# Chapter I

# INTRODUCTION

Human are living longer than before with several population life expectancies at birth now exceeding 80 years. The elderly today are living almost 20 years longer than their ancestors at the beginning of the twentieth century. Life expectancy is increasing for men and women alike. Between 1981 and 2001 the number of older people in the population increased by 50%, with an ever greater increase in those aged over 70. Women lives have changed over the centuries. Historically, life was particularly difficult for most women. Aside from the numerous dangers and diseases, women became wives and mothers often when they were just emerging from their own childhood. Most women in the past did not live long enough to be concerned about menopause or old age. Men born in 2020 can expect to live to 79 years and women to 87 years **(Gibney, et al., 2007).**

There are currently over 32 million post menopausal women in the united states, and an estimated 700 million women 45 years of age and older in the world **(Mary Ireland and Aurelia Nattiv, 2003).**

Not only are women living longer, but they also have the possibility of enjoying a better quality of life throughout their span of years. But to do this, it is essential that women take charge of their own bodies and comprehend how they can maximize their health and fitness.

## 1.1 WOMEN HEALTH

Women health status varies widely both within and among countries because of such factors as local disease prevalence, health related behaviours and women educational attainment, exposure to health information influence on decision making, and access to health care. Poverty, environmental degradation, civil conflict, and migration also influence women health **(Paltiel and Freda, 1993)**.

Women health is broadly defined as biophysical, emotional, socioeconomic, political, cultural, and spiritual well-being. Three elements characterize a new perspective on women's health. First, health is viewed as the product of cultural, social, biological, psychological and other factors. Gender-based social inequalities are understood as a basis for identifying health issues specific to women. Second, women's health is viewed from a life span and multirole perspective, with the implication that overall health includes, but is not defined by, reproductive health. Third, health is more than the absence of disease; it includes health promotion and health maintaining strategies by both the individual and society **(Weisman and Changing, 1997)**.

The health concerns associated with aging are critical for women since they live longer with chronic illness and disability. Disease, rather than normal aging, usually accounts for loss of function in the mature woman. Nothing can be done about the passage of years, but a great deal can be done throughout women life to prevent and treat the diseases that keep from being in the best possible health.

As a result of urbanization, migration, and changing family structure, women are increasingly neglected in their old age. The cumulative effects of a lifetime of nutritional deprivation, hazardous and heavy work, continuous childbearing and low self-esteem leaves them both physically and mentally frail, while abandonment and widowhood often leave them destitute. Because of their tendency to marry men older than themselves, as well as their longer life expectancy, women are more likely than men to be widowed. Loss of a partner and living alone may have important health implications.

Most of the problems affecting women after the age of 45 are chronic. Injuries and infections also contribute to women disability in their later years, as do malnutrition, anaemia, and loss of visual acuity. Menopause leads to alterations in the skeletal, cardiovascular, nervous, skin, genitourinary, and gastrointestinal systems and can affect women capacity to perform everyday activities. The health problems of postmenopausal women, however, continue to be largely ignored.

## 1.1.1 Cardiovascular and Cerebrovascular Disease

Cardiovascular diseases include many among them ischemic heart disease, myocardial infarction, and cerebrovascular disease are the leading cause of death among adults age 45 and older in developing countries and represent a higher proportion of the disease burden among women than men in this age group.

### 1.1.2 Diabetes

Among urban women in Asia, where obesity and inadequate exercise are becoming more common, the prevalence of diabetes mellitus is growing. Diabetes is a major cause of morbidity and can lead to blindness, kidney damage, and damage to the lower limbs.

### 1.1.3 Osteoporosis and Osteoarthritis

Osteoporosis is most common in women beyond reproductive age because bone loss rises sharply after menopause. Insufficient calcium, inadequate exercise, smoking, and excessive consumption of alcohol are contributing factors.

During and after menopause, women are particularly prone to the development of osteoarthritis, a painful degenerative joint disease.

### 1.1.4 Under Nutrition

In the poorer developing countries, chronic malnutrition is common among women, often reflecting a lifetime of inadequate intake of calories, vitamins, and minerals. In times of food shortage, elderly women are often most adversely affected.

### 1.1.5 Gynecological Cancers

These may occur during the reproductive years, but they are more prevalent after age 40. Cancers of the cervix and breast are the most common.

There is credible information available to women not only on such problems as eating disorders, stress, alcoholism, addictions, and depression, but also on basic topics such as good nutrition, heart health, and exercise. For example, it is beneficial that a woman maintain the optimum weight. If a woman's waist size measures more than 35 inches, one is more likely to develop heart disease, high blood pressure, and diabetes.

Not only does the mature woman often have to deal with osteoporosis, diabetes, hypertension, cancer and heart disease, but one can also confronted with a myriad of other health problems including hearing loss, eye problems, incontinence, insomnia, memory loss, and sexual dysfunction **(Fauci, et al., 2008)**.

## 1.2 WOMEN IN RURAL INDIA

Women are generally more scrutinized in rural areas where 73 percent of the poor live. Women need more high-quality nutrients when they are pregnant or nursing. Malnutrition is high among women. A third of rural women were underweight and more than half were anaemic in 2005–06. Pregnancy and lactation in adolescent girls impedes growth, leading to weight loss and low BMI **(Rah, et al., 2008).**

In 2005– 06, about 20 per cent of rural women between the ages of 15 and 19 were either pregnant or already mothers (National Family Health Survey-3). Poor maternal nutrition, in turn, affects child health as nutritional disadvantage begins during the intra uterine period. About a third of Indian

infants are born underweight and around a fifth stunted **(Mamidi, et al., 2011 & Ramchandran and Gopalan., 2011).**

Economic factors, social and cultural differences, limited educational opportunities, lack of recognition by legislators, and the isolation of living in remote areas all impact rural residents' ability to lead a healthy life **(Sara Beth Mueller, et al., 2009)**.

## 1.3 MENOPAUSE

Menopause is a natural part of a women life. Menopause is the permanent cessation of menstruation resulting from the loss of ovarian follicular activity. It is a stage when the menstrual cycle stops for longer than 12 months and there is a drop in the levels of estrogen and progesterone, the two most important hormones in the female body **(World Health Organization, 1996)**.

Although menopause is a universal phenomenon, there is a considerable variation among women regarding the age of attaining menopause and the manifestation of menopausal signs and symptoms. Worldwide, the estimates for the median age at menopause range from 45 to 55 years **(Bernis and Reher., 2007)**.

The onset of this physiological development not only marks the end of women's reproductive function but also introduces them to a new phase of life. During the transition to menopause, women may experience vasomotor, urogenital, psychosomatic, and psychological symptoms, as well as sexual dysfunction. The prevalence of each of these symptoms related to

menopause varies across ethnic and socioeconomic groups, and between rural and urban women **(Malacara, et al., 2002)**.

### 1.3.1 Stages of Menopause

Stages and nomenclature of the menopausal transition were defined by experts in 2001 at the Stages of Reproductive Aging Workshop (STRAW). The group recognized seven stages of the reproductive aging continuum, and acknowledged that most women do not progress precisely through each stage. These stages are also described by the following terms:

1. **Premenopause:** the time up to the beginning of the perimenopause, but is also used to define the time up to the last menstrual period.

2. **Perimenopause:** the time around menopause during which menstrual cycle and endocrine changes are occurring but 12 months of amenorrhea has not yet occurred

3. **Postmenopause**: begins at the time of the last menstrual period, although not recognized until after 12 months of amenorrhea.

Post menopause is defined as dating from the first year after menopause, regardless whether the menopause was induced or spontaneous. The term induced menopause is defined as the cessation of menstruation which follows either surgical removal of both ovaries or iatrogenic ablation of ovarian function **(Shalini Rajaram., 2008)**.

