Energy Requirement in Man

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- **Energy is not a nutrient but is required in the body for metabolic processes, physiological functions, muscular activity, heat production, growth and synthesis of new tissues. It is released from food components by oxidation.**

- **They are not increased to cover the needs of most members of the group or population, as this level of intake would lead to overweight or obesity in most people.**

- **There are differences between the actual energy requirements needed to maintain current body size and level of physical activity and the desirable energy requirements needed to maintain body size and levels of physical activity consistent with good health.**

- **Desirable energy requirements may be lower than actual requirements for people who are overweight or obese.**

- **Desirable requirements may be higher than actual for inactive people.**

- **For people who are both overweight/obese and physically inactive, the difference between actual and desirable will depend on the balance between degree of overweight and level of inactivity.**

- **They can be applied carefully to individuals, using estimates of energy expenditure. However, predictive estimates are much less accurate for individuals than for groups, and variations in energy expenditure can be large, even between apparently similar individuals.**

- **There is wide inter-individual variation in the behavioral, physiologic and metabolic components of energy needs.**

- **The average energy intake recommended for a defined group cannot be applied to other groups or individuals who differ from the defined group average in gender, age, body size, activity level and possibly other factors.**

Estimating daily energy needs:

To maintain a healthy weight, energy intake should equal energy expended .

Because of sedentary life style, some may need less energy than standard energy requirement, in contrast, the serious competitive athletes energy intake must support their training and competitive schedule, patients who are acutely ill and hospitalized or adapting to chronic disorders may require energy intake levels specifically calculated to meet their changing physiological needs.

ENERGY IN TAKE

The total overall energy balance within the body depends on the energy intake in relation to energy output.

The main source of energy for all body work is food, backup by stored energy in body tissues.

Sources of Food Energy

The three energy nutrients in food keep our bodies supplied with fuel.

Carbohydrates ,Protein ,Fat

Sources of Stored Energy

When food is not available ,as during sleep, or longer periods of fasting or extreme stress of starvation , the body draws from Its(3)stores of energy.

1- Glycogen

A 12to 48-hour reserve of glycogen exists in liver and muscles and quickly depleted if not replenished by daily food intake .

For example, glycogen stores maintain normal blood-glucose levels for body functions during sleep hours ,our first meal , breakfast , has a significant function for energy intake.

2-Adipose tissue

Although fat storage is larger than glycogen , the supply varies from person to person , and the balanced amount needs to maintained as an added resource.

3-Muscle mass

Energy stored as protein exist in limited amounts in muscle mass, but this lean mass must be maintained for health.

Only during longer periods of fasting or starvation dose the body turn to these tissues for energy.

Factors Influencing Energy Requirement

1. **Physical activity**
2. **Age and sex**
3. **Body composition [height and weight]**
4. **Climate**

Also conditions like growth during pregnancy, childhood and lactation all affect the total energy need.

Components of Total Energy Expenditure [need]

1. Basal metabolic need
2. Physical activity
3. Thermic effect of food

BASAL METABOLISM

Represent the amount of energy required to maintain life-sustaining activities [breathing , circulation, heartbeat, & secretion of hormones], for specific period of time.

Basal Metabolic Rate [BMR]

Is the rate at which the body spends energy to keep all these life –supporting processes going.

BMR is measured in the morning upon a wakening before any physical activity, and 12-18 hours after last meal.

BMR also called resting energy expenditure (REE).

its accounts approximately(60-75%) of our total energy need.

BMR for man = 1×body weight ×24 hours

BMR for woman= 0.9×body weight ×24 hours

During sleep the BMR usually decrease by 10%.

Factors affecting BMR

- Body weight affects BMR
- Decrease in BMR with increase in age
  - BMR $\propto \frac{1}{Age}$
- BMR → men vs. women
- Energy requirements increase with activity
  - Sedentary vs. Rigorous activity

Several factors affecting BMR including:

1-age
2- body size
3-sex
4-body temperature
5-fasting / starvation
6- stress
7- menstruation
8-thyroid function.

Factors affecting BMR

- 1. Age
- 2. Sex
- 3. Climate temperature
- 4. Exercise / Activity
- 5. Fever
- 6. Thyroid hormones
- 7. Barometric pressure
- 8. Racial variation
- 9. Body surface area
- 10. State of nutrition
- 11. Drugs
- 12. Pregnancy

What is the importance of BMR?

