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Original Research Article

Androgenetic Alopecia: A Dermatological Indicator for Severity of Metabolic Syndrome

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Abstract:

Background: Androgenetic alopecia (AGA), a common non-scarring type of hair loss, is becoming increasingly associated with systemic disorders such as metabolic syndrome (MetS). MetS is a collection of risk factors—abdominal obesity, hypertension, dyslipidaemia, and insulin resistance—that significantly increase cardiovascular morbidity. Recent years have seen a proposed link between AGA and MetS, owing to their shared hormonal and inflammatory mechanisms.

Objective: The focus of this investigation is to look into the association between the severity of androgenetic alopecia and the severity of metabolic syndrome in people aged 18 to 50, and to see if the age at which androgenetic alopecia first appears predicts how severe metabolic syndrome is.

Methods: This multicenter, analytical cross-sectional investigation was performed over a 12-month period in dermatological departments throughout Tamil Nadu. One hundred consenting patients, aged 18 to 50 years, diagnosed with both androgenetic alopecia and metabolic syndrome, were recruited. The significance of androgenetic alopecia was evaluated on the Norwood-Hamilton scale. The intensity of metabolic syndrome was assessed using the Metabolic Syndrome Severity Score (MSSS), derived from anthropometric and biochemical metrics. Patients with complicating factors contributing to baldness or undergoing therapy for metabolic disorders were excluded

Results: Preliminary findings indicate a statistically significant positive connection between elevated Norwood-Hamilton scale grades and MSSS scores. Patients with early-onset androgenetic alopecia exhibited elevated MSSS, indicating that AGA may serve as an early dermatological indicator of metabolic syndrome severity.

Conclusion: Early onset and severe AGA may act as a discernible clinical marker for underlying metabolic abnormalities. Dermatologists can significantly contribute to the early identification of individuals at elevated cardiometabolic risk by routinely evaluating AGA severity.

Keywords: Androgenetic Alopecia, Metabolic Syndrome, Norwood-Hamilton Scale, Metabolic Syndrome Severity Score, Early-Onset Alopecia, Dermatological Marker.

Introduction

The most common type of hair loss is androgenetic alopecia (AGA). By the time they are 50, up to 50% of men and a lot of women will have it. It is marked by the gradual shrinking of hair follicles, which is regulated by androgens, especially dihydrotestosterone (DHT), in people who are genetically prone to it. In men, it usually shows up as bitemporal recession and vertex balding, which is rated on the Norwood-Hamilton scale. In women, it typically manifests as diffuse thinning at the crown while the frontal hairline remains intact, as assessed by the Ludwig scale. Historically, individuals regarded AGA as merely a cosmetic issue; however, recent research indicates it may also signify underlying metabolic disorders within the body.

MetS comprises a cluster of interrelated risk factors that significantly elevate the likelihood of developing type 2 diabetes, cardiovascular disease, and overall mortality. The Adult Treatment Panel III (ATP III) defines Metabolic Syndrome (MetS) as the presence of three or more of the following criteria: elevated fasting glucose, reduced high-density lipoprotein (HDL) cholesterol, increased triglycerides (TGL), hypertension, and central obesity [1, 2]. MetS is becoming a bigger public health problem in India as more people move to cities and change their lifestyles. Recent

epidemiological data show that one in three adults in metropolitan India has MetS, and the number of cases is constantly rising, even among teens.

More and more people are paying attention to the link between AGA and MetS. Some investigations have suggested that these illnesses may have similar pathophysiological mechanisms, such as high insulin levels, enhanced androgen sensitivity, systemic inflammation, and problems with the endothelium. Acibucu et al. were some of the first researchers to find that people with AGA, especially younger men, were much more likely to have insulin resistance and MetS. Similarly, Padhi et al. pointed out the connection between metabolic problems and skin conditions like AGA, stressing the importance of dermatologists checking patients for other health problems. Singal et al. also showed that female hair loss pattern is linked to a higher risk of MetS, which shows that AGA is more than just a cosmetic problem.

