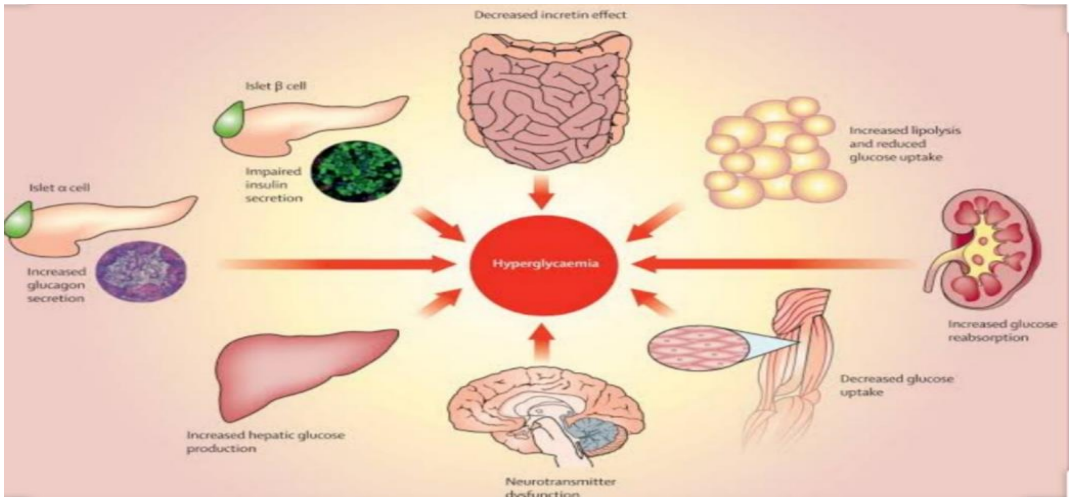

Physical Therapy and Rehabilitation for Internal Medicine and geriatrics

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Introduction

Physical therapy plays an important role with major diseases related to metabolic disorders and provides different techniques in evaluation and management of such disorders.

This book promotes the reflective, critical, objective, and analytical practice of physical therapy applied to internal medicine health problems and geriatrics care. All physical therapy students should possess strong foundational knowledge about vascular, metabolic, geriatrics and internal medicine diseases and be able to apply this knowledge to a variety of patients.

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Overweight and obesity

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health.

Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2).

The WHO definition is:

- a BMI greater than or equal to 25 is overweight
- a BMI greater than or equal to 30 is obesity.

BMI provides the most useful population-level measure of overweight and obesity as it is the same for both sexes and for all ages of adults. However, it should be considered a rough guide because it may not correspond to the same degree of fatness in different individuals.

The latest classification of obesity according to BMI is shown in table (1) by the World Health Organization WHO.

Table (1): Classification of under-and overweight in adults according to BMI

Classification	**BMI (kg /m2)**	**Population description**
Underweight	<18.5	Thin
Normal range	18.5-24.9	Normal, healthy, acceptable weight
Pre obese	25-29.9	Overweight
Obese class 1	30-34.9	Obesity 1
Obese class 2	35-39.9	Obesity 2
Obese class 3	≥40	Obesity 3

(World health Organization, 2010)

Obesity means having too much body fat. It is not the same as being overweight, which means weighing too much. A person may be overweight from extra muscle, bone, or water, as well as from having too much fat.
Both terms mean that a person's weight is higher than what is thought to be healthy for his or her height. **(A.D.A.M. Medical Encyclopedia2012).**

'Obesity' is a clinical term used to describe excess body fat associated with increased risks to health. Being obese can increase the risk of diseases such as type 2 diabetes, cancer and heart disease. Not only does obesity affect people's health, their lives and the lives of their families, but it places a large financial burden and the wider economy**.(U.S. Department of Health and Human Services).**

Health risks of obesity

There is now good evidence to show that obesity is associated with a wide range of health problems, these are summarised below.

Musculoskeletal system

- Raised body weight puts strain on the body's joints, especially the knees, increasing the risk of osteoarthritis (degeneration of cartilage and underlying bone within a joint).
- There is also an increased risk of low back pain.

Circulatory system

- Raised BMI increases the risk of hypertension (high blood pressure), which is itself a risk factor for coronary heart disease and stroke and can contribute to other conditions such as renal failure.
- The risk of coronary heart disease (including heart attacks and heart failure) and stroke are both substantially increased.
- Risks of deep vein thrombosis and pulmonary embolism are also increased.

Metabolic and endocrine systems

- The risk of Type 2 diabetes is substantially raised: it has been estimated that excess body fat underlies almost two-thirds of cases of diabetes in men and three quarters of cases in women. Diabetes currently affects nearly 200 million people worldwide and International Diabetes Federation predict that this will increase to over 330 million by 2025, with a massive burden in developing countries. Worldwide, the number of people with diabetes has tripled since 1985.
- There is a greater risk of dyslipidemia (for example, high total cholesterol or high levels of triglycerides), which also contributes to the risk of circulatory disease by speeding up atherosclerosis (fatty changes to the linings of the arteries).
- Metabolic syndrome is a combination of disorders including high blood glucose, high blood pressure and high cholesterol and triglyceride levels. It is more common in obese individuals and is associated with significant risks of coronary heart disease and Type 2 diabetes.

Cancers

- The risk of several cancers is higher in obese people, including endometrial, breast and colon cancers.

Reproductive and urological problems

- Obesity is associated with greater risk of stress incontinence in women.
- Obese women are at greater risk of menstrual abnormalities, polycystic ovarian syndrome and infertility.
- Obese men are at higher risk of erectile dysfunction.
- Maternal obesity is associated with health risks for both the mother and the child during and after pregnancy.

During and after surgeries

Obese patient at a high risk during and after surgeries and more liable to local or systemic complications

Respiratory problems

- Overweight and obese people are at increased risk of sleep apnoea (interruptions to breathing while asleep) and other respiratory problems such as asthma.

Gastrointestinal and liver disease

Obesity is associated with:

- Increased risk of non-alcoholic fatty liver disease.
- Increased risk of gastro-oesophageal reflux.
- Increased risk of gall stones.

Psychological and social problems

- Overweight and obese people may suffer from stress, low self-esteem, social disadvantage, depression and reduced libido. **(Bray GA,2010).**

In a recent government study, the Centers for Disease Control and Prevention (CDC) estimated that obesity is fast approaching tobacco as the top underlying preventable cause of death in the USA**.(National Center for Health Statistics,2011**)

Childhood obesity is a serious medical condition that affects children and adolescents. It occurs when a child is well above the normal weight for his or her age and height. Childhood obesity is particularly troubling because the extra pounds often start children on the path to health problems that were once confined to adults, such as diabetes, high blood pressure and high cholesterol. Childhood obesity can also lead to poor self-esteem and depression.

One of the best strategies to reduce childhood obesity is to improve the diet and exercise habits of your entire family. Treating and preventing childhood

obesity helps protect the health of your child now and in the future**.(Centers for Disease Control and Prevention,2012).**

Etiology of obesity

Weight gain occurs when you eat more calories than your body uses up. If the food you eat provides more calories than your body needs, the excess is converted to fat. Initially, fat cells increase in size. When they can no longer expand, they increase in number. If you lose weight, the size of the fat cells decreases, but the number of cells does not.

- Obesity, however, has many causes. The reasons for the imbalance between calorie intake and consumption vary by individual. Your age, gender, genes, psychological makeup, and environmental factors all may contribute.
    - Genes: Your genes may play a role in efficiency of metabolism and storage and distribution of body fat.
    - Family lifestyle: Obesity tends to run in families. This is caused both by genes and by shared diet and lifestyle habits. If one of your parents is obese, you have a higher risk of being obese.
    - Emotions: Some people overeat because of depression, hopelessness, anger, boredom, and many other reasons that have nothing to do with hunger. This doesn't mean that overweight and obese people have more emotional problems than other people. It just means that their feelings influence their eating habits, causing them to overeat.
    - Environmental factors: The most important environmental factor is lifestyle. Your eating habits and activity level are partly learned from the people around you. Overeating and sedentary habits (inactivity) are the most important risk factors for obesity.
    - Sex: Men have more muscle than women, on average. Because muscle burns more calories than other types of tissue, men use

more calories than women, even at rest. Thus, women are more likely than men to gain weight with the same calorie intake.
    - Age: People tend to lose muscle and gain fat as they age. Their metabolism also slows somewhat. Both of these lower their calorie requirements.
    - pregnancy: Women tend to weigh an average of 4-6 pounds more after a pregnancy than they did before the pregnancy. This can compound with each pregnancy.
- Certain medical conditions and medications can cause or promote obesity, although these are much less common causes of obesity than overeating and inactivity. Some examples of these are as follows:
    - Cushing syndrome
    - Depression and other psychological factors.
    - Certain medications (examples are steroids, antidepressant, birth control pills)
    - Prader-Willi syndrome
    - Poly cystic overian syndrome
- Obesity can be associated with other eating disorders, such as binge eating or bulimia.
- The distribution of your body fat also plays a role in determining your risk of obesity-related health problems. There are at least two different kinds of body fat. Studies conducted in Scandinavia have shown that excess body fat distributed around the waist ("apple"-shaped figure, intra-abdominal fat) carries more risk than fat distributed on the hips and thighs ("pear"-shaped figure, fat under the skin.**(Galletta,2010).**

Clinical assessment of obesity

Body mass index

A measure called the body mass index (BMI) is used to assess your weight relative to your height. It is defined as weight in kilograms divided by height in meters squared (kg/m^2). It can also be calculated for weight in pounds and height in inches.

Body mass index is closely related to body fat percentage but is much easier to measure. Therefore, it is used by many primary-care providers to identify obesity. The greater your BMI, the higher your risk of developing health problems related to excess weight.

Body fat percentage

Many health professionals agree that percentage of body weight that is fat is a good marker of obesity. Men with more than 25% fat and women with more than 32% fat are considered obese.

Body fat percentage is difficult to measure accurately, however. Special equipment is needed that is not found at most medical offices. The methods used at health clubs and weight-loss programs may not be accurate if not done properly. Inexpensive scales for home use that estimate body fat are now widely available. They may not be entirely accurate, but are generally consistent, so may be used over time to track one's progress.

Waist measurement is also an important factor. People with "apple" shapes, who tend to put on weight around their waist, have a higher risk of obesity-related health problems. This includes women with a waist measurement of greater than 35 inches and men.

Waist circumference

Measuring a person's waist circumference (WC) is the simplest way to assess central obesity. WC has been shown to be one of the most accurate anthropometrical indicators of abdominal fat. It is closely correlated to the waist to hip ratio (WHR), but is thought to be a more reliable measure of abdominal fat; the WHR can mask the status of abdominal obesity with a disproportionately large hip circumference. WC can also be used as a complimentary measurement tool to give additional information on body fat to people within the healthy weight range wanting to build muscle or improve their diet.

Weight-to-height tables

These tables give general ranges of healthy weights and overweight for adult

height. The tables do not take into account individual conditions. For one thing, they do not distinguish fat from muscle, water, or bone. They are much less helpful than body mass index in identifying risk of health problems related to weight.

Skin folds

By using special calipers to measure key areas of subcutaneous fat (e.g., triceps, subscapular, pectoral), body composition can be determined after applying mathematical models with inherent assumptions. This method is limited by the high level of technical expertise required; even with well-trained, experienced technicians, it is still considered among the least reliable measures of body composition.

Bioelectrical impedance

Bioelectrical impedance, an indirect method of determining body composition, relies on disparities in the electrical conductance of different tissues, fat and bone being poor conductors compared with aqueous tissues (e.g., muscle). Again, like all indirect methods, bioelectrical impedance must use mathematical models with inherent assumptions to determine percent body fat rather than biophysical principles.

Some other tests:

-Body density
-total body water
-total body potassium
-blood analysis(thyroid, blood sugar, triglycerides)
-CAT &MRI scanning

Regional Distribution of Fat

A preponderance of adipose tissue distributed in the abdominal region is associated with severe metabolic disturbances and increased morbidity and mortality. This obese condition is referred to by various terms: central, upper body, upper segment, or android obesity. This is in contrast to lower body,

lower segment, or gynoid obesity in which the risks for morbidity and mortality are intermediate to those with normal BMI versus upper body obesity. Therefore, when characterizing obesity, fat distribution is an important parameter to determine overall risk in overweight and obese individuals. Historically, the waist-to-hip ratio is the most studied established measurement of fat distribution. Those with a high ratio were deemed to have upper body obesity. However, as reviewed in the NIH report, it has been determined that waist circumference alone without hip measurement correlates better with biomarkers of health risk (e.g., hyperlipidemia, hyperglycemia, hypertension) and presumably health outcomes (actual disease manifestation and mortality). The waist circumference cut-offs established by the NIH to identify those at increased risk are Men: >102 cm (>40 in.) Women: >88 cm (>35 in.) **(Leonard et al,2011)**.

