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Soybean and Turmeric Nanoemulsion for the Prevention and Management of Striae Gravidarum: A Narrative Literature Review

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ABSTRACT

Striae gravidarum is a common dermatological condition affecting pregnant and postpartum women. Conventional topical therapies often demonstrate limited effectiveness because of poor dermal penetration and the physicochemical instability of natural bioactive compounds. Nanoformulation technologies may enhance the delivery and therapeutic performance of plant-derived agents such as turmeric (*Curcuma longa*) and soybean (*Glycine max*). This review aimed to evaluate current evidence regarding the potential of turmeric and soybean nanoformulations for skin regeneration and the management of striae gravidarum. A literature review was conducted between June and September 2025 using PubMed, ScienceDirect, Wiley Online Library, and Google Scholar. Articles published between 2020 and 2025 in English or Indonesian were screened using predefined eligibility criteria. Seventeen eligible studies were included in the narrative synthesis. Eleven studies (64.7%) demonstrated that curcumin-based nanoformulations enhanced antioxidant activity, reduced inflammation, and stimulated collagen synthesis. Seven studies reported improved dermal penetration with particle sizes below 250 nm and encapsulation or absorption efficiencies exceeding 80%. Soybean-derived isoflavones increased type I collagen synthesis by up to 43.9% and reduced reactive oxygen species (ROS)-mediated oxidative stress. Clinical studies reported significant improvements in skin condition, hydration, elasticity, and striae severity following botanical interventions. However, no clinical trial has directly evaluated a combined turmeric–soybean nanoemulsion formulation for striae gravidarum. Current evidence suggests that turmeric and soybean nanoformulations possess promising regenerative, antioxidant, and collagen-stimulating properties relevant to striae gravidarum management. Nevertheless, evidence remains predominantly preclinical, and well-designed clinical trials are required to establish the efficacy, safety, and therapeutic value of combined turmeric–soybean nanoemulsion formulations in pregnant and postpartum populations.

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INTRODUCTION

Striae gravidarum (stretch marks) are common dermal alterations experienced by pregnant and postpartum women because of excessive mechanical stretching of the skin,

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which disrupts the structural integrity of collagen and elastin fibers within the dermis.(1,2) Such mechanical stress impairs fibroblast activity and extracellular matrix (ECM) organization, leading to reduced skin elasticity. In addition, hormonal changes during the second and third trimesters, particularly increased melanocyte stimulating hormone (MSH) due to fluctuations in estrogen and progesterone, contribute to hyperpigmentation and darkening of the abdomen, breasts, and thighs.(3) Early-stage lesions appear as pink to violaceous curved streaks accompanied by pruritus and later progress to hypopigmented atrophic lines during the chronic stage.(4) In postpartum women, striae often become more pronounced on the lower abdomen, hips, and inner thighs as the abdomen decreases in size following delivery.(4,5)

Globally, striae gravidarum affect approximately 50–90% of pregnant women, as reported in dermatological reviews and cohort studies across diverse populations. (6,7) The wide variation in prevalence is influenced by genetic predisposition, maternal age, body mass index, parity, and hormonal factors. The high prevalence is frequently associated with psychological distress, including reduced self-confidence and anxiety. In the United States, 21.9% of 8,000 pregnant women reported body-image-related anxiety, while estimates in Indonesia reach approximately 28%.(8) These findings suggest that striae gravidarum should not be viewed solely as a cosmetic concern but rather as a condition with significant psychosocial implications.

Despite the widespread use of topical therapies, the stretch-mark problem remains largely unresolved. Several factors contribute to the limited success of current interventions: (a) conventional products such as emollient creams, cocoa butter, and vitamin E oil often show inconsistent or minimal clinical efficacy; (b) safe treatment options for pregnant and breastfeeding women remain scarce due to concerns about the safety profiles of many active cosmetic ingredients; and (c) natural ingredients in traditional formulations generally suffer from poor dermal penetration, low physicochemical stability, and limited bioavailability, preventing sufficient delivery of active compounds to the dermis.(9) These limitations underscore the need for alternative therapeutic strategies that are both effective and safe for maternal use.

Among the natural compounds investigated for skin regeneration, soybean and turmeric have attracted considerable attention because of their complementary biological activities. Soybean and turmeric represent two potentially effective natural ingredients with documented dermatological benefits. Soybean isoflavones, functioning as phytoestrogens, can bind to estrogen receptors (ERα and ERβ), enhancing cell proliferation, antioxidant defense, anti-inflammatory activity, and collagen synthesis.(10) Turmeric contains curcuminoids with potent antioxidant, anti-inflammatory, and skin-regenerative effects, contributing to improved dermal repair and promote uniform skin pigmentation.(11,12) However, in their conventional forms, both ingredients experience rapid degradation, poor solubility, and limited dermal penetration, which substantially reduces their therapeutic effectiveness.

Nanoemulsion technology provides an effective and superior formulation strategy to overcome these challenges. Nanoemulsions enhance the stability of active compounds and improve their bioavailability without increasing toxicity. Their nanometer-scale droplet size facilitates deeper dermal penetration and more efficient delivery to the dermis.(13,14) Their physicochemical stability and high loading capacity make nanoemulsions particularly suitable for delivering bioactive natural compounds such as isoflavones and curcuminoids. Consequently, combining soybean and turmeric extracts into a nanoemulsion system offers a potentially effective, safe, and biocompatible approach that warrants confirmation in clinical trials for improving dermal repair and stimulating collagen synthesis in pregnant and postpartum women an area where conventional topical products have largely fallen short.(13)

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Although numerous studies have evaluated turmeric nanoformulations, soybean-derived isoflavones, or other botanical preparations separately, no previous review has comprehensively synthesized evidence regarding the combined use of soybean and turmeric nanoemulsion formulations for the prevention and management of striae gravidarum in pregnant and postpartum women. Addressing this gap is essential for guiding future research and clinical application. Therefore, this literature review aims to systematically evaluate the mechanisms, efficacy, and safety potential of soybean and turmeric nanoemulsion formulations for the prevention and treatment of striae gravidarum in pregnant and postpartum women.

METHOD

Study Design

This study employed a narrative review to summarize and evaluate current evidence regarding the use of soybean and turmeric based nanoemulsion formulations for the prevention or reduction of striae gravidarum (stretch marks). Although the review followed systematic steps, its protocol was not registered in PROSPERO, an international database for systematic review protocols. PROSPERO registration is typically used to prevent duplication and ensure methodological transparency; however, because this review used a traditional (non-systematic) approach without predefined clinical outcomes, formal registration was not required. Although this review is narrative in nature, the reporting was guided by key elements of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 framework to enhance transparency and clarity of the search and selection process.

Research Question

The research question guiding this review was explicitly formulated as follows: “What is the current evidence regarding the efficacy of soybean and turmeric nanoemulsion formulations in preventing or reducing striae gravidarum (stretch marks) in pregnant or postpartum women?”

Information Sources

A structured literature search was conducted in four major scientific databases Google Scholar, ScienceDirect, Wiley Online Library, and PubMed to ensure broad coverage of biomedical, pharmaceutical, and maternal-health research. These databases were selected to capture studies related to topical nanoemulsions, dermatology, phyto pharmacy, and obstetrics.

Search Strategy

The search was carried out from 9 June to 30 September 2025 using combinations of Indonesian and English keywords. Boolean operators were applied to refine the search, using the following search string: (“stretch marks” OR “striae gravidarum”) AND (“turmeric” OR “curcuma longa”) AND (“soybean” OR “glycine max”) AND (“nanoemulsion” OR “nano formulation”).

Eligibility Criteria

Articles were selected based on the following inclusion criteria: (1) Published between 2020–2025; (2) Written in Indonesian or English; (3) Original research articles (not reviews); (4) Available in full text; and (5) Investigating turmeric, soybean, nanoemulsions, or related formulations relevant to skin regeneration or stretch-mark management. The exclusion criteria included: (1) Review papers, editorials, or conference abstracts; (2) Studies unrelated to stretch marks or nanoemulsion-based formulations; (3) Duplicate publications; and (4) Articles focusing on unrelated dermatological conditions.

Study Selection and Quality Assesment

The literature selection process consisted of several steps. All records were screened by a single reviewer according to the predefined inclusion and exclusion criteria.

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(1) Identification**:** All articles retrieved from the four databases were combined using Mendeley Reference Manager and duplicate records were removed; (2) Screening**:** Titles and abstracts were screened to exclude irrelevant publications; (3) Eligibility Assessment**:** Full texts were reviewed to ensure they fulfilled the predefined eligibility criteria; and (4) Final Selection**:** Eligible articles were included for synthesis and documented in the PRISMA flow diagram.

The complete literature selection process was shown in a PRISMA flow diagram that illustrates the number of articles at each stage of screening, from initial identification to the final articles analyzed. Details of the stages of the process could be seen in Figure 1.

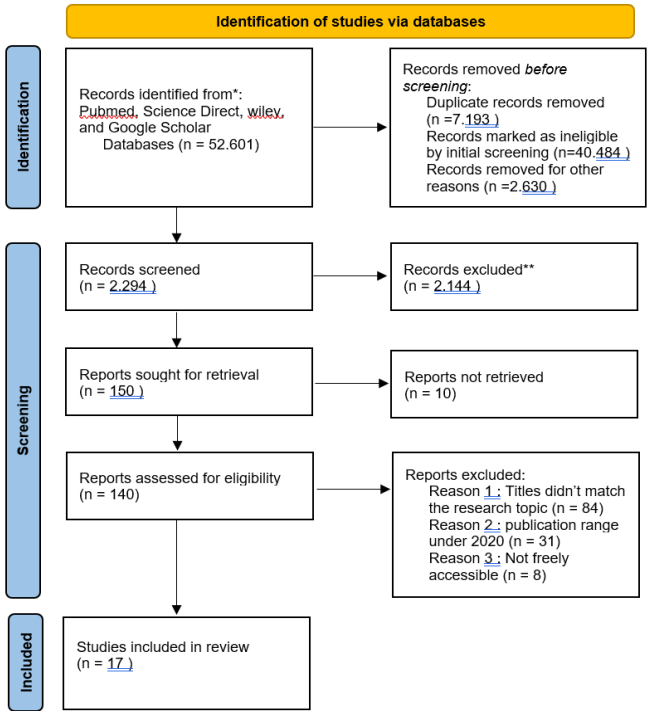

Figure 1. Flow Diagram of Trial Selection Process for Literature Review

After conducting a scientific article search through Google Scholar, Science Direct, Wiley, and PubMed, 17 articles were found that met the inclusion criteria, published between 2020 and 2025.

Data Extraction

Data extraction was conducted using a structured extraction form developed prior to the review process. The following variables were extracted from each included study: (1) Bibliographic information (author, year of publication, country); (2) Study design (in vitro, in vivo, clinical trial, quasi-experimental, randomized controlled trial); (3) Sample characteristics (sample size, model type: pregnant/ postpartum women, animal model, fibroblasts, keratinocytes); (4) Active compounds (e.g., curcumin, turmeric extract, soybean isoflavones, genistein); (5)Type of formulation or delivery system (gel, ointment, nanoemulsion, nanostructured lipid carriers, hydrogel, hybrid nanoparticles); (6) Physicochemical characteristics (particle size, polydispersity index, entrapment efficiency, release profile, stability data); (7) Skin-related outcomes, including striae gravidarum score (e.g., Davey score), collagen deposition or type I collagen expression, skin hydration, wound contraction percentage, angiogenesis markers, and oxidative stress parameters:

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Reactive oxygen species (ROS), Superoxide dismutase (SOD), Glutathione peroxidase (GPX), Catalase (CAT); and (8) Main quantitative findings (mean difference, percentage change, p-value when available). Data extraction was performed by one reviewer and verified through repeated cross-checking of the original articles to ensure accuracy and completeness.

Data Synthesis and Analysis

The included studies were synthesized using a thematic narrative analysis to integrate findings from heterogeneous study designs, formulations, and outcome measures precluded a quantitative meta-analysis. The synthesis was conducted in three analytical stages: (1) Studies were categorized based on study design and evidence level (clinical, in vivo, and in vitro); (2) Findings were synthesized according to formulation strategies, including nanoemulsions, lipid nanocarriers, hydrogels, and topical preparations containing curcumin, soybean derivatives or combination formulations; and (3) Outcomes were analyzed based on skin-related effects, including striae severity reduction, dermal repair, collagen synthesis, antioxidant, and anti-inflammatory activity, and enhancement of dermal penetration.

This structured approach enabled integration of mechanistic, preclinical, and clinical evidence to support interpretation of therapeutic potential of soybean–turmeric nanoformulations for skin regeneration and striae management.

RESULT

Search Results

The database search identified studies published between 2020-2025. After screening and eligibility assessment, 17 studies included in inclusion criteria.

Study Characteristics

The following section presents an overview of the studies included in this review to provide a context for the findings discussed.

Table 1. Characteristics of Included Studies

Category	Number (N)	Percentage (%)
Year of Publication		
2025	5	29.41
2024	3	17.65
2023	6	35.29
2022	2	11.76
2020	1	5.88
Source literature		
National	5	29.41
International	12	70.59
Research Design		
Laboratory Experiment	14	82.35
Quasi Experimental	2	11.76
RCT	1	5.88

Based on Table 1, the publication distribution, the analysis of 17 articles shows an increasing scientific interest over the past five years, with the highest number of publications in 2023 (35.29%), followed by 2025 (29.41%). Most studies were published in international journals (70.59%), while the remaining 29.41% came from national journals. In terms of research design, the majority were pre-clinical laboratory studies (82.35%), including nanoemulsion formulation work, in vitro assays, ex vivo penetration tests, and in vivo animal models. Only two studies evaluated clinical effects in humans, one quasi-experimental study in pregnant women and one randomized controlled trial (RCT) in postmenopausal

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women. The dominance of pre-clinical research indicates that most of the available evidence is still exploratory and cannot yet be generalized to pregnant women or postpartum women, who represent the primary clinical target for stretch-mark prevention. Seventeen studies met the eligibility criteria, comprising three clinical studies, six in vivo studies, four in vitro mechanistic studies, and four formulation optimization studies. A comprehensive summary of the study characteristics and extracted variables was presented in Table 2.

Table 2. Characteristics of Included Studies

No	Author (Year)	Country	Study Design	Model/ Participants	Intervention/ Formulation	Primary Outcome
1	Oktavia et al (2023)	Indonesia	Quasi-experimental	Pregnant women (n=32)	Centella asiatica + Curcuma domestica gel	Davey striae score
2	Nengsih & Khairiah (2023)	Indonesia	Quasi-experimental	Pregnant women (n=30)	Turmeric extract	Striae severity score
3	Rizzo et al (2023)	Italy	RCT	Postmenopausal women (n=44)	Soy isoflavones	Skin hydration, wrinkle score
4	Mahajan et al (2023)	India	In vivo	Rat wound model	Keratin + genistein hydrogel	Wound closure
5	Abdel Mageed et al (2025)	Egypt	In vitro & In vivo	Rats burn wound model	Curcumin hybrid nanoparticles	Particle size (150 nm), EE (90%), wound closure, collagen deposition
6	Ali et al (2022)	Pakistan	In vivo	Diabetic rats	Curcumin + α tocopherol nanoemulsion	Droplet size (26 nm), release collagen, re-epithelialization
7	Chartterjee et al (2022)	India	In vivo	Rat excision model	Curcumin nanohydrogel	Particle size (47 nm), hydroxyproline, Collagen synthesis
8	Garcia et al (2025)	Italy	In vitro & In vivo	Rat wound model (n=63)	Curcumin	Angiogenesis markers, collagen
9	Ma et al (2025)	China	In vivo	Diabetic rats	Composite hydrogel	Angiogenesis markers, Interleukin-10 (IL-10)
10	Leite et al (2023)	Brazil	In vitro & ex vivo	Fibroblast & skin explants	Bio transformed soybean cream	Collagen type I expression
11	Wójciak et al (2024)	Poland	In vitro	Fibroblast & keratinocytes	Soy isoflavones	ROS, SOD, GPX, CAT
12	Prathumwon et al (2025)	Thailand	In vitro	Enzyme assays	Curcumin + EGCG NLC	Collagenase inhibition Entrapment efficiency (EE) (98%), Sirtuin 1 (SIRT1) activity
13	Liakopoulou et al (2025)	Greece	In vitro	Skin cell model	Curcumin nanoformulation	GPX1, SOD1 expression carrier size (122-134 nm), gene expression

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No	Author (Year)	Country	Study Design	Model/ Participants	Intervention/ Formulation	Primary Outcome
14	Ningsih et al (2023)	Indonesia	Experimental	In vitro	Curcumin nanoemulsion	Particle size (132-154 nm), EE (49%)
15	Larasati & Jusnita (2020)	Indonesia	Laboratory	In vitro	Turmeric extract	Antioxidant activity particle size (16-18 nm), IC50 (31 ppm)
16	Tanjungsari et al (2024)	Indonesia	Experimental	In vitro	Centella asiatica nanoemulsion serum	Stability test, antioxidant assay
17	El-Hosary et al (2024)	Egypt	Experimental	Ex vivo skin	Curcumin spanlastic gel	Dermal Penetration depth (112 µm)

The included studies were subsequently synthesized according to the level of evidence and primary biological mechanisms (Table 3).

Table 3. Summary of Main Clinical and Biological Findings

Evidence Category	Main Findings	Representative Studies
Clinical evidence	Topical turmeric preparations significantly reduced striae severity among pregnant women	Oktavia; Nengsih
Clinical evidence	Soy isoflavones improved hydration, elasticity and wrinkle severity	Rizzo
Collagen remodeling	Increased collagen deposition and type I collagen expression	Leite; Chatterjee; Abdel-Mageed
Wound repair	Accelerated wound closure and re-epithelialization	Mahajan; Ali; García
Antioxidant activity	Reduced ROS and preserved antioxidant enzymes	Wójciak; Prathumwon
Angiogenesis	Increased vascularization and ECM remodeling	García; Ma
Dermal penetration	Nanoformulations enhanced penetration through the skin barrier	El-Hosary

Most nanoformulation studies consistently demonstrated improved physicochemical characteristics that may facilitate dermal drug delivery (Table 4).

Table 4. Physicochemical Characteristics of Nanoformulations

Study	Formulation	Particle Size (nm)	Entrapment Efficiency (%)	Main Pharmaceutical Advantage
Ali	Nanoemulsion	26.8	—	Enhanced re-epithelialization
Chatterjee	Nanohydrogel	47	96.2	Increased collagen deposition
Abdel-Mageed	Hybrid nanoparticles	150.5	90.2	Sustained release
El-Hosary	Spanlastic gel	212.8	99.8	Improved dermal penetration
Ningsih	Nanoemulsion	132–154	49	Stable formulation
Larasati	Nanoemulsion	16–18	—	Enhanced antioxidant activity
Prathumwon	Nanostructured lipid carrier	—	98.6	Sustained release
García	Nanohyaluronan glycerosomes	543	80	Long-term stability

Clinical Evidance

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Among the 17 included studies, only three (17.6%) investigated botanical interventions in human participants. Two quasi-experimental studies involving pregnant women demonstrated significant reductions in *striae gravidarum* severity following topical turmeric-based formulations. One study reported a significant improvement in the Davey striae score after treatment with a gel containing *Centella asiatica* and *Curcuma domestica*, while another observed decreased striae gravidarum severity after 14 days of topical turmeric ointment application. In addition, one randomized controlled trial involving postmenopausal women found that oral soybean isoflavone supplementation significantly improved skin hydration by 39–68% and reduced wrinkle severity compared with baseline.

Although these findings suggest that botanical compounds may improve skin quality and dermal integrity, the available clinical evidence remains limited. Importantly, no randomized controlled trials have evaluated nanoformulated turmeric, soybean, or combined turmeric–soy formulations specifically for the prevention or treatment of *striae gravidarum*. Likewise, no clinical studies have assessed the efficacy or safety of these nanoformulations in postpartum women, who represent another key target population for stretch-mark management.

Preclinical Evidence

Preclinical investigations accounted for the majority of the included studies (14/17; 82.4%), comprising in vivo wound-healing models and mechanistic in vitro experiments. Overall, these studies consistently demonstrated the regenerative potential of curcumin and soybean-derived bioactive compounds.

Eleven studies (64.7%) reported that curcumin enhanced endogenous antioxidant defenses, suppressed inflammatory pathways, and stimulated collagen synthesis. Nanoformulated curcumin also promoted accelerated wound closure, increased angiogenesis, enhanced re-epithelialization, and improved extracellular matrix remodeling. Several studies further demonstrated significant reductions in oxidative stress through decreased reactive oxygen species (ROS) generation and preservation of endogenous antioxidant enzymes, including superoxide dismutase (SOD), glutathione peroxidase (GPX), and catalase (CAT).

Four studies (23.5%) evaluating soybean-derived isoflavones demonstrated increased type I collagen synthesis, with collagen expression improving by up to 43.9% in ex vivo skin models. Soy isoflavones also reduced oxidative stress, preserved fibroblast viability, and maintained skin elasticity through β-estrogen receptor-mediated pathways.

Overall, curcumin-based nanoformulations consistently demonstrated stronger antioxidant activity, collagen stimulation, dermal regeneration, and wound-healing effects than soybean-derived formulations across preclinical models. Nevertheless, soybean isoflavones provided complementary regenerative benefits through collagen synthesis and oxidative stress reduction. Although these biological mechanisms suggest potential synergistic interactions between curcumin and soybean isoflavones, no study has directly evaluated a combined turmeric–soy nanoformulation; therefore, any synergistic effect remains hypothetical.

Formulation Evidence

Eight formulation-oriented studies evaluated the physicochemical characteristics and drug-delivery performance of nanoscale systems, including nanoemulsions, nanostructured lipid carriers (NLCs), spanlastic vesicles, nanohydrogels, and hybrid nanoparticles. Across these studies, nanoformulations consistently demonstrated favorable physicochemical properties, with particle sizes generally below 250 nm, low polydispersity indices (approximately 0.20–0.45), and high encapsulation efficiencies exceeding 80–90%.

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These optimized physicochemical characteristics improved formulation stability, enhanced the aqueous solubility of curcumin, and enabled sustained drug release. Moreover, nanoscale delivery systems substantially increased dermal penetration compared with conventional formulations. For example, spanlastic vesicles achieved penetration depths of up to 112.5 μm, whereas nanoemulsions and lipid nanocarriers demonstrated enhanced skin permeation and improved bioavailability of encapsulated phytochemicals.

Collectively, these findings indicate that limited solubility, poor chemical stability, and inadequate dermal penetration represent major barriers to the therapeutic effectiveness of conventional botanical preparations. Nano-enabled delivery systems effectively overcome these limitations by enhancing drug penetration, maintaining sustained release, and improving the biological activity of curcumin and soybean-derived bioactive compounds.

Overall Evidence Synthesis

Overall, the included evidence indicates that nanoformulated curcumin demonstrates greater preclinical efficacy than soybean-derived formulations, particularly in enhancing dermal penetration, antioxidant activity, collagen synthesis, and tissue regeneration. Soybean-derived isoflavones primarily provide complementary regenerative effects by promoting collagen production, preserving skin elasticity, and reducing oxidative stress. Despite these promising mechanistic and preclinical findings, the available clinical evidence remains insufficient to support routine clinical application.

Of the 17 included studies, 82.4% were preclinical, whereas only 17.6% involved human participants, highlighting a substantial translational gap between laboratory findings and clinical practice. Furthermore, no study has investigated a combined turmeric–soy nanoemulsion, and none has specifically evaluated its efficacy and safety in pregnant or postpartum women, the populations most affected by *striae gravidarum*.

These findings emphasize the need for well-designed randomized controlled trials, standardized dermatological outcome measures, and comprehensive safety evaluations before nanoformulated turmeric–soy preparations can be recommended as evidence-based interventions for the prevention or management of *striae gravidarum*.

DISCUSSION

The findings from seventeen analyzed studies demonstrate consistent evidence regarding the effectiveness of the natural ingredient's turmeric (*Curcuma longa*) and soybean (*Glycine max)*, as well as the crucial role of nanotechnology in enhancing their stability, dermal penetration, and biological activity. In general, available evidence indicates that the active ingredients of soy and turmeric have great potential to support regeneration of the dermis, increase skin elasticity, and reduce tissue damage caused by skin stretching, which underlies the formation of striae gravidarum. This review is the first to synthesize evidence on turmeric-soybean bioactive compounds and nanotechnology-based delivery systems within the specific context of maternal skin changes and striae gravidarum. By integrating dermatological, pharmacological, and obstetric perspectives, this review provides a translational framework for developing evidence based topical interventions suitable for pregnant and postpartum women.

Clinical Effectiveness of Natural Ingredients in Human Population

Three clinical studies make important contributions to the understanding of the effectiveness of such natural ingredients on human skin. The use of Centella Asiatica Curcuma domestica combination gel was shown to significantly reduce Davey scores in primigravid women within 14 days.(15) Similar findings were reported by Nengsih and Khairiah (2023), who showed that turmeric ointment was able to lower striae scores from

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16.03 to 8.97 (p=0.000).(11) On the other hand, consumption of soy protein with high isoflavone content has been shown to improve hydration, decrease wrinkles, and improve pigmentation in postmenopausal women.(10) These findings confirm that both natural ingredients have strong biological activity on human skin through antioxidant, anti-inflammatory, and fibroblast activity and collagen synthesis.

Advantages of Nanotechnology Based Topical Delivery Systems

Most publications reviewed showed that nanotechnology including nanoemulsions, nanostructured lipid carriers (NLC), spanlastics, hybrid nanoparticles, and nanohyaluronan glycerosomes significantly improve the topical performance of active ingredients. Most studies report particle sizes <250 nm, low polydisperse index (PDI) values (~0.2-0.4), and high encapsulation efficiency (EE) (87-99.8%). (16,17,18) Spanlastic formulations of curcumin show much deeper dermal penetration, reaching 112.5 µm versus 15.5 µm in non-nano preparations.(19) The hybrid system of nanoparticles and NLCs also allows for gradual release of up to 24-48 hours, enhances skin retention, and maintains active compound stability.(18,20) This advantage answers the main obstacles of conventional herbal formulations, namely low dermal penetration, rapid degradation of active ingredients due to oxidation, as well as low bioavailability.

Biological Effects on Dermal Regeneration and Oxidative Stress

The seventeen articles collectively show a consistent trend towards improved dermal regeneration. Biotransformed soy cream increases collagen type I by 43.89% in human skin explants (21), while curcumin nanoformulations enhance angiogenesis through increased expression of CD31 and α-SMA, decreased inflammation (decreased IL-6, increased IL-10), as well as accelerated wound epithelialization by 96.47%. (22,23,24) Isoflavones such as coumestrol and biochanin A can significantly decrease ROS production in fibroblasts and keratinocytes.(25), highlighting the strong antioxidant potential of soybean-derived isoflavones. In addition, genistein in hydrogel formulations suggest the ability to accelerate wound healing and suppress inflammatory mediators.(26) The combination of curcumin and Epigallocatechin gallate (EGCG) in the NLC system even elicits synergistic effects through increased SIRT1 activity and suppression of collagen-destroying enzymes.(18)

Safety of Nanoformulations in Pregnancy and Postpartum Women

Safety aspects are important material of consideration in the context of striae gravidarum. Two clinical studies in pregnant women reported no significant adverse events during the use of saffron-based gels or ointments.(11,15) Nanoformulations based on natural ingredients such as *Centella asiatica* have also been shown to cause no irritation in animal tests.(7) However, the long-term evidence for the use of nanosystems in obstetric populations is still very limited and requires further investigation. The synthesis of these results highlights several reasons why the handling of striae gravidarum is still not optimal. First, conventional topical preparations have low dermal penetration and cannot reach the dermis, the layer where collagen and elastin damage occur. Secondly, herbal active ingredients such as curcumin and isoflavones are easily degraded by light, heat, and oxygen. Third, most commercial products that are claimed to be effective do not have strong scientific evidence, especially in pregnant women. Therefore, the turmeric-soybean nanoemulsion approach has provides a sound scientific rationale as it is able to enhance dermal penetration, active ingredient stability, and therapeutic activity.

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Clinical and Theoretical Implications

Clinically, turmeric–soy nanoemulsion formulations may represent a potentially safe topical strategy; however, clinical evidence remains insufficient to confirm long-term maternal safety for pregnant and postpartum women. This formulation may serve as a more physiologically compatible plant-based alternative in improving skin elasticity and reducing the risk of striae formation. Theoretically, the results of this review reinforce the relationship between phytoestrogenic activity of isoflavones, regenerative abilities of curcumin, and biological changes of maternal skin during pregnancy, while affirming the strategic value of nanotechnology in phytochemical-based dermatological therapy.

Importantly, most dermatological studies focused on cosmetic outcomes such as anti-aging, wrinkle reduction, and hydration improvement, whereas obstetric applications require safety, tolerability, and long-term maternal and fetal safety considerations. Skin stretching during pregnancy involves hormonal, mechanical, and connective tissue remodeling processes that differ from photoaging or wound healing, indicating that cosmetic findings cannot be directly extrapolated to striae gravidarum.

