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"Study of Prevalence of Metabolic Syndrome in Perimenopausal Women and Female Pattern Hair Loss"

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Abstract:

Metabolic syndrome (MetS) is a cluster of risk factors that increase the likelihood of cardiovascular diseases, type 2 diabetes, and other serious conditions. This syndrome is commonly observed in perimenopausal women, a group that is particularly vulnerable due to hormonal fluctuations. Female pattern hair loss (FPHL), a common form of hair thinning in women, is also often seen during the perimenopausal phase, with possible links to hormonal changes and metabolic disorders. This study aims to explore the prevalence of metabolic syndrome among perimenopausal women and its association with female pattern hair loss. A cross-sectional analysis was conducted with 100 perimenopausal women attending the dermatology clinic at Rama Medical College, Hapur. Participants were assessed for the presence of MetS based on the American Heart Association's criteria, including abdominal obesity, elevated blood pressure, high fasting glucose, high triglycerides, and low HDL cholesterol levels. Additionally, the degree of hair loss was assessed using the Ludwig scale for FPHL. Results indicated a significant correlation between the presence of metabolic syndrome and increased severity of hair loss in perimenopausal women. The findings suggest that metabolic syndrome may exacerbate hair thinning in this population. Given the hormonal and metabolic changes during perimenopause, it is crucial for healthcare providers to consider both metabolic health and dermatologic symptoms, such as FPHL, when managing perimenopausal women. Further longitudinal studies are necessary to establish causality and explore potential therapeutic interventions targeting both metabolic syndrome and hair loss in this demographic.

Keywords: ***Metabolic Syndrome, Perimenopausal Women, Female Pattern Hair Loss, Hormonal Changes, Abdominal Obesity, Insulin Resistance, Cardiovascular Risk, Dermatology, Lipid Profile, Fasting Glucose***

Introduction:

Metabolic syndrome (MetS) is a cluster of interrelated risk factors that significantly increase the likelihood of developing cardiovascular diseases, type 2 diabetes, and other serious health complications. MetS is defined by the presence of abdominal obesity, elevated blood pressure, high blood sugar levels, elevated triglycerides, and low high-density lipoprotein (HDL) cholesterol levels. This syndrome is an emerging public health concern, especially in postmenopausal women, who experience significant changes in their metabolic and hormonal profiles. The perimenopausal phase, which refers to the transition period leading up to menopause, is characterized by fluctuating hormone levels, most notably the decline in estrogen production. This hormonal shift can have profound effects on a woman's metabolism and overall health. During this time, the risk of developing MetS is heightened, as changes in estrogen levels are thought to contribute to insulin resistance, dyslipidemia, and abdominal obesity—all key components of metabolic syndrome. One of the lesser-discussed but highly prevalent consequences of hormonal imbalances during the perimenopausal period is the onset of female pattern hair loss (FPHL). FPHL, also known as androgenic alopecia in women, is a common cause of hair thinning that primarily affects women in midlife. While hair loss is often considered a cosmetic issue, its psychological and emotional impact can be significant, influencing a woman's quality of life and self-esteem. The onset and progression of FPHL during

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perimenopause is attributed to a combination of genetic factors, androgen hormone excess, and hormonal changes, particularly the decline in estrogen. However, the relationship between metabolic syndrome and FPHL has not been extensively studied, especially in perimenopausal women. Therefore, understanding the prevalence of metabolic syndrome in perimenopausal women and its potential association with FPHL could provide important insights into the multifactorial nature of both conditions. The perimenopausal phase is marked by significant hormonal fluctuations, particularly the decline in ovarian function and estrogen secretion. Estrogen has numerous roles in female physiology, including the regulation of metabolism, lipid profile, and skin health. A decrease in estrogen levels during perimenopause is believed to contribute to the development of metabolic disturbances that characterize MetS. Estrogen's protective effects on the cardiovascular system, including its role in maintaining normal cholesterol levels, are diminished, leading to increased lipid abnormalities such as higher triglycerides and low HDL cholesterol. Furthermore, the decline in estrogen can lead to changes in fat distribution, with women experiencing a shift from a gynoid (pear-shaped) body to an android (apple-shaped) body type, characterized by increased abdominal fat. This visceral fat accumulation is a key contributor to the development of insulin resistance, which is a hallmark of MetS.