## 1.4 POST MENOPAUSE WOMEN

Increasing life expectancy had led to an increasingly elderly population. Now women spend a third of their lives in the estrogen deficit postmenopausal state **(Shalini Rajaram, et al., 2008)**.

Postmenopausal women throughout the world are facing an ever increasing burden of responsibilities; as caregivers to the young and old, bread winners preparing for retirement and contributors to the welfare of the communities in which they live. Another, more insidious, burden is being imposed upon mothers and grandmothers, sisters and aunts, and wives and partners.

Post Menopause is the stage following menopause generally starts between 24 and 36 months after a women's last menstrual period. Outwardly, the most marked difference between menopause and Post menopause is different in every woman. The age after menopause varies significantly and so does the cessation, or lack thereof, of the symptoms. The problem with waiting for menopause to pass is the uncertainty of the time frame and the severity of the symptoms. The ovaries of postmenopausal women are small, and the residual cells are predominantly stromal in type. Estrogen and Androgen levels in plasma are reduced but not absent from circulation **(Wilson, et al., 1991)**.

A hot flash or flush refers to the spontaneous sensation of warmth, often associated with perspiration, resulting from a vasomotor response to declining estrogen levels. Night sweats are hot flashes or flushes occurring

at night, often while sleeping. Other symptoms, such as vaginal dryness, sleep disturbance, mood symptoms, cognitive disturbances, somatic complaints, urinary complaints, uterine bleeding problems, sexual dysfunction, and reduced quality of life are also attributed to the menopausal transition **(Soules, et.al., 2001)**.

Furthermore, while post menopause may bring relief from, menopause symptoms unbalanced hormones put subject at risk for certain conditions up to 20% bone mineral density can be lost at menopausal; which can sharply increase risk of osteoporosis and bone fractures. The loss of estrogen at menopause also cause LDL cholesterol levels in the blood to rise and levels of HDL cholesterol to fall, increasing risk of heart attack and stroke **(Michael Zimmermannn, 2001)**.

The physiological and psychological changes in menopause have an impact on food intake and nutritional status of women **(Karnataka Journal, 2008)**.

## 1.5 MENOPAUSAL SYMPTOMS

The important symptoms and the health concerns of menopause are

### 1.5.1. Vasomotor Symptoms

The characteristic symptom of menopause is hot flush Hot flush is characterised by sudden feeling of heat followed by profused sweating. There may also be symptoms of palpitation, fatigue ,and weakness Vasomotor symptoms affect up to 75% 0f perimenopausal women. Symptoms last for 1-2 years after menopause in most women, but may continue for up to 10 years or long in others **(Berek and Novaks, 2007)**.

### 1.5.2. Urogenital Symptoms

Urogenital complaints such as vaginal discomfort, dysuria, dyspareunia and recurrent lower urinary tract infections are more common in women after the menopause and more than 50% of postmenopausal women suffer from at least one of these symptoms and hence Post menopausal women may develop problems with urination **(Julia Schlam Edelman, 2009).**

### 1.5.3. Sexual Dysfunction

Interest in sexual activities declines in both men and women with increasing age and this change appears to be more pronounced in women. Female sexual dysfunction consists of decreased sexual desire, decreased sexual arousal, dyspareunia **(Shaw, et al., 2003)**.

### 1.5.4. Psychological Changes

There is increased frequency of anxiety, head ache, insomnia (sleeplessness), irritability, dysphagia and depression. Women also suffer from dementia (due to oestrogen deficiency), mood swing, Loss of confidence and inability to concentrate. Alzheimer disease is most common in post menopausal women.

### 1.5.5. Skin Changes

There is substantial evidence that oestrogen influence epidermis and dermis. This hormone preserves collagen content and thickness. Skin ageing in women is of due to combination of factors including intrinsic biological ageing, extrinsic damage, particularly ultraviolet radiation and oestrogen

deficiency. In post menopausal women the level of oestrogen is less. This may result in few skin wrinkles and dry skin **(Ransom, et al., 2000).**

### 1.5.6. Cardiovasular Diseases

The primary end points of cardiovascular disease are Myocardial infarction and cerebrovascular accident. For women cardiovascular disease is largely a disease of post menopause. Oestrogen is cardio protective in maintaining high level of High Density Lipoproteins and lowering the Low Density Lipoproteins and Triglycerides. Oestrogen deficiency can cause atherosclerosis, ischemic heart diseases and Myocardial infarction. Obese women with hypertension, previous thromboembolic episodes are liable to cerebrovascular accident **(Howkins and Bourne, 2004).**

### 1.5.7. Osteoporosis and Fracture

After menopause there is decline in collagenous bone matrix resulting in osteoporotic changes. Osteoporosis is reduced bone mass per unit volume of bone with normal ratio of mineral to matrix without any abnormality in the mineral or matrix composition. Osteoporosis may be Type I (primary) due to oestrogen loss, age, deficient nutrition (calcium, vitamin D) or hereditary. It may be Type II (secondary) to endocrine abnormalities (parathyroid, diabetes) or medication.

Worldwide, osteoporosis causes more than 8.9 million fractures annually, resulting in an osteoporotic fracture every 3 seconds. Osteoporosis is estimated to affect 200 million women worldwide - approximately one-tenth of women aged 60, one-fifth of women aged 70, two-fifths of women aged 80 and

two-thirds of women aged 90. Osteoporosis affects an estimated 75 million people in Europe, USA and Japan. Worldwide, 1 in 3 women over 50 will experience osteoporotic fractures, as well 1 in 5 men 80%, 75%, 70% and 58% of forearm, humerus, hip and spine fractures, respectively, occur in women. Overall, 61% of osteoporotic fractures occur in women, with a female-to-male ratio of 1.6 Post menopausal osteoporosis is seen in women within 15-20 years after menopause the bone loss is mainly trabecular with fractures mainly of vertebrae and distal radius with a female to male ratio of 6:1 and is mainly attributed to estrogen deficiency **(Kulkarani,1999)**.

The **World Health Organization** has developed definitions for low bone mass (osteopenia) and osteoporosis. These definitions are based on a T-score. The T-score is a measure of how dense a patient's bone is compared to a normal, healthy 30-year-old adult.

## Normal Bone Mineral Density Value

A bone Bone mineral density is considered normal if the T-score is within 1 standard deviation of the normal young adult value. Thus a T-score between 0 and -1 is considered a normal result. A T-score below -1 is considered an abnormal result.

## Low Bone Mass (Medically Termed Osteopenia)

A Bone mineral density defines osteopenia as a T-score between -1 and -2.5. This signifies an increased fracture risk but does not meet the criteria for osteoporosis.

**Osteoporosis**

A Bone mineral density greater than 2.5 standard deviations from the normal (T score less than or equal to -2.5) defines osteoporosis.

Postmenopausal women provide the back-bone to families throughout the world; maintaining a strong skeleton will enable them to continue to do so.

## 1.6 HORMONES AND MENOPAUSE

### 1.6.1. The Adrenals and Menopause

Menopause should occur without difficulties if the adrenal and thyroid glands function normally. In fact, it should be a time of great joy, ease and even relief for women who have been concerned with unwanted pregnancy or perhaps plagued by symptoms related to premenstrual tension, heavy menstrual bleeding, or other symptoms.

The sources of precursors for estrogens, testosterone and progesterone are produced by the adrenal glands in postmenopausal women, it seems reasonable to assume that optimal adrenal gland function is needed for a smooth menopausal transition and to remain symptom free during postmenopausal years **(Nair, et al., 2006)**.

