# NUTRITION, HEALTH AND MENSTRUAL WELL-BEING OF PREMENOPAUSAL WOMEN IN COCHIN: A CROSS-SECTIONAL STUDY

***Dissertation submitted to***

**ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM**

**Affiliated to**

**MAHATMA GANDHI UNIVERSITY**

***In partial fulfilment of requirement for the***

***AWARD OF THE DEGREE OF MASTER OF SCIENCE IN***

**HOME SCIENCE (BRANCH C)**

**FOOD SCIENCE AND NUTRITION**

By

**NEHA M K**

**Register No. AM23HFN012**

**DEPARTMENT OF HOMESCIENCE AND CENTRE FOR RESEARCH**

**APRIL 2025**

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***'Certified as bona fide research work'***

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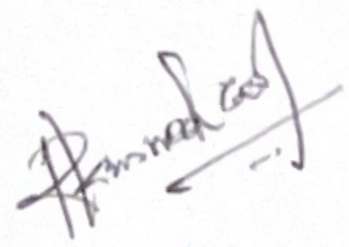
# DECLARATION

I hereby declare that this research work entitled '***Nutrition, Health and Menstrual well-being of Premenopausal women in Cochin: A Cross-sectional Study***' is an original research work carried out by me under the supervision and guidance of Dr. Rashmi H Poojara, Associate Professor, Department of Home Science and Centre for Research, St Teresa's College, Ernakulam.



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## CERTIFICATE

This is to certify that the thesis entitled '***Nutrition, Health and Menstrual well- being of Premenopausal women in Cochin:A Cross-sectional study***' is an authentic record of the original research work carried out by **Ms. Neha M K** with **Reg No.AM23HFN012** under my supervision and guidance during the academic year 2023-25.

Ernakulam

28-04-2025

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# CHAPTER 1

# INTRODUCTION

Women's health across the life span is influenced by different biological stages like the adolescence, reproductive years, midlife and postmenopausal years.The constant interaction of different social, cultural, environmental, psychological and nutritional factors in each of these stages influence the quality of life as well. Menarche, pregnancy and finally menopause experienced by a healthy woman as she ages, is associated with major adaptation of the female body to the changing nutrient requirements, psychological states, hormonal fluctuations, metabolic changes etc. These changes that bring about major transformations signifies the resilience and complexity of the female body and in turn influence the different health outcomes like occurrences of diseases like cardiovascular diseases, diabetes, osteoporosis etc.Among these transitions, menopause could be considered as a very important stage in the reproductive life of a woman. Menopause is a natural biological event that is experienced by all women at a particular age which is marked by the cessation of monthly menstrual cycles. According to WHO (2024) " menopause marks the end of the reproductive cycle and is the permanent cessation of ovarian follicle and also decreases in the production of circulating estrogen". Natural menopause is said to be experienced after 12 months of amenorrhea (Ambikairajah *et al*.,2022). Women experience menopause between the ages of 45 and 55 years and are accompanied by various physical, metabolic and psychological alterations.The drop in estrogen production prior to menopause causes certain changes in the female body which includes vasomotor, somatic symptoms, sexual dysfunctions and psychological problems. Among the vasomotor symptoms hot flashes and night sweats are the most experienced menopausal symptoms (Melby *et al.,*2011).Other than these, symptoms like vaginal dryness, mood swings, irritability, depression, anxiety, difficulty concentrating etc can severely impact the quality of life of women. WHO (2024) highlights the perimenopause, a stage before menopause is the time during which women start experiencing changes in the menstrual cycle. This is the period prior to menopause during which the endocrinological, biological and clinical features related to approaching to menopause commences(Ambikairajah *et al*.,2022).Premenopause is a transition phase before perimenopause,

where women are menstruating regularly and are still in their reproductive years. Premenopause can be used to refer to 1 or 2 years immediately before menopause or can be used alternatively to refer to the entire reproductive years of a woman until the final menstrual period is experienced (Ambikairajah *et al.*,2022). Premenopause is the period during which climacteric women have menstrual cycles whether regular or not (Pandey *et al*.,2010). During premenopause women experience fluctuations in menstrual cycles and psychological states and also transitions in reproductive functions. Even though premenopause is not considered as a pathological phase, women have a higher risk of vulnerability to experience nutrient deficiencies, imbalances in metabolic processes, changes in mental health etc (Santoro *et al.*,2015). Women often consider the symptoms related to these transitions as normal changes and ignore them. Studies suggest that premenopausal women have an increased risk of developing insulin resistance, weight gain, metabolic syndrome etc which can in turn be a predisposing factor to develop diabetes type-2, cardiovascular diseases etc (Janssen *et al.*, 2020).Studies also suggest that family responsibilities, hormonal fluctuations and other life stressors during premenopause can cause the occurrence of mental health issues like anxiety, depression and stress (Freeman *et al*.,2014). Lack of awareness regarding anemia and other nutritional requirements could also bring about nutrient deficiencies that can add on to the existing problems due to premenopausal transitions. Therefore it becomes important to address the interlinked nature of these physiological and metabolic changes through holistic health assessments and the present study tries to explore by concerning the health, nutrition and menstrual well being of premenopausal women belonging to a community setup.

One of the major physiological changes undergone by women in these life stages is the fluctuations in the levels of hormones namely estrogen and progesterone. These shifts in the hormonal level are necessary in some way to regulate the reproductive function, metabolism, mental well-being etc of women. During menopause the estrogen production significantly drops (WHO,2024). The variations in the estrogen and progesterone productions are seen in premenopausal and perimenopausal stages as well. During premenopause, than can span several years before menopause women start experiencing irregular menstrual cycles due to these hormonal fluctuations and can manifest as subtle or overt symptoms (Pandey et al.,2010).A sudden change in the hormones is responsible for a wide range of physical and mental changes that takes place in women which thereby influence the overall health and well-being of women.

Another area of concern when it comes to women's health is psychological well-being which is influenced by hormonal changes to a great extent. Hormonal fluctuations can cause changes in mood leading to irritability, sleep disturbances when addressed these symptoms escalate into clinically significant depression, anxiety and stress (Avis *et al.,*2015). Researchers have found that hormonal changes during premenopause affects a woman's brain as well as body (Niloofar *et al*.,2019).Many studies have published results that showed that women are particularly vulnerable to depression during menopause due to the hormonal fluctuations (Koch *et al.,*2021). An individual's capability to function is affected by the somatic and cognitive symptoms and is in harmony with stress, anxiety and depression (American Psychiatric Association 2013).Various other research studies have also reported that anxiety and depression caused by these hormonal changes can have a robust association with conditions associated with the respiratory system, cardiovascular system and gastrointestinal tract (Maurer *et al.,*2008).

The decline in production of estrogen, even before the complete cessation of menstruation particularly during premenopausal stage contributes to a number of other symptoms like the somatic and vasomotor symptoms. This includes the most commonly reported symptoms like hot flashes, night sweats, vaginal dryness, disturbances in sleep, fluctuations in mood etc during this phase(Melby et al.,2011) Psychological symptoms like irritability, depression and anxiety are prevalent in women because of the changes happening in the neuroendocrine system which affects the neurotransmitter activity (Freeman et al.,2014). Also it is observed that the hormonal fluctuations during this phase altered the brain, leading to the high chance of developing mental health disorders (Avis et al.,2015;Niloofar et al.,2019). Despite all of these conditions women in this phase of life ignore and normalize the symptoms and show reluctance to diagnose and treat these conditions (American Psychiatric Association, 2013;Koch et al.,2021).

Women also experience various metabolic changes during the different life stages as well. One among the most prevalent changes experienced by women is the occurrence of central obesity which is the deposition of fat around the abdomen along with the increasing body weight. This altered distribution of fat around the abdomen is often associated with insulin resistance, abnormal lipid profiles like increased LDL cholesterol, triglycerides and cholesterol along with decreased level of HDL cholesterol, reduced glucose tolerance (Carr,2003). According to the

National Family Health Survey (International Institute for Population Sciences [IIPS] & ICF, 2021) more than half of women, that is almost 57% of women, were found to be at substantial risk of developing metabolic complications due to an increase in the WHR- ratio. WHR ratio is used to identify the distribution of body fat particularly around the abdomen and is closely associated with increased risk of metabolic aberrations like type 2- diabetes, cardiovascular diseases, stroke, premature death etc. In a study by Singh & Malik (2023) it was observed that fasting blood glucose, triglycerides, HDL cholesterol was found lower in premenopausal women when compared to postmenopausal women. The nutrient deficiencies and metabolic imbalances during premenopause also serve as precursors for more serious health conditions in the later life of women (Santoro *et al*.,2015). This indicates that during the transition to menopause women experience physiological changes that could cause metabolic changes as well and if ignored could result in serious health issues.

Hormones like estrogen play a very important protective role in the maintenance of the metabolic homeostasis by the regulation of glucose uptakes,fat distribution and lipid metabolism.The decline in estrogen makes women more susceptible to conditions like abdominal obesity, hypertension, dyslipidemia, elevated fasting glucose etc which are collectively called as the metabolic syndromes. This could increase the risk of developing cardiovascular diseases, and type-2 diabetes (Janssen *et al*.,2020;Derby *et al.*,2009). Also there are evidences from the Study of Women's Health Across the Nation (SWAN) that highlights the increase in fasting insulin levels and insulin resistance, independent of age and other lifestyle factors in premenopausal women which also can be related to the hormonal fluctuations induced metabolic changes (Sowers *et al.*, 2007). Therefore these changes brought about by the hormonal fluctuations will interact with the dietary patterns, genetic predispositions, physical activity, immunity etc and bring about major metabolic alterations.This emphasize the need for early detection and interventions during perimenopause.Therefore assessing the anthropometric and biochemical parameters will give an objective measure which will help in understanding nutritional status, risk for occurrence of metabolic disorders, deficiencies of nutrients in diet etc.

Even though there is growing evidence regarding the prevalence of chronic health conditions in premenopausal women, globally this category of women are often underserved when it comes to public health initiatives.According to WHO (2021) it was highlighted that the increased

prevalence of non-communicable diseases like CVDs, diabetes and osteoporosis are the reason behind the cause of death among the midlife women. Still, it is seen that interventions to prevent this situation are not much developed and global strategies majorly focus on maternal and elderly care. This creates a significant gap in addressing the needs of premenopausal women mainly belonging to the 40-55 age group. According to the United Nations Population Fund (UNFPA, 2019), the global health agenda is required to adopt a life course approach when it comes to women's life which will recognize the interventions to prevent the long term health complications.Also a Lancet Commission on Women and Health(2015) indicates that the economic and caregiving role of performed by women at the expense of their health can have negative impacts on the families and communities.Globally, there is a urgent need for more targeted, preventive and holistics interventions that address the overall health and well-being of women in their midlife. In the Indian setting, it is observed that women aged between 41-55 years are often underrepresented and studies mainly focus on women in their childbearing years and postmenopausal stage. Premenopausal women belonging to urban as well as rural settings face a lot of challenges due to sociocultural expectations, limited access to health care, lack of awareness regarding menstrual health and well being etc. According to the National Family Health Survey (International Institute for Population Sciences [IIPS] & ICF, 2021) there is an increase in the prevalence of anemia, psychological distress and undernutrition observed among middle aged women.The health and nutrition status of premenopausal women is closely related to determinants including socioeconomic status, lifestyle and dietary habits, awareness of health problems especially non-communicable diseases, nutrient requirements like requirements for iron to prevent anemia and access to preventive care. It is often considered that women belonging to higher socioeconomic groups have better access to preventive care and with better education levels have more awareness regarding nutrition and health. Even though Kerala is a state with hundred percent literacy, women in kerala still face problems related to menopausal health due to their lack of awareness regarding the major changes that take place during their lifespan.Nutrient inadequacy especially deficiency of nutrients like Iron and Calcium in diet are prevalent in women in kerala, this is related to many menstrual cycle problems and occurrence of osteoporosis in midlife women. Therefore interventions should be developed as soon as possible to address all the midlife related issues in order to help women to improve their quality of life.

Therefore on the basis of these interlinked concerns, the current study aims to explore the health, nutrition, and menstrual well-being of premenopausal women aged 40–55 years in Cheranalloor and Mulavukad Panchayats. The research uses an integrated assessment approach which includes socioeconomic assessment, anthropometric and biochemical assessment, evaluation of mental health, assessing the menstrual history and symptoms and identifying the dietary intake patterns of premenopausal women. The selection and application of these tools enables an elaborate understanding of the health, nutrition and menstrual status of premenopausal women in these semi-urban areas of Kerala.

This study is different from other research studies on postmenopausal women, as it mainly focuses on the transitional phase before menopause sets in, which is premenopause where immediate preventive measures can be very effective. Unlike women who reached menopause who might exhibit long-term consequences of estrogen deficiency, premenopausal women often show emerging symptoms and risks that can be modified. Early detection and management of these symptoms and risks would help in preventing the onset of metabolic syndromes and thereby improve the overall health of women when they age. The study not only adds to the limited body of literature on premenopausal health of women in India but also acts as a source of data for policymakers, health workers and other stakeholders to implement and improve programs that aim at women's health. By evaluating all the health dimensions of premenopausal women in Cheranalloor and Mulavukad, this study aims to look into an often-neglected population group, with the ultimate goal to update and inform public health efforts and contribute to holistic women's wellness in India.

Based on the above factors in mind the present study 'Nutrition, Health and Menstrual well-being of Premenopausal women in Cochin; A Cross-sectional study' was conducted with the following objectives:

- To evaluate the association of socio-demographic and reproductive factors in premenopausal females.
- To study the nutritional status of premenopausal women using anthropometric, biochemical and dietary assessment.
- To assess the prevalence of psychological distress among premenopausal females using Depression, Anxiety and Stress Scale.
- To identify and analyse the occurrence of menopausal symptoms in premenopausal females using the Greenes Climacteric Scale(GCS)

CHAPTER 2

# REVIEW OF LITERATURE

A literature review is a research method that involves the collection and synthesizing of previous research (Synder *et al.,*2019). It serves to survey all the existing literature related to the chosen area of study and helps to analyse the information by identifying the gaps and areas for further research. It involves the systematic identification, location, scrutiny and summary of written materials which contain information on an identified research problem (Polit & Beck, 2010). The review of literature pertaining to the study entitled **'Nutrition, Health and Menstrual well-being of Premenopausal women in Cochin : A Cross-sectional study'** is discussed under the following headings:

## 2.1 PRE MENOPAUSE AND MIDLIFE WOMEN'S HEALTH

A woman's midlife is often considered as a transitional and very complex phase which is usually accompanied by major physiological, psychological and social transformations. One of the crucial and often underrepresented stages in midlife is the period known as premenopause. Premenopause is the stage in women's life that comes before perimenopause, where women continue to menstruate regularly but may begin to experience slight changes in hormonal balance (Ambikairajah *et al.,*2022*)***.** Premenopause also include women in the age group of 40-55 years who are more prone to health problems that are significantly caused by the early occurrence of psychological, metabolic and reproductive transformations (Santoro *et al.,*2016).According to WHO, menopause is described as a stage in a woman's life when there is a complete cessation of regular monthly menstruation, which indicates there is an eventual loss of follicular function, therefore the ovaries stop releasing eggs for fertilization. Most women worldwide experience menopause between the age of 45 to 55 years *(World Health Organization, 2024)*.The transition to menopause is usually accompanied by many vasomotor, urogenital, psychosomatic, psychological changes as well as sexual dysfunction. According to *Shah & Prajapati (2024*) factors like genetics, lifestyle, socioeconomic factors, cultural background etc influence the severity and manifestation of these symptoms among women.

However, premenopause occurs before any changes take place in the menstrual cycle and is differentiated from perimenopause as well. Therefore, premenopause is often ignored for clinical and epidemiological studies associated with women's health.During premenopause, women are in their reproductive years yet begin to experience symptoms like weight gain, sleep disturbances, irritability and other signs that ascribe to the later implications of menopausal transitions (Kuck & Hogervorst, 2024).

