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COMPARATIVE STUDY OF SERUM TSH AND LIPID PROFILE AMONG PREMENOPAUSAL AND POSTMENOPAUSAL WOMEN

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Abstract

Background:*Due to reducing ovarian follicular function and lower estrogen synthesis, menopause is a usual physiological change in women characterized by the lasting end of menstruation, which reasons major hormonal and metabolic changes. These hormonal variations have the possible to impact lipid metabolism also thyroid function, which can increase the risk of metabolic diseases and heart disease.*

Objective:*The recent research aimed to study the relationship between menopausal position and serum thyroid-stimulating hormone (TSH) amounts as well as lipid profile measures in premenopausal and postmenopausal women.*

Methods:*Ethical permission was acquired before this cross-sectional research remained was conducted Novo Care International Hospital in Sargodha for a period of three months. Based on their menstrual history, 301 women were selected using non-random convenience sampling and separated into premenopausal and postmenopausal groups. Age, body mass index (BMI), height, weight, and medical history were among the population characteristics that were collected. Lipid profile indicator, such as total cholesterol, triglycerides, LDL, and VLDL, as well as serum TSH levels, were analyzed by obtaining blood samples. Regression examination using standardized coefficients, one-way ANOVA, and descriptive numerically were used to statistically analyze the relationship between biochemical factors and menopausal status.*

Results:*The connection between menopause and increasing age was clear, associate the notion that menopause is a biological change connected with age. Differences in thyroid function during reproductive aging were presented by a sturdy correlation between serum TSH levels and menopausal state. Menopausal metabolic changes are multifactorial, as proved by the restricted independent statistical role of differences in lipid profile parameters between groups within the regression model.*

Conclusion: *The outcomes expose that menopause is related to major hormonal and metabolic changes that capacity makes women more liable to thyroid disorders and cardiovascular disease. For the early identification of metabolic irregularities and the implementation of preventative healthcare involvements to enhance long-*

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term health outcomes and excellence of life among aging women, routine monitoring of serum TSH and lipid profile during menopause is advised.

INTRODUCTION

BACKGROUND OF STUDY

Menopause is a normal and irreversible biological phase in a woman's life after menstruation completely stops and her capability to produce ends. It is affected by the advancing aging of the ovaries, which effects in a slow reduction in the ovarian reserve. The ovaries have a restricted number of follicles at birth, and these follicles finally degenerate and become exhausted. The ovaries' capacity to create sufficient amounts of reproductive hormones, notably estrogen and progesterone, reduces as follicular activity declines and their capacity to release mature ova is lessened. The fall in these hormones causes a discrepancy in the normal menstrual cycle, which eventually leads to the end of menstruation Clinically, a woman is said to have got menopause when she has expert 12 conservative months of amenorrhea that is not produced by any fundamental physiological or pathological factors, such as pregnancy, drug use, or systemic disease. This principle ensures that menopause signifies ovarian failure on a permanent basis and not transient menstrual disturbance. During this transitional phase, women experience an alteration in their hormone levels and menstruation before ovarian activity ends. The transitional phase preceding menopause is called perimenopause [1,2].

Since estrogen and progesterone have an effect on other organ systems apart from the reproductive system, menopause brings about an important change in the hormonal status. The receptors of estrogen are found in many areas of the body such as the liver, fatty tissues, urogenital organs, cardiovascular system, skeletal system, and brain. The drop in levels of estrogen leads to various physiological changes, which include rapid bone loss, endothelial cell malfunction, poor sensitivity to insulin, increased fat deposition, and lipids metabolism. The common signs associated with menopause like hot flushes, night sweats, mood alterations, sleep disorders, memory problems, and urogenital thinning are due to these hormonal changes. Menopause is therefore a very important time in the health transition of women since it greatly influences their psychological and physiological wellbeing [3].

The typical onset age of menopause ranges between 45 and 55 years, although there are variations based on different biological and environmental causes. Because many women undergo menopause around the same age as their maternal blood relations, the role of genes and inheritance should not be underestimated.

Susceptibility plays an important role in it. In relation to variations in menopause onset between populations, another contributing factor is ethnicity. Nutritional status is a determining factor in ovarian aging, and malnutrition or obesity can contribute to hasten the deterioration of hormones. Socioeconomic factors, which include education status, health care availability, and occupational stress, influence reproductive health results indirectly. Physical activities, along with balanced nutrition, can help delay menopausal onset. On the other hand, some lifestyle habits, such as smoking, leading a sedentary lifestyle, and chronic stress, may result in early onset of menopause [4,5].

Life expectancy has been enhanced globally owing to medical progress, better diet, and improvement in general lifestyle factors. As a result, women spend a long time beyond menopause since almost one-third of their life occurs when they are postmenopausal. Due to the increased susceptibility to various chronic disorders resulting from deficiency in estrogen, this long span is important clinically. Women who are postmenopausal have a high chance of developing heart disease owing to alterations in their lipid profile, which is not favorable, deposition of visceral fat, and vascular stiffening. Moreover, low levels of estrogen accelerate the loss of mineral content in the bones, hence osteoporosis and fracture.

As such, menopause cannot only be viewed as a point of closure to fertility but also as a critical transition stage in a woman's life, which requires

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both medical awareness and preventive measures. Healthcare professionals can leverage their understanding of the physiology involved during menopause to detect metabolic and hormonal changes at an earlier stage, initiate preventive screening programs, and promote lifestyle modifications that reduce the likelihood of developing chronic conditions. Early diagnosis and intervention in response to menopause changes are crucial for increasing longevity and quality of life in older women.

1 THE PHASES OF THE MENOPAUSE TRANSITION

The menopausal transition, which is the collective name for the clearly defined sequential stages of female reproductive aging, is a slow biological process. These phases show a gradual evolution of hormonal production, reproductive potential, and ovarian function. The changeover from reproductive maturity to reproductive senescence is usually broken down into premenopause, perimenopause, and postmenopause, each of which has unique endocrine, metabolic, and clinical traits.

1.1 pre-menopause

The term "premenopause" describes the reproductive period before the start of the menopausal transition, when ovarian function is still completely intact. At this point, women have regular menstrual cycles with healthy ovulation and reasonably constant amounts of estrogen and progesterone. The hormonal control of the menstrual cycle is important because of the functionality of the HPO axis. In premenopause stage, it is important for women to have estrogen as it has many protective functions for the body. Estrogen helps with insulin sensitivity, metabolic homeostasis, proper lipid metabolism, and also ensures proper functioning of the vascular endothelium. Apart from that, estrogen helps store more fat deposits subcutaneously rather than viscerally. Moreover, estrogen helps with calcium metabolism as well.

It is the beneficial influence of estrogen on arteries through its ability to increase nitric oxide synthesis, decrease inflammation, and improve lipid profile by boosting HDL and reducing LDL that mainly makes premenopause women immune from cardiovascular diseases. It is because of these reasons that premenopausal females generally pose less risk of heart disease compared to men and even post-menopausal females [6].

1.2 Perimenopause

The time period between reproductive maturity and menopause is termed perimenopause, also described as the phase of menopause transition. This phase is characterized by the aging process of ovaries and hormone production, and it may begin several years prior to the final menstrual period.

In connection with the decreasing sensitivity of ovarian follicles to the follicle stimulating hormone (FSH), ovulation becomes irregular, and the level of estrogen hormone production becomes uncertain. The variations in clinical presentation among women during this period result from hormone fluctuations rather than from hormone reduction.

Irregular menstruation in terms of shorter intervals, extended bleeding, missed periods, and menstrual flow changes is considered one of the characteristics of perimenopause. In addition to changes in reproduction, women often experience vasomotor symptoms like hot flashes and night sweats due to changes in the hypothalamus's thermoregulatory control. Due to the diminished responsiveness of ovarian follicles to follicle-stimulating hormone (FSH) during perimenopause, ovulation is erratic and estrogen production is unpredictable. The variability in clinical symptoms that women experience during this time is due to hormonal swings rather than a steady decline.

Irregular menstruation, which can include shorter cycles, longer bleeding, skipped periods, or variations in menstrual flow, is the defining characteristic of perimenopause. In addition to changes in reproduction, women often experience vasomotor symptoms like hot flashes and night sweats due to changes in the hypothalamus's thermoregulatory control. Commonly seen psychological and neurological

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issues during this time span are mood swings, anxiety, irritability, sadness, concentration problems, and insomnia. Changes in hormone levels can also lead to weight gain, fatigue, and low energy. The perimenopause period is characterized by the start of metabolic changes, such as slow gains in visceral fat deposition, insulin resistance, and early lipid profile changes, which indicate an increased risk of cardiovascular disease [7].

1.3 After-menopause

A woman is considered postmenopausal after she has gone 12 months in a row without menstruating, which indicates complete ovarian failure. Estrogen production decreases dramatically at this point and stays consistently low. Circulating estrogen is primarily produced by the peripheral conversion of adrenal androgens in fat tissue, as opposed to ovarian secretion, because the ovaries stop producing follicles. Long-term estrogen deficiency during postmenopause results in significant metabolic and endocrine effects. The loss of the protective effect that estrogen had on the cardiovascular system in the past is one of the most significant changes. Typical lipid profile alterations in women include higher total cholesterol, higher LDL cholesterol, higher triglycerides, and lower HDL cholesterol levels. Chronic low-grade inflammation, decreased insulin sensitivity, and increased visceral fat deposition are other symptoms of menopause in women, which, taken together, raise the risk of cardiovascular disease, metabolic syndrome, and type 2 diabetes mellitus. Increased osteoclastic activity causes accelerated bone mineral loss, which has a major impact on bone health and increases a woman's chance of developing osteoporosis and fractures. Estrogen deficiency also causes sexual dysfunction, urinary problems, vaginal dryness and urogenital atrophy. In addition to memory loss and mood swings, there may be lasting cognitive and psychological consequences. Given that women now live for many years after menopause, this long-term health repercussions make postmenopause a significant topic of discussion for clinical research and preventative healthcare [8].

2 HORMONE CHANGES ASSOCIATED WITH MENOPAUSE

The most significant endocrine occurrence during menopause is a dramatic shift in the production of ovarian hormones. The progressive decrease in estrogen and progesterone production caused by ovarian follicle depletion is the most notable hormonal change. These hormonal shifts impact several physiological systems that control metabolism, cardiovascular health, bone integrity, and neurological stability in addition to ending reproductive function.

2.1 Reduced Estrogen Synthesis

Maintaining metabolic homeostasis throughout a woman's reproductive life depends heavily on estrogen. During the reproductive years, ovarian follicles are the primary source of production, and it controls menstrual cyclicity via feedback loops involving the hypothalamic pituitary ovarian axis. The ovarian follicular reserve decreases during menopause transition, resulting in lower estradiol synthesis and dysfunction of hormone feedback loops. In many organs, including the liver, brain, adipose tissue, vascular endothelium, bones, and skeletal muscles, estrogen receptors (ER-α and ER-β) are abundant. Due to this broad distribution of receptors, estrogen deficiency causes systemic physiological effects rather than
only reproductive alterations [9,10].

Cause:

- Lipid metabolism is impaired.
- Modified glucose management.
- Heightened inflammatory reactions
- Dysfunctional endothelium
- variations in the distribution of body fat
- The combination of these changes raises the cardiometabolic risk associated with menopause.

2.2 Variations in Hormones of Gonadotropin

The inhibitory effect of negative feedback on the pituitary and hypothalamus reduces as the production of ovarian estrogen decreases. As a

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result, there is a notable increase in the release of gonadotropins, notably follicle-stimulating hormone (FSH) and luteinizing hormone (LH). Increased FSH levels are thought to be among the first biochemical indicators of the change in menopause. Reduced follicular responsiveness and ovarian insufficiency are indicated by elevated circulating FSH levels. Despite the significant increase in gonadotropins, they are unable to restore ovarian function because of the loss of functional follicles.