Many women today have a condition that is termed adrenal insufficiency. This is basically under activity of the adrenal glands. These women adrenals do not respond correctly to the new need for sex hormones in response to diminished ovarian hormone secretion. The causes of weakened adrenals include stress of any kind, nutritional deficiencies and almost always a build-up of toxic substances. At times, an imbalance of the autonomic nervous system is

at fault as well. This can cause the adrenals to malfunction, secreting either too much or too little or the incorrect balance of hormones.

If the adrenal and thyroid glands are not functioning well, many women experience hot flashes, fatigue, irritability, depression and perhaps some vaginal dryness at menopause. Also, their risk for osteoporosis and some cancers increases.

### 1.6.2. The Thyroid Gland and Menopause

Thyroid imbalances are very common and definitely affect female hormone regulation in the body. The thyroid produces thyroxin, powerful hormones that affect the burning of sugar or glucose in the body and in so doing regulates the rate of metabolism, body temperature and much more. It is such a critical hormone that many people are given thyroid hormone replacement when they feel tired, cold, short of breath or have thin, brittle or falling hair. Low thyroid activity can also cause weight gain and many more problems for a person. The risk of developing thyroid disease increases with increasing age, elderly women have a particularly high risk for such disorders. The majority of post-menopausal women with thyroid disorders will have either no or very subtle symptoms and have what is known as asymptomatic thyroid disease (Schindler, 2003).

### 1.6.3. Estrogen and Menopause

The estrogenic hormones are uniquely responsible for the growth and development of female sexual characteristics and reproduction in both humans and animals. The term "estrogen" includes a group of chemically

similar hormones: estrone, estradiol (the most abundant in women of reproductive age) and estriol. Overall, estrogen is produced in the ovaries, adrenal glands and fat tissues. More specifically, the estradiol and estrone forms are produced primarily in the ovaries in premenopausal women, while estriol is produced by the placenta during pregnancy.

In women, estrogen circulates in the bloodstream and binds to estrogen receptors on cells in targeted tissues, affecting not only the breasts and uterus, but also the brain, bone, liver, heart and other tissues. Estrogen controls growth of the uterine lining during the first part of the menstrual cycle, causes changes in the breasts during adolescence and pregnancy and regulates various other metabolic processes, including bone growth and cholesterol levels. Estrogen acts to help keep Calcium in the bony matrix to maintain strength **(Mary Ireland and Aurelia Nattiv, 2003).**

### 1.6.3.1 Bone

Estrogen produced by the ovaries helps prevent bone loss and works together with calcium, vitamin D and other hormones and minerals to build bones. Osteoporosis occurs when bones become too weak and brittle to support normal activities.

Body constantly builds and remodels bone through a process called resorption and deposition. Up until around age 30, the body makes more new bone than it breaks down. But once estrogen levels start to decline, this process slows. Thus, after menopause body breaks down more bone than it rebuilds. In the years immediately after menopause, women may lose

as much as 20 percent of their bone mass. Although the rate of bone loss eventually levels off after menopause, keeping bone structures strong and healthy to prevent osteoporosis becomes more of a challenge.

### 1.6.3.2 Vagina and Urinary Tract

When estrogen levels are low, as in menopause, the vagina can become drier and the vaginal walls thinner, making sex painful. Additionally, the lining of the  urethra, the tube that brings urine from the bladder to the outside of the body, thins. Urinary symptoms such as urinary incontinence, urgency and frequency are highly prevalent in postmenopausal women. The women are also at high risk of having cystitis syndrome **(Michael Karasek, 2006)**.

Other physical and emotional changes are associated with fluctuating estrogen levels during the transition to menopause, called perimenopause. This phase typically lasts two to eight years. Estrogen levels may continue to fluctuate in the year after menopause.

### 1.6.4. Androgens and Menopause

In women, androgens are produced in the ovaries, adrenal glands and fat cells. In fact, women may produce too much or too little of these hormones disorders of androgen excess and deficiency are among the more common hormonal disorders in women.

In women, androgens play a key role in the hormonal cascade that kick-starts puberty, stimulating hair growth in the pubic and underarm areas. Additionally, these hormones are believed to regulate the function of many

organs, including the reproductive tract, bone, kidneys, liver and muscle. In adult women, androgens are necessary for estrogen synthesis and have been shown to play a key role in the prevention of bone loss, as well as sexual desire and satisfaction. They also regulate body function before, during and after menopause.

In postmenopausal women, there is a reduction of circulating androstenedione to approximately 50% of the concentration found in young women reflecting the absence of follicular activity **(Decherney and Pernoll, 1994).**

### 1.6.5. Progesterone and Menopause

This hormone is produced in the, ovaries, the placenta (when a woman gets pregnant) and the adrenal glands. It helps prepare the body for conception and pregnancy and regulates the monthly menstrual cycle. It also plays a role in sexual desire. During perimenopause (the menopause transition phase, which can last six years or more and ends one year after the final menstrual period), hormone levels fluctuate and decrease, causing irregular ovulation and menstruation, as well as bothersome symptoms like hot flashes. In post menopausal women ,the levels of progesterone are only 30% of the concentration seen in young women during the follicular phase. Progestrone deficiency can cause bone loss, thinning hair and facial whiskers **(Ann Louise Gittleman, 1998).**

### 1.6.6. Gonadotropins and Menopause

Luteinizing hormone (LH) and follicle-stimulating hormone (FSH) are called gonadotropins. The main functions of follicle-stimulating hormone and

Luteinizing hormone are follicular maturation and ovulation. In postmenopausal women and men with primary hypogonadism, gonadal failure results in a marked increase in follicle-stimulating hormone and Luteinizing hormone concentrations.

## 1.7 WEIGHT GAIN AND MENOPAUSE

A post-menopausal woman has a problem of "unexplained" weight gain. Weight gain was experienced by women going through both natural and surgically induced menopause. Extra pounds that show up at menopause may be due to lack of progesterone and the consequent estrogen dominance. Estrogen that is not balanced by an adequate amount of progesterone causes weight gain. Another reason for weight gain is that during the first ten days to two weeks of menstrual cycle bodies use up a substantial number of calories in the process of ovulation. So when women enter menopause they are left with extra calories, up to 300 daily in some cases, that are not being burned **(Ann Louise Gittleman ,1998).**

## 1.8 FIBROIDS AFTER MENOPAUSE

Fibroids are innocuous estrogen dependent benign tumours occurring in the uterus. Myomas commonly regress after menopause, which is accompanied with an atrophic endometrium and cessation of uterine bleeding. Postmenopausal women on hormone therapy, however, may experience persistence of abnormal uterine bleeding. It has been reported that postmenopausal women with submucosal myomas using hormone therapy experience a twofold increase in the incidence of abnormal bleeding as compared with the women with no submucosal myomas **(Stewart, et al., 2006).**

## 1.9 WOMEN SPECIFIC CANCER AFTER MENOPAUSE

Starting menopause after age 55 increases a woman's risk of breast cancer and endometrial cancer because of exposure to more estrogen. During menstrual cycle, estrogen stimulates the uterus and breast tissue. So the more menstrual periods a woman has, the longer these tissues are exposed to estrogen. Women who start menopause later also may have an increased risk of ovarian cancer possibly because they have had more ovulations. Age at menopause is an established risk factor for breast cancer **(Sweeney, et al., 2004).**

Eating sensible meals, eliminating after dinner snacks, and making physical activity a part of daily life are significant ways to help control weight and lower the risk of a long list of health problems.

