ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 07 | July - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ASSOCIATION OF ACANTHOSIS NIGRICANS WITH METABOLIC SYNDROME AND ITS INDIVIDUAL COMPONENTS: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

Dermatology

Dr. Priyanka Choudhary* MBBS, PG Resident, Department of Dermatology, Venereology and Leprology, Muzaffarnagar Medical College and Hospital, Muzaffarnagar, Western Uttar Pradesh, India*Corresponding Author

Dr. Tarang Goyal MBBS, MD, Professor, Head of Department, Department of Dermatology, Venereology and Leprology, Muzaffarnagar Medical College and Hospital, Muzaffarnagar, Western Uttar Pradesh, India

ABSTRACT

Objective: To analyze the clinical and epidemiological characteristics of acanthosis nigricans (AN) and to evaluate its association with metabolic syndrome and its individual components. **Methods:** A hospital-based observational cross-sectional study was conducted among 100 patients of AN clinically diagnosed for a period of 18 months in the Department of Dermatology at Muzaffarnagar Medical College and Hospital. Clinical examination, anthropometric assessment, blood pressure measurement, and laboratory investigations including fasting blood glucose, Hemoglobin A1c (HbA1c), fasting serum insulin, and lipid profile, were performed. Analysis of data was done by SPSS version 27.0. $p<0.05$ was considered statistically significant. **Results:** The mean age of the participants was 32.61 ± 10.55 years, with most patients belonging to the 21–30-year age group. Male predominance (54%) and urban residence (58%) were observed. The neck was the most commonly involved site (95%), followed by the axillae (48%). Weight gain was reported in 87% of participants. Among female patients, irregular menstrual cycles, hirsutism, and polycystic ovarian syndrome were observed in 43%, 32%, and 22% respectively. Abnormal glucose metabolism was identified in a substantial proportion of participants, with 28% classified as diabetic and 7% as prediabetic based on fasting blood glucose levels. Dyslipidemia was present in 54% of patients, predominantly as isolated hypertriglyceridaemia. Metabolic syndrome was identified in 27% of participants. Among the components of metabolic syndrome, abnormal waist circumference showed a statistically significant association ($p = 0.029$). **Limitations:** The study was limited by its single-center hospital-based design, relatively small sample size, and cross-sectional nature, which limit causal interpretation and generalizability of the findings. **Conclusion:** From the results obtained from the current study, there was a relationship between AN and different metabolic disorders, including obesity, dysglycemia, dyslipidemia, and central obesity. It implies that AN can be used as a marker for the presence of any metabolic problems.

KEYWORDS

Acanthosis Nigricans, Metabolic Syndrome, Insulin Resistance, Dyslipidemia, Central Obesity.

INTRODUCTION

Acanthosis nigricans (AN) is a dermatological condition characterized by hyperpigmented, velvety thickening of the skin, commonly involving the neck, axillae, and other flexural regions[1, 2]. AN was classically described as a paraneoplastic dermatological sign; however, it is now increasingly recognized as a cutaneous marker of metabolic abnormalities, particularly obesity and insulin resistance[3]. The prevalence of AN has been reported to be considerably higher among obese individuals, reflecting its close association with metabolic risk factors[3].

The pathogenesis of AN is closely associated with hyperinsulinemia and insulin resistance. Elevated insulin levels stimulate insulin-like growth factor-1 (IGF-1) receptors on keratinocytes and dermal fibroblasts, resulting in epidermal proliferation and the characteristic cutaneous changes observed in AN[3, 4]. Previous studies have demonstrated significant associations between AN and obesity, insulin resistance, and type 2 diabetes mellitus[4, 5]. In addition, AN has been associated with increased cardiometabolic risk and metabolic syndrome[6,7,8].

Metabolic syndrome comprises a cluster of metabolic abnormalities, including central obesity, dyslipidemia, hypertension, and impaired glucose metabolism, which contribute substantially to cardiovascular morbidity and mortality[7, 8]. The increasing burden of obesity and metabolic disorders has emphasized the importance of early identification of individuals at risk for cardiometabolic complications. As AN can be identified through routine clinical examination, it may serve as a simple and non-invasive clinical indicator of underlying metabolic abnormalities[8,9].