2.3 Lowering Progesterone Levels

During the menopausal transition, progesterone levels fall before estrogen levels because ovulation becomes irregular. Reduced progesterone impacts thermoregulation, mood stability, and sleep quality and contributes to menstrual irregularity during perimenopause. A lack of progesterone might also exacerbate metabolic issues that are independent of oestrogen and make one more prone to anxiety and sleep problems.

2.4 Consequences for Lipid Metabolism

In lipid metabolism, estrogen plays a protective role. through:

- Raising cholesterol levels of high-density lipoprotein (HDL)
- Lowering cholesterol in low-density lipoprotein (LDL)
- Boosting the rate at which lipids are cleared from the liver

After menopause, decreased estrogen causes undesirable lipid profile changes that include increased total cholesterol, triglycerides, and LDL levels, as well as lower HDL concentrations. The increased risk of cardiovascular illness and atherosclerosis in postmenopausal women is largely attributable to these lipid changes [(11)].

2.5 Glucose Metabolism and Insulin Sensitivity

By controlling glucose uptake in adipose tissues and skeletal muscles, estrogen increases insulin sensitivity. A lack of estrogen during menopause contributes to insulin resistance, greater visceral fat accumulation, and abnormal glucose metabolism. The risk of developing metabolic syndrome and type 2 diabetes mellitus is raised by these metabolic abnormalities.

2.6 Calcium and Bone Metabolism

By suppressing osteoclast activity and encouraging osteoblast survival, estrogen is essential for preserving the balance of bone remodeling. Due to increased bone resorption caused by estrogen deficit, postmenopausal women are more prone to osteoporosis and fragility fractures as a result of lower bone mineral density.

Effects on the Cardiovascular and Vascular Systems Estrogen helps keep blood vessels healthy by:

- encouraging vasodilation mediated by nitric oxide
- Lowering oxidative stress
- anti-inflammatory action on the vascular endothelium

After menopause, the risk of cardiovascular illness increases as a result of estrogen depletion, which causes endothelial dysfunction, arterial stiffness, and high blood pressure.

Psychological and Neuroendocrine Consequences

Neurotransmitter systems, including norepinephrine, dopamine, and serotonin, are also impacted by hormonal fluctuations. The typical signs of menopause, such as these, can be explained by these shifts:

- Night sweats and hot flashes
- Changes in mood
- Anxiety and sadness
- Disruptions to sleep
- Alterations in cognition

Total Metabolic Effect:

In general, hormonal changes during menopause increase women's vulnerability to chronic non-infectious illnesses by shifting them from a metabolically protected hormonal condition. This means that menopause can be viewed as not only an important reproductive change but also a key metabolic one requiring early detection and preventive healthcare measures.

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3 METABOLIC SYNDROME AND MENOPAUSE

There are increasing efforts being directed at understanding the relationship between menopause and metabolic syndrome, which is a cluster of interrelated metabolic disorders associated with an increased risk of heart diseases, type 2 diabetes mellitus, and other complications. Obesity, hypertriglyceridemia, high blood pressure, insulin resistance, and abnormal glucose metabolism are the main features of metabolic syndrome. Menopause is critical since the hormonal changes in the body, such as low levels of estrogen, increase susceptibility to metabolic problems.

3.1 The Role of Estrogen Deficiency in Metabolic Syndrome

The role of estrogen in maintaining proper glucose homeostasis, lipid metabolism, vascular regulation, and energy balance involves its protective properties. Estrogen helps achieve a proper fat deposition, maintains proper insulin sensitivity, and has anti-inflammatory effects. Unfortunately, these physiological processes are impaired as a result of declining levels of estrogen in postmenopausal women. One of the first metabolic changes occurring postmenopause includes redistribution of body fat mass from peripheral areas (gluteofemoral) to central/visceral depots. Given the endocrine activity of visceral adipose tissue, this shift towards visceral adiposity is metabolically unfavorable. Indeed, visceral fat depots secrete various adipocytokines such as interleukins-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) resulting in chronic inflammation and oxidative stress (12). Postmenopause directly affects cardiometabolic health through induction of inflammation that leads to the development of endothelial dysfunction, insulin resistance, and atherosclerosis.

3.2 Fat Redistribution and Central Obesity

One important element of metabolic syndrome is central obesity, which occurs more frequently after menopause. The lipolysis process cannot be regulated due to lack of estrogen; thus, adipocyte metabolism is disturbed and more visceral fat deposition occurs. The difference between visceral and subcutaneous fat tissue is that free fatty acids released from the former are delivered directly to the portal circulation, influencing liver metabolism and causing insulin resistance.

An important impact of hormones on body composition is emphasized by common occurrence of increased waist circumference and body mass index in women after menopause despite the fact that their caloric consumption stays constant.

Atherogenic lipid profile and dyslipidemia

The lipid metabolism changes noticeably during menopause. Typically, estrogen raises HDL cholesterol and boosts hepatic LDL receptor activity, but it also lowers LDL cholesterol and triglycerides.

Causes:

- Total cholesterol levels have risen.
- High cholesterol in LDL
- Higher levels of triglycerides
- HDL cholesterol reduction or functional dysfunction

These modifications result in an atherogenic lipid profile, which hastens the development of plaque in blood arteries. Menopause has been shown to be an independent risk factor for dyslipidemia and cardiovascular disease in several studies that have found that postmenopausal women have significantly higher levels of triglycerides, LDL cholesterol, and total cholesterol than premenopausal women [13,14].

3.3 Glucose Metabolism and Insulin Resistance

Metabolic syndrome, which is significantly impacted by menopause, also includes insulin resistance as a key element. Glucose absorption in skeletal muscles is increased by estrogen, and insulin signaling pathways are improved. A decrease in estrogen lowers insulin sensitivity, which results in decreased glucose metabolism and compensatory hyperinsulinemia. Furthermore, the buildup of visceral fat raises the level of free fatty acids and inflammatory mediators in the bloodstream, both of which impair insulin receptor signaling. Postmenopausal women are more prone to type 2 diabetes mellitus as a result of these

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metabolic changes.

3.4.Dysfunction of the Vascular System and Hypertension

By encouraging nitric oxide–mediated vasodilation, lowering oxidative stress, and preserving arterial flexibility, estrogen helps support vascular health. A lack of estrogen during menopause leads to greater vascular stiffness, activation of the renin-angiotensin system, and increased sympathetic nervous system activity.

As a result, hypertension is a typical characteristic of metabolic syndrome in older women, as blood pressure levels tend to increase following menopause.[15]

3.5Oxidative Stress and Inflammation

The link between menopause and metabolic syndrome is now believed to be primarily mediated by chronic low-grade inflammation. Increased oxidative stress, mitochondrial malfunction, and inflammatory cytokine synthesis all contribute to endothelial injury and metabolic dysregulation. These processes work together to advance the development of metabolic abnormalities and cardiovascular disease

3.6 Implications for Public Health and Clinical Practice

Metabolic syndrome is a major public health concern since women spend a large portion of their lives in the postmenopausal phase. The early identification of metabolism disturbances associated with menopause allows making necessary alterations in one's behavior, including dieting, regular exercising, maintaining the healthy body weight and conducting regular metabolism tests.

One should know about the connection between menopause and metabolic syndrome since without knowledge of this connection there might be several negative outcomes of this state, which include such conditions as malfunction of the thyroid gland, stroke, diabetes, and coronary artery disease. Thus, monitoring metabolism of women at menopause is extremely important.

4 CARDIOVASCULAR RISK FOR WOMEN FOLLOWING MENOPAUSE

The major cause of deaths in women all around the world is cardiovascular disease (CVD). It accounts for a great majority of deaths among females in the global community. While women experience low CVD rates before reaching menopause, they lose this advantage significantly once they become postmenopausal. Menopause constitutes an important turning point for women in terms of cardiovascular health due to many physiological changes occurring due to estrogen deficiency.

4.1 Estrogen's Cardioprotective Function

There are various protective mechanisms exerted by estrogen in the reproductive life cycle to maintain homeostasis and vascular health. The production of nitric oxide by estrogen causes vasodilation, which improves blood circulation. Additionally, it lowers oxidative stress, inhibits the multiplication of smooth muscle cells in blood vessels, and suppresses inflammatory reactions.

In addition, by raising HDL cholesterol while decreasing LDL cholesterol and total cholesterol levels, estrogen has a favorable impact on lipid metabolism. Together, these mechanisms shield premenopausal women from the early onset of coronary artery disease and atherosclerosis [15].

4.2 Effects of Stopping Estrogen After Menopause

The cardiovascular protection provided by estrogen falls away after menopause. Estrogen withdrawal causes a variety of functional and structural changes in the vasculature, such as:

- Dysfunction of the endothelium
- Enhanced arterial stiffness
- Decreased vascular flexibility
- Increased oxidative stress
- Increased inflammation

An early indicator of atherosclerosis is thought to be endothelial malfunction. Nitric oxide scarcity reduces vasodilation, encourages platelet aggregation, and hastens vascular damage. Consequently, postmenopausal women suffer from the gradual thickening of their arterial walls and the development of atherosclerotic plaques

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[16].

Aging of the Vascular System and Atherosclerosis

The aging of blood vessels is sped up during the menopausal transition. Increased LDL cholesterol oxidation, chronic inflammation, and lipid buildup in the arterial walls contribute to plaque development and narrowing of the coronary arteries. The likelihood of these pathological alterations increases the risk of:

- Disease of the coronary arteries
- Myocardial infarction
- Stroke
- Peripheral vascular illness

Regardless of age, research suggests that cardiovascular risk increases significantly in the first ten years after menopause. This increased vulnerability is mostly caused by hormonal changes, not by aging itself [17].

4.3 Factors in Metabolism that Increase the Risk of Cardiovascular Disease

Apart from hormonal depletion, menopause involves certain metabolic changes that increase the risk of cardiovascular problems:

- Greater obesity in the center of the body.
- Dyslipidemia
- Resistance to insulin
- High blood pressure
- Inflammatory condition

Together, all these problems lead to what is called metabolic syndrome, a condition that greatly promotes atherosclerosis. Dyslipidemia, characterized by increased levels of total cholesterol, LDL cholesterol, and triglycerides, along with decreased HDL cholesterol levels, is prevalent in postmenopausal women.

Preventive methods include:

- Assessment of cardiovascular risk
- Balanced dietary patterns
- Maintaining appropriate body mass index via exercise
- Staying away from tobacco smoke
- Monitoring various metabolic and hormonal markers

As women continue to live longer and enter menopause at a younger age, preventive care for the cardiovascular system has become an essential part of their health care management.

4.4 Importance to Public Health

Due to an increase in the aging population and life expectancy around the globe, an increase in the prevalence of heart disease due to post-menopausal women has been observed. In order to develop targeted prevention strategies for improving quality of life among women, it becomes imperative to understand the relationship between menopause and cardiovascular risks.

Hence, assessing hormonal and metabolic markers like thyroid hormone profile and lipid profile become significant when evaluating the cardiovascular risk in women before and post-menopause.

5 METABOLIC REGULATION AND THYROID FUNCTION

One of the most important organs in the endocrine system is the thyroid gland. It ensures the maintenance of metabolism. By releasing two hormones called thyroxine (T4) and triiodothyronine (T3), the gland is responsible for regulating oxygen uptake, energy metabolism, and overall metabolism. Both hormones are critical in the control of growth, development, and metabolism of almost all body systems.

5.1 The Thyroid Hormones' physiological Function

The basal metabolic rate (BMR) is largely regulated by thyroid hormones. By raising cellular oxygen consumption and boosting mitochondrial activity, they promote thermogenesis, which is the creation of heat and energy. By means of these processes, thyroid hormones aid in preserving a healthy body temperature and metabolic efficiency. including:

Metabolism of carbohydrates:

They enhance glycogen breakdown, hepatic gluconeogenesis, and glucose absorption from the intestine, all of which contribute to sufficient energy supply.

The metabolism of lipids:

Cholesterol is removed from the circulation, fat

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is mobilized, and fatty acids are oxidized by thyroid hormones. While thyroid abnormalities can cause dyslipidemia, healthy thyroid function helps maintain balanced serum lipid levels.