Management of obesity

Weight gain increases the prevalence of several risk factors for chronic disease and therefore increases morbidity and mortality. Recent studies also have demonstrated that weight cycling is associated with increased health risks. Many epidemiological studies of weight loss have not adequately addressed these issues creating confusion among the public. The evidence regarding sustained weight loss in adults clearly supports the health benefits of intentional weight loss and maintenance. Numerous studies show that weight loss, even if only 5-10%, significantly improves lipoproteins, hypertension, diabetes mellitus (DM) and insulin resistance, risk for osteoarthritis and it's symptoms, risk for selected cancers, and other risk factors for chronic diseases. (**American Diabetes Association ,2012).**

Successful treatment requires intelligent cooperation by both patient and therapist. Failed treatment is probably worse than no treatment, therefore, goals and methods must be agreed and realistic. Treatment of severely obese patient involves a major long term commitment by both parties**.(Leslie et**

al,2010).

The optimal management of overweight and obesity requires a combination of diet, exercise, and behavioral modification. In addition, some patients eventually require pharmacologic therapy or bariatric surgery. The risk of overweight to the subject should be evaluated before beginning any treatment program. Selection of treatment can then be made using a risk-benefit assessment . The choice of therapy is dependent on several factors including the degree of overweight or obesity and patient preference**(National Institutes of Health, National Heart, Lung, and Blood Institute, 2011)**

1-Dietary treatment of obesity

Dietary treatment is fundamental to the management of obesity , but unless the obese person is willing and able to make long term changes in lifestyle (of which diet is the most important aspect) treatment will fail. However, merely going on diet for a finite period (weeks or months) may cause temporary weight loss, but this weight is regained when the diet is abandoned**.** Dietary weight loss programmes should include long term support for maintenance of weight loss. **(Thomas et al,2011).**

Low-Calorie Diets

The major component of dietary therapy for weight loss is generally known as a low-calorie diet, or LCD. The diet calls for 1,000 to 1,200 calories per day for women and 1,200 to 1,600 calories per day for men. In addition, LCDs involve specific changes to nutrients, which both help you to drop body fat but also reduce health issues like high blood pressure and high cholesterol. Total fat in the diet is limited to 30 percent or less of all calories, saturated fat to about 8 percent. Mono- and polyunsaturated fats are increased to 15 and 10 percent, respectively. Approximately 15 percent of your total calories is reserved for protein and 55 percent for carbs. Dietary cholesterol should be kept lower than 300 mg per day, and sodium to no

more than 2.4 g. Moreover, your nutritionist or doctor will want you to get up to 1,500 mg of calcium and up to 30 g of fiber each day.

Very-Low Calorie Diets

Under the strict care of a physician, you may be placed on a very-low calorie diet, or VLCD, which is designed to produce rapid weight loss, as part of a comprehensive plan to treat heart disease or morbid obesity or prepare you for bariatric surgery. VLCDs are extraordinarily difficult to maintain and should never be practiced without a health care provider's oversight. The mechanics involve restricting calories to about 800 calories per day, often using prescription medications and meal replacements over whole foods. They are for short-term use only, but a researcher publishing in the "Obesity" research journal said that with active follow-up, VLCDs "seems to be one of the better treatment modalities related to long-term weight-maintenance success."

Nutrient Mix in VLCDs

VLCDs attempt to make you drop significant weight, quickly, but without risking a negative nitrogen and electrolyte balance that will make you go into starvation mode. By severely decreasing your insulin output, you will first lose a great deal of fluid; then the diet works to make stored fat your body's preferred source of energy. The two nutrient concerns in the diet is keeping carbohydrates at a level that maintains blood sugar, prevents electrolyte loss and spares lean muscle mass while keeping them low enough to induce ketosis. This is around 50 g of carbs. As a point of reference, the Dietary Guidelines for Americans calls for at least 45 percent of healthy people's diets to come from carbs. On 2,000-calorie diet, that's 225 g per day**.(Journal of the American Medical Association,2010)**

2-physical activity and exercise

Physical activity is a useful adjunct to dietary restriction for weight loss and seems to be very important for successful long term maintenance of healthy

weight. Furthermore, inactivity is a primary risk factor for mortality and morbidity and should be targeted in its own right, but the benefits are potentially even greater for obese people, than for normal population**.(Donnelly et al,2010).**

Obesity is a complex malrelationship between energy intake and expenditure that results in a homeostasis that is resistant to change. Obesity clearly has negative health implications that are well documented in consensus literature. Likewise, correction of body weight reduces the incidence and severity of co morbid diseases. A key aspect to this end is a significant amount of physical activity that is appropriately supervised and quantified. The objective of this review was not so much to explore the intricate physiologic details of the treatment of obesity but rather to provide an overview of the preparticipation assessment and practical application of an exercise program for the treatment of obese patients. Many physicians never broach this subject with their patients because of time limitations or comfort-level constraints. This is unfortunate because a physician's recommendations and proper guidance at the point of care are important predictors of patient participation in exercise. **(Haskell et al,2011)**

Resistance exercise has also been examined as a potential intervention strategy for weight control. A review of the literature in this area conducted by Donnelly
et al. did not show any advantages for weight loss compared with other forms of exercise. Unfortunately, few of these studies have examined the long-term impact of resistance exercise on weight loss, which indicates that there is a need for research in this area. However, inthe few long-term studies examining the impact of resistance exercise on weight loss, there appears to be no clear advantage compared with other forms of exercise. For example, in one of the few long-term studies examining the effect of resistance exercise on weight loss, Wadden et al reported no improvement in weight loss across a 40-week intervention period with the inclusion of resistance exercise. Thus, in the absence of energy restriction, it appears that resistance

exercise has a minimal impact on changes in body weight. However, resistance exercise may be important for overweight and obese adults because of the potential improvements in strength, which may have a positive impact on physical function in these individuals.**(Flegal et al,2010).**

Obesity is very difficult to treat without incorporating exercise. Exercise can double the rate that you lose weight, and can set the stage for good habits later on when you need to maintain your weight. Even people who have obesity-related health problems such as joint pain can add exercise to their daily routine. The most obvious role that exercise plays in the treatment of obesity is weight reduction. A 300-lb. person who walks for one hour at a 3 mph pace will burn close to 500 calories. Over the course of a week, if done daily, the exercise will burn 3,500 calories , in other words, a pound of excess weight. Many obese individuals have a difficult time losing a significant amount of weight through calorie-cutting alone. Exercise can make a significant difference. Exercise also can provide you with a sense of well-being, accomplishment, and control over your weight. Many people who struggle with obesity also suffer from high-blood pressure, type 2 diabetes and unhealthy cholesterol levels. Exercise can reduce the severity of these problems, and in some cases, even make them disappear entirely. You will be more likely to build lean muscle mass if you exercise, which can help to increase your metabolism. If you use only diet to address obesity, you risk losing lean muscle mass, which can lead to future weight gain. Walking is one of the best exercises you can do if you are obese. Even low-intensity walking can be effective, according to University of New Mexico professor Byung-Kon Yoon. The reason for the effectiveness of walking is that it is easily accessible, and in the case of obese people, requires greater cardiovascular effort. Other exercises can benefit obese individuals as well, however. Swimming, water aerobics and cycling provide calorie-burning workouts without adding stress to hips, knees and ankles.

Obese patients are more likely to get breast cancer and also have a worse prognosis from the disease. Exercise appears to attenuate the physiologic processes that increase the incidence and mortality from breast cancer. The

feasibility of increasing physical activity in patients with breast cancer has been studied, and the results are encouraging. Exercise has also been shown to decrease all-cause mortality in patients with breast cancer. This could be a reflection of the known benefits of exercise in decreasing cardiovascular mortality. With the current obesity epidemic, it is essential that oncologists discuss the beneficial effects of exercise and weight loss in improving overall survival in patients with breast cancer**.(Natarajan et al,2011).**

Among aerobic options for obese people, the standard exercise--running--might not be a valid option for numerous reasons. Fortunately, there are a variety of other aerobic options available that can yield positive results. As long as exercises are intense enough to raise the heart rate for an appropriate amount of time and are done three to four times per week, you have your choice of exercises.

Walking Walking can provide a tremendous workout for obese individuals. It causes less impact on the knee joints and back than jogging, and is can be an easy way to introduce exercise into your lifestyle. Walking requires no equipment, other than a decent pair of sneakers, and it can be done virtually anywhere, at any time. You also can control the intensity of the workout, based on your ability and current fitness level, by simply going faster or slower.

Cycling Whether you are riding on a stationary bike or going out for a cruise around the neighborhood, bike riding can significantly increase your heart rate while causing no impact on your joints. Stationary bikes provide an variety of workout programs and give feedback, such as heart rate and calories burned, on digital readouts. If you ride a traditional bike, choose a route with interesting scenery or a buddy to ride with. Either way, riding is a fine exercise to challenge your aerobic capacity.

Elliptical Trainer Elliptical trainers, sometimes referred to as cross-trainers, can provide a tremendous aerobic workout. They provide no-impact workouts and incorporate the upper body when you grip the handlebars and

move your arms in unison with your legs. Like other aerobic machines, elliptical trainers provide a variety of workout options, and you can track your progress. One downside to these machines is that if you do not belong to a gym, they can cost hundreds of dollars, depending on their features.

Steppers Cardiovascular-steppers provide intense workouts for those up to the challenge. They tend to be low-impact if performed correctly and can be manipulated to focus on leg strength or cardiovascular fitness, based on how you set the resistance level. Workouts steppers provide can be very intense if you are new to them. Much like elliptical trainers, if you are not a member of a gym, they are expensive, costing as much as a few thousand dollars.

Aerobics Participating in an aerobics class is easy and fun at a gym. Generally, the classes are free to members. There are all types of classes, tailored to all sorts of fitness levels. Low-impact and no-impact classes, Pilates, yoga and many others can challenge the body and the mind and help you reach reach your weight-loss goals**.(Don Rainey et al,2011).**

3-Behavior Therapy

Behavior therapy usually consists of behavior modification directed toward diet and exercise. Behavior modification involves counseling the patient regarding stimulus control, goal setting, cognitive restructuring, self-monitoring, and contracts to reward behavior. As mentioned, it is difficult to separate out studies that are diet only or exercise only versus behavior modification associated with diet and exercise. The studies reporting the use of behavioral therapy usually involved regular ongoing contact with a professional other than a physician. The level of recommendation was grade B .The lower grade of evidence was the result of fewer available RCTs. In addition, in those studies that were available, the comparison groups chosen did not allow a determination of the unique effect of behavioral therapy. Therefore, we were unable to determine the NNT. However, summary of evidence from more recent studies suggests that brief infrequent counseling by physicians (1 to 3 times/year) may be less effective than physician

counseling plus weekly or bimonthly counseling from another para/professional (dietician, nurse counselor, commercial weight loss program**. (Stuart RB,2010)**

Behavioral treatment is an approach used to help individuals develop a set of skills to achieve a healthier weight. It is more than helping people to decide what to change; it is helping them identify how to change. The behavior change process is facilitated through the use of self-monitoring, goal setting, and problem solving. Studies suggest that behavioral treatment produces weight loss of 8–10% during the first 6 mo of treatment. Structured approaches such as meal replacements and food provision have been shown to increase the magnitude of weight loss. Most research on behavioral treatment has been conducted in university-based clinic programs. Although such studies are important, they tell us little about the effectiveness of these approaches in settings outside of specialized clinics. Future research might focus more on determining how these behavioral techniques can be best applied in a real-world setting**.(Foster GD et al,2010).**

In general, comprehensive lifestyle modification programs delivered in person induce a loss of approximately 10% of initial weight in 16–26 weeks of treatment. The use of portion-controlled diets, which typically involve the use of meal replacement products, was associated with significantly larger weight losses in the short term. In contrast, interventions delivered via the Internet induced a loss of approximately 5%. However, web-based programs appear to have potential in facilitating the continuation on patient provider contact, which along with high levels of physical activity, appear to be key strategies for successful long-term weight control. Recent studies also have suggested that the combination of lifestyle modification with long-term use of pharmacotherapy holds promise for maximizing initial weight losses and promoting long-term maintenance**.(Stevens J et al,2012).**