BMR varies with amount of lean tissue in the body; higherlevels of lean body mass increase BMR, men have higher BMR thanwomen, because of larger bodysize and more lean tissues in the body.

The BMR slow after the age of 35 because of decreases in the lean body tissues associated with aging. BMR also depends on the thyroid function.

BMR, also varies with the menstrual cycle, it increases 7.7% in the post ovulatory period and drops in early stage of pregnancy and lactation .

Fever increases heat production approximately 13% of BMR for each 1ċ rise in body temperature .

Physical Activity

The second largest component of energy expenditure after BMR.

It demands about 20-30% of our total energy needs, of all the components, it varies the most among people.

The amount of energy we expend depends on the intensity and duration of the activity.

Level of activity	% of BMR
SEDENTARY	20%
LIGHT	30%
MODERATE	40%
VIGOROUS	50%

Examples of occupations for each physical activity level

PAL	Typical occupation
Light	People working in offices, students, and unemployed
Moderate	Shop assistants, domestic servants, housewives, drivers
Heavy	Farmers, builders, laborers.

Thermic Effect of Food: it is the energy required by our body to digest, absorb, metabolize and store food.

When we eat our body's cells increase their activities, this increase in cellular activity is the **Thermic effect of food [TEF] or diet induced thermo- genesis.**

TEF is determined primarily by the amount

and composition of the food consumed, mainly owing to the metabolic costs incurred in handling and storing ingested nutrients

Thermic Effect of Food

(per 100 kcals consumed of each macronutrient)

Protein

20-30 Calories

Carbohydrates

5-10 Calories

Dietary Fat

0-3 calories

The TEF is relatively small, accounting approximately 7-10% of a person total energy needs.

In case of protein, TEF is [20-30%], while for CHO is [5-10%] and for fat is[0- 5%]of the energy value of the food ingested.

For a mixed diet, the TEF is estimated to be [6-10%]of the calories needed for basal metabolism and activity.

TEF = 6% BMR

Thermic Effect of Food

- Increased energy expenditure after a meal
- Calories are burned to provide the energy needed to digest and absorb nutrients
- An ingested meal of 800 calories burns 40 to 80 kcalories

