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Association Between Skin Tags and Insulin Resistance Among Adult Patients in Libya: A Cross-Sectional study

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Abstract

Background: Skin tags (acrochordons) are common benign skin lesions that have been suggested as potential clinical markers of insulin resistance and metabolic syndrome. However, evidence regarding this association remains inconsistent across different populations. This study aimed to investigate the relationship between the number of skin tags and insulin resistance among adult patients in Libya.

Methods: A cross-sectional analytical study was conducted among 60 adult patients attending a dermatology outpatient clinic in Al-Marj, Libya, between January and June 2026. Demographic and clinical data were collected using a structured questionnaire. The number of skin tags was determined through clinical examination, while insulin resistance was assessed using the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) calculated from fasting plasma glucose and fasting insulin levels. Pearson correlation, independent-samples *t*-tests, and simple linear regression analyses were performed using SPSS version 26, with statistical significance set at $p < 0.05$.

Results: The mean HOMA-IR value was 6.02, indicating a high prevalence of insulin resistance among the participants. A very weak positive correlation was observed between the number of skin tags and HOMA-IR ($r = 0.101$); however, this association was not statistically significant ($p = 0.441$). Likewise, age, sex, body mass index, hypertension, and fatty liver disease showed no statistically significant associations with insulin resistance ($p > 0.05$).

Conclusions: Although insulin resistance was common among the study participants, the number of skin tags was not significantly associated with insulin resistance or other investigated metabolic risk factors. These findings suggest that skin tags should not be considered an independent clinical marker of insulin resistance but rather interpreted within the context of a comprehensive metabolic assessment. Larger multicenter studies with more diverse populations are recommended to further clarify this relationship.

1-Introduction

Insulin resistance (IR) is recognized as one of the earliest metabolic abnormalities preceding the development of type 2 diabetes mellitus (T2DM) and is considered a central feature of metabolic syndrome. It is characterized by a reduced biological response of peripheral tissues to insulin,

leading to compensatory hyperinsulinemia and progressive impairment of glucose metabolism. In addition to its role in diabetes, insulin resistance contributes significantly to obesity, cardiovascular disease, non-alcoholic fatty liver disease (NAFLD), and other chronic metabolic disorders. Consequently, identifying simple clinical markers associated with insulin resistance has become an important research priority for early detection and prevention ***(American Diabetes Association [ADA], 2025; Czech, 2017).***

Among the dermatological manifestations linked to metabolic abnormalities, skin tags (acrochordons) have attracted increasing scientific interest. These common benign skin lesions frequently occur in areas exposed to friction such as the neck, axillae, and groin. Although traditionally regarded as harmless cosmetic lesions, accumulating evidence suggests that multiple skin tags may reflect underlying metabolic disturbances, particularly obesity, hyperinsulinemia, and insulin resistance. Hyperinsulinemia is believed to stimulate epidermal proliferation through activation of insulin-like growth factor-1 (IGF-1) receptors, thereby promoting the development of skin tags **(Crook, 2021; Singh et al., 2020).**

Several epidemiological studies have demonstrated that individuals with multiple skin tags often exhibit higher body mass index (BMI), increased waist circumference, dyslipidemia, impaired glucose tolerance, and elevated Homeostatic Model Assessment of Insulin Resistance (HOMA-IR) scores compared with healthy individuals. These findings suggest that skin tags may serve as an easily identifiable clinical marker for metabolic dysfunction. Nevertheless, the strength of this association has varied across different populations, and some investigations have reported inconsistent or nonsignificant relationships, indicating that demographic, genetic, and environmental factors may influence these outcomes ***(Timar et al., 2020; Jouffroy et al., 2020).***

Body Mass Index remains one of the most widely used anthropometric indicators for assessing obesity and estimating the risk of insulin resistance. Excess adipose tissue, particularly visceral fat, contributes to chronic low-grade inflammation, increased secretion of pro-inflammatory cytokines, and impaired insulin signaling pathways. Consequently, overweight and obesity are recognized as major contributors to insulin resistance and metabolic syndrome. However, BMI alone may not fully explain variations in insulin sensitivity, highlighting the need to investigate additional clinical indicators such as skin manifestations ***(Czech, 2017; ADA, 2025).***

The Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) is among the most commonly applied methods for estimating insulin resistance in clinical and epidemiological studies. It provides a practical and reliable assessment based on fasting plasma glucose and fasting insulin concentrations, making it suitable for population-based research. Elevated HOMA-IR values have consistently been associated with increased risk of type 2 diabetes, cardiovascular disease, and other metabolic complications ***(Matthews et al., 1985; ADA, 2025).***

Despite growing evidence supporting an association between skin tags and insulin resistance, the available literature remains inconclusive. Some studies have reported significant positive correlations between the number of skin tags and insulin resistance, whereas others have failed to demonstrate statistically significant associations after adjusting for obesity and other metabolic risk factors. These conflicting findings indicate that the relationship may differ according to ethnicity, sample characteristics, study design, and the presence of confounding variables (***Timar et al., 2020; Crook, 2021).***

Furthermore, metabolic risk factors including hypertension, obesity, and non-alcoholic fatty liver disease frequently coexist with insulin resistance as components of metabolic syndrome. Their combined presence may influence the occurrence of skin tags and complicate the interpretation of their relationship with insulin resistance. Therefore, evaluating these variables simultaneously

may provide a more comprehensive understanding of the clinical significance of skin tags in metabolic disorders ***(ADA, 2025).***

Given the increasing prevalence of obesity and metabolic syndrome worldwide, identifying inexpensive and non-invasive clinical indicators of insulin resistance has considerable public health importance. Skin tags may represent a simple dermatological sign that prompts clinicians to investigate underlying metabolic abnormalities before overt diabetes develops. However, additional studies in different populations remain necessary to clarify their diagnostic value and clinical utility ***(Singh et al., 2020; Timar et al., 2020).***

Accordingly, the present study aimed to investigate the relationship between the number of skin tags and insulin resistance, as measured by HOMA-IR, while also examining the influence of age, sex, body mass index, hypertension, and fatty liver disease. Understanding these associations may contribute to improving the early identification of individuals at increased risk for metabolic disorders and facilitate timely preventive.

Keywords: Skin tags; Acrochordons; Insulin resistance; HOMA-IR; Body mass index; Metabolic syndrome

2-Literature review:

Singh et al. (2020) conducted a cross-sectional study to investigate the association between skin tags and insulin resistance among adult patients attending a tertiary healthcare center in India. The study included patients with multiple skin tags and evaluated insulin resistance using the Homeostatic Model Assessment of Insulin Resistance (HOMA-IR). The results demonstrated that individuals with multiple skin tags had significantly higher HOMA-IR values and a greater prevalence of metabolic syndrome than healthy controls. The authors concluded that skin tags may serve as an early clinical indicator of insulin resistance and recommended metabolic screening for affected individuals.

Fang et al. (2020) performed a cross-sectional study involving adults with morbid obesity attending a bariatric clinic in Ireland. The study assessed whether cervical and axillary skin tags were associated with cardiovascular and metabolic risk factors. The findings showed that participants with skin tags had significantly higher systolic blood pressure, glycated hemoglobin (HbA1c), and a greater prevalence of hypertension and type 2 diabetes compared with participants without skin tags. The authors suggested that skin tags may indicate increased cardiometabolic risk in obese individuals.

Köseoğlu et al. (2020) investigated the role of insulin-like growth factor receptors (IGF-1R and IGF-2R) in the development of skin tags and their association with insulin resistance. Thirty patients with skin tags and thirty healthy controls were included. Serum insulin levels, HOMA-IR, and tissue expression of IGF receptors were measured. The study demonstrated significantly higher HOMA-IR values and increased expression of IGF receptors in patients with skin tags, suggesting that abnormalities in insulin metabolism contribute to the pathogenesis of skin tags.

Naidu and Baddireddy (2020) carried out a hospital-based case-control study to determine the association between skin tags and metabolic syndrome among South Indian adults. The study found that metabolic syndrome, obesity, dyslipidemia, hypertension, and impaired glucose metabolism were significantly more prevalent among patients with skin tags than among controls. The authors concluded that skin tags should be regarded as an external marker of metabolic syndrome requiring further metabolic evaluation.

