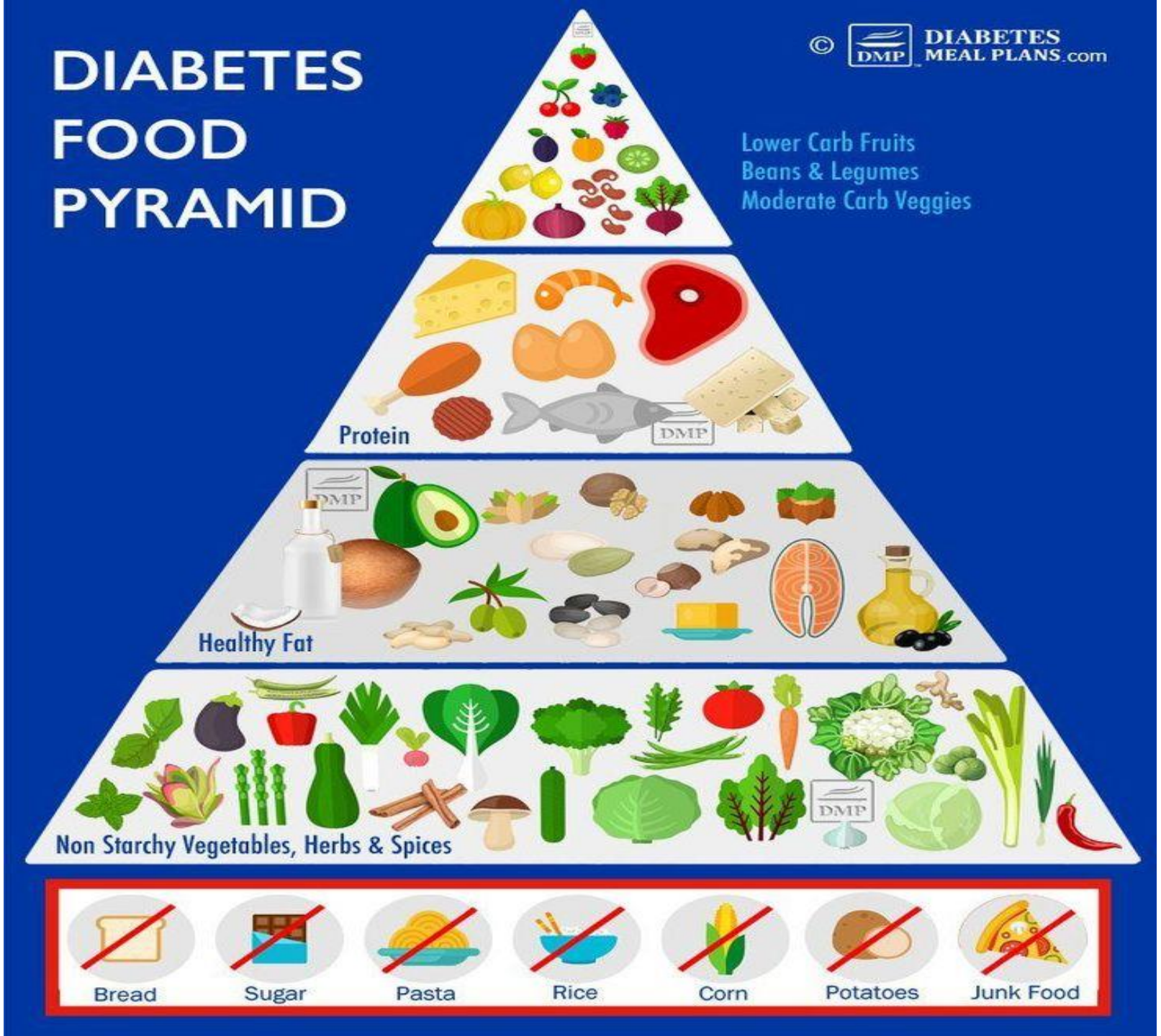
- The persons diabetes, there background, and preference.
- Current clinical, psychological and dietary status.
- Appropriate clinical and nutritional goal.
- Life style factors
- Emphasis on maintaining discipline to follow diet chart