## 1.10 NUTRITION

Nutrition is a key element in any strategy to reduce the global burden of disease. Nutrients are the constituents in food that must be supplied to the body in suitable amounts. They include carbohydrates, fats, proteins, minerals, vitamins, and water. The nutrition status of communities is a reflection of our individual nutritional health. Perhaps the most significant factor affecting the nutritional status of communities is economics. Depending on a persons living situation, available food supply, and health condition, individual nutritional status varies.

### 1.10.1 Ideal Nutrition

Evidence of optimal nutrition is well developed body, ideal weight for body composition and height, and good muscle development and tone. The skin is smooth and clear, the hair is glossy, and the eyes are clear and bright. Appetite, digestion, and elimination are normal. Well nourished persons are much more likely to be alert, mentally and physically. They are not only meeting their day- to- day needs but also are maintaining essential nutrient reserves for resisting infectious diseases and generally extending their years of normal functioning **(Sue Rodwell Williams, 1993).**

### 1.10.2 Nutritional Status

Nutritional status is the condition of health of the individual influenced by the utilisation of the nutrition. Good nutritional status refers to the intake of a balanced diet containing all the essential nutrients to meet the body's requirement for energy, maintenance and growth. There is not one single parameter that serves as the only and best parameter to discover malnourished individuals.

### 1.10.3 Nutritional Assessment

Assessment of nutritional status of community is one of the first steps in the formulation of any public health strategy to combat malnutrition. The principle aim of such an assessment is to determine the type, magnitude and distribution of malnutrition in different geographical areas, to in identify 'at risk' groups and to determine the contributory factors. In addition, factual evidence of the exact magnitude of malnutrition is essential to sensitise administrators

and politicians to obtain allocation of material and human resources and to plan appropriately **(Srilakshmi, 2011)**.

The most important goals of Nutritional Assessment are as follows

1) In time discovery of malnourished individuals or individuals at risk, so the dietician can start the nutritional treatment as soon as possible.

2) To determine the quantity of malnutrition, so an adequate definition of the individual nutritional need is possible.

3) Diagnostic purposes.

4) Monitoring of changes in nutritional state during nutritional intervention.

5) Collecting data for scientific research.

6) Attention for the nutritional status of an individual in the hospital.

7) Improvement of accomplishment of Nutritional Assessment measurements **(Edington, 1999)**.

Nutritional Assessment Components are indicated below

1) Review dietary intake for factors affecting health conditions and nutrition risk.

2) Evaluate health and diseases condition for nutrition related consequences.

3) Evaluate psychosocial, functional, and behavioural factors related to food access, selection, preparation, physical activity, and understanding of health condition.

4) Evaluate groups knowledge, readiness to learn, and potential for changing behaviours.

5) Identify standards by which data will be compared.

6) Identify possible problem areas for making nutrition diagnoses **(Michele Grodner, et al., 2007)**.

## 1.11 FOOD GUIDE PYRAMID

In 2005 the U.S Department of Agriculture (USDA) released a food pyramid called "MyPyramid".

The design of MyPyramid consists of vertical coloured stripes. Each colour has a different size, suggesting the amount of food that one should choose from each group. The figure on the stairs is there to remind the importance of physical activity.

### 1.11.1 Grains and Cereals

My Pyramid recommends that at least 50% of the grains should be whole grain. Eat at least 3 ounces of whole grain breads, crackers, cereals, crackers, rice or pasta every day.

1 ounce= 1 slice of bread, or 1 cup of breakfast cereal.
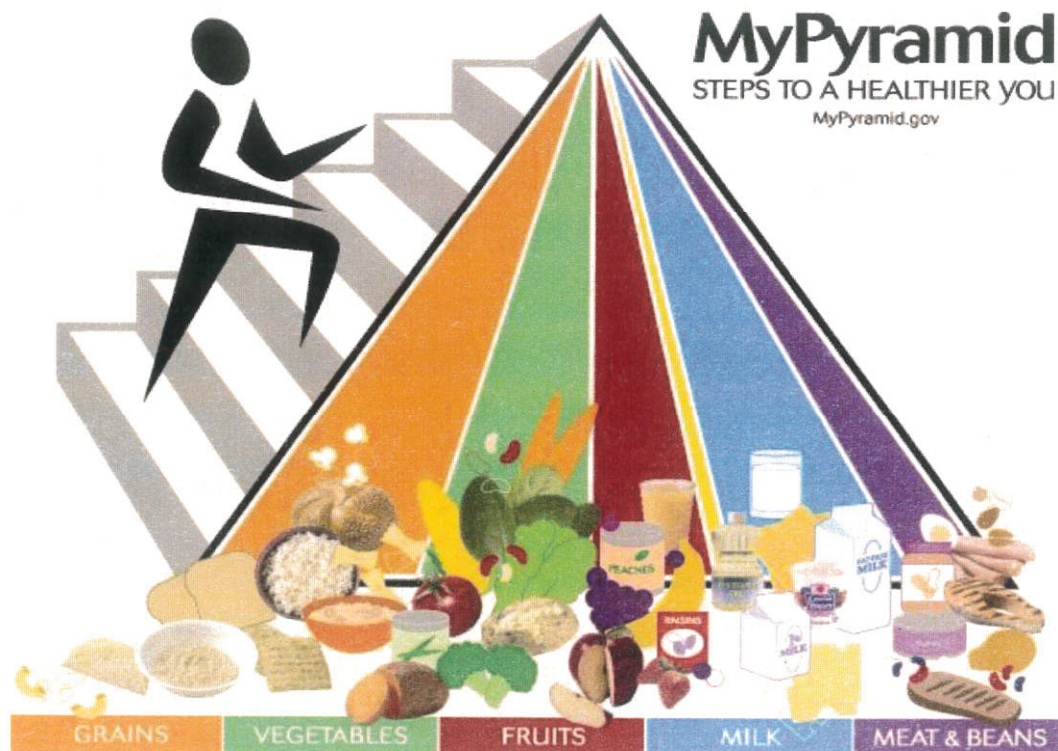
### 1.11.2 Vegetable

My Pyramid recommends eating more of the dark green and orange veggies and more of the dry beans and peas. The amount of vegetables one need to eat depends on ones age, sex and level of physical activity. For adults 2 1/2 cups of vegetables and 2 cups of fruit per day is recommended for a reference of 2000 calorie intake, with higher or lower amounts depending on the calorie level.

1 cup=1 cup of raw/cooked vegetables, or vegetable juice.1 cup=2 cups of raw leafy greens.

### 1.11.3 Fruits

MyPyramid recommends that one should eat a variety of fruits. Chose fresh, frozen, canned or dried fruit. For adults2 cups of fruit and 2 1/2 cups of vegetables per day is recommended for a reference of 2000 calorie intake, with higher or lower amounts depending on the calorie level.

1 cup= 1 cup of fruit, or 100% fruit juice, or 1/2 cup of dried fruit

Fruit contains many important vitamins and minerals that most people don't generally get in their regular diet. Fruit is a good source of fibre and contains very little fat. Eat at least two-three fruits a day.

### 1.11.4 Oils

My Pyramid recommends that most of the fat should come from fish, nuts and vegetable oils. Keep total fat intake between 20-35% of calories with most fats from polyunsaturated and monounsaturated fatty acids. Oils from plant

sources (vegetable and nut oils) are better for ones health since they do not contain any cholesterol. One should limit solid fats like butter and margarine.

### 1.11.5 Milk and Milk Products

My Pyramid recommends 3 cups per day of fat-free or low-fat milk, or milk products for adults. Milk, yogurt and cheese are all rich in calcium.