Although previous regional studies have reported an association between AN and metabolic syndrome, evidence regarding its clinical utility as a marker of metabolic syndrome remains limited[7, 10, 11]. Therefore, the present study was undertaken to analyze the clinical and epidemiological characteristics of AN and to evaluate its association with metabolic syndrome and its individual components.

MATERIALS AND METHODS

Study Design and Setting

A hospital-based observational cross-sectional study was conducted over a period of 18 months in the Department of Dermatology at Muzaffarnagar Medical College and Hospital. Patients attending the dermatology outpatient department with clinical features suggestive of AN were screened for eligibility and enrolled in the study after obtaining written informed consent.

Participants

The study included patients aged ≥18 years of either gender with clinically diagnosed AN who were willing to participate in the study. The diagnosis of AN was established clinically based on the presence of hyperpigmented, velvety thickened lesions involving flexural regions such as the neck, axillae, and other intertriginous areas.

Patients with previously diagnosed diabetes mellitus or metabolic syndrome receiving treatment, pregnant women, individuals receiving medications known to induce AN such as systemic corticosteroids, oral contraceptive pills, or growth hormone therapy, and patients with features suggestive of malignant AN or severe systemic illness were excluded from the study. However, newly detected cases of diabetes mellitus or metabolic syndrome identified during study evaluation were included in the analysis.

Sample size:

The sample size was estimated using the Cochran formula for prevalence studies at a 95% confidence interval. Based on a previously reported prevalence of metabolic syndrome of 45.5% among patients with AN by Bano et al., and considering an allowable error of 10 percentage points, the calculated minimum sample size was 95 participants. To improve study precision, a total of 100 participants were included in the study[11].

Data collection and clinical assessment

After enrollment, all participants underwent detailed history taking and clinical examination. Demographic and epidemiological details, including age, gender, and residence, were recorded. Clinical characteristics of AN, including duration, distribution, and associated cutaneous findings such as skin tags, were documented.

Anthropometric measurements, including body weight and waist

circumference, were obtained using standard methods. Blood pressure was measured under standardized conditions. Laboratory investigations included fasting blood glucose, glycated hemoglobin **A1c** (HbA1c), fasting serum insulin levels, lipid profile, liver function tests, and thyroid profile.

Variables and outcome measures

The primary outcome measures included the prevalence of metabolic syndrome and its individual components among patients with AN. Clinical and epidemiological characteristics of the participants were also evaluated. Metabolic syndrome was assessed using established diagnostic criteria based on anthropometric, clinical, and biochemical parameters. Components of metabolic syndrome evaluated in the study included central obesity, hypertension, dyslipidemia, and impaired glucose metabolism.

Ethical Consideration:

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval for the study was obtained from the Institutional Ethics Committee of Muzaffarnagar Medical College and Hospital prior to commencement of the study. Written informed consent was obtained from all participants before enrolment.

Statistical analysis

Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) software version 27.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Associations between AN and components of metabolic syndrome were analyzed using the Chi-square test. A p-value of <0.05 was considered statistically significant. No missing data were observed for the variables included in the final analysis.

RESULTS

Demographic and epidemiological characteristics

The study included 100 patients with a clinical diagnosis of AN. Patients not fulfilling the eligibility criteria or unwilling to participate were excluded from the study. A total of 100 eligible participants were included in the final analysis and there was no missing data. The mean age of the patients was 32.61 ± 10.55 years. Most patients belonged to the young adult age group, and males represented 54% while females comprised 46% of the study population. The majority of patients were coming from urban areas (58%) (Table I).