Protein metabolism:
They have an impact on protein production and breakdown, which aids in tissue development, cell repair, and enzymatic action.

Heat production and energy use:
Thyroid hormones aid in regulating body weight and energy use by enhancing metabolic activity [18]. The hypothalamus, pituitary gland, and thyroid gland comprise the hypothalamic pituitary thyroid (HPT) axis.
The hypothalamic-pituitary-thyroid (HPT) axis, which uses a feedback control system to maintain hormonal balance, tightly controls the production and release of thyroid hormones. Thyrotropin-releasing hormone (TRH) is released by the hypothalamus. The thyroid-stimulating hormone (TSH) is produced by the anterior pituitary gland in response to TRH. The thyroid gland is the target of TSH, which stimulates the production and release of T3 and T4 hormones. To keep hormonal balance, circulating thyroid hormones provide negative feedback to the hypothalamus and pituitary gland. Due to the fact that even small variations in thyroid hormone levels cause measurable changes in TSH concentration, serum TSH is regarded as the most sensitive and dependable biochemical marker for evaluating thyroid health among all thyroid function variables

5.2 Metabolic Health and Thyroid Function

To maintain cardiovascular and metabolic stability, the thyroid must function properly. Both overt and subclinical thyroid dysfunctions have a major impact on lipid metabolism, glucose utilization, and weight management. A slower metabolism, weight gain, high cholesterol, and a higher risk of cardiovascular disease are all symptoms of hypothyroidism. Hyperthyroidism increases metabolic rate, causes catabolism, and can cause arrhythmias and muscle atrophy. Increased serum cholesterol, decreased lipid clearance, and an increased risk of atherosclerosis have all been associated with even minor thyroid issues, particularly subclinical hypothyroidism.

5.3 The Relationship Between Menopause and Thyroid Function

Other hormonal changes brought about by menopause may have an impact on thyroid regulation. Lowering estrogen levels affect the quantity of thyroid-binding globulin and alters the metabolism of thyroid hormone in the periphery. Due to the overlap between thyroid dysfunction symptoms like weariness, weight gain, mood swings, and heat intolerance and menopause symptoms, thyroid illnesses may go unnoticed in middle-aged women.
The importance of assessing thyroid health during the menopausal transition is emphasized by the greater frequency of thyroid illness in postmenopausal women as compared to younger women. Monitoring serum TSH together with metabolic indicators offers crucial information for evaluating cardiovascular and endocrine risk in this group. Therefore, a fundamental understanding of thyroid function in connection to metabolic regulation is necessary for studies that compare the serum TSH and lipid profile of premenopausal and postmenopausal women.

6 THE RELATIONSHIP BETWEEN THYROID HORMONES AND MENOPAUSE

Hormonal fluctuations during menopause can have various impacts on several endocrine axes including the thyroid gland. This connection is particularly important considering how thyroid hormones interact with reproductive hormones to regulate metabolism, energy, and heart functions.

6.1 Estrogen's Effect on Thyroid Function

Estrogen plays a major role in the regulation of metabolism and transport of thyroid hormones. The induction of the synthesis of thyroid-binding globulin (TBG) in the liver constitutes one of the important effects of estrogen on thyroid function. By binding thyroid hormones present in the blood, TBG controls the balance between free thyroxine (T_4) and triiodothyronine (T_3) hormones. Proper estrogen concentration is

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required during the entire reproductive period of a woman to sustain regular thyroid hormone transport and secretion. Estrogen also affects the peripheral conversion of T_4 into T_3 by affecting deiodinase enzymes [20].

6.2 The impact of a drop in estrogen during menopause

The reduction in the amount of estrogen in the body during the onset of menopause leads to physiological changes in the regulation of thyroid hormones. Decrease in estrogen levels may cause disruption in hormonal balance due to effects on peripheral thyroid hormone metabolism and reduction in the formation of thyroid-binding globulin. There have been several studies that showed an increase in thyroid diseases among postmenopausal women with subclinical hypothyroidism, which is characterized by high TSH levels but normal thyroid hormone levels. Increased predisposition to such disease is worsened by hormonal changes and age-related autoimmune dysfunction due to menopause (21). Overlapping of symptoms in menopause and thyroid disorders. Symptoms of menopause and thyroid disease have overlapping characteristics; this poses as a major problem for women in their Middle Ages. Some of these symptoms of thyroid disease that are very similar to menopause include:

- Exhaustion and loss of vitality
- Modifications in body structure and obesity
- Depression and alteration of moods
- Disturbed sleep
- Hot or cold intolerance
- Impaired mental functioning

As a result of these similarities between both disorders, thyroid problems could remain undetected and could easily be confused as a symptom of menopause only. Therefore, an accurate diagnosis through biochemical examination of thyroid activity, especially by measuring serum TSH level, is essential [22].

6.3 Impact on Metabolism and the Cardiovascular System

Metabolism is influenced to a large degree by the relationship between menopause and thyroid hormones. The impact of thyroid diseases and estrogen deficiency can be evaluated independently regarding lipid metabolism, insulin resistance, and risk factors for cardiovascular disease.

Therefore, assessment of thyroid functions in relation to lipid profile provides valuable data concerning metabolic status in pre-menopausal and menopausal women.

6.4 Significance in Clinical Practice

Comparative studies on TSH and lipids will significantly profit from the knowledge about the connection between the two. Diagnosing thyroid disorders early during the menopausal transition allows for the timely treatment and better metabolic outcomes with a reduced probability of cardiovascular complications in the future.

7 THYROID HORMONES AND LIPID PROFILE

Thyroid hormones are very important in controlling lipids metabolism and heart health. Lipid synthesis, mobilization, absorption, and breakdown are regulated by thyroid hormones, such as T3 (triiodothyronine) and T4 (thyroxine), ensuring proper levels of serum lipids. Even slight changes in the thyroid system can have great effects on serum lipids parameters, leading to heart diseases.

7.1 Role of Thyroid Hormones in Lipid Metabolism

There are several ways through which the thyroid hormones can affect the lipid metabolism. The thyroid hormones enhance the breakdown of lipids in the liver; promote the breakdown of cholesterol, and help to clear lipids from the body through increased clearance. An essential function of the thyroid hormones is increasing the number of the low-density lipoprotein (LDL) receptors in the liver, which helps in the clearance of cholesterol from the bloodstream.

Thyroid hormones also:

- Increase the synthesis of bile acids from cholesterol
- Increase the action of the lipoprotein lipase enzyme

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- Promote the oxidation of fatty acids
- Modulate the metabolism of triglycerides [23].

7.2 Impact of Hypothyroidism on Lipid Profile

With hypothyroidism, there is an inhibition of thyroid hormones, which reduces the LDL receptors leading to inefficient removal of lipids from the body. This causes lipids to remain in the blood longer than required, hence giving rise to abnormal:

- Elevated total cholesterol
- Increased LDL cholesterol
- Raised triglyceride levels
- Reduced lipid catabolism

These modifications facilitate the formation of an atherogenic lipoprotein profile, which is known to be highly associated with CAD and cardiovascular mortality.

Mild thyroid disorders can also have a significant effect on lipid metabolism. Patients with hypothyroidism often display lipid abnormalities even though they have relatively minor symptoms.

7.3 Subclinical Hypothyroidism and Elevated TSH

Serum thyroid-stimulating hormone (TSH) is considered a sensitive indicator of thyroid function. Elevated TSH levels, even when circulating T_3 and T_4 remain within normal ranges (subclinical hypothyroidism), have been shown to correlate with adverse lipid abnormalities.

Research demonstrates that increased TSH concentrations are associated with:

- Higher LDL cholesterol levels
- Increased triglyceride concentrations
- Reduced HDL cholesterol
- Increased cardiovascular disease risk

Subclinical thyroid dysfunction is particularly common among middle-aged and postmenopausal women, making thyroid evaluation essential in metabolic risk assessment [24].

7.4 Thyroid Function, Menopause, and Cardiovascular Risk

The estrogen deficiency during menopause puts women at increased risk for lipid abnormalities. In case there is dysfunction of the thyroid glands along with menopause hormonal imbalance, metabolic disorders can result.

The combined effects of:

- Declining estrogen levels
- Altered thyroid hormone regulation
- Increased TSH concentrations

may result in faster progression of dyslipidemia and lead to early atherosclerosis. Thus, combined evaluation of serum TSH and lipids can provide important data about metabolism and cardiovascular condition in both premenopausal and postmenopausal females [25].

7.5 Clinical Significance

Knowledge of how thyroid hormones interact with lipids is the basis for scientific studies that make comparisons of the two. Detection of thyroid-induced dyslipidemia will enable earlier treatment and therefore reduce any cardiovascular complications arising out of this among elderly women.

8 DYSLIPIDEMIA DURING MENOPAUSE

Dyslipidemia is a significant metabolic result of menopause and is common among women following menopause. Estrogen shortage coupled with metabolic alterations related to aging are the main cause of the illness. Lipid metabolism is typically controlled by estrogen, which also keeps cholesterol levels in check. Changes in the lipid profile occur as a result of lower estrogen levels following menopause.

- Postmenopausal women often exhibit the following:

- Higher overall cholesterol levels
- Higher LDL cholesterol
- Elevated triglycerides
- Lowered HDL cholesterol

These changes in lipids result in an atherogenic lipid profile, which raises the risk of:

Arteriosclerosis:

A condition affecting the coronary arteries. Morbidity of the cardiovascular system. According to research, postmenopausal women have a consistently higher prevalence of dyslipidemia than premenopausal women [26].

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Because thyroid hormones also affect lipid metabolism, evaluating lipid profile alone may not provide a comprehensive picture of metabolic risk. As a result, a combined evaluation of lipid profile and thyroid function assessment offers improved cardiovascular risk stratification and early detection of metabolic abnormalities [27].

9 THE SIGNIFICANCE OF SERUM TSH EVALUATION

Measuring serum thyroid-stimulating hormone (TSH) is the most accurate laboratory test for detecting thyroid abnormalities. The hypothalamic pituitary thyroid axis controls the release of TSH.

Minor shifts in thyroid hormone levels result in large fluctuations in serum TSH concentration. As a result, thyroid health is best measured by TSH. Middle aged and postmenopausal women are frequently found to have subclinical hypothyroidism.

Features Include:

- Increased level of TSH in the serum
- Typical T_3 and T_4 levels
- Frequently, clinical indicators are minor or unclear. Thyroid problems can lead to:
- Dyslipidemia
- A rise in weight
- Insulin resistance
- Increased cardiovascular risk

Biochemical evaluation is necessary for an accurate diagnosis because thyroid illness symptoms overlap with menopausal symptoms such as exhaustion, mood swings, and metabolic changes [28].

Serum TSH measurement enables early identification, which allows:

- Prompt medical care
- Avoiding thyroid illness that is obvious
- Lowering the risk of cardiovascular disease
- Postmenopausal women have better metabolic health outcomes [29].

10 RATIONALE OF THE STUDY

The severe hormonal and metabolic changes that occur during menopause have a big impact on the long-term health of women. The fall in estrogen levels during menopause causes several physiological changes, such as insulin resistance, changes in body fat distribution, disruptions in lipid metabolism, and an increased risk of cardiovascular disease. Additionally, thyroid function, notably serum thyroid-stimulating hormone (TSH), is critical in controlling metabolic activities and preserving lipid balance. Dyslipidemia and a higher risk of atherosclerotic cardiovascular disease have been associated with even minor thyroid malfunction, particularly subclinical hypothyroidism. Due to the fact that thyroid hormone imbalance and menopause independently affect metabolic regulation, their combined effect may significantly raise the risk of cardiometabolic disorders in older women.

Comparative data from local populations are scarce, despite numerous international studies examining the connection between menopause, thyroid function, and lipid abnormalities. A woman's hormonal state and metabolic patterns may be impacted by regional variations in genetics, food habits, socioeconomic circumstances, environmental exposures, and healthcare access. As a result, the metabolic and endocrine profile of women in the local community may not be accurately represented by data from other populations. There is a knowledge gap on the degree to which menopausal condition impacts serum TSH levels and lipid profile indicators due to the paucity of evidence produced locally.

