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ASSOCIATIONS BETWEEN ANTHROPOMETRIC INDICES AND THE SEVERITY OF ACANTHOSIS NIGRICANS IN ADULTS IN HANOI, 2025

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ABSTRACT

Objective: To describe the characteristics of acanthosis nigricans (AN) and to analyze the associations between selected anthropometric indices and AN severity in adults in Hanoi in 2025.

Methods: A cross-sectional descriptive study was conducted on 57 adults with AN at the Phuong Mai Commune Health Station, Dong Da District, Hanoi, from January to May 2025. Participants underwent clinical examination, grading of neck AN severity according to the Burke scale, and measurement of anthropometric indices including body mass index (BMI), waist circumference (WC), and waist-to-height ratio (WHtR).

Results: The mean age was 34.8 ± 10.7 years and 61.4% were female. Neck involvement was present in 100% of participants, followed by the axilla (70.2%) and the knuckles (29.8%). Burke grades of neck AN were distributed mainly in grade 3 (38.6%) and grade 2 (26.3%), with 24.6% in grade 4. Mean BMI was 27.9 ± 4.1 kg/m^2; abdominal obesity by WC was present in 73.7% and WHtR ≥ 0.50 in 78.9%. Neck AN severity correlated positively and significantly with WC (rho = 0.61; p < 0.001), WHtR (rho = 0.59; p < 0.001) and BMI (rho = 0.56; p < 0.001), whereas age was not significantly correlated (p = 0.157). The distribution of neck AN severity differed significantly across BMI, WC and WHtR groups (p < 0.05).

Conclusion: The severity of AN correlated positively with BMI, WC and WHtR, with WC and WHtR showing the strongest associations.

Keywords: Acanthosis nigricans, anthropometric indices, Burke scale.

1. INTRODUCTION

Acanthosis nigricans (AN) is a skin disorder characterized by symmetric, velvety, hyperpigmented, thickened plaques distributed in the flexural areas of the body, most commonly on the neck, axilla, groin and knuckles [1]. AN has long been regarded as an important cutaneous marker of insulin resistance, obesity and metabolic syndrome; its presence may indicate underlying metabolic disturbances and increased cardiometabolic risk in adults [1], [2]. Along with the rapid rise in the prevalence of overweight and obesity worldwide, the frequency of AN has been increasing and is being observed at younger ages, underscoring the need for early detection and timely intervention [2].

The pathogenesis of AN in the context of obesity is thought to be closely related to hyperinsulinemia and insulin resistance. When insulin levels are elevated, insulin not only binds to its own receptor but also cross-activates type 1 insulin-like growth factor receptors (IGF-1R) on keratinocytes and dermal fibroblasts, leading to proliferation, hyperkeratosis and papillomatosis of the epidermis — the histological hallmarks of AN [2], [3]. Abdominal obesity, through chronic low-grade inflammation and adipose tissue dysfunction, is considered a powerful driver of insulin resistance and is therefore more closely associated with the severity of AN than general obesity alone [2], [4].

The Burke scale, introduced in 1999, remains a widely used quantitative tool for assessing the severity of neck AN, with good discriminative ability and significant correlation with metabolic indices [5]. In addition to body mass index (BMI), anthropometric indices reflecting abdominal obesity, such as waist circumference (WC) and waist-to-height ratio (WHtR), have increasingly been recognized as simple yet valuable screening tools for cardiometabolic risk [6]. In Vietnam, studies that quantitatively assess AN severity and analyze its correlation with anthropometric indices remain limited. Therefore, this study was conducted with the objective: "To describe the characteristics of acanthosis nigricans and to analyze the associations between selected anthropometric indices and the severity of AN in adults in Hanoi in 2025."

2. SUBJECTS AND METHODS

2.1. Subjects, setting and study period

The study was conducted on 57 adults with acanthosis nigricans examined at the Phuong Mai Commune Health Station, Dong Da District, Hanoi, from January 2025 to May 2025.

- ***Inclusion criteria:*** Aged 18 years or older; having clinical features consistent with AN; complete clinical

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examination, anthropometric measurements and AN severity assessment as specified in the study form; and willing to participate in the study.

- ***Exclusion criteria:*** Non-cooperation during examination and measurement; clinical features suggestive of malignant AN or acute endocrine disease; pregnant women; and cases with missing essential data required for analysis.

2.2. Study methods

- ***Study design:*** A cross-sectional descriptive study.

Convenience sampling was used, enrolling all eligible cases during the study period.