TABLE – I DEMOGRAPHIC AND EPIDEMIOLOGICAL CHARACTERISTICS OF THE STUDY POPULATION

Variable	Category	Number of Patients	Percentage (%)
Age Group (years)	10–20	9	9%
	21–30	40	40%
	31–40	31	31%
	41–50	14	14%
	> 51	6	6%
	Total	**100**	**100%**
Age Statistics	Mean ± SD	32.61 ± 10.55	—
Gender	Female	46	46%
	Male	54	54%
	Total	**100**	**100%**
Residence	Rural	42	42%
	Urban	58	58%
	Total	**100**	**100%**

SD: Standard deviation.

Clinical presentation

Pigmentation was the only presenting problem in 60% of patients, while the remaining 40% presented with pigmentation associated with skin tags. Lesions were chronic in most individuals: 41% had a duration between 6 and 10 years. Weight gain was reported in 87% of the patients (Table II).

TABLE – II CLINICAL PRESENTATION OF PATIENTS WITH AN

Variable	Category	Number of Patients	Percentage (%)
Clinical Presentation	Pigmentation	60	60%
	Pigmentation + Skin Tags	40	40%
	Total	**100**	**100%**
Duration of Lesions	0 to 5 Years	32	32%
	6 to 10 Years	41	41%
	11 to 15 Years	11	11%
	16 to 20 Years	8	8%
	21 to 25 Years	6	6%
	> 25 Years	2	2%
	Total	**100**	**100%**
Associated clinical feature	Weight gain	87	87%

Distribution of lesions

The neck was the most commonly involved site (95%), followed by the underarms at 48%, inner thighs at 22%, and the periorbital region at 17%. Multiple site involvement was commonly observed (Figure 1).

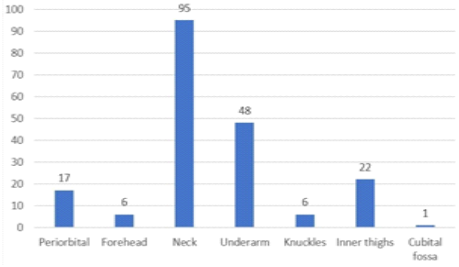

Figure 1: Sites involved in pigmentation

Associated clinical feature

Among female patients, irregular menstrual cycles were observed in 43% and hirsutism in 32%. Ultrasonographic evaluation revealed polycystic ovary syndrome (PCOS) in 22% of patients (Table III).

Table - III HYPERANDROGENIC AND ULTRASONOGRAPHIC FEATURES AMONG FEMALE PATIENTS (N = 46)

Category	Variable	Total	Percentage (%)
Hyperandrogenic Features	Irregular menstrual cycles	20	43%
	Hirsutism	15	32%
Ultrasonographic Finding	Normal	34	74%
	Fatty liver	2	4%
	PCOS	10	22%

PCOS: Polycystic ovary syndrome.

Glycaemic profile and blood pressure indices

Abnormal glucose metabolism was observed in a substantial proportion of patients. Based on fasting blood glucose levels, 28% of participants were diabetic and 7% were prediabetic. HbA1c assessment identified 14% of patients as diabetic and 10% as prediabetic. Elevated or borderline-high fasting serum insulin levels were observed in 33% of participants. Elevated systolic and diastolic blood pressure was observed in 27% and 24% of patients, respectively (Figure 2).

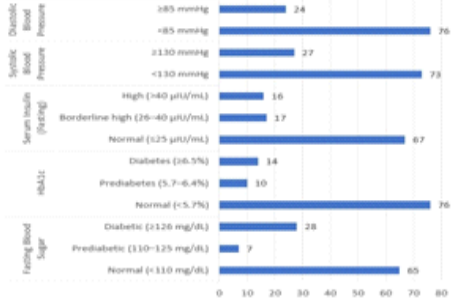

Figure 2: Glycaemic profile and blood pressure indices

Lipid and thyroid profile

Dyslipidemia was observed in 54% of participants, with isolated hypertriglyceridaemia being the most common abnormality (40%). Low high-density lipoprotein (HDL) levels and combined dyslipidemia were observed in 6% and 8% of participants,

respectively. Thyroid dysfunction was diagnosed among 4% of the participants. Most patients had normal liver function tests (97%) (Figure 3).