Early identification of metabolic abnormalities during the menopausal transition is crucial since several risk factors remain asymptomatic in the beginning. Screening for thyroid dysfunction in conjunction with lipid abnormalities can facilitate prompt intervention through lifestyle changes, medical care, and preventative healthcare practices. These steps can assist lessen the burden of dyslipidemia, metabolic syndrome, and cardiovascular disease, which continue to be major contributors to morbidity and mortality in women after menopause.

As a result, the purpose of this study is to

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compare the serum TSH levels and lipid profiles of premenopausal and postmenopausal women. Creating local evidence will aid in increasing clinical knowledge, promoting early screening initiatives, and helping healthcare professionals in creating focused preventative interventions aimed at lowering cardiovascular problems and enhancing the quality of life for women going through the menopausal shift [30].

OBJECTIVE HYPOTHESIS OF STUDY

AIMS AND OBJECTIVES:

Aim:

To compare serum Thyroid Stimulating Hormone (TSH) levels and lipid profile parameters among premenopausal and postmenopausal women, and to study the interrelationship between thyroid function and lipid metabolism in both groups.

Objectives:

- To estimate serum TSH levels in premenopausal and postmenopausal women.
- To measure serum lipid profile parameters — total cholesterol, triglycerides, HDL, LDL, and VLDL — in both groups.
- To compare the mean values of TSH and lipid profile parameters between premenopausal and postmenopausal women.
- To evaluate the correlation between serum TSH and lipid parameters (total cholesterol, LDL, HDL, and triglycerides) in each group.
- To identify whether menopausal transition contributes to an increased risk of dyslipidemia and thyroid dysfunction.

HYPOTHESIS OF THE STUDY

Null Hypothesis (H_0):

- There is no significant difference in serum TSH and lipid profile levels between premenopausal and postmenopausal women.

Alternative Hypothesis (H_1):

- There is a significant difference in serum TSH and lipid profile levels between premenopausal and postmenopausal women, with postmenopausal women showing higher TSH, total cholesterol, LDL, and triglyceride levels and lower HDL levels compared to premenopausal women.

LITERATURE REVIEW

Al-Maamori and Abbas (2025) carried out a study titled "Assessment of Thyroid Hormonal Dysfunction and Related Oxidative Stress in Menopausal Women with Irritable Bowel Syndrome. " The trial comprised 80 postmenopausal women, divided into early and late menopause stages, with 30 healthy controls and 50 IBS patients. The thyroid hormones T3, T4, FT3, FT4, and TSH were measured using an automated immunoassay system, and oxidative stress indicators such as total oxidant status (TOS) and total antioxidant capacity (TAC) were evaluated by ELISA techniques. In menopausal women with IBS, the findings revealed markedly higher TSH and FT3 levels along with lower TT3, TT4, and FT4 levels when compared to controls. Compared to women who experience early menopause, those who experience late menopause had higher TSH levels and a larger drop in thyroid hormones. TOS is high and TAC is low in terms of oxidative stress testing, mainly when menopause occurs in the late stages along with IBS. According to this research, the individuals experiencing menopause along with IBS are at an increased risk of developing oxidative stress and thyroid disorder, which increases the chance of hypothyroidism in menopause. [31]

The study conducted by Orhan et al. (2025) to determine the cardiometabolic risk in women before and after menopause was aimed at identifying and comparing cardiometabolic risk factors between these two groups of women. The sociodemographic characteristics, anthropometric measurements, and biochemical parameters in menopausal women were studied in this cross-sectional correlation study. As per the findings, menopausal women were found to have significantly higher values of body weight, BMI, waist and hip circumferences, WHR, blood pressure, fasting blood glucose, hemoglobin, liver enzyme (AST) values, and Framingham cardiovascular risk scores compared to premenopausal women. However, the serum albumin, ALT, HbA1c, TSH, LDL, HDL, and VAI values were significantly lower in menopausal women. Hence, the research found

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that there were significant metabolic alterations during menopause that increased cardiometabolic risk among menopausal women [32].

A study by Kindie et al. (2025) conducted a comparative community-based cross-sectional analysis in Ethiopia to identify and compare the prevalence of dyslipidemia and associated parameters among premenopausal and postmenopausal women. Using multistage random sampling, 320 women were recruited overall. An automated analyzer was used to measure lipid profiles, reproductive hormones (estrogen, follicle-stimulating hormone, progesterone, luteinizing hormone), and glucose levels. To discover dyslipidemia indicators, a multivariable logistic regression analysis was used. The results showed a considerably greater incidence of dyslipidemia in postmenopausal women (41. 9%) than in premenopausal women (22. 5%). In menopausal women, dyslipidemia was predicted by low estrogen levels, obesity, and physical inactivity. The study concluded that lowering estrogen levels during menopause exacerbates unfavorable lipid changes, raising cardiovascular risk, and highlighted the significance of early preventative measures to promote cardiovascular and metabolic health in menopausal women [33].

Daukšienė et al. (2025) conducted a large population-based study of 1,569 women between the ages of 25 and 69 to examine the link between thyroid disorders, menopause, and female sexual function, taking into account thyroid function, morphology, autoimmunity, body mass index, and reproductive aging. The thyroid structure was evaluated by ultrasound, whereas thyroid function markers like TSH, free T4, and anti-thyroid peroxidase antibodies were quantified by ELISA tests. The Female Sexual Function Index (FSFI) was used to assess sexual function, and anthropometric data such the body mass index (BMI) was collected. The findings revealed that sexual dysfunction was very common (64. 1%) and much more prevalent among postmenopausal women than among premenopausal women. A higher BMI and older age were strongly negatively correlated with all aspects of sexual function, especially lubrication and arousal. Women who had Hashimoto's thyroiditis had higher TSH levels, greater BMI, higher incidence of hypothyroidism, and more frequent sexual dysfunction, which was characterized by decreased lubrication and increased pain. Following adjustment for age and BMI, multivariate analysis revealed goiter to be the sole independent predictor of sexual dysfunction. The study came to the conclusion that reproductive aging, autoimmune thyroid illness, and thyroid dysfunction are all factors that contribute to women's poor sexual health, emphasizing how thyroid health affects menopausal well-being [34].

Fasero and Coronado (2025) assessed the risk of cardiovascular disease and menopause by analyzing the effects of the menopausal transition on metabolic changes and vascular health. According to the review, estrogen deficiency during menopause causes endothelial dysfunction, higher arterial stiffness, and lipid profile decline, all of which raise the risk of cardiovascular disease. During the menopausal period, conventional risk factors such hypertension, hyperlipidemia, diabetes, inadequate diet, and low physical activity had a greater impact. The study highlighted that cardiovascular outcomes are further influenced by age at onset and severity of symptoms, among other menopausal characteristics. According to the writers, menopause greatly raises cardiovascular risk, emphasizing the significance of lifestyle changes, tailored risk assessment, routine cardiovascular screening, and suitable treatment treatments to lessen the disease burden in menopausal women [35].

The incidence and patterns of dyslipidemia between premenopausal and postmenopausal women were compared in a study done by P. P. et al. (2025). The study involved 214 participants where 107 were premenopausal women and 107 were postmenopausal women. Dyslipidemia was significantly associated with an overall high prevalence rate (81. 77%). A higher percentage of mixed dyslipidemia was detected among premenopausal women (37. 3%) than postmenopausal women (64. 4%), but a lower

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incidence of isolated lipid disorders was observed among premenopausal women (26. 1%) than postmenopausal women (35. 5%). It indicates the greater complexity and severity of lipid disorders after menopause [36].

According to Iizuka et al. (2024), a study was done on the influence of body size on serum lipid concentration and hemoglobin A1c in young and middle-aged Japanese women in order to analyze the influence of age and body size on lipid profiles and glycemic status. In the period between 2012 and 2022, the current cross-sectional study analyzed data obtained from 26,118 women aged 20-65 years old with yearly physical examinations. In order to analyze the difference in serum lipid parameters and hemoglobin A1c levels (HbA1c) in different age ranges, the participants were subdivided into underweight, healthy weight, and overweight according to BMI.

It has been discovered that younger women were more frequently underweight, whereas this trend changed with aging. Total cholesterol and non-high-density lipoprotein cholesterol increased gradually with age regardless of body size with few differences between underweight and overweight women aged 50-65. However, in case of middle-aged women, variations of triglycerides, hemoglobin A1c, and HDL cholesterol were larger between underweight and overweight people. The research found that lipid metabolism is significantly affected by age, even in underweight women, implying that dietary counseling and metabolic risk monitoring are essential regardless of body weight, especially during middle age when cardiometabolic risk starts to increase [37].

The function of thyroid-stimulating hormone in controlling lipid metabolism: Consequences for communication between the brain and the body the physiological function of thyroid-stimulating hormone (TSH) in lipid metabolism and its effects on body-brain interaction were

examined in a study conducted by Wang et al. (2024). The research emphasized that thyroid hormone production, especially thyroxine (T4) and triiodothyronine (T3), which are crucial for metabolic control, energy balance, and endocrine feedback mechanisms, is regulated by TSH. The study highlighted that, via central and peripheral routes, TSH not only regulates thyroid function but also has a direct impact on lipid metabolism. Lipids serve two functions: as energy storage molecules and as signaling molecules participating in metabolic regulation and cellular processes. Dysregulation of thyroid hormones and TSH has been associated with aberrant lipid metabolism, which contributes to metabolic illnesses like obesity, atherosclerosis, non-alcoholic fatty liver disease, neurodegenerative diseases, and cerebrovascular disorders such as stroke. The authors came to the conclusion that disruptions in thyroid regulation might raise the risk of metabolic and cardiovascular illnesses and that TSH is essential for maintaining lipid homeostasis through body-brain interaction [38].

To determine the risk of atherosclerosis, Chaudhry et al. (2024) conducted a comparative cross-sectional study to analyze changes in serum estrogen levels and lipid profiles between premenopausal and postmenopausal women. Railway General Hospital in Rawalpindi, Pakistan, provided the 100 women (50 premenopausal and 50 postmenopausal) for the research. Using enzymatic and ELISA techniques, we measured serum lipid profiles and estrogen levels, and we conducted statistical analysis using the Pearson correlation and Student's t-test. The findings revealed that postmenopausal women had considerably greater levels of total cholesterol, triglycerides, LDL, and VLDL, but significantly lower levels of HDL cholesterol. In postmenopausal women, estrogen levels were significantly lower than those of premenopausal subjects. While estrogen was positively associated with HDL levels, it was negatively correlated with LDL cholesterol. The study came to the conclusion that lower estrogen levels following menopause are linked to negative lipid changes, which contribute to a reduction in cardiovascular protection and designate menopause as an independent risk factor for cardiovascular illness and atherosclerosis [39].

Park etal. in 2023 investigated longitudinal lipid profile alterations in relation to reproductive aging among Korean middle-aged women. This

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prospective cohort study included 1,436 premenopausal women from the Korean Genome and Epidemiology Study (KoGES) Ansan and Anseong cohort who experienced natural menopause during a median follow-up period of 15.76 years. Serum lipid levels were assessed biennially, and piecewise linear mixed-effects models were used to evaluate annual lipid changes before and after menopause. The results demonstrated significant increases in all lipid parameters beginning approximately 3–5 years before menopause and continuing up to one year after menopause, independent of premenopausal body mass index. The level of HDL-C steadily rose; however, non-HDL-C increased considerably more over the menopausal transition period. The ratio of non-HDL-C/HDL-C rose up to three years after menopause until it reached stabilization. This means that the menopausal transition is a key time when changes in blood lipids take place; thus, it is crucial to assess cardiovascular risks among middle-aged women [40].