Total Energy Need=

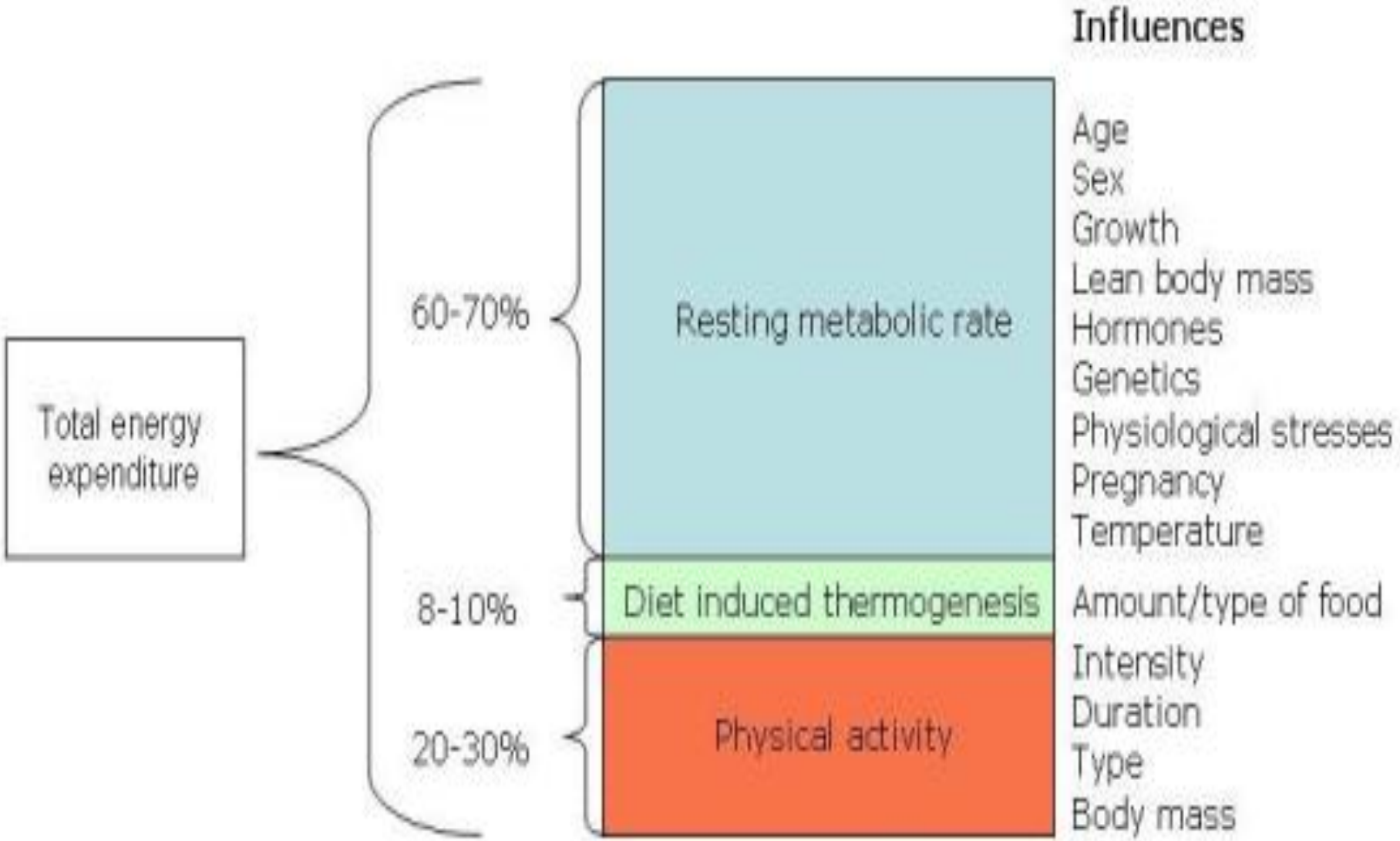
[BMR-10%for sleep] +TEF+ Physical activity

Total Energy expenditure (TEE)=

OR TOTAL ENERGY NEED OR REQIUREMENT=

[BMR-10%for sleep] +TEF+ Physical activity

Important note : If the total energy need is calculated for pregnant woman
The following points be notice .
If she is in 1st trimester ,her TEE will be like any other woman
But during 2nd and 3rd trimester , we added 300 Kcal to the calculated TEE
While during lactation and the woman is breast feeding, we added 500 Kcal to her TEN


Influences
Total energy expenditure
60-70%
Resting metabolic rate
Age
Sex
Growth
Lean body mass
Hormones
Genetics
Physiological stresses
Pregnancy
Temperature
8-10%
Diet induced thermogenesis
Amount/type of food
20-30%
Physical activity
Intensity
Duration
Type
Body mass

THE ENERGY BALANCE EQUATION
(Calories In vs Calories Out)

The Energy balance equation will dictate whether you lose, maintain or gain weight.

Energy balance includes a number of components that affect calories in (energy intake) vs calories out (energy expenditure)

Energy balance Is dynamic! Altering something on one side of the equation can affect factors on both sides of the equation.

CALORIES IN

Carbohydrates, Fats, Protein & Alcohol
(from consumed food and beverages)

Calorie intake is influenced by...

- **Appetite (hormones)**
- **Environment**
- **Palatability/Reward**
- **Psychology & Habits**

CALORIES OUT

Total Daily Energy Expenditure

Components of TDEE...

- **Basal Metabolic Rate**
- **Thermic Effect of Food**
- **Exercise Activity Thermogenesis**
- **Non-Exercise Activity Thermogenesis (NEAT)**

A man, his weight is 75kg, he is a teacher. [light physical activity]

Calculate his total energy need and his daily need of CHO, protein and fat.