BASIC TOOLS OF DIETARY EDUCATION

- Awareness of healthy life
- The food pyramid
- The signal system (healthy food choice)
- The Zimbabwe hand jive
- The plate model
- Food exchange system
- Carbohydrate counting
- Glycaemic index

FOOD PYRAMID




DIABETES FOOD PYRAMID
© DMP DIABETES MEAL PLANS.com
Lower Carb Fruits
Beans & Legumes
Moderate Carb Veggies
Protein
Healthy Fat
Non Starchy Vegetables, Herbs & Spices
Bread
Sugar
Pasta
Rice
Corn
Potatoes
Junk Food

SIGNAL SYSTEM

The signal system is based on a traffic lights concept:

Red foods (to be taken in small amounts)

- those rich in fat
- sugars (refined carbohydrate)
- high glycaemic index foods
- low fibre content

Yellow foods (to be taken in moderation)

MODERATE glycaemic index foods

- low fibre content
- Moderate amount of fat

SIGNAL SYSTEM

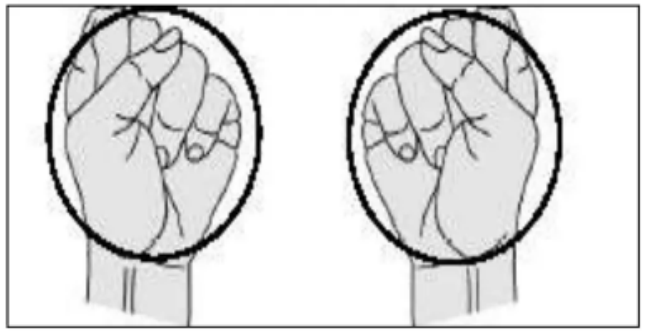
Green foods (healthy choice)

- low glycaemic index
- high fibre content
- low in fat

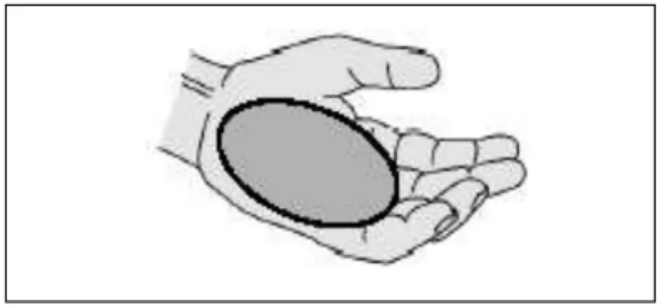
HEALTHY VERSUS UNHEALTHY FOOD CHOICES?

Food groups	Green zone	Yellow zone	Red zone
Rice	Steamed rice	Pulao	Fried rice/biryani
Bread	Whole wheat bread	White bread	cakes
Noodles	Steamed noodles		Deep fried noodles
Indian breads	Chappati	Naan	Butter naan/ puri
Potatoes	Baked potato		French fries
Vegetables	Steamed vegetable	Sauteed vegetable	Deep fried vegetable
Salad	Green salad		Salad with mayonnaise
Sauce	Tomato based		Cream based
Fish	Steamed fish	Fish curry	Fried fish
Chicken	Grilled chicken	Pan fried	Butter chicken