Pleić et al. (2023) applied bidirectional Mendelian randomization for two samples to assess causality in the association between thyroid function and metabolic syndrome (MetS). Specifically, the Mendelian randomization included genetic data related to free thyroxine (fT4), thyroid-stimulating hormone (TSH), metabolic syndrome, and its components like triglycerides, waist circumference, hypertension, fasting glucose, and high-density lipoprotein cholesterol (HDL-C). According to the authors, higher genetic prediction of fT4 levels indicated a reduced probability of developing MetS and positive correlation with HDL-C levels. However, increased genetic prediction of triglyceride concentrations had a positive correlation with TSH. As part of the reverse analysis, it was also found out that higher genetic predictions for HDL-C levels were negatively correlated with TSH levels. Thus, the researchers came to the conclusion that the changes in thyroid function within the physiological level have a causal effect on metabolic syndrome and lipid metabolism [41].

Jabbar et al. (2022) conducted a study regarding the association between hyperthyroidism disorders among menopausal women in Iraq. This study examined the correlation between menopause and the metabolic effects of hyperthyroidism among women patients. This study was based on 120 women that included hyperthyroid patients and pre- and post-menopausal healthy subjects. Measurements in this research included progesterone level, blood pressure, lipid profile index, thyroid hormones (T3, T4, TSH) as well as other indicators of oxidative stress like superoxide dismutase (SOD), malondialdehyde (MDA), and advanced oxidation protein products (AOPP). As per the study results, hyperthyroid patients had significantly elevated levels of T3 and T4 and reduced TSH in comparison to healthy controls. High oxidative stress markers (MDA and AOPP) along with reduced antioxidant enzymes (SOD) was observed in hyperthyroid women after menopause. Hypertension with increased systolic and diastolic blood pressure and low progesterone levels were reported in menopausal hyperthyroid women compared with the patients group. Total cholesterol level was lower among hyperthyroid women than control groups [42].

In order to investigate how menopause influences the association between thyroid disease and lipid disorders, Han et al. (2022) conducted a cross-sectional analysis. The patients were classified into the following categories: hypothyroidism, subclinical hypothyroidism, hyperthyroidism, subclinical hyperthyroidism, and euthyroid control. High triglycerides correlated positively with hypothyroidism in this investigation. Subclinical hypothyroidism increased the odds of hypertriglyceridemia and higher levels of low-density lipoprotein (LDL) cholesterol. On the other hand, hyperthyroidism had a protective effect against hypercholesterolemia and elevated LDL cholesterol levels; however, it was associated with lower levels of high-density lipoprotein (HDL) cholesterol. In the case of subclinical hyperthyroidism, no abnormal lipid results could be observed. Moreover, these associations could change depending on menopausal status. In both premenopausal and postmenopausal women with hypothyroidism, there was an increase in triglyceride concentrations; subclinical

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hypothyroidism caused more pronounced changes in lipid profile only among premenopausal women. Low HDL cholesterol odds increased in postmenopausal women, and hyperthyroidism decreased the cholesterol concentration mainly in premenopausal women. As noted by the authors, thyroid diseases influence lipid metabolism considerably, and menopause is a crucial variable for cardiovascular risk assessment in women [43].

Ejaz et al. (2021) have examined whether there is any correlation between the lipid profile and subclinical hypothyroidism (SCH) through a longitudinal trial in a tertiary care setting of Pakistan, where the lipid profile of patients with and without SCH was compared. The sample consisted of 900 subjects aged between 40 and 70 years. Data on the serum thyroid markers and lipid profile of these people was analyzed, and SCH status was taken into consideration. According to the findings, 19. 8% of the studied population had subclinical hypothyroidism. In comparison with euthyroid patients, SCH patients presented significantly higher values of TC and LDL. Thus, the study demonstrates that there is a clear association between dyslipidemia, especially elevated levels of TC and LDL, which are cardiovascular risk factors, and SCH. In turn, early diagnosis and treatment of SCH could help decrease lipid imbalance [44].

In their study on variation in lipid profile in pre- and postmenopausal females with or without type 2 diabetes mellitus, Rani et al. (2020) indicated that changes in lipid metabolism and associated development of various health problems can be attributed to the process of aging and the onset of menopause. Specifically, hormonal changes, increased insulin resistance, changes in body composition, and lifestyle factors are known to contribute to the development of metabolic disorders. It was shown that due to menopause, the profile of lipids became more atherogenic because of increased levels of triglycerides, total cholesterol, and low-density lipoprotein cholesterol. Estrogen deficiency is considered one of the causes of lipid disorders and cardiovascular problems in postmenopausal females. Besides, diabetes mellitus worsened dyslipidemia and, therefore, resulted in the higher cardiovascular morbidity and mortality of postmenopausal females than of those without diabetes. According to the study's conclusion, menopause, especially when combined with diabetes, increases the risk of cardiovascular illness by significantly exacerbating lipid abnormalities [45].

Literature Gap

- Numerous international studies have explored the relationship between menopause, thyroid function, and lipid metabolism.
- However, limited local data are available regarding metabolic and endocrine changes among Pakistani women.
- Existing research mainly focuses on either lipid profile or thyroid function individually rather than their combined evaluation.
- Comparative studies assessing serum TSH levels and lipid profile between premenopausal and postmenopausal women remain scarce.

Therefore, this study was conducted to generate local evidence for improved Screening and prevention of cardiometabolic risk in menopausal women.

METHODOLOGY

RESEARCH DESIGN

The study was designed as a hospital-based cross-sectional comparative study. It involved observation and analysis of data collected from premenopausal and postmenopausal women attending the hospital during the study period. The assessment was carried out at a single point in time to compare serum thyroid-stimulating hormone (TSH) levels and lipid profile parameters between the two groups and to determine the association between menopausal status and metabolic alterations.

Sample Size

The sample size was 301 calculated using a 95% confidence level, 5% margin of error, 26.7% population proportion, and an estimated population size of 250,000,000 to ensure reliable and representative study results.

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Confidence Level	95%
Margin of Error	5%
Population Proportion	26.7%
Population Size	250000000

Study Duration

The study was conducted over a period of 3 months following approval of the research synopsis. This duration allowed sufficient time for recruitment of premenopausal and postmenopausal women, collection of blood samples, assessment of serum TSH levels and lipid profile parameters, and completion of the required data analysis.

Sampling Technique

Non-probability convenience sampling was used for selecting study participants. All eligible premenopausal and postmenopausal women who fulfilled the inclusion criteria during the study period were recruited based on their availability and willingness to participate in the study.

Study Setting

The research was carried out at the Novo Care International Hospital in Sargodha.

SELECTION CRITERIA

Inclusion Criteria

These criteria were included in the study:

- Premenopausal women aged 30–45 years, with regular menstrual cycles (occurring every 21–35 days), and no history of irregular bleeding patterns.
- Postmenopausal women aged 46–65 years, defined by the permanent cessation of menstruation for at least 12 consecutive months, without the use of hormone replacement therapy.
- Healthy volunteers who provide informed consent to participate in the study.
- Women with no history of chronic systemic illness, such as cardiovascular disease, diabetes mellitus, or thyroid disorders.
- Women willing to comply with the study protocol, including fasting for blood sample collection and attending scheduled follow-ups.

Exclusion Criteria

- Women with known thyroid disorders (hypothyroidism, hyperthyroidism, thyroiditis, goiter) or a history of thyroid surgery.
- Women with diabetes mellitus, hypertension, or any diagnosed cardiovascular disease, including coronary artery disease, arrhythmias, or heart failure.
- Women currently taking thyroid medications, lipidloweringdrugs (statins, fibrates), corticosteroids, or hormone replacement therapy (HRT).
- Women with chronic systemic diseases, including but not limited to liver disease, kidney disease, autoimmune disorders, or malignancies.
- Obese women (BMI > 30 kg/m²), as obesity can independently affect lipid profiles and thyroid function.
- Women who are pregnant, lactating, or planning pregnancy during the study period.

SAMPLE COLLECTION

- A fasting venous blood sample of 5 mL was collected aseptically from each participant in a plain vacutainer tube after an overnight fast of 10–12 hours.
- The blood was allowed to clot at room temperature and then centrifuged at 3000 rpm for 10 minutes to obtain clear serum
- The separated serum was used for estimation of TSH and lipid profile.
- Samples not analyzed immediately was stored at –2- –6°C until further analysis

BIOCHEMISTRY ANALYZER

Serum TSH Estimation:

Serum TSH was estimated by Chemiluminescent Immunoassay (CLIA) using a fully automated analyzer following the manufacturer's standard protocol. The reference range will be taken as 0.4–4.2 µIU/mL

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(Mindray 1000i) Lipid Profile Estimation.
Serum lipid parameters were measured using enzymatic colorimetric methods on an automated analyzer:

(Thermo Scientific Indiko)
Total Cholesterol – CHOD–PAP method
Triglycerides – GPO–PAP method
HDL-Cholesterol – Direct enzymatic method
LDL-Cholesterol and VLDL-Cholesterol – Calculated using Friedewald's Formula

1. Total Cholesterol – CHOD–PAP Method Principle (CHOD–PAP)

- Cholesterol is first broken down by cholesterol esterase (CHE).
- Then cholesterol oxidase (CHOD) converts cholesterol → cholestenone + hydrogen peroxide
- Peroxidase (PAP) reacts with H_2O_2 to produce a red-colored quinonimine dye.
- Intensity of color is directly proportional to cholesterol concentration.

2.Triglycerides – GPO–PAP Method Principle (GPO–PAP)

- Lipase breaks triglycerides → glycerol + fatty acids.
- Glycerol is phosphorylated → glycerol-3-phosphate
- Glycerol-3-phosphate is oxidized by glycerol phosphate oxidase (GPO)
- → forms H_2O_2.
- Peroxidase (PAP) reacts with H_2O_2 to produce a colored dye.

Color intensity = triglyceride concentration
Wavelength: 500–546 nm (commonly 505 nm).

3. HDL-Cholesterol – Direct Enzymatic Method Principle (Calculated, not measured)

- Friedewald's formula estimates LDL and VLDL using measured values of Total Cholesterol, HDL, and Triglycerides.
- Formula: VLDL = Triglycerides / 5
- LDL = Total Cholesterol – HDL – VLDL

All biochemical tests will be performed using quality control sera to ensure accuracy and precision.

Procedure:
All biochemical tests were performed using quality control sera to ensure accuracy and precision.

- Venous blood was collected and allowed to clot.
- It was centrifuged to obtain clear serum.
- The analyzer was switched on and water, waste, and cuvettes were checked.
- Lipid profile reagents (Cholesterol, HDL, LDL, Triglycerides) were loaded.
- Calibration was verified and quality control (QC) was run.
- Serum samples were placed in the sample rack.
- Patient details were entered and Lipid Profile test panel was selected.
- Start was pressed to run the test.
- The analyzer automatically aspirated, mixed, incubated, and measured absorbance.
- Results were reviewed, QC was confirmed, and the report was printed or transferred to LIS

4. Thyroid-stimulating hormone (TSH):
Principle:
TSH works on the principle of negative feedback regulation. When the level of thyroid hormones (T_3 and T_4) in the blood is low, the anterior pituitary gland releases more TSH to stimulate the thyroid gland. When T_3 and T_4 levels become high, they suppress TSH secretion to maintain hormonal balance in the body.

Procedure:

- Venous blood was collected in a gel separator tube.
- Blood was allowed to clot and centrifuged to obtain serum.
- The analyzer was switched on and status was checked (reagents, wash solution, waste).
- The TSH reagent kit was loaded into the reagent compartment.
- Calibration was performed and quality control (QC) was run if required.
- Serum samples were placed in the sample rack.
- Patient details were entered and TSH test was selected on the screen.

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- Start was pressed to begin the test.
- The analyzer automatically performed incubation, washing, and chemiluminescence measurement.

Results were reviewed, QC was confirmed to be within range, and the report was printed or transferred to LIS.

