RESEARCH PAPER

Serum Follicle-Stimulating Hormone levels and Cardio-Metabolic Risk Factors in Perimenopausal and Postmenopausal women

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Abstract:

Background: Menopause is associated with significant hormonal changes, including decreased estrogen and increased Follicle Stimulating Hormone (FSH) levels, which may contribute to cardio-metabolic risk factors. The prevalence of metabolic syndrome increases markedly during the perimenopausal and postmenopausal periods. Recent research suggests that, beyond estrogen deficiency, increased FSH levels may also play a role in metabolic imbalance. Observational studies have linked higher FSH levels to metabolic issues like elevated triglycerides, low HDL cholesterol, increased fasting blood glucose, hypertension, and body fat. These findings indicate that FSH might impact lipid and glucose metabolism and contribute to adiposity. Various studies in India show that over 60% of menopausal women have a high prevalence of metabolic syndrome. How serum follicle-stimulating hormone levels influence cardiometabolic risk factors like Body Mass Index (BMI), waist-hip ratio, blood glucose, lipid profile, and blood pressure is yet to be fully understood.

Conclusion: This review aims to provide insights into how the role of FSH is evolving as a potential biomarker for assessing cardiometabolic disease risk in perimenopausal and postmenopausal women. Understanding the underlying pathogenic mechanisms could aid the detection, prevention, and management of menopausal complications.

Keywords: FSH, Metabolic Syndrome, Cardiometabolic Risk, Perimenopause, Postmenopause.

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Introduction:

Menopause is a normal physiological stage in a woman's reproductive life, typically occurring between 45 to 55 years of age [1, 2]. During this transition, progressive decline in ovarian function causes reduced estrogen production and a compensatory rise in FSH levels [3]. Traditionally, the increased risk of obesity, dyslipidemia, insulin resistance, hypertension, and cardiovascular disease during and after menopause has been mainly attributed to estrogen deficiency. However, recent evidence suggests that FSH may also influence metabolic processes independently of estrogen [4, 5, and 6].

FSH receptors have been identified in adipose tissue, liver, bone, and blood vessels, suggesting possible roles in fat accumulation, lipid metabolism, and energy balance [5, 6, and 7]. Studies have reported associations between FSH levels and BMI, waist circumference, triglycerides, HDL cholesterol, fasting blood glucose, and cardiovascular risk. These relationships may differ between perimenopausal and postmenopausal women [4, 8, 9, and 10]. In India, the burden of metabolic syndrome among menopausal women is considerable, with studies reporting high prevalence of metabolic syndrome and central obesity [11, 12, and 13]. Therefore, understanding the relationship between serum FSH and cardiometabolic risk factors may provide insight into menopausal metabolic changes and may help identify women at increased cardiometabolic risk.

Discussion

Physiology of FSH and changes during Menopause:

FSH promotes the development of ovarian follicles and the synthesis of estrogen, which help regulate the menstrual cycle and reproductive function [3]. As menopause nears, the ovarian follicle count diminishes, causing a drop in estrogen production. This disrupts the brain's feedback system, resulting in steadily rising FSH levels. In perimenopause, FSH secretion varies greatly from day to day. After menopause, FSH levels remain high, reaching as much as 30 IU/L and sometimes up to 100 IU/L [2]. FSH receptor sites have been found not only in ovarian tissue but also in adipose tissue, liver, bone cells, and certain blood vessel walls [5, 6, and 7]. This suggests that increased FSH levels influence fat storage, cholesterol production, and energy metabolism. These findings help explain how specific metabolic processes can happen even when estrogen levels are maintained in experimental settings.

FSH and Obesity / Body Fat Distribution:

The first and foremost physical change following menopause is central obesity, characterized by the deposition of fat around the midsection [14]. There is ample research showing an inverse correlation between serum FSH levels and indicators of obesity in postmenopausal women, meaning that women with higher FSH levels have lower BMI, waist circumference, waist-hip ratio, and total body fat percentage. Jung et al. (2020) examined Korean postmenopausal females and divided them into FSH quartiles. Females with high FSH levels were found to have low body weight, waist circumference, and body fat percentage. This association proved to be