- ***Study variables:*** General characteristics (age, sex, duration of AN, weight gain in the previous 12 months, family history of type 2 diabetes); characteristics of AN lesions (number and location of lesions, severity of neck AN); and anthropometric indices (height, weight, BMI, WC and WHtR).

The severity of neck AN was classified according to the Burke scale (1999), ranging from grade 1 to grade 4. For comparative analysis, severity was grouped into three categories: mild (grades 1–2), moderate (grade 3) and severe (grade 4) [5]. BMI was categorized as < 23.0; 23.0–24.9; 25.0–29.9; and ≥ 30.0 kg/m^2. Abdominal obesity was defined by WC (> 90 cm in men and > 80 cm in women). WHtR was categorized by the cutoff < 0.50 and ≥ 0.50, in accordance with international recommendations for screening cardiometabolic risk [6].

2.3. Study procedures

Step 1. Identification and screening of cases with AN at the Phuong Mai Commune Health Station during the study period.

Step 2. Face-to-face interviews using a pre-designed questionnaire to collect information on demographics, duration of AN, weight change during the previous 12 months, and family history of type 2 diabetes.

Step 3. Clinical examination to record the location and number of affected sites and to grade neck AN severity according to the Burke scale. Doubtful cases were discussed to reach consensus before coding.

Step 4. Measurement of anthropometric indices following a standardized procedure: height measured with a stadiometer (cm); weight measured with an electronic scale (kg); WC measured at the midpoint between the lower costal margin and the iliac crest at the end of normal expiration (cm). BMI was calculated as weight divided by height squared; WHtR was calculated as WC divided by height.

Step 5. Data entry using a standardized collection form with a unique identifier for each participant, followed by cross-checking and statistical analysis as planned.

2.4. Statistical analysis

Data were entered and analyzed using SPSS 26.0. Categorical variables were presented as frequencies and percentages; continuous variables were presented as mean ± standard deviation. The distribution of AN severity across BMI, WC and WHtR groups was compared using the Pearson Chi-square test; Fisher's exact test was used when any expected cell count was < 5. Correlations between AN severity and anthropometric indices were assessed using the Spearman correlation coefficient. Statistical significance was defined at $p < 0.05$.

2.5. Ethical considerations

The study was conducted on a voluntary basis. Participants were clearly informed of the study objectives and provided consent before data collection. Personal information was coded, kept confidential and used solely for scientific research purposes.

3. RESULTS

The study was conducted on 57 adults with acanthosis nigricans at the Phuong Mai Commune Health Station, Dong Da District, Hanoi, from January 2025 to May 2025. The following results were obtained:

Table 1. General characteristics of the study subjects (n = 57)

Characteristic		n	%
Age group (years)	18–29	16	28.1
	30–39	21	36.8
	40–49	13	22.8
	≥ 50	7	12.3
Mean age ($\bar{X}$ ± SD)	34.8 ± 10.7		
Sex	Male	22	38.6
	Female	35	61.4
Duration of lesions	< 1 year	12	21.1
	1–3 years	24	42.1
	> 3 years	21	36.8
Weight gain in the past 12 months	Yes	27	47.4
	No	30	52.6
Family history of type 2 diabetes	Yes	19	33.3
	No	38	66.7

The mean age of the study subjects was 34.8 ± 10.7 years, with the 30–39 age group accounting for the highest proportion (36.8%). Females predominated, representing 61.4% of the sample. The most common duration of AN lesions was 1–3 years (42.1%); 47.4% of subjects reported weight gain in the previous 12 months and 33.3% had a family history of type 2 diabetes.

Table 2. Distribution of sites and severity of acanthosis nigricans (n = 57)

Lesion characteristic		n	%
Number of affected sites	1 site	16	28.1
	2 sites	20	35.1
	≥ 3 sites	21	36.8
Location of lesions	Neck	57	100.0
	Axilla	40	70.2
	Knuckles	17	29.8
	Elbow	9	15.8
	Groin	8	14.0
Neck AN severity (Burke scale)	Grade 1	6	10.5
	Grade 2	15	26.3
	Grade 3	22	38.6
	Grade 4	14	24.6

Acanthosis nigricans involved the neck in 100% of cases, followed by the axilla (70.2%) and the knuckles (29.8%). Lesions involved two or more sites in 71.9% of subjects, while 36.8% had lesions at three or more sites. With regard to severity, grade 3 was the most common (38.6%), followed by grade 2 (26.3%) and grade 4 (24.6%).