Current practice guidelines for management of overweight and obesity recommend a program of diet, exercise, and behavior therapy for all persons with a body mass index (calculated as kg/m(2)) of at least 30 (and those with

body mass index > or =25 plus two weight-related co morbidities). In this tripartite treatment--often referred to as lifestyle modification--behavior therapy provides a structure that facilitates meeting goals for energy intake and expenditure. Although standard behavior therapy reliably induces mean weight losses of approximately 10% of initial weight, these reductions are difficult to maintain. Some authors argue that a shift in focus from behavior change to cognitive change will improve long-term results of lifestyle modification programs. This review describes, in detail, the standard behavioral treatment of obesity and compares it with an alternative treatment model that is based in a cognitive conceptualization of weight control. A review of the literature suggests that the differences between standard behavior therapy and cognitive-behavioral therapy of obesity lie more in their underlying theories than in their implementation. Empirical comparisons of the long-term effects of these approaches are needed**.(Bray GA,2012).**

3-Pharmacotherapy of obesity

Past therapies for the treatment of obesity have typically involved pharmacological agents usually in combination with a calorie-controlled diet. Her we reviews the efficacy and safety of pharmacotherapies for obesity focusing on drugs approved for long-term therapy (orlistat), drugs approved for short-term use (amfepramone [diethylpropion], phentermine), recently withdrawn therapies (rimonabant, sibutamine) and drugs evaluated in Phase III studies (taranabant, pramlintide, lorcaserin and tesofensine and combination therapies of topiramate plus phentermine, bupropion plus naltrexone, and bupropion plus zonisamide). No current pharmacotherapy possesses the efficacy needed to produce substantial weight loss in morbidly obese patients. Meta-analyses support a significant though modest loss in bodyweight with a mean weight difference of 4.7kg (95% CI 4.1 to 5.3kg) for rimonabant, 4.2kg (95% CI 3.6 to 4.8kg) for sibutramine and 2.9kg (95% CI 2.5 to 3.2kg) for orlistat compared to placebo at ≥12 months. Of the Phase III pharmacotherapies, lorcaserin, taranabant, topiramate and bupropion with naltrexone have demonstrated significant weight loss compared to placebo

at ≥12 months. Some pharmacotherapies have also demonstrated clinical benefits. Further studies are required in some populations such as younger and older people whilst the long term safety continues to be a major consideration and has led to the withdrawal of several drugs . **(Journal of Obesity 2011)**.

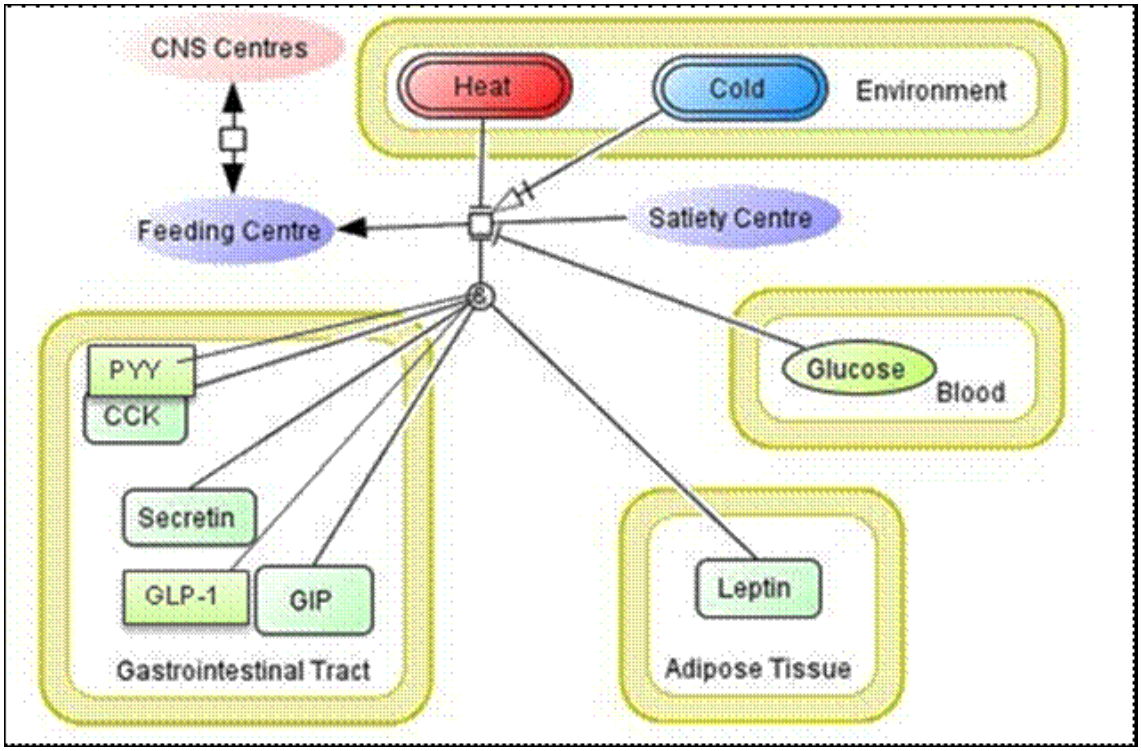
Orlistat (peripherally acting)

Orlistat (Xenical Roche) is the only anti-obesity drug that remains on the market after the withdrawal of sibutramine in 2010. This stable analog of lipstatin, a naturally occurring lipase inhibitor produced by Streptomyces toxytricini, is indicated for the treatment of obesity in conjunction with a reduced-calorie diet. Orlistat acts locally to potently inhibit pancreatic and gastric lipase and thus the hydrolysis of triglycerides. As a result, only approximately two-thirds of dietary triglyceride intake is absorbed by the small intestine. Orlistat has been shown to be modestly efficacious (120 mg three-times daily) in several long-term randomized clinical trials where it induced weight loss of approximately 2–4 kg more than diet and exercise alone. The most common side effects are diarrhea, flatulence, bloating, abdominal pain and dyspepsia. After independent reports of liver injuries (including six cases of liver failure between 1999 and 2008), the FDA has recently approved a label revision for orlistat containing an additional a warning of possible severe liver injury. Compounds that inhibit glucosidase (acarbose and miglitol) and thus the digestion of starches, which induces carbohydrate absorption, have little effect on weight.**(Christensen R et al,2011)**

(Centrally actig drugs)A variety of potentially satiety-enhancing drugs have been developed targeting different hypothalamic circuits. Meal-induced hormonal and neuronal signals travel from the GI tract to the area postrema and nucleus tractus solitarius in the brainstem. From here, sensory input is transmitted to other centers (including the amygdale and nucleus accumbens). Dopaminergic, opioid and endocannabinoid signaling assign reward value to meals consumed. Inputs from these pathways appear to be

integrated with circulating signals of nutritional state, such as fatty acids and the adipocyte hormone leptin, which are detected in the arcuate nucleus (Figure 1). Leptin is known to stimulate the activity of neurons expressing pro-opiomelanocortin (POMC), while inhibiting neurons expressing neuropeptide Y (NPY). POMC neurons in turn stimulate the release of α-melanocyte-stimulating hormone (α-MSH), activating the melanocortin receptor 4 (MC4R), leading to a reduction in food intake and increase in energy expenditure. By contrast, activation of NPY-Y1 and Y5 receptors is known to cause increases in food intake and reduction in energy expenditure. NPY-expressing neurons also release agouti-related peptide (AgRP), an endogenous antagonist of the MC4R.

Many of the neuropeptide receptors expressed centrally are also expressed peripherally and thus actions of agonists or antagonists of these receptors cannot be assumed to induce weight loss by central mechanisms alone.



Appetite control: messengers from the gastrointestinal tract (e.g. CCK, secretin and GIP), from the pancreas (insulin) and from adipose tissue

(leptin) converge upon the hypothalamus and provide a symbolic representation of the feeding status of the organism. These messages are then translated into either a food-seeking (orexic) or a fasting (anorexic) behaviour.

PYY: Peptide YY

CCK: Cholecystokinin

GIP: glucose-dependent insulinotropic peptide or gastric inhibitory polypeptide

GLP-1: Glucagon-like peptide-1 (**O'Meara S, et al 2010).**

The prevalence of obesity has rapidly increased in all industrialized countries in the past few decades, most likely due to dietary and lifestyle changes. Since 1980, the prevalence of obesity has increased threefold or more worldwide. Obesity is associated with a number of diseases and metabolic abnormalities, many of which have high morbidity and mortality rates. These diseases include type 2 diabetes, hypertension, dyslipidemia, coronary heart disease, gallbladder disease, and some cancers. Even relatively modest decreases in body-weight (5-10% of the initial body weight) lead to marked improvements in blood pressure, and sugar and lipid control in obese patients. Obesity treatment should begin with lifestyle changes that focus on behavioral modifications, diet control, and regular exercise. Pharmacotherapy provides an adjunct for obesity treatment, but should be used in conjunction with non-pharmacological approaches such as reduced caloric intake and increased exercise. The history of pharmacotherapy for obesity is no great success story because most anti-obesity drugs have been withdrawn from the market based on the US Food and Drug Administration warnings of serious adverse reactions. At present, only orlistat and sibutramine have been approved by the US Food and Drug Administration for long-term use, but sibutramine was withdrawn from sale in the European Union in January 2010. Rimonabant was approved for use in the European Union in 2006 but officially withdrawn in 2009. There are still many compounds under clinical development, including a new cannabinoid-1 receptor antagonist, a 5-HT2c receptor agonist, ghrelin receptor antagonists,

and inhibitors of gastrointestinal lipases. All of these compounds are still in preclinical or early clinical development stages. It will take time to tell whether these compounds can be used as anti-obesity drugs in the near future(**Rosenbaum M et al,2009).**

4-Surgical treatment of obesity

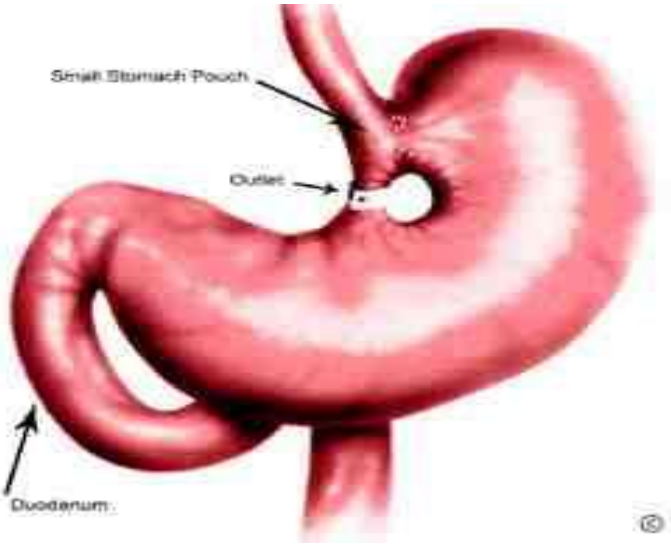
Obesity is a major health problem approaching an epidemic proportions. An NIH consensus conference on the surgical treatment of obesity recommended consideration of surgery in patients with a BMI of greater than 40 kg/m2 without medical complications or a BMI of greater than 35 kg/m2 if a severe comorbidity were present. Nearly all morbidly obese patients with satisfactory postoperative weight loss, experience substantial improvement in the quality of their lives. At present, Roux en Y Gastric Bypass (RYGB) may be the only bariatric operation that has produced durable long-term weight loss at an acceptable level of risk. Complications, either peri-operative or delayed occur frequently. Early recognition of these complications and meticulous attention to details are thus of paramount importance in this group of high-risk patients.
Bariatric surgery should be considered in persons with a body mass index (BMI) above 40—about 100 pounds of excess weight for men and 80 pounds for women. Persons with a BMI between 35 and 40 who suffer from type 2 diabetes or life-threatening cardiopulmonary problems such as severe sleep apnea or obesity-related heart disease may also be candidates for surgery. In addition, a person with obesity-related physical problems that interfere with employment, walking, or family function may be a candidate. Body mass index is determined by dividing a person's weight in kilograms by height in meters squared. To determine BMI using pounds and inches, multiply the patient's weight in pounds by 704.5, then divide the result by the patient's height in inches, and divide that result by the patient's height in inches a second time. An NIH consensus conference on the surgical treatment of obesity recommended consideration of surgery in patients with a BMI of greater than 40 kg/m2 without medical complications or a BMI of greater than 35 kg/m2 if a severe comorbidity were present. Other factors to consider

are:

- BMI > 35 kg/m2 and significant obesity comorbidity (e.g., hypertension, diabetes, sleep apnea, pickwickian syndrome, incapacitating osteoarthritis)
- Documented failure to keep weight off or to prevent further weight gain using aggressive medical management that has included behavioral, pharmacologic, and low-calorie-diet components
- Psychological ability to comprehend the expected changes in dietary intake necessary following surgery to achieve and sustain weight loss
- Willingness to maintain continued medical management following surgery, including visits to registered dietitians, internists
- Adult, nonpregnant, absence of drug addiction or chronic disease unrelated to obesity

Bariatric surgery alters the digestive process and is classified into two categories: restrictive and malabsorptive.