Many studies have reported that the premenopausal phase in a women's life may be associated to the increasing vulnerability of women to conditions like metabolic syndrome, insulin resistance, osteoporosis and other cardiovascular diseases especially in Indian women who live in unique sociocultural and nutritional obstacles (Pandey *et al.,*2010; Ganguli *et al.,*2011).The replacement of traditional dietary patterns with the westernized diets especially in urban Indian populations, combined with sedentary lifestyles and hormonal fluctuations have also contributed to this risk profile (Ganguli *et al.,*2011).

In a study that was conducted in the Western India, it was found that the prevalence of metabolic syndromes among premenopausal women was as high as 44%, which indicates the immediate need for targeting the screening and prevention of such conditions(Pandey *et al.,*2010). Moreover, research conducted by Alonso-Cabezas *et al.,*(2022)has also highlighted that even before menstrual irregularities begin, women show poor adherence to dietary recommendations, which can impact long-term health.

Latest psychological studies also highlight an increased prevalence of depression, anxiety and stress symptoms in premenopausal phase often more than shown in postmenopausal phase, indicating that more attention is required in the emotional well-being of this age group of women (Kuck & Hogervorst, 2024). In a systematic review of Indian women, the somatic and psychosomatic symptoms were shown to be highly prevalent in this demographic group accompanied with joint pain and fatigue being the most prevalent symptoms (Shah & Prajapati,2024). Other Nutritional studies conducted in North India Have also observed suboptimal dietary intake of nutrients among premenopausal and menopausal women, which highlights a necessity for dietary counseling and public health interventions (Dubey *et al.,*2022). These studies are further supported by other international and national large scale studies especially from Spain and from India as well indicating that education, physical activity, income level significantly affect the adherence to health recommendations and the quality of diet (Alonso-Cabezas *et al.,*2022; Ganguli *et al.,*2011).

The increase in the number of midlife women in India as well as the increase in the global health implications necessitates the need to examine premenopause not only as a biological transition phase but also as a very important opportunity to prevent health issues that interfere in later life stages through early interventions. By a thorough understanding of the interconnected changes in diet, metabolism and mental well-being during premenopause, the quality of life can be improved by reducing any future health care implications.

## 2.2 SOCIODEMOGRAPHIC AND REPRODUCTIVE DETERMINANTS

This section explores the sociodemographic and reproductive determinants that influence the health of premenopausal women. These variables play a very important role in shaping the physical, nutritional, psychological and overall well-being of women during midlife. Alterations in these variables can be associated with various comorbidities and other health implications experienced by women in premenopause as well as during their transition to menopause.

### 2.2.1 Sociodemographic determinants

Socio Demographic variables play a very important role in understanding the overall health outcomes of women. Variables like age, education , income level, occupation, marital status etc interact with reproductive factors like age at menarche, menstrual cycle related aspects like flow, cycle duration etc and can influence physical as well as mental health of premenopausal women.

Educational status has always been linked to better knowledge in health and healthEducational status has consistently been linked to health literacy and health-seeking behaviors. Women who have acquired higher education are more likely equipped with health practices that are preventive in nature and have better access to nutritious diet and healthcare services (Alonso-Cabezas *et al.*,2002). At the same time women with lower level of education are often more vulnerable to nutritional deficiencies and other health risk because of their limited knowledge on utilisation of health care and awareness regarding optimum nutrition.Therefore, for evaluating these sociodemographic variables like income , occupation, socioeconomic status etc by making use of scales like the Kuppuswamy Socioeconomic Scale, will help in determining women's access to the various health care services, nutritious food and other living conditions which are interconnected with prevalence and health outcomes of various diseases(Ganguli *et al.,*2011)

Many Indian studies have highlighted the interconnection between socioeconomic status and health of midlife women. A study by Ganguli *et al.*,(2011) found out that low-income women in West Bengal had a poor dietary diversity which is associated with the higher prevalence of cardiovascular disease risk among them. A study by Mamgai *et al*.,(2024)shows that higher risk for CVD was among rural, poor and low educated women subjects and also showed that women with less than primary level schooling had the highest prevalence of high blood pressure and

women with secondary level of schooling has highest prevalence of self-reported hypertension. Another study by Dubey *et al*.,(2022) points out that the disparities present in socio-economic conditions influenced the factors like nutritional awareness and purchasing behaviours that results in nutrient deficient diets, often deficient with macro and micronutrients like calcium, iron etc. Other than these variables, the living conditions of women like the family members also points out the family support structure that plays an important role in determining the mental health of premenopausal women.

### 2.2.2 Reproductive determinants

Reproductive variables are another important determinant of women's health. In a retrospective historical cohort study it was found that earlier age of menarche has been linked to heightened risk of metabolic syndrome as the women age (Heys *et al.,*2007). Therefore age at menarche can be used to identify women who have metabolic syndrome (Kim *et al.,*2019).Furthermore, irregularities in the menstrual cycle have been linked to occurrence of insulin resistance and other metabolic risks in women. In study by (Rostami Dovom *et al*.,2016) it was found that women with irregular menstrual cycles had a higher prevalence for higher triglyceride and dyslipidemia also, compared to women with regular cycles, women with irregular cycles also have higher risk for Diabetes and pre-diabetes. Increased menstrual cycle disturbances have been linked to increased psychosocial symptoms in women (Barkoot *et al.,*2022). In a Keral based study by Sarika *et al.,*(2022) found that age at menarche and parity influenced menopausal timing. Earlier menarche were associated with earlier menopause.

Menstrual cycle variables like irregular cycles or heavy menstrual bleeding, may indicate underlying hormonal fluctuations or some other gynecological conditions. These symptoms are often normalized. Prolonged occurrence of these symptoms can impact the mood, sleep ,physical and mental health of premenopausal women leading to diminished quality of life. Aziz *et al.* (2023) in his study observed that women who experience menstrual irregularities, early menarche showed higher vulnerability to anxiety, somatization, and mood disturbances. THe study also relates hormonal fluctuation and altered menstrual factors during the reproductive age as contributors to mental health challenges.

## 2.3 NUTRITIONAL STATUS OF PREMENOPAUSAL WOMEN

### 2.3.1 Anthropometric Assessment

Anthropometric measurements are very important measurements used for assessing the health and the nutritional status of women. Anthropometric measurements are vital for assessing the nutritional and health status of premenopausal women. A study by Patil and Deshmukh (2022) showed that a significant proportion of women residing in Central India was overweight and exhibited obesity which are considered risk factors for health. Another research study by (Ganguli *et al.,*2011) in West Bengal also found out that central obesity and elevation in waist circumference correlated to the low physical activity and poor diet quality among women. These anthropometric markers serve as indicators of various metabolic health risks, because during premenopause women undergo various hormonal fluctuations that can lead to changes in body composition including a considerable decrease in muscle mass and increase in body fat particularly around hips and waist. Also in a study by Farahmand *et al*.,(2021) it was found that central adiposity, as measured by Body Mass Index (BMI) Waist circumference and waist-Hip ratio was associated with delayed onset of natural menopause. Singh and Malik (2023) in their study used anthropometric assessments like BMI, waist circumference, waist-hip ratio etc and found out that nearly half of the premenopausal women showed signs of central obesity and were at risk of metabolic syndrome. In a regional study conducted by Sarika *et al.,(*2022) in Kerala showed that higher BMI was associated with delayed age of menopause. Even though this study focused on menopause, it is to be taken into consideration that premenopause comes before menopause and women with higher BMI might experience prolonged premenopausal phase because of delay in ovarian aging. This will in turn influence menstrual patterns, metabolic health, mood and the onset of vasomotor symptoms as well.. Since menopause is preceded by the premenopausal stage, women with higher BMI may experience a prolonged premenopausal phase due to delayed ovarian aging. Thus, anthropometric trends identified in menopausal studies also hold relevance for understanding and managing health risks during premenopause.

In a study by Sreenivas and Kashyap (2022) they highlighted the association between obesity and menopausal symptoms among midlife women. Their findings using the Menopause Rating Scale (MRS) suggest that higher rating scales are related to higher BMI which shows that obesity

could intensify somatic problems. A BMI more than normal values observed among women is related to somatic symptoms.

### 2.3.2 Biochemical Assessments

Biochemical assessments help in providing very useful insights into the metabolic status of premenopausal women. Since there is a global increase in the occurrence of metabolic syndromes like obesity , it becomes essential to examine the biomarkers. Premenopausal women are prone to the changes that take place in hormones, therefore the biochemical determinants act as valuable variables in determining the risk for various metabolic diseases.In a study by Pandey *et al*., (2010) it was found that more than 30% of premenopausal women were having abnormal lipid profiles that included elevated level of triglycerides and LDL. This can be an indicator of women experiencing cardiovascular diseases soon after they reach menopause. Low haemoglobin levels are another concern among women especially among the Indian premenopausal women. Since they are in their reproductive years , anemia can have serious health effects that could even disturb the mental as well as physical well-being of midlife women. According to Dubey *et al*.,(2022) a significant population had their haemoglobin level below normal which shows that inadequate micronutrient intakes could have an impact on the work capacity, immunity and overall quality of life of women. A study conducted in Iranian women by Sasanfar *et al*.,(2022) showed that consumption of a diet rich in fruits, vegetables and whole grain improved the biochemical profile and correlates to reduced risk of breast cancer.

A study explored the relationship between body composition, biochemical parameters, and antioxidant status in a healthy group of postmenopausal women. It involved comprehensive biochemical assessments, including measurements of lipid profiles, glucose, uric acid, vitamin levels, and antioxidant enzymes such as glutathione peroxidase and superoxide dismutase. The researchers discovered that changes in body composition, particularly an increase in fat mass and a decrease in muscle mass, were linked to altered oxidative stress markers and reduced antioxidant defenses. These findings emphasize the importance of monitoring biochemical indicators, not only for metabolic health but also to better understand how oxidative stress may contribute to the physical and somatic symptoms experienced during and after the menopausal transition. Although the study focused on postmenopausal women, it highlights the value of early

biochemical screening in premenopausal and perimenopausal women to anticipate potential risks and inform preventive strategies Vázquez-Lorente *et al*., (2022)

Lokam and Sree (2021) conducted a study comparing biochemical markers in premenopausal and postmenopausal women from the Khammam district. They assessed common markers such as serum lipid profiles, blood glucose levels, liver enzymes, and hormonal levels (FSH, estradiol) to examine the physiological changes associated with menopause. The study found that postmenopausal women had higher levels of serum cholesterol, low-density lipoprotein (LDL), and triglycerides, along with decreased estradiol levels and increased FSH levels. In contrast, premenopausal women showed more stable hormonal levels and healthier lipid profiles. This shift in biochemical markers among postmenopausal women may be linked to an increased risk of cardiovascular diseases and metabolic disorders. The study underscores the importance of regular biochemical monitoring to track these changes in menopausal women and the potential need for early interventions to reduce associated health risks (Lokam and Sree,2021)

Vázquez-Lorente *et al.*,(2023) investigated the biochemical factors influenced by age in postmenopausal women, specifically focusing on parameters such as lipid profiles, glucose metabolism, insulin resistance, and oxidative stress markers. The study found that as women age after menopause, there is a notable increase in serum cholesterol, triglycerides, and low-density lipoprotein (LDL) levels, alongside a decline in high-density lipoprotein (HDL). Additionally, glucose levels and markers of insulin resistance were elevated in older postmenopausal women. The study also observed higher levels of oxidative stress markers and a decline in antioxidant defense as women aged. These biochemical changes are associated with an increased risk for metabolic disorders, including cardiovascular disease and diabetes, emphasizing the importance of biochemical monitoring to identify and manage these health risks in postmenopausal women (Vázquez-Lorente *et al.,* 2023)

A study investigated the relationship between anthropometric measurements and biochemical parameters in both premenopausal and postmenopausal women. The study evaluated serum lipid profiles, glucose levels, and hormonal markers (such as estradiol and FSH) in relation to body mass index (BMI), waist-to-hip ratio, and other body composition indicators. The researchers found significant differences between premenopausal and postmenopausal women in cholesterol

levels, triglycerides, and glucose metabolism. Postmenopausal women had higher total cholesterol, LDL, and triglycerides, along with lower HDL levels, indicating an elevated cardiovascular risk. Additionally, insulin resistance was more pronounced in postmenopausal women, reflecting the metabolic changes associated with menopause. These biochemical alterations were also correlated with anthropometric measurements, suggesting that changes in body composition, such as increased central adiposity, are closely linked to these biochemical shifts in postmenopausal women. The study highlights the importance of biochemical monitoring to assess and manage the metabolic health of women during and after the menopausal transition (Jamal Frayyeh and Al-Lami, 2023)

### 2.3.3 Dietary Assessments and Nutrient Intake

Dietary Diversity is another important determinant of the micronutrient as well as macronutrient sufficiency and the effect of quality diet. In a study conducted in Spain by Alonso-Cabezas *et al.*,(2022), it was shown that premenopausal women failed in meeting their recommended intakes for fruits, vegetables and dairy, which lead to suboptimal intake of nutrients and increased the risk for diseases. Similar patterns were seen in Indian studies as well. Ganguli *et al.,*(2011)in his study showed that dietary patterns among the midlife women in India consists of high carbohydrate and low fiber foods combined with low intake of micronutrient rich foods. These dietary habits were found to be associated with higher waist circumference and caused dyslipidemia.In a North Indian study by Dubey *et al*.,(2022) it was highlighted that the inadequate intake of iron and calcium rich foods, correlated with menopausal women reporting fatigue and reduction in physical performance. Many studies conducted in the past have always tried to link inadequacy in diet to the occurrence of diseases. Dietary patterns were connected to diseases like breast cancer, ovarian cancers, cardiovascular diseases, type 2 diabetes etc.Dietary patterns are related to the occurrence of obesity and related diseases (Kapoor *et al*.,2019). In a study conducted among premenopausal women it was found that healthy dietary patterns reduce the risk of breast cancer in women(Sasanfar *et al*.,2022). In a Healthy women study by Park *et al.*,(2007)it was reported premenopausal women who had a higher BMI are shown to consume more sugary foods, red meat, cream and saturated fat foods, they are more prone to cardiovascular risk factors. Healthy dietary patterns were also shown to reduce oxidative stress in premenopausal women as the intakes of antioxidants increase , the chances of oxidative stress

found to be low (Crawford *et al.*,2022). Similarly Esmaillzadeh and Azadbakht(2010) conducted a meta analysis by connecting the consumption of dairy to breast cancer risk and found an influence of the diet on metabolic balance.Promoting balanced diet and healthy patterns will help in reducing the burden of chronic diseases.

## 2.4 METABOLIC SYNDROME IN PREMENOPAUSAL WOMEN

In a study highlighting key differences in metabolic health between premenopausal and postmenopausal women, shedding light on the protective effects of estrogen. Their research found that premenopausal women generally had a lower prevalence of metabolic syndrome (MetS), thanks to estrogen's role in supporting insulin sensitivity, healthier cholesterol levels, and reduced belly fat. However, the study also revealed that some younger women still showed early signs of MetS, including high blood pressure, abdominal obesity, and poor lipid levels often linked to inactive lifestyles, poor diet, and genetic factors. The researchers stress that early intervention through healthier habits is crucial to preventing MetS from worsening as women transition into menopause. Their work underscores the need for better health awareness and regular check-ups even before menopause to lower long-term metabolic risks (Singh & Malik, 2023).

Recent research has raised alarms about the rising rates of metabolic syndrome (MetS) and related conditions like fatty liver disease among premenopausal women, a group once thought to be largely protected by their hormones. A 2024 study by Danpanichkul and colleagues found that more young women are developing metabolic issues including weight gain around the waist, insulin resistance, unhealthy cholesterol levels, and excess liver fat despite estrogen's usual protective effects. The researchers warn that if current trends continue, cases of MetS and fatty liver disease could surge by 2040, fueled by modern diets, sedentary lifestyles, and urban living. Their findings call for immediate action, stressing the importance of early screening, better nutrition, and increased physical activity to protect younger women's metabolic health before more serious complications develop (Danpanichkul *et al.*, 2024).

