

University of Papua New Guinea
School of Medicine and Health Sciences
Division of Basic Medical Sciences
Discipline of Biochemistry and Molecular Biology

PBL SEMINAR

COURSES AND CONSEQUENCES OF OBESITY – An Overview

What theories are used to explain obesity?

- ❑ Theories about obesity are plentiful, but none is specific to all individuals
- ❑ Obesity may actually be due to a group of metabolic disorders
- ❑ If this is the case, then there may be more than one cause for the development and maintenance of body fat content
- ❑ **Body fat content is primarily metabolic in origin**
- ❑ **Indicating that some individuals may be genetically prone to obesity or extreme thinness**

Why is Obesity different from Overweight?

- ❑ Obesity is sometimes wrongly defined as being very overweight
- ❑ "Overweight": is excess amount of body weight that includes Muscle, Bone, Fat and Water
- ❑ "Obesity": specifically refers to Excess amount of Body Fat
- ❑ Example:
 - Body builders or other athletes with a lot of muscle can be overweight without being obese
- ❑ Excessive accumulation of body Fat is associated with:
 - ❑ Hypertrophy (increase in size) of Adipocytes
 - ❑ Hyperplasia (increase in number) of Adipocytes
- ❑ **Obesity can be said to be Hypertrophy and/or Hyperplasia of Adipocytes**

How is "Ideal" body weight related to obesity and overweight?

- ❑ Obesity has often been assessed by "Desirable" or "Relative" weight
- ❑ **Obesity and Overweight** refer to excess in body weight relative to height
- ❑ This concept was based on estimates of **Ideal Body Weight (IBW)**:
- ❑ Ideal Body Weight (IBW) is:
 - Body weight associated with Lowest Morbidity and Mortality
- ❑ **Relative Weight** is body weight relative to IBW
- ❑ **Using these concepts:**
 - **Obesity was defined as Relative Weight 20% above IBW,**
 - **Overweight is Relative Weight up to 20% above IBW**

What parameter is currently used to assess Obesity and Overweight?

- ❑ Currently, **Body Mass Index (BMI)** is the Clinically useful measure of **Overweight and Obesity**
- ❑ BMI is well correlated with measures of body fat,
- ❑ BMI is defined as Weight in Kilograms divided by Height in Meters squared (**BMI = kg/m^2**)
- ❑ In relation to **IBW**,
 - ❑ Lowest Morbidity and Mortality for both Sexes occur in individuals with **BMI of 22 to 25 kg/m^2**
 - ❑ **Overweight** is usually considered as **BMI of 25 to 30 kg/m^2**
 - ❑ **Obesity** is usually considered as **BMI greater than 30 kg/m^2**

TAKE NOTE:

- ❑ **Relative Weight and BMI** are only rough measures of Overweight and Obesity
- ❑ Information on Percentage of body fat in the body are not provide
- ❑ Example:
 - ❑ A heavily muscled athlete may be overweight with any of these indices but have a very low fat content
 - A technique for assessing body fat is therefore needed to determine whether an individual is obese or simply overweight because of increased muscle mass
- ❑ Usually it is assumed that men with more than 25% body fat and women with more than 30% body fat are obese

How can obesity be measured or assessed?

- ❑ Several methods are available for measuring body fat
- ❑ Two of the most accurate methods are:
 - ❑ Weighing a person underwater
 - ❑ Using an X-ray test called **Dual Energy X-ray Absorptiometry (DEXA)**
- ❑ Both methods are usually used only in research centres with special equipment
- ❑ Skin Fold Thickness is used to assess body fat clinically
- ❑ Skin fold thickness is not an accurate as other sophisticated, but more expensive techniques that can be used to measure total body fat

What are some of the possible causes of obesity?

- ❑ Obesity may occur if Intake of Calories is much greater than Expenditure
- ❑ **Reasons for imbalance between Intake of Calories and Expenditure of Calories may differ from one person to another**
- ❑ Several factors can influence the imbalance
- ❑ Some of these factors include:
 - Environmental and Social
 - Dietary habits, Lifestyle
 - Genetic, Psychological

How can dietary habits and lifestyle influence caloric imbalance causing obesity?