BMR =1×body weight×24 hours

BMR=1×75×24= 1800Cal

10% of BMR for sleep=10/100×1800=180Cal

TEF=6% of BMR =6/100×1800=108 Cal

Physical activity =30/100×1800= 540Cal

TER=BMR-10% [for sleep] +TEF+ Physical activity

TER=[1800-180]+ 108+ 540=2268Cal/day

50-60%CHO

50% CHO = 50/100×2268=1134Cal

1gram CHO=4Cal, he need 283.5gram CHO

Protein 15-29%****

If he is older or with any health problem, protein need ,

calculated as | **moderation**

15% from protein=15/100×2268 = 340.2Cal

1gram protein = 4Cal , he need 85g protein

25-30%fat

25%fat= 25/100×2268=567Cal

1g fat=9Cal, he need 63g fat/day

We can divide the need of fat according to its types , 10%sat fat.

Harris-Benedict equation

Energy requirements (kcal/day) = 66.5+13.8 (weight in kg) + 5.0 (height in cm) – 6.8 (age in years).

Energy requirements (kcal/day) = 655.0+9.6 (weight in kg) + 1.8 (height in cm) – 4.7 (age in years).

Factors that determine energy requirement: age, gender, height and weight.

Adaptive Thermogenesis: is the energy used by our bodies to adjust to changing physical and biological environmental situations.

Because the expenditure depends on individualized variables, it is not calculated into average energy requirements.

How do you estimate energy requirement in over-weight?

It is more difficult to predict energy requirements in obese people because of their great variability in body composition.

The one commonly used technique is to use an {adjusted weight}, which is the ideal weight plus [25%] of the difference between the observed and ideal weight.

Adjusted weight

ideal weight+0.25× [observe wt - ideal wt]

Example: 45 years old lady, with DM, her weight now is 95kg, if you know that her ideal weight should be 70kg, with moderate physical activity, calculate her total energy need/day?***CHO,PROTEIN , FAT

Adjusted weight= ideal weight+0.25× [observe wt- ideal wt]

Adjusted weight=70+0.25× [95-70] =76kg

BMR =0.9×76×24=1641.6Cal

For sleep 10% of BMR = 10/100×1641=164.16Cal

TEF=6% OF BMR= 6/100×1641=98Cal

Physical activity [moderate]