Restrictive procedures

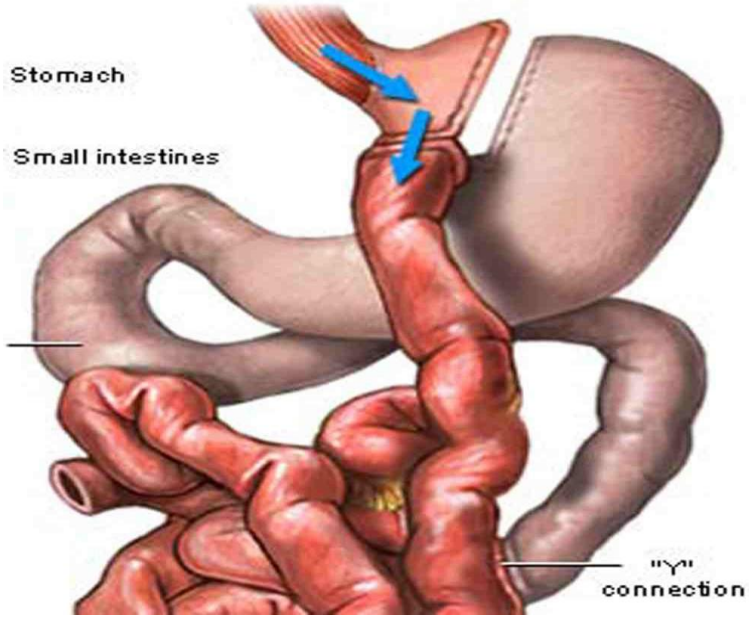


Restrictive procedures promote weight loss by closing off parts of the stomach to make it smaller, thus restricting the amount of food the stomach can hold. Restrictive procedures do not interfere with the normal digestive process.

To perform the surgery, a small pouch is created at the top of the stomach where food enters from the esophagus. Initially, the pouch holds about 1 ounce of food and later expands to 2 to 3 ounces. The lower outlet of the pouch usually has a diameter of only about ¾ inch. This small outlet delays the emptying of food from the pouch and causes a feeling of fullness. As a result of this surgery, most persons lose the ability to eat large amounts of food at one time. After an operation, the person usually can eat only ¾ to 1 cup of food without discomfort or nausea. Also, food has to be well chewed.

Restrictive operations for obesity include the following:
Adjustable gastric banding: In this procedure, a hollow band made of special material is placed around the stomach near its upper end, creating a small pouch and a narrow passage into the larger remainder of the stomach. The band is then inflated with a salt solution. It can be tightened or loosened over time to change the size of the passage by increasing or decreasing the amount of salt solution.
Vertical banded gastroplasty: This procedure has been the most common restrictive operation for weight control. In this procedure, both a band and staples are used to create a small stomach pouch**.(Anaise,2012)**.

Malabsorptive procedures,



The most common gastrointestinal surgeries for weight loss, combine stomach restriction with a partial bypass of the small intestine. A direct connection from the stomach to the lower segment of the small intestine is created, bypassing portions of the digestive tract that absorb calories and nutrients.

Malabsorptive operations for obesity include the following: Roux-en-Y gastric bypass: This operation is the most common and successful malabsorptive surgery. First, a small stomach pouch is created to restrict food intake. Next, a Y-shaped section of the small intestine is attached to the pouch to allow food to bypass the lower stomach, the duodenum, and the first portion of the jejunum. This bypass reduces the amount of calories and nutrients the body absorbs. Biliopancreatic diversion (BPD): In this more complicated malabsorptive operation, portions of the stomach are removed. The small pouch that remains is connected directly to the final segment of the small intestine, completely bypassing the duodenum and the jejunum. Although this procedure successfully promotes weight loss, it is used less frequently than other types of surgery because of the high risk for nutritional deficiencies. A variation of BPD includes a "duodenal switch," which leaves a larger portion

of the stomach intact, including the pyloric valve that regulates the release of stomach contents into the small intestine. It also keeps a small part of the duodenum in the digestive pathway. Malabsorptive operations produce more weight loss than do restrictive operations and are more effective in reversing the health problems associated with severe obesity. Persons who have malabsorptive operations generally lose two thirds of their excess weight within 2 years.

Although restrictive operations lead to weight loss in almost all persons, they are less successful than malabsorptive operations in achieving substantial, long-term weight loss. About 30% of those who undergo vertical banded gastroplasty achieve normal weight, and about 80% achieve some degree of weight loss. Some persons regain weight. Others are unable to adjust their eating habits and fail to lose the desired weight. Successful results depend on the patient's willingness to adopt a long-term plan of healthy eating and regular physical activity.

Complications from bariatric surgery

General complications

Weight loss from dieting or bariatric surgery further increases the risk of gallstones. The incidence of new gallstones has been estimated at 12% during very-low-calorie dieting and 38% after successful gastric bypass surgery. Higher initial BMI and greater absolute rate of weight loss are significant and independent predictors.

Large and rapid weight loss has been shown to increase the prevalence of inflammatory hepatitis. One case report describes the development of occult cirrhosis in a patient whose preoperative liver biopsy was normal. Two series of patients who had liver biopsies pre- and postweight reduction have been reported. The increase in the prevalence of hepatitis is not due to surgical therapy but rather to the weight loss itself. **.(Anaise,2012)**.

Liposuction

Also known as lipoplasty, liposuction slims and reshapes specific areas of the body by removing excess fat deposits, improving your body contours and proportion, and ultimately, enhancing your self-image.

Despite good health and a reasonable level of fitness, some people may still have a body with disproportionate contours due to localized fat deposits. These areas may be due to family traits rather than a lack of weight control or fitness.

Liposuction surgery can be used to treat stubborn fat pockets in many parts of the body including the thighs, arms, neck, hips, waist, back, inner knee, chest, cheeks, chin, calves, and ankles. In some cases, liposuction is performed alone, in other cases it is used with plastic surgery procedures such as a facelift, breast reduction, or a tummy tuck.

Liposuction surgery is not a treatment for obesity and is not a replacement for regular exercise and good eating habits. People with stubborn areas of fat and who exercise regularly are the best candidates for this procedure**.(Schauer et al, 2012)**

5-Acupuncture

According to Traditional Chinese Medicine (TCM), a life force called "Qi" circulates longitudinally within energy pathways, called meridians, throughout the body. Acupuncture points are connected to the energy meridians. When a person is sick, Qi is regarded as out of balance. Proper stimulation of acupuncture points fixes the imbalance. With TCM, excess appetite and obesity are conceptualized as deficient Qi in the stomach or spleen, heat in the stomach and intestine or a primary Qi deficiency. In terms of Western medicine, the 14 major meridians in TCM correspond somewhat with the definition of organs. Westerners believe acupuncture works by stimulating peripheral nerves at acupoints, thus altering central nervous system neurotransmitter levels, according to Lacey. Ear acupuncture is most often used to treat obesity, according to Lacey. The vagus nerve in the ear shares a common path to the brain with the nerves in the digestive tract. In theory, ear acupuncture causes interference with appetite signals from a person's gastrointestinal tract. Studies on rats suggest that ear acupuncture

does, indeed, reduce weight gain by affecting the body's satiety center. Anectdotal evidence suggests that appetite is reduced and cravings are eased when people wear ear acupuncture devices**(Richards D,2009).**

It is indicated by clinical practice that acupuncture has fairly good weight-reducing effect in treating simple obesity due to the neuroendocrine regulation, on one hand, acupuncture can inhibit the patients' hyperorxia decrease the intake of energy by means of inhibiting the digestive functions, readjust the feeding center of hypothalamus to block the transmission of hunger message to the hypothalaxnus, and renormalize the autonomic nerve dysfunction by inhibiting the excitation of the sympathetic nerve and reinforce that of the parasympathetic nerve; and on the other hand, acupuncture could activate the metabolism of energy increase the energy consumption, and speed up the lipid catabolism, hence the weight-reducing effect. This method is also free of the side effect resulting from the simple hunger therapy, medication, and overdose of exercise, thus is worthy of being popularized**.(Liu et al 2009).**

6-Herbal therapy

Herbal products for weight reduction in motivated patients may be effective in helping to treat clinically significant obesity, which is an important public health problem in the United States. The consistency and safety of a bioavailable active herbal product for weight reduction, as well as its efficacy, remain important factors in the consideration of such therapy for weight reduction.(**Pietrobelli A et al,2012)**

Obesity is a global epidemic and most common disorder in the developed world. Traditional herbal therapy may have more acceptance than prescription drugs in many cultures with emerging epidemics of obesity. Treatment of obesity may include lifestyle modification interventions , pharmacotherapy and weight loss supplement. Lifestyle modification and herbal therapy remains the main pillar of any intervention aiming at decreasing body weight . New scientific investigations and researches proved the efficacy of some herbal kinds in the treatment ob obesity and

overweight e.g :- Jujube, Cabbage, Aloe-Vera, Green tea , Finger Millet , Garcinia , Ephedra and Caffeine, Cascara, Dandelion and Guggle**(Alberti KG,2010).**

7-Cold Showers

Brown fat as opposed to white fat is heavily involved in burning energy. Exposure to cold naturally stimulates the production of these brown fats. These cells burn glucose (the calories you eat and the white fat that you store) to try and produces as much heat energy as possible. Having a higher amount of brown fat leads to more energy being burned per second and therefore, more weight is lost. Losing weight with cold showers is possible, according to the 2008 study, "Human Skeletal Muscle Mitochondrial Uncoupling Is Associated With Cold Induced Adaptive Thermogenesis." This means that human brown fat tissue can increase fat burning in response to cold temperatures. One simple way to do this is to take cold showers. The confirmation of human brown fat is official, but the science of enacting it is still theoretical. Researchers do not know how much weight you can lose with this technique, but it may accelerate metabolism more than diet and exercise alone. Follow a few simple steps to lose weight with cold showers.(**PLOSone.org2012**)

Diabetes mellitus

Definition and classification:

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia, hyperlipidemia, polyphagia, polydipsia and polyuria, resulting from defects in insulin secretion, insulin action or both.

Type I: Caused by an absolute deficiency of insulin secretion from beta cells. Also called insulin-dependent diabetes or juvenile-onset diabetes.

Type II: Caused by a combination of resistance to insulin action and an inadequate compensatory insulin secretory response. Also called adult-onset diabetes

Gestational Diabetes: Diabetes that's triggered by pregnancy is called gestational diabetes (pregnancy, to some degree, leads to insulin resistance). The rate of gestational diabetes is between 2% to 10% of pregnancies. Gestational diabetes usually resolves itself after pregnancy. Having gestational diabetes does, however, put mothers at risk for developing type 2 diabetes later in life. Up to 10% of women with gestational diabetes develop type 2 diabetes.

Difference between type I and type II diabetes mellitus

Characteristics	**Type I**	**Type II**
% of diabetics	**2-5 %**	**90-95 %**
Age of onset	< 35-40 years	> 35-40 years
Type of onset	Abrupt	Insidious
Symptoms at onset	Often in ketoacidosis	Many times asymptomatic
Physical appearance	Thin or normal	80 % are obese
Insulin requirement	In all cases	In 25 % of cases
Ketonuria	Yes	No
Autoantibodies	Yes	No
Diabetic complications	Found usually after 5 or more years of onset of disease	Frequent
Other autoimmune disease	Yes	Uncommon

Prevalence:

Diabetes mellitus (DM) is a prevalent disease, especially among the elderly. Approximately 20 percent of population over age 65 years has DM. Half of these people may be unaware that they have DM. The prevalence seems to decline slightly in those older than 75 compared with those 65-74 years old and decreases further in those older than 85 years.

Risk factors

- Obesity
- Lack of physical inactivity
- Loss of muscle mass
- Hyperlipidemia
- Hypertension

Clinical features

- The classic symptoms of DM are polyuria, polydipsia and polyphagia and glucosurea.
- Unexplained weight loss
- Fatigue
- Blurred vision
- Dry mouth and tongue
- Symptoms of chronic infection, especially of the genitourinary tract, skin or mouth
- DM in elderly is associated with impaired cognitive function which correlates with glucose control
- retinopathy and neuropathy

Normal fasting blood glucose:

A normal fasting blood sugar level is 70- 125 mg/dl, less than 100 mg/dL(5.5 mmol/L) is normal. A fasting blood sugar level from 100 to 125

mg/dL(5.6 to 6.9 mmol/L) is considered prediabetes. If it's 126 mg/dL (7 mmol/L) or higher on two separate tests, you have diabetes.