ZIMBABWE HAND JIVE

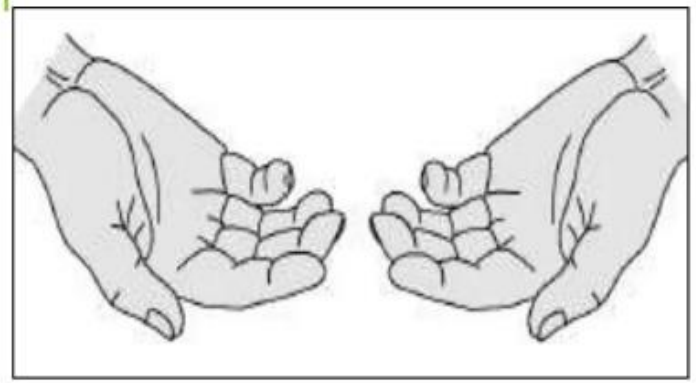


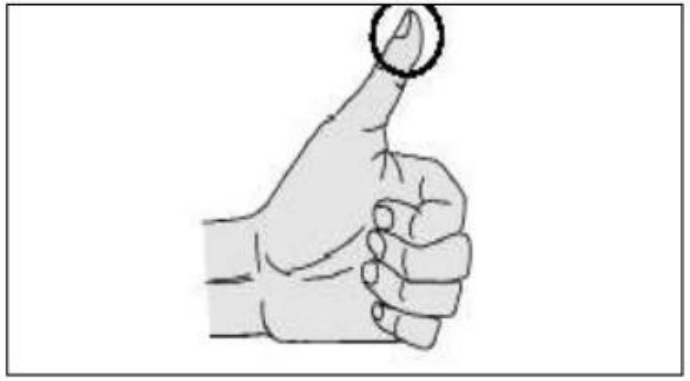
Carbohydrates (starch and fruit): choose an amount equivalent to the size of two fists. For fruit use one fist.



Protein: choose an amount equivalent to the size of the palm of your hand and the thickness of your little finger