A research sheds light on the critical connection between menopause and metabolic health, revealing how hormonal shifts can trigger long-term health risks. Their study confirms that while

premenopausal women experience some metabolic protection related to estrogen which helps regulate blood sugar, cholesterol, and body fat distribution this advantage fades as estrogen levels drop during menopause. Even before this transition, however, modern lifestyle habits like inactivity and processed food consumption can start undermining metabolic health, leaving some premenopausal women with early warning signs like insulin resistance or weight gain. The researchers stress that waiting until menopause to address these risks is too late; instead, they advocate for early lifestyle interventions and regular health screenings in younger women to preserve metabolic function and reduce future complications (Jeong & Park, 2022).

Ou in his study provides important insights into how menopause affects women's metabolic health and the potential role of hormone therapy in managing these changes. Their research confirms that premenopausal women benefit from natural estrogen's protective effects, which help maintain healthy cholesterol levels, blood sugar control, and cardiovascular function. However, the study found that metabolic risks don't suddenly appear at menopause early warning signs often emerge in the premenopausal years, particularly among women with poor diet and exercise habits. One of the study's most significant findings was that properly supervised hormone therapy after menopause may help counteract some negative metabolic changes. This suggests a two-pronged approach to women's metabolic health: First, promoting early lifestyle changes during premenopause to prevent issues before they develop, and second, considering personalized hormone therapy options when appropriate during postmenopause. The research underscores why healthcare providers should monitor metabolic markers in women well before menopause occurs, allowing for earlier interventions that could prevent serious long-term health consequences (Ou *et al*., 2023).

### 2.4.1 Prevalence and risk factors of metabolic syndrome

Chen and colleagues' (2021) eye-opening study reveals a troubling shift in women's metabolic health, showing that fatty liver disease, once considered a middle-aged concern, is now appearing much earlier in life. Their research in urban China found surprisingly high rates of metabolic-associated fatty liver disease (MAFLD) among premenopausal women, shattering the assumption that younger women are naturally protected from such conditions. The study

identified several warning signs that should sound alarms: excess belly fat, blood sugar irregularities, and unhealthy triglyceride levels are all red flags for metabolic syndrome.

What makes these findings particularly urgent is their link to modern urban living. The convenience of sedentary jobs, processed foods, and hectic schedules appears to be rewriting the timeline for metabolic disorders. For premenopausal women, this means the window for prevention may need to start much earlier than previously thought. The researchers emphasize that simple lifestyle changes,better nutrition, regular movement, and weight management could be powerful tools to stop this dangerous trend before it leads to more serious liver and metabolic complications (Chen *et al.*, 2021).

In a study of 2.8 million women delivered crucial insights into the metabolic syndrome-endometrial cancer connection, with sobering implications for women's long-term health. Their research revealed that MetS components, particularly abdominal obesity, insulin resistance, and hypertension acted as potent risk amplifiers for endometrial cancer. While postmenopausal women faced the highest absolute risk, the study uncovered a more insidious finding: the metabolic dysfunction underlying this increased cancer risk often takes root during premenopausal years. This suggests that what we dismiss as "minor" weight gain or "borderline" blood sugar issues in our 30s and 40s may actually be laying the groundwork for serious health consequences later. The researchers make a compelling case for reframing premenopausal metabolic health as cancer prevention, advocating for proactive lifestyle changes and metabolic monitoring well before menopause to disrupt this dangerous trajectory (Jo *et al.*, 2022).

Yoshida and colleagues' (2023) research sounds an alarm about a hidden health crisis emerging among young women. Their study reveals a disturbing trend: while estrogen traditionally shields premenopausal women from metabolic disorders, modern lifestyle factors are breaking down this natural protection. The researchers found skyrocketing rates of prediabetes and undiagnosed diabetes in young women, fueled by our increasingly sedentary lives, processed food diets, and expanding waistlines. What makes these findings particularly concerning is how silently this crisis develops, many young women walk around with elevated blood sugar and insulin resistance completely unaware, only to face serious health consequences later. The study highlights three key warning signs: stubborn belly fat that won't budge, creeping blood sugar

levels, and the body's decreasing ability to process insulin properly. These aren't just numbers on a lab report, they're red flags signaling that the body's metabolic systems are beginning to malfunction. The researchers make a compelling case for routine metabolic screening in young women, arguing that catching these warning signs early could prevent a lifetime of health complications. Their work suggests that the window for prevention may be closing much earlier than we thought, and that simple lifestyle changes in our 20s and 30s could be our best defense against the diabetes epidemic (Yoshida *et al.*, 2023)

### 2.4.2 Metabolic syndrome in Indian Scenario

Gara and Vanamali (2024) explored the significance of platelet indices in evaluating cardiovascular risk among premenopausal Indian women with metabolic syndrome (MetS). Their research shed light on the rising incidence of MetS in this demographic, linking it to metabolic disturbances such as central obesity, hypertension, dyslipidemia, and insulin resistance. The study pointed out that lifestyle factors including unhealthy diets, sedentary behavior, and chronic stress are contributing to the growing cardiovascular risk among premenopausal women in India. Importantly, the authors identified certain platelet indices as promising early indicators of cardiovascular risk, proposing their use as biomarkers for MetS and associated complications. The findings highlight the necessity of early diagnosis and customized interventions to address metabolic dysfunction and mitigate cardiovascular disease risk in this population. Additionally, the study advocates for improved public health initiatives that encourage lifestyle changes, such as increased physical activity and better dietary habits, to alleviate the impact of MetS and its cardiovascular consequences in premenopausal Indian women (Gara & Vanamali, 2024).

Nandhini *et al.*,(2022) conducted a cross-sectional study examining the prevalence and distribution of metabolic syndrome (MetS) and its individual components among pre- and post-menopausal women in northern India. Published in the *Journal of Mid-Life Health*, their research revealed distinct patterns in metabolic risk factors between the two groups. Post-menopausal women exhibited a higher prevalence of MetS, likely due to age-related hormonal changes, while premenopausal women also showed significant metabolic disturbances linked to obesity, dyslipidemia, and insulin resistance. The study emphasized the need for

targeted screening and intervention strategies tailored to menopausal status, as both groups faced elevated risks for cardiovascular and metabolic diseases. These findings underscore the importance of early detection and lifestyle modifications to mitigate MetS-related health burdens in women across different life stages (Nandhini *et al*., 2022).

A study performed a systematic review and narrative synthesis to identify key predictors of obesity in perimenopausal women and their role in the onset of metabolic syndrome (MetS). The study revealed that hormonal fluctuations particularly declining estrogen levels play a significant role in altering fat distribution, leading to increased central adiposity. Additionally, modifiable lifestyle factors such as sedentary behavior, unhealthy diets, and chronic stress were found to further exacerbate weight gain and metabolic dysfunction. The authors highlighted that obesity during perimenopause substantially elevates the risk of cardiovascular disease, type 2 diabetes, and other metabolic disorders. Their findings advocate for early lifestyle interventions, including improved nutrition, regular exercise, and stress reduction, to mitigate these risks. The review calls for focused public health initiatives to address the growing burden of obesity and metabolic complications in perimenopausal women (Verma *et al*., 2024).

## 2.5 PSYCHOLOGICAL DISTRESS IN PREMENOPAUSAL WOMEN

A study investigated psychological distress and sexual dysfunction across menopausal stages, revealing significant mental health challenges among women. While perimenopausal and postmenopausal women exhibited higher distress levels due to hormonal changes, the study found that premenopausal women also experienced considerable psychological strain. Contributing factors included lifestyle stressors, body image issues, early hormonal shifts, and societal expectations regarding career and family responsibilities. Common symptoms reported were anxiety, mood swings, irritability, and depressive tendencies. The research underscores the need for early mental health support for premenopausal women, recommending counseling, stress reduction techniques, and public awareness initiatives to enhance well-being during the initial phases of reproductive aging (Altaf, 2024).

In a study which explored the psychological and health-related implications of body dissatisfaction in women approaching menopause, with particular attention to premenopausal

individuals, revealed that negative body image concerns emerge early in the menopausal transition and are significantly associated with psychological distress, diminished self-worth, and increased depressive and anxious symptomatology. Among premenopausal women, these perceptions were found to stem from initial physical transformations, body weight variability, and societal expectations surrounding beauty standards and aging. The study identified these concerns as potential precursors to maladaptive coping mechanisms, such as eating disorders and sedentary lifestyles, which may amplify metabolic dysfunction. The findings highlight the critical need for proactive mental health interventions and body-positive education during the premenopausal stage, which could serve as preventive measures against both psychological distress and metabolic complications throughout subsequent menopausal phases (Saraulli *et al.*, 2023).

In a study the relationship between physical activity, social support systems, and psychological well-being among women navigating menopause-related challenges, with important implications for premenopausal populations was examined. Their findings demonstrated a significant inverse association between both physical inactivity and low social support with increased psychological distress, manifesting as anxiety, depressive symptoms, and emotional dysregulation. While the study primarily focused on menopausal women, the results emphasize that cultivating active lifestyles and robust social networks may serve as critical protective factors for premenopausal women, particularly those exhibiting early transitional symptoms. The research identified regular physical activity and quality social support as key moderators of mental health outcomes, suggesting their potential to buffer against distress and promote psychological resilience. Consequently, the authors advocate for comprehensive interventions combining lifestyle modification and psychosocial support to optimize mental health outcomes for women in the premenopausal to menopausal transition (Denche-Zamorano *et al.*, 2024).

A study conducted a cross-sectional investigation examining the interplay between psychological health and oxidative stress biomarkers in menopausal women, yielding important implications for women in earlier menopausal transitions. Their results demonstrated significant positive correlations between psychological distress (encompassing anxiety, depressive symptoms, and mood disorders) and elevated oxidative stress markers. While these associations were most pronounced in the postmenopausal cohort, the study's findings suggest a potential continuum of

psychological and physiological changes beginning in the premenopausal phase. This underscores the critical need for early psychological assessment and proactive stress-reduction strategies during the premenopausal period, which may help attenuate the progression to more severe oxidative and metabolic dysregulation in later menopausal stages. The authors posit that timely mental health interventions during the initial transition phases could serve as a preventive approach against the development of oxidative stress-related pathologies and associated health complications (Chandankhede *et al.,* 2021).

### 2.5.1 Hormonal shift and emotional well-being

A comprehensive examination of the bidirectional relationship between neuroendocrine changes and psychosocial factors in shaping emotional well-being across critical reproductive transitions, with particular emphasis on perimenopause was conducted. The study elucidated how the dynamic fluctuations and progressive decline of ovarian hormones (estrogen and progesterone) directly modulate neural circuits involved in mood regulation and stress response. Importantly, the research established that these biological processes interact synergistically with psychosocial determinants including quality of social support networks, individual coping strategies, and healthcare accessibility to influence mental health outcomes. The investigation revealed that perimenopausal women experience heightened susceptibility to affective disturbances, including clinically significant anxiety symptoms, emotional lability, and depressive tendencies. These manifestations were particularly pronounced in contexts characterized by inadequate social scaffolding or limited health literacy. The author proposed an integrative biopsychosocial framework for clinical practice, advocating for: (1) enhanced patient education regarding neuroendocrine changes, (2) systematic strengthening of support systems, and (3) implementation of evidence-based psychological interventions. This multidimensional approach aims to optimize emotional well-being by addressing both the physiological and sociocultural dimensions of menopausal transition (Schweizer-Schubert, 2022).

In a literature review examining the psychosocial dimensions of menopausal transition and their influence on psychological well-being, highlighting menopause as both a physiological process marked by hormonal changes (e.g., declining estrogen and progesterone) and a significant psychosocial transition affecting identity, social roles, and emotional stability, the authors found

that psychological outcomes during menopause are mediated by coping mechanisms, cultural perceptions, social support, and pre-existing mental health, with women holding positive attitudes toward aging or strong support networks demonstrating better emotional adjustment. Conversely, those viewing menopause negatively or experiencing social stigma reported higher anxiety, depression, and reduced life satisfaction. To address these challenges, the study recommended psychosocial interventions including counseling, support groups, and education to enhance resilience and mental well-being during this transition (Barmawi *et al.,* 2023).

In a study which investigated the influence of menopausal symptoms on mental health, emotional perception, and quality of life using a multi-faceted approach, it highlighted how common symptoms associated with menopause, such as hot flashes, sleep disturbances, and mood swings, are intricately linked to emotional well-being. The authors found that these symptoms significantly impact women's emotional regulation, leading to higher levels of psychological distress, anxiety, and depressive symptoms. Additionally, the study revealed that menopausal symptoms can impair emotional perception, affecting the ability to process and respond to emotions in social interactions, which in turn detracts from overall quality of life. The research emphasizes the need for a holistic approach to managing menopause, combining medical treatment with psychological support and lifestyle interventions to mitigate the negative effects on mental health. The findings suggest that addressing both the physical and emotional aspects of menopause is essential for enhancing women's quality of life during this transitional phase (Mueller *et al*., 2024).

Wieczorek, Targonskaya, and Maslowski (2023) explored the complex relationship between reproductive hormones and female mental well-being, particularly during key transitions such as menopause. The study highlighted that fluctuations in estrogen, progesterone, and other hormones significantly influence emotional regulation, mood, and cognitive function. During the menopausal transition, these hormonal changes are often linked to increased rates of anxiety, depression, and irritability, which can negatively impact overall mental health. The authors discussed how hormonal fluctuations contribute to symptoms like sleep disturbances and hot flashes, which further exacerbate emotional distress. They emphasized that understanding this connection is crucial for improving mental health outcomes for women during menopause,

advocating for individualized care that integrates hormonal therapy, psychological support, and lifestyle changes to optimize emotional well-being during this life stage (Wieczorek *et al*., 2023).

### 2.5.2 Depression, Anxiety and Stress among Premenopausal women in India

A cross-sectional study comparing psychological distress between perimenopausal or postmenopausal women using the DASS scale, revealed significantly higher levels of depression, anxiety, and stress among women during menopausal transition. The findings linked this elevated psychological burden to menopausal physical challenges, particularly hormonal fluctuations and knee joint osteoarthritis, suggesting that the interplay of physiological and psychological factors intensifies emotional distress during this life stage. While focusing on perimenopausal and postmenopausal women, the study implies that similar patterns may emerge in premenopausal women approaching this transition, especially when compounded by physical health issues. The effective use of the DASS scale in quantifying symptom severity underscores the need for proactive mental health monitoring and support for women throughout the menopausal continuum (Koch & Sarma, 2021).

A study investigated psychological distress among Indian working women during perimenopause using the DASS scale, revealing significantly elevated levels of depression, anxiety, and stress relative to population norms. The study identified a confluence of contributing factors, including occupational demands, domestic responsibilities, and physiological changes characteristic of menopausal transition, which collectively exacerbated emotional vulnerability. While some participants demonstrated adaptive coping through social support networks and physical activity, many exhibited maladaptive responses due to limited resources or ineffective stress management strategies. These findings underscore the critical need for culturally tailored workplace interventions and mental health support systems that address the intersection of professional pressures and menopausal symptoms. The research provides valuable insights into the psychological challenges faced by perimenopausal working women in India, highlighting both their distress patterns and coping mechanisms, while advocating for comprehensive support frameworks to enhance mental well-being during this transitional phase (Chaturvedi *et al.*, 2024).

Psychiatric morbidity and somatic symptoms in perimenopausal women using the DASS scale, revealing elevated levels of depression, anxiety, and stress, often compounded by physical manifestations such as fatigue, sleep disturbances, and vasomotor symptoms were examined. The study identified hormonal fluctuations alongside psychosocial stressors including occupational and familial demands as key contributors to this heightened psychological burden. These findings underscore the bidirectional relationship between somatic and mental health challenges during perimenopause, advocating for integrated clinical approaches that address both domains. The authors stress the necessity of early mental health screening and tailored interventions to mitigate distress and enhance quality of life in this vulnerable population (Aziz *et al*., 2024).