statistically significant even after adjusting for age, body weight, and estradiol levels [8]. Lee et al. (2022) conducted another study among 219 postmenopausal women and found that those with Metabolic Syndrome (Meets) had low levels of FSH. Elevated FSH was linked to decreased body fat mass [9]. The situation is somewhat different when it comes to perimenopause. Zhang et al. (2020) showed that elevated FSH levels were positively correlated with waist circumference, triglycerides, and Meets [10] as this study found that the highest FSH textile had significantly higher waist circumference (90.73 cm; p=0.008). Raised triglycerides (26.92% vs 17.72%) and Meets (48.72% vs 34.17%) were also more prevalent in women with higher FSH, supporting its association with cardiometabolic risk. In an Indian study, Rimini et al. (2017) documented a high prevalence of metabolic syndrome (Meets), central obesity, and vitamin D deficiency among postmenopausal women in West Bengal [11] as the study found that 46% of postmenopausal women had metabolic syndrome, while 29.3% had central obesity (WC ≥80 cm). Additionally, 51% had vitamin D deficiency and 19% had vitamin D insufficiency, indicating a substantial cardiometabolic burden.

Overall, these studies suggest that FSH may be linked with changes in body fat and cardio metabolic health during the menopausal transition. Therefore, studying FSH along with BMI, waist circumference, and other metabolic risk factors can help better understand its role in menopausal women.

FSH and Dyslipidemia (Lipid Profile):

Dyslipidaemia is defined as a disorder that causes an imbalance of lipid concentrations in blood plasma, such as higher concentrations of triglycerides, high LDL-cholesterol, and lower HDL-cholesterol. Dyslipidaemia is a significant reversible risk factor for CVD, which has a higher prevalence among postmenopausal women due to hormonal changes. The lipid profile of postmenopausal women is unfavourable – they have higher concentrations of total cholesterol, LDL-cholesterol, and triglycerides, as well as lower HDL-cholesterol. This leads to the formation of plaques in blood vessels [15]. According to Wang et al., high levels of serum were inversely correlated with the incidence of ASCVD in Chinese women over a period of 10 years. High levels of FSH were associated with increased obesity markers and lipid profile [4, 16]. Jung et al. (2020) reported a similar finding of higher FSH levels; however, this was associated with higher HDL and lower triglycerides [8]. Still, there is a suggestion that a very high FSH level can increase LDL levels by reducing their clearance from the liver [17].

FSH assessment may help identify postmenopausal women at higher risk of dyslipidaemia and cardiovascular complications, supporting early prevention and lifestyle intervention.

FSH and Hypertension:

During perimenopause, changes in FSH and estrogen levels may accompany changes in blood pressure, with studies showing an increase in BP from early to late menopausal transition [18]. Hypertension is more prevalent among postmenopausal women. Another research shows that elevated FSH levels are associated with improved blood pressure regulation, though this is often accompanied by a low BMI [4, 16].

These findings suggest that hormonal changes, particularly in FSH and estrogenic, may influence blood pressure during the menopausal transition. Studying FSH along with BP in peril menopausal and postmenopausal women may help clarify its possible role in hypertension and cardiovascular risk.

Overall Metabolic Syndrome and Cardiovascular Disease Risk:

Research studies by Wang (2017), Jung (2020), Lee (2022), and Chen (2023) consistently show that postmenopausal women with high FSH levels have a higher risk of developing metabolic syndrome (Meets) and cardiovascular disease [4,8,9,17]. This relationship may be quite different in the case of perimenopause, caused by hormonal changes.[14] In India, where the prevalence of Meets is high at baseline, measuring FSH levels will help to identify high-risk patients [11,12,13]. FSH influences metabolism via various pathways: In adipose tissue, FSH stimulates leptocyte proliferation and reduces the conversion of white fat to brown fat [5, 6]. In the liver, it may affect enzyme systems responsible for cholesterol production. It may induce low-level inflammation that increases insulin resistance [7]. Effects on bone and muscle indirectly affect energy homeostasis [6]. Meets is common in menopausal females in India due to lifestyle and dietary habits. Rimini et al. (2017) have found this in their research conducted in rural India. [7] But few studies have measured FSH levels in conjunction with cardiometabolic parameters across various parts of India [9]. FSH may be linked to metabolic changes and cardiovascular risk during menopause. Studying FSH alongside metabolic parameters may help identify Indian women at higher risk of metabolic syndrome and cardiovascular disease.