### 1.11.6 Meat, Eggs and Nuts

My Pyramid recommends that one should choose low-fat or lean meats and poultry. Bake it, broil it or grill it. Eat more fish, beans, peas, nuts and seeds. They contain healthier unsaturated fats, Salmon, trout and herring are high in omega-3 fatty acids, which are good for your health. Flax and walnuts are excellent sources of essential fatty acids. Sunflower seeds, almonds, hazelnuts are good sources of vitamin E. 2 servings or fish per week (8 ounces total) may reduce the risk of mortality from coronary heart disease.

### 1.11.7 Physical Activity

The figure on the stairs is there to remind the importance of physical activity. My Pyramid recommends that adults should engage in physical activity (above usual activity) for at least 30 minutes every day, or most days.

## 1.12 ESSENTIAL NUTRIENTS EVERY WOMAN NEEDS DURING MENOPAUSE

Around the time of the menopause oestrogen hormone is diminishing. To help body adapt, one should ensure getting enough of the right foods to provide specific nutrients to keep one healthy during the menopause and beyond. A healthy, nutritious diet will help support a healthy menopause and general health during this time.

### 1.12.1 Calcium and Vitamin D

During menopause dietary needs changes. Calcium requirements go back up to teen levels from 1,000 to 1,500 milligrams a day. Foods high in calcium: Milk, yogurt, cheese, tofu, fortified orange juice.

It is important for menopausal women to get enough calcium. "If there is not enough dietary calcium, the body will take calcium from the bones to use for nerves, muscles, and the heart. Estrogen helps deposit calcium in the bones. Menopausal women start losing their bone mass without estrogen."

In older women, calcium supplementation is associated with higher bone mineral density, by around 1-3%, and with reductions in bone loss in the first 1-2 years after supplementation is started.

Vitamin D is obtained from either diet or by endogenous production in the skin by the action of sunlight. Like calcium, vitamin D is important for retaining bone mass. It helps the body to absorb calcium and helps with bone vitamin D women need 400 international units (IU) for women 51-70 years, 600 IU for women over 70 years. Foods high in vitamin D are Fish, milk, fortified cereals (Melinda Johnson, 2009).

Vitamin D is important not only for bones, but also for immune function and muscle strength, and as a cell differentiator to reduce the risk of neoplastic disease.

### 1.12.2 Fiber

Fiber helps reduce the risk of coronary heart disease, diabetes, diverticulosis, and irritable bowel syndrome. One should be able to get the recommended 21 grams per day by eating a healthy diet with plenty of fruits, vegetables, and whole grains.

One common health problem for women over 50 is high blood pressure and high cholesterol. DASH (Dietary Approaches to Stop Hypertension) diet is recommended, which focuses on lowering sodium and eating fruits, vegetables, and low fat dairy. "A dietary approach and losing weight can lower cholesterol 20% to 30%.

### 1.12.3 Nutrients that Help in Hormone Balance

Phytoestrogens such as soy Is flavones found in soya beans, tofu, soya milk, soya flour and other soya based products are associated with a wide range of positive health benefits. Soy's two prominent is flavones are genistein and daidzein. 'Phytoestrogens' may help to maintain health at menopause. As for symptoms of menopause, phyestrogens may alter a women monthly hormonal cycle in ways that may reduce the risk of adult bone loss and the sensation of elevated body temperature known as hot flash common in menopause **(Frances Sienkiewicz Sizer, et al.,2012).**

Beneficial effects of soya through diet were originally highlighted by studies showing substantial differences between high intakes (asian) versus low intake (western) of dietary soya. Studies show that soy proteins may help support healthy High density Lipoprotein (HDL) cholesterol, having a positive

influence on heart health. New research demonstrates that soy isoflavones also act as antioxidants helping to inhibit the production of free radicals, which are associated with ageing.

Gamma Linolenic Acid (G.L.A) is an essential fatty acid found primarily in vegetable oils in the diet such as evening primrose oil, blackcurrant seed oil, borage oil and hemp seed oil. Gamma Linolenic Acid is the precursor for the production of the protective and calming prostaglandin which helps regulate hormonal balance and support menopausal health. Gamma Linolenic Acid Synthesis two minerals, zinc and magnesium, and three vitamins, namely vitamin C, vitamin B6 and niacin for prostaglandin systhesis, and are essential for the natural synthesis .of Gamma Linolenic Acid from Linolenic Acid and its conversion to prostaglandins. Gamma linolenic acid is also necessary for the normal functioning of the reproductive system and the adrenal glands, a source of post menopausal hormones **(Ann Louise Gittleman, 1998)**.

## 1.12.4 Diet and Bone Health

As oestrogen levels diminish in the female body during the menopause, bone density may lessen and can contribute to osteoporosis (brittle bones). Increasing calcium intake (in milk, yoghurt, cheese, sardines or small fish with bones, vegetable such as; broccoli, as well as nuts and seeds) may help support a healthy bone density. To ensure that the calcium is fully absorbed and deposited in the bones, it should be combined with foods rich in phosphorus such as (peanuts, meat, cheese, onions, garlic) and combined with vitamin D (in oily fish, lentils, eggs and brown rice).

Enzymes are biomolecules that catalyse, in other words, increase the rates of chemical reactions in the body. They are important because they help with many essential chemical processes within the body. Over 300 enzymes require the presence of magnesium for their catalytic action, including all enzymes utilizing or synthesizing Adenosine Tri Phosphate (energy in cells). Adult human bodies contain about 24 grams of magnesium, with 60% in the skeleton. Magnesium appears to facilitate calcium absorption and is found in fish like halibut, nuts, cereals, grains, seeds and vegetables (especially green leafy ones).

Avoid drinking tea and fizzy, carbonated drinks with meals and steer clear of high protein slimming diets which can all interfere with calcium absorption. Consumption of coffee and other hot drinks and of hot, spicy foods and eating large meals appear to trigger hot flashes in some menopausal women **(Ann Louise Gittleman, 1998)**.

## 1.12.5 Maintaining a Strong Immune System during Menopause

Nutrients that are important in immune function include protein, zinc, Vitamin A, Vitamin C, pyridoxine, riboflavin and tocopherols **(Gibney, 2007)**. Selenium and vitamins A, C and E act through their antioxidant action, while zinc, magnesium and copper act as co-factors in antioxidant enzymes.

Immune system nutrients found in certain foods

**Zinc:** shellfish, liver, oxtail and corned beef, chickpeas, pumpkin seeds, nuts, whole grains and cheese.

**Iron:** Heme-Iron from; meat and fish sources beef, pork, lamb, eggs and seafood, (pick red meats that are lean). Non-heme iron from: green leafy vegetables, spinach, asparagus, broccoli, collard greens, mustard greens, kale, parsley, cabbage, dried beans and certain fortified foods cereals, oatmeal. Dried fruits apricots, raisins, dates prunes, figs.

**Copper:** Liver, sesame seeds, raw cashews, soybeans, barley, raw sunflower seeds.

**Selenium:** Brazil nuts, wheat germ, kidney and liver, oily fish including tuna, sunflower seeds, lentils, cashew nuts).

## 1.12.6 Antioxidants

Oxidative stress is caused by an imbalance between the production of reactive oxygen and a biological system's ability to detoxify or easily repair the resulting damage, i.e. in tissues. Free radicals can be created and cause damage to the cell, including proteins, lipids, and DNA. Free Radicals are an important factor in the ageing process and are constantly formed in most cells and tissues. They are typically scavenged by antioxidants such as vitamins A, C, and E; these antioxidants may help support the body from free radical damage.

Vitamin E is thought to help maintain the heat regulation capacity of the body and reduce the breakdown of the body's progesterone, hence it may help to maintain a healthy body temperature as well as have benefits to the cardiovascular system. In menopausal women vitamin E has been recognised for its effectiveness against hot flashes for close to fifty years **(Ann Louise Gittleman, 1998).**

Antioxidant vitamins found in certain foods

**Vitamin A**: liver (beef, pork, chicken, turkey, fish), carrots, broccoli especially in the leaves, sweet potatoes, kale, butter, spinach and leafy vegetables and pumpkin.