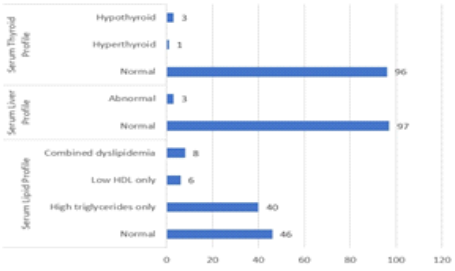

Figure 3: Serum lipid, serum liver, and thyroid profile among patients with AN

Association between AN and Metabolic Syndrome Components

Metabolic syndrome was identified in 27% of patients. Among the components of metabolic syndrome, abnormal waist circumference was the most common abnormality, observed in 66% of patients, and showed statistical significance (p = 0.029). Elevated blood pressure, abnormal fasting blood sugar, high triglycerides, and low HDL levels were observed in 29%, 35%, 48%, and 14% of patients, respectively; however, these parameters were not statistically significant (p >0.05).

DISCUSSION

This current observation study assessed the clinical features, as well as epidemiological features, of AN along with its relationship with metabolic syndrome in 100 patients belonging to Western Uttar Pradesh. The results obtained from the study indicated a strong relationship between AN and various metabolic disorders such as obesity, dysglycemia, dyslipidemia, central obesity, and hypertension.

Demographic and epidemiological characteristics

The average age of the study population was 32.61±10.55 years; the majority of cases belonged to the age group of 21-30 years. Male preponderance (54%) and high urban prevalence (58%) was seen in our study. Similar results regarding demographics have been reported by Philip et al., 2022 and Puri, 2011; both these researchers have also reported that cases of AN are relatively younger in age [12, 13]. The relatively high percentage of cases belonging to occupations like students and housewives along with urbanization could be explained on the basis of increasing metabolic disorders due to a sedentary way of life, findings comparable to those reported by Dassanayake et al. (2011)[7].

Clinical presentation and distribution

Hyperpigmentation was the most common presenting complaint, while 40% of patients demonstrated associated acrochordons (skin tags). The neck and axillae were the most frequently involved anatomical sites, consistent with the distribution patterns observed in studies by Puri (2011), Philip et al. (2022), and Dassanayake et al. (2011)[7, 12, 13]. The frequent coexistence of skin tags with AN further supports their association with underlying insulin resistance, as previously reported in earlier studies[12,13].

Associated clinical features and PCOS

The incidence of weight gain was recorded among 87% of the study population, confirming the relationship between obesity, hyperinsulinemia, and AN[10, 14]. From this study, 41% of the patients presented lesions for 6 to 10 years, hence signifying that AN could occur before metabolic alterations become clinically evident in some cases[15]. Among female study participants, disorders such as irregular menstruation, hirsutism, and polycystic ovary syndrome (based on ultrasonic findings) have been noticed, which is consistent with the hyperandrogenic state of the disease. Similar observations have been documented by Puri (2011) and Philip et al. (2022)[12,13].

Glycemic profile and blood pressure

However, glucose metabolism abnormalities were noted in a significant number of patients, with 28% being diagnosed with diabetes and 7% with prediabetes based on their fasting blood glucose values. Insulin resistance was suggested by the presence of increased or marginal concentrations of serum insulin in 33% of the study subjects. All these results prove the importance of using AN as an indicator of impaired insulin resistance and glucose metabolism, similar to the reports by Puri (2011), Philip et al. (2022), and Dassanayake et al. (2011)[7, 12, 13]. Increased values of systolic and diastolic blood pressure were also recorded for the study population, which is also consistent with the existing literature on adolescents and adults with AN[9,12].