Hajra, Choudhuri, and Maity investigated psychological distress and coping mechanisms among perimenopausal women in West Bengal using the DASS scale, revealing significant levels of depression, anxiety, and stress attributed to both biological changes and sociocultural stressors. The study identified hormonal fluctuations as contributing to emotional instability, sleep disturbances, and mood swings, while external pressures including familial obligations, economic strain, and insufficient social support further exacerbated psychological distress. Although some women employed adaptive coping strategies such as seeking social connections, practicing spirituality, and maintaining physical activity, many lacked effective mechanisms to manage their symptoms, leading to worsened mental health outcomes. The findings highlight the necessity for culturally sensitive interventions that address the dual burden of physiological and psychosocial challenges faced by perimenopausal women in this region, advocating for enhanced psychological support and tailored coping resources to improve overall well-being (Hajra *et al.,* 2023).

A comparative study conducted, examining differential psychological impacts between natural and surgical menopause using the Depression, Anxiety and Stress Scale (DASS-21). Their findings revealed that women experiencing surgical menopause demonstrated significantly greater severity of depressive symptoms (mean difference = 3.2 points, $p<0.01$), anxiety (mean difference = 2.8 points, $p<0.05$), and stress (mean difference = 4.1 points, $p<0.01$) compared to those undergoing natural menopause. The researchers attributed this disparity to the acute estrogen withdrawal syndrome following bilateral oophorectomy, which precipitates more pronounced neuroendocrine disruption than the gradual follicular depletion of natural

menopause. Notably, even after controlling for confounding variables like age and baseline mental health status, surgical menopause remained an independent predictor of worse psychometric outcomes (β = 0.42, 95% CI 0.31-0.53). These results underscore the necessity for differentiated clinical protocols, including preoperative psychological counseling and more aggressive post-surgical hormone replacement strategies for this vulnerable population (Siddharth *et al.,* 2023).

## 2.6 MENSTRUAL SYMPTOMS AND CLIMACTERIC CHANGES IN PREMENOPAUSAL WOMEN

Menstrual symptoms and climacteric changes play a crucial role in women's health, especially during the transition to menopause. Climacteric syndrome includes a variety of physical, psychological, and vasomotor symptoms that result from fluctuating and declining estrogen levels during the perimenopausal and postmenopausal stages. Understanding these symptoms requires a holistic view of their complex causes, including hormonal shifts, psychosocial influences, and lifestyle factors. Their review points out that while hot flashes and night sweats are the most frequently reported vasomotor symptoms, many women also experience sleep disruptions, mood swings, and changes in menstrual patterns. The way women perceive and report these symptoms varies greatly, highlighting the need for individualized assessment and care. Standardized tools like the Menopause Rating Scale (MRS) help clinicians evaluate symptoms more effectively, supporting better treatment decisions. Ultimately, recognizing the interconnected nature of menstrual and climacteric symptoms is key to enhancing quality of life during midlife transitions ( Sourouni *et al*., 2021).

A study provides a thorough overview of the clinical approach to assessing women in the climacteric transition. The authors emphasize that this phase, typically beginning in perimenopause and extending through postmenopause, is characterized by a wide range of symptoms driven by hormonal changes, including menstrual irregularities, vasomotor issues, mood disturbances, and genitourinary problems. They stress the importance of a personalized, multidisciplinary evaluation that incorporates a detailed medical history, symptom assessment, physical examination, and relevant laboratory tests. Special focus is placed on risk factors such as osteoporosis, cardiovascular disease, and metabolic disorders, which become more prevalent

during this stage of life. The study advocates for the use of validated symptom scales and tools to aid in both diagnosis and treatment planning. Crucially,the study highlights the need for shared decision-making between healthcare providers and patients, ensuring that management strategies are customized to each woman's unique clinical situation, preferences, and quality of life goals (Baccaro *et al*. 2022).

A study exploring the link between mental health and climacteric adjustment in middle-aged women, emphasizing the crucial role of psychological well-being during the menopause transition, highlights that mental health issues, such as anxiety and depression, can worsen the physical and emotional symptoms typically seen during the climacteric phase, including menstrual irregularities. The research suggests that women facing mental health challenges during perimenopause are more likely to struggle with adjusting to the hormonal changes that disrupt regular menstrual cycles. This connection illustrates the intricate relationship between mental health and the physiological changes of the climacteric, underscoring the need for integrated care that addresses both psychological and physical aspects of the menopause transition. Managing menstrual changes, particularly irregular or missed periods, may require psychological support alongside traditional treatments, as mental health significantly influences how women navigate the fluctuations in reproductive function during this stage of life (Khakkar and Kazemi, 2023).

A study conducted a scoping review to examine whether midlife climacteric women with metabolic syndrome experience different symptoms compared to those without the condition during the menopausal transition. Their findings revealed notable differences in both the type and severity of symptoms between the two groups. Women with metabolic syndrome reported more severe vasomotor symptoms, such as hot flashes and night sweats, along with higher levels of emotional distress than those without the syndrome. The study also found that menstrual irregularities, a common feature of the climacteric phase, were more pronounced in women with metabolic syndrome, likely due to the combined effects of hormonal fluctuations and metabolic dysfunction. This underscores the importance of factoring in metabolic health when assessing and managing menopausal symptoms. The research suggests that women with metabolic syndrome may require more tailored interventions that address both their climacteric symptoms

and underlying metabolic risks to enhance their overall health and well-being during the menopause transition (Min *et al*.,2022).

### 2.6.1 Greene Climacteric scale and symptom severity

A study investigated the relationship between climacteric symptoms, age, sense of coherence, and sexual function in menopausal women. The study found that women with more severe climacteric symptoms, such as hot flashes, sleep disturbances, and mood swings, reported lower sexual function. Interestingly, the sense of coherence in how individuals perceive and manage stress was found to play a key role in moderating sexual health outcomes. Women with a stronger sense of coherence tended to report better sexual function despite experiencing climacteric symptoms. This emphasizes the importance of psychological and emotional factors in sexual health during menopause, highlighting that mental well-being is crucial for managing physical changes. The study suggests that, alongside addressing physical symptoms, interventions aimed at enhancing emotional resilience could help reduce the negative impact of climacteric symptoms on sexual function. Overall, the research contributes to the broader understanding that, like other menopause-related changes, sexual health is influenced by both physical and psychological factors, and a holistic approach may improve women's quality of life during the climacteric transition (Armeni *et al*.,2023).

A European survey conducted to examine the prevalence and quality-of-life impact of vasomotor symptoms (VMS) during menopause. Their findings revealed that VMS, such as hot flashes and night sweats, significantly affect women's physical, emotional, and social well-being, with severe symptoms causing substantial disruptions to daily life. The Greene Climacteric Scale (GCS), which measures the severity of climacteric symptoms, including vasomotor symptoms, could serve as a valuable tool in clinical settings to assess symptom intensity and inform personalized treatment. By using the GCS, healthcare providers can gain a clearer understanding of women's symptom burden and develop targeted interventions to enhance quality of life during menopause (Nappi *et al*.,2023).

A study investigated the link between the number of menopausal symptoms and work performance in Japanese working women. The study revealed that a higher number of menopausal symptoms, such as hot flashes, sleep disturbances, and mood swings, was strongly

associated with decreased work performance. Women experiencing more severe menopausal symptoms reported greater difficulty focusing, higher absenteeism, and reduced productivity at work. These findings underscore the significant impact of menopause on women's professional lives, highlighting the need for workplace accommodations and interventions to support women during this transition. The study suggests that effectively managing menopausal symptoms could improve work performance, benefiting both women and their employers (Hashimoto *et al.,* 2021).

Verma examined life satisfaction and well-being among working midlife menopausal women, finding that menopausal symptoms, such as hot flashes, sleep disturbances, and mood swings, significantly impacted their overall quality of life. Women who reported more severe symptoms on tools like the Greene Climacteric Scale (GCS), which assesses the severity of climacteric symptoms across physical and emotional domains, showed lower levels of life satisfaction and well-being. The study emphasizes the role of both physical and emotional symptoms in shaping women's quality of life during menopause. It suggests that interventions targeting symptom management, including those measured by the GCS, can improve life satisfaction and well-being by alleviating the burden of these symptoms. Effective use of the GCS in clinical settings can help identify women at risk of diminished well-being, leading to more personalized and supportive approaches to care (Verma, 2024).

### 2.6.2 Psychosocial and somatic influence of climacteric symptoms

A study investigated the relationship between menopausal symptoms, quality of life during menopause, and premenstrual syndrome (PMS) in women. The study found that women with a history of PMS tended to report more severe menopausal symptoms, especially in areas such as mood swings, hot flashes, and sleep disturbances. These women also experienced a poorer quality of life during menopause, with greater psychosocial and physical impacts. The study suggests that the severity of PMS may predict more intense menopausal symptoms, implying that women with significant premenstrual symptoms could face a more difficult transition into menopause. The findings highlight the importance of early identification and management of PMS to help prevent the worsening of symptoms during menopause. By addressing PMS

symptoms earlier, healthcare providers could improve the menopausal experience and enhance women's quality of life during this phase ( Tuygar-Okutucu *et al*.,2023)

A study explored menopausal symptoms among Indonesian women aged 40–65, focusing on the prevalence and types of symptoms experienced during the climacteric phase. The study found that many women reported common somatic symptoms, such as joint and muscle pain, fatigue, and hot flashes, as well as psychosocial symptoms like irritability, anxiety, and mood swings. These results reflect the broader understanding that menopause impacts both physical and emotional health. The study also highlighted the influence of cultural and lifestyle factors on how symptoms are perceived and reported, emphasizing the need for context-specific health education and support. The authors called for greater awareness and improved access to healthcare services for Indonesian women to help them manage the complex challenges of menopause more effectively (Diyu and Satriani, 2022)

In a study examining the connection between climacteric symptoms, age, sense of coherence, and sexual function in postmenopausal women, providing important insights into the somatic and psychosocial impacts of menopause, found that women who experienced more severe physical symptoms such as fatigue, joint pain, and hot flashes as well as psychological symptoms like anxiety and depression, reported significantly lower levels of sexual function. This underscores how climacteric symptoms affect not only physical health but also emotional intimacy, self-esteem, and relationship dynamics. Notably, the study showed that a strong sense of coherence reflecting psychological resilience and stress-coping ability helped reduce the negative impact of these symptoms on sexual well-being. The authors highlight the value of using assessment tools like the Greene Climacteric Scale (GCS), which captures both physical and emotional symptom burdens, to inform tailored interventions that enhance overall quality of life and relational health in postmenopausal women (Armeni et al.,2023).

Matsuura and Yasui investigated the relationships between menopausal symptoms, job-related stress, and social support among Japanese school teachers. The study revealed that women experiencing more severe menopausal symptoms particularly psychological ones such as anxiety, irritability, and sleep disturbances also reported higher levels of workplace stress and decreased job satisfaction. In contrast, strong social support from colleagues and supervisors was linked to

a lower perceived symptom burden and improved emotional well-being. These findings highlight the significant psychosocial impact of climacteric symptoms, especially in high-stress professions, and demonstrate the protective role of workplace support. The authors advocate for the inclusion of menopause education and awareness initiatives in occupational health programs and stress the importance of fostering supportive work environments to help women manage their symptoms effectively without compromising their job performance or mental health (Matsuura and Yasui, 2025).

CHAPTER 3

# METHODOLOGY

Research is an art of attaining scientific knowledge. It is an organized investigation of a problem where an investigator attempts to gain answers to the problem. Research can also be defined as a systematic search for pertinent information on a specific topic (Patel *et al*., 2019).Research leads to discoveries and also helps to search for new knowledge about unexplored facts.
Research is paramount for advancing knowledge, fostering progress, enabling individuals to better interact with their environment, achieve their goals, and resolve conflicts (Kumar *et al.*,2023).

Research methodology is the science that helps to conduct research scientifically and systematically. Research methodology is a way to systematically solve the research problem (Kothari, C R, 2004). Research methodology aims at analysing the methods and techniques used in research and helps in identifying and clarifying the limitations in the techniques used.

The methodology of the present study titled "**Nutrition, Health and Menstrual Well being of Premenopausal women in Cochin: A Cross-sectional study**" can be discussed under the following headings:

**3.1 Selection of area**

**3.2 Selection of subjects**

**3.3 Selection of tools and techniques**

**3.3.1 Sampling techniques**

**3.3.2 Selection of Tools**

**3.4 Data analysis and interpretation**

The methodology includes the procedure adopted to carry out the current study.

## 3.1 Selection of area

The area selected for the study was located in Ernakulam district in Kerala state. Premenopausal women between the age group 40-55 years belonging to Cheranalloor and Mulavukad

panchayats of Ernakulam district that falls into the Edapally Block panchayat, Kanayannur Taluk were considered for the conduct of this cross-sectional study.

### 3.2 Selection of subjects

A sample can be defined as a subset of the population from which a researcher collects data. It is difficult to collect data from the entire population, therefore in research, a representative sample of the study population is chosen for collecting data using suitable sampling techniques (Taherdoost, 2016).

For the purpose of the study women between the age group of 40-55 years who have not reached menopause are selected as study subjects.

*Inclusion criteria*

- All women in the age group 40-55 years who have not reached menopause and experience irregularities in monthly menstrual periods.

*Exclusion criteria*

Operational definition :

In this study, premenopausal women are defined as women aged between 41-55 years and have reported ongoing menstrual cycles whether regular or irregular. Women who have reported having experienced at least one menstrual cycle in the past three months, as recommended by Ambikairajah *et al.,*(2022) is included in this definition.

Exclusion criteria also includes:

- Pregnant and lactating women as they have diverse requirements and risks (Brooke *et al*.,2020).
- Women who have undergone surgical menopause (hysterectomy), who are more likely to have a higher prevalence of metabolic disorders were also excluded from the study (Jeong *et al*.,2022)
- Women unwilling to participate in the study were also excluded from the study.

### 3.3 Selection of tools and techniques

#### 3.3.1 Sampling techniques

The study recruited 100 menopausal women using a purposive random sampling technique.A purposive sampling method is a non-probability sampling technique that depends on the

researchers decision making skills to select the subjects based various factors like their willingness to be part of the study, the research questions to be answered etc (Rai *et al*., 2015) This sampling method was used as it fits well with the purpose and objectives of the study. Several observational visits were made to the sites in order to select the suitable sampling technique. Inorder to establish a rapport with the community, site visits and selection of subjects were carried out with the help of Accredited Social Health Activist (ASHA) workers belonging to different areas.

### 3.3.2 Selection of Tools

The study used a combination of face -to face interviews along with a structured questionnaire as the tool for data collection. A structured questionnaire consists of a predetermined set of questions to be asked to the interviewee. According to Kumar (2011) an interview schedule is a predetermined list of either open or closed ended questions that are prepared and used by the interviewer during the face to face interaction with the interviewee.

A predesigned, pretested questionnaire was used to collect data on sociodemographic status, anthropometric measurements, biochemical assessments, general health, menstrual details, dietary patterns and knowledge. A questionnaire is a list of questions that are answered by the respondents (Kumar *et al*.,2011).According to Roopa *et al*.,(2012) a structured questionnaire contains definite, concrete and predetermined questions that are presented to the respondents in the same wordings and in the same order. The questionnaire used in the study contains following sections:

1. Sociodemographic data- Kuppuswamy Socio-economic Status Scales
2. Anthropometric Assessment
3. Biochemical Assessment
4. Blood pressure
5. General Health
6. Menstrual details
7. Dietary assessment

### 3.3.2.1 SOCIODEMOGRAPHIC DATA

Kuppuswamy Socio-economic Status Scales

The Kuppuswamy Socio-economic scale is the most extensively used scale in India for measuring the socio-economic status in urban areas and is also widely employed in health studies.Socioeconomic status (SES) affects the incidence and prevalence of a variety of health disorders, thus making it a significant factor for both health status and standard of living (Javalkar *et al*.,2024). The scale developed by Kuppuswamy in 1976 contains three important indices which are total income, educational status and employment status. According to the total scores obtained for each family which could be between three to twenty nine points, the families are classified into five categories: upper class, upper middle class, lower middle class, upper lower class and lower class. An individual's socioeconomic status has a very important effect on factors regarding the quality of life, their health, social standing and social class (Sood P. *et al.*, 2022). Based on the scoring of Kuppuswamy socioeconomic status scale (2024) the subjects were categorized as depicted in Table 1.