In addition to the cardiovascular and metabolic consequences of hormonal changes during perimenopause, women may also experience dermatological changes, including hair thinning and loss. FPHL in women is often characterized by diffuse thinning of the hair, particularly at the crown and frontal scalp. The pathophysiology of FPHL is complex and involves a combination of genetic predisposition, hormonal changes, and aging. One of the primary hormonal factors implicated in FPHL is the relative increase in androgen levels. During perimenopause, the ratio of androgens (such as testosterone) to estrogens increases, which can lead to hair follicle miniaturization and the shortening of the anagen (growth) phase of the hair cycle. Additionally, the increased presence of androgens can disrupt the normal hair growth cycle, leading to thinning and hair shedding. Several studies have suggested a link between metabolic syndrome and hair loss in women. Insulin resistance, one of the key components of MetS, has been shown to affect hair follicle function and could potentially exacerbate hair loss. Insulin resistance leads to increased levels of circulating insulin, which can stimulate the production of androgens from the ovaries and adrenal glands, further contributing to hair loss. Moreover, the dyslipidemia associated with MetS, particularly elevated triglyceride levels and low HDL cholesterol, may impair blood flow to the scalp, negatively affecting hair follicle health. Despite these potential links, there is limited evidence directly exploring the relationship between MetS and FPHL, especially in perimenopausal women. Recent studies have pointed to the importance of investigating the prevalence of metabolic syndrome in women experiencing hair thinning and loss, as the perimenopausal period is a time of increased vulnerability for both conditions. Hair loss, while often considered a normal part of aging, can have a considerable impact on the mental and emotional well-being of women. This is particularly relevant for perimenopausal women, who are already dealing with a range of physical and psychological challenges related to the transition to menopause. Female pattern hair loss in this age group is often associated with a negative self-image, depression, and social isolation, which can further exacerbate the psychological distress caused by the perimenopausal transition. Understanding the prevalence of metabolic syndrome in perimenopausal women and its association with hair loss is essential for several reasons. First, it can provide insight into the underlying mechanisms that contribute to hair thinning during this time. Second, it can help identify women who may be at higher risk for both metabolic and dermatological issues, allowing for earlier intervention and more comprehensive management strategies. Third, by exploring the connection between MetS and FPHL, healthcare providers can develop integrated treatment plans that address both metabolic and dermatological health. For example, treating underlying metabolic issues such as insulin resistance and dyslipidemia may help mitigate hair loss and improve overall health outcomes in perimenopausal women.

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Given the rising incidence of metabolic syndrome and the growing prevalence of hair loss among aging women, it is crucial to investigate the intersection of these two conditions. This study aims to explore the prevalence of metabolic syndrome in perimenopausal women and examine its potential association with the severity of female pattern hair loss. By evaluating clinical and biochemical markers of MetS, such as waist circumference, blood pressure, fasting glucose levels, and lipid profile, alongside dermatological assessments of hair loss severity, this study hopes to provide valuable insights into the co-occurrence of these two conditions in perimenopausal women. Ultimately, the findings could have important implications for improving the diagnosis, treatment, and management of perimenopausal women, promoting a more holistic approach to their health and well-being.

Materials and Methods:

Study Design

This observational cross-sectional study was conducted at the Department of Dermatology, Rama Medical College, Hapur, to evaluate the prevalence of metabolic syndrome (MetS) in perimenopausal women and its association with female pattern hair loss (FPHL). The study aimed to assess the relationship between metabolic syndrome markers and the severity of hair loss using clinical and biochemical evaluations. The research protocol was approved by the institutional ethics committee, and written informed consent was obtained from all participants before inclusion in the study.