Table 3. Anthropometric characteristics of the study subjects (n = 57)

Anthropometric index		n	%
Height (cm), $\bar{X}$ ± SD		160.8 ± 7.5	
Weight (kg), $\bar{X}$ ± SD		72.1 ± 11.8	
BMI (kg/m^2), $\bar{X}$ ± SD		27.9 ± 4.1	
WC (cm), $\bar{X}$ ± SD		91.8 ± 10.2	
BMI (kg/m^2)	< 23.0	14	24.6
	23.0–24.9	11	19.3
	25.0–29.9	20	35.1
	≥ 30.0	12	21.1
Abdominal obesity by WC	Yes	42	73.7
	No	15	26.3
WHtR	< 0.50	12	21.1
	≥ 0.50	45	78.9

The mean BMI of the study group was 27.9 ± 4.1 kg/m^2 and the mean WC was 91.8 ± 10.2 cm. The BMI category of 25.0–29.9 kg/m^2 was the most common (35.1%), and 21.1% had a BMI ≥ 30.0 kg/m^2. Abdominal obesity by WC was found in 73.7% of subjects, and 78.9% had a WHtR ≥ 0.50.

Table 4. Distribution of AN severity by BMI, WC and WHtR groups

Anthropometric feature	Mild n (%)	Moderate n (%)	Severe n (%)	p
BMI (kg/m^2)				
< 23.0 (n=14)	10 (71.4)	4 (28.6)	0 (0.0)	< 0.001
23.0–24.9 (n=11)	6 (54.5)	4 (36.4)	1 (9.1)	
25.0–29.9 (n=20)	5 (25.0)	10 (50.0)	5 (25.0)	
≥ 30.0 (n=12)	0 (0.0)	4 (33.3)	8 (66.7)	
Abdominal obesity by WC				
No (n=15)	11 (73.3)	4 (26.7)	0 (0.0)	0.001
Yes (n=42)	10 (23.8)	18 (42.9)	14 (33.3)	
WHtR				
< 0.50 (n=12)	9 (75.0)	3 (25.0)	0 (0.0)	0.005
≥ 0.50 (n=45)	12 (26.7)	19 (42.2)	14 (31.1)	

The severity of AN tended to increase with overweight and abdominal obesity. In the group with BMI < 23.0 kg/m^2, no severe cases were recorded, whereas in the group with BMI ≥ 30.0 kg/m^2, severe AN accounted for 66.7%. Similarly, among subjects with abdominal obesity defined by WC, the proportion of severe AN was 33.3%, while no severe cases were observed in the non-abdominally obese group. Differences across BMI, WC and WHtR groups were all statistically significant (p < 0.05).

Table 5. Correlations between neck AN severity and selected anthropometric and clinical variables

Variable	Spearman correlation coefficient (rho)	p
WC	0.61	< 0.001
WHtR	0.59	< 0.001
BMI	0.56	< 0.001
Weight	0.49	< 0.001
Duration of lesions	0.28	0.035
Age	0.19	0.157

The severity of neck AN showed moderate positive correlations with the anthropometric indices. The strongest correlation was observed with WC (rho = 0.61), followed by WHtR (rho = 0.59) and BMI (rho = 0.56); all of these correlations were statistically significant (p < 0.001). In contrast, age was not significantly correlated with AN severity (rho = 0.19; p = 0.157).

4. DISCUSSION

Our study found that the mean age of the subjects was 34.8 ± 10.7 years, with the 30–39 age group accounting for the highest proportion (36.8%) and females predominating (61.4%). These findings reflect a notable epidemiological characteristic: AN is increasingly observed in younger adults, in parallel with the trend toward earlier onset of overweight and obesity. Radu et al. (2022), in a review on AN, reported that its prevalence varied widely from 4.5% to more than 70% depending on the population studied, and emphasized an alarming rise among younger individuals in parallel with the obesity and metabolic syndrome epidemics [2]. The female predominance in this study may partly reflect differences in health-care seeking behavior, as AN is often regarded as a cosmetic concern that prompts women to seek medical attention earlier [1].

Regarding lesion characteristics, the neck was affected in 100% of cases, followed by the axilla (70.2%) and the knuckles (29.8%). This distribution is consistent with previous reports showing that the neck and axilla are the most characteristic sites of obesity- and insulin resistance-associated acanthosis nigricans [1], [3]. In our study, lesions involved two or more sites in 71.9% of subjects, and more than one-third of participants had lesions at three or more sites, suggesting that AN in adults is often not limited to a single anatomical area. This pattern may reflect a more widespread cutaneous expression of the metabolic disturbances underlying the disease. Quantitative assessment of neck AN severity using the Burke scale has been shown to have good inter-observer reliability and meaningful associations with metabolic abnormalities, making it suitable for both clinical studies and community-based screening [5]. In the present study, grade 3 was the most common severity level (38.6%), while grade 4 accounted for 24.6%; overall, 63.2% of participants had moderate-to-severe neck AN. This relatively high proportion suggests that many

patients presented when the lesions were already well established, which may be related to delayed recognition of AN in the community or to the close link between lesion severity and excess adiposity.