**Table 1: Socioeconomic Class based on Kuppuswamy SES, 2024**

| SI. No | Total Score | Socio-economic class |
|---|---|---|
| 1 | 26-29 | Upper (I) |
| 2 | 16-25 | Upper middle (II) |
| 3 | 11-15 | Lower middle (III) |
| 4 | 5-10 | Upper lower (IV) |
| 5 | <5 | Lower (V) |

### 3.3.2.2 ANTHROPOMETRIC ASSESSMENT

Anthropometry is a widely used index for the measurement and evaluation of the nutritional status of individuals or population groups. Nutritional anthropometry is defined as measurements that involve physical dimensions as well as gross body composition parameters at different age and degree of nutrition (Shetty, 2003). Anthropometric measurements can be taken at two different levels, one to assess the growth and other to assess the body composition. Combination of suitable sensitive indices can directly point out the nutritional status of individuals. All anthropometric measurements are compared on the basis of predetermined reference cutoffs.

Measurements of body size include height, weight, BMI etc. Measurements of body composition include skeletal muscle percentage, Body fat percentage, waist - hip ratio etc. Anthropometric measurements can be used to define obesity ( Casadei *et al*.,2022). Skinfold measurements are strong predisposing factors for the risk of heart failure, diabetes, other cardiovascular diseases etc.Anthropometric assessments are a significant tool to evaluate the nutritional health status of menopausal women.

**Height**

Height assessment is a non- invasive readily obtainable measurement used to identify nutritional status of individuals. Height or stature is an inherent characteristic which can be easily used to estimate Body Mass Index (BMI) and diagnose the underlying disorders in individuals. The World Health Organization and Center for Disease Control and Prevention (CDC) have put into place a standardized protocol for measuring body height by ensuring reliability along with accuracy (Warrier *et al*., 2023).

**Procedure**

The height of the subjects was assessed using a Stadiometer (Seca, Germany).The subject was asked to stand erect against the stadiometer with back of the head, buttock and thoracic area in touch with vertical walls of the stadiometer on barefoot. They were also asked to position their heads straight along with arms touching the thighs on either side and heels kept close together. The subject's height was measured to the closest millimetre as the distance from the standing platform to the vertex, which is the highest point on the skull positioned straight. Height was measured to the nearest 0.1cm.

**Weight**

Weight is another important anthropometric measurement used to measure the body mass of an individual. It can be used alone or can be used to determine BMI. Weight along with measurements like height, waist and hip circumference can be used to determine weight loss as well as weight gain. Using weight measurements one can interpret the nutrition and health status of an individual. According to certain previous literature, significant unintentional weight loss has been linked to underlying diseases like cancer, depression etc in individuals.

**Procedure**

Body weight was measured using Omron Karada Scan Body Composition Monitor HBF-375 (Omron Corporation, Japan). The subjects were asked to stand on the Omron Karada Scan Body Composition Monitor HBF-375 ( Omron Corporation, Japan) and were made sure to be wearing light clothes without socks or gloves. Inorder to measure the body weight, the subjects height, gender and age were entered into the machine after which they were asked to stand on the machine and the bar was kept below their waist.

**Body Mass Index (BMI)**

Body Mass Index or BMI is a very easy to calculate measure which can be used to correlate health problems with weight especially in population studies. BMI also known as the Quetelet Index can be used to understand the nutritional status of adults. It can be defined as the measure of an individual's weight in kilograms divided by the individual's square of height in meters. It is expressed in $kg/m^{2.}$

Omron Karada Scan Body Composition Monitor HBF-375 ( Omron Corporation, Japan) was also used to measure the BMI.

Body Mass Index (BMI) = weight in kg ÷ Height in $(m)^2$

Individual variations do occur in BMI classification. This classification of BMI is used in White, Hispanics and Black individuals. For Asian and South Asian populations, BMI is found to be relatively low but they have a higher prevalence of central obesity due to higher prevalence of abdominal fat. Therefore considering these ethnic variations, a WHO expert consultation came up with an alternative criteria of BMI classification in Asian populations (Table 2).

**Table 2.Body Mass Index (BMI) classification for Asians**

| Classification | Cut- offs for BMI ($kg/m^2$) |
|---|---|
| Underweight | <18.5 |
| Normal range | 18.5-22.9 |
| Overweight | ≥23 |
| At risk | 23-24.9 |
| Obesity Class I | 25-29.9 |
| Obesity Class II | ≥30 |

Source: Asia Pacific report (WHO, IASO, IOTF 2000)

**Waist and Hip Circumference (WC & HC)**

Waist and Hip circumference can be used to define central obesity. Larger values for waist circumference have been associated with increased occurrence of cardiovascular diseases, insulin resistance, dislipidemia, coronary heart diseases etc and highly associated with mortality (Jacon E L et al.,2010).Waist circumference and Hip circumference are measured using a un-stretchable tape. The subjects are asked to stand with their feet close together and arms on either side with body weight evenly distributed. The measurements are taken at the end of normal expiration considering the subjects are relaxed. Waist measurements are taken from the midpoint between the least palpable rib and the top of the iliac crest. Hip measurements are taken around the widest portion of the buttocks, keeping the tape parallel to the ground. Waist and Hip circumference measurements are used to calculate Waist- Hip ratio (WHR). Waist- Hip ratio is estimated by dividing the waist circumference(cm) by hip circumference(cm). WHR can be used as a tool to proxy visceral fat. Abdominal obesity assessed through waist-hip ratio (Bulletin of World Health Organization, 2007) is greater than 0.85 for women.

**Body Composition Data**

Boy composition data include Body fat percentage, visceral fat percentage and skeletal muscle mass percentage. These data were also obtained using Omron Karada Scan Body Composition Monitor HBF-375 (Omron Corporation, Japan). After entering the age, gender and height of the subject, the subject was asked to stand on the machine with a bar kept below their waist. Once

the machine had calculated the weight of the subject, they were instructed to raise and hold the bar with both hands at their shoulder level at a 90 degree angle to analyse the body fat percentage, visceral fat percentage and skeletal muscle mass percentage.Table 3 depicts the optimal guidelines for the various body composition parameters.

**Table 3. Criteria for Optimal Body Composition in women**

| Criteria | Age (years) | Low | Normal | High | Very High |
|---|---|---|---|---|---|
| **Percent Body Fat[1]** | 40-59 | <23 | 23-33.9 | 34-39.9 | ≥40 |
| **Percent Visceral Fat[2]** | 20-80 | <9 | ≥9 | 10-14 | ≥15 |
| **Percent Skeletal muscle[3]** | 40-59 | <24.1 | 24.1-30.1 | 30.2-35.1 | ≥35.2 |

Source: [1]Gallagher *et al.*,(2000) [2]Suresh, Reddy.,(2014) [3]Walowski *et al*.,(2020)

**3.3.2.3 BIOCHEMICAL ASSESSMENT**

**Specimen collection**

Biochemical data was collected from subjects who were willing to give their blood for analysis. Women were asked to go to the health center to give out fasting venous blood samples which were taken in the morning after 12 to 24 hours of overnight fasting.

**Fasting Blood Sugar analysis**

Fasting Blood Sugar was analysed using GOD-POD (glucose oxidase-peroxidase coupled method). In this method an enzyme glucose oxidase oxidizes glucose to gluconic acid and simultaneously reduces oxygen to hydrogen peroxide which gets split to form water and nascent oxygen by another enzyme called peroxidase. This nascent oxygen will react with 4-aminoantipyrine in the presence of phenol to produce a coloured compound called quinoneimine that can be analysed using colorimetric methods (Shaker *et al*.,2023).

**Hemoglobin analysis**

Hemoglobin was analysed using a Complete Blood Count (CBC) machine. In the machine a WBC solution which is lysed is kept in Hgb cuvette and a light of 525 nm is passed through it. This is compared to the light transmitted in a reagent blank. The ratio obtained is converted to Hgb value using calibration factor and also considering the WBC interference. Finally the weight of hemoglobin (Hb) is expressed in g/dL (National Centre for Health Statistics, 2017). WHO guidelines for hemoglobin cut offs (2024) are used to classify the subjects into three categories as depicted in Table 4.

**Table 4. Haemoglobin (g/dl) cut-offs for diagnosis of anemia**

| Diagnosis | Haemoglobin level (g/dl) |
|---|---|
| Normal | ≥12 |
| Mild anemia | 11-11.9 |
| Moderate | 8.0-10.9 |
| Severe | <8.0 |

Source: WHO(2024)

**LIPID PROFILE**

Lipid profile included parameters like total triglycerides, HDL cholesterol, VLDL cholesterol, LDL cholesterol and Total cholesterol. CHOP PAP method is used for analysing cholesterol in serum. Using reagents like cholesterol esterases and cholesterol oxidases are used to evaluate the total cholesterol .The reaction involves the enzymatic hydrolyzation of cholesterol by cholesterol esterase enzymes into free fatty acids and cholesterol.

Cholesterol oxidase further oxidizes the free cholesterol. In the presence of hydrogen peroxide the reaction further proceeds to yield a red coloured quinoneimine dye that can be detected using colorimetric principles by the same machine itself.

The International Diabetes Federation (IDF) criteria is used to define metabolic syndrome risk. According to the definition, for a person to be defined as having the MetS, they must have any three of the five factors. These five factors considered include Waist Circumference(WC),

triglycerides, HDL-Cholesterol, blood pressure and fasting plasma glucose respectively. The diagnostic criteria is given in Table 5.

**Table 5: Diagnostic criteria for Metabolic Syndrome**

| Component | Clinical cut off values |
|---|---|
| Waist Circumference (cm) | ≥88 in women |
| Triglycerides ( mmol/l ) | ≥ 1.7 (150 mg/dl) |
| HDL-cholesterol (mg/dl) | < 50 in females |
| Blood pressure(mm Hg) | ≥ 130 mm Hg Systolic BP or<br>≥ 85 mm Hg Diastolic BP |
| Fasting plasma glucose | ≥100 mg/dL |

Source:IDF (2006)

**3.3.2.4 BLOOD PRESSURE**

Blood pressure was measured using automated devices to minimize observer bias or digit preferences. Omron digital Blood Pressure Monitor was used for measuring both systolic and diastolic pressure. Trained medical laboratory technicians record 3 readings with an appropriately sized cuff in the right upper arm with the study participant in a sitting position with a gap of at least 2 minutes between the readings. Valid second and third BP readings were considered to obtain the mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) (Vasudevan *et al.*, 2022).

International Society Of Hypertension, 2020 guidelines are used for classifying hypertension in adults. A cutoff of 30/85 is used as the threshold cut off for hypertension in adults (Unger *et al*.,2020).

### 3.3.2.5 GENERAL HEALTH

**Depression Anxiety Stress Scale (DASS)**

In this study, Psychological distress is measured using the Depression, Anxiety and Stress Scale (DASS-21). The Depression, Anxiety and Stress Scale (DASS-42; Lovibond & Lovibond, 1993) were developed to be self-reported measures of anxiety and depression by assessing negative emotional symptoms. The DASS is a set of psychometrically sound scales that is widely used to assess negative emotional states in adults. The following cutoffs (Table 6) were used to classify the severity of symptoms among participants. The DASS-Y scale is included in Appendix B of the study.

**Table 6: DASS-Y severity ratings for Depression, Anxiety and Stress scores**

| | **Depression (1-7)** | **Anxiety (8-14)** | **Stress (15-21)** | **Total** |
|---|---|---|---|---|
| Normal | 0-6 | 0-5 | 0-11 | 0-23 |
| Mild | 7-8 | 6-7 | 12-13 | 24-29 |
| Moderate | 9-13 | 8-12 | 14-16 | 30-39 |
| Severe | 14-16 | 13-15 | 17-18 | 40-46 |
| Extremely Severe | 17+ | 16+ | 19+ | 47+ |

Source: Lovibond (1995)

### 3.3.2.6 MENSTRUAL DETAILS

General menstrual details such as age of menarche, number of cycles in a year, Number of cycles that are missed in year, intensity of menstrual flow, and number of days of menstrual flow are included in the questionnaire to understand the menstrual details of study participants.

**Greene Climacteric Scale (GCS)**

The Greene Climacteric Scale (GCS) is a tool to help to identify where a patient is on their menopause journey produced by Dr. Greene (Greene,1976). It is used to assess the climacteric symptoms related to menopause.The Greene Climacteric Scale contains 21 items in four domains plus one sexual function probe.Other than this, it includes symptoms related to anxiety,

depression and also somatic symptoms and vasomotor symptoms. Each symptom can be rated by the subject according to a 4 point likert scale. The total sum of all the answers would give the quality of life measure. Three main areas assessed with respect to the symptoms of menopause-Psychological, Somatic and Vasomotor respectively. Greene Climacteric Scale for menopause symptoms is included in Appendix of the study. The scoring of the scale is as follows:

Not at all = 0

A little = 1

Quite a bit = 2

Extremely = 3

**3.3.2.7 DIETARY ASSESSMENT**

Dietary assessment was conducted among the subjects using the 24 hour dietary recall questionnaire and Minimum Dietary Diversity for Women (MDD-W) computation.

**24 hour dietary recall questionnaire**

Dietary recall was obtained via a 24-hour recall method of one weekday , enabling the calculation of dietary nutrient intake. Visual aids including standardized cups , spoons and paper cut-outs of different sizes of foods were used to facilitate accurate visual understanding of portion sizes and consumption of cooked foods.

A standardized software called the NSR Nutrical was used to calculate the participants' micronutrient as well as macronutrient intake. The nutrient content data in the software is sourced from the Indian Food Composition Tables (IFCT,2017).

**Dietary Diversity Score (DDS)**

Dietary Diversity Scores were computed based on surveys conducted by trained enumerators. The FAO details ten food groups reflecting micronutrient adequacy for women that were used in this study. Consumption of these food groups is quantified through Minimum Dietary Diversity for Women (MDD-W). This metric is recommended to be used for adult women (FAO, 2016).Consuming less than 50% of food groups, or 5 groups is defined as below minimally adequate diet diversity. The ten food groups coming under MDD-W are shown in Table 7

**Table 7. Minimum Dietary Diversity for Women (MDD-W)**

| SI No | Food Group |
|---|---|
| 1 | Grains, white roots and tubers, and plantains |
| 2 | Pulses (beans, peas and lentils) |
| 3 | Nuts and Seeds |
| 4 | Dairy |
| 5 | Meat, poultry and fish |
| 6 | Eggs |
| 7 | Dark Green leafy vegetables |
| 8 | Other vitamin A rich fruits and vegetables |
| 9 | Other vegetables |
| 10 | Other fruits |

**PILOT STUDY**

A pilot study serves a very crucial role in determining the reliability & credibility of the tools and techniques used for the conduct of a survey research. According to the National Center for Complementary and Integrative Health (NCCIH), it is defined as "a small- scale test of the methods and procedures to be used on a larger scale (NIH,2025). Inorder to test the effectiveness of the research methodology a pilot study was conducted for the current study. For the pilot study 30 middle aged women were recruited. It helped to validate, refine and identify the potential changes to be made in the design of the tools, therefore to ensure the study's feasibility.

**DATA ANALYSIS AND INTERPRETATION**

Appropriate analysis and interpretation of the data was done.The analysis of the data requires many closely related operations like establishment of categories, application of these categories to raw data through coding , tabulation and finally drawing statistical inferences. All the data was processed and analysed using Python version 3.13. Data that was collected from 100 premenopausal participants was analysed by using descriptive as well as inferential statistical

techniques. Out of the 100 study participants, 15 premenopausal women were considered as subsample available for biochemical assessments. Frequencies along with percentages were calculated inorder to quantify the prevalence of overweight, anemia, psychological markers etc. For establishing relations between variables like sociodemographic factors, menstrual details, anthropometric, biochemical and dietary assessments Pearson's correlation coefficient were calculated.