Lipid and Thyroid profile

Dyslipidemia was identified in 54% of the study population, predominantly in the form of isolated hypertriglyceridaemia. Although this association did not demonstrate statistical significance in the present study, similar lipid abnormalities have been reported by Dassanayake et al. (2011) and Philip et al. (2022)[7, 12]. Thyroid disorder occurred in only a few subjects, whereas most patients showed normal liver function profiles. This implies that other endocrine disorders apart from insulin resistance may be associated with the condition of AN in certain patients. The same has been observed previously as well[7, 12]

Association between AN and metabolic syndrome

The overall prevalence of metabolic syndrome in the present study was 27%, with central obesity demonstrating statistical significance (p = 0.029). This prevalence was comparatively lower than that reported in previous hospital-based studies by Bano et al. (2025), Shah et al. (2019), and Philip et al. (2022)[8, 11, 12]. The difference may be attributable to the younger age profile of the present study population and the exclusion of patients already receiving treatment, making the findings more comparable to those reported by Dassanayake et al. (2011)[7].

Central obesity was found to be the commonest of the abnormalities among the parameters for metabolic syndrome, and there was a statistically significant relationship observed in waist circumference (P= 0.029). Hypertension, high fasting blood sugar, hypertriglyceridemia, and low HDL cholesterol were also identified in study subjects but their relationships were statistically insignificant. The results indicate that central obesity may be a significant factor in the metabolic profile of patients with AN and are congruent with what has been observed by Dassanayake et al. (2011), Videira-Silva et al. (2019), and Philip et al. (2022)[7, 9, 12].

The results obtained in the current study are consistent with AN being a potentially useful marker for detecting cases of insulin resistance, obesity, and metabolic syndrome. In addition, early detection of AN can be useful for the purpose of identifying people who have a higher risk of developing cardiometabolic complications.

There are several drawbacks associated with the current study. First, due to its nature as a hospital-based cross-sectional study conducted at a single center, it is difficult to make conclusions about the applicability of the findings to other populations. Secondly, the use of a limited sample size and absence of a control group is likely to negatively affect the associations found in the study. Moreover, a cross-sectional design makes it impossible to draw a conclusion about causality between AN and metabolic syndrome.

Despite these limitations, the study provides clinically relevant data regarding the metabolic profile of patients with AN in a tertiary care setting. The findings may be applicable to similar hospital-based populations, particularly in regions with increasing prevalence of obesity and metabolic disorders.

CONCLUSION

The present study demonstrated an association between AN and multiple metabolic abnormalities, including obesity, dysglycemia, dyslipidemia, hypertension, and central obesity. Metabolic syndrome was identified in a considerable proportion of patients, with waist circumference showing a statistically significant association. The findings of the study support the growing evidence linking AN with underlying metabolic dysfunction and insulin resistance.

As AN can be recognized through routine clinical examination, its presence may help identify individuals who could benefit from further metabolic evaluation and early lifestyle intervention. Although the present study was limited by its single-center cross-sectional design, it highlights the clinical relevance of AN as an easily identifiable cutaneous marker associated with metabolic risk factors.

Funding: The authors did not receive any financial support or funding for conducting this study.

Author contributions: All authors contributed to the conception and

design of the study, data collection, data analysis, manuscript preparation, and final review of the manuscript. All authors read and approved the final manuscript. One or more authors acted as guarantors for the integrity of the study.

Conflicts of interest: The authors declare no conflicts of interest.

Ethics statement: Ethical approval was obtained from the Institutional Ethics Committee of Muzaffarnagar Medical College and Hospital prior to commencement of the study. Written informed consent was obtained from all participants before enrollment in the study.