The anthropometric characteristics of the study group revealed a high prevalence of overweight and abdominal obesity: mean BMI was 27.9 ± 4.1 kg/m^2, with 35.1% in the 25.0–29.9 kg/m^2 group and 21.1% in the ≥ 30.0 kg/m^2 group; the prevalence of abdominal obesity by WC reached 73.7% and 78.9% had a WHtR ≥ 0.50. These findings are consistent with community- and hospital-based studies in Asia. Dassanayake et al. (2011), in a survey of 2,957 adults in Sri Lanka, found that AN was closely related to all components of metabolic syndrome, including abdominal obesity, hypertension and dysglycemia [4]. Philip et al. (2022) also reported that metabolic syndrome was present in more than 78% of AN patients, the majority of whom were overweight or obese [7]. The high rates of abdominal obesity and overweight in our study reinforce the view that AN in adults is largely a cutaneous manifestation of underlying metabolic dysregulation, particularly insulin resistance related to visceral adiposity.

Analysis of AN severity distribution by anthropometric categories showed that AN severity increased markedly and significantly across BMI, WC and WHtR groups ($p < 0.05$). Notably, no severe cases were observed in the BMI < 23.0 kg/m^2 group, whereas the proportion of severe AN rose to 66.7% in the BMI ≥ 30.0 kg/m^2 group. A similar trend was observed with abdominal obesity by WC and WHtR. These findings are consistent with the results of Burke et al. (1999), who showed that neck AN severity closely correlated with BMI and fasting insulin, and suggested that AN could serve as a simple clinical marker for identifying individuals with metabolic disorders [5]. Banti et al. (2022), in a study of AN patients, also found that AN severity was significantly associated with BMI and waist-to-hip ratio, further supporting the role of obesity in its pathogenesis [8].

Spearman correlation analysis in our study showed that the severity of neck AN was moderately and positively correlated with WC (rho = 0.61), WHtR (rho = 0.59) and BMI (rho = 0.56), all with $p < 0.001$. Notably, the indices reflecting abdominal obesity (WC and WHtR) showed higher correlation coefficients than BMI, which reflects general obesity. This is in line with the current understanding of AN pathogenesis, in which visceral adipose tissue plays a central role through chronic low-grade inflammation, increased secretion of pro-inflammatory adipokines and promotion of insulin resistance, thereby activating the IGF-1 pathway in keratinocytes and dermal fibroblasts [2], [3]. For screening purposes, WHtR has been shown to be a better predictor of cardiometabolic risk than BMI alone in several meta-analyses, with a cutoff of 0.50 commonly applied for both sexes across ethnicities [6]. Our findings support the routine use of WC and WHtR, alongside BMI, in the clinical evaluation of AN patients and may help identify those who warrant further metabolic assessment. In contrast, age did not show a significant correlation with AN severity (rho = 0.19; $p = 0.157$), suggesting that in the relatively young population of this study, overweight and abdominal obesity — rather than age per se — were the main determinants of lesion severity.

Our study has several limitations that should be acknowledged. First, the sample size was small (n = 57) and was drawn from a single commune health station, which limits generalizability to the broader population. Second, the cross-sectional design only allows identification of associations and cannot establish causal relationships between anthropometric indices and AN severity. Third, the study did not assess biochemical metabolic indices such as fasting glucose, fasting insulin or HOMA-IR, which could further clarify the mechanistic links between obesity, insulin resistance and AN. Future studies with larger sample sizes, concurrent assessment of anthropometric and biochemical parameters, and longitudinal follow-up after weight-reduction interventions will help to further elucidate the clinical value of AN in screening and monitoring metabolic disorders.

5. CONCLUSION

In this study of 57 adults with acanthosis nigricans at the Phuong Mai Commune Health Station, Dong Da District, Hanoi, from January to May 2025, neck involvement was present in all participants and grade 3 was the most common level of neck AN severity. The severity of neck acanthosis nigricans was positively and significantly correlated with BMI, waist circumference and waist-to-height ratio, with waist circumference and waist-to-height ratio showing the strongest associations. In addition, the distribution of neck AN severity differed significantly across BMI, waist circumference and waist-to-height ratio categories. These findings suggest that waist circumference and waist-to-height ratio, used together with BMI, may be useful anthropometric measures in the clinical assessment of adults with acanthosis nigricans.

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