=40%of BMR=40/100× 1641 =656Cal

TER= [BMR-10%for sleep] +TEF+ physical activity

TER= [1641-164] +98+656=2231Cal

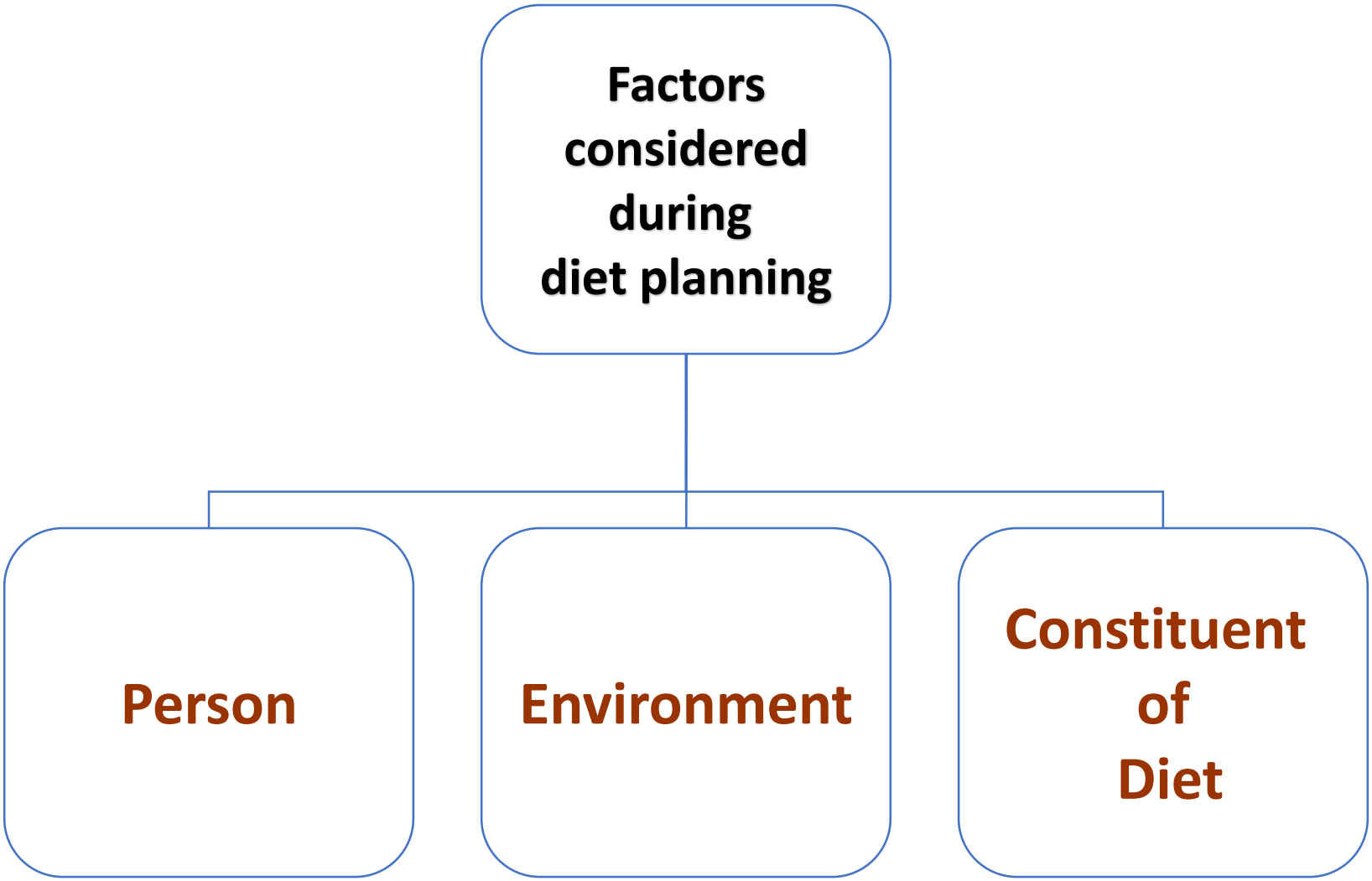
Diet Planning

Planning diets refers to determining what usual nutrient intake should be.

Regardless of whether one is planning diets for individuals or groups, the goal is to have diets that are nutritionally adequate, or conversely, to ensure that the probability of nutrient inadequacy or excess is acceptably low.

It is the determination of the quantity & the quality of diet to be consumed by individual.

Diet Planning



Factors to be considered during diet planning:

A- Factors related to the individuals themselves

- **Age and Sex**
- **Body weight and surface area: which affect the BMR**
- **Physiological conditions: which reflect the need during growth of the children, pregnancy and lactation.**
- **Level of activities.**
- **Pathological conditions**

B-Factors related to the environment:

In hot climate, individuals need less calories and more salts and fluids than in cold ones.

In cold regions more caloric food is required.

C-Factors related to the diet itself: The food should:

-Fulfill the qualitative and quantitative requirements of the individual.

- Be tasty and satisfy the food habits of the individuals.
- Be variable from meal to meal
- Be free from infectious agents and toxins.
- Be digestible and of sufficient size to relieve hunger.

- Its nutrients should be of certain proportion to get best benefit.
- **Examples:**

Less fat intake affects the absorption of fat-soluble vitamins.

-Vitamin C facilitates iron absorption

-vitamin D facilitates calcium absorption.

Diet-Planning Principles

- Six Basic Diet-Planning Principles: ABCDMV planning
- Adequacy
- Balance
- kCalorie (energy) control
- Nutrient Density
- Moderation
- Variety

Diet-Planning Principles....

- **1. Adequacy:** means that the diet should provide sufficient energy and enough of all the nutrients required by the healthy people.
- **2. Balance**: The art of balance means use enough - but not too much - of each type of food while planning a diet.
- e.g. meat, fish and poultry are rich in iron but poor in calcium and dietary fiber; milk and milk products are rich in calcium but poor in iron and dietary fiber.
- Grains, fruits and vegetables are rich in many vitamins, minerals and dietary fiber but low in good quality proteins. Consuming any one food may results in deficiency of a nutrient lacking in that food, but create a balance among all these foods to provide all essential nutrients in your diet.
- ***Balance in the diet helps to ensure adequacy.***

Diet-Planning Principles....