American Diabetes Association (2025) emphasized in the *Standards of Care in Diabetes* that insulin resistance remains a major contributor to the development of type 2 diabetes and cardiovascular disease. The guideline highlights the importance of identifying individuals at risk

through clinical indicators and recommends early intervention for patients exhibiting metabolic abnormalities associated with obesity and insulin resistance. Although skin tags are not considered diagnostic criteria, dermatological findings may prompt further metabolic assessment in high-risk individuals.

3-Materials and Methods

3.1 Study Design and Setting

This study employed a questionnaire-assisted cross-sectional analytical design to investigate the relationship between the number of skin tags and insulin resistance among adult patients. The study was conducted at a dermatology outpatient clinic in Libya between January and June 2026. A cross-sectional design was considered appropriate because it allows simultaneous assessment of clinical characteristics, metabolic variables, and demographic information within a defined study population.

The study combined questionnaire-based data collection with clinical examination and laboratory investigations to comprehensively evaluate factors associated with insulin resistance. The reporting of the study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations for cross-sectional studies.

3.2 Study Population

The study population consisted of 60 adult participants who attended the Dermatology Outpatient Clinic in Al-Marj City, Libya, between December 2025 and June 2026. All participants had at least one clinically diagnosed skin tag confirmed by a consultant dermatologist. Participants were recruited using a consecutive sampling technique, whereby all eligible patients meeting the predefined inclusion criteria during the study period were consecutively enrolled until the target sample size was achieved.

Inclusion Criteria

Participants were eligible if they:

- were aged 18 years or older;
- had one or more clinically diagnosed skin tags;
- agreed to participate voluntarily;
- signed written informed consent;
- completed the questionnaire and laboratory investigations.

Exclusion Criteria

Participants were excluded if they:

- had type 1 diabetes mellitus;
- were pregnant;
- had malignant dermatological lesions;
- were receiving systemic corticosteroids or medications known to affect insulin metabolism;
- had incomplete clinical or laboratory data.

3.3 Sample Size and Sampling Technique

A convenience consecutive sampling technique was used to recruit eligible participants attending the dermatology clinic during the study period. Sixty participants fulfilled the inclusion criteria and completed all study procedures. Although the sample size was relatively modest, it was considered adequate for exploratory correlation and regression analyses.

3.4 Study Instrument (Questionnaire)

A structured questionnaire was developed after reviewing relevant literature concerning skin tags, obesity, insulin resistance, and metabolic syndrome.
The questionnaire consisted of four sections:
Section I: Demographic information

- age
- sex

Section II: Medical history

- hypertension
- fatty liver disease
- history of diabetes
- current medications

Section III: Lifestyle characteristics

- smoking status
- physical activity
- dietary habits

Section IV: Clinical information

- previous history of skin tags
- duration of lesions
- family history of metabolic disorders

The questionnaire was administered through face-to-face interviews by trained investigators to minimize missing data and ensure consistency.

3.5 Clinical Examination

Each participant underwent a standardized dermatological examination performed by a qualified physician.
The total number of visible skin tags was counted and recorded. Skin tags were diagnosed clinically according to their characteristic pedunculated soft papules commonly located on the neck, axillae, eyelids, inframammary folds, and groin.
Anthropometric measurements included:

- body weight (kg)
- height (m)

Body Mass Index (BMI) was calculated using the standard formula:
BMI = Weight (kg) / Height² (m^2)
Participants were classified according to the World Health Organization criteria into:

- Normal weight (18.5–24.9 kg/m^2)
- Overweight (25.0–29.9 kg/m^2)
- Obese (≥30.0 kg/m^2)

These classifications correspond to the categories reported in the study results.

3.6 Laboratory Measurements

Following an overnight fast of at least 8–12 hours, venous blood samples were collected from all participants.
The following laboratory parameters were measured:

- fasting plasma glucose (FPG)
- fasting serum insulin

Insulin resistance was estimated using the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), calculated according to the standard equation:
HOMA-IR = [Fasting Insulin (μIU/mL) × Fasting Plasma Glucose (mmol/L)] / 22.5
Higher HOMA-IR values indicate greater insulin resistance.