REFERENCES

[1] Burke, J. P., Hale, D. E., Hazuda, H. P., & Stern, M. P. (1999). A quantitative scale of acanthosis nigricans. *Diabetes Care, 22*(10), 1655–1659. https://doi.org/10.2337/diacare.22.10.1655

[2] Phiske, M. M. (2014). An approach to acanthosis nigricans. *Indian Dermatology Online Journal, 5*(3), 239–249. https://doi.org/10.4103/2229-5178.137765

[3] Radu, A. M., Carsote, M., Dumitrascu, M. C., & Sandru, F. (2022). Acanthosis nigricans: Pointer of endocrine entities. *Diagnostics, 12*(10), 2519. https://doi.org/10.3390/diagnostics12102519

[4] Bhagyanathan, M., Dhayanithy, D., Parambath, V., & Bijayraj, R. (2017). Acanthosis nigricans: A screening test for insulin resistance—An important risk factor for type 2 diabetes mellitus. *Journal of Family Medicine and Primary Care, 6*(1), 43–46. https://doi.org/10.4103/2249-4863.214961

[5] Callanan, N., & Wright, N. (2022). Single-centre case-control study investigating the association between acanthosis nigricans, insulin resistance and type 2 diabetes in a young, overweight, UK population. *BMJ Paediatrics Open, 6*(1), e001574. https://doi.org/10.1136/bmjpo-2022-001574

[6] Lopez-Alvarenga, J. C., Chittoor, G., Paul, S. F. D., Puppala, S., Farook, V. S., Fowler, S. P., et al. (2020). Acanthosis nigricans as a composite marker of cardiometabolic risk and its complex association with obesity and insulin resistance in Mexican American children. *PLoS ONE, 15*(10), e0240467. https://doi.org/10.1371/journal.pone.0240467

[7] Dassanayake, A. S., Kasturiratne, A., Niriella, M. A., Kalubovila, U., Rajindrajith, S., De Silva, A. P., et al. (2011). Prevalence of acanthosis nigricans in an urban population in Sri Lanka and its utility to detect metabolic syndrome. *BMC Research Notes, 4*(1), 25. https://doi.org/10.1186/1756-0500-4-25

[8] Shah, N., Khatu, S., Gokhale, N., More, Y., & Khismatrao, D. (2019). Acanthosis nigricans: A cutaneous marker for metabolic syndrome. *Medical Journal of Dr. D. Y. Patil Vidyapeeth, 12*(1), 16–21.

[9] Videira-Silva, A., Albuquerque, C., & Fonseca, H. (2019). Acanthosis nigricans as a clinical marker of insulin resistance among overweight adolescents. *Annals of Pediatric Endocrinology & Metabolism, 24*(2), 99–103.

[10] Sett, A., Saha, A., Patra, S., Das, S., & Gharami, R. C. (2022). Clinico-demographic study of patients with acanthosis nigricans. *International Journal of Scientific Research, 11*(12), 75–78.

[11] Bano, N., Chaudhary, S., & Siddiqui, M. A. (2025). A study to assess the association of acanthosis nigricans with metabolic syndrome and its individual parameters: A case-control descriptive study from a tertiary care hospital. *RA Journal of Applied Research, 11(5). https://doi.org/10.47191/rajar/v11i5.03*

[12] Philip, N. E., Girisha, B. S., Shetty, S., Pinto, A. M., & Noronha, T. M. (2022). Estimation of metabolic syndrome in acanthosis nigricans: A hospital-based cross-sectional study. *Indian Journal of Dermatology, 67(1), 92. https://doi.org/10.4103/ijd.ijd_442_21*

[13] Puri, N. (2011). A study of pathogenesis of acanthosis nigricans and its clinical implications. *Indian Journal of Dermatology, 56*(6), 678–683. https://doi.org/10.4103/0019-5154.91828

[14] Richards, G. E., Cavallo, A., Meyer, W. J., Prince, M. J., Peters, E. J., Stuart, C. A., et al. (1985). Obesity, acanthosis nigricans, insulin resistance, and hyperandrogenemia: Pediatric perspective and natural history. *The Journal of Pediatrics, 107*(6), 893–897. https://doi.org/10.1016/S0022-3476(85)80182-7 [15]Gilkison, C., & Stuart, C. A. (1992). Assessment of patients with acanthosis nigricans skin lesion for hyperinsulinemia, insulin resistance and diabetes risk. *The Nurse Practitioner, 17*(2), 26–44. https://doi.org/10.1097/00006205-199202000-00013