DATA ANALYSIS

- We were using excel for data collection
- Data was analyzed using SPSS software
- Data were summarized using mean ± standard deviation (SD) for biochemical parameters.
- Descriptive statistics were used to summarize the characteristics of the study population
- ANOVA (pre and postmenopausal)
- Standardized coefficients to assess the strength and direction of relationships between variables

A p-value < 0.05 was considered statistically significant.

RESULTS

This chapter presents the findings of the statistical analysis performed on the collected data. The data were analyzed using both descriptive and inferential statistics to evaluate the differences in serum TSH levels and lipid profile parameters between premenopausal and postmenopausal women. Descriptive statistics were used to summarize the characteristics of the study population, while inferential analysis was performed using one-way ANOVA to compare mean differences among groups and standardized coefficients to assess the strength and direction of relationships between variables. The findings are systematically provided based on the research objectives, including analysis of differences among thyroid and lipid profiles in relation to the menopausal status and assessing correlations between these variables.

Table 1: Age Distribution of Study Participants (n = 301)

Age			
		Frequency	Percent
Age Group	less than 30	41	13.6
	30 to 45	160	53.2
	More than 45	100	33.2
	Total	301	100.0

According to the study participants' age distribution, the majority of the women, 160 or (53.2%), were between the ages of 30 and 45. 41 individuals (13.6%) were under 30, 100 or (33. 2%) were over 45. Majority of the study subjects were in the middle-aged group for reproductive purposes and also during menopausal transition period as evident from the table above; this makes it possible to differentiate between pre-menopausal and post-menopausal women.

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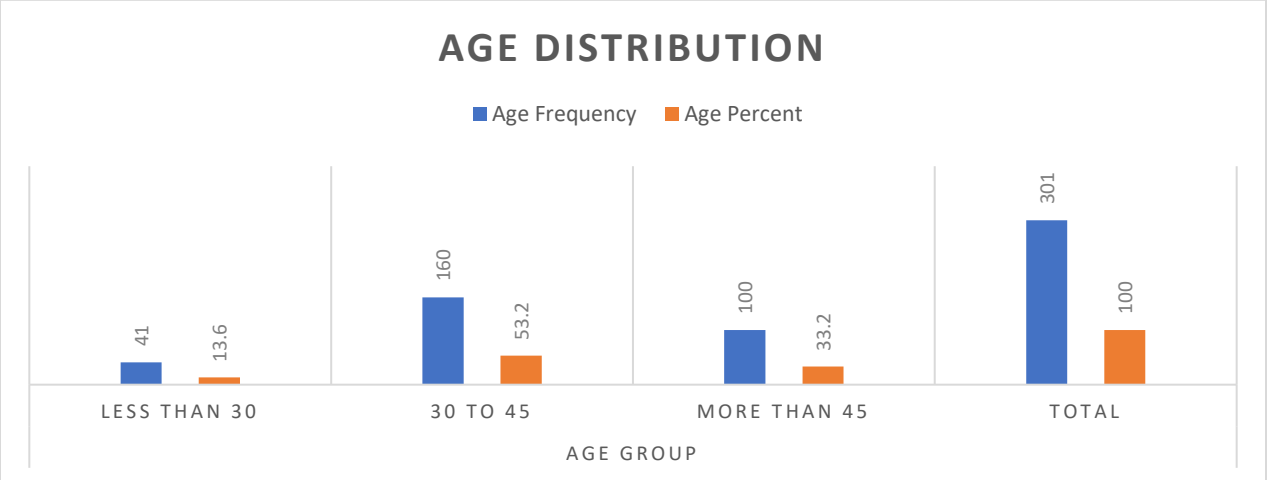

Graph 1: Age Distribution of Study Participants (n = 301)

The age distribution of the study participants is shown in the diagram above. The participants were separated by age into three categories: under 30, 30 to 45, and over 45. The study population's demographic profile is revealed through the frequency and percentage breakdown of each group.

The majority of the respondents were in the 30 to 45 age range, with 160 (53. 2%) belonging to this group, as shown in the figure. This suggests that the majority of women in the study were in the middle of their reproductive to early menopausal transition. More than 45 years old, the second-largest group had 100 members (33.2%), which suggested that they were probably in the postmenopausal phase. With 41 people (13.6%) representing a lower proportion of younger premenopausal women, the group of people under 30 years old had the fewest participants. The distribution as a whole indicates that the study sample is adequately representative of women across reproductive and menopausal age groups, which enables a significant comparison of lipid profile changes and serum TSH levels between premenopausal and postmenopausal women.

Table 2: Menstrual History of Study Participants (n = 301)

		Frequency	Percent
Menstrual History	Regular	38	12.6
	Irregular	4	1.3
	Premenopausal	160	53.2
	Postmenopausal	99	32.9
	Total	**301**	**100.0**

The distribution of research participants based on their menstrual history is shown in the table. The participants were divided into four groups: women with regular menstrual cycles, women with irregular menstrual cycles, women who are premenopausal, and women who are postmenopausal. The reproductive condition of the study group is shown by the frequencies and percentages.

The majority of the subjects, 160 (53. 2%), were premenopausal women, according to the findings. A large proportion of the study sample relevant to the study goals was made up of postmenopausal women, totaling 99 (32. 9%). With 38 (12. 6%) having normal periods and just 4 (1. 3%) reporting erratic menstruation, a smaller proportion of the participants had normal menstrual cycles. The study population,

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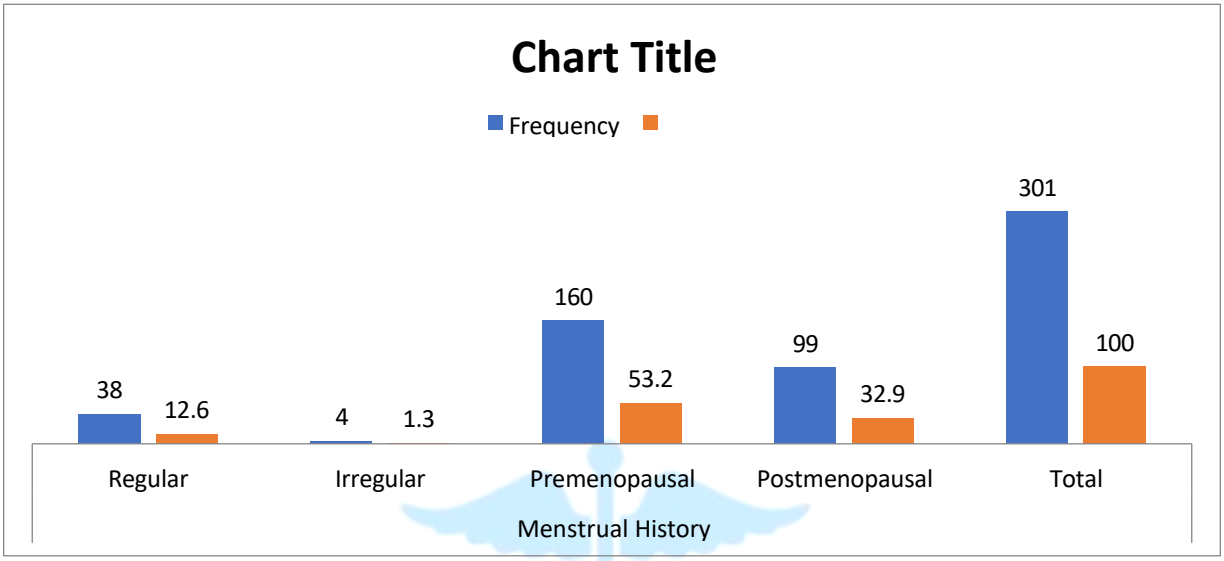
according to the data, includes a significant representation of both premenopausal and postmenopausal women, which is necessary for comparing serum TSH levels and lipid profile characteristics between the two groups.



Graph 2: Menstrual History of Study Participants (n = 301)

Table 3: ANOVA Analysis for Predictors of Menstrual History

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	224.007	10	22.401	218.043	.000[b]
	Residual	29.793	290	.103		
	Total	253.801	300			
a. Dependent Variable: Menstrual history						
b. Predictors: (Constant), medical history, BMI, VLDL, LDL, Triglycerides, Cholesterol, Age, TSH Value, Height (Feet), Weight (Kg)						

To assess the overall importance of the regression model, which looked at the correlation between demographic, anthropometric, thyroid, and lipid profile variables with menstrual history among research participants, an analysis of variance (ANOVA) was conducted.

The regression model is statistically significant, according to the ANOVA findings ($F = 218.043$, $p < 0.001$). The unexplained variation is represented by the residual sum of squares (29.793), while the variability in menstrual history that is explained by the independent variables in the model is represented by the regression sum of squares (224.007).

The highly significant p-value suggests that age, BMI, TSH levels, lipid profile parameters (cholesterol, triglycerides, LDL, VLDL), anthropometric measurements, and medical history— when combined—have a meaningful relationship with the status of menstruation. According to this research, hormonal and metabolic variables play a significant role in differentiating premenopausal and postmenopausal women in the study group.

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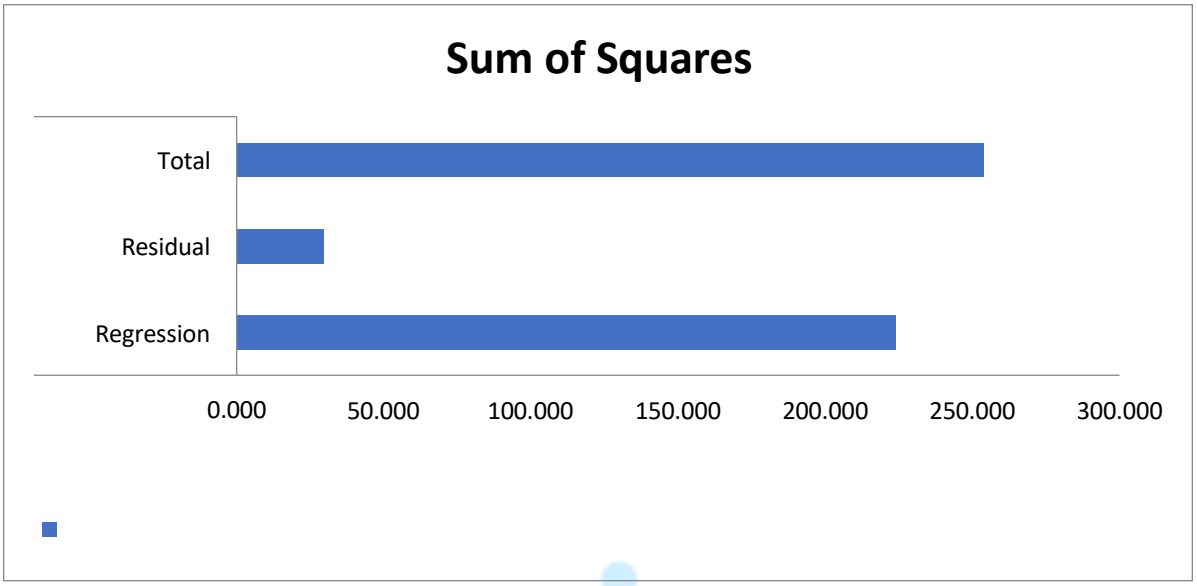

Graph 3: Graphical Representation of ANOVA Sum of Squares for Menstrual History Model

The sum of squares from the ANOVA regression analysis, which assesses variables that predict menstrual history in study participants, is shown in the diagram. The Total Sum of Squares, Residual Sum of Squares, and Regression Sum of Squares are the three elements that the graph displays.The proportion of variation in menstrual history that is accounted for by independent variables such as age, BMI, thyroid-stimulating hormone (TSH), lipid profile parameters, anthropometric measurements, and medical history is represented by the regression sum of squares (224. 007). The total sum of squares (253. 801) represents the dataset's overall variation, whereas the residual sum of squares (29. 793) represents unexplained variability not covered by the model. The regression value, which is significantly higher than the residual value, shows that the chosen predictors account for a large amount of variance in the menstrual history status, proving the regression model's high explanatory power and statistical significance.

