Energy imbalance completely deals with weight regulation. In order to understand the concept of weight regulation, it is necessary to understand the meaning of energy balance.

Energy balance therefore is a condition in which caloric value of food intake is particularly equal to the total energy expenditure and the body weight remains stationary.

\[ \text{Energy Input} = \text{Energy Out Put} \]
\[ \text{(Fuel Food)} = \text{(Physical Activity + SDA + Basal)} \]

Energy imbalance, if the amount of caloric (energy) intake through fuel foods remains constant but the energy output is either in excess or less than the energy intake, then the energy balance is not maintained.

If there is differences between the calorie intake or consumption and energy expenditure is called energy imbalance.
Energy Imbalance
1) Positive Energy Balance
2) Negative Energy Balance

Positive Energy Balance:
Is a condition in which high amount of energy intake and low energy expenditure (calorie burn) leads to overweight / Obesity
   Increasing energy consumption not equal to decreasing energy expenditure.

Negative Energy Balance:
Is a condition in which low amount of energy consumption and high amount of energy expenditure (calorie burn) leads to 'under weight.'
   Increasing energy consumption not equal to increasing energy expenditure.

OBESITY
One in every two adults in the United States is overweight & the prevalence of obesity is increasing all over the world. According to WHO India is the “3rd” most obese country in the world. 2.8 million People die in a year with overweight or obesity. In 2014 1.9 billion adult of age 18 years suffer with obesity and 42 million children of age group 5 years affected with overweight/obesity. Obesity is a state in which there is a generalised accumulation of fat in adipose tissue in the body leading to more than 20% of the desired weight. Therefore increasing more than 10% weight of the desired weight is overweight. Increasing more than 20% weight of desired weight is obesity. The fundamental cause of obesity / overweight is an energy imbalance difference between calorie consumed & calorie expenditure i.e., positive energy balance. Obesity invites disability, disease and premature death. The desired & drive to eat food, satiety choice of food, digestibility of the food eaten & its adsorption in the body, metabolism of nutrients and the metabolic rate, drive & ability to exercise are the factors that determine body weight.

ASSESSMENT
1. Visual inspection: deposition of fat on certain parts of the body giving it a particular shape, resembling “apple” or a “pear”
   Weight gain in the area of & above the waist (apple type) is more harmful than weight gain around the hips & flank area (pear type). Fat cells in the upper body have different qualities than those found in hips & thighs.

2. Anthropometric measurement:
   (a) BMI/ QUETLET INDEX is accepted as a better estimation of body fatness & health risk than body weight.
   \[ BMI = \frac{\text{weight in kg}}{\text{height in (meter)}^2} \]
   By calculating the person's BMI using above formula, identifying the range of person by comparing with the standard BMI classification.

   \[
   \begin{align*}
   \text{<18.5} & \quad \text{under weight} \\
   18.5-24.9 & \quad \text{normal (desired range)} \\
   25-29.9 & \quad \text{over weight} \\
   30-34.9 & \quad \text{grade 1 obesity} \\
   35-39.9 & \quad \text{grade 2 obesity} \\
   \text{>40} & \quad \text{grade 3 obesity}
   \end{align*}
   \]

   Therefore for children Gomez classification is used to know the nutritional status.

Percent of reference weight for age = \( \frac{\text{wt of patient}}{\text{weight of normal child of same age}} \times 100 \)

(b) Broka's index: measurement is easy to calculate & accurate.
   \[ \text{Height (cm)} - 100 = \text{IBW (kg)} \]

(c) Waist circumference: measuring abdominal fat before 7 after weight loss treatment
   High risk waist circumference:
   \[
   \begin{align*}
   \text{Men} & > 40" (>102 \text{ cm}) \\
   \text{Women} & > 35" (88 \text{ cm})
   \end{align*}
   \]

(d) Waist hip ratio: identify the distribution of fat in the upper part or the lower part of the body
The normal ratio waist/hip = 0.7
Women > 0.85 greater risk.
Men > 1.0 greater risk.

(e) Measurement of body fat: body composition analysers are used to measure the body fat percentage.
   Normal range for male = 12-20%
   Female = 20-30%

Skin fold measurement can be taken to measure body fat. Triceps, biceps, subsacapular, superiliac. A combination of skinfold (four skin fold) are particularly advisable for individuals who are undergoing pronounced weight gain.