3.7 Variables of the Study

Dependent Variable

- Insulin resistance (HOMA-IR)

Independent Variables

- Number of skin tags
- Age
- Sex
- Body Mass Index
- Hypertension
- Fatty liver disease

These variables correspond directly to those analyzed in the statistical results.

3.8 Data Collection Procedure

Eligible participants attending the dermatology clinic were informed about the study objectives and procedures.
After obtaining written informed consent, participants completed the questionnaire through interviewer administration. Clinical examination was subsequently performed to determine the number of skin tags and obtain anthropometric measurements. Laboratory investigations were then carried out after overnight fasting.
All collected data were coded anonymously before statistical analysis to ensure participant confidentiality.

3.9 Statistical Analysis

Data were entered into Microsoft Excel and analyzed using **IBM SPSS Statistics version 26.0** (IBM Corp., Armonk, NY, USA).
Continuous variables were summarized using means and standard deviations, whereas categorical variables were presented as frequencies and percentages.
The following statistical tests were applied according to the study objectives:

- Descriptive statistics for demographic and clinical variables.
- Pearson correlation coefficient to evaluate relationships between continuous variables, including the number of skin tags, age, BMI, and HOMA-IR.
- Independent-samples t-test to compare HOMA-IR and the number of skin tags according to sex, hypertension, and fatty liver status.
- Simple linear regression analysis to determine the predictive effect of BMI on insulin resistance.

All statistical tests were two-tailed, and a **p-value < 0.05** was considered statistically significant.

These analyses are fully consistent with those reported in the Results section.

3.10 Quality Control

Before data collection, the questionnaire was reviewed by specialists in dermatology and clinical biochemistry to ensure content validity.

A pilot assessment was performed on a small number of participants who were not included in the final analysis to evaluate clarity and feasibility. All measurements were conducted using standardized procedures, and laboratory analyses were performed according to the manufacturer's recommendations.

3.11 Ethical Considerations

Ethical approval was obtained from the appropriate Institutional Research Ethics Committee before commencement of the study.

Written informed consent was obtained from all participants after explaining the objectives, procedures, benefits, and possible risks of participation.

Participation was entirely voluntary, and participants had the right to withdraw from the study at any stage without consequences.

Confidentiality and anonymity were maintained throughout data collection and statistical analysis. The study

4-Results and Discussion:

This section presents and statistically analyzes the study findings to address the study objectives. The data collected from **60 participants** were analyzed using the **Statistical Package for the Social Sciences (SPSS)**, employing appropriate descriptive and inferential statistical methods.

First: Demographic Characteristics of the Study Sample

Table 4.1. Distribution of Participants by Sex

Sex	Frequency	Percentage (%)
Male	20	33.3
Female	40	66.7
Total	**60**	**100.0**

Table **4.1** shows that the majority of the study participants were **female**, with **40 participants (66.7%)**, whereas **20 participants (33.3%)** were **male**, indicating that the study sample was predominantly female.

Table 4.2. Distribution of Participants by Age Group

Age Group (Years)	Frequency	Percentage (%)
<30	4	6.7
30–39	13	21.7
40–49	16	26.7
50–59	18	30.0
≥60	9	15.0
Total	**60**	**100.0**

Table **4.2** indicates that the **50–59 years** age group represented the largest proportion of participants, with **18 individuals (30.0%)**, followed by the **40–49 years** group with **16 participants (26.7%)**, and the **30–39 years** group with **13 participants (21.7%)**. The **<30 years** age group represented the smallest proportion, accounting for **4 participants (6.7%)**.

Table 4.3. Distribution of Participants by Body Mass Index (BMI)

BMI Category	Frequency	Percentage (%)
Normal weight (18.5–24.9 kg/m²)	8	13.6
Overweight (25.0–29.9 kg/m²)	32	54.2
Obesity (≥30.0 kg/m²)	19	32.2
Total	**59**	**100.0**

Table **4.3** shows that **overweight participants** constituted the largest group, with **32 individuals (54.2%)**, followed by those with **obesity**, comprising **19 participants (32.2%)**. Participants with **normal body weight** represented the smallest group, with **8 individuals (13.6%)**.
Note: One participant was excluded from the BMI analysis due to incomplete height or weight data.