Table 4: Standardized Coefficients Showing Predictors of Menstrual History

Variable	Unstandardizd Coefficient		Standardizd Coefficients	t	Sig.
Constant	-7.089	3.668		-1.933	.054
Age	1.342	.031	.958	43.180	.000
TSH Value	-.009	.002	-.087	-3.815	.000
Cholesterol	5.213E-05	.001	.001	.059	.953
Triglycerides	.000	.003	-.003	-.134	.893
LDL	.000	.001	-.004	-.205	.838
VLDL	.002	.003	.011	.547	.584
BMI	.118	.067	.505	1.768	.078

The table shows the results of a multiple regression analysis that examines the effects of demographic, thyroid, and lipid profile factors on menstrual history status. T-values, significance levels (p-values), and both unstandardized (B) and standardized (Beta)coefficients are

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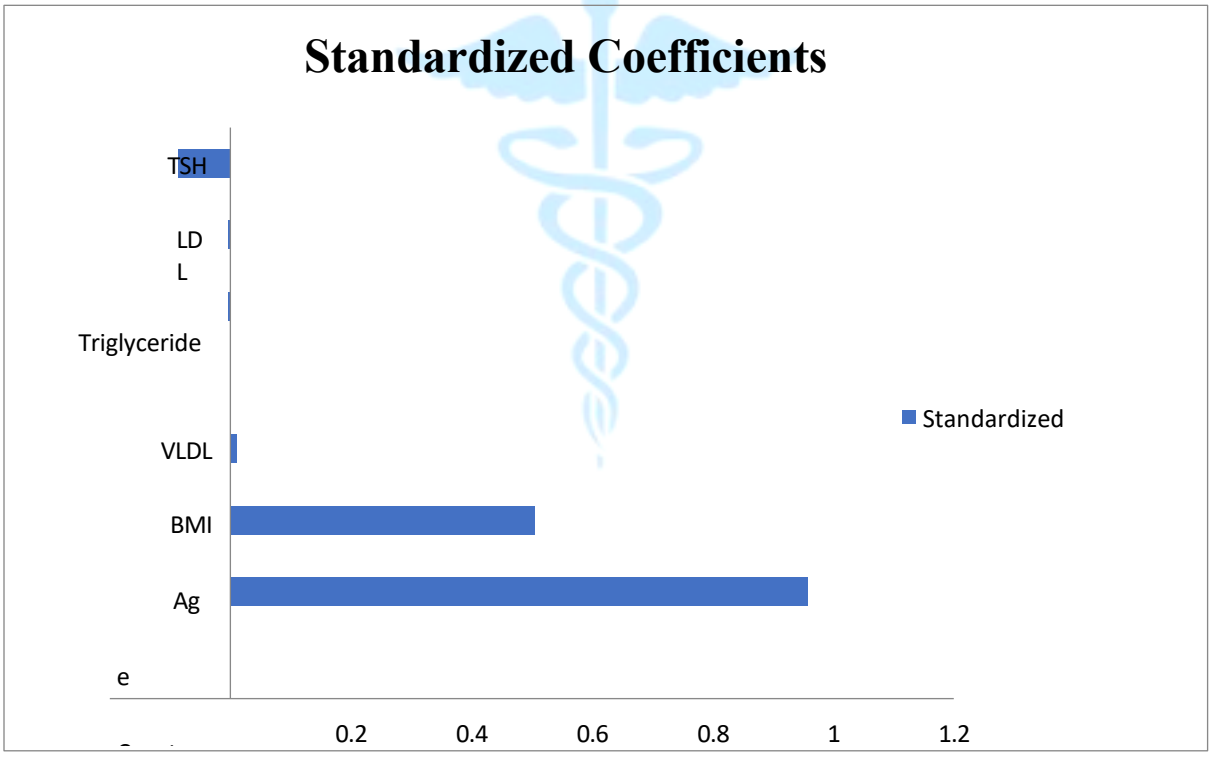
s h o w n .

Age was the most potent factor in determining menopausal status among participants, as evidenced by a strong and statistically significant positive relationship with menstrual history (β = 0. 958, p < 0. 001). Because menopause is a natural part of getting older, this discovery is not unexpected. Variations in thyroid function are linked to menopausal transition and hormonal changes, as evidenced by a statistically significant negative correlation between menstrual history and TSH values (β = −0. 087, p < 0. 001). Changes in TSH levels, even minor ones, seem to affect a woman's menstrual condition. Triglycerides, cholesterol, LDL, and VLDL levels showed no statistically significant correlations (p > 0. 05), suggesting that, when other factors were held constant in the model, lipid parameters alone could not independently predict a person's menstrual history.

Menopausal status may be influenced by an increasing body mass index, as evidenced by the positive but nearly insignificant connection between BMI (β = 0. 505, p = 0. 078), albeit the statistical significance was not attained.

The constant value had little interpretive value, as it was not statistically significant

(p= 0. 054). In general, the regression analysis emphasizes age as the major factor, with TSH also playing a significant role, while lipid profile factors had little independent predictive value in this research group.



Graph 4: Standardized Coefficients Showing Predictors of Menstrual History

DISCUSSION

The current research was shown to comparative study between serum thyroid-stimulating hormone (TSH) levels and lipid profile parameters among premenopausal and postmenopausal women, with the purpose of assessing metabolic then endocrine changes linked with menopausal transition. Menopause represents a dangerous biological transition characterized by disturbances in ovarian function with gradual estrogen depletion resulting in notable changes in metabolism and cardiovascular system. Rising prevalence calls for menopause to be regarded not just as a

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reproductive phenomenon but also an endocrine one facilitating thyroid function and lipid metabolism and enhancing cardiometabolic health.

It was established that age is the most reliable predictor of menopause in the current investigation. According to epidemiological data, menopause generally happens in the period from 45 to 55, and it is associated with accelerating endocrine aging. Advanced age causes reduction in the functioning of the hypothalamic pituitary ovarian axis and metabolism which predisposes to cardiovascular diseases and metabolic syndrome (Zhu et al., 2019) [16].

The strong relationship between serum TSH levels and menopause became one of the key decisions for the research. Thyroid function is strongly related to the female reproductive system, and changes in estrogen lead to alterations in the thyroid hormones metabolism, TGB levels and pituitary feedback mechanism. Subclinical hypothyroidism is more common in postmenopausal women and can go unnoticed due to overlapping symptoms like exhaustion, weight gain, and mood swings (Biondi & Cappola, 2019) [3].

By controlling hepatic cholesterol synthesis, lipoprotein clearance, and LDL receptor activity, thyroid hormones are crucial for lipid metabolism. High TSH levels have been linked to dyslipidemia and an increased risk of cardiovascular disease, even within normal reference ranges (Razvi et al., 2019). As a result, the current data corroborate prior research indicating that thyroid dysfunction plays a role in metabolic changes during the menopausal shift.

Physiological evidence consistently supports lipid changes related to menopause, even if the current study's lipid parameters did not have significant independent statistical significance. By enhancing lipid metabolism and vascular function, estrogen protects the heart. Its fall leads to higher levels of total cholesterol, triglycerides, and LDL cholesterol, which contributes to an atherogenic lipid profile (El K Choudary et al., 2020) [47,2].

According to a large cohort study, postmenopausal women have a greater incidence of dyslipidemia than premenopausal women, which greatly raises their risk of cardiovascular disease after menopause (Muka et al., 2020). It's possible that dietary diversity, genetic makeup, or the cross-sectional nature of the current investigation, rather than a biological link, account for the lack of statistical significance in lipid variables [48].

The body mass index (BMI) was found to have a positive correlation with menopausal status. Due to an estrogen deficiency, menopause is frequently linked to a slower metabolism and central fat deposition. Greater visceral adiposity raises cardiometabolic risk by increasing insulin resistance, systemic inflammation, and lipid abnormalities (Davis et al., 2020) [7].

There is more and more research focusing on how thyroid function affects lipid metabolism. According to studies, even minor thyroid abnormalities can have an impact on lipid levels, cause endothelial dysfunction, and contribute to the onset of atherosclerosis (Peeters, 2019; Taylor et al., 2021). As a result, a more thorough assessment of metabolic health during menopause is obtained by combining thyroid hormones and lipid profile [49,50].

The primary cause of death for women worldwide, especially after menopause, is still cardiovascular disease. Lower estrogen levels cause endothelial dysfunction, higher arterial stiffness, and negative lipid changes that contribute to the development of coronary artery disease (Cho et al., 2023). Due to genetic predispositions and lifestyle variables, South Asian groups, such as Pakistani women, show a higher cardiometabolic risk, highlighting the significance of preventative screening programs [20].

This study's overall regression model revealed a considerable predictive capacity, suggesting that a variety of interacting variables, such as age, thyroid function, body composition, and metabolic characteristics, have an impact on menopausal status. The implications of these findings further emphasize the fact that menopause is a complex process involving metabolism and hormones.

From a clinical perspective, regular evaluation of

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serum TSH and lipoprotein profiles can assist in identifying women who may be predisposed to developing cardiovascular disease and metabolic syndrome. Among postmenopausal women, early intervention via lifestyle changes, weight control, and suitable medical treatment can greatly lower long-term morbidity.

Several constraints need to be recognized. Causal interpretation is constrained by the cross-sectional design, and the generalizability may be limited by the single-center sampling. In order to evaluate the dynamic hormonal changes throughout the stages of menopause and their potential long-term cardiovascular effects, future longitudinal studies are advised.The current study, in conclusion, demonstrates the strong correlation between menopause, increasing age, and changes in serum TSH levels, emphasizing the relationship between reproductive aging and thyroid function. Established biological mechanisms support the significance of lipid variables in elevating cardiovascular risk after menopause, even if they do not independently predict menopausal status. This research emphasizes that menopause is a critical moment to conduct early endocrine and metabolic screening in order to enhance women's health outcomes.

CONCLUSION

The aim of this study was to assess the metabolic and endocrine changes linked to menopausal transition by comparing serum thyroid-stimulating hormone (TSH) levels and lipid profile variables between premenopausal and postmenopausal women. Menopause is a significant physiological change that involves a reduction in the synthesis of ovarian hormones, which may affect several metabolic functions and predispose an individual to developing chronic diseases. Based on the outcomes obtained from this study, the main predictor of menopausal state is age, thus providing evidence that menopause is a natural physiological change that takes place with age. Hormonal changes and menstrual history were highly related to age increase. Furthermore, the study provided evidence for a significant relationship between TSH levels and menopausal state, indicating that reproductive aging brings about changes in thyroid function. This finding was expected since previous studies have indicated that hypothyroidism is common among postmenopausal women.

Even though no independent statistical correlation was found by using regression analysis for the relationship between menopause and lipid profiles like cholesterol, triglycerides, LDL, and VLDL, yet because of the deficiency of estrogen, there still remains physiological association between menopause and the dyslipidemia. The decline in estrogen levels results in increase of visceral adiposity, slowing down metabolism rate, and formation of lipid profile that predisposes one to cardiovascular diseases after menopause.

The overall predictive value of the statistical model was high, suggesting that menopause is caused by both endocrine and metabolic factors, not just a single physiological factor. The findings emphasize the importance of recognizing menopause as a significant phase where hormonal imbalance and metabolic problems can be identified early. From the medical perspective, the study underscores the need for constant monitoring of serum TSH and lipid levels among middle-aged women, especially during menopause. Early diagnosis of metabolic disorders and thyroid dysfunction will prevent the occurrence of complications like heart disease, metabolic syndrome, and reduced quality of life.

Conclusively, menopause causes many changes in terms of hormones and metabolism, and thyroid functions are very instrumental in that regard. In order to reduce the disease burden in the future and ensure healthy aging among women, biochemical assessments, prevention strategies, and awareness drives should be targeted toward both premenopausal and postmenopausal women.

RECCOMENDATIONS

- Monitoring of serum TSH concentrations and lipid profile needs to become an integral part

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of general health check-ups in women approaching the menopause years.