Table:

Author(s)&year	Title	Result	Conclusion

Lumen MA et al. -2025	European Society of Endocrinology clinical practice guideline for evaluation and management of menopause and the perimenopause	Menopause is associated with hormonal, cardiovascular and metabolic changes requiring comprehensive assessment.	Individualized evaluation and management of menopause and perimenopause are recommended.
Barba Gallo F et al. (2025)	Relationship b/w FSH&glucose metabolism disorders in postmenopausal women	Lower FSH in women with T2 DM; inverse correlation with insulin and HOMA-IR	FSH levels inversely correlate with glucose metabolism disorders
Singh A et al. (2023)	Menopause and cardiometabolic risk in Indian women: Current evidence and gaps	Menopause is associated with increased obesity, diabetes, hypertension and cardiovascular risk in Indian women.	Early screening and prevention of cardiometabolic risk are needed in menopausal women.
Mundhra R et al. (2023)	Metabolic Syndrome and Its Association with Menopausal Symptoms among Postmenopausal Women: A Cross-sectional Study	MetS was present in 34.38% of women; hypertriglyceridemia was associated with more severe menopausal symptoms.	MetS is associated with menopausal symptoms, particularly in women with hypertriglyceridemia.

Gupta R et al. (2022)	Prevalence of metabolic syndrome in Indian menopausal women: A systematic review and meta-analysis	Metabolic syndrome showed a high prevalence among Indian menopausal women, with variation across studies.	Metabolic syndrome is a major cardiometabolic concern among Indian menopausal women, highlighting the need for screening and prevention.
Lee SW et al. (2022)	Association b/w FSH levels and metabolic syndrome in postmenopausal women	Lower FSH in MetS group; higher FSH linked to better insulin sensitivity and higher adiponectin	Higher FSH levels appear protective against MetS
Mao L et al. (2022)	Effects of follicle-stimulating hormone on fat metabolism and cognitive impairment in women during menopause	High FSH was associated with altered fat metabolism, body composition and central obesity during menopause.	FSH may play a role in adipogenesis and metabolic disturbances during menopause
Nappi RE et al. (2022)	Menopause: a cardiometabolic transition	Menopausal transition is associated with increased fat mass, insulin resistance, dyslipidemia and vascular dysfunction	Menopause is an important cardiometabolic transition, requiring early assessment and management of cardiovascular risk factors.

Jung ES et al. (2020)	Association between Serum FSH Levels and Cardiometabolic Risk Factors among Postmenopausal Korean Women	Higher FSH quartiles linked to lower BMI, waist circumference, TG, and higher HDL-C	An inverse relationship exists between serum FSH levels and cardiometabolic risk factors
Zhang C et al. (2020)	Serum FSH levels show a positive association with metabolic risk factors in perimenopausal women	Elevated FSH levels were associated with increased waist circumference, higher triglyceride levels, and an elevated risk of metabolic syndrome (MetS)	Elevated FSH levels may contribute to an increased risk of metabolic disturbances during the perimenopausal period
Srimani S et al. (2017)	Prevalence of Metabolic Syndrome in Rural Postmenopausal Women of West Bengal, India	A high prevalence of MetS & central obesity has been reported among Indian postmenopausal women	Metabolic syndrome is highly prevalent in Indian postmenopausal women; targeted screening needed
Wang N et al. (2017)	FSH and cardiometabolic risk in postmenopausal women	Elevated FSH levels were linked to a lower estimated 10-year risk of atherosclerotic cardiovascular disease (ASCVD) and improved measures of obesity	Low circulating FSH levels may serve as an early marker for increased cardiovascular risk in postmenopausal women

FSH testing can be used as another aid in determining risk, particularly in low-level cases among

postmenopausal women [17]. The best initial measures in lifestyle intervention include walking/yoga regularly, eating a balanced diet low in fatty foods, managing weight, and reducing stress. In making decisions about hormone replacement therapy, the effects on both estrogen and FSH should be considered. Potential future therapies to manage FSH (including FSH blockers, which have been tested in animals) can provide new approaches for managing fat and cholesterol [5,6].

The majority of the currently available studies are cross-sectional, and hence the cause-and-effect relationship is needs to be further studied. Future research should include better control for age, BMI, smoking, and dietary intake, while also including longitudinal studies and local population.

Conclusion:

Menopause is not merely the cessation of menstruation, but a major hormonal transition marked by significant changes in FSH and estrogen levels, with increasing evidence suggesting that FSH may be associated with changes in adiposity, glucose and lipid metabolism, blood pressure, and overall cardiometabolic risk.. Recent studies have shown that FSH is more than a mere indicator of menopause, as it is involved in fat redistribution, lipid metabolism, and glycemic regulation. Current literature supports the fact that increased FSH post-menopause is usually associated with reduced cardiometabolic risks; however, the perimenopausal stage requires careful consideration because fluctuations in FSH levels may influence its association with cardiometabolic risk factors.

With further studies and investigation in Indian population, it will become possible to increase the efficiency of early diagnosis and prevention in the local context, which is crucial for millions of women who undergo menopause.

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