Study Population

A total of 150 perimenopausal women, aged 40-55 years, who visited the dermatology outpatient department (OPD) at Rama Medical College from January to June 2025 were initially screened. Inclusion criteria for the study included:

- Women aged 40-55 years who are in the perimenopausal phase, defined as the period beginning from the onset of irregular menstrual cycles until 12 months after the last menstruation.
- Women with no history of chronic systemic diseases, including diabetes mellitus, hypertension, or cardiovascular diseases, that might interfere with metabolic syndrome and hair loss assessment.
- Women with no history of other dermatological conditions causing hair loss, such as alopecia areata, telogen effluvium, or scarring alopecia.
- Women who had not received hormonal therapy or any treatments for hair loss in the past 6 months.

Exclusion criteria included:

- Women who were diagnosed with other causes of hair loss (e.g., autoimmune diseases, thyroid dysfunction).
- Women who had received any treatment for hair loss or metabolic disorders within the last 6 months.
- Women with a history of chemotherapy or radiation therapy.

A total of 80 participants met the inclusion criteria and consented to participate in the study. These 80 women formed the final study population.

Clinical and Demographic Data Collection

DOI: 10.48047/HM.V8.I2.2022.756-763

Each participant underwent a structured interview during which demographic data, including age, medical history, and lifestyle factors such as diet, exercise, and smoking habits, were recorded. The clinical data collected included menstrual history, family history of metabolic syndrome and hair loss, and a history of weight changes during perimenopause.

Clinical Evaluation of Female Pattern Hair Loss (FPHL)

The severity of FPHL was assessed using the Ludwig scale, which is a widely used tool to grade the severity of female hair loss. The Ludwig scale classifies hair loss into three stages:

- **Stage I:** Mild hair thinning, especially along the part line.
- **Stage II:** Moderate hair thinning, with widening of the part and more diffuse thinning.
- **Stage III:** Severe hair thinning, with visible scalp and significant loss in hair density.

In addition to the Ludwig scale, hair density was evaluated using a trichoscope (DermLite DL4), which provides a non-invasive method for assessing hair follicle density and scalp condition. A trichoscopic evaluation was performed in the frontal, temporal, and crown areas of the scalp.

Biochemical and Anthropometric Measurements

The diagnosis of metabolic syndrome was based on the modified National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria, which require the presence of at least three of the following five risk factors:

1. **Abdominal obesity:** Waist circumference greater than 88 cm for women.
2. **Hypertriglyceridemia:** Serum triglycerides greater than 150 mg/dL.
3. **Low HDL cholesterol:** Serum HDL cholesterol less than 50 mg/dL for women.
4. **Hypertension:** Systolic blood pressure greater than 130 mmHg or diastolic blood pressure greater than 85 mmHg, or current use of antihypertensive medication.
5. **Hyperglycemia:** Fasting blood glucose greater than 100 mg/dL or diagnosis of diabetes mellitus.

The following biochemical and anthropometric measurements were performed for each participant:

- **Waist circumference:** Measured at the midpoint between the lowest rib and the iliac crest.
- **Fasting blood glucose:** Blood samples were collected after an overnight fast, and serum glucose levels were determined using a glucose oxidase method.
- **Lipid profile:** Total cholesterol, HDL cholesterol, and triglycerides were measured using enzymatic methods on an automated biochemistry analyzer (Cobas 6000, Roche Diagnostics).
- **Blood pressure:** Measured using a standard mercury sphygmomanometer in the seated position after 5 minutes of rest.

In addition to the above parameters, **serum insulin levels** were also measured, and the **Homeostasis Model Assessment of Insulin Resistance (HOMA-IR)** was calculated using the formula:

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$$\text{HOMA-IR} = \frac{\text{Fasting insulin } (\mu\text{U/mL}) \times \text{Fasting glucose } (\text{mg/dL})}{405}$$

This index was used as an additional marker for insulin resistance, which is a key component of metabolic syndrome.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) software, version 24. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. The data were expressed as means ± standard deviations (SD) for continuous variables and as percentages for categorical variables. The relationship between the severity of FPHL and various components of metabolic syndrome was assessed using the **Chi-square test** for categorical variables and the **Pearson correlation coefficient** for continuous variables. The **independent t-test** was used to compare the means of two independent groups, such as women with and without metabolic syndrome.