- **Renal threshold for glucose:** 180 ml/dl

Diagnostic criteria of diabetes mellitus:

• FBG > 126 mg/dL

• A random plasma glucose > 200 mg/dL with classic diabetic symptoms

• 2 h plasma glucose > 200 mg/dL during an oral glucose tolerance test (OGTT)

• Impaired glucose metabolism is considered to exist when FPG >110 and < 126 mg/dL or 2 h plasma glucose > 140 and < 200 mg/dL during an OGTT.

Tests for blood sugar level:

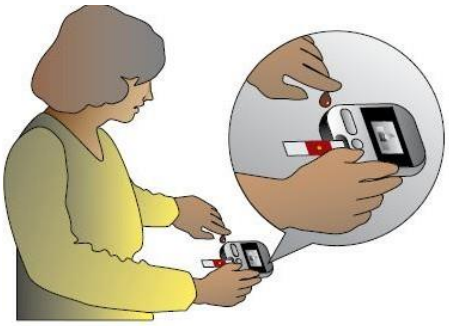
- **Random blood sugar test.** A blood sample is taken at a random time. Regardless of the last ate, a random blood sugar level of 200 milligrams per deciliter (mg/dL) — 11 millimoles per liter (mmol/L) — or higher suggests diabetes.
- **Fasting blood sugar test (FBG).** A blood sample is taken after an overnight fast. A fasting blood sugar level less than 100 mg/dL(5.5 mmol/L) is normal. A fasting blood sugar level from 100 to 125 mg/dL(5.6 to 6.9 mmol/L) is considered prediabetes. If it's 126 mg/dL (7 mmol/L) or higher on two separate tests, it indicates diabetes.
- **Oral glucose tolerance test (OGTT).** Patient fast overnight, and the fasting blood sugar level is measured. Then patient drink a sugary liquid, and blood sugar levels are tested periodically for the next two hours. A blood sugar level < 140 mg/dL(7.8 mmol/L) is normal. A reading of > 200 mg/dL(11 mmol/L) after two hours indicates diabetes. A reading between 140 and 199 mg/dL (7.8 mmol/L and 11 mmol/L) indicates prediabetes.

– **Glycated hemoglobin (A1C) test.** Blood test doesn't require fasting, indicates the average blood sugar level for the past two to three months. It measures the percentage of blood sugar attached to hemoglobin, the oxygen-carrying protein in red blood cells. The higher blood sugar levels, the more sugar will attach to the hemoglobin.

  - An A1C below 5.5 is considered normal.
  - An A1C between 5.6 and 6.9 percent indicates prediabetes.
  - An A1C level of 7 percent or higher on two separate tests indicates diabetes.

• Lipid profile:

– Total cholesterol is commonly elevated
– Triglyceride is elevated
– HDL cholesterol is low
– LDL cholesterol may or may not be elevated.



Management

- **Pharmacological management:**

  – Type I: All patients require insulin therapy. It is administered subcutaneously by using glass syringe, plastic syringe, pen device or infusion pump. The commonest and simplest choice of insulin regimen is two injections/day of short-acting and intermediate-acting insulin, given in combination before breakfast and the evening meal.

  – Type II: either oral hypoglycemic medications or insulin. Oral medications include sulphonylurea medications usually for

non-obese patients, whereas metformin is prescibed to obese patients.

Combined therapy such as sulphonylurea + metformin is also used.

If diabetes is not controlled with oral medications, insulin therapy, usually in large doses is recommended.

- **Non-pharmacological management:**
  - Comprehensive education of patient and family, especially in newly diagnosed case of DM
  - Alcohol and smoking cessation
  - Healthy diet
  - Regular exercise
  - Self-monitoring of blood glucose
  - No physical or emotional stress
- **Diet:** Diet control is essential in all types of diabetes. Two types of diet are used to achieve the ultimate goal of management, i.e. normal metabolism:
  - Low-energy, weight-reducing diets: Diet that causes a daily deficit of 500 kcal is essential for obese diabetic patients. However, this may lead to loss of lean body mass, particularly in elderly individuals. Therefore, diet restriction should be combined with exercise therapy. In addition, the diet should include nutrients, vitamins and minerals in sufficient amount.
  - Weight maintenance diets: This is recommended for non-obese patients. Such type of diet should be high in carbohydrate and low in fat.

Meal composition:

- ***Carbohydrates*:** 50-60 % in form of complex carbohydrates, concentrated sweets and simple sugars should be avoided.

– ***Fat***: represent 30 % of the total calories.

– ***Protein:*** represents 20 % or 0.8 g/Kg.

– **Fibers:**15- 30 g per day to prevent diarrhea and constipation (fruits and vegetables).

- **Exercise:** A regular exercise program of moderate intensity reduces the requirements for insulin or oral medication in patients with DM. The possible mechanisms are increased glucose use by muscle and improved muscle sensitivity to insulin. However, these metabolic effects of exercise can increase risk of hypoglycemia. Thus, exercise does not always improve the glucose control. Hence, the exercise program should be tailored individually. There should be a combination of exercise in weight-bearing and non-weight bearing positions. Nevertheless, 80 percent of exercise duration should be spent in non-weight bearing position to avoid undue stress on the degenerative joints of elderly, e.g. swimming or cycling. In addition, following precautions should be observed during exercise in diabetics.

– The first step is to increase glucose monitoring during exercise, especially for patients on insulin or oral medications.

– At the beginning of an exercise program, particularly with type I diabetic patients, glucose levels should be checked prior to exercise, every 15 to 30 min during exercise and after stopping exercise. A final blood glucose check should be performed approximately 4 to 5 hrs later to know the fall in glucose levels.

– Type I diabetics should not exercise during insulin insufficiency, as it maypromote a hyperglycemic response and increase the risk for metabolic acidosis.This is because ketosis is very common in type I diabetics exhibiting a higher secretion of glucagons and catecholamines during exercise. In fact the secretion of

catecholamines during exercise is so great that release of glucose from the liver exceeds the rate of consumption by muscle. Thus, additional insulin may have to be given and exercise should be stopped if the glucose level is higher than 250 mg/dL or if ketones are present in the urine.

– The upper value for deferring exercise in type II diabetics is higher than type I diabetics, i.e. 300 mg/dL because ketosis is uncommon and also unlikely to be provoked by exercise in type II diabetics.

Before starting an exercise program, the following strategies should be considered to avoid any complication:

1. Hypoglycemia: Exercise should be done 45-60 min after eating. Dietary intake is increased as displayed in Table 10.2 and sugar supplements should be kept handy. Remember that hypoglycemia may occur for up to 24 hrs after exercising.

2. Insulin levels: Exercise should be done 1 hr after insulin injections. Glucose should be monitored carefully and exercise should be avoided during peak insulin activity. Caution should be observed when injecting insulin over exercising muscle, because insulin injected this way is absorbed more quickly and translated into more potent glucose-lowering effects.

3. Cardiovascular problems: Remember that vital signs may not be an accurate indicator of exercise tolerance. In general, exercise should be stopped if patient feels dizziness, excessive shortness of breath, nausea or chest pain.

4. Proliferative retinopathy: Systolic BP should not be > 170 mm Hg duringexercise. Isometrics, Valsalva maneuvers and head-jarring should be avoided.

5. Autonomic nervous system dysfunction: Physical therapist should keep a strict watch for orthotic hypotension, anginal pain, distal anhidrosis and poor heat compensation. Pulse should be monitored during and after exercise.

6. End-stage renal disease: Patient should be sufficiently hydrated and systolic BP should not be > 170 mm Hg during exercise.

7. Peripheral neuropathy: Patient should use proper footwear during exercise. Repetitive stresses should be avoided and distal extremities should be examined carefully.

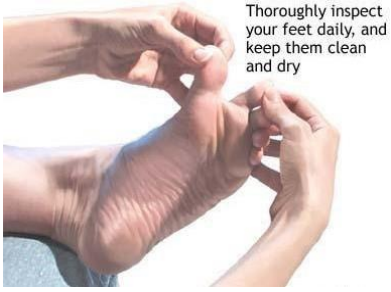
Dietary strategy for exercising diabetics:

Blood glucose level (Before the start of exercise)	Duration and intensity of exercise	Carbohydrate exchanges*
< 130 mg/dL	35-40 min < 60% of VO2 max	Two
<130mg/dL	35-40 min > 70% of VO2 max	Three
>130 and <180 mg/dL	35-40 min < 60% of VO2 max	One
>130 and <180 mg/dL	35-40 min > 70% of VO2 max	two
>180 and <240 mg/dL	35-40 min mild to moderate	no
> 250 mg/dL	Exercise is not recommended till blood glucose level is brought back to the safety limits	
*One carbohydrate exchange = 60 kcal		

Mortality rate

Mortality rate among the elderly diabetics is more than double that of age-matched non-diabetic individuals, largely because of increased deaths from cardiovascular disease.

Diabetic complications



• Acute complications:

– Hypoglycemia due to (Too much insulin or oral medications; insufficient

food intake, increased physical activity)

– Diabetic ketoacidosis (lack of insulin action)

– Diabetic coma (dehydration)

• Chronic complications:

– Microvascular complications: neuropathy, retinopathy and nephropathy

– Macrovascular complications: cardiovascular disease (angina and myocardial infarction.)

Neuropathy

- Affects 30 percent patients, caused by vasculitis and subsequent ischemia. Sensory loss is more prevalent than motor loss.
- It include focal neuropathies, polyneuropathy and autonomic neuropathy

1. **Focal neuropathies:** include entrapment syndromes (carpal tunnel syndrome), mononeuropathies (single peripheral or cranial nerve e.g. 3rd and 6th cranial nerves)
2. **Polyneuropathy:**
   - There is decreased perception of vibration sensation distally, loss of tendon reflexes and loss of all sensations in a stocking/glove pattern.
   - Muscle weakness and wasting develops in later stage, which results into clawing of toes. This further leads to development of callus and pressure points, particularly under the metatarsal heads.
   - Patients with polyneuropathy are predisposed to Charcot joints and foot ulcer.
3. **Autonomic neuropathy:** a affects sympathetic and parasympathetic nervous system of 20-40 % of patients with the following:
   – Postural hypotension: A sharp fall in BP in response to postural change causing faintness

- Fixed heart rate: No rise or fall in HR in response to normal body functions or exercise
- Constipation: results from colonic atony
- Dysphagia: results from esophageal atony
- Gastroparesis: causing nausea, vomiting, distention, loss of desire to eat and unstable diabetes
- Genitourinary Urinary tract dysfunction: Inability to evacuate bladder completely, urinary incontinence, recurrent infection due to atonic bladder.
- Decreased sexual response: Impotence in men, difficulty with lubrication, arousal or orgasm in women

- Advices to patients with distal sensory polyneuropathy to reduce risk for foot ulceration:
  - Do not walk barefoot
  - Test the water temperature with elbow
  - Inspect your feet daily
  - Use non weight-bearing exercises as cycling or swimming rather than walking
  - Prefer loose cotton socks instead of tight nylon ones
  - Use proper footwear with orthotics

Osteoporosis

Osteoporosis was defined as 'a progressive skeletal disorder, that weakens the bones, making them fragile and more likely to break that results in reduction of bone mass; a failure of bone formation (osteoblast activity) to keep pace with bone reabsorption and destruction (osteoclast activity).

Etiologic factors

(1) Hormonal deficiency: estrogens or androgens.

(2) Nutritional deficiency: inadequate calcium, impaired absorption of calcium; excessive alcohol, caffeine consumption.

(3) Decreased physical activity: inadequate mechanical loading.

(4) Diseases that affect bone loss: hyperthyroidism, diabetes, hyperparathyroidism, rheumatoid arthritis, liver disease, certain types of cancer.

(5) Medications that affect bone loss: corticosteroids, thyroid hormone, anticonvulsants catabolic drugs, some estrogen antagonists, chemotherapy.

Vitamin D:

Vitamin D Deficiency: Vitamin D is essential for strong bones, because it helps the body use calcium from the diet. Traditionally, vitamin D deficiency has been associated with rickets, a disease in which the bone tissue doesn't properly mineralize, leading to soft bones and skeletal deformities. But increasingly, research is revealing the importance of vitamin D in protecting against a host of health problems.

Causes of Vitamin D Deficiency:

1. A strict vegan diet, because most of the natural sources are animal-based, including fish and fish oils, egg yolks, fortified milk, and beef liver.
2. Limited exposure to sunlight. Because the body makes vitamin D when

your skin is exposed to sunlight, you may be at risk of deficiency if you are homebound, live in northern latitudes, wear long robes or head coverings for religious reasons, or have an occupation that prevents sun exposure.