(f) Skin fold thickness:

Metabolic changes:
Metabolic changes commonly present in obese patient
Glucose tolerance decreases
Sensitivity to insulin decreases
Plasma insulin increases

Response to starvation:
Production of ketone bodies decreases
Plasma free fatty acids increases
Plasma triglycerides increases
Plasma cholesterol increases
Plasma uric acid increases

Urinary 17-hydroxy corticoids increases
Sensitivity to growth hormone decrease

Treatment:
1. Diet therapy
2. Physical exercise
3. Stress management
4. Pharmaco therapy
5. Weight loss surgery

Diet therapy: the initial goal of weight loss therapy is to reduce body weight. The person should be put in negative energy balance, ideally 500-1000 calories less than RDA

DIETARY PRINCIPLE:
Low calorie, normal protein, vitamin and mineral (except Na+), restricted CHO, restricted fat and liberal fluid, high fiber diet

Energy: 20 k.cal / kg bdwt (sedentary)
   25 kcal/kg bdwt (moderate)

Protein: 0.8 - 1 g / kg

Fat: avoid transfats and include MUFA : PUFA : SA  1:2:1/2

Vitamin: vit A & D are supplemented.

Minerals: restricted sodium as common salt is helpful in weight reducing diet as excess Na+ predisposes to retention of fluid. Ca+ may depress certain hormones which consequently improves the body's ability to breakdown fat in cells & slow fat production.

Fluids: fluids can take liberally. A glass of water before males helps to cut down food intake.

Fibre: inclusion of high fibre foods in diet help for obese
1. Low in calorie density.
2. Foods like green provides many vit & min
3. Give satiety
4. Hip in regulating bowel movement.
5. Reduce blood cholesterol.
6. Promote chewing & decreases rate of ingestion

Higher intake of fiber automatically cut down fat & calorie (British nutrition foundation 1990)

Dietary guidelines:
- Modification of normal diet is the best way of planning good reduction diet.
- The diet should be adequate in all other nutrient except calories ,the diet should consist of all the five food groups.
- Low glycaemic index foods may benefit weight control in two ways
  1) by promoting satiety
  2) by promoting fat oxidation

At the expense of carbohydrate oxidation
- Mixed meals with low Gls induce greater cholecystol kinin secretion & greater satiety.
- When high Gl foods are consumed rise in glucose & insulin concentration increase carbohydrate oxidation through rate limiting enzymes , for example ,malonyl – co A ,an intermediate of glucose oxidation, strongly inhibits fatty acids's transport into mitochondria resulting in decreased fatty acids's oxidation which is linked with greater weight gain.
- The diet should be rich in fiber ,males should contain salads, sprouted legumes.
- The diet should be low in fat (saturated & trans fatty acid should be avoided.)
- The diet should be low in sugar , concentrated sweets, sweet preparations strictly avoided.
- Plenty of colourful fruits & vegetables should be included in the diet.
- Water can be consumed in unlimited quantity.
- Food giving empty calories should be avoided.
- Generally foods taken outside the home is rich in calories.
- Reduce serving sizes , portion size & use of small utensils.
- method of cooking should be modified- boiling, poaching,steaming,pressure cooking & simmering.

1) Restricted / avoided foods:
High fat foods: pizza, Chips, French fries, deep fry foods, concentrated sweetened foods: sugar syrups, chocolate, cakes, pastries, sweets, condensed milk.
Whole milk, cream, high fat butter, high fat fried foods, fatty fish , fatty muscle of chicken, mutton & other.
- Fruit juices, carbohydrate & sweetened beverages
- Alcoholic beverages
- Processed & preserved
- Repeated cooking oil

2) Physical exercise:
A low calorie diet accompanied by moderate exercise will be effective in causing weight loss. Aerobic exercise directly increases the daily energy expenditure & is particularly useful for long term weight maintenance. Include poicycleing, swimming, jogging, and walking (best) for weight reduction. Physical activity in overweight & obese adults increases cardio respiratory fitness independent of weight loss. At least 30- 45 min is recommended for weight reduction.

3) Stress management:
Stress is a major reason for over eating and relapse. Subject should reduce stress related overeating by learning how to implement methods other than eating to deal with or reduce stress. Stress can affect muscles, tissues, blood vessels and organs. It seeps up heart rate & respiration, raises blood pressure & body temperature & can interfere with metabolism, appetite, digestion, fertility & sleep; early menopause stress can affect immune system & impair memory. Stress can be reduced by music therapy, dance therapy, aromatherapy, and sleep and other.

4) Pharmacotherapy:
Drug therapy may be used as part of a comprehensive weight loss programme, including diet therapy and physical activity for Patients with a BMI of 30kg/m^2 with no concomitant obesity related risk factor or diseases. Weight loss drugs should never be used without lifestyle modifications.

Drugs: sibutramine.
Orlistat combined with phentermine

5) Behaviour therapy:
Psychological problems involved in overeating need to be understood. Record keeping not only aids in behavioural change; the availability of records helps the provider to make specific suggestions for problem solving.