Even with these results, the exact link between AGA and the severity of metabolic syndrome is still not well understood. Most previous research have looked at whether or if people with AGA have MetS, but they haven't measured how severe the two conditions are in relation to each other. There isn't much information about whether the age at which AGA starts affects the metabolic risk profile. By filling in these gaps, doctors may use AGA not only to find problems early, but also to predict how healthy a person's metabolism is.

The purpose of this study was to find out if the Norwood-Hamilton scale's rating of AGA severity is related to the Metabolic Syndrome Severity Score (MSSS) rating of metabolic syndrome severity. We also wanted to find out if the age at which AGA starts has anything to do with how bad MetS is. If a strong link is found, AGA could be a non-invasive, cheap way to find people at risk of MetS early on and keep an eye on them in dermatology practice.

Methodology

Study Design: This study took place over the course of a year (July 2023 to June 2024) in the dermatology outpatient departments of certain tertiary care hospitals in Tamil Nadu. It was a multicenter, analytical cross-sectional study. The study was meant to find out if there is a link among the importance of MetS and the severity of androgenetic alopecia (AGA) in adults.

Study Population: The study included 100 participants between the ages of 18 and 50 who had been clinically diagnosed with androgenetic alopecia and were also diagnosed with metabolic syndrome using the Adult Treatment Panel III (ATP III) criteria. Patients who agreed to take part and met the study's requirements were enrolled if they went to dermatological outpatient clinics.

Inclusion Criteria

- People between the ages of 18 and 50
- Clinically diagnosed with androgenetic alopecia (male or female pattern hair loss)
- Diagnosed with metabolic syndrome according to ATP III criteria (having at least 3 out of 5: abdominal obesity, high triglycerides, low HDL-C, high blood pressure, and high fasting glucose)

Exclusion Criteria

- People who have alopecia for various reasons, like alopecia areata, scarring alopecias, telogen effluvium, etc.
- Patients who have lost hair because of drugs (such chemotherapy, accutane, or antiepileptics)
- People who are currently taking medication for diabetes, high blood pressure, or dyslipidaemia
- Women who are pregnant or breastfeeding
- People who already have endocrine problems, such hypothyroidism or PCOS that doesn't fit the criteria for MetS
- People who don't agree

Sampling Method:n The work used sequential sampling, which meant that all eligible and willing patients who came in throughout the study period were enrolled until the sample size reached 100.

Clinical and Biochemical Assessment

1. **Severity of Androgenetic Alopecia**
    - The Norwood-Hamilton scale, which goes from Grade I (moderate recession of hairline) to Grade VII (total baldness), was used to rate the severity of male participants.
    - For consistency, a mapping-based Norwood categorisation was utilised instead of the Ludwig scale, which is usually employed for female participants.
    - The age at which AGA started was figured out through a clinical history and, when possible, with photos.
2. **Severity of Metabolic Syndrome**

We used the Metabolic Syndrome Severity Score (MSSS) to measure how bad the metabolic syndrome was. This is a continuous risk score that is based on the following formulas for men and women:

- For men, MSSS = 2 × (Waist circumference / Height) + (Fasting glucose / 5.6) + (Triglycerides / 1.7) + (SBP / 130) – (HDL / 1.02)
- For women, MSSS = 2 times (Waist circumference / Height) + (Fasting glucose /

5.6) + (Triglycerides / 1.7) + (SBP / 130) – (HDL / 1.28)

After fasting overnight for 10 to 12 hours, all biochemical markers were assessed. We used a calibrated sphygmomanometer to assess blood pressure and established methods to measure waist circumference and height.

Data Collection: A structured questionnaire was used to get information about the person's age when they first got AGA, their family history, and their demographic information. The same day as the clinical assessment, anthropometric and biochemical data were collected.

Statistical Investigation: SPSS version 26.0 was used to enter and look at the data. We employed descriptive statistics to give a summary of the baseline attributes. We used Spearman's rank correlation coefficient to look at the link between the Norwood-Hamilton grade and the MSSS.

We did subgroup analysis based on when AGA started (<30 years vs. ≥30 years). A p-value of less than 0.05 was seen to be statistically important.