## RESEARCH DESIGN

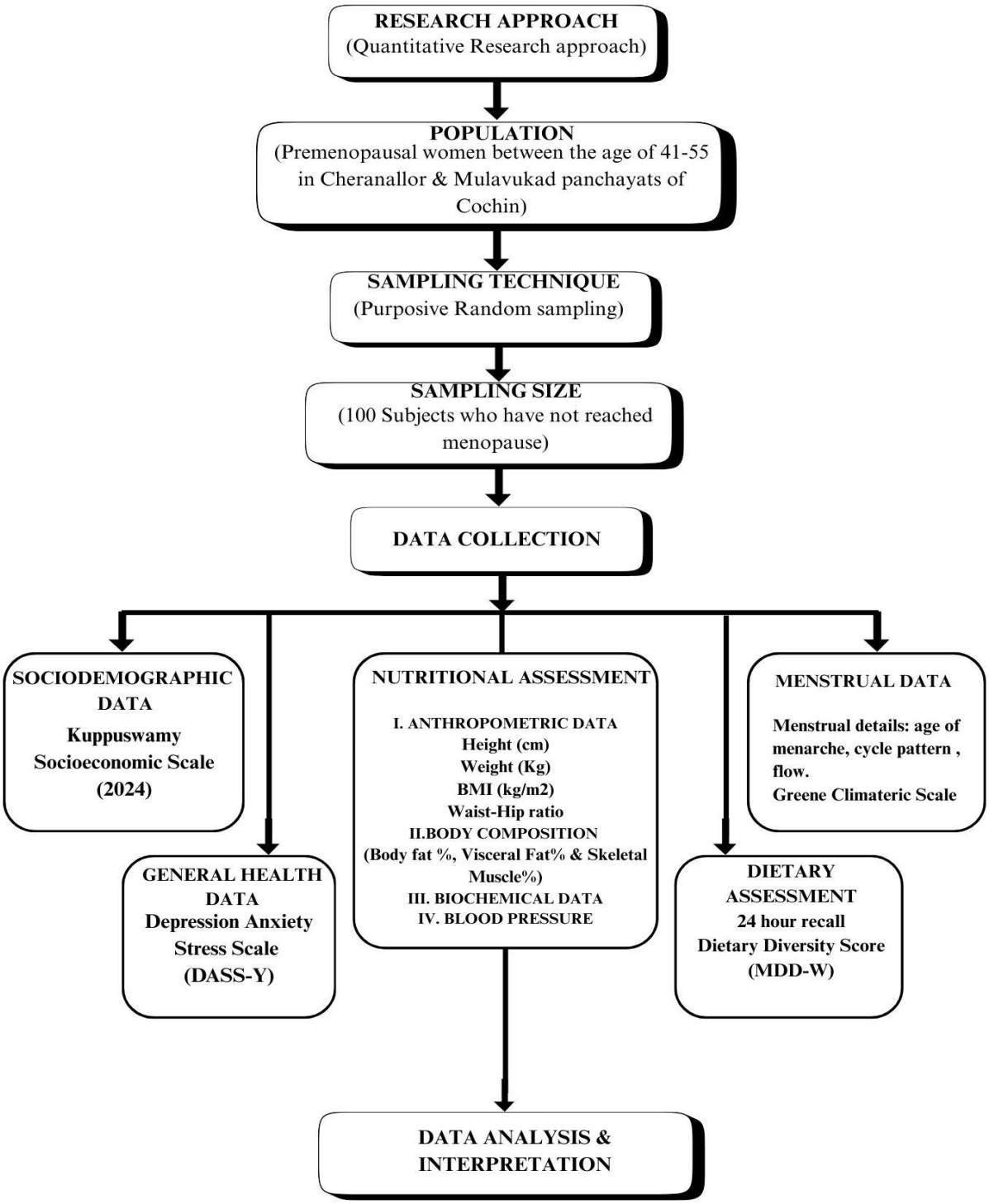



**Plate 1: Methodology Framework**

# CHAPTER 4

# RESULTS AND DISCUSSION

The results section reports the findings of the study based upon the methodology applied to gather information or simply state the findings of the research arranged in a logical sequence without bias or interpretation. The results pertaining to the study entitled '**Nutrition, Health and Menstrual well-being of premenopausal women in Cochin; A Cross-sectional study'** are presented and discussed under the following headings:

**4.1 Socio Demographic details of study participants**

**4.2 Nutritional Status Assessment of study participants**

- **4.2.1 Anthropometric assessment**
- **4.2.2 Biochemical assessment**
- **4.2.3 Blood Pressure and Cholesterol of study participants**
- **4.2.4 Risk of metabolic syndrome in study participants**
- **4.2.5 Prevalence of lifestyle diseases among participants**
- **4.2.6 Dietary Assessment of study participants**
  - **4.2.6.1 Nutrient Intakes**
  - **4.2.6.2 Dietary Diversity Score**
  - **4.2.6.3 Nutrient Adequacy**

**4.3 Psychological Distress among study participants**

**4.4 Menstrual details of study participants**

**4.5 Menopausal symptoms and their correlates**

**4.6 Correlates of menstrual details**

**4.7 Correlates of Nutritional Status assessment**

The study consisted of 100 female subjects belonging to the age group 40-55 years. While all samples underwent anthropometric, sociodemographic, dietary and psychological assessment, biochemical data for only 15 subjects were obtained. They are considered as subsample in the study.

### 4.1 Socio Demographic details of study participants

The general profile of the participants is depicted in Table 8.

**Table 8: Socio Demographic profile of the study participants**

| CRITERIA | CATEGORY | FREQUENCY (N=100) | PERCENTAGE (%) |
|---|---|---|---|
| Age | 40- 45 | 42 | 42 |
| | 46 - 50 | 46 | 46 |
| | 51- 55 | 12 | 12 |
| Type of family | Nuclear | 97 | 97 |
| | Joint | 3 | 3 |
| Number of family members | 2- 4 | 74 | 74 |
| | 5-9 | 26 | 26 |
| Marital Status | Married | 97 | 97 |
| | Unmarried | 2 | 2 |
| | Widow | 1 | 1 |
| Socioeconomic Status | Upper | 3 | 3 |
| | Upper middle | 18 | 18 |
| | Lower middle | 48 | 48 |
| | Upper lower | 31 | 31 |
| | Lower | 0 | 0 |
| Employment Status | Unemployed/ Homemaker | 35 | 35 |
| | Employed Private sector | 41 | 41 |
| | Employed Government sector | 24 | 24 |
| | Student (or internship) | 0 | 0 |

| CRITERIA | CATEGORY | FREQUENCY (N=100) | PERCENTAGE (%) |
|---|---|---|---|
| | Retired | 0 | 0 |

It was observed that the age of the participants ranged between 40 to 50 years and a vast majority belonged to 46-50 years. Majority of them (97%) lived in a nuclear family. Majority(97%) of the participants were married. Approximately half (48%) of the participants belonged to the upper middle socioeconomic status and 41% were employed in private sectors.

### 4.2 Nutritional Status Assessment of study participants

#### 4.2.1 Anthropometric assessment

Body composition analysis among the women was conducted and the findings are presented in Table 9 showing the BMI, Waist Hip ratio, Body fat percent, Skeletal muscle percent and Visceral fat percent of the participants.

**Table 9: Anthropometric status of participants**

| CRITERIA | CATEGORIES | FREQUENCY (N=100) | PERCENTAGE(%) |
|---|---|---|---|
| BMI | Overweight (≤ 18.5) | 3 | 3 |
| | Normal range (18.5-22.9) | 13 | 13 |
| | Overweight(≥23) | 0 | 0 |
| | At risk(23-24.9) | 18 | 18 |
| | Obesity Class I (25-29.9) | 46 | 46 |
| | Obesity Class II (≥30) | 20 | 20 |
| Waist-Hip Ratio (WHR) | High | 60 | 60 |
| | Normal | 40 | 40 |

| CRITERIA | CATEGORIES | FREQUENCY (N=100) | PERCENTAGE(%) |
|---|---|---|---|
| Body fat percent | Low | 1 | 1 |
| | Normal | 28 | 28 |
| | High | 53 | 53 |
| | Very high | 18 | 18 |
| Skeletal muscle percent | Low | 80 | 80 |
| | Normal | 20 | 20 |
| | High | 0 | 0 |
| | Very high | 0 | 0 |
| Visceral fat percent | Low | 48 | 48 |
| | Normal | 8 | 8 |
| | High | 26 | 26 |
| | Very high | 18 | 18 |

It was observed that 46% of the participants belonged to the obese class 1 category. Abdominal obesity was high among 60% of the participants. Around half (53%) of the participants had a high body fat percentage. Skeletal muscle was low among the majority (80%) of the participants. This can be a contributing factor to high body fat in women.

Findings from the National Family Health Survey (NFHS) showed that Indian women displayed rising trends of overweight or obesity with BMI measurements higher than 23 $kg/m^2$ between 1998 to 2005. The prevalence rate climbed from 18.8% to 23.4% during this period. The growing number of obese Indian female citizens shows that obesity is emerging as a significant health issue for women in the nation. The assessment of North Indian adult females revealed body adiposity measures by percentage of body fat serve as superior predictors for cardiovascular mortality and morbidity compared to BMI.

### 4.2.2 Biochemical assessment

Blood haemoglobin was tested for 15 participants who gave consent for biochemical analysis. The prevalence of anemia is represented in Table 10.

**Table 10: Prevalence of anemia among a subsample of study participants**

| HAEMOGLOBIN LEVEL(g./dl) | PERCENTAGE(%) |
|---|---|
| Normal (≥12) | 50 |
| Mild anemia (11-11.9) | 20 |
| Moderate (8.0-10.9) | 30 |
| Severe (<8.0) | 0 |

Half of the study participants had normal haemoglobin levels.Mild anemia was seen in 20% of the study participants and 30% of them had moderate anemia. None of the participants were observed to have severe levels of anemia.

The National Family Health Survey (NFHS-5, 2019–21) indicated that 57% of Indian women aged 15–49 were anemic where mild to moderate anemia cases prevailed over severe anemia cases which accounted for less than 3% of total anemic patients.A study conducted by Sharma et al. (2022) revealed anemic women presented mild anemia in 33.57% of cases and moderate anemia in 57.24% of cases together with severe anemia in 9.19% of cases.The research conducted by Little et al. (2018) in rural South India determined that 18.0% of women experienced mild anemia and moderate anemia affected 35.9% while severe anemia affected 3.4%.

### 4.2.3 Blood Pressure and Cholesterol of study participants

Among fifteen adult women in whom blood pressure was recorded, 46% recorded an elevated blood pressure.On assessing the blood cholesterol of the participants (n=15), 46% had an elevated cholesterol level.

**Table 11:Blood pressure and Cholesterol among participants**

| Criteria | Category | Frequency (N=15) | Percentage (%) |
|---|---|---|---|
| Blood Pressure(mm/Hg) | Elevated | 7 | 46 |
| Total Cholesterol(mg/dl) | Normal | 8 | 53 |
| | Elevated | 7 | 46 |

### 4.2.4 Risk of metabolic syndrome in study participants

According to the International Diabetes Federation (IDF), for a person to be defined as having MetS, they must have any three of the five factors. These five factors are Waist circumference, triglycerides, HDL, blood pressure and fasting plasma glucose. Out of the total sample size, 15 study participants gave blood samples for the determination of fasting plasma glucose, triglycerides and HDL. This was used for the determination of metabolic syndrome risk.

Though the number of subjects were few, more than half of the women (60%) indicated the prevalence of metabolic syndrome. .

**Table 12: Risk for metabolic syndrome among participants**

| Criteria | Category | Frequency (N=15) | Percentage |
|---|---|---|---|
| Risk for metabolic syndrome | Low risk | 6 | 40 |
| | At risk | 9 | 60 |

According to Krishnamoorthy et.,al(2020), analysis and systematic review studies demonstrate that Indian adults show a MetS prevalence rate of 30% while women (35%) presented a higher incidence than men (26%).

The study conducted in rural Tamil Nadu areas revealed MetS occurred in 36% of women between 30–50 years old while high waist circumference (56%) followed by low HDL cholesterol (45.3%) became the main MetS components. Research conducted in urban Mumbai showed MetS affected 32.6% of residents but women (38%) experienced higher prevalence rates than men (26%). Subjects who had enlarged waist dimensions displayed a strong connection to Metabolic Syndrome diagnosis.

Table 13 depicts the correlation of metabolic syndromes with blood pressure and total cholesterol.

**Table 13: Correlation between Blood pressure, cholesterol with Metabolic syndrome**

| Variable 1 | Variable 2 | Correlation coefficient (r) |
|---|---|---|
| Metabolic syndrome | Blood Pressure | 0.98* |
| | Cholesterol | 1* |

* Statistically significant

Metabolic syndrome was observed to have a strong positive correlation with both blood pressure and blood cholesterol respectively.

### 4.2.5 Prevalence of lifestyle diseases among participants

Out of the participants (N=100), 68 adult women ascertained the presence of lifestyle or non communicable diseases as communicated to them by a doctor or health professional. This is depicted in Figure 1. Others were unaware of any pre-existing morbidities.

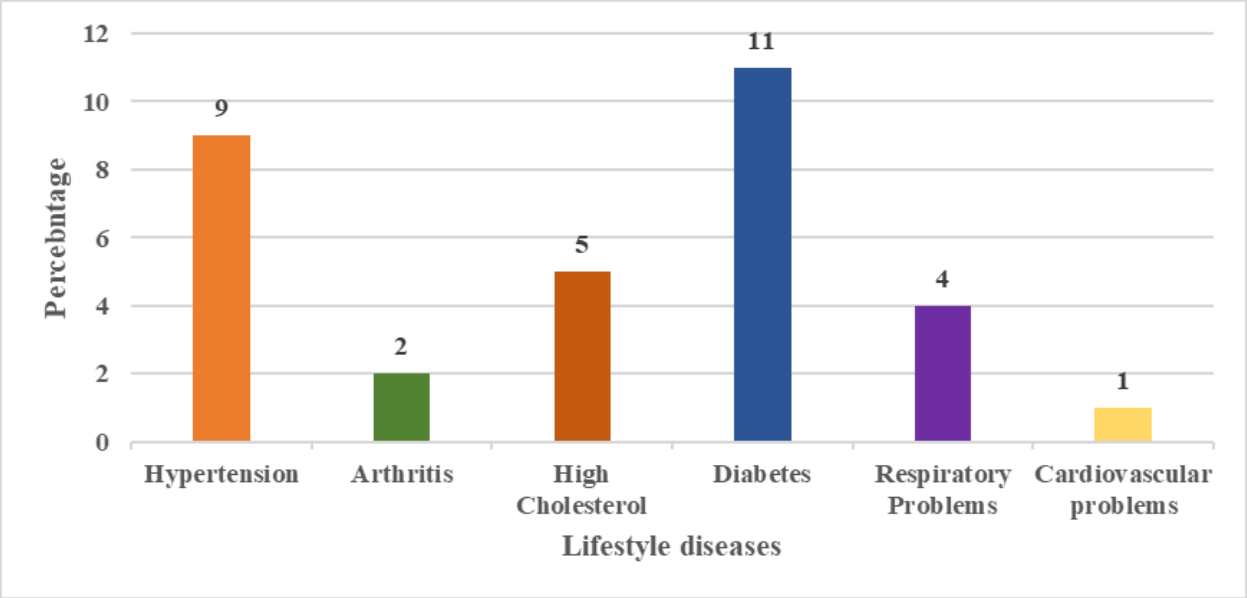



**Fig.1: Prevalence of lifestyle diseases among women**

It was seen that diabetes was most prevalent amongst the women with 11 percent of the women having diabetes mellitus and 9 percent of study participants also pre diagnosed hypertension.
The National NCD Monitoring Survey (NNMS) from 2018 showed India had an overall diabetes rate of 9.3% based on their data. The trend indicated continuous increases in diabetes cases nationwide.Research using NFHS-5 data showed that hypertension impacts 11.3% of women aged 15–49 years so about 282.5 million women needed healthcare.