3. Dark skin. The pigment melanin reduces the skin's ability to make vitamin D in response to sunlight exposure. Some studies show that older adults with darker skin are at high risk of vitamin D deficiency.
4. Kidneys cannot convert vitamin D to its active form. As people age, their kidneys are less able to convert vitamin D to its active form, thus increasing their risk of vitamin D deficiency.
5. Digestive tract cannot adequately absorb vitamin D. Certain medical problems, including Crohn's disease, cystic fibrosis, and celiac disease, can affect your intestine's ability to absorb vitamin D from the food you eat.
6. Obesity. Vitamin D is extracted from the blood by fat cells, altering its release into the circulation. People with a body mass index of 30 or greater often have low blood levels of vitamin D.

Tests for Vitamin D Deficiency:

The most accurate way to measure how much vitamin D is in your body is the 25-hydroxy vitamin D blood test. A level of 20 nanograms/milliliter to 50 ng/mL is considered adequate for healthy people. A level less than 12 ng/mL indicates vitamin D deficiency.

Calcium:

Calcium is a mineral that is an essential part of bones and teeth. The heart, nerves, and blood-clotting systems also need calcium to work. Calcium is used for treatment and prevention of low calcium levels and resulting bone conditions including osteoporosis (weak bones due to low bone density), rickets (a condition in children involving softening of the bones), and osteomalacia (a softening of bones involving pain). Calcium is also used for premenstrual syndrome (PMS), leg

cramps in pregnancy, high blood pressure in pregnancy (pre-eclampsia), and reducing the risk of colon and rectal cancers.

Normal serum Calcium:

The corrected total serum calcium concentration is normally 8.5-10.2 mg/dL.

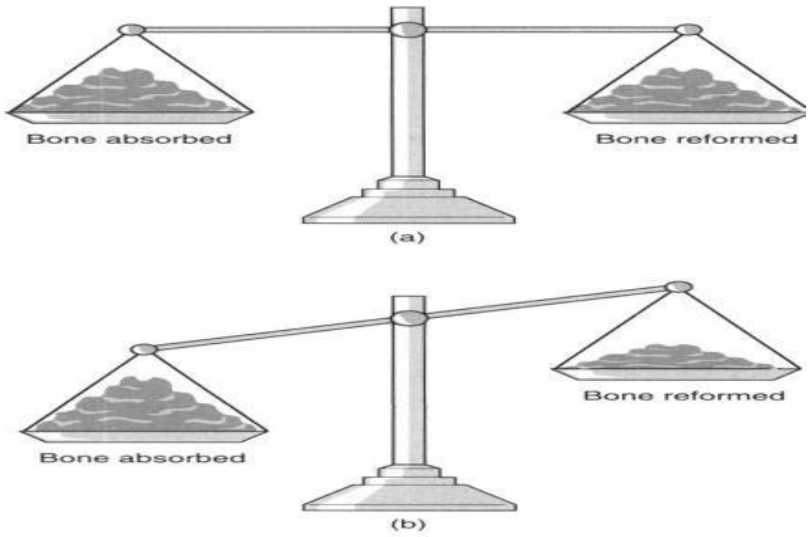


Figure 11.2 Bone remodelling: (a) normal – osteoblast activity matches osteoclast activity; (b) osteoporosis – osteoclast activity exceeds osteoblast activity.

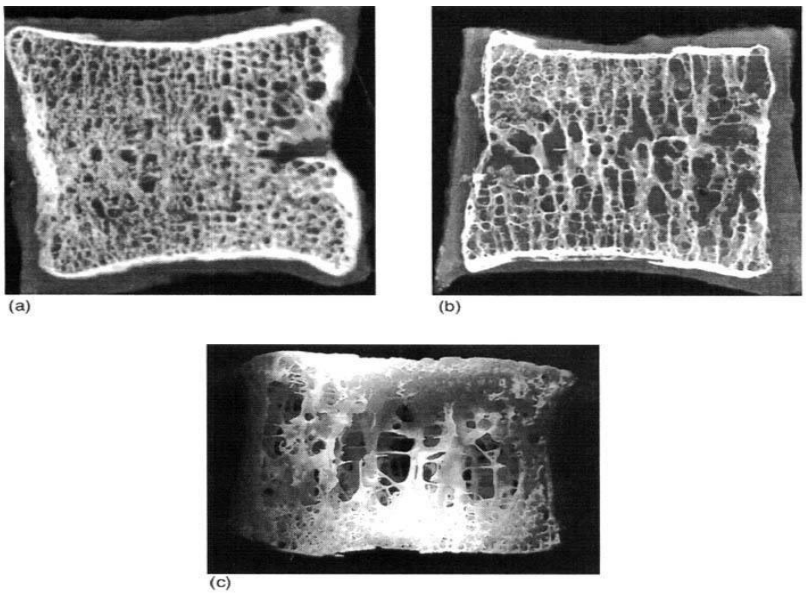


Figure 11.3 (a) Cross-section of a vertebra showing normal bone density. (b) Cross-section through an osteoporotic vertebra. (c) Lateral view of an osteoporotic vertebra.

Clinical features

(1) Bone loss is about 1% per year (starting for women at ages 30-35, for men ages 50-55), accelerating loss in post-menopausal women, approximately 5% per year for 3-5 yrs.

(2) Structural weakening of bone.

(3) Disability to support loads.

(4) High risk of fractures.

(5) Trabecular bone more involved than cortical bone; common areas affected:

(a) Vertebral column.

(b) Femoral neck.

(c) Distal radius/wrist, humerus

Examination

DEXA Scan (Dual X-ray Absorptiometry) to Measure Bone Health:

The most common test doctors use is called dual energy X-ray absorptiometry (DXA or DEXA). A DXA scanner is a machine that produces two X-ray beams. One is high energy and the other is low energy. The machine measures the amount of X-rays that pass through the bone from each beam. This will vary depending on how thick the bone is. Based on the difference between the two beams, your doctor can measure your bone density.

DXA Scan Results:

T-score of -1.0 or above = normal bone density

T-score between -1.0 and -2.5 = low bone density, or osteopenia (which is bones are weaker than normal but not so far gone that they break easily, which is the hallmark of osteoporosis).

T-score of -2.5 or lower = osteoporosis

Sometimes doctors will give you another DXA scan result -- a Z score. It compares your bone density to a normal score for a person of your same age and body size.

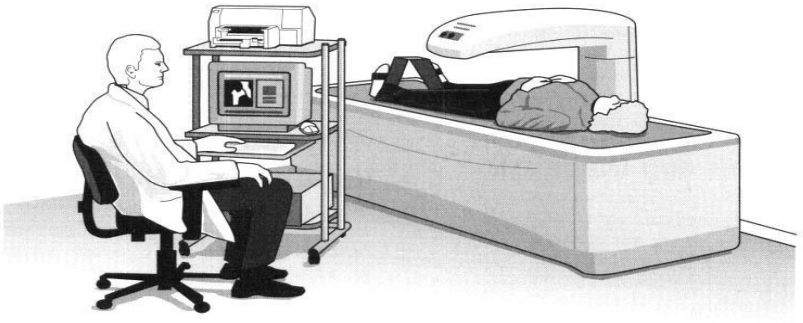


Figure 11.8 A bone density scan in progress.

Interventions

(I) Medications:

(a) Evista. (b) Fosamax (alendronate). (c) Calcitonin.

Evista. Selective (o) estrogen receptor modulators it works by acting as an oestrogen agonist in bone and an oestrogen antagonist in areas like the breast and uterus.

Hormone replacement therapy

- HRT,, is an anti-resorptive therapy and works by stimulating the oestrogen receptors on the bone cells
- HRT is best prescribed for the five or so years during and just after the menopause
- It is associated with very slight increases in the risks of developing breast cancer, venous thromboembolism (VTE), cardiovascular disease and strokes.

1) **Promote health, provide counseling**.

(a) The recommended daily calcium intake.

- Children 1-3 years old: 700 milligrams (mg)
- Children 4-8 years old: 1,000 mg
- Children 9-18 years old: 1,300 mg
- Adults 19-50: 1,000 mg
- 1000 mg premenopause
- 1500 mg after age 50 years of age

(b) The recommended daily vitamin D intake (RDI) is usually around 400–600 IU

• 200 IU premenopausal

• 400 IU after menopause

• 600 IU after age 75

(b) Diet: low in salt, avoid excess protein: inhibits body's ability to absorb calcium.

Maintenance of the bonne mass

Exercise:

- Exercise has two important roles in the prevention of fractures.
- Firstly it is shown to aid bone density, and secondly it tones and strengthens muscles, thereby ensuring good balance, coordination and skeletal support.
- Loading the skeleton with physical weights or bodyweight stimulates the osteogenic cells,
- Many people are not used to doing any regular exercise and would need to start very gently and carefully

Mode of exercise

(a) Weight bearing (gravity-loading) exercises: walking (30 min/day); stair climbing; jogging use of weight belts to increase loading.

(b) Resistance exercises, e.g., hip and knee extensors, triceps. Weight lifting

(4) Postural balance training

(a) Postural reeducation, postural exercises to reduce kyphosis, forward head position.

(b) Flexibility exercises.

(c) Functional balance exercises. (e.g. toe raise, unilateral stance, hip extension, hip abduction)

(d) Tai Chi.

(e) Gait training.

(5) Safety education/fall prevention

(a) Proper shoes: thin soles, flat shoes enhance balance abilities (no heels).

(b) Assistive devices: cane; walker as needed.

(c) Fracture prevention: counseling on safe activities; avoid sudden forceful movements, twisting, standing, and bending over, lifting, supine sit-ups.

Geriatrics

✍Aging

The process of growing old. It describes a wide array of physiological changes in the body systems:

Complex and variable.

a. Common to all members of a given species.

b. Progressive with time.

c. Evidenced by:

(1) Decline in homeostatic efficiency.

(2) Increasing probability that reaction to injury will not be successful.

d. Varies among and within individuals.

Gerontology

The scientific study of the factors impacting the normal aging process and the effects of aging.

Geriatrics

The branch of medicine concerned with the illnesses of old age and their care.

Life span

Maximum survival potential, the inherent natural life of the species, in humans 110-120 years.

Life expectancy

The number of years of life expectation from year of birth, 75.8 years in U.S. women live 6.6 years longer than men.

Senescence

Last stages of adulthood through death.

Categories of elderly

a. Young elderly: ages 65-74 (60% of elderly population).

b. Old elderly: ages 75-84.

c. Old, old elderly or old & frail elderly: ages> 85.

Ageism

The discrimination and prejudice leveled against individuals on the basis of their age.

Causes of death

The Leading causes of death (mortality) in persons over 65, in order of frequency.

- Coronary heart disease (CHD), accounts for 31% of deaths.
- Cancer, accounts for 20% of deaths.
- Cerebrovascular disease (stroke).
- Chronic obstructive pulmonary disease (COPD).
- Pneumonia/flu.

CAUSES OF DISABILITY/CHRONIC CONDITIONS

Leading causes of disability/chronic conditions(morbidity) in persons over 65, in order of frequency

a. Arthritis, 49%.

b. Hypertension, 37%.

c. Hearing impairments, 32%.

d. Heart impairments, 30%.

e. Cataracts and chronic sinusitis, 17% each.

f. Orthopedic impairments, 16%.

g. Diabetes and visual impairments, 9% each.

Most older persons (60-80%) report having one or more chronic conditions

✍Aging theories

1-Aging change

a. Cellular changes.

(1) Increase in size.

(2) Fragmentation of Golgi apparatus and mitochondria.

(3) Decrease in cell capacity to divide and reproduce.

(4) Arrest of DNA synthesis and cell division.

b.Tissue changes

(1) Accumulation of pigmented materials.

(2) Accumulation of lipids and fats.

(3) Connective tissue changes:

- Decreased elastic content.
- Degradation of collagen.
- Presence of pseudoelastins.

c. Organ change

(I) Decrease in functional capacity.

(2) Decrease in homeostatic efficiency.

2- Biological theories

a. Genetic:

- aging is intrinsic to the organism
- genes are programmed to modulate aging changes overall rate of progression

(1) Individuals vary in the expression of aging changes, e.g., graying of hair, wrinkles, etc.

(2) Polygenic controls exist (multiple genes are involved): no one gene can modulate rate of development in all aspects of aging.

(3) Premature aging syndromes (progeria) provide evidence of defective genetic programming individuals' exhibit premature aging changes, i.e.

- Atrophy
- Thinning of tissues
- Graying of hair
- Arteriosclerosis

(a) Hutchinson-Gilford syndrome: progeria of childhood.

(b) Werner's syndrome: progeria of young adults.

b. Free radical theory: (oxidative stress theory)

Free radicals are highly reactive and toxic forms of oxygen produced by cell mitochondria; the released radicals

(1) Cause damage to cell membranes and DNA cell replication.

(2) Interfere with cell diffusion and transport, resulting in decreased oxygen delivery and tissue death.

(3) Decrease cellular integrity, enzyme activities

c. Hormonal theory:

Functional decrements in neurons and their associated hormones lead to aging changes.