**Vitamin C:** colourful fruit and vegetables such as rose hips, oranges, kiwi, lemon, berries like blackberries, blueberries, strawberries, peppers, sprouts, kale and spring greens.

**Vitamin E:** avocado, nuts such as almonds or hazelnuts and seeds. Spinach and other green leafy vegetables. Vegetable oils like sunflower and olive oil. Wheat germ, wholegrain foods, milk and asparagus.

Some of the diseases that women are particularly vulnerable to is cardiovascular disease, Osteroporosis, depression, rheumatoid arthritis can be favourable influenced by nutrition or specific foods or food components. Diets low in saturated fat, rich in fibre, whole grains, n- 3 fatty acids, fruits and vegetable are protective against cardiovascular disease. Similarly bone health is influenced by calcium and vitamin D intakes throughout the life cycle.

In addition calcium improved the efficacy of hormone replacement therapy at preserving bone mass in post menopausal women. Mental health outcomes such as depression score are improved with vitamin supplementation, particularly folate & omega 3 fatty acids.

Many diseases are thought to occur as a result of inflammatory responses. Thus n 3 fatty acids, particularly long chain PUFA abundant in

fish oil have been the subject of extensive investigations in variety of diseases including cardiovascular disease, osteoporosis, and inflammatory bowel disease **(Lilian, et al.,2007).**

### 1.12.7 Other Nutrients for a Healthy Menopause

Pantothenic acid is known to play a role in supporting the function of the adrenal glands and adipose tissue, which form the body's major sources of oestrogens after the menopause. Pantothenic acid, along with vitamin B1 found in: yeast, oatmeal, flax, brown rice whole grain flour, asparagus kale, cauliflower, potatoes, oranges, pork liver beef or pork, eggs may also help maintain the action of oestradiol. B vitamins play an important role in the central nervous system and brain methylation pathways, helping to maintain emotional balance during the menopause.

Vitamin B6 and magnesium complement each other to help maintain a healthy mood during the menopause. Moreover, vitamin B12, thiamine, niacin and folate are essential for a healthy nervous system because the brain has a special need for them to perform at its best, and is more sensitive to fluctuations in the body levels of these nutrients.

**Vitamin B6:** Good sources include meats, whole grain products, vegetables, and nuts.

**Vitamin B12**: meat, dairy products and eggs. Vegans may find it difficult to get enough vitamins B12 so should try to eat foods fortified with vitamin B12. These may include yeast extracts, certain vegetable stocks,

veggie burger mixes, textured vegetable protein, soya milks, vegetable and sunflower margarines, and breakfast cereals.

Niacin is essentially found in meat, wheat germ, dairy products, and yeast.

Folate found in leafy vegetables such as spinach, turnip greens, lettuces, dried beans and peas, fortified cereal products, sunflower seeds and certain other fruits and vegetables. Liver and liver products also contain high amounts of folate.

A number of minerals, including chromium, magnesium and zinc, along with the vitamin C, B6 help to control the balance of glucose in the body. An imbalance of glucose can be associated with mood swings as are commonly experienced throughout the day, often resulting in difficulty getting to sleep.

Vitamins E, A and C plus zinc are important for keeping the vaginal membranes healthy as the declining oestrogen levels tend to dry up the vaginal secretions, which in turn affects a woman's normal healthy sex life. Increased levels of certain minerals and vitamins such as selenium and vitamin A, B, and C help keep vaginal tissue membranes lubricated during and after menopause **(Ann Louise Gittleman,1998).**

Tryptophan, found in proteins such foods such as bananas, mangoes, eggs, milk, sesame, soya beans and sunflower seeds, can help produce serotonin as it is synthesised via tryptophan hydroxylase. Serotonin is the feel good chemical in the brain and can help to assist in sleep and mood.

Eat little and often to maintain blood sugar levels. Complex carbohydrates, such as oats, wholegrain bread, brown rice, may help sustain energy release, as blood sugar levels may have an effect on menopausal symptoms. Avoid sugary foods, junk food/ highly processed food, which can be high in salt and additives as well as sugar which can contribute to imbalances in blood sugar as well as weight gain.

Eat plenty of fresh fruit, most are rich in potassium to help support a healthy fluid retention. Fresh vegetables, especially dark leafy vegetables, which provide micronutrients. Limit stimulants such as coffee and tea which can hinder the absorption of nutrients and produce heat in the body. Limit or moderate the intake of salt, too much can affect blood pressure and water retention. Limit saturated fat which can affect blood lipid levels, the arteries and heart health. Avoid spicy foods and hot foods and drinks and these can often make menopausal symptoms worse.
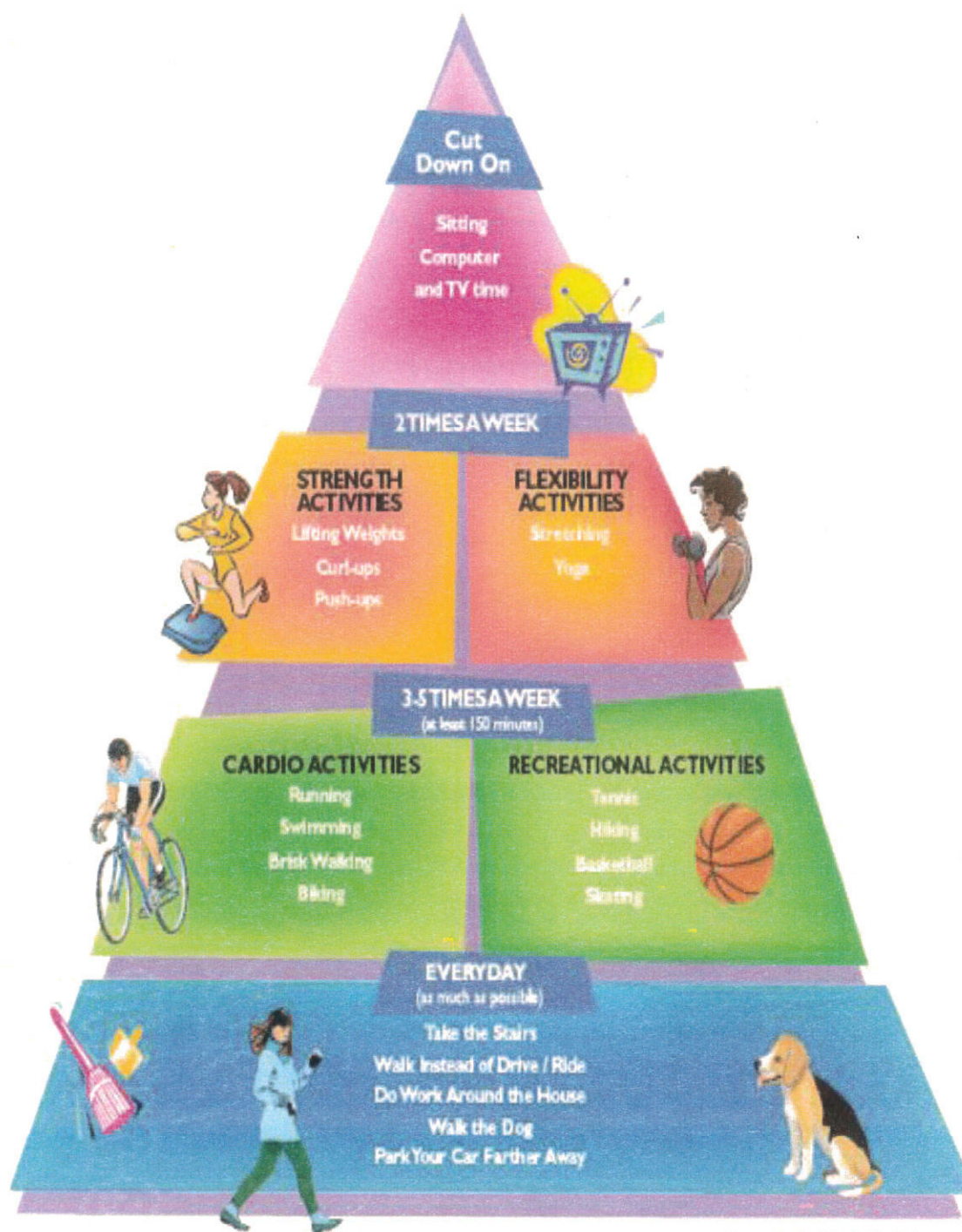
## 1.13 EXERCISE

