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 12-to 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.

The average BMR:

- for adult man is 40 kcal /square meter surface area / hour.

- for adult woman is 37 kcal / square meter surface area/ hour.

For many clinical purposes BSA is a better indicator of metabolic mass than body weight because it is less affected by abnormal adipose mass.

$$BSA\ (m^2) = \left([Height(cm) \times Weight(kg)\ ] / 3600 \right)^{1/2}$$

$$BSA\ (m^2) = \sqrt{H \times W / 3600}$$

It can also be assessed by using body weight, where:

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%.

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.

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, its 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

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

Total Energy Need=

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

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 divided the need of fat according to its types , 10%sat fat.

Simple often- used clinical estimate :

TEE (kcal/d) = 25X weight (kg)

This is adjusted upwards to between 25kcal /kg/day and 40 kcal /kg/ day in stressed patients.

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.

PAL Physical Activity Leve

Calculate the patient's daily estimated energy requirement to maintain weight by multiplying BMR and PAL.

Activity level	Description	man	Woman
Inactive	Assume sitting most of the day with less than 2 hours on their feet	1.4	1.4
Light	Assume some daily exercise – at work or tasks about the house or garden – with at least 2 hours on their feet.	1.5	1.5
Moderate	Assume 6 hours on their feet or regular strenuous exercise	1.78	1.64
Heavy	Those in heavy labouring jobs or serious athletes in training.	2.1	1.82

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

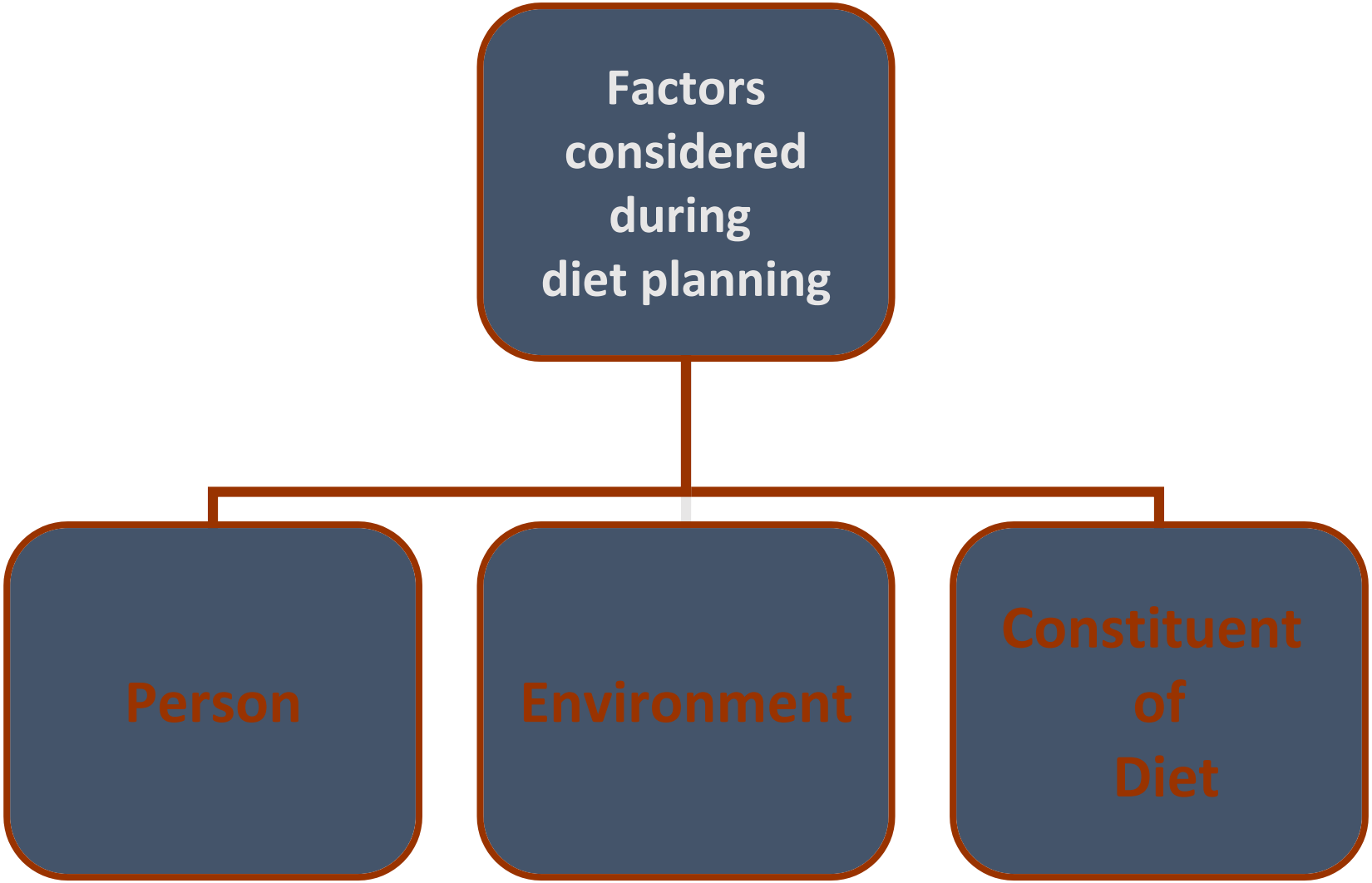
Physical activity [moderate]

=40%of BMR=40/100× 1641 =656Cal

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

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

Diet Planning



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

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**

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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.

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 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)

	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**