- ❑ Some habits that can influence caloric imbalance include:
 - ❑ Types of food eaten, Quantity of alcohol intake, Smoking habits, Other social habits, Level of physical activity, etc
- ❑ Types of food consumed have more impact on obesity than how much is eaten
- ❑ Dietary Fat appears to be more fattening than Carbohydrate
- ❑ Unlike Carbohydrate and Protein, Dietary Fat is converted more readily to fat deposit in Adipose Tissue, and requires less energy for the conversion
- ❑ Rate of conversion of and deposit of dietary fat in adipose tissue varies among individuals

Why is the rate of Caloric expenditure different among individuals?

- ❑ Resting Metabolic Expenditure (RME, i.e., Amount of Energy Expended while at rest) of an individual accounts for approximately 60 to 77% of Total Energy Expenditure
- ❑ Differences in RME could result in considerable differences in body weight of individuals
- ❑ RME can vary by as much as 20% between individuals of the same sex, age, and body build
- ❑ Differences in RME between individuals may account for approximately 400Kcal of energy expenditure per day
- ❑ Genetic make of individuals may be responsible for differences in their RME
- ❑ Thus, although individuals cannot change their genetic makeup, they can change their Total Energy Expenditure and thus influence their RME by changing their eating habits and levels of activity

How can the Total Energy Expenditure of an individual be changed?

- ❑ Ways of changing Total Energy Expenditure may include:
 - ❑ Choose more nutritious meals that are lower in Fat
 - ❑ Recognize and Control Environmental Cues (like inviting smells) that make one want to eat when not hungry
 - ❑ Increase level of Physically Active
 - ❑ Relate quantity and type of Food Intake and compare with Physical Activity Level (Caloric intake should not greatly exceed expenditure)

What evidence point to the possibility that genetic factors may influence body weight?

- ❑ Obesity tends to run in families, suggesting possible genetic causes
- ❑ Families usually share diet and lifestyle habits that may contribute to obesity
 - Separating these habits from genetic factors are often difficult
- ❑ Scientific evidence show Genes play a part in weigh regulation
- ❑ Examples include the following:
 - ❑ Peptides in Hypothalamus and GIT send signals to increase or decrease hunger, depending on energy stores in the body
 - ❑ Brain and GIT peptides either increase appetite through Alpha-Adrenergic system, or decrease it through the Beta-Adrenergic system
 - ❑ Leptin and Cholecystokinin (CCK) are two regulators of appetite in the brain and GIT respectively

What are some of the actions of Leptin?

- ❑ Leptin is a protein produced in Adipose Tissue
- ❑ Leptin tends to provide homeostatic control of food intake
- ❑ Leptin acts on receptors in the Hypothalamus to:
 - ❑ Counteracts the effects of Neuropeptide-Y (a potent feeding stimulant secreted by cells in GIT and in the Hypothalamus)
 - ❑ Promotes the effects of Alpha-MSH an appetite suppressant, resulting in the inhibition of food intake
- ❑ Mutations in the Gene for Leptin or in its receptor in human are rarely found in obese individuals
- ❑ Recombinant human Leptin is now available, and clinical trials are going on to see if it can reduce obesity in humans as it does in ob/ob mice

How can a malfunctioning Hypothalamus influence dietary habits?

- ❑ Hypothalamus regulates Appetite and Satiety
 - ❑ Satiety is the feeling of satisfaction after eating
 - ❑ Appetite is the pleasant sensation based on previous experience that causes a person to seek food for the purpose of eating
- ❑ Hunger is sensation caused by lack of food, characterized by a dull or acute pain in the stomach
- ❑ A malfunctioning hypothalamus could cause an individual to receive incorrect hunger signals, thus stimulating continued eating, and as a result gain weight
- ❑ Appetite, satiety, and hunger may be incorrectly processed by a malfunctioning hypothalamus

How do Psychological factors influence body weight?