### 4.2.6 Dietary Assessment of study participants

#### 4.2.6.1 Nutrient Intake of study participants

Intake of particular nutrients was computed among premenopausal women (n=100) and is presented in Table 14.

**Table 14: Mean nutrient Intake of study participants**

| NUTRIENT | MEAN INTAKE |
|---|---|
| Energy(KCal) | 1594.1± 643.5 |
| Protein(g) | 50.9± 21.8 |
| Total Dietary Fibre(g) | 24.8± 10.9 |
| Iron(mg) | 7.3± 3.3 |
| Calcium(mg) | 242.2± 146.1 |
| Folic acid(microgram) | 427.5± 712.0 |

According to the ICMR-NIN report of nutrient requirements for Indians (2024), the estimated energy requirements in order to maintain normal BMI for an adult woman between the age 30-60 years with a body weight of 63 kg is 1727 Kcal/d. After considering the average body weight of study participants, it was found that the mean energy intake is lower than the recommended values.Similarly, the mean intake of iron is far lower from the RDA value that is 29 mg/d. This reflects on the increased risk for iron deficiency anemia. Mean Calcium intakes are also lower than the RDA recommendations of 1000 mg/d.

#### 4.2.6.2 Dietary Diversity Scores

The Minimum Dietary Diversity of the participants using the Minimum Dietary Diversity for Women (MDD-W) was taken for premenopausal women is presented in Table 15.

**Table 15: Minimum Dietary Diversity of participants**

| DIETARY DIVERSITY | FREQUENCY (N=100) | PERCENTAGE |
|---|---|---|
| Adequate dietary diversity (≥5) | 70 | 70 |
| Inadequate dietary diversity (<5) | 30 | 30 |

It was observed that 30% of the study participants had an inadequate dietary diversity. This indicates that a considerable percentage of women could be lacking micronutrients and macronutrients in their diet due to a diet that lacks diversity with respect to the food groups consumed. Poor dietary patterns are associated with breast and ovarian cancers, cardiovascular diseases and type-2 diabetes and also related to occurrence of obesity (Kapoor *et al.,*2019).

#### 4.2.6.3 Nutrient Adequacy of study participants

The Nutrient Adequacy Ratio (NAR) for nutrients is calculated as an individual's intake as the percentage of Estimated Average Requirement (EAR) given by ICMR-NIN. This is presented in Table 16.

**Table 16: Nutrient Adequacy Ratio(NAR) among study participants**

| NUTRIENT ADEQUACY VS NUTRIENT | ENERGY (Kcal.) | PROTEIN (g.) | CALCIUM (mg.) | IRON (mg.) | FOLIC ACID (µg) |
|---|---|---|---|---|---|
| Severely low intake (<50%) | 7 | 4 | 84 | 58 | 15 |
| Moderately low intake (50-75%) | 23 | 8 | 14 | 30 | 25 |
| Mildly low intake | 28 | 14 | 2 | 9 | 15 |

| NUTRIENT ADEQUACY VS NUTRIENT | ENERGY (Kcal.) | PROTEIN (g.) | CALCIUM (mg.) | IRON (mg.) | FOLIC ACID (µg) |
|---|---|---|---|---|---|
| (75-100%) | | | | | |
| Optimum intake (>100%) | 42 | 74 | 0 | 3 | 45 |

According to the Nutrient Adequacy Ratio (NAR) for each nutrient, <50% indicates severely low intake, 50-75% indicates moderately low intake, 75-100% indicates mildly low intake and >100% indicates optimum intake. Therefore the intake of macronutrients like energy and protein among premenopausal women is considerably better than the intake of micronutrients.Two critical micronutrients during premenopause namely, iron and calcium are not adequate in the diet of the study participants. 58% of study participants have a severely low intake of iron and 84% of study participants have a severely low intake of calcium.

### 4.3 Psychological Distress among study participants

**Table 17: DASS(Depression, Anxiety and Stress) of the participants**

| DASS | CATEGORY | PERCENTAGE(%) |
|---|---|---|
| Depression | Normal | 89 |
| | Mild | 3 |
| | Moderate | 4 |
| | Severe | 3 |
| | Extremely Severe | 1 |
| Anxiety | Normal | 89 |
| | Mild | 6 |
| | Moderate | 4 |
| | Severe | 1 |

| DASS | CATEGORY | PERCENTAGE(%) |
|---|---|---|
| | Extremely Severe | 0 |
| Stress | Normal | 89 |
| | Mild | 4 |
| | Moderate | 3 |
| | Severe | 3 |
| | Extremely Severe | 1 |

Even though the majority of the study participants were normal when depression, anxiety and stress was assessed using the DASS scale; it was noted that a very few had mild, moderate and severe levels of depression, anxiety and stress. Overall, the level of severe depression, anxiety and stress was less than five per cent among the study participants.

**4.4 Menstrual details of study participants**

The menstruation related details collected from premenopausal women are presented in Table 18

**Table 18: Details pertaining to Menstrual health**

| MENSTRUAL DETAILS | CATEGORY | PERCENTAGE(%) |
|---|---|---|
| Age of menarche(Years) | 9-12 | 34 |
| | 13-16 | 66 |
| Irregularity in periods | Yes | 35 |
| | No | 65 |
| | 5–8 | 11 |
| | 8-12 | 89 |
| Number of menstrual cycles missed per year | None | 24 |
| | 1 | 4 |

| MENSTRUAL DETAILS | CATEGORY | PERCENTAGE(%) |
|---|---|---|
| Age of menarche(Years) | 9-12 | 34 |
| | 13-16 | 66 |
| Irregularity in periods | Yes | 35 |
| | No | 65 |
| | 2-4 | 11 |
| | 5-8 | 1 |
| Nature of menstrual flow | Heavy | 34 |
| | Medium | 56 |
| | Light | 10 |

The most frequently reported age of menarche was between 13-16 years (66%). But (34%) reported menarche at the age of 9-11 years. 35% of the women reported irregularities in periods which can be correlated to women approaching their menopause. Also 16% of study participants showed missing menstrual cycles in a year. Heavy menstrual flow was experienced by 56% of study participants.

**4.5 Menopausal symptoms and their correlates**

**Table 19: GCS (Greene Climacteric Scale) score of study participants**

| GCS SCORE | PERCENTAGE (%) |
|---|---|
| Higher severity of menopausal symptoms | 52 |
| Lower severity of menopausal symptoms | 48 |

52 % of study participants are shown to have higher severity of menopausal symptoms as depicted by the GCS score.Menstrual details were seen to be positively correlated to some of the sociodemographic factors and Greene Climacteric Scale (GCS)as shown in Table 19.

### 4.6 Menstrual details and its correlates

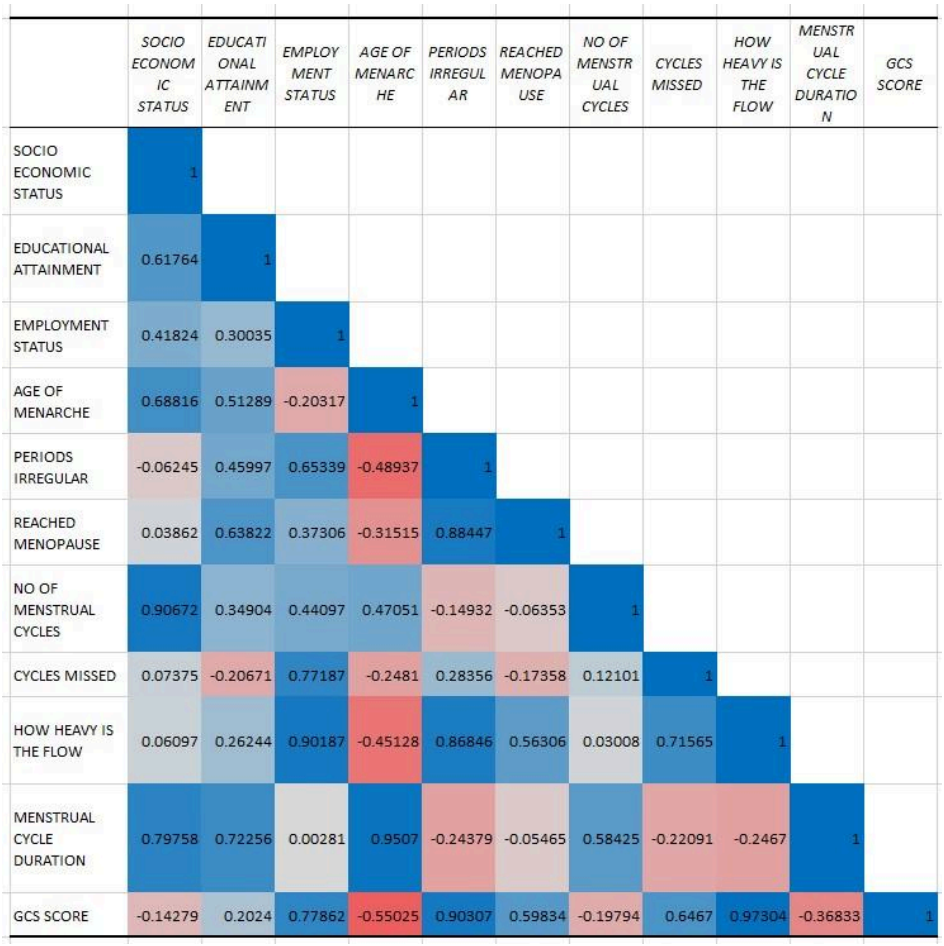
Correlation is a statistical measure that describes the strength and direction of a relationship between two variables.

- If two variables tend to increase or decrease together, they have a positive correlation.
- If one variable increases while the other decreases, they have a negative correlation.
- If there's no predictable pattern between the two variables, the correlation is zero or weak.

The most common way to express correlation is the correlation coefficient (usually "r"), which ranges from:

- +1 (perfect positive correlation)
- to -1 (perfect negative correlation)
- with 0 indicating no correlation

Pearson correlation coefficients were computed to measure the strength and direction of linear relationships between pairs of variables (sociodemographic and reproductive factors in premenopausal women). Coefficients range from -1 (perfect negative) to +1(perfect positive), with values near 0 indicating no linear correlation. The correlations identified are depicted in Figure 2.



| | SOCIO ECONOMIC STATUS | EDUCATIONAL ATTAINMENT | EMPLOYMENT STATUS | AGE OF MENARCHE | PERIODS IRREGULAR | REACHED MENOPAUSE | NO OF MENSTRUAL CYCLES | CYCLES MISSED | HOW HEAVY IS THE FLOW | MENSTRUAL CYCLE DURATION | GCS SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SOCIO ECONOMIC STATUS | 1 | | | | | | | | | | |
| EDUCATIONAL ATTAINMENT | 0.61764 | 1 | | | | | | | | | |
| EMPLOYMENT STATUS | 0.41824 | 0.30035 | 1 | | | | | | | | |
| AGE OF MENARCHE | 0.68816 | 0.51289 | -0.20317 | 1 | | | | | | | |
| PERIODS IRREGULAR | -0.06245 | 0.45997 | 0.65339 | -0.48937 | 1 | | | | | | |
| REACHED MENOPAUSE | 0.03862 | 0.63822 | 0.37306 | -0.31515 | 0.88447 | 1 | | | | | |
| NO OF MENSTRUAL CYCLES | 0.90672 | 0.34904 | 0.44097 | 0.47051 | -0.14932 | -0.06353 | 1 | | | | |
| CYCLES MISSED | 0.07375 | -0.20671 | 0.77187 | -0.2481 | 0.28356 | -0.17358 | 0.12101 | 1 | | | |
| HOW HEAVY IS THE FLOW | 0.06097 | 0.26244 | 0.90187 | -0.45128 | 0.86846 | 0.56306 | 0.03008 | 0.71565 | 1 | | |
| MENSTRUAL CYCLE DURATION | 0.79758 | 0.72256 | 0.00281 | 0.9507 | -0.24379 | -0.05465 | 0.58425 | -0.22091 | -0.2467 | 1 | |
| GCS SCORE | -0.14279 | 0.2024 | 0.77862 | -0.55025 | 0.90307 | 0.59834 | -0.19794 | 0.6467 | 0.97304 | -0.36833 | 1 |

**Fig 2. Correlates of details related to menstruation**

The correlations and its interferences can be depicted in the following Table 20

**Table 20: Correlates of Menstrual details**

| VARIABLE 1 | VARIABLE 2 | CORRELATION COEFFICIENT(r) | INFERENCE |
|---|---|---|---|
| Menstrual Flow Heaviness | GCS score | 0.97 | Extremely high correlation |
| Socio economic status | Number of menstrual cycles | 0.91 | Strong correlation |
| Age of menarche | Menstrual cycle duration | 0.95 | Strong correlation |
| Flow heaviness | Employment status | 0.90 | Strong correlation |

From the table it is understood that menstrual flow heaviness and GCS score are extremely correlated (r=0.97). Socio economic status and number of menstrual cycles have a strong correlation (r=0.91). Similarly age of menarche and menstrual cycle duration have a strong correlation (r=0.95). Flow heaviness and employment also have a strong correlation (r=0.90).

Women who come from disadvantaged financial backgrounds face additional severe complications during menopause. According to the research conducted in Haridwar middle-income family women started menopause later than individuals from poorer social backgrounds (Kapur.,et al 2019)

**4.7 Correlates of Nutritional status assessment**

The correlations and its inferences are depicted in the following Table 21

**Table 21: Correlates of Nutritional Status assessment**

| VARIABLE 1 | VARIABLE 2 | CORRELATION COEFFICIENT (r) |
|---|---|---|
| BMI | Body fat% | 0.91 |
| WHR ratio | Systolic pressure | 0.99 |
| Fasting Blood Glucose | Risk for Metabolic syndrome | 0.78 |

From the table BMI and body fat% indicated to have a strong correlation. Similarly, WHR ratio and Systolic pressure also had a correlation of (r=0.99). A positive correlation coefficient of r=0.78 was found between fasting blood glucose and risk for metabolic syndrome.

# CHAPTER 5

# SUMMARY AND CONCLUSION

The study entitled **'Nutrition, Health and Menstrual well -being of premenopausal women in Cochin : A Cross-sectional study'** was conducted inorder to access the multifactorial determinants of women's health especially during the premenopausal period, in women aged 41-55 years who are residents of Cheranalloor and Mulavukad Panchayats of Cochin, India.The primary objectives of this study was to evaluate the association of sociodemographic and reproductive factors, to assess the nutritional status of premenopausal women using anthropometric, biochemical and dietary intake measurements, to estimate the prevalence of metabolic syndrome, to assess the psychological well-being using the Depression, Anxiety and Stress scale (DASS-Y), and to identify the menopausal symptoms using the Greene Climacteric Scale(GCS).

- The age of the participants ranged between 40 to 50 years and a majority of the study participants belonged to 46-50 years. Majority of them (97%) lived in a nuclear family. Similarly 97% of study participants were married. Approximately half (48%) of the participants belonged to the upper middle socioeconomic status and 41% were employed in private sectors. Study participants with a number of family members between 2 and 4 (74%) were mostly seen.
- The distribution of study participants according to the BMI classification reveals that 46% of the participants belonged to the obese class 1 category. Abdominal obesity was high among 60% of the participants. Around half 53% of the participants had a high body fat percentage. Skeletal muscle was low among the majority (80%) of the participants. This can be a contributing factor to high body fat in women.
- Half of the study participants had normal haemoglobin levels. This distribution of study participants according to haemoglobin levels reveals that mild anemia was seen in 20% of the study participants and 30% of them had moderate anemia. None of the participants were observed to have severe levels of anemia.
- Out of the total sample size, 15 study participants gave blood samples for the determination of fasting plasma glucose, triglycerides and HDL. This was used for the

determination of metabolic syndrome risk. Though the number of subjects were few, more than half of the women (60%) indicated the prevalence of metabolic syndrome.