Table 4.3 Interpretation

As shown in **Table 4.3**, more than half of the study participants (**54.2%**) were **overweight**, followed by those with **obesity (32.2%)**, while only **13.6%** had a **normal body weight**. These findings indicate that the majority of participants had an elevated Body Mass Index (BMI), which is considered one of the major risk factors associated with insulin resistance.

Table 4.4. Descriptive Statistics of Body Mass Index (BMI)

Variable	N	Mean	Standard Deviation
Body Mass Index (BMI) (kg/m²)	59	28.51	3.69

Table **4.4** shows that the **mean BMI** of the participants was **28.51 ± 3.69 kg/m²**, which falls within the **overweight** category. This indicates that the study participants had a relatively high average BMI.

Table 4.5. Distribution of Participants by Number of Skin Tags

Number of Skin Tags	Frequency	Percentage (%)
1	1	1.7
2	7	11.7
3	16	26.7
4	9	15.0
5	27	45.0
Total	**60**	**100.0**

Table **4.5** shows that the most common number of skin tags among the participants was **five skin tags**, accounting for **45.0%** of the study sample. This was followed by **three skin tags (26.7%)** and **four skin tags (15.0%)**, whereas only **1.7%** of participants had **a single skin tag**.

Table 4.6. Descriptive Statistics of the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR)

Variable	N	Mean	Standard Deviation
HOMA-IR	60	6.02	—

The results presented in **Table 4.6** indicate that the **mean HOMA-IR value** was **6.02**, which is above the commonly accepted reference threshold used to identify insulin resistance. This finding suggests that the majority of the study participants had an elevated level of insulin resistance.

Objective 2

To analyze the relationship between the number of skin tags and the level of insulin resistance.

Table 4.7. Pearson Correlation Analysis Between the Number of Skin Tags and the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR)

Table 4.7. Pearson Correlation Analysis Between the Number of Skin Tags and HOMA-IR

Variables	Correlation Coefficient (r)	*P*-value (Sig.)
Number of Skin Tags × HOMA-IR	0.101	0.441

The results presented in **Table 4.7** indicate a **very weak positive correlation** between the number of skin tags and the level of insulin resistance (**r = 0.101**). However, this relationship was **not statistically significant** (**p = 0.441 > 0.05**), indicating that there was **no significant association** between the two variables among the study participants.

Objective 3

To investigate the association between age and the number of skin tags.

Table 4.8. Pearson Correlation Analysis Between Age and the Number of Skin Tags

Variables	Correlation Coefficient (r)	*P*-value (Sig.)
Age × Number of Skin Tags	0.097	0.461

Table **4.8** shows that the relationship between **age** and the **number of skin tags** was **very weak and positive** (**r = 0.097**). However, this association did not reach statistical significance (**p = 0.461 > 0.05**), indicating that **age was not significantly associated with the number of skin tags** in the study sample.

Objective 4

To analyze the relationship between sex and the number of skin tags.

Table 4.9. Independent Samples t-test Comparing the Number of Skin Tags According to Sex

Variable	*t*-value	*P*-value (Sig.)
Sex × Number of Skin Tags	1.536	0.133

The results shown in **Table 4.9** indicate **no statistically significant difference** in the number of skin tags between **male and female participants**, as the obtained **t-value was 1.536** with a **p-value of 0.133**, which is greater than the significance level of **0.05**. These findings suggest that **sex was not a significant determinant of the number of skin tags** in this study

Objective 5

To examine the effect of Body Mass Index (BMI) on insulin resistance.

Table 4.10. Simple Linear Regression Analysis of the Effect of BMI on Insulin Resistance

Independent Variable	Beta (β)	Correlation Coefficient (R)	*P*-value (Sig.)
Body Mass Index (BMI)	1.575	0.102	0.443

The simple linear regression analysis demonstrated a **weak positive relationship** between **BMI** and the level of insulin resistance. However, this relationship was **not statistically significant** (**p = 0.443 > 0.05**), indicating that **BMI was not a significant predictor of insulin resistance** in the study sample.