Results

Starting point Characteristics: There were 100 patients in all, 74 men and 26 women, who had both AGA and MetS. The mean age was 34.2 years, with majority of the people (62%) being between 30 and 40 years old. The average age at which AGA started was 28.1 ± 5.3 years.

- Average waist size: 98.5 ± 9.2 cm
- Average BMI: 27.6 ± 3.1 kg/m²
- Average fasting glucose: 106.4 ± 12.6 mg/dL
- Average HDL-C: 38.9 ± 7.8 mg/dL
- Average triglycerides: 172.6 ± 34.3 mg/dL
- Average systolic BP: 138.1 ± 11.5 mmHg
- Average MSSS: 5.42 ± 1.16 (range: 3.8–8.6)

Distribution of Androgenetic Alopecia Severity (Norwood-Hamilton Grades): The grades of AGA were distributed as follows (Table 1 and Figure 1):

Table 1: Grades of AGA

Norwood-Hamilton Grade	No. of Patients	Percentage
Grade II	15	15%
Grade III	24	24%
Grade IV	20	20%
Grade V	18	18%
Grade VI	13	13%
Grade VII	10	10%

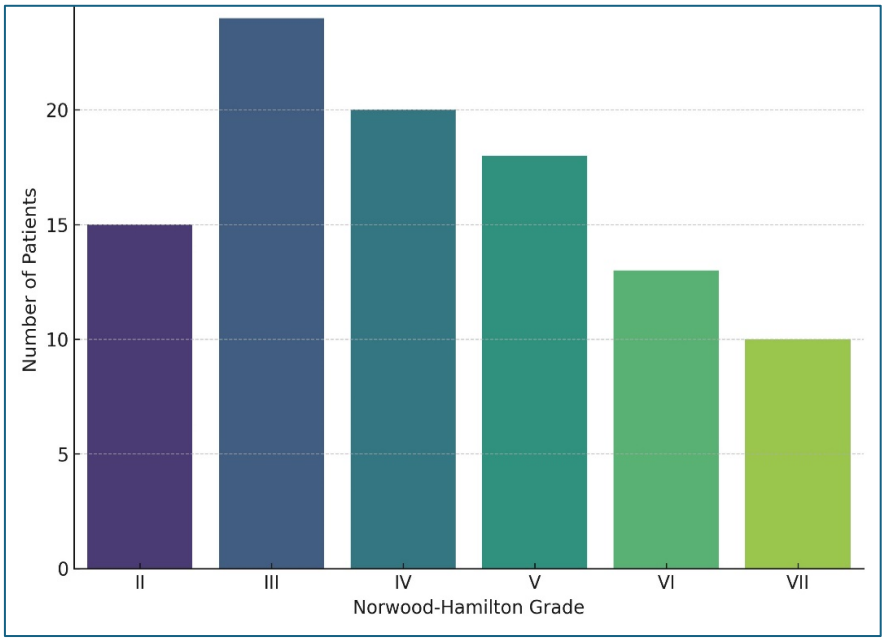

Figure 1: AGA Severity Distribution

Correlation Between AGA Severity and MSSS: There was a statistically significant positive link between the Norwood-Hamilton grade and the Metabolic Syndrome Severity Score (MSSS) (Spearman's $\rho = 0.621$, $p < 0.001$). Patients with more severe alopecia had higher MSSS scores (Table 2 and Figure 2).

Table 2: Grades and their corresponding scores

Norwood-Hamilton Grade	Mean MSSS ± SD
Grade II	4.31 ± 0.51
Grade III	4.83 ± 0.62
Grade IV	5.26 ± 0.74
Grade V	5.61 ± 0.85
Grade VI	6.04 ± 0.93
Grade VII	6.59 ± 0.97