Exercise is a planned, structured, repetitive and purposeful physical activity. Any bodily movement produced by skeletal muscles that results in energy expenditure above resting level is Physical activity. The WHO's recommendation is that adults should accumulate 30 minutes or more of moderate-intensity Physical activity (and at least 1 hour for children) on preferably all days of the week **(ACSM, 2006).**

The Pyramid of Physical Activity encompasses examples of those activities that one should do on a daily regular basis and those other activities

that one should do less often throughout the week in order to control weight and to feel both physically and mentally good.

## 1.13.1 Pyramid of Physical Activity



Adapted from Park Nicolet HealthSource

### 1.13.2 Benefits of Exercise for Menopausal Women

Exercise increases the cardiorespiratory function. If done regularly, it reduces the metabolic risks associated with declining estrogen. It increases HDL, reduces LDL, triglycerides and fibrinogen. There is an additional benefit of a reduced risk of high blood pressure, heart attacks, and strokes. Exercise can help create a calorie deficit and minimize midlife weight gain.

Exercise increases the bone mass. Strength training and impact activities (like walking or running) can help to offset the decline of bone mineral density and prevent osteoporosis. It also reduces low back pain. Exercise is proven to help reduce stress and improve the mood. It may help to reduce hot flashes **(Pandey, 2010)**.

### 1.13.3 Varieties of Exercise

Exercises that can help in building and maintaining the bone density and mass are as follows:

Weight bearing, high impact exercises, Includes dancing, high impact aerobics, running / jogging, jumping rope, stair climbing, and sports like tennis, basketball, volleyball or gymnastics. These are best for those who are not osteoporotic, not have low bone mass, and are not frail.

Weight bearing, low impact exercises: Are walking (treadmill/outside), elliptical training machines, stair step machines, and low impact aerobics. This group of exercises may be opted to build bones, by women who cannot do high impact exercises.

Weight or strength training or resistance training exercises: Include lifting weights, using elastic bands or weight machines for exercise, using simple functional movements such as standing or lifting the own body weight.

Non weight bearing, nonimpact activities: Are cycling, swimming, stretching, and flexibility exercises. These should be included as components of a comprehensive exercise program. Alone these do not help building up the bones.

### 1.13.4 Menopause Friendly Exercise Prescription

The exercise program for postmenopausal women includes endurance exercise (aerobic), strength exercise. These are all effective in increasing the bone mineral density in postmenopausal women. Keeping physically active during this time of change can help with many different health aspects. Appetite, digestion, weight control, agility, heart health and bone health can have a powerful, positive effect on emotions and mental health.

Women can enjoy a good quality of life after menopause even without hormones. Research indicates that postmenopausal women, who engage in the comprehensive exercise program, benefit by maintaining a healthy body, bone density levels, and good mental health **(Bonaiuti, 2002).**

### 1.14 ANTHROPOMETRY

Anthropometric values are closely related to nutrition, genetic makeup, environmental characteristics, social and cultural conditions, lifestyle, functional status and health. Anthropometric evaluation is an essential feature of geriatric nutritional evaluation for determining malnutrition, being overweight, obesity,

muscular mass loss, fat mass and adipose tissue redistribution. Anthropometric indicators are used to evaluate the prognosis of chronic and acute diseases and to guide medical intervention in the elderly **(Villareal et al, 2005)**.

Human body reflects changes in morphological variation due to inappropriate food intake or malnutrition. A variety of anthropometric measurements can be made either covering the whole body or parts of the body **(Srilakshmi, 2010)**.

Anthropometric measurements are determined by simple, noninvasive techniques that measure height and weight. Evaluation of anthropometric data involves comparison of data collected with pre determined reference limits. Various anthropometric measurements include height, weight, body mass index, waist hip ratio, and etcetera.

## 1.15 BIOCHEMICAL ASSESSMENT

Biochemistry is a complex web of interactions that controls the way the body uses amino acids, vitamins, minerals, carbohydrates, and fats for all body functions. Amino acids, for example, are used to produce hormones, skin, and bone. For biochemistry to function properly, body requires the right amounts and proportions of nutrients. The amount of a certain nutrient the average person requires may not be the optimal amount one need for good health.

Nutritional biochemistry testing is the best way to learn about the specific nutrient requirements. The most comprehensive versions of these test panels can evaluate over 400 aspects of biochemical function to provide a complete snapshot of one's unique nutritional needs. Results of laboratory data should

always be interpreted by the standards for normal values established by the individual laboratory and its methods used **(Sue Rodwell Williams, 1993).**

## 1.16 STATEMENT OF THE PROBLEM

The purpose of the study was to analyse the nutritional status, anthropometrical, physiological and biochemical parameters among rural and urban post menopausal women.

## 1.17 SIGNIFICANCE OF THE STUDY

1. The study would throw knowledge about prevalence of major non-communicable diseases in rural and urban post menopausal women.

2. The study would be helpful for policy makers to address this condition for improving the morbidity of Postmenopausal Women.

3. The study would be helpful for the dieticians; nutritionists and exercise physiologists to know the status of rural and urban post menopausal women and counsel them to prevent complication.

4. The study would be of great help in designing a more specific treatment schedule for post menopausal osteoporotic women thus preventing fractures.

5. The study would be of great value to understand the importance of physical activity.

6. The study would serve as a guidance for creating awareness about women health among the subjects.

7. The study would help to improve the nutritional and health status of postmenopausal women.

## 1.18 HYPOTHESIS

In light of the various literatures gone through, on basis of several research findings, expert opinions and own apprehension of the problem the following hypothesis were framed.

1. It was hypothesised that there would be significant difference between rural and urban post menopausal women on nutritional parameters.

2. It was again hypothesised that the anthropometrical parameters would have significant difference between urban and rural post menopausal women.

3. It was also hypothesised that the physiological parameters would have significant difference between urban and rural post menopausal women.

4. It was further hypothesised that the biochemical parameters would have significant difference between urban and rural post menopausal women.

## 1.19 DELIMITATION

1. 500 subjects were randomly selected, 250 post menopausal women from urban area and 250 post menopausal women from rural area.

2. The study was delimited to post menopausal women subjects with age between 50 to 60 years.

3. Rural subjects were selected from Soomangalam region, Kancheepuram District. Urban subjects were selected from Perambur region, Chennai.