- Metabolic syndrome was observed to have a strong positive correlation with both blood pressure and blood cholesterol respectively.

- Out of the participants (N=100), 68 adult women ascertained the presence of lifestyle or non communicable diseases as communicated to them by a doctor or health professional.

- It was seen that diabetes was most prevalent amongst the study participants, with 11 percent of the women having diabetes mellitus and 9 percent of them were also pre diagnosed with hypertension.
- According to the ICMR-NIN report of nutrient requirements for Indians (2024), the estimated energy requirements in order to maintain normal BMI for an adult woman between the age 30-60 years with a body weight of 63 kg is 1727 Kcal/d. After considering the average body weight of study participants, it was found that the mean energy intake is lower than the recommended values.Similarly, the mean intake of iron is far lower from the RDA value that is 29 mg/d. This reflects on the increased risk for iron deficiency anemia. Mean Calcium intakes are also lower than the RDA recommendations of 1000 mg/d.
- It was observed that 30% of the study participants had an inadequate dietary diversity. This indicates that a considerable percentage of women could be lacking micronutrients and macronutrients in their diet due to a diet that lacks diversity with respect to the food groups consumed. Poor dietary patterns are associated with breast and ovarian cancers, cardiovascular diseases and type-2 diabetes and also related to occurrence of obesity (Kapoor *et al.,*2019).
- According to the Nutrient Adequacy Ratio (NAR) for each nutrient, <50% indicates severely low intake, 50-75% indicates moderately low intake, 75-100% indicates mildly low intake and >100% indicates optimum intake. Therefore the intake of macronutrients like energy and protein among premenopausal women is considerably better than the intake of micronutrients.Two critical micronutrients during premenopause namely, iron and calcium are not adequate in the diet of the study participants. 58% of study

participants have a severely low intake of iron and 84% of study participants have a severely low intake of calcium.

- Even though the majority of the study participants were normal when depression, anxiety and stress was assessed using the DASS scale; it was noted that a very few had mild, moderate and severe levels of depression, anxiety and stress. Overall, the level of severe depression, anxiety and stress was less than five per cent among the study participants.

- The most frequently reported age of menarche was between 13-16 years (66%). But (34%) reported menarche at the age of 9-11 years. 35% of the women reported irregularities in periods which can be correlated to women approaching their menopause. Also 16% of study participants showed missing menstrual cycles in a year. Heavy menstrual flow was experienced by 56% of study participants.
- 52 % of study participants are shown to have higher severity of menopausal symptoms as depicted by the GCS score. Menstrual details were seen to be positively correlated to some of the sociodemographic factors and Greene Climacteric Scale (GCS)
- The menstrual flow heaviness and GCS score were found to be extremely correlated (r=0.97). Socio economic status and number of menstrual cycles have a strong correlation (r=0.91). Similarly age of menarche and menstrual cycle duration have a strong correlation (r=0.95). Flow heaviness and employment also have a strong correlation (r=0.90).
- BMI and body fat% indicated to have a strong correlation. Similarly, WHR ratio and Systolic pressure also had a correlation of (r=0.99). A positive correlation coefficient of r=0.78 was found between fasting blood glucose and risk for metabolic syndrome.

- This study was able to provide insights into the health, nutrition and menstrual well-being of premenopausal women in Cochin. But there are certain limitations to the study as well.
- Due to the cross-sectional nature of the study there is a restriction in establishing a strong relationship between the variables considered in the study.
- Another limitation was that only few participants were willing to provide blood samples for biochemical assessment, therefore a subsample of (n=15) was considered for

assessing blood parameters like fasting blood glucose, HDL cholesterol, total cholesterol, VLDL cholesterol, triglycerides etc. This limits the generalizability of results associated to identify the prevalence of metabolic syndromes.

- The stages of menopause were not confirmed biochemically using criteria like STRAW (Stages of Reproductive Aging Workshop). This could have improved the accuracy of the classification of reproductive phase.
- The correlation between nutrient intake and anthropometric determinants was not established which restricts the understanding of how deficiencies or abundance of certain nutrients influence the anthropometric determinants like BMI, body fat percentage, waist-hip ratio etc.
- Other than this there are chances of occurrence of bias or reporting discrepancies in the data related to dietary intake and psychological symptom assessments.
- Even though there are certain limitations to this study, it offers a foundation for future research related to premenopausal women. Premenopausal women are often underrepresented in terms of health and well-being, therefore exploring more into the interrelationship between hormonal fluctuations, nutritional status and mental well being would provide more in-depth understanding and knowledge.
- Longitudinal studies that can study more samples and studies including qualitative methodologies would be able to figure out more clearly the transitions in midlife women and its relationship to various health determinants.
- Future studies could use hormonal biomarkers like STRAW to classify the reproductive phases.
- Establishing the correlation between nutrient intakes and anthropometric measurement understanding the factors that shape metabolic and reproductive health.
- This could be used for designing community-based interventions that would meet the health requirements and overall development of premenopausal women.

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# APPENDIX I

## SOCIO ECONOMIC STATUS
## Kuppuswamy Socio-economic Status Scale

**Table 1: Scoring for education level of the head:**

| Sl. No. | Education of head | Score |
|---|---|---|
| a. | Profession or honours | 7 |
| 2. | Graduate | 6 |
| 3. | Intermediate or diploma | 5 |
| 4. | High school certificate | 4 |
| 5. | Middle school certificate | 3 |
| 6. | Primary school certificate | 2 |
| 7. | Illiterate | 1 |

**Table 2: Scoring for occupation of the head**

| Sl. No. | Occupation of head | Score |
|---|---|---|
| 1. | Legislators, senior officials and managers | 10 |
| 2. | Professionals | 9 |
| 3. | Technicians and associate professionals | 8 |
| 4. | Clerks | 7 |
| 5. | Skilled workers and shop and market sales workers | 6 |
| 6. | Skilled agricultural and fishery workers | 5 |
| 7. | Craft and related trade workers | 4 |
| 8. | Plant and machine operators and assemblers | 3 |
| 9. | Elementary occupation | 2 |
| 10. | Unemployed | 1 |

**Table 3: Scoring for monthly family income**

| Sl. No. | Monthly family income | Score |
|---|---|---|
| 1. | 185,574 | 12 |
| 2. | 92,764- 185,574 | 10 |
| 3. | 69,584- 92,764 | 6 |
| 4. | 46,405- 69,584 | 4 |
| 5. | 27,815- 46,405 | 3 |
| 6. | 9276- 27,815 | 2 |
| 7. | <9276 | 1 |

# APPENDIX II

## DEPRESSION ANXIETY STRESS SCALE

## DASS-Y SCALE

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.
The rating scale is as follows:

0- Did not apply to me at all

1- Applied to me to some degree, or some of the time

2- Applied to me to a considerable degree or a good part of time

3- Applied to me very much or most of the time

| Sl No. | Feeling | Response | | | |
|---|---|---|---|---|---|
| 1. | I got upset about little things | 0 | 1 | 2 | 3 |
| 2. | I felt dizzy, like I was about to faint | 0 | 1 | 2 | 3 |
| 3. | I did not enjoy anything | 0 | 1 | 2 | 3 |
| 4. | I had trouble breathing (e.g. fast breathing), even though I wasn't exercising and I was not sick. | 0 | 1 | 2 | 3 |
| 5. | I hated my life | 0 | 1 | 2 | 3 |
| 6. | I found myself over-reacting to situations | 0 | 1 | 2 | 3 |
| 7. | My hands felt shaky | 0 | 1 | 2 | 3 |
| 8. | I was stressing about lots of things | 0 | 1 | 2 | 3 |
| 9. | I felt terrified | 0 | 1 | 2 | 3 |

| Sl No. | Feeling | Response | | | |
|---|---|---|---|---|---|
| 10. | There was nothing nice I could look forward to | 0 | 1 | 2 | 3 |
| 11. | I was easily irritated | 0 | 1 | 2 | 3 |
| 12. | I found it difficult to relax | 0 | 1 | 2 | 3 |
| 13. | I could not stop feeling sad | 0 | 1 | 2 | 3 |
| 14. | I got annoyed when people interrupted me | 0 | 1 | 2 | 3 |
| 15. | I felt like I was about to panic | 0 | 1 | 2 | 3 |
| 16. | I hated myself | 0 | 1 | 2 | 3 |
| 17. | I felt like I was no good | 0 | 1 | 2 | 3 |
| 18. | I was easily annoyed | 0 | 1 | 2 | 3 |
| 19. | I could feel my heart beating really fast, even though I hadn't done any hard exercise | 0 | 1 | 2 | 3 |
| 20. | I felt scared for no good reason | 0 | 1 | 2 | 3 |
| 21. | I felt that life was terrible | 0 | 1 | 2 | 3 |

# APPENDIX III

## Greene Climacteric Scale

| Sl. No. | Symptoms | Severity | | | | |
|---|---|---|---|---|---|---|
| | | Not at all (0) | A little (1) | Quite a bit (2) | Extremely (3) | Comments |
| **A.** | **Psychological symptoms** | | | | | |
| 1. | Heart beating quickly or strongly | | | | | |
| 2. | Feeling tense or nervous | | | | | |
| 3. | Difficulty in sleeping | | | | | |
| 4. | Memory problems | | | | | |
| 5. | Attacks of anxiety, panic | | | | | |
| 6. | Difficulty in concentration | | | | | |
| 7. | Feeling tired or lacking in energy | | | | | |
| 8. | Loss of interest in most things | | | | | |
| 9. | Feeling unhappy or depressed | | | | | |
| 10. | Crying spells | | | | | |
| 11. | Irritability | | | | | |
| **B.** | **Somatic symptoms** | | | | | |
| 12. | Feeling dizzy or faint | | | | | |
| 13. | Pressure or tightness in head | | | | | |
| 14. | Tinnitus (ringing or buzzing in ear) | | | | | |
| 15. | Headaches | | | | | |
| 16. | Muscle and joint pains | | | | | |
| 17. | Pins and needles in any part of the body | | | | | |
| 18. | Breathing difficulties | | | | | |
| **C.** | **Vasomotor symptoms** | | | | | |
| 19. | Hot flushes | | | | | |
| 20. | Symptoms due to vaginal dryness | | | | | |
| Score | | | | | | |

# APPENDIX IV

## Survey Questionnaire

Questionnaire on Health, Nutrition & Metabolic health profile in Pre and Post menopause(41-55 years)

The questionnaire is designed to study the health, dietary practices and metabolic health of adult women (41-55 years). Kindly answer each question. Your cooperation is appreciated. Participation in the study is voluntary. The information collected will be confidential and will be used for research purposes only.

### A. General Information

1. Name
2. Age: *select one option*
    1. 40-48 yrs
    2. 49-55 yrs
3. Email ID
4. Mobile no
5. Date of birth
6. Age
7. Type of family
    1. Nuclear family
    2. Joint family
    3. Extended family
8. Number of family members

**B. Sociodemographic details**

9. Education level of the head
10. Occupation of the head
11. Monthly family income
12. Socio economic status

**C. Anthropometric assessment**

13. Height (cm)
14. Weight (kg)
15. BMI ($Kg/m^2$)
16. Body fat%
17. Body muscle %
18. Visceral fat%
19. Waist circumference (cm)
20. Hip circumference (cm)

**C. Biochemical assessment**

21. Haemoglobin (g/dL)
22. Blood pressure (mmHg)
23. Total Triglyceride(mg/dL)
24. HDL (mg/dL)
25. Fasting Blood Glucose (mg/dL)
26. Cholesterol (mg/dL)
27. LDL cholesterol (mg/dL)
28. VLDL cholesterol (mg/dL)
29. Risk for metabolic syndrome (yes/no)

**C. General Health**

30. Typically how many hours do you sleep per day

a. Less than 4 hours
b. 4 to 6 hours
c. 6 to 8 hours
d. 8 to 10 hours
e. More than 10 hours

31. Hours of use of any gadget for productive work/environment?

a. Less than 1 hour per day
b. 1 to 2 hours per day
c. 3 to 4 hours per day
d. 5 to 6 hours per day
e. 7 to 8 hours per day

32. Do you engage in any type of physical activity?

a. Yes
b. No

**C. Menstrual related details**

33. Age of menarche
34. Are your periods irregular? (yes/no)
35. Have you reached menopause?
36. Date of last period
37. Number of menstrual cycles
    a. 0-4 cycles
    b. 5-8 cycles
    c. 8-12 cycles

38. How many cycles do you miss in a year?

a. 1 cycle
b. 2-4 cycle
c. 5-8 cycle
d. 8-12 cycle
e. None

39. How heavy is your flow?

a. Heavy:5 pads a day
b. Medium: 3 pads a day
c. Light: 2 pads a day

40. In how many days do you get your periods?(ie. Cycle duration)

a. Spotting only

b. 2 days

c. 3 days

d. 5 days

e. More than 5 days

**C. Greene climacteric scale**

41. Which of the following symptoms apply to you at this time? Tick the appropriate box.

| Sl. No. | Symptoms | Severity | | | | |
|---|---|---|---|---|---|---|
| | | Not at all (0) | A little (1) | Quite a bit (2) | Extremely (3) | Comments |
| A. Psychological symptoms | | | | | | |
| 1. | Heart beating quickly or strongly | | | | | |
| 2. | Feeling tense or nervous | | | | | |
| 3. | Difficulty in sleeping | | | | | |
| 4. | Memory problems | | | | | |
| 5. | Attacks of anxiety, panic | | | | | |
| 6. | Difficulty in concentration | | | | | |
| 7. | Feeling tired or lacking in energy | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 8. | Loss of interest in most things | | | | | |
| 9. | Feeling unhappy or depressed | | | | | |
| 10. | Crying spells | | | | | |
| 11. | Irritability | | | | | |
| B. Physical symptoms | | | | | | |
| 12. | Feeling dizzy or faint | | | | | |
| 13. | Pressure or tightness in head | | | | | |
| 14. | Tinnitus (ringing or buzzing in ear) | | | | | |
| 15. | Headaches | | | | | |
| 16. | Muscle and joint pains | | | | | |
| 17. | Pins and needles in any part of the body | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 18. | Breathing difficulties | | | | | |
| C. Vasomotor symptoms | | | | | | |
| 19. | Hot flushes | | | | | |
| 20. | Symptoms due to vaginal dryness | | | | | |
| Score | | | | | | |

**D. Dietary assessment**

42. Dietary pattern that you follow?

a. Vegetarian
b. Non – vegetarian
c. Lactovegetarian
d. Ovo vegetarian
e. Pescatarian

43. Dietary diversity score- The table shows various food groups with consumption quantities. Mark Yes/No in the appropriate column.

| **SI No** | **Food groups** | **Consumed**<br>**Yes=1**<br>**No=0** |
|---|---|---|
| 1 | Grains, white root and tubers, plantain | |
| 2 | Pulses (beans, peas, lentils) | |

| | | |
|---|---|---|
| 3 | Nuts and seeds | |
| 4 | Dairy | |
| 5 | Meat, Poultry, Fish | |
| 6 | Eggs | |
| 7 | Dark Green Leafy vegetables | |
| 8 | Other vitamin A rich fruits and vegetables | |
| 9 | Other fruits | |
| 10 | Other vegetables | |

44. How often do you eat junk foods or packed foods?

a. Daily
b. Weekly
c. Once in 2-3 weeks
d. Monthly

45. How many times have you skipped breakfast?

a. Daily skipping breakfast
b. Weekly
c. Sometimes very rarely
d. Never skipped breakfast

46.Enter the food you have consumed on one working day.

| **Meal** | **Food/Drink item** | **Raw Ingredients (gm)** |
|---|---|---|
| Breakfast (am/pm) | | |
| Snack (am/pm) | | |
| Lunch (am/pm) | | |
| Snack (am/pm) | | |
| Dinner (am/pm) | | |