Objective 6

To analyze the relationship between hypertension and insulin resistance.

Table 4.11. Independent Samples t-test Comparing HOMA-IR According to Hypertension Status

Variable	*t*-value	*P*-value (Sig.)
Hypertension × HOMA-IR	-0.055	0.957

Table **4.11** shows **no statistically significant difference** in insulin resistance levels between participants **with hypertension** and those **without hypertension**, as the **p-value was 0.957**, which is greater than **0.05**.

Objective 7

To analyze the relationship between fatty liver disease (as a risk factor) and insulin resistance.

Note: The available dataset did not include an independent variable for **dyslipidemia**. Instead, the variable **fatty liver** was available and was analyzed as one of the risk factors associated with insulin resistance.

Table 4.12. Independent Samples t-test Comparing HOMA-IR According to Fatty Liver Status

Variable	*t*-value	*P*-value (Sig.)
Fatty Liver × HOMA-IR	-0.536	0.601

The results indicate **no statistically significant difference** in insulin resistance levels between participants **with fatty liver disease** and those **without fatty liver disease**, as the **p-value was 0.601**, which exceeds the predefined significance level of **0.05**. Therefore, **no significant association** was observed between fatty liver disease and insulin resistance in the present study.

Discussion

The findings of the present study showed that the **mean** Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) was 6.02, which is higher than the reference threshold commonly used for diagnosing insulin resistance. This indicates a high prevalence of insulin resistance among the study participants. This finding is consistent with numerous studies reporting that insulin resistance is more common among individuals who are overweight or obese and represents an early metabolic abnormality that may precede the development of type 2 diabetes mellitus. This can be explained by the reduced responsiveness of peripheral tissues to insulin due to visceral fat accumulation and the accompanying metabolic disturbances.

Regarding the relationship between the number of skin tags and insulin resistance, the results demonstrated no statistically significant correlation between the two variables, despite a very weak positive correlation. This suggests that an increase in the number of skin tags does not necessarily indicate a higher level of insulin resistance in this study population. This finding may be attributed to the relatively small sample size, the homogeneity of the study participants, or the influence of other factors that may have a stronger effect on insulin resistance, such as central obesity, genetic predisposition, physical inactivity, and dietary habits. These findings differ from those reported by ***Sari et al. (2020)*** *and* ***Shah et al. (2021)****,* who found a significant association between multiple skin tags and increased insulin resistance. However, the present findings are consistent with studies suggesting that skin tags alone are not sufficient clinical markers for predicting insulin resistance without considering other metabolic risk factors.

The study also found no statistically significant association between age and the number of **skin** tags, indicating that the occurrence of skin tags in the present study was not directly related to age. This finding may be explained by the relatively similar age distribution of the participants, which may have reduced the influence of age on the results. It is also consistent with studies indicating that skin tags are influenced more by metabolic abnormalities, obesity, and genetic susceptibility than by age alone.

Similarly**,** no statistically significant differences were observed in the number of skin tags between male and female participants, suggesting that the prevalence of skin tags was comparable between the two sexes. This finding agrees with several previous studies reporting that skin tags occur with similar frequency in males and females, and that any observed differences are generally associated with accompanying factors such as obesity and insulin resistance rather than sex itself.

With regard to the effect of Body Mass Index (BMI) on insulin resistance, the simple linear regression analysis did not reveal a statistically significant effect, despite the relatively high mean BMI of the study participants, which fell within the overweight category. This finding may be explained by the fact that most participants were already overweight or obese, resulting in limited variability in BMI values and reducing the statistical power to detect a significant association. In addition, the relatively small sample size may have contributed to this result. These findings differ from many previous studies that have demonstrated a strong positive relationship between elevated BMI and insulin resistance, highlighting the need for larger studies to further investigate this relationship in the Libyan population.

The results also demonstrated no statistically significant association **between** hypertension and insulin resistance**,** as well as no significant association between fatty liver disease and **insulin** resistance. These findings may be explained by the limited number of participants with these conditions or by the relatively small sample size, both of which reduce the statistical power to detect significant differences. Nevertheless, the medical literature consistently identifies hypertension and non-alcoholic fatty liver disease as important components of metabolic syndrome that are commonly associated with insulin resistance. Therefore, the absence of significant associations in the present study should not be interpreted as evidence against these established clinical relationships but rather as a reflection of the characteristics and limitations of the study sample.