(1) Hypothalamus, pituitary gland, adrenal gland are the primary regulators, timekeepers of aging

(a) Thyroxine is the master hormone of the body; controls rate of protein synthesis and metabolism

(b) Secretion of regulatory pituitary hormones influence thyroid

(2) Decreases in protective hormones: estrogen, growth hormone.

(3) Increases in stress hormones (cortisol): can damage brain's memory center, the hippocampus, and destroy immune cells.

d. Immunity theory:

- Thymus size decreases
- becomes less functional
- bone marrow cell efficiency decreases
- results in steady decrease in immune responses during adulthood

(1)Immune cells

T-cells, become less able to fight foreign organisms

B-cells become less able to make antibodies.

(2) Autoimmune diseases increase with age

3-Environmental theories

Aging is caused by an accumulation of insults from the environment.

b. Environmental toxins include:

- Ultraviolet.

- Crosslinking agents (unsaturated fats).
- Chemicals (metal ions, Mg, Zn).
- Radiation.
- Viruses.

b. Can result in: errors in protein synthesis and in DNA synthesis/genetic sequences (error theory), cross-linkage of molecules, mutations.

4-Sociological theories

- life experience/lifestyles influence aging process
- **Activity theory:**
- Older persons who are socially active exhibit improved adjustment to the aging process
- Allows continued role essential for positive self-image and improved life satisfaction.

An integrated model of aging assumes aging is a complex, multifactorial phenomenon

- some or all of the above processes may contribute to the overall aging of an individual

Aging is not adequately explained by any single theory.

Age related changes on muscular and skeletal system

Muscular Changes

Age-related changes

a. Changes may be due more to decreased activity levels (hypokinesis) and disuse than from aging process.

b. Loss of muscle strength: peaks at age 30, remains fairly constant until age 50; after which there is an accelerating loss, 20-40% loss by age 65 in the non-exercising adult.

c. Loss of power (force/unit time): significant declines, due to losses in speed of contraction, changes in nerve conduction and synaptic transmission.

d .Loss of skeletal muscle mass (atrophy): both size and number of muscle fibers decrease, by age 70 lose 33% of skeletal muscle mass.

e. Changes in muscle fiber composition: selective loss of Type II, fast twitch fibers, with increase in proportion of Type I fibers.

f. Changes in muscular endurance.

Muscles fatigue more readily.

- Decreased muscle tissue oxidative capacity.
- Decreased peripheral blood flow, oxygen delivery to muscles.
- Altered chemical composition of muscle: decreased myosin ATPase activity, glycoproteins and contractile protein.
- Collagen changes: denser, irregular due to cross-linkages, loss of water content and elasticity; affects tendons, bone, cartilage.

Clinical implications:

- a. Movements become slower.
- b. Movements fatigue easier; increased com plaints of fatigue.
- c. Connective tissue becomes denser and stiffer.

(1) Increased risk of muscle sprains, strains nd tendon tears.

(2) Loss of range of motion: highly variable by joint and individual activity level.

(3) Increased tendency for fibrinous adhesions and contractures.

d. Decreased functional mobility, limitations to movement.

e. Gait changes.

(1) Stiffer, fewer automatic movements.

(2) Decreased amplitude and speed, slower cadence.

(3) Shorter steps, wider stride to increased double support to ensure safety, compensate for decreased balance.

(4) Decreased trunk rotation, arm swing.

(5) Gait may become unsteady due to changes in balance, and strength which increased need for assistive devices.

f. Clinical : increasing risk of falls.

3. Interventions to low or reverse changes.

a.Improve health.

(1) Correction of medical problems that may cause weakness, hyperthyroidism, excess adrenocortical steroids (e.g., Cushing's disease, steroids); hyponatremia (low sodium in blood).

(2) Improve nutrition.

- Correction of hyponatremia and increased fatigue associated with diarrhea, prolonged use of diuretics.

b. Increase levels of physical activity, stress functional activities and activity programs.

(1) Gradual increase in intensity of activity to avoid injury.

(2) Adequate warm ups and cool downs; appropriate pacing and rest periods.

c. Provide strength training.

(1)Significant increases in strength noted in older adults with isometric and progressive resistive exercise regimes.

(2) High-intensity training programs (70-80% of one-repetition maximum) produce quicker and more predictable results than moderate intensity programs; both have been successfully used with the elderly.

(3) Age not a limiting factor: significant improvements noted in frail, institutionalized 80 and 90 year-olds.

(4) Improvements in strength correlate to improved functional abilities.

d. Provide flexibility, range of motion exercises.

(1)Utilize slow, prolonged stretching, maintained for 20-30 seconds.

(2) Tissues heated prior to stretching are more distensible, e.g., warm pool.

(3) Maintain newly gained range: incorporate into functional activities

Skeletal System

1. Age-related changes.

a. Cartilage changes: decreased water content becomes stiffer, fragments and erodes by age 60 more than 60% of adults have degenerative joint changes, cartilage abnormalities.

b. Loss of bone mass and density: peak bone mass at age 40; between 45 and 70 bone mass decreases (women by about 25%, men 15%) decreases another 5% by age 90.

(1) Loss of calcium, bone strength: especially trabecular bone.

(2) See discussion of osteoporosis under pathological manifestations of aging.

(3) Decreased bone marrow red blood cell production.

c. Intervertebral discs: flatten, less resilient due to loss of water content (30% loss by age 65) and loss of collagen elasticity; trunk length, overall height decreases.

d. Senile postural changes.

(1) Forward head.

(2) Kyphosis of thoracic spine.

(3) Flattening of lumbar spine.

(4) With prolonged sitting, tendency to develop hip and knee flexion contractures.

2. Clinical implications

Maintenance of weight-bearing is important for cartilaginous/joint health which decrease Clinical risk of fractures.

3. Interventions to slow or reverse changes.

a. Postural exercises: stress components of good posture.

b. Weight bearing (gravity-loading) exercise can decrease bone loss in older adults.

c. Maintenance of weight-bearing is important for cartilaginous/joint e.g., walking and weight bearing exercise can increase load.

d. Nutritional, hormonal and medical therapies: (see discussion of osteoporosis)

Neurological and cognitivechanges

1- Age related changes on neurological

a. Atrophy of nerve cells in cerebral cortex

Brain weigh 20 % from age (45-85).

Normal weigh of the brain 3 pound (1,300 – 1.400 g)

b. Changes in brain morphology.

(1) Gyral atrophy: narrowing of gyri (folds or bumps), with widening of sulci (the grooves on the surface of the brain)

(2) Ventricular dilation due to loss of cells surrounding the ventricle (the space in the brain that contain cerebrospinal fluid)

(3) Generalized cell loss in cerebral cortex (frontal and temporal lobes)

(4) Presence of lipofuscins, significant accumulations associated with pathology, e.g., Alzheimer's dementia.

(5) Selective cell loss in basal ganglia, cerebellum, hippocampus.

c. Decreased cerebral blood flow and energy metabolism.

d. Changes in synaptic transmission.

(1) Decrease synthesis and metabolism of major neurotransmitters, e.g., acetylcholine, dopamine.

(2) Slowing of many neural processes.

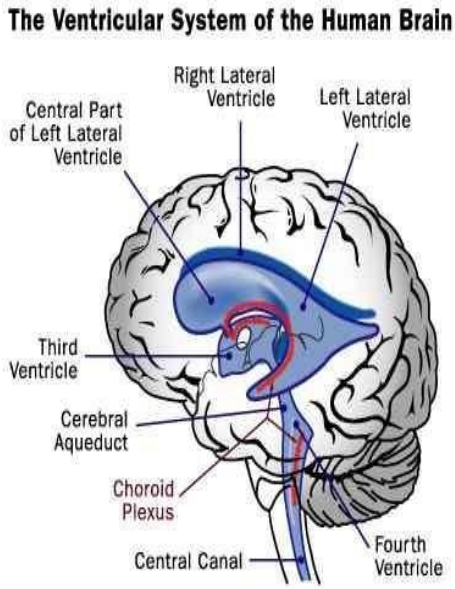
e. Changes in spinal cord/peripheral nerves.

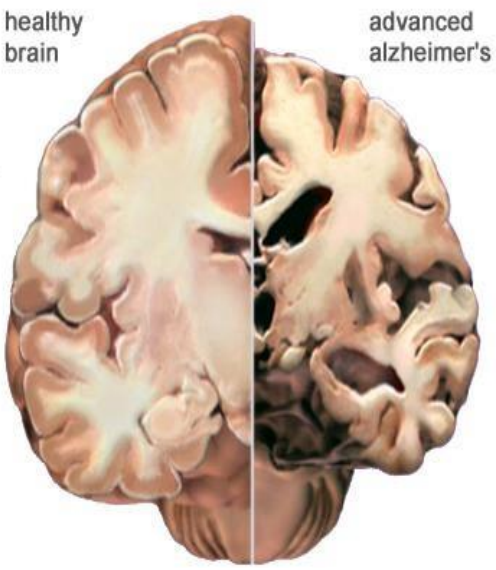
(1) Neuronal loss and atrophy: 30-50% loss of AHC, 30% loss of posterior roots (sensory fibers) by age 90.

(2) Loss of motor neurons results in increase in size of remaining motor units (development of macro motor units).

(3) Slowed nerve conduction velocity: sensory >motor.

(4) Loss of sympathetic fibers,





f. Age-related tremors (essential tremor, ET).

(1) Isolated symptom, particularly in hands, head and voice.

(2) Characterized as postural or kinetic, rarely resting.

(3) Benign, slowly progressive; in late stages may limit function.

(4) Exaggerated by movement and emotion.

g. Memory

(1) Decline in short term memory; long-term memory retained.

(2) Impairments are task dependent, e.g., new learning.

h. Learning

All age groups can learn; learning in older adults affected by:

(I) Increased cautiousness.

(2) Anxiety.

(3) Pace of learning.

(4) Interference from prior learning.

2- Interventions to slow or reverse changes

a. Correction of medical problems

b. Improve health: diet, smoking cessation.

c. Increase levels of physical activity.

d. Provide effective strategies to improve motor learning and control.

a. Improve health

(1) Correction of medical problems: imbalances between oxygen supply and demand to CNS, e.g., cardiovascular disease, hypertension, diabetes, hypothyroidism.

(2) Pharmacological changes: drug re-evaluation; decreased use of multiple drugs; monitor closely for drug toxicity.

(3) Reduction in chronic use of tobacco and alcohol.

(4) Correction of nutritional deficiencies (vit.B-6, B-12, anti oxidant, and vit. E, vit. C), sea food, meat , green vegetables, fruit and eggs.

b. Increase physical activity.

Exercise programs

c. Increase mental activity

(1) Keep mentally engaged (new language, new courses). e.g chess, crossword puzzles, high level of reading.

(2) Engaged lifestyle: socially active, e.g. clubs, travel, work.

d. Auditory processing may be decreased: provide written instructions.

e. Provide stimulating, "enriching" environment;

f. Reduction of stress: counseling and family support.

Age related changes on sensory system

Vision

a. Aging changes:

There is a general decline in visual acuity gradual prior to sixth decade, rapid decline between ages 60 and 90, visual loss may be as much as 80% by age 90.

(1) Presbyopia: visual loss in middle and older ages characterized by inability to focus properly and blurred images, due to loss of accommodation, elasticity of lens.

(2) Decreased ability to adapt to dark and light.

(3) Increased sensitivity to light and glare.

(4) Loss of color discrimination, especially for blues and greens.

(5) Decreased pupillary responses, size of resting pupil increases.

(6) Decreased sensitivity of corneal reflex: less sensitive to eye injury or infection.

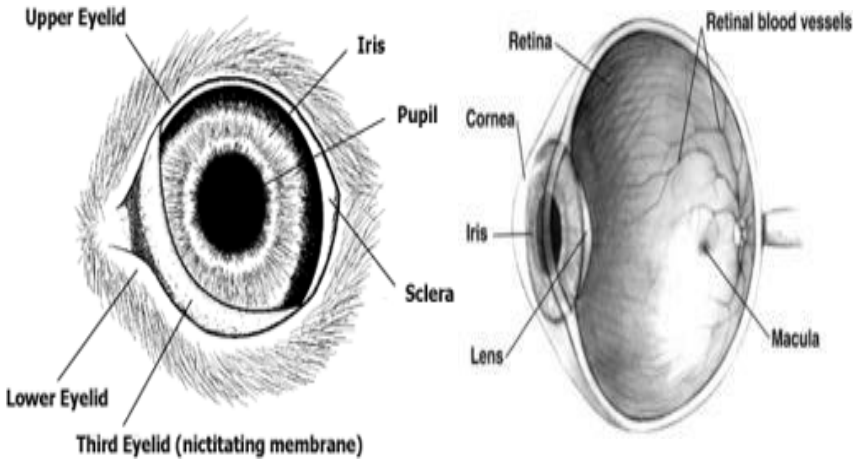
(7) Oculomotor responses diminished: restricted upward gaze, reduced pursuit eye movements; ptosis may develop.