- Since cardiovascular disease risk increases after menopause, it is necessary to employ prevention measures such as lifestyle modifications (healthy eating, exercise, and maintaining healthy weight).
- There needs to be a campaign for educating women about hormonal and metabolic changes associated with menopause, the need for biochemical tests, and their significance.
- It is important for postmenopausal women to undergo medical supervision regarding potential dysfunctions in the metabolism, thyroid gland function, and heart-related conditions.
- The treatment of menopausal syndrome requires a holistic approach with a close collaboration of various medical specialists.
- National health programs need to include routine health screening for menopause among other health issues, particularly in developing countries.

LIMITATIONS OF THE STUDY

- One of the details of this research that may influence the results' realism to the general population is the fact that it was conducted within only one hospital setting.
- Because of the cross-sectional nature of the research, it was intolerable to establish any causal connections between menopause, thyroid hormone activity, and variations in the lipid profile.
- Regarding the long-term metabolic and hormonal changes, their estimation became rather limited because of the relatively short period of data gathering.
- Such factors as genetic predisposition, socioeconomic background, diet, and physical activity might act as potential confounders of metabolic alterations but were not adequately controlled in the study.
- The measurement of TSH levels in serum was sufficient for assessing thyroid function; however, the whole endocrine panel should include other hormones such as T3 and T4.

REFRENCES

M Kugajeevan Vigneswaran, Haitham Hamoda,The pathophysiology and management of menopausal symptoms,Obstetrics, Gynaecology & Reproductive Medicine,Volume 33, Issue 5,2023, Pages 135-140, ISSN 1751-7214.

El Khoudary SR, Aggarwal B, Beckie TM, et al. Menopause transition and cardiovascular disease risk. Circulation. 2020.

Biondi B, Cappola AR. Subclinical hypothyroidism in aging populations. Lancet Diabetes & Endocrinology. 2019.

Santoro N, Randolph JF Jr. Reproductive aging overview. *Endocr Rev.* 2021;42(3):233–270.

Zhu D, Chung HF, Dobson AJ, Pandeya N, Giles GG, Bruinsma F, et al. Age at menopause and cardiovascular risk. *JAMA Cardiol.* 2021;6(12):1396–1403.

Razvi S, Jabbar A, Pingitore A, Danzi S, Biondi B, Klein I, et al. Thyroid dysfunction and lipid metabolism. *Thyroid.* 2021;31(6):855–865.

Davis SR, Lambrinoudaki I, Lumsden M, Mishra GD, Pal L, Rees M, et al. Menopause health consequences. *Nat Rev Endocrinol.* 2021;17(11):705–718.

Ahmed S, Khan MA, Ali R, Hussain A. Thyroid hormones and lipid abnormalities. *BMC Endocr Disord.* 2022;22(1):115.

Mishra SR, Chung HF, Waller M, Mishra GD. Global menopause epidemiology. *Lancet Healthy Longev.* 2022;3(8):e545–e557.

Taylor PN, Razvi S, Pearce SHS, Dayan CM. Thyroid function and cardiovascular outcomes. *BMJ.* 2022;376:e068137.

Stevenson JC. Cardiovascular risk in menopause. *Climacteric.* 2022;25(3):215–220.

Kim ES, Shin JA, Lee YJ, Kim SH. Thyroid status and metabolic syndrome. *Endocr J.* 2022;69(9):1021–1030.

Kapoor E, Faubion SS. Menopause management strategies. *Mayo Clin Proc.* 2023;98(4):678–690.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Gencer B, Collet TH, Virgini V, Bauer DC. Lipid metabolism and endocrine disorders. *Eur Heart J.* 2023;44(5):420–430.

Shahbaz I, Naseem HF, Saleem MN, Yaseen F, Rao A, Aziz MY. OVARIAN STROMAL AND UTERIN ARTERY BLOOD FLOW PATTERN IN HYPERTENSIVE PATIENTS DIAGNOSED ON ULTRASOUND. IJHR-Journal of Health and Rehabilitation. 2025 Nov 12;3(11):i1508-.

Ding EL, Song Y, Malik VS, Liu S. Thyroid hormones and lipid regulation. *J Clin Endocrinol Metab.* 2023;108(2):345–356.

Zhu L, Jiang X, Sun Y, Wang Y. Postmenopausal metabolic changes. *Front Endocrinol (Lausanne).* 2023;14:1182456.

Sudha Thiruvengadam, Pooja Luthra,Thyroid disorders in elderly: A comprehensive review,Disease-a-Month,Volume 67, Issue 11,2021,101223,ISSN 0011-5029,.

Rahman M, Ahmed N, Khan S. Dyslipidemia in menopausal women. *Cureus.* 2023;15(3):e35821.

Khan SH, Fatima S, Malik F. Cardiovascular risk among Pakistani women. *Pak J Med Sci.* 2023;39(2):456–462.

Cho L, Davis M, Elgendy I, Epps K, Lindley KJ, Mehta PK, et al. Women's cardiovascular health review. *J Am Coll Cardiol.* 2023;83(6):565–582.

Patel J, Mehta N, Shah R. Thyroid hormones and lipid interaction. *Metabolism.* 2024;149:155600.

Ahuja M, Sharma JB, Perumal V, Sharma P, Bansal R, Sarkar A, Agrawal M. A Survey on Relation of Menopause to Metabolic Syndrome - SAFOMS STUDY (South Asian Federation of Menopause Societies) - Interim Analysis. J Midlife Health. 2023 Oct-Dec;14(4):291-298.

Lee SY, Kim JH, Park YJ. Subclinical hypothyroidism outcomes. *Endocr Pract.* 2024;30(2):180–188.

Malik R, Hussain T, Ahmad S. Lipid changes after menopause. *J Womens Health (Larchmt).* 2024;33(4):512–520.

World Health Organization. *Women ageing and health report.* Geneva: WHO; 2024.

International Menopause Society. *Global menopause practice guidelines update.* London: IMS; 2024.

Wang X, Liu H, Zhang Y. TSH levels and cardiovascular risk. *Endocr Connect.* 2025;14(1):e240112.

Singh A, Kumar P, Verma R. Thyroid and lipid association study. *Sci Rep.* 2025;15:11245.

Ahmed Z, Rahim F, Ali S. Menopause metabolic risk in South Asia. *Front Public Health.* 2025;13:1284567.

Global Burden of Disease Study Collaborators. Women cardiovascular risk analysis. *Lancet.* 2026;407(10380):1021–1035.

Al-Maamori, Marwa Thear Abed and Jafar Abbas. "Assessment of Thyroid Hormonal Dysfunction and Related Oxidative Stress in Menopausal Women with Irritable Bowel Syndrome." International Journal of Environmental Sciences (2025): n. pag.

Orhan İ, Koçak HS, Kaplan E. Determination of cardiometabolic risk in pre- and post-menopausal women. BMC Cardiovasc Disord. 2025 May 24;25(1):399. doi: 10.1186/s12872-025-04850-1. PMID: 40413434; PMCID: PMC12103035.

Kindie Y, Fetene G, Worede A, Zenaw A, Yechale M. Prevalence of dyslipidemia and associated factors among premenopausal and post-menopausal women: a community-based comparative cross-sectional study in Debre Markos city, Northwest, Ethiopia, 2024. BMC Endocr Disord. 2025 Dec 22;25(1):290. doi: 10.1186/s12902-025-02137-2. PMID: 41430170; PMCID: PMC12751773.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Daukšienė D, Klimaitė R, Kondrotienė A, Matukaitienė R, Čeponis J, Rimkutė A, Dudonytė L, Steponavičiūtė R, Lukšienė D, Lesauskaitė V, Veličkienė D, Verkauskienė R, Žilaitienė B. Linking Thyroid Function, Morphology, Autoimmunity, Body Mass Index, and Reproductive Aging to Women's Sexual Health: Evidence from a Population Study in Kaunas. J Clin Med. 2025 Nov 28;14(23):8441. doi: 10.3390/jcm14238441. PMID: 41375744; PMCID: PMC12692949.

Fasero M, Coronado PJ. Cardiovascular Disease Risk in Women with Menopause. J Clin Med. 2025 May 23;14(11):3663. doi: 10.3390/jcm14113663. PMID: 40507425; PMCID: PMC12156203.

P P, K Pandya C, Begum S, Ekambaram G, B M, N S, S V. Comparative study of dyslipidemia among pre and post - menopausal women. Bioinformation. 2025 Jun 30;21(6):1385-1390. doi: 10.6026/973206300211385. PMID: 40978584; PMCID: PMC12449542.

Iizuka, K.; Kobae, K.; Yanagi, K.; Yamada, Y.; Deguchi, K.; Ushiroda, C.; Seino, Y.; Suzuki, A.; Saitoh, E.; Naruse, H. Differing Effects of Body Size on Circulating Lipid Concentrations and Hemoglobin A1c Levels in Young and Middle-Aged Japanese Women. Healthcare 2024, 12, 465.

Xueqin Wang, Zhen Wu, Yuting Liu, Chengxi Wu, Jun Jiang, Kenji Hashimoto, Xiangyu Zhou, The role of thyroid-stimulating hormone in regulating lipid metabolism: Implications for body–brain communication, Neurobiology of Disease, Volume 201, 2024, 106658, ISSN 0969-9961,

Chaudhry A, Ikram K, Ayesha K, Waheed M, Ulain N, Tariq A, Khalid T. The Comparative Study of Serum Estrogen and Lipid Profile in Pre- and Post-menopausal Women as Atherosclerosis Risk Factors in Pakistan. Cureus. 2024 Jul 28;16(7):e65604. doi: 10.7759/cureus.65604. PMID: 39205738; PMCID: PMC11350152

Park, Jungeun, Mi Kyoung Son and Hyun Young Park. "Substantial Lipid Increases During Menopausal Transition in Korean Middle-Aged Women." *Journal of Korean Medical Science* 38 (2023): n. pag

Nikolina Pleić, Ivana Gunjača, Mirjana Babić Leko, Tatijana Zemunik, Thyroid Function and Metabolic Syndrome: A Two-Sample Bidirectional Mendelian Randomization Study, *The Journal of Clinical Endocrinology & Metabolism*, Volume 108, Issue 12, December 2023, Pages 3190–3200,

Khinteel Jabbar N, Al-Abady ZN, Jasib Thaaban Almzail A, Al-Athary RAH. Relationship between Menopause and Complications of Hyperthyroidism in Female Patients in Iraq. Arch Razi Inst. 2022 Aug 31;77(4):1481-1489. doi: 10.22092/ARI.2022.357618.2071. PMID: 36883144; PMCID: PMC9985776.

Han Y, Wang C, Zhang L, Zhu J, Zhu M, Li Y, Teng D, Teng W and Shan Z (2022) Menopausal Impact on the Association Between Thyroid Dysfunction and Lipid Profiles: A Cross-Sectional Study. Front. Endocrinol. 13:853889. doi: 10.3389/fendo.2022.853889.

Ejaz M, Kumar P, Murlidhar M, et al. (August 19, 2021) Comparison of Lipid Profile in Patients With and Without Subclinical Hypothyroidism. Cureus 13(8): e17301. DOI 10.7759/cureus.1730

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Rani, Vibha, Mohammed Siddique Ahmed Khan, Madhu Swamy and S Jagannatham. "A Comparative Study of Lipid Profile in Pre- and Post-Menopausal Women with and without Diabetes." International Journal of Biotechnology & Biochemistry (2020): n. pag.

Zhu D, Chung HF, Pandeya N, et al. Age at natural menopause and risk of cardiovascular disease. JAMA Cardiology. 2019. .

Razvi S, Jabbar A, Pingitore A, et al. Thyroid hormones and cardiovascular function. Nature Reviews Cardiology. 2019.

Muka T, Oliver-Williams C, Kunutsor S, et al. Association of age at menopause with cardiovascular outcomes. Human Reproduction Update. 2020.

Peeters RP. Thyroid function and aging. European Thyroid Journal. 2019.

Taylor PN, Albrecht D, Scholz A, et al. Global epidemiology of thyroid disease. Nature Reviews End ocrinology.