- **3. Kcalorie (Energy) Control**: It is the management of food energy intake. So, it is very important to design an adequate, balanced diet without overeating. For this purpose, the basic rule is to select foods of high nutrient density.
- **4. Nutrient Density:** It is measure of the nutrients a food provides relative to the energy it provides.
- Nutrient density promotes adequacy and kcalorie control. The more the nutrients and the fewer kcalories, the higher is the nutrient density of food.
- Select foods that supply the most nutrients but the least amount of food energy (kcalories).

Diet-Planning Principles….

- **5. Moderation:** is the key for good diet planning and means providing enough but not too much of a nutrient.
- Moderation contributes to adequacy, balance and kcalorie control.
- Although, foods rich in fat sugar provide greater enjoyment and energy, but these provide relatively few nutrients.
- So, eat sparingly foods that are rich in fat and sugar, and select foods that are low in fat and sugar.
- ***Moderation contributes to adequacy, balance, and kcalorie control.***

Diet-Planning Principles....

- **6. Variety:** means eating a wide selection of foods within and among the major food groups.
- A diet may have all the nutrients but may still lack variety, if a person eats same foods day after day.
- One can choose among various fruits, vegetables, meat, poultry, eggs, fish dishes to create variety.
- Select foods form each of the food groups daily and vary choices within each group.

Methods of diet Planning:

Quantitative Method

Qualitative Method.

Methods of diet Planning:

1-Quantitative Method

Determine the daily caloric requirements

2-Qualitative Method

A high-quality diet is the balanced diet which contains a variety of foods that provide energy, amino acids, vitamins, minerals, fats, carbohydrates

A balanced diet is one that fulfills all a person's nutritional needs. Humans need a certain amount of calories and nutrients to stay healthy.

A balanced diet provides all the nutrients a person requires, without going over the recommended daily calorie intake.

A balanced diet could be achieved through:

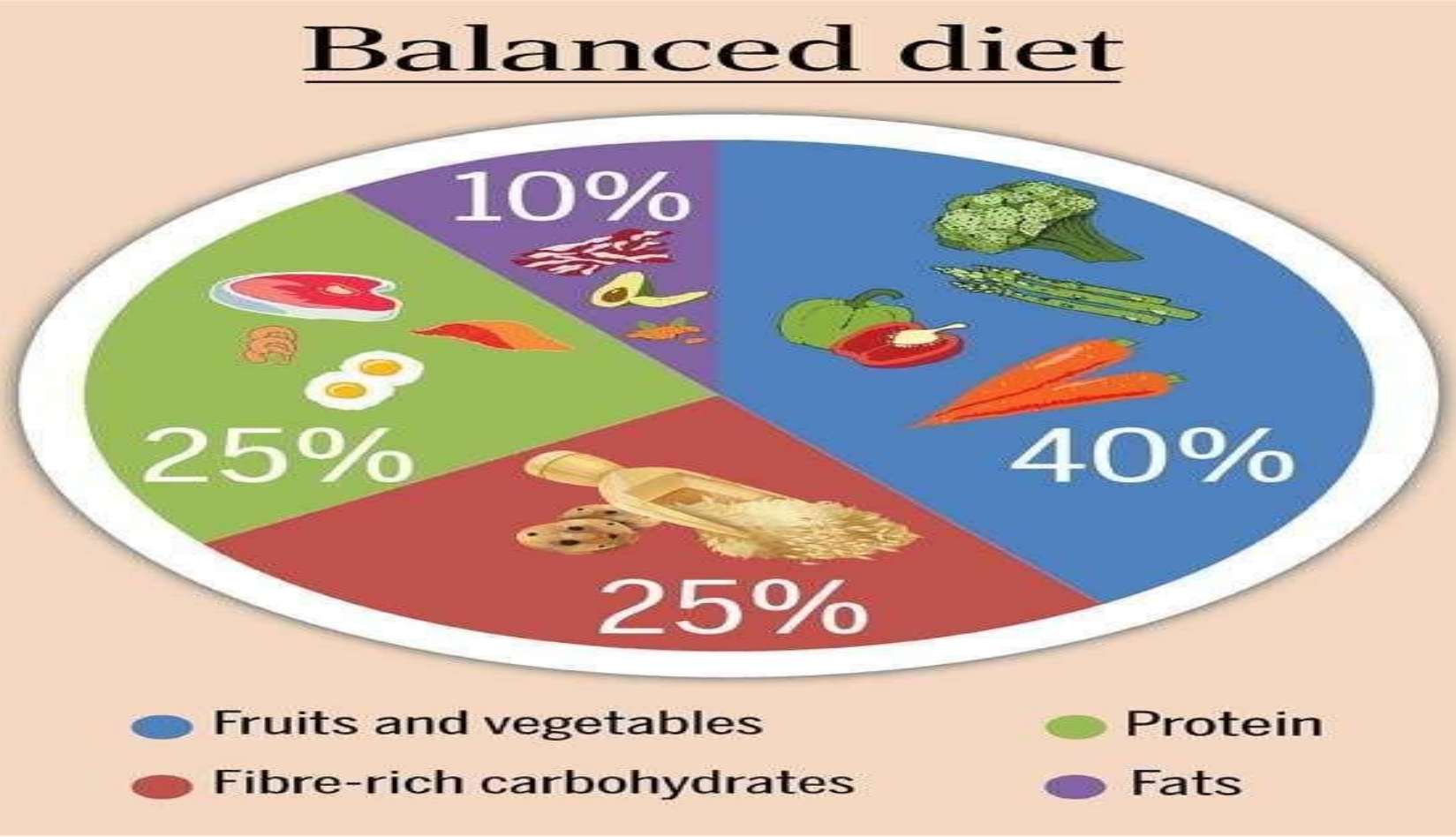
Food groups

1-Bone building group (as milk and milk products)

2-Tissue building group (as meat, poultry, fish, eggs and legumes)

3-Energy group (as foods rich in carbohydrates, fats and oils)

4-Vitality or protective group (vegetables and fruits)



الجداول القادمه للاطلاع فقط

	Meal	Calories	Carbs (g)	Fat (g)	Protein (g)
Day 1					
Breakfast	scrambled egg with bacon and veggies	244	9	16	20
Lunch	chicken fajita salad	425	35	21	29
Snack	pb&j Paleo style	420	27	33	13
Dinner	salmon with coconut cream sauce	400	8	22	43
Total		**1489**	**79**	**92**	**105**
% Calories			**21**	**56**	**28**
Day 2					
Breakfast	sausage stir fry breakfast	237	7	15	21
Lunch	spicy tuna salad	425	35	21	29
Snack	pb&j Paleo style	420	27	33	13
Dinner	chicken & sweet pot with shallots w/ sauteed kale	637	43	36	37
Total		**1719**	**112**	**105**	**100**
% Calories			**26**	**55**	**23**
Day 3					
Breakfast	breakfast smoothie	358	29	28	10
Lunch	chicken & sweet pot with shallots w/ sauteed kale	637	43	36	37
Snack	deli meat & veggies	152	12	0	25
Dinner	pepper steak	367	21	28	23
Total		**1514**	**105**	**92**	**95**
% Calories			**28**	**55**	**25**
Day 4					
Breakfast	western omelet	284	9	19	23
Lunch	pepper steak	367	21	28	23
Snack	paleo trail mix	496	44	33	16
Dinner	spicy breaded pork chops w/ roasted asparagus	472	14	37	16
Total		**1619**	**88**	**117**	**78**
% Calories			**22**	**65**	**19**

	Calories	Protein	Carbs	Fats
Meal 1				
2 Slices Whole Wheat Bread (56g)	138	7	23	2
Natural Peanut Butter (25g)	150	7	3	12
Total	**288**	**14**	**26**	**14**
Meal 2				
Banana (100g)	89	1	23	0
Apple (125g)	65	0	18	0
2 Slices Whole Wheat Bread (56g)	138	7	23	2
Turkey Breast (50g)	65	15	0	1
Total	**357**	**23**	**64**	**3**
Meal 3				
Whole Wheat Pasta (150g)	186	8	40	1
Total	**186**	**8**	**40**	**1**
Meal 4				
Peanuts (30g)	170	8	5	15
Banana (100g)	89	1	23	0
Total	**259**	**9**	**28**	**15**
Meal 5				
Chicken Breast (200g)	330	62	0	8
Brown Rice (100g)	111	3	23	1
Total	**441**	**65**	**23**	**9**
Total	**1531**	**119**	**181**	**42**
Needed	**2000**	**167**	**167**	**74**