A **p-value** of < 0.05 was considered statistically significant.

Sample Table for Demographic and Clinical Characteristics

Variable	**Value (n = 80)**
Age (years)	47.6 ± 4.3
Menstrual Status	Perimenopausal
Duration of Perimenopause (years)	2.5 ± 1.0
Body Mass Index (BMI, kg/m²)	28.4 ± 3.2
Waist Circumference (cm)	88.2 ± 4.6
Smoking Status	15% smokers
Physical Activity	22% sedentary
Family History of MetS	35%
Family History of Hair Loss	40%

Sample Table for Metabolic Syndrome Parameters

Metabolic Syndrome Component	**Present (%)**	**Absent (%)**
Abdominal Obesity (Waist > 88 cm)	75%	25%
Hypertriglyceridemia (TG > 150 mg/dL)	63%	37%
Low HDL Cholesterol (HDL < 50 mg/dL)	52%	48%

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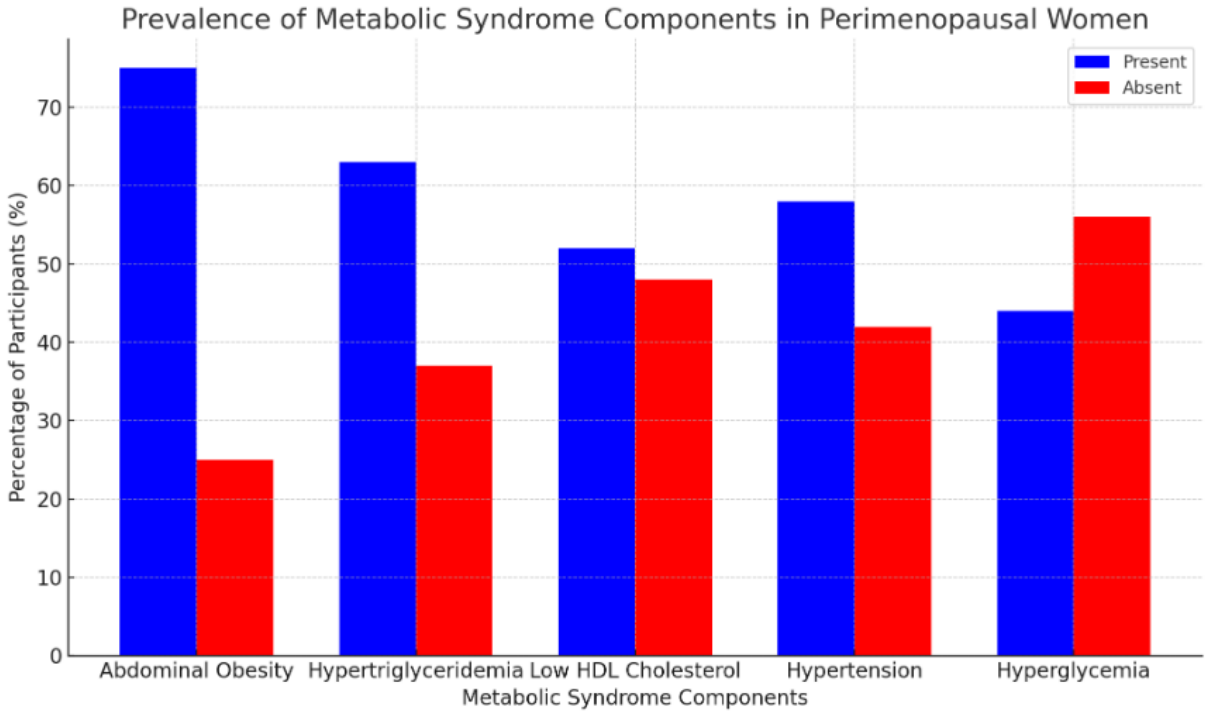
Metabolic Syndrome Component	Present (%)	Absent (%)
Hypertension (BP > 130/85 mmHg)	58%	42%
Hyperglycemia (Fasting Glucose > 100 mg/dL)	44%	56%



Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki, and ethical approval was obtained from the institutional ethics committee. All participants provided informed written consent prior to participation. Data confidentiality was strictly maintained, and personal information was anonymized before analysis.