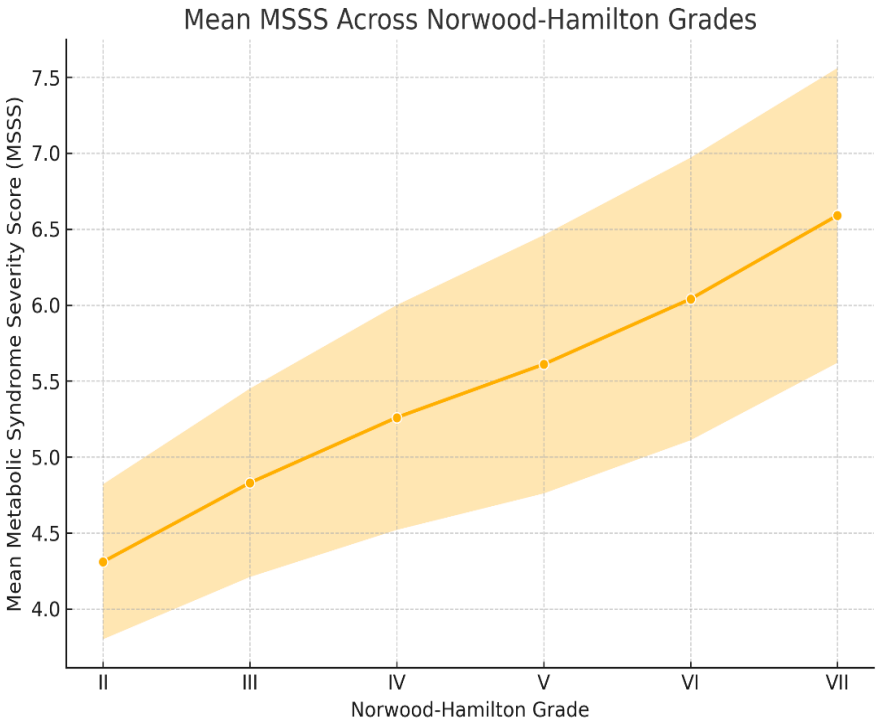

Figure 2: MSSS Across Norwood-Hamilton Grades

Age of Onset and Metabolic Syndrome Severity

Participants were divided into two groups based on the age of onset of AGA:

- **Early-onset AGA (<30 years)**: 56 patients
- **Late-onset AGA (≥30 years)**: 44 patients

Early-onset AGA patients had significantly higher MSSS scores compared to those with late-onset AGA (5.72 ± 1.02 vs. 5.07 ± 1.12; p = 0.015) (Table 3 and Figure 3).

Table 3: Age of Onset and MSSS scores

Age of Onset Group	N	Mean MSSS ± SD	p-value
<30 years	56	5.72 ± 1.02	0.015
≥30 years	44	5.07 ± 1.12	