Additional vision loss with pathology:

(1) Cataracts: opacity, clouding of lens due to changes in lens proteins; results in gradual loss of vision: central first, then peripheral; increased problems with glare general darkening of vision; loss of acuity, distortion.

(2) Glaucoma: increased intraocular pressure, with degeneration of optic disc, atrophy of optic nerve; results in early loss of peripheral vision (tunnel vision), progressing to total blindness.

(3) Senile macular degeneration: loss of central vision associated with age-related degeneration of the macula compromisedby decreased blood supply or abnormal growth of blood vessels under the retina; initially patients retain peripheral vision;may progress to total blindness.



4. Diabetic retinopathy:

Damage to retinal capillaries, growth of abnormal blood vessels and hemorrhage leads to retinal scarring and finally retinal detachment; central vision, impairment complete blindness is rare.

Clinical implications/compensatory strategies

2) Examine vision: acuity, peripheral vision, light and dark adaptation, depth perception; diplopia, eye fatigue, eye pain.

(2) Maximize visual function: assess for use ofglasses, need for environmental adaptations.

(3) Sensory thresholds are increased: allow extra time for visual discrimination and response.

(4) Work in adequate light, reduce glare; avoid abrupt changes in light, e.g., light to dark

(5) Decreased peripheral vision may limit social interactions, physical function: stand directly in front of patient at eye level when communicating with patient.

(6) Assist in color discrimination: use warm colors (yellow, orange, red) for identification and color coding.

(7) Provide other sensory cues when vision islimited: e.g., verbal descriptions to new environments, touching to communicate you are listening.

(8) Provide safety education; reduce fall risk.

Hearing

a. Aging changes:

- occur as early as fourth decade;
- affects a significant number of elderly

(23% of individuals aged 65-74 have hearing impairments and 40% over age 75 have hearing loss; rate of loss in men is twice the rate of women, also starts earlier).

(1) Outer ear: buildup of cerumen (ear wax) may result in conductive hearing loss; common in older men.

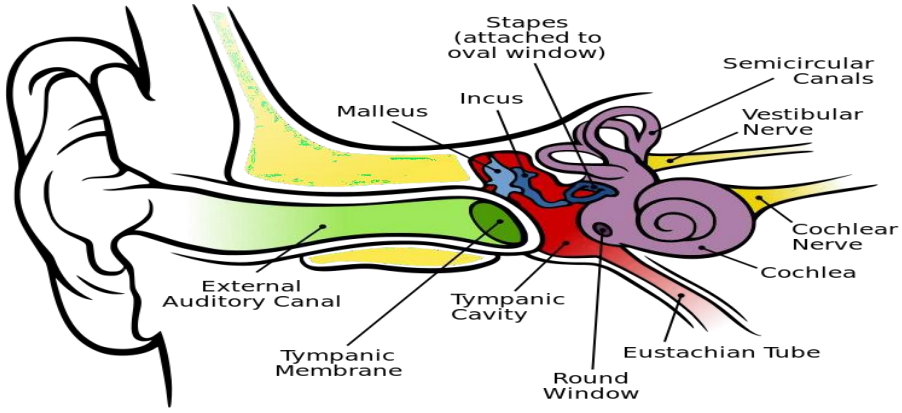
(2) Middle ear: minimal degenerative changes of bony joints.

(3) Inner ear:

- significant changes in sound sensitivity
- understanding of speech

Maintenance of equilibrium may result with degeneration and atrophy of cochlea and vestibular structures, loss of neurons

Hearing (Structure of the ear)



Vestibular /balance control

a. Aging changes:

1. Degenerative changes in otoconia of utricle and saccule.
2. Loss of vestibular hair-cell receptors.
3. Decreased number of vestibular neurons.
4. Vestibular ocular reflex (VOR) gain decreases.
5. Begins at age 30, accelerating decline at ages 55-60.
6. Resulting in diminished vestibular sensation.
7. Diminished acuity, delayed reaction times, longer response times.
8. Reduced function of vestibular ocular reflex (VOR); affects retinal image stability with head movements, produces blurred vision.
9. Altered sensory organization: older adults more dependent upon somatosensory inputs for balance.
10. Less able to resolve sensory conflicts when presented with inappropriate visual or proprioceptive inputs due to vestibular losses.

11. Postural response patterns for balance are disorganized.

b. Additional loss of vestibular sensitivity with pathology.

(1) Meniere's disease:

Episodic attacks characterized by tinnitus, dizziness, and a sensation of fullness or pressure in the ears; may also experience sensorineural hearing loss.

(2) Benign paroxysmal positional vertigo (BPPV):

Brief episodes of vertigo (less than1 minute) associated with position change; the result of degeneration of the utricularotoconia that settle of the posterior semicircular canal; common in older adults.

(3) Medications:

Antihypertensives (postural hypotension); anticonvulsants; tranquilizers, sleeping pills, aspirin, NSAIDS.

(4)**Cerebrovascular disease**:

Vertebrobasilar artery insufficiency (TIAs, strokes); cerebellar artery stroke, lateral medullary stroke.

(5) **Cerebellar dysfunction**:

Hemorrhage, tumors (acoustic neuroma, meningioma); degenerative disease of brainstem and cerebellum; progressive supranuclear palsy.

(6) Migraine.

(7) Cardiac disease.

c. Clinical implications/compensatory strategies.

(1) Increased incidence of falls in older adults.

(2) Refer to section on falls and instability.

Somatosensory changes

a. Aging changes.

(1) sensitivity of touch

- Decreased associated with decline of peripheral receptors,
- atrophy of afferent fIbers
- Lower extremities more affected than upper.

(2) Proprioceptive losses,

- Increased thresholds in vibratory sensibility,
- Beginning around age 50:
- Greater in lower extremities than upper extremities,
- Greater in distal extremities than proximal.

(3) Loss of joint receptor sensitivity;

- Losses in lower extremities,
- Cervical joints may contribute to loss of balance.

b. Additional loss of sensation with pathology

(1) Diabetes, peripheral neuropathy.

(2) CVA, central sensory losses.

(3) Peripheral vascular disease, peripheral ischemia.

c. Clinical implications/compensatory strategies.

(1) **Examine sensation:** check for increased thresholds to stimulation, sensory losses by modality, area of body.

(2) Allow extra time for responses with increased thresholds.

(3) **Use touch to communicate**: maximize physical contact, e.g., rubbing, stroking.

(4) Highlight, enhance naturally occurring intrinsic feedback during movements, e.g., stretch, tapping.

(5) Provide augmented feedback through appropriate sensory channels, e.g., walking on carpeted surfaces may be easier than on smooth floor.

(6) Teach compensatory strategies to prevent injury to anesthetic limbs, falls.

(7) Provide assistive devices as needed for fall prevention.

(8) Provide biofeedback devices as appropriate (e.g., limb load monitor).

Taste and smell

a. **Aging changes**.

(1) Gradual decrease in taste sensitivity.

(2) Decreased smell sensitivity.

b. Additional loss of sensation.

(1) Smokers.

(2) Chronic allergies, respiratory infections.

(3) Dentures.

(4) CVA, involvement of hypoglossal nerve.

c. Clinical implications/compensatory strategies.

(1) Examine ability to identify odors, tastes (sweet, sour, bitter, salty). Somatic sensations (temperature, touch)

(2) Decreased taste, enjoyment of food leads to poor diet and nutrition.

(3) Older adults frequently increase use of taste enhancers: e.g., salt or sugar.

(4) Decreased home safety: e.g., gas leaks, smoke.

Cardiovascular and Pulmonary System

Age-related changes Cardiovascular System

A- Heart muscle

1- accumulation of lipofuscins (brown heart);

2- mild cardiac hypertrophy left ventricular wall.

B- Cardiac valves thicken and stiffen.

C. Changes in conduction system: loss of pace maker cells in SA node.

D. Changes in blood vessels:

1-Arteries thicken,

2- Less distensible;

3- Slowed exchange capillary walls.

4- Increased peripheral resistance.

E. Decline in neurohumoral control.

F- Blood changes

1-Increase blood coagulability.

2-Decrease blood volume.

3- Decrease Coronary blood flow

4- Increase resting hear rate (RHR) systolic greater than diastolic**.**

Clinical implications

A. Cardiovascular responses to exercise:

1- Decrease in heart rate acceleration,

2- Decrease maximal oxygen uptake and heart rate;

3- Reduce exercise capacity, increased recovery time.

4-.Decreased stroke volume

5-Decrease myocardial contractility

B. Maximum heart rate declines with age (HR max = 220-age).

C. Cardiac output decreases, 1% per year after age 20: due to decreased stroke volume.

D. Orthostatic hypotension: due to reduced baroreceptor sensitivity and vascular elasticity. (blood pressure control –regulation) presented on the aortic arch and carotid sinus.

E. Increased fatigue as anemia common in elderly.

F. Systolic ejection murmur common in elderly.

G. Possible ECG change : loss of normal sinus.

2. Rhythm; longer PR & QT intervals; wider QRS.

3. Increased arrhythmias.

Pulmonary System - Age-related changes

A. Chest wall stiffness declining strength of respiratory muscle results in increased work of breathing.

B- Lung changes

1- Elastic recoil decreased

2-Decreased lung compliance

3. Changes in lung parenchyma

4-Alveoli enlarge, become thinner; fewer capillaries for delivery of blood.

C- Pulmonary blood vessels: thicken, less distensible.

D. Lung volume changes

1- Decline in total lung capacity

2- Residual volume increases

3- Vital capacity decreases

4- Forced expiratory volume (air flow) decrease

E. Altered pulmonary gas exchange: oxygen tension falls with age (at a rate of 4mmHg/decade, Pa02 at age 70 is 75, versus 90 at age 20).

F. Blunted ventilatory responses of chemoreceptors in response to respiratory acidosis:

G. Blunted defense/immune responses:

- Decreased ciliary action to clear secretions,
- Decreased secretory immunoglobulins,
- Alveolar phagocytic function.

Clinical implications

a. Respiratory respones to exercise similar to younger adult at low and moderate intensities;

- At higher intensities, responses include increased ventilatory cost of work, greater blood acidosis, increased likelihood of breathlessness, and increased perceived exertion.

Interventions to slow or reverse changes in cardiopulmonary system

a. Examination prior an exercise program is essential.

(1) Exercise tolerance testing protocol (ETT) is important.

(2) Many elderly cannot tolerate maximal testing;

(3) Submaximal testing commonly used.

(4)Testing and training modes should be similar

An exercise program

(1) Choice of training program is based on: fitness level, presence or absence of cardiovascular disease, musculoskeletal limitations, individual's goals and interests.

(2) Prescriptive elements (frequency, intensity,duration, mode) are the same as for younger adults.

(3) Walking, chair and floor exercises, modified strength/flexibility calisthenics well tolerated by most elderly.

(4) Consider pool programs (exercises, walking, swimming) with bone and joint impairments.

(5) Consider multiple modes of exercise (circuit training) on alternate days to reduce likelihood of muscle injury, joint overuse pain, and fatigue.

Aerobic training programs can significant

(1) Decreases heart rate at a given submaximal power output.

(2) Improves maximal oxygen uptake (V02max).

(3) Greater improvements in peripheral adaptation, muscle oxidative capacity then central changes; major difference from training effects in younger adults.

(4) Improves recovery heart rates.

(5) Decreases systolic blood pressure, may produce a small decrease in diastolic blood pressure.

(6) Increase maximum ventilatory capacity: vital capacity.

(7) Reduces breathlessness, lowers perceived exertion.

(8) Psychological gains: improve sense of well- being, self-image.

(9) Improves functional capacity.

Improve overall daily activity levels for independent living

(1) Lack of exercise is an important risk factor in the development of cardiopulmonary diseases.

(2) Lack of exercise contributes to problems of immobility and disability in the elderly.

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Student activities

Course title: P.T for Internal Medicine and Geriatrics. level : Third

Academic year: 2024/2025 - First semester

Student name: …….. ID #:……Lab section #:…….

1. **Attendance**

Lectures														
Practical sections														

2. **Quizzes :**

Quiz 1	**Quiz 2**	**Quiz 3**	**Quiz 4**	**Quiz 5**	**Quiz 6**	**Quiz 7**	**Quiz 8**	**Quiz 9**	**Quiz 10**
Student average mark									

2. Practical assignment:

……..

3. Teamwork research assignment

…….

Student total mark	

Lab section demonstrator **lecturer of the course**

…… **…….**