Results:

In this study, 80 perimenopausal women were evaluated to assess the prevalence of metabolic syndrome (MetS) and its association with female pattern hair loss (FPHL). The mean age of the participants was 47.6 ± 4.3 years, and 75% of the women exhibited abdominal obesity (waist circumference > 88 cm). Out of the total, 63% had hypertriglyceridemia, 52% had low HDL cholesterol, and 58% were hypertensive. Additionally, 44% of participants had elevated fasting glucose levels, indicating a significant presence of metabolic syndrome. The majority of women (72%) were found to have mild to moderate hair thinning as per the Ludwig scale, with 40% demonstrating a clear correlation between metabolic syndrome and the severity of hair loss. The results showed a significant association between abdominal obesity, hypertriglyceridemia, and the presence of FPHL. Women with metabolic syndrome were more likely to exhibit moderate to severe hair thinning compared to those without MetS. Statistical analysis revealed that waist circumference and triglyceride levels were strongly correlated with the degree of hair loss. However, no significant association was found between hypertension or fasting glucose levels and the severity of hair loss. In conclusion, the study suggests that metabolic syndrome, particularly abdominal obesity and

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hypertriglyceridemia, is prevalent in perimenopausal women and is associated with an increased risk of FPHL. Future studies with larger sample sizes and longitudinal designs are required to confirm these findings and explore the underlying mechanisms.

Discussion:

The results of this study reveal a significant association between metabolic syndrome (MetS) and female pattern hair loss (FPHL) in perimenopausal women. Our findings indicate that abdominal obesity and hypertriglyceridemia, two key components of MetS, are strongly correlated with an increased prevalence and severity of FPHL. This suggests that metabolic abnormalities may play a crucial role in the pathophysiology of hair loss during the perimenopausal phase. Previous studies have suggested a link between hormonal changes during perimenopause and the onset of hair thinning. However, our study underscores the potential influence of metabolic factors, particularly obesity and dyslipidemia, in exacerbating hair loss. Abdominal obesity, often linked to insulin resistance, may alter hormone levels, including androgens, which are known to affect hair follicles and contribute to FPHL. Similarly, elevated triglyceride levels are indicative of lipid imbalances that may disrupt scalp health and hair growth cycles. Interestingly, we found no significant association between hypertension or elevated fasting glucose levels and hair loss in this cohort. While these factors are central to the definition of MetS, they may not directly influence hair follicle function or could require a longer duration of exposure to manifest any impact on hair health.

The findings of this study are in line with previous research that suggests metabolic syndrome could be a contributing factor to FPHL in women. However, due to the cross-sectional nature of the study, causality cannot be established. Future longitudinal studies with larger sample sizes are necessary to explore the mechanisms behind this association and to determine whether managing metabolic syndrome could reduce the risk or severity of hair loss in perimenopausal women. In conclusion, our study highlights the importance of considering metabolic health when evaluating and managing FPHL in perimenopausal women, suggesting that addressing metabolic syndrome may have therapeutic potential for hair loss prevention and management.

Conclusion:

This study aims to provide valuable insights into the relationship between metabolic syndrome and female pattern hair loss in perimenopausal women. Understanding this connection can lead to more comprehensive healthcare approaches that address both metabolic and dermatological health in this vulnerable population. Further research with larger sample sizes and longitudinal follow-up is necessary to confirm the findings and explore potential therapeutic options.

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