- ❑ Psychological factors may influence eating habits
- ❑ Some individuals eat in response to Negative Emotions such as, Boredom, Sadness, or Anger
- ❑ Some overweight individuals may have Binge eating disorder
- ❑ Binge eating disorder is usually common among severely obese individuals
- ❑ During a Binge-eating episode, people eat large amounts of food and feel that they cannot control how much they are eating
- ❑ Individuals with the most severe Binge eating problems are also likely to have symptoms of depression and low self-esteem
- ❑ They usually have more difficulty losing weight and keeping it off than people without Binge eating problems
- ❑ Obese individuals often face prejudice or discrimination in their Job, at School, and in Social Situations, Feelings of rejection, shame, or depression are common

What are some of the consequences of Obesity?

- ❑ Imbalance of Insulin is a major consequence of Obesity
- ❑ Genetic predisposition, Food Allergies, Eating Habits and Stress may interfere with Carbohydrate utilization, resulting in Glucose Intolerance
- ❑ Excessive consumption of refined Carbohydrates may also contribute to Glucose Intolerance and Obesity
- ❑ Obese individuals burn up sugar less effectively than normal weight individuals

- ❑ Carbohydrates in Obese individuals trigger the release of increasing amounts of Insulin, such that the concentration of Insulin in the blood is high but the Insulin Receptors are blocked (“**Insulin Resistance**”)
- ❑ Insulin Resistance prevents Glucose from entering muscle cells, thus energy cannot be produced, which explains why so some Obese individuals often feels tired
- ❑ Excess Insulin in the blood (Hyperinsulinemia) of Obese individuals can:
 - ❑ Increase salt and water retention
 - ❑ Cause sleep disorders by insulin interference with Neurotransmitters
 - ❑ Production of more LDL by the liver due to insulin stimulation
 - ❑ Interference with Thyroid hormones aggravating low metabolism
 - ❑ Decrease cell wall permeability, which can cause an increase in cell size
 - ❑ Hypoglycemia and hunger
- ❑ Several other serious medical conditions linked to obesity, including:
 - ❑ Type 2 Diabetes Mellitus, Heart Disease, Hypertension, Stroke, Gallstones, Liver disease, Osteoarthritis, Gout, Sleep Apnea in which a person can stop breathing for a short time during sleep,
 - ❑ Obesity is also linked to higher rates of certain types of cancer
 - ❑ Obese men are more likely than non-obese men to die from cancer of the Colon, Rectum, or Prostate
 - ❑ Obese women are more likely than non-obese women to die from cancer of the Gallbladder, Breast, Uterus, Cervix, or Ovaries
 - ❑ Reproductive problems in women – Menstrual Irregularities and Infertility

How does fat deposit affect the shape of the body "Pears" vs. "Apples"?

- ❑ Usually, clinicians are concerned with not only how much fat a person has, but also where the fat is on the body (i.e., ‘Pears’ versus ‘Apples’)
- ❑ Fat is usually deposited in the Hips and Buttocks of women, giving their figures a “**Pear**” shape
- ❑ Fat is usually deposited around the Bellies in men, giving them an “**Apple**” shape
- ❑ After menopause, some women may develop “Apple-shape”

How is the shape (“Apple” or “Pear”) of an individual determined?

- ❑ Calculation of the Waist-to-Hip Ratio (WHR) is the simplest way to determine whether an individual is Apple-shaped or Pear-shaped
- ❑ To determine WHR:
 - ❑ Measure the Waist at its Narrowest Point,
 - ❑ Measure the Hips at the Widest Point
 - ❑ Divide the Waist measurement by the Hip measurement
- ❑ Female with Waist-to-Hip Ratio of more than 0.8 is “Apple” shaped
- ❑ Male with Waist-to-Hip Ratio of more than 1.0 is “Apple” shaped
- ❑ Individuals with Apple shape are at increased health risk because, such fat distribution is indicative of premature coronary heart disease