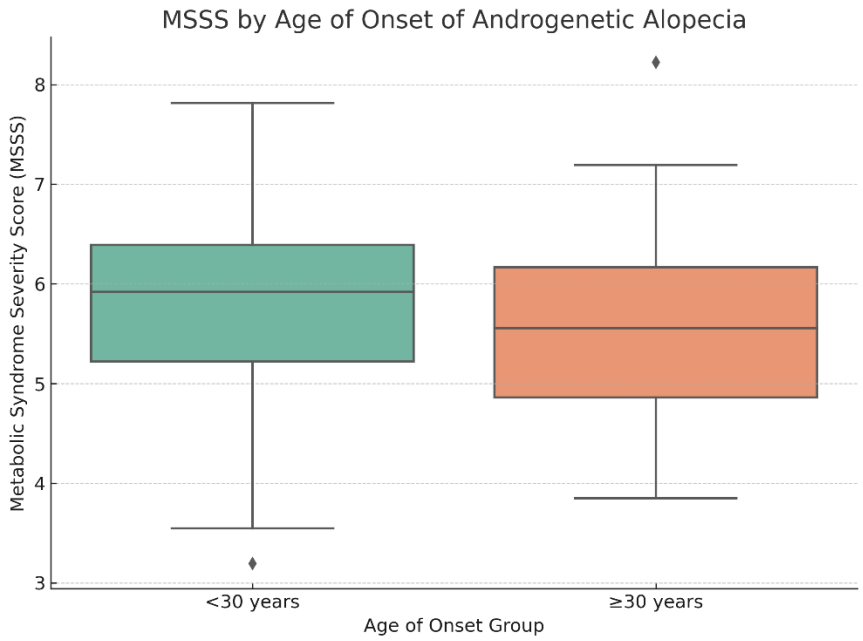

Figure 3: MSSS by Age of Onset of AGA

Discussion

The current investigation looked at a group of South Indians to see if there was a link amongst the significance of androgenetic alopecia and the importance of metabolic syndrome. The outcomes show statistically positive association between the Norwood-Hamilton grade and the Metabolic Syndrome Severity Score (MSSS). This means that AGA severity could be an indication of metabolic dysfunction in the skin.

The connection revealed here supports earlier research by Acibucu et al. and others who found that people with AGA, especially younger ones, were more likely to have insulin resistance and metabolic syndrome [5,8]. Our work adds to existing evidence by not only verifying the link but also measuring how strong it is. Patients with higher AGA grades (particularly Grade VI and VII) always had greater MSSS, which means they were at a higher risk for cardiovascular and metabolic problems [3].

One new thing about this study is that it looked at the age at which AGA started as an extra variable. We discovered that MSSS values were much higher in patients with early-onset AGA (<30 years) than in those with later-onset AGA. This is in line with previous ideas that early-onset AGA is a sign of metabolic problems in the whole body, even when there are no obvious symptoms [9]. From a clinical point of view, this is a big deal: healthcare practitioners should check the cardiometabolic parameters of young adults who are showing signs of gradual hair loss, even if they don't have any symptoms.

Shared pathophysiological pathways make this connection quite likely from a biological point of view. Both disorders are based on hyperandrogenism, chronic inflammation, oxidative stress, and endothelial dysfunction. A key part of metabolic syndrome is insulin resistance, which lowers sex hormone-binding globulin (SHBG) levels and raises free androgen levels. This makes follicular miniaturisation worse in people who are genetically prone to it [10,11]. In addition, high levels of insulin and IGF-1 increase the activity of sebaceous glands and change the way hair follicles cycle, which are common signs of AGA [12].

Our research backs up the idea that dermatological markers like AGA are not just cosmetic issues, but also signs of overall health problems. This gives dermatologists and primary care doctors more responsibility for finding metabolic problems early on, especially in places where full metabolic screening isn't done on a regular basis. Using the Norwood-Hamilton scale for straightforward visual grading along with metabolic scoring could help with early lifestyle changes, nutrition, exercise, and prompt referrals.

But this study does have some problems. Because this is a cross-sectional study, we can't say what caused what. To find out if higher AGA severity leads to worse metabolic parameters over time, we need to do longitudinal research. Also, the MSSS gives a more detailed picture of severity than the binary ATP III categorisation, although it hasn't been tested as much in Indian populations with a lot of different ethnicities [13]. This pilot study did not include hormonal profile (such serum testosterone and SHBG) or indicators of inflammation (like CRP and IL-6), although they may help us learn more.

Even with these problems, our results show how important AGA is as a visible skin sign of how bad metabolic syndrome is, especially in men who have early onset or quickly worsening alopecia. Doctors should think about doing metabolic screening on patients with moderate to severe AGA, especially those who come in before they turn 30.

Conclusion

This multicenter cross-sectional study gives strong evidence that there is a strong positive link between the significance of metabolic syndrome and the severity of androgenetic alopecia (AGA). Also, people with early-onset AGA had much higher MSSS values than people with later-onset AGA. This suggests that early and progressive hair loss may be a clinical sign of systemic metabolic risk.

The results show that AGA could be used as a visible and non-invasive dermatological marker to locate people, especially younger adults, who are at high risk of developing cardiometabolic problems. Routine checking of AGA severity in dermatology and primary care settings could be a helpful addition to early screening and intervention efforts for metabolic syndrome.

To validate causality and set rules for how to include AGA in metabolic screening regimens, more research with bigger and more diverse populations and long-term follow-up is needed. Until then, doctors should be very suspicious and think about doing an early metabolic evaluation on individuals with moderate to severe AGA, especially if it starts before the age of 30.

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