

The effectiveness of herbal remedies in preventing striae gravidarum: A systematic review and meta-analysis

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ABSTRACT

Background: Striae gravidarum is a common skin condition that affects approximately 60–90 % of pregnant women. This systematic review aimed to evaluate the effectiveness of herbal remedies in preventing stretch marks during pregnancy.

Methods: A comprehensive literature search was conducted in PubMed, Cochrane Library, Embase, Scopus, and SID databases for studies published between January 1972 and May 2024. Randomized controlled trials (RCTs) assessing the preventive effects of herbal remedies—including oils, creams, and plant-based extracts—on pregnant women were included. Data were analyzed using RevMan software, and meta-analysis was performed using fixed-effect or random-effects models based on the degree of heterogeneity. Subgroup analysis was performed based on the type of herbal remedies on incidence (primary outcome) and itching and erythema (secondary outcomes).

Results: A total of 12 randomized controlled trials involving 1956 pregnant women were included. Herbal treatments such as Aloe vera gel, sweet almond oil, and sesame oil showed a significant reduction in the incidence of stretch marks compared to placebo (12 studies, $n = 1956$; OR = 0.47, 95 % CI: 0.28–0.79, $p = 0.004$). In addition, four subgroup analyses from four distinct studies ($n = 601$) demonstrated that herbal products significantly reduced the incidence of itching compared to controls (OR = 0.09, 95 % CI: 0.03–0.30, $p < 0.00001$), while two studies ($n = 139$) showed a significant reduction in erythema incidence in the intervention groups (OR = 0.17, 95 % CI: 0.07–0.38, $p < 0.0001$).

Conclusion: Although some herbal remedies, especially Aloe vera, Sweet Almond oil and Sesame oil have high potential for the prevention and management of stretch marks, the heterogeneity in the studies' design and results indicates the need for more high-quality research.

1. Introduction

Pregnancy striae, also known as stretch marks, are one of the most common skin changes occurring during pregnancy, affecting approximately 60–90 % of pregnant women [1,2]. These marks typically appear as fine, linear, and parallel lesions, predominantly located on the abdominal region, although they may also develop on the breasts, hips, and thighs [3]. The exact pathophysiology of striae gravidarum remains unclear. However, several mechanisms have been proposed, including mechanical stretching of the skin as the uterus enlarges, hormonal influences such as increased levels of estrogen, cortisol, and relaxin, and underlying genetic predisposition [4–6]. Additionally, a range of risk

factors may increase the likelihood of developing these lesions. These include younger maternal age, higher pre-pregnancy body mass index (BMI), carrying multiple fetuses, delivering a high birth-weight infant, and having a family history of striae gravidarum [7].

Although striae gravidarum do not pose any physical health risk, they are often perceived as cosmetically undesirable and may cause considerable emotional distress for affected women [8,9]. The appearance of these marks can negatively impact body image and self-esteem, leading to psychological discomfort and reduced self-confidence during pregnancy [7,10]. Given the emotional sensitivity of this period, addressing such concerns is important not only for maternal well-being but also for fetal health. Maternal stress has been associated with

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adverse pregnancy outcomes, including preterm birth and low birth weight [11].

Preventing stretch marks can help improve the quality of a mother's life after childbirth [12,13]. Stretch marks can cause pain and discomfort and may require further medical treatment. Prevention of striae can help reduce treatment costs associated with this problem [1].

Although a definitive cure for striae has not yet been established [14, 15], regular exercise, adequate fluid intake, and proper nutrition can help reduce the likelihood of its occurrence [16]. There are modern treatment methods such as laser therapy, skin shaving, and tretinoin therapy [2]. In addition to being expensive, these methods may also have side effects and require multiple treatment sessions [15]. For this reason, more research has focused on its prevention, and several studies have investigated the effect of oiling and hydrating the skin by using oils and creams [17,18].

Recently, much attention has been drawn to the use of herbal methods for the prevention and treatment of pregnancy striae. These methods have received more attention due to their natural properties, low risk, and fewer side effects compared to chemical methods. Among the herbs and herbal compