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MANIFESTACIONES CUTÁNEAS ASOCIADAS A LA OBESIDAD PEDIÁTRICA Y LA DISFUNCIÓN METABÓLICA: UNA REVISIÓN EXPLORATORIA Y UN MAPA DE LA EVIDENCIA

CUTANEOUS MANIFESTATIONS ASSOCIATED WITH PEDIATRIC OBESITY AND METABOLIC DYSFUNCTION: A SCOPING REVIEW AND EVIDENCE MAP

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Resumen

Los hallazgos cutáneos visibles pueden indicar disfunción metabólica relacionada con la obesidad en niños, pero su asociación con la adiposidad a menudo se confunde con el valor diagnóstico o predictivo. Esta revisión exploratoria rápida y mapa de evidencia examinó los vínculos entre las manifestaciones cutáneas, la obesidad pediátrica y las anomalías cardiometabólicas. Se utilizaron MEDLINE/PubMed, PubMed Central, sitios web de editores, contenido indexado en SciELO y búsqueda de citas hasta el 25 de julio de 2026. La evidencia se clasificó desde la asociación con la obesidad (Nivel 1) hasta la predicción metabólica longitudinal (Nivel 5). Se mapearon veinticinco estudios primarios publicados entre 2008 y 2025, incluido un estudio de edad mixta retenido como evidencia contextual cuyas estimaciones agregadas no se trataron como específicas para la población pediátrica. La acantosis nigricans tuvo la evidencia más desarrollada, con asociaciones que involucran adiposidad, resistencia a la insulina, presión arterial, disglucemia, anomalías lipídicas y, en algunas cohortes, esteatosis hepática. El

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rendimiento diagnóstico varió; Un estudio pediátrico reportó una sensibilidad del 73,5% y una especificidad del 50,0% para la resistencia a la insulina. El análisis de mediación sugirió que el índice de masa corporal explicaba gran parte de la asociación en niños mexicoamericanos. Otros hallazgos, incluyendo acrocordones, estrías distensas, queratosis pilaris, acné, hiperhidrosis, intertrigo, infecciones, hiperqueratosis plantar e hidradenitis supurativa, se asociaron con la obesidad, pero su valor metabólico independiente seguía siendo incierto. Las cohortes longitudinales vincularon la adiposidad con la hidradenitis supurativa y las dermatosis inmunomediadas posteriores; no establecieron estas afecciones como predictores de futuras enfermedades metabólicas. La acantosis nigricans puede respaldar la evaluación del riesgo clínico, pero no puede reemplazar la evaluación metabólica basada en guías. Ninguno de los estudios mapeados proporcionó evidencia convincente de que un hallazgo cutáneo prediga de forma independiente futuras enfermedades metabólicas pediátricas después de tener en cuenta la adiposidad. Se necesitan definiciones estandarizadas, análisis ajustados, estudios de rendimiento diagnóstico y cohortes prospectivas..

Palabras claves: Obesidad pediátrica; acantosis nigricans; resistencia a la insulina; síndrome metabólico; manifestaciones cutáneas; hidradenitis supurativa; acrocordones; revisión exploratoria.

Abstract

Visible skin findings may signal obesity-related metabolic dysfunction in children, but their association with adiposity is often conflated with diagnostic or predictive value. This rapid scoping review and evidence map examined links between cutaneous manifestations, pediatric obesity, and cardiometabolic abnormalities. MEDLINE/PubMed, PubMed Central, publisher websites, SciELO-indexed content, and citation searching were used through July 25, 2026. Evidence was classified from association with obesity (Level 1) to longitudinal metabolic prediction (Level 5). Twenty-five primary studies published from 2008 to 2025 were mapped, including one mixed-age study retained as contextual evidence whose aggregate estimates were not treated as pediatric-specific. Acanthosis nigricans had the most developed evidence, with associations involving adiposity, insulin resistance, blood pressure, dysglycemia, lipid abnormalities, and, in some cohorts, hepatic steatosis. Diagnostic performance varied; one pediatric study reported 73.5% sensitivity and 50.0% specificity for insulin resistance. Mediation analysis suggested that body mass index explained much of the association in Mexican American children. Other findings, including acrochordons, striae distensae, keratosis pilaris, acne, hyperhidrosis, intertrigo, infections, plantar hyperkeratosis, and hidradenitis suppurativa, were associated with obesity, but their independent metabolic value remained uncertain. Longitudinal cohorts linked adiposity with subsequent hidradenitis suppurativa and immune-mediated dermatoses; they did not establish these conditions as predictors of future metabolic disease. Acanthosis nigricans can support clinical risk assessment but cannot replace guideline-based metabolic evaluation. None of the mapped studies provided convincing evidence that a cutaneous finding independently predicts future pediatric metabolic disease after accounting for adiposity. Standardized definitions, adjusted analyses, diagnostic-performance studies, and prospective cohorts are needed.

Keywords: Pediatric obesity; acanthosis nigricans; insulin resistance; metabolic syndrome; skin manifestations; hidradenitis suppurativa; acrochordons; scoping review.

Abbreviations

Abbreviation	Definition
AN	acanthosis nigricans
BMI	body mass index
HOMA-IR	Homeostatic Model Assessment for Insulin Resistance
HS	hidradenitis suppurativa
IGF	insulin-like growth factor
IR	insulin resistance
JB	Joanna Briggs Institute



Abbreviation	Definition
PCC	Population-Concept-Context
PRESS	Peer Review of Electronic Search Strategies
PRISMA-ScR	Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews
PRISMA-S	Preferred Reporting Items for Systematic Reviews and Meta-Analyses Literature Search Extension
ALT	alanine aminotransferase
AUC	area under the receiver operating characteristic curve
BP	blood pressure
HDL	high-density lipoprotein
HOMA2-IR	updated Homeostatic Model Assessment for Insulin Resistance
NPV	negative predictive value
OGTT	oral glucose tolerance test
PPV	positive predictive value

1. Introduction

Pediatric obesity is a chronic, relapsing disease with global cardiometabolic consequences. In 2022, more than 390 million children and adolescents aged 5-19 years had overweight, including more than 160 million living with obesity.¹ Excess adiposity in childhood is associated with hypertension, dyslipidemia, impaired glucose metabolism, metabolic dysfunction-associated steatotic liver disease, and persistence of obesity into adulthood.¹⁻³ The severity of obesity and insulin resistance already stratify metabolic-syndrome risk during childhood.³

The skin is a visible interface between adiposity, endocrine signaling, inflammation, mechanical stress, sweating, barrier function, and microbial ecology.^{9,10} Acanthosis nigricans (AN), acrochordons, striae distensae, keratosis pilaris, plantar hyperkeratosis, hyperhidrosis, intertrigo, bacterial and fungal infections, acne, psoriasis, atopic dermatitis, and hidradenitis suppurativa (HS) have all been reported in pediatric populations with overweight or obesity.¹¹⁻³⁶ However, three distinct questions are often merged: whether a lesion is more common with obesity; whether it correlates with metabolic biomarkers; and whether it can

independently discriminate or predict metabolic disease.

This distinction is clinically important. A common lesion may reflect adiposity without adding information beyond BMI, whereas a useful clinical marker should demonstrate incremental association after adjustment, reproducible diagnostic discrimination, or longitudinal prediction. The objective of this review was to map the pediatric evidence across these levels and to develop a cautious, guideline-compatible clinical interpretation.

2. Materials and methods

Design and reporting framework

This rapid scoping review and evidence map was informed by Joanna Briggs Institute guidance.⁴ Reporting followed PRISMA-ScR and PRISMA-S principles where

applicable.^{5,6} The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework was used as a reporting standard. No prospective protocol was prepared or registered, and the electronic search did not undergo independent peer review using the Peer Review of Electronic Search Strategies (PRESS) framework.⁷

Review question and eligibility

The review question was: What cutaneous manifestations have been associated with obesity, insulin resistance, metabolic syndrome, or related cardiometabolic abnormalities in children and adolescents, and what level of evidence supports their use as clinical metabolic markers? Eligibility was structured using the Population-Concept-Context framework (Table 1).

Table 1. Population-Concept-Context framework and eligibility criteria

Domain	Included	Excluded	Operational note
Population	Human participants aged 0–19 years or a clearly separable pediatric subgroup; mixed-age evidence was considered separately for context.	Adult-only data; mixed-age aggregate results were excluded from pediatric-specific inference.	One study aged 2–24 years was retained as contextual evidence, with its applicability explicitly identified.



Domain	Included	Excluded	Operational note
Concept	At least one cutaneous manifestation evaluated in relation to overweight, obesity, adiposity, insulin resistance, dysglycemia, dyslipidemia, hypertension, hepatic steatosis, or metabolic syndrome.	Skin disorders mentioned without an obesity/metabolic analysis.	The primary interest was a marker value, not merely treatment.
Context	Any country or clinical/community setting.	No geographic exclusion.	Hospital, outpatient, school, community, and administrative cohorts were eligible.
Evidence type	Primary observational studies, diagnostic studies, trials with relevant data, and sufficiently informative large case series.	Case reports, narrative reviews as primary evidence, editorials, and nonhuman studies.	Reviews were used only for context and citation chasing.

Information sources and search approach

Searches were performed through July 25, 2026, using MEDLINE through PubMed, PubMed Central, publisher websites, SciELO-indexed content, and complementary backward and forward citation

searching. Search concepts combined pediatric terms, obesity and metabolic terms, and general and lesion-specific dermatologic terms. The PubMed strategy and supplementary search concepts are provided in Supplementary Appendix A.

Table 2. *Information sources and their application*

Source	Coverage	Search date	Purpose	Application
PubMed/MEDLINE	Database inception to July 25, 2026	July 25, 2026	Primary bibliographic search	Bibliographic identification
PubMed Central	Available full-text archive	July 25, 2026	Full-text verification	Full-text review
Publisher websites	Available article pages/full text	July 25, 2026	Metadata, tables, errata, and full-text verification	Article details and corrections
SciELO and regional journal platforms	Available coverage	July 25, 2026	Latin American and regional evidence	Regional evidence retrieval
Citation chasing	References and citing articles	July 25, 2026	Identify linked primary studies and errata	Linked studies and corrections

Study selection, data charting, and verification

Titles, abstracts, and available full texts were evaluated against the eligibility criteria. Screening and data charting used automated support without independent duplicate human verification. Numerical results were retained when traceable to a primary report or correction. Missing information was recorded as not reported rather than interpreted as a negative finding. The published 2024 erratum for Hasse et al. was used in place of the superseded values.^{28,29} One study with participants aged 2–24 years was retained for contextual mapping; its aggregate estimates were not interpreted as pediatric-specific.²¹

Critical appraisal and evidence classification

A descriptive appraisal considered population representativeness, pediatric obesity definitions, standardized skin examination, objective metabolic measurement, confounder adjustment, and temporality. Domain-level concerns are summarized in Table 7 and Supplementary Appendix C; this was not a formal duplicate appraisal with

validated design-specific instruments. Studies were not excluded on the basis of methodological concerns. Evidence was classified as Level 1, association with obesity; Level 2, unadjusted metabolic association; Level 3, metabolic association persisting after relevant adjustment; Level 4, diagnostic discrimination; or Level 5, longitudinal prediction of future metabolic disease. These levels describe the function of the evidence, rather than overall study quality or certainty.

Synthesis

Findings were synthesized descriptively by cutaneous manifestation. Study counts, publication year, country, design, and manifestation–outcome matrices were generated from the charted study set. No meta-analysis was undertaken because definitions, populations, thresholds, and effect measures were heterogeneous. Numerical selection-flow counts are not presented because a record-level screening and deduplication log was not retained. Figure 1 summarizes the review workflow.

3. Results

Evidence-base characteristics

Twenty-five primary studies published between 2008 and 2025 were charted (Figure 2), including one mixed-age study retained as contextual evidence. Its aggregate estimates were not interpreted as pediatric-specific. India and the United States contributed the largest

numbers, followed by Türkiye, Brazil, and Denmark (Figure 3). Most studies were cross-sectional clinical investigations; only two large cohorts directly assessed longitudinal weight-to-skin-disease relationships (Figure 4). Sample sizes ranged from 55 to more than 2.1 million participants (Figure 7). Detailed characteristics are provided in Supplementary Appendix B.

Figure 1. Workflow of the rapid scoping review and evidence map. The diagram summarizes the review stages without numerical selection-flow estimates.

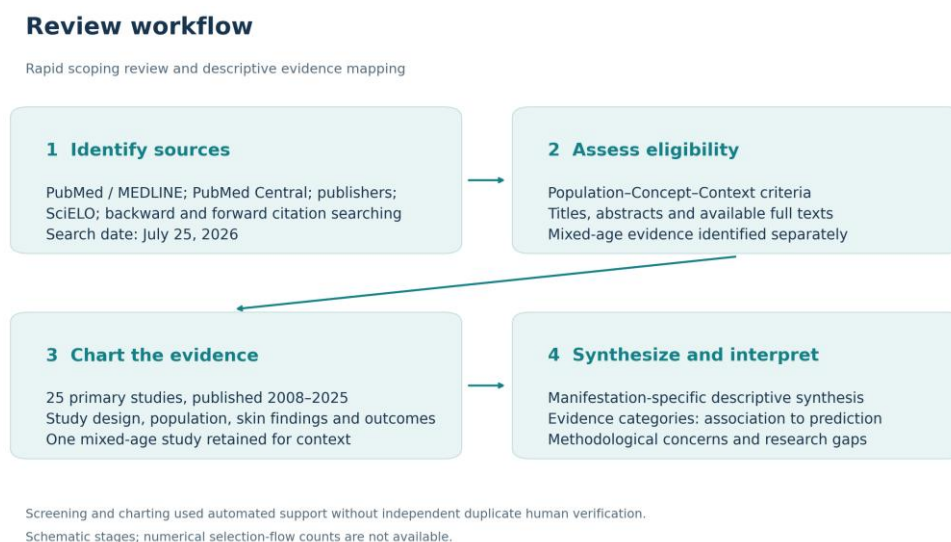


Figure 2. Publication timeline of the 25 charted primary studies.

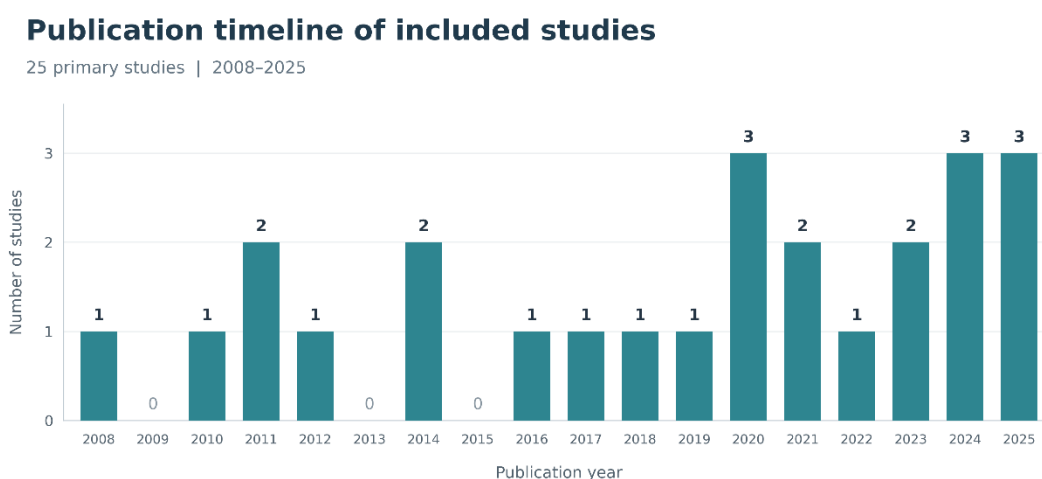


Figure 3. Geographic distribution of the charted evidence base. International denotes a multicenter cohort spanning more than one country.

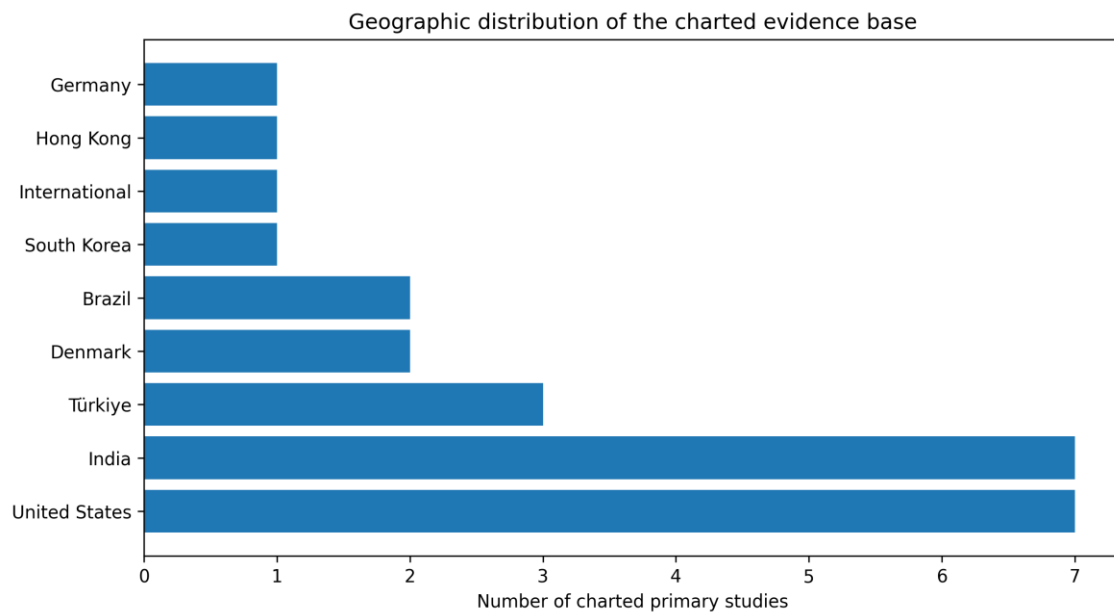
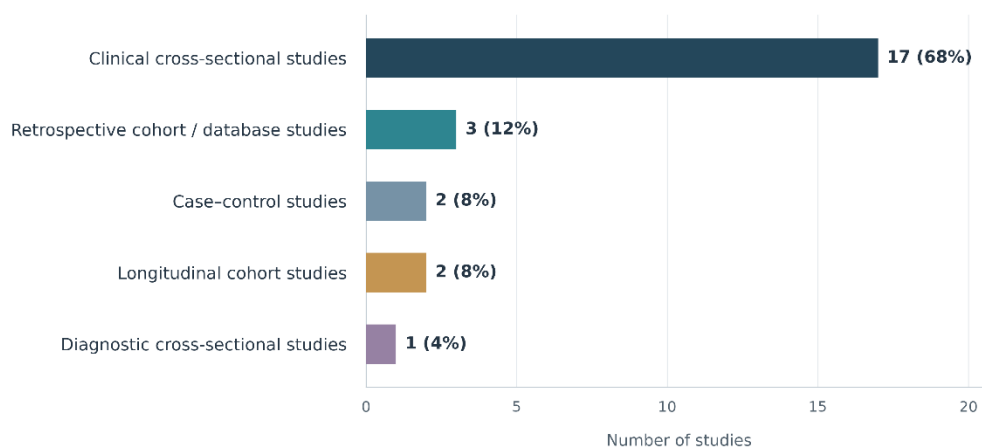


Figure 4. Distribution of study designs. Cross-sectional clinical studies dominated the evidence base.

Distribution of study designs

25 included studies



Spectrum of cutaneous manifestations

AN was evaluated most often, followed by acne, acrochordons, striae distensae, infections/intertrigo, and HS (Figure 5). Clinical

examination studies consistently demonstrated that children with obesity carry multiple simultaneous skin findings. In the comparative Turkish cohort, striae, AN, acrochordons, keratosis pilaris, intertrigo, folliculitis, seborrheic



dermatitis, and facial erythema were more frequent in children with obesity than in normal-weight controls.²⁷ In the erratum-corrected German cohort, striae and keratosis pilaris

each affected 63.1%, AN 44.7%, acne 40.8%, acrochordons 25.2%, and plantar hyperkeratosis 17.5%.^{28,29}

Figure 5. Number of studies contributing to the selected manifestations charted in this evidence map. Counts represent the charted categories, rather than an exhaustive inventory of all reported skin findings.

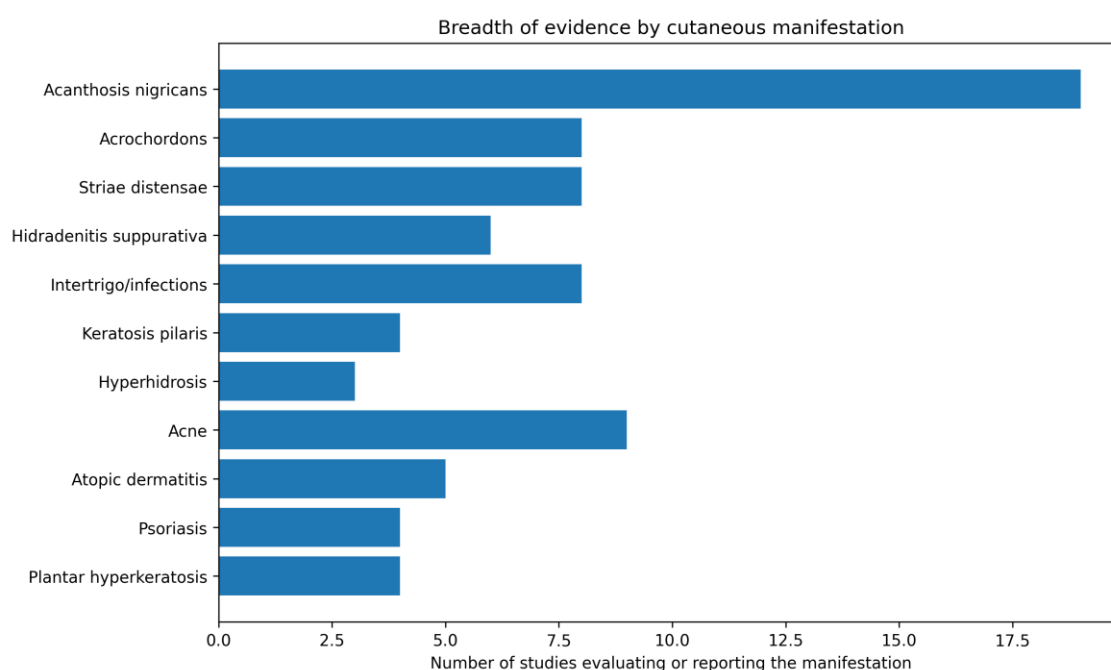


Table 3. Representative prevalence estimates from direct dermatologic examination studies

Study	Population	Most frequent reported findings	Selected prevalence	Interpretive caution
Gupta 2017	100 participants, age 3-18; BMI >30 kg/m ²	AN; striae; fungal infection/intertrigo; acrochordons; acne	42%; 19%; 16%; 12%; 10%	Adult BMI cutoff and no control group
Güven 2022	82 with obesity vs 86 controls	Striae; AN; acrochordons; keratosis pilaris; intertrigo	72.0% vs 26.7%; 63.4% vs 3.5%; 17.1% vs 1.2%; 32.9% vs 17.4%; 11.0% vs 0%	Single-center and multiple comparisons
Hasse 2023/erratum 2024	103 tertiary weight-program participants	Striae; keratosis pilaris; AN; acne; acrochordons	63.1%; 63.1%; 44.7%; 40.8%; 25.2%	Values reflect the published 2024 erratum
Thomas 2024	150 participants aged 5-19 with overweight/obesity	AN; striae; acne; dermatophytosis	74.7%; 32.7%; 20.0%; 17.3%	No normal-weight controls or metabolic laboratory data
Mohan 2025	150 children with obesity	AN; striae; pityriasis versicolor; seborrheic dermatitis; dermatophytosis	76.0%; 24.0%; 16.7%; 14.7%; 12.7%	Single-center; limited adjusted analyses

Acanthosis nigricans

AN had the strongest and most consistent metabolic evidence. Across ethnically and geographically diverse cohorts, AN was associated with BMI, central adiposity, fasting insulin, HOMA-IR, blood pressure, glucose abnormalities, triglycerides, low high-density lipoprotein cholesterol, and, in a Chinese cohort, alanine aminotransferase and fatty liver.^{11-13,15,17,20,24,34} The 2025 Indian school-based study found AN in 46.4% of children with overweight or obesity and reported higher BMI, waist circumference, blood pressure, glycemia, insulin, and HOMA-IR among affected participants.³⁴

The evidence does not support a simple causal or diagnostic interpretation. Aswani et al. reported 73.5% sensitivity and 50.0% specificity for AN as a marker of insulin resistance in a small White pediatric cohort.¹³ Other populations have shown a pattern of higher specificity but lower sensitivity depending on AN grading, ethnicity, and insulin-resistance thresholds. In Mexican American children, AN severity correlated with HOMA-IR and inflammatory/metabolic variables, but structural modeling suggested that BMI mediated much of the relationship.²⁴ Thus, AN is best viewed as a visible risk-enrichment sign rather than a stand-alone test.

Table 4. Key pediatric studies of acanthosis nigricans and metabolic outcomes

Study	N	Population	Metabolic outcomes	Key result	Marker interpretation
Aswani 2011	76	White children with obesity	HOMA-IR	Sensitivity 73.5%; specificity 50.0%; PPV 54.3%; NPV 70.0%	Level 4, but imprecise and population-dependent
Brickman 2010	236	High-risk multiethnic youth	Glucose homeostasis, BP, HDL-C	AN identified a group with frequent metabolic abnormalities	Level 2-3; not a stand-alone diagnostic study
Ng 2014	543	Chinese youth with overweight/obesity	Insulin, HOMA-IR, OGTT, lipids, BP, ALT, fatty liver	Broad adverse metabolic profile with AN	Level 2; adjustment varied
Lopez-Alvarenga 2020	670	Mexican American children	HOMA-IR, CRP, HDL-C	BMI mediated much of the AN-IR association	Important evidence against overclaiming independence
Das 2025	545	School-based overweight/obesity sample	Waist, glucose, insulin, HOMA-IR, BP, HDL-C	AN associated with multiple cardiometabolic risk factors	Level 2; cross-sectional

Acrochordons

Acrochordons were reported in several obesity-clinic cohorts,

commonly in axillary sites.^{18,19,26-31}

The 2024 pediatric cohort of 55 patients found a high burden of



obesity and metabolic comorbidity compared with propensity-matched controls; three of 55 patients (5.5%) met metabolic-syndrome criteria, although only 21 underwent a complete metabolic evaluation.³¹ However, the study did not demonstrate that acrochordons predict metabolic disease independently of adiposity. Current evidence therefore reaches Level 2, not diagnostic or predictive validation.

Striae, keratosis pilaris, hyperhidrosis, acne, and plantar hyperkeratosis

Striae distensae and keratosis pilaris were among the most prevalent findings in direct examination studies.^{19,26-30} In the German cohort, HOMA was associated with keratosis pilaris and acne, but not reported as independently associated after comprehensive adjustment.^{28,29} The Turkish case-control study reported positive correlations between insulin resistance and keratosis pilaris, striae, AN, hyperhidrosis, and plantar hyperkeratosis.³⁰ These signals are hypothesis-generating; puberty, sex, mechanical factors, skin phototype, and obesity severity were not

uniformly controlled. Their highest supported category is Level 2.

Intertrigo and recurrent infections

Intertrigo, dermatophytosis, candidal or other fungal disease, folliculitis, and pyoderma were repeatedly observed in clinical cohorts and large administrative datasets.^{16,18,19,25-27,33,35,36} The likely pathways include occlusion, moisture, friction, barrier disruption, and altered host-microbial interactions. Pediatric studies rarely tested whether infection burden independently tracks insulin resistance or dysglycemia. These findings support Level 1 association with obesity, not their use as metabolic screening tests.

Hidradenitis suppurativa

HS showed a robust relationship with adiposity but limited evidence as a metabolic marker. Screening 195 Danish children with BMI above the 90th percentile identified five clinically confirmed, generally mild cases.²² In the international pediatric HS cohort, obesity was the most frequent comorbidity and scarring was present in nearly half at first assessment.²⁵ A population cohort of 347,200 schoolchildren linked higher



childhood BMI with later HS, predominantly in adulthood; weight normalization before puberty was associated with attenuated risk.²³ These data support obesity as a risk factor for HS; they do not show that HS independently predicts future metabolic dysfunction.

Atopic dermatitis, psoriasis, and other immune-mediated dermatoses

Large studies support an obesity-to-inflammatory-skin-disease relationship. A pediatric case-control study associated obesity, particularly

early and persistent obesity, with atopic dermatitis.¹⁴ A nationwide Korean cohort of more than 2.1 million children associated childhood obesity with subsequent atopic dermatitis, psoriasis, and alopecia areata. Weight gain was associated with higher atopic-dermatitis risk, whereas transition to normal weight was associated with lower risk.³² These longitudinal data strengthen temporal inference for adiposity as an exposure, but they do not validate these dermatoses as early metabolic markers.

Figure 6. Evidence heat map for selected manifestations and metabolic or anthropometric outcomes. Counts indicate the volume of charted evidence, not effect magnitude or certainty.

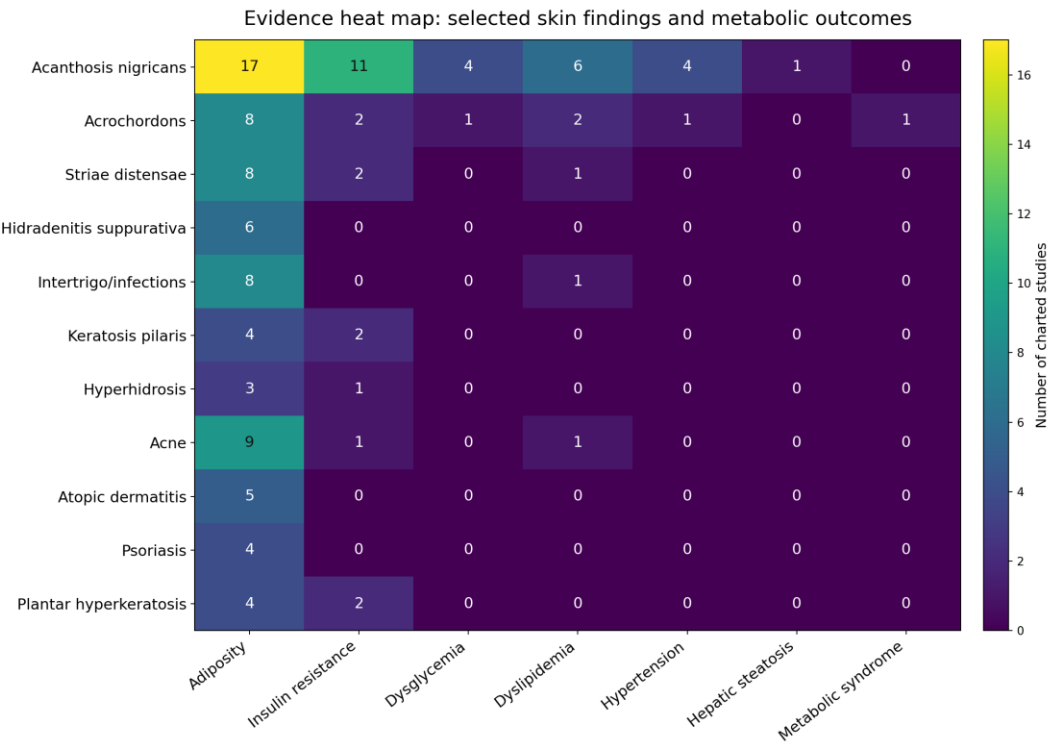


Figure 7. Bubble plot of publication year and study sample size. Bubble size also represents sample size; administrative and nationwide cohorts dominate the upper range. For Epstein et al., sample size represents the sum of the two cohorts reported in the original Table 1.

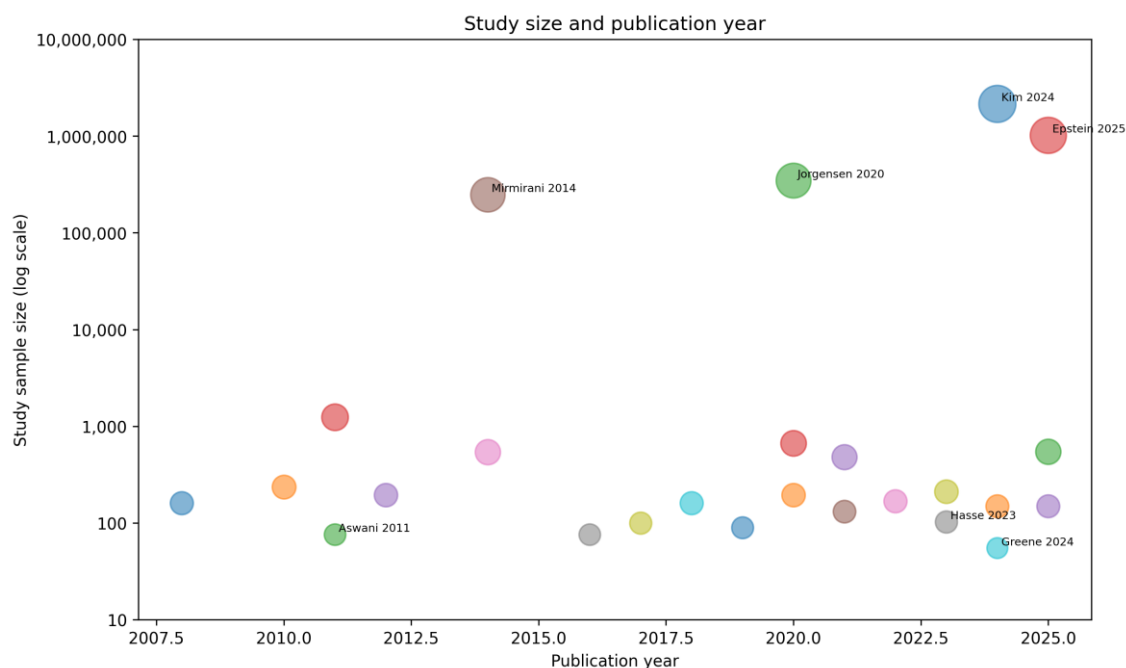


Figure 8. Evidence-gap map for selected manifestations. Acanthosis nigricans reached Level 4 because diagnostic-performance data were available; no charted manifestation had evidence meeting Level 5 criteria for longitudinal metabolic prediction.

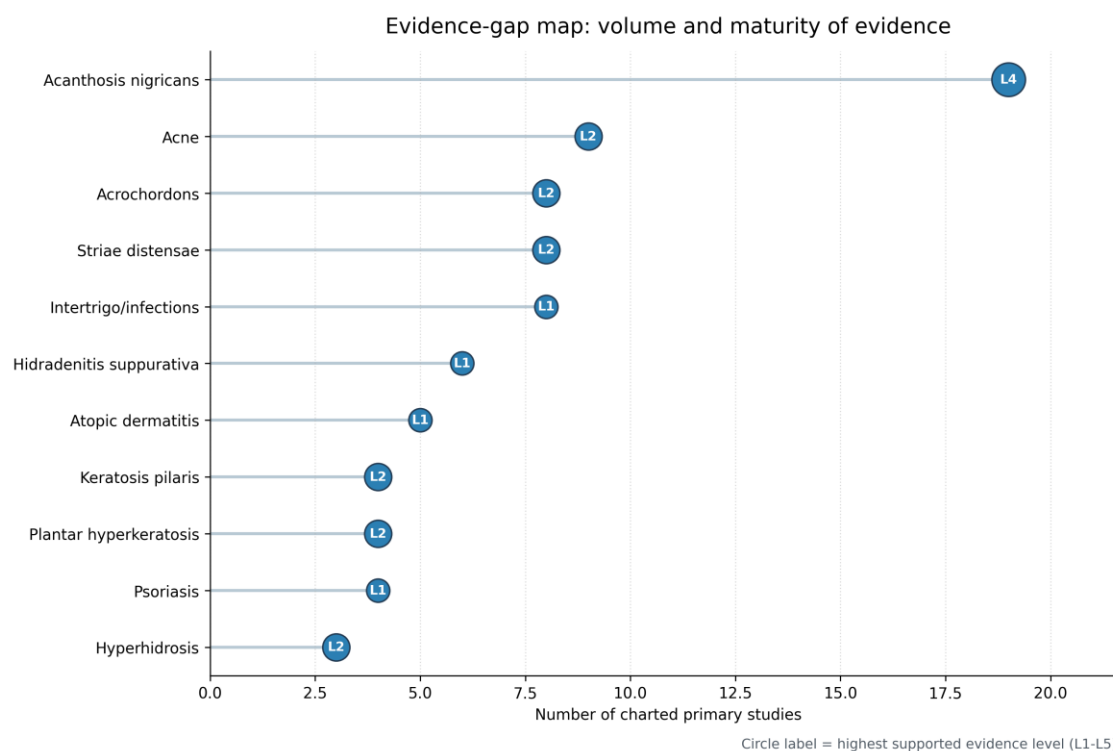


Table 5. Evidence supporting cutaneous manifestations as potential metabolic markers

Manifestation	Highest level	What is supported	What is not established	Clinical interpretation
Acanthosis nigricans	Level 4	Consistent obesity and metabolic associations; limited diagnostic-performance data	Reliable stand-alone diagnosis; longitudinal prediction independent of adiposity	Risk-enrichment sign that should trigger complete clinical risk assessment
Acrochordons	Level 2	Association with obesity and metabolic comorbidity in a small cohort	Independent discrimination or prediction	Consider broader risk profile, but do not infer metabolic syndrome from skin tags alone
Striae distensae	Level 2	Common with obesity; occasional unadjusted IR correlation	Incremental metabolic value	Primarily a marker of tissue stretching/adiposity
Keratosis pilaris	Level 2	Common with obesity; HOMA/IR signals in two studies	Reproducible independent association	Hypothesis-generating only
Hyperhidrosis	Level 2	Reported more frequently and correlated with IR in one comparative study	Validated metabolic screening value	Treat symptoms and assess overall obesity risk
Intertrigo/infections	Level 1	Repeated obesity association	Independent metabolic association or prediction	Evaluate local mechanical/infectious drivers; follow obesity guidelines separately
Hidradenitis suppurativa	Level 1	Strong association with obesity and longitudinal obesity-to-HS risk	HS-to-future-metabolic-disease prediction	Treat HS and assess comorbidity burden; not a validated metabolic test
Acne/atopic dermatitis/psoriasis	Level 1-2	Obesity/inflammation associations; some HOMA association for acne	Independent skin-to-metabolic prediction	Interpret within puberty and inflammatory context

4. Discussion

Principal findings

This evidence map identifies AN as the only pediatric obesity-associated skin finding with a substantial body of metabolic correlation and at least some diagnostic-discrimination data. Even for AN, results vary across populations and definitions, and adiposity explains an important part

of the association. The practical conclusion is therefore narrower than the phrase “early metabolic marker” may imply: AN increases clinical suspicion, but it cannot confirm or exclude insulin resistance and should not determine laboratory testing in isolation.

Other manifestations are common and clinically important but less mature as metabolic indicators.



Acrochordons, striae, keratosis pilaris, plantar hyperkeratosis, hyperhidrosis, acne, intertrigo, and infections may reflect combinations of adiposity, mechanical stress, endocrine milieu, puberty, barrier dysfunction, and inflammation. Their associations with HOMA-IR or lipid abnormalities generally arise from small cross-sectional cohorts and often lack adjustment for BMI severity, waist circumference, puberty, sex, ethnicity, and treatment. HS and immune-mediated dermatoses have stronger obesity-association evidence, including temporal evidence, but the temporal direction examined is mainly obesity preceding skin disease.

Biological plausibility

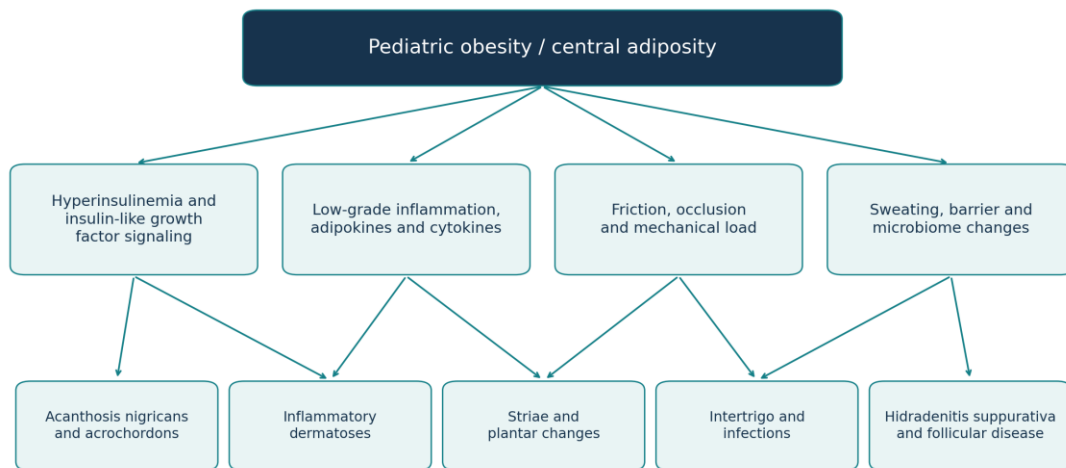
Hyperinsulinemia can increase signaling through insulin and insulin-like growth factor pathways, promoting keratinocyte and fibroblast proliferation; this mechanism is biologically coherent for AN and possibly acrochordons.^{9,10} Pediatric clinical data directly support the hyperinsulinemia-AN association, whereas molecular detail is largely extrapolated from adult or experimental evidence. Chronic low-grade inflammation and adipokine

dysregulation plausibly contribute to psoriasis, atopic dermatitis, HS, and acne, but lesion-specific pediatric causal evidence remains incomplete. Mechanical friction, tissue stretching, occlusion, and sweating provide stronger direct explanations for striae, intertrigo, plantar hyperkeratosis, and some follicular disorders. Barrier and microbiome alterations may increase susceptibility to bacterial and fungal infection, although pediatric metabolic mediation is insufficiently studied.

Figure 9. Conceptual pathophysiology. Solid clinical support is strongest for obesity/hyperinsulinemia and acanthosis nigricans; several other pathways are extrapolated from adult or experimental evidence and should be regarded as plausible rather than proven.

Conceptual pathophysiology

Plausible pathways linking adiposity with cutaneous findings



Pediatric clinical support is strongest for hyperinsulinemia-acanthosis nigricans associations.

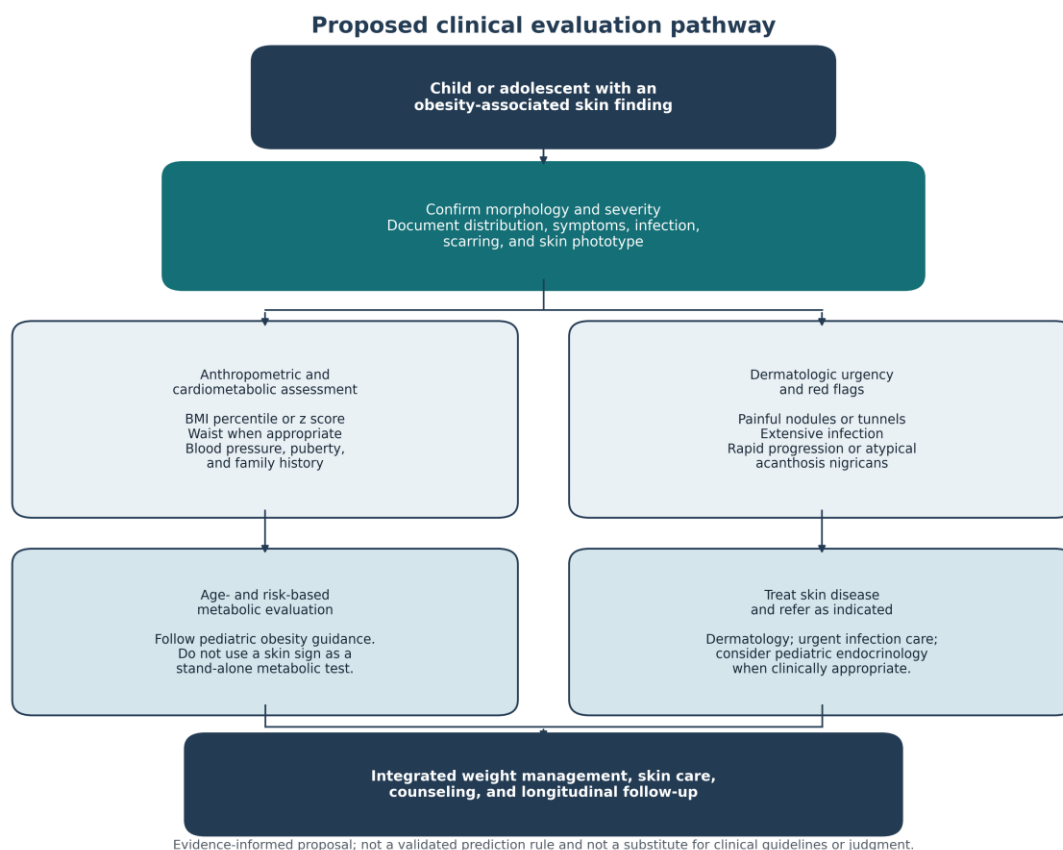
Several other mechanisms are extrapolated from adult or experimental evidence; arrows do not establish causality.

Clinical implications

A deliberate skin examination can improve recognition of obesity-related morbidity and quality-of-life impairment. When AN, extensive acrochordons, recurrent intertrigo/infections, or HS is identified, the clinician should document morphology, distribution, severity, symptoms, scarring, and alternative diagnoses; assess BMI percentile or z score, waist measures when appropriate, blood pressure, pubertal stage, family history, and obesity trajectory; and follow accepted pediatric obesity guidance for laboratory evaluation.² The skin

finding should enrich clinical concern, not substitute for age- and risk-based recommendations. Atypical, rapidly progressive, generalized, mucosal, or non-obesity-associated AN requires evaluation for alternative endocrine, medication-related, genetic, or rarely paraneoplastic causes.

Figure 10. Proposed clinical evaluation pathway. This pathway is derived from the mapped evidence, is not a validated prediction rule, and does not replace pediatric obesity guidelines or clinical judgment.



Research priorities

Priority studies should use age- and sex-specific obesity definitions; standardized lesion definitions and severity scores; trained dermatologic examiners; objective metabolic phenotyping; prespecified adjustment for adiposity, puberty, sex, ethnicity, socioeconomic factors, and medication; and sufficient representation across skin tones. Diagnostic studies should report sensitivity, specificity, likelihood ratios, calibration,

discrimination, and incremental value beyond BMI and waist measures. Longitudinal cohorts are needed to test whether any lesion predicts incident prediabetes, type 2 diabetes, metabolic syndrome, or steatotic liver disease after adjustment. None of the studies mapped in this review provided convincing Level 5 evidence.

Table 6. Evidence gaps and research priorities

Gap	Why it matters	Preferred design	Minimum reporting elements
No longitudinal metabolic prediction	Cross-sectional association cannot establish temporal or incremental value	Prospective multicenter cohort	Baseline lesion severity, repeated metabolic outcomes, BMI/waist trajectory, adjusted risk estimates
Heterogeneous AN and IR definitions	Performance estimates are not transportable	Diagnostic-accuracy study	Explicit index-test grading, prespecified HOMA/OGTT reference, sensitivity, specificity, likelihood ratios, AUC
Understudied lesions	Common findings may be markers or merely correlates	Comparative clinical cohort	Normal-weight controls, standardized dermatology exam, puberty and phototype
Limited adjustment	Adiposity may fully explain associations	Multivariable or causal-inference analysis	BMI severity, central adiposity, age, sex, puberty, ethnicity, socioeconomic status
Skin-tone and geographic gaps	Visual recognition and prevalence differ across populations	International prospective collaboration	Validated skin-tone measure, region, examiner training, inter-rater reliability
Sparse patient-centered outcomes	Burden extends beyond biomarkers	Mixed-methods/longitudinal study	Dermatologic quality of life, stigma, pain, scarring, treatment access

5. Conclusions

Cutaneous manifestations are frequent in children and adolescents with obesity, but evidence maturity differs sharply by lesion. AN has the most consistent links with adiposity and metabolic dysfunction and can usefully enrich risk assessment. Its sensitivity and specificity are variable, and its association may be substantially mediated by obesity severity; it should not be used to diagnose or exclude insulin resistance. Acrochordons, striae, keratosis pilaris, hyperhidrosis, acne, intertrigo, infections, plantar hyperkeratosis, HS, and immune-

mediated dermatoses are clinically relevant but the mapped studies did not establish validated independent metabolic discrimination or longitudinal prediction. Within the studies mapped in this review, no lesion had convincing Level 5 evidence for prediction of future pediatric metabolic disease. Skin examination should prompt comprehensive, guideline-based evaluation rather than replace it.

Figure 11. Graphical abstract. Summary of the evidence hierarchy and clinical interpretation

Skin findings in pediatric obesity

From visible clinical signs to interpretation of metabolic risk



Skin findings support clinical assessment; they do not replace metabolic evaluation.

25 mapped primary studies (2008–2025), including one mixed-age contextual study.
 Level 5 denotes longitudinal prediction of future metabolic disease after relevant adjustment.

Bibliografía

1. World Health Organization. Obesity and overweight. Updated December 8, 2025. Accessed July 25, 2026.
2. Hampl SE, Hassink SG, Skinner AC, Armstrong SC, Barlow SE, Bolling CF, et al. Clinical Practice Guideline for the Evaluation and Treatment of Children and Adolescents With Obesity. *Pediatrics*. 2023;151(2):e2022060640. doi:10.1542/peds.2022-060640. [DOI]
3. Weiss R, Dziura J, Burgert TS, Tamborlane WV, Taksali SE, Yeckel CW, et al. Obesity and the metabolic syndrome in children and adolescents. *N Engl J Med*. 2004;350(23):2362-2374. doi:10.1056/NEJMoa031049. [DOI]
4. Peters MDJ, Marnie C, Tricco AC, Pollock D, Munn Z, Alexander L, et al. Updated methodological guidance for the conduct of scoping reviews. *JB I Evid Synth*. 2020;18(10):2119-2126. doi:10.11124/JBIES-20-00167. [DOI]
5. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med*. 2018;169(7):467-473. doi:10.7326/M18-0850. [DOI]
6. Rethlefsen ML, Kirtley S, Waffenschmidt S, Ayala AP, Moher D, Page MJ, et al.



- PRISMA-S: an extension to the PRISMA Statement for Reporting Literature Searches in Systematic Reviews. *Syst Rev.* 2021;10:39. doi:10.1186/s13643-020-01542-z. [DOI]
7. McGowan J, Sampson M, Salzwedel DM, Cogo E, Foerster V, Lefebvre C. PRESS Peer Review of Electronic Search Strategies: 2015 guideline statement. *J Clin Epidemiol.* 2016;75:40-46. doi:10.1016/j.jclinepi.2016.01.021. [DOI]
 8. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ.* 2021;372:n71. doi:10.1136/bmj.n71. [DOI]
 9. Uzuncakmak TK, Akdeniz N, Karadag AS. Cutaneous manifestations of obesity and the metabolic syndrome. *Clin Dermatol.* 2018;36(1):81-88. doi:10.1016/j.clindermatol.2017.09.014. [DOI]
 10. Shipman AR, Millington GWM. Obesity and the skin. *Br J Dermatol.* 2011;165(4):743-750. doi:10.1111/j.1365-2133.2011.10393.x. [DOI]
 11. Guran T, Turan S, Akcay T, Bereket A. Significance of acanthosis nigricans in childhood obesity. *J Paediatr Child Health.* 2008;44(6):338-341. doi:10.1111/j.1440-1754.2007.01272.x. [DOI]
 12. Brickman WJ, Huang J, Silverman BL, Metzger BE. Acanthosis nigricans identifies youth at high risk for metabolic abnormalities. *J Pediatr.* 2010;156(1):87-92. doi:10.1016/j.jpeds.2009.07.011. [DOI]
 13. Aswani R, Lochow A, Dementieva Y, Lund VA, Elitsur Y. Acanthosis nigricans as a clinical marker to detect insulin resistance in Caucasian children from West Virginia. *Clin Pediatr (Phila).* 2011;50(11):1057-1061. doi:10.1177/0009922811414288. [DOI]
 14. Silverberg JI, Kleiman E, Lev-Tov H, Silverberg NB, Durkin HG, Joks R, et al. Association between obesity and atopic dermatitis in childhood: a case-control study. *J Allergy Clin Immunol.* 2011;127(5):1180-1186.e1. doi:10.1016/j.jaci.2011.01.063. [DOI]
 15. Kluczynik CEN, Mariz LS, Souza LCF, Solano GB, Albuquerque FC, Medeiros CCM. Acanthosis nigricans and insulin resistance in overweight children and adolescents. *An Bras Dermatol.* 2012;87(4):531-



537. doi:10.1590/S0365-05962012000400002. [DOI]
16. Mirmirani P, Carpenter DM. Skin disorders associated with obesity in children and adolescents: a population-based study. *Pediatr Dermatol.* 2014;31(2):183-190. doi:10.1111/pde.12271. [DOI]
17. Ng HY, Young JHM, Huen KF, Chan LTW. Acanthosis nigricans in obese Chinese children. *Hong Kong Med J.* 2014;20(4):290-296. doi:10.12809/hkmj134071. [DOI]
18. Dash M, Jena AK, Panda M, Patro N. Prospective clinical study of the skin markers in childhood obesity-an emerging pandemic. *Pediatric Review: International Journal of Pediatric Research.* 2016;3(6):462-466. doi:10.17511/ijpr.2016.i06.15. [DOI]
19. Gupta M. Cutaneous manifestations of obesity in children: a prospective study. *Indian J Paediatr Dermatol.* 2017;18(1):28-30. doi:10.4103/2319-7250.193004. [DOI]
20. Palhares HMC, Zaidan PC, Dib FCM, Silva AP, Resende DCS, Borges MF. Association between acanthosis nigricans and other cardiometabolic risk factors in children and adolescents with overweight and obesity. *Rev Paul Pediatr.* 2018;36(3):301-308. doi:10.1590/1984-0462/;2018;36;3;00017. [DOI]
21. Nithun TM, Ranugha PSS, Betkerur JB, Shastry V. Association of acanthosis nigricans and insulin resistance in Indian children and youth: a HOMA2-IR-based cross-sectional study. *Indian Dermatol Online J.* 2019;10(3):272-278. doi:10.4103/idoj.IDOJ_303_18. [DOI]
22. Andersen PL, Kromann C, Fonvig CE, Riis PT, Jemec GBE, Holm JC. Hidradenitis suppurativa in a cohort of overweight and obese children and adolescents. *Int J Dermatol.* 2020;59(1):47-51. doi:10.1111/ijd.14639. [DOI]
23. Jorgensen AHR, Aarestrup J, Baker JL, Thomsen SF. Association of birth weight, childhood body mass index, and height with risk of hidradenitis suppurativa. *JAMA Dermatol.* 2020;156(7):746-753. doi:10.1001/jamadermatol.2020.1047. [DOI]
24. Lopez-Alvarenga JC, Chittoor G, Paul SFD, Puppala S, Farook VS, Fowler SP, et al. Acanthosis nigricans as a composite marker of cardiometabolic risk and its complex association with



- obesity and insulin resistance in Mexican American children. *PLoS One*. 2020;15(10):e0240467. doi:10.1371/journal.pone.0240467. [DOI]
25. Liy-Wong C, Kim M, Kirkorian AY, Eichenfield LF, Ambarus CA, Friedlander SF, et al. Hidradenitis suppurativa in the pediatric population: an international, multicenter, retrospective, cross-sectional study of 481 pediatric patients. *JAMA Dermatol*. 2021;157(4):385-391. doi:10.1001/jamadermatol.2020.5435. [DOI]
 26. Sunkwad A, Mahajan S. Cutaneous manifestations in overweight and obese children and adolescent. *Int J Contemp Pediatr*. 2021;8(10):1662-1666. doi:10.18203/2349-3291.ijcp20213726. [DOI]
 27. Guven M, Anik A, Unuvar T, Ilgun Gurel D, Sendur N. Cutaneous manifestations of obesity in Turkish children: a comparative study. *Pediatr Dermatol*. 2022;39(4):513-519. doi:10.1111/pde.14978. [DOI]
 28. Hasse L, Jamiolkowski D, Reschke F, Kapitzke K, Weiskorn J, Kordonouri O, et al. Pediatric obesity and skin disease: cutaneous findings and associated quality-of-life impairments in 103 children and adolescents with obesity. *Endocr Connect*. 2023;12(9):e230235. doi:10.1530/EC-23-0235. [DOI]
 29. Hasse L, Jamiolkowski D, Reschke F, Kapitzke K, Weiskorn J, Kordonouri O, et al. Erratum: Pediatric obesity and skin disease: cutaneous findings and associated quality-of-life impairments in 103 children and adolescents with obesity. *Endocr Connect*. 2024;13(11):x230235. doi:10.1530/EC-23-0235e. [DOI]
 30. Kus MM, Mulayim MK, Kus C, Doganer A, Ozturk P, Temiz F, et al. Dermatoses in overweight and obese children and their relationship with insulin and skin color. *J Cosmet Dermatol*. 2023;22(10):2791-2798. doi:10.1111/jocd.15773. [DOI]
 31. Greene RK, Gangidi S, Zhao R, Nelson JM, Harms K, Nakamura M. The relationship between acrochordons, obesity, and metabolic syndrome in the pediatric population: a retrospective cohort study. *Pediatr Dermatol*. 2024;41(4):660-666. doi:10.1111/pde.15639. [DOI]
 32. Kim SR, Koh SJ, Park H. Childhood obesity, weight change, and pediatric immune-mediated skin



diseases. J Invest Dermatol.
2024;144(9):1975-1984.e10.
doi:10.1016/j.jid.2024.01.037.
[DOI]

33. Thomas AW, Bhatia A, Sharma M. A cross-sectional study of cutaneous manifestations in overweight and obese children. Indian J Paediatr Dermatol. 2024;25(1):27-30. doi:10.4103/ijpd.ijpd_29_23. [DOI]

34. Das RR, Mangaraj M, Nayak S, Satapathy AK, Mahapatro S. Acanthosis nigricans and its association with cardio-metabolic risk factors in children with overweight/obesity: a school-based cross-sectional study. J Family Med Prim Care. 2025;14(1):254-258. doi:10.4103/jfmpc.jfmpc_866_24. [DOI]

35. Epstein S, Shah SD. Evaluating the cutaneous manifestations and associated comorbidities of childhood obesity. Pediatr Dermatol. 2025;42(4):800-802. doi:10.1111/pde.15887. [DOI]

36. Mohan A, Abdul Samad K, Nair SP. A cross sectional study of cutaneous manifestations in obese children in a tertiary care center. Indian J Paediatr Dermatol. 2025;26(1):10-15. doi:10.4103/ijpd.ijpd_174_24. [DOI]