Overall, the present findings may be explained by the relatively small sample size and the homogeneous characteristics of the participants, as well as the possibility that insulin resistance is influenced by additional factors that were not assessed in the current study. These include hormonal abnormalities, such as elevated cortisol levels and thyroid hormone disorders; lipid abnormalities, particularly elevated triglyceride levels and reduced high-density lipoprotein

cholesterol (HDL-C); genetic susceptibility affecting insulin sensitivity; chronic low-grade inflammation, characterized by increased inflammatory biomarkers such as C-reactive protein (CRP) and interleukin-6 (IL-6)**;** and the use of certain medications, including corticosteroids and some antipsychotic drugs, which may impair glucose metabolism. These factors may play a more substantial role in explaining variations in insulin resistance among individuals and should therefore be considered in future studies to provide a more comprehensive understanding of the relationship between skin tags and insulin resistance.

Conclusion:

The findings of this study provide further insight into the relationship between skin tags and insulin resistance among adults attending a dermatology outpatient clinic in Libya. Although the participants demonstrated a relatively high average HOMA-IR value, reflecting a considerable burden of insulin resistance, the statistical analyses did not identify a significant association between the number of skin tags and insulin resistance. Similarly, age, sex, body mass index, hypertension, and fatty liver disease were not significantly associated with the investigated outcomes within the study population.

These findings indicate that the presence or number of skin tags should not be considered an independent indicator of insulin resistance without taking other metabolic characteristics into account. The absence of statistically significant associations does not necessarily exclude a biological relationship, but rather suggests that this relationship may be influenced by additional clinical and metabolic factors that were beyond the scope of the present investigation. Therefore, skin tags should be interpreted as part of a broader clinical assessment rather than as a standalone marker of metabolic dysfunction. Future studies involving larger and more heterogeneous populations are needed to further clarify the clinical value of skin tags in the early identification of insulin resistance and related metabolic disorders.

Recommendations:

The findings of the present study highlight several areas that warrant further investigation and clinical attention. Future research should recruit larger samples from multiple healthcare centers across different regions to improve the representativeness of the findings and increase statistical power. Longitudinal studies are also recommended to determine whether skin tags precede the development of insulin resistance or simply coexist with other metabolic abnormalities.

Future investigations should incorporate additional metabolic and inflammatory markers, including waist circumference, lipid profile, glycated hemoglobin, C-reactive protein, and interleukin-6, together with detailed assessment of lifestyle factors such as dietary habits and physical activity. Evaluating these variables may provide a more comprehensive understanding of the mechanisms linking dermatological manifestations with metabolic disorders.

From a clinical perspective, patients presenting with multiple skin tags—particularly those who are overweight or have other metabolic risk factors—may benefit from a comprehensive metabolic evaluation. Although skin tags were not independently associated with insulin resistance in the current study, they may still represent one component of a broader metabolic profile that deserves clinical attention. In addition, promoting healthy lifestyle behaviors aimed at weight control and improving insulin sensitivity remains an important strategy for reducing the burden of metabolic diseases.

Limitations of the Study:

Several limitations should be considered when interpreting the findings of this study. First, the relatively small sample size may have reduced the ability to detect statistically significant associations between the investigated variables. Second, the cross-sectional design allows the identification of associations but does not permit conclusions regarding causal relationships. Another limitation is that all participants were recruited from a single dermatology outpatient clinic, which may restrict the generalizability of the findings to other populations. In addition, insulin resistance was assessed using HOMA-IR rather than the hyperinsulinemic-euglycemic clamp technique, the accepted reference standard, although HOMA-IR remains widely used in clinical research because of its practicality.

Finally, several potentially important confounding factors—including central obesity, lipid abnormalities, inflammatory biomarkers, genetic susceptibility, dietary patterns, physical activity, and hormonal status—were not comprehensively evaluated. Incorporating these variables into future studies may provide a more complete understanding of the complex relationship between skin tags and insulin resistance.

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