Previous systematic reviews have examined the dermatological benefits of curcumin nanoformulations and soy isoflavones separately, particularly in anti-aging and wound healing contexts. However, no prior review has integrated these bioactive compounds within a nanotechnology framework specifically targeting maternal skin changes and striae gravidarum. Therefore, this review extends the existing literature by bridging pharmacological evidence with obstetric dermatology needs. Overall, curcumin-based nanoformulations demonstrated stronger evidence for dermal penetration, anti-inflammatory activity, and collagen remodeling, whereas soybean-derived formulations primarily contributed to antioxidant protection and elasticity preservation.

Comparative Interpretation of Findings

Although most studies reported beneficial effect, differences in outcomes were observed depending on formulation type, study model, and outcome measures. Curcumin based nanoformulations consistently demonstrated stronger dermal penetration, anti-inflammatory activity, and collagen stimulation compared with soybean derived formulations, which primarily exerted antioxidant and phytoestrogenic effects on skin elasticity. Variability in physicochemical properties, including particle size, encapsulation efficiency, and carrier composition, contributed to differences in biological performance across studies. For instance, spanlastic and nanostructured lipid carriers showed deeper dermal penetration than conventional nanoemulsions, whereas hydrogel-based systems provided prolonged release and enhanced wound healing.

Limitations of Review and the Next Research

As a narrative review, the findings of this study are influenced by the heterogeneity of study designs, variations in formulation methods, and differences in outcome parameters across the included studies. Most of the available evidence derives from in vitro and in vivo investigations, while clinical data remain limited. Only a small number of human studies have evaluated botanical interventions for striae or skin regeneration, and no randomized controlled trials have examined combined turmeric–soybean nanoemulsion formulations. Consequently, the generalizability and clinical applicability of the conclusions remain restricted. Because screening and data extraction were conducted by a single reviewer, the possibility of selection bias cannot be entirely excluded. In addition, the synthesis process relied on narrative thematic interpretation, which may introduce subjectivity in categorizing formulation characteristics and skin-related outcomes. The absence of standardized reporting across primary studies limited the uniform extraction and comparison of key

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variables, while incomplete methodological details in several articles constrained cross-study comparability and the depth of analysis.

Future research should focus on optimizing nanoemulsion formulations to enhance stability, penetration efficiency, and controlled release characteristics. Ex vivo dermal penetration studies and comprehensive toxicological safety evaluations are necessary to confirm dermal delivery performance and safety profiles. Moreover, early-phase clinical trials involving pregnant and postpartum women are essential to determine efficacy and safety in obstetric populations. These studies should incorporate objective and standardized outcome measures, including validated striae severity scores, dermal thickness, collagen density, skin elasticity, and transepidermal water loss (TEWL), to strengthen clinical relevance and support evidence-based application.

CONCLUSION

Based on an analysis of 17 studies published between 2020 and 2025, this review suggests that turmeric (*Curcuma longa L.*) and soybean (*Glycine max*) possess complementary biological properties that may support the prevention and management of striae gravidarum. Curcuminoids and soybean-derived isoflavones demonstrated antioxidant, anti-inflammatory activities, and collagen-stimulating activities that contribute to dermal remodeling and extracellular matrix protection. Nanoemulsion and other nanocarrier systems were consistently associated with improved physicochemical stability, dermal penetration, and bioavailability of these bioactive compounds.

Although the available evidence suggests promising therapeutic potential, most most findings are derived from preclinical studies, and direct clinical evidence in pregnant and postpartum women remains limited. Importantly, no published study has yet evaluated a combined turmeric–soybean nanoemulsion formulation for the prevention or treatment of striae gravidarum. Therefore, the proposed synergistic benefits remain hypothetical and require experimental confirmation. future studies should prioritize the development and optimization of combined turmeric–soybean nanoemulsions formulations, followed by rigorous preclinical evaluation and well-designed clinical trials assessing efficacy, dermal penetration, physicochemical stability, maternal safety, and long-term outcomes. Such evidence will be essential before these formulations may serve as recommended for routine clinical application in maternal skin care.

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There is no conflict of interest.

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