ZIMBABWE HAND JIVE

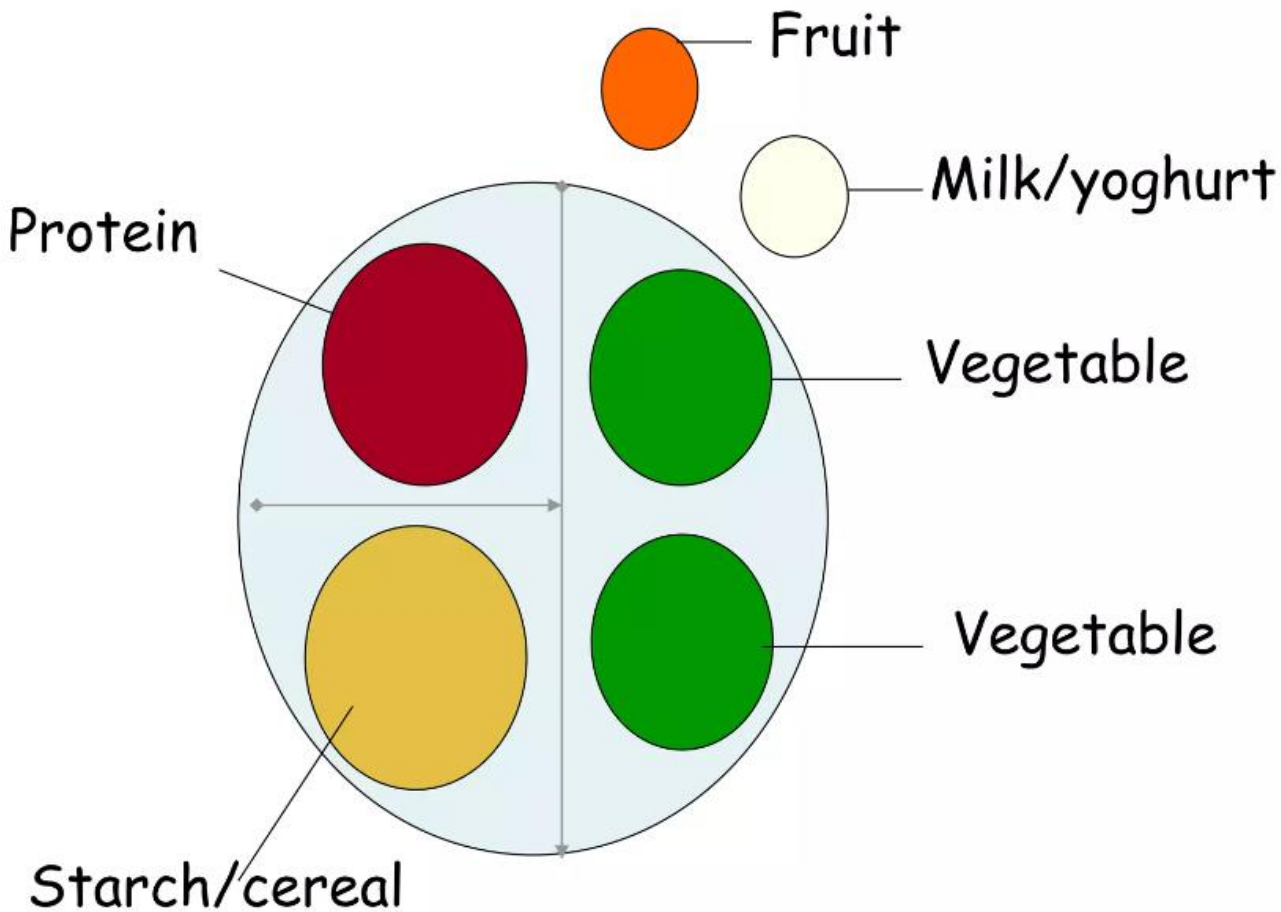




Vegetables: choose as much as you can hold in both hands. These should be low carbohydrate vegetables – green or yellow beans, cabbage or lettuce.

Fat: limit fat to an amount the size of the tip of your thumb. Drink no more than 250 ml of low-fat milk with a meal

PLATE MODEL


Fruit
Milk/yoghurt
Protein
Vegetable
Vegetable
Starch/cereal

ADVANCED EDUCATION TOOLS

- Food exchanges
- Carbohydrate counting
- Glycaemic index and load

FOOD EXCHANGES

- Carbohydrate exchange
- Cereal and pulse exchange
- Fat/oil exchange
- Protein exchange
- Milk exchange
- Fruit exchange
- Vegetable exchange

FOOD EXCHANGES

- Similar food types placed in exchange groups
- Within groups, a single food based on weight/measure/size has the same carbohydrate or kcal value as another and can be interchanged
- In the case of cereal exchanges: 1 slice of bread can be exchanged for 1/3 cup rice
- Foods from different groups cannot be interchanged

CARBOHYDRATE COUNTING

- Carbohydrate counting means carbohydrate content of a particular food.
- Carbohydrate is measuring in grams.
- One carbohydrate serving equals to 15 gm carbohydrate.
- Carbohydrate counting helps to determine the amount of carbohydrate in a different food, so that the foods can be interchanged accordingly.

MEAL PLAN

- 3 major meals
- 2- 3 snacks

Timing and amount of food will depend on type of diabetes, type of medication, insulin and life style

ESTIMATION OF DAILY CALORIE REQUIREMENT

- Daily calorie requirement *(DCR)* Kcal = kcal required/kg body wt x *DBW*
- Desirable body weight *(DBW)* kg = height (cm) – 100 (*DBW* can also obtained by height and weight chart)
- DCR should be increased in increased physical activity, pregnancy and lactation

ESTIMATION OF DAILY CALORIE REQUIREMENT

- DCR should be reduced in patients with sedentary life style and those who are obese and elderly (200 – 500 kcal).
- If underweight add 300-500 extra cal, if overweight reduce 300-500 cal from daily requirement

CONT..

Most men & physically active women

30-35 kcal required/ kg body wt

Most women, sedentary men & adults >55 age

28 kcal required/ kg body wt

Sedentary women, obese adults & sedentary adults >55 age

20 kcal required/ kg body wt