4. The following variables were selected for the study.

**Nutritional Variables**

    a. General Health Profile

    b. Type of Diet

c. Frequency of Food Consumption of the Respondents

d. Mean Nutrient in Takes

e. Life Style and Activity Pattern

## Anthropometrical Variables

a. Height

b. Weight

c. Body Mass Index (BMI)

d. Bone Mineral Density (BMD)

e. Waist Hip Ratio

## Physiological Variables

a. Pulse Rate

b. Systolic Blood Pressure

c. Diastolic Blood Pressure

d. Mean Arterial Pressure

## Biochemical Variables

a. Serum Calcium

b. Serum Albumin

c. Haemoglobin

d. Lipid Profile

> Triglycerides

> High Density Lipoprotein,

> Low Density Lipoprotein

> Total Cholesterol

## 1.20 LIMITATION

The following were considered as the limitations of the study on which the investigator could not have any control.

1. The general mood and environmental factors at the time of responding to the questionnaire would affect the responses of the subjects, which were recognized as limitations.

2. External factors like body temperature were not taken into consideration.

3. Heredity factors, which contribute to individual structural development, were not controlled.

4. Some of subjects were taking medicines for various illnesses were also considered as limitations.

## 1.21 MEANING AND DEFINITION OF THE TERMS

### 1.21.1 Menopause

Menopause is defined as twelve months of amenorrhea following the final menstrual period (FMP), permanent cessation of menstruation after the loss of ovarian function **(Michael Karasek., 2006)**.

### 1.21.2 Post menopause

Post menopause is defined as dating from the first year after menopause, regardless whether the menopause was induced or spontaneous. The term induced menopause is defined as the cessation of menstruation which follows either surgical removal of both ovaries or iatrogenic ablation of ovarian function **(Shalini Rajaram, 2008)**.

### 1.21.3 Nutritional Status

The condition of health of a person that is influenced by the intake and utilisation of nutrients is called nutritional status.It can be determined only by the correlation of information obtained through a careful medical history ,dietary history,a thorough physical examination and laboratory investigation **(Srilakshmi, 2009)**.

### 1.21.4 Food Frequency Questionnaire

The respondent is presented with a list of foods and is requested to say how often each is eaten per day /per week /per month etc. Food lists are usually chosen because they are important sources of the particular nutrient under study and may not assess total diet. The food frequency questionnaire may be intiewer administered or self completed **(Garrow, 1993)**.

### 1.21.5 Diet Survey

Diet surveys constitute an essential part of any complete study of nutritional status of individuals or groups, providing essential information on nutrient intake levels, sources of nutrients, food habits and attitudes. Diet surveys are helpful in studying the quality and quantity of food consumed by the family and the community **(Sheila john and Jasmine Jenifer, 2007)**.

### 1.21.6 Anthropometry

Anthropometry is the science of measuring the size and proportions of the human body **(Mathew and Fox, 1982)**.

### 1.21.7 Body Mass Index (Quetlet index)

The body mass index accounts for difference in body composition by defining the adiposity according to the relationship of weight to height and eliminates dependence on frame size **(Standard and Margolin, 1990)**.

$$BMI = \frac{Weight\ in\ kg}{Height\ in\ m2}$$

### 1.21.8 Waist Hip Ratio

Waist hip ratio is a technique that focuses on the distribution of body fat. To determine the waist to hip ratio, the waist circumference measurement is divided by the measurement of widest circumference around the hips **(Patricia, et al., 2007)**.

$$Waist\ to\ Hip\ ratio = \frac{Waist\ circumference}{Hip\ circumference}$$

For males this ratio should be less than 0.95 and for females the ratio should be less than 0.8. Higher ratios suggest high risk.

### 1.21.9 Physiology

Physiology is the study of functions of living things **(Lauralee , 2011)**.

### 1.21.10 Biochemistry

Biochemistry is the science concerned with various molecules that occur in living cell and organisms and with their chemical reaction **(Murray, et al., 2000)**.

### 1.21.11 Biochemical Assessment

Variations in the intake of different nutrients present in the diet are reflected by changes in the diet are reflected by changes in the concentration of

the corresponding nutrients or metabolites influenced by the nutrients, in blood, tissues and in urine. Biochemical assessment can reveal sub-clinical states of deficiency due to lowered intake or absorption or impaired transport or abnormal utilization of a nutrient **(Swaminathan, 2008).**

### 1.21.12 Pulse Rate

Pulse rate is the number of times a persons heart beats in one minute **(Glenn Toole and Susan Toole, 2004).**

### 1.21.13 Blood Pressure

Blood pressure is the force exerted against the arterial walls by the blood .The measurement indicates the pressure on the arterial wall at the highest and lowest pressures when the ventricle undergoes systole and diastole. It is written as systolic pressure over diastolic pressure. Systolic blood pressure represents contraction pressure and diastolic blood pressure represents relaxation. The device used to measure blood pressure is sphygmomanometer **(Judi Lindsley Nath, 2005).**

### 1.21.14 Mean Arterial Blood Pressure

Mean arterial pressure (MAP) is the mean or average blood pressure in the arterial system. Mean arterial pressure (MAP) represents the integration, or combination, of both the Systolic blood pressure (SBP) and the Diastolic blood pressure (DBP) **(ACSM, 2008).**

The formula for Mean arterial pressure (MAP) = Diastolic blood pressure (DBP) + 1/3 (Systolic blood pressure - Diastolic blood pressure).

### 1.21.15 Cholesterol

A white crystalline substance found in animal tissues and various foods, normally synthesized by the liver and important as a constituent of cell membranes and precursor to steroid hormones **(Medical Dictionary, 2002)**.

### 1.21.16 High-Density Lipoprotein (HDL)

High-density lipoprotein (HDL) is commonly referred to as the "good cholesterol" High-density lipoprotein has higher protein content and a smaller triglyceride and cholesterol content than low-density lipoproteins (LDL). HDL levels in the body are supposed to be fairly high. HDL helps excess cholesterol from the blood stream and arteries and delivering to the liver for excretion through the gastrointestinal system. High-density lipoprotein (HDL) is often considered protective against cardiovascular disease **(Heather, 2006)**.

### 1.21.17 Low-Density Lipoprotein (LDL)

Low-density lipoprotein (LDL) is the main cholesterol transporter and carries cholesterol from liver to the cells that need it. If there is too much cholesterol for the cells to use, this can cause a harmful build-up in blood. Too much LDL cholesterol in the blood can cause cholesterol to build up in the artery walls, leading to disease of the arteries. For this reason, LDL cholesterol is known as 'bad cholesterol **(Heather, Burgoon and Mikesky, 2006)**.

### 1.21.18 Triglycerides

Triglycerides are commonly occurring fats that are more accurately classified as simple lipids and predominant form of fats found in the human diet. Triglycerides consist of a glycerol backbone with three fatty acids attached.

Triglycerides serve as a major energy reserve and are stored primarily in adiposities located throughout the body. Triglycerides are also stored in lesser amounts in the liver and muscle where they are more readily available for use as energy during exercise **(Heather, Burgoon and Mikesky, 2006)**.

### 1.21.19 Serum Albumin

Serum albumin is the body's protector of blood volume and fliud - electrolyte balance. Normal values range from 3.5 to 5.5g/dl .Serum albumin provides an assessment of visceral protein status. For nutritional analysis, values between 2.8 and 3.5 g/dl indicate compromised protein status **(Michele Grodner, et al., 2007)**.

### 1.21.20 Serum Calcium

Serum calcium levels are closely regulated in the body so as to maintain optimum muscle contractility and cellular function. All cells need calcium in order to work. Calcium helps build strong bones and teeth. It is important for heart function, and helps with muscle contraction, nerve signalling, and blood clotting. Normal values range from 8.5 to 10.2 mg/dL **(Wysolmerski and Insogna, 2011)**.

### 1.21.21 Haemoglobin

The test for haemoglobin provides a serum measure of red blood cell. Normal values are for women, 14g/100ml, and for men, 16g/100ml. **(Williams, 1993)**.