6) Surgery:
a) In morbidly obese patient surgery remains the only option.
b) Bariatric surgery

1) Laparoscopic surgery is also known as minimally invasive surgery (MIS) /bandaid surgery/ key hole surgery. This techniques telescopic red lens system with video camera (simple clip): used or digital laparoscope by this they make snake incisions 0.5-1.5cms diameters to make surgery.

2) Bariatric surgery: weight loss is achieved by reducing the size of the stomach with gastric band/ through removal of a portion of the stomach (sleeve gastrectomy or biliopancreatic diversion with duodenal switch) / by resisting and re-routing the small intestine to a small stomach pouch. Bariatric surgery is advised in patients with a BMI> 40.

DIET:
Blended high protein, restricted caloric, fluid or soft foods.
1 day: clear fluid, broths, strained and diluted fruit juices, gelatine dessert (very soft)
2 day: blended 46-64 fluid OZ small sips throughout the day and sugar free pureed diet for 2 weeks.

Next cont: high protein, liquid and soft diet
Diet should be high protein , low caloric , restricted fat and restricted high CHO foods.
Ex: protein shakes, soft meats , dairy products( low)
Low caloric fruit juices others.

General information:
Name:
Age: 24 years (adult)
Sex: female
Occupation: lecturer (sedentary)

Anthropometric data:
Height: 5.7” ie 169.78 cms.
Weight: 85 kg
BMI: 29.8 (over weight)
IBW: 69.7

Recommended weight range = 62-70 kg.
= 15 to 23 have to reduce.

ENERGY DEFICIT CALCULATION:
Step: 1
Estimate the recommended individual caloric requirement (k.cal/day) by calculating the "RESTING ENERGY EXPENDITURE"(REE)
REE of adult female=
10x weight (in kg) +6.25 x height[in cm]- 5 x age(year)-161
substitute the weight, ht,age
= 10x 65+6.25 x 169.78-5x 24-161
=650+ 1061.125-120-161
=1711.125-120-161
= 1591.125-161
=1430.125 k.cal

Step: 2
Multiply REE by activity factor (AF)
AF for women 1.5           AF for male   1.6
=REE x AF
So, = 430.125 x 1.5
= 2145.1 estimated total caloric need (k.cal/day)to maintain weight

Step: 3
Subtract 500k.cal/day to obtain adjusted caloric intake required to achieve weight loss.
=2145.1-500
=1645.1 k.cal per day.

<table>
<thead>
<tr>
<th>TIME</th>
<th>MENU</th>
<th>AMOUNTS</th>
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<tbody>
<tr>
<td>6:00</td>
<td>green tea</td>
<td>1 cup (150 ml)</td>
</tr>
<tr>
<td>Early morning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:00</td>
<td>oats idly</td>
<td>3 (medium size)</td>
</tr>
<tr>
<td></td>
<td>Mint chutney</td>
<td>4 tblsp</td>
</tr>
<tr>
<td></td>
<td>Egg white</td>
<td>1</td>
</tr>
<tr>
<td>11:00</td>
<td>fruit guva/pomegranate</td>
<td>70-100g</td>
</tr>
<tr>
<td>1:00</td>
<td>methi stuffed paratha</td>
<td>1 medium size</td>
</tr>
<tr>
<td>Lunch</td>
<td>rice</td>
<td>30 (raw)</td>
</tr>
<tr>
<td></td>
<td>Mixed vegetable curry</td>
<td>1 ½ k (cooked)</td>
</tr>
<tr>
<td></td>
<td>Thin less fat buttermilk</td>
<td>1 glass (250 ml)</td>
</tr>
<tr>
<td>3:00</td>
<td>veg salad/ sprouted legumes</td>
<td>1 k (120g)</td>
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<tr>
<td>Mid afternoon</td>
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<td></td>
</tr>
<tr>
<td>5:00</td>
<td>lemon tea/ green tea/cinomom tea</td>
<td>1 cup</td>
</tr>
<tr>
<td>Snacks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:00</td>
<td>pulka</td>
<td>2 medium size</td>
</tr>
<tr>
<td>Dinner</td>
<td>beans curry</td>
<td>1 k</td>
</tr>
<tr>
<td></td>
<td>Butter milk</td>
<td>1 glass</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

**TIPS:**
- Use low glycimic foods.

Kusuma Neela Bolla et al.
Diet during energy balance,
Indian Journal of Science, 2016, 23(79), 178-184,
www.discoveryjournals.com
- High fibre (soluble) foods like fruits, vegetables, oats and others.
- Add functional foods to reach nutrients.
- Low fat high protein foods should include maintaining normal muscle mass.
- Physical activity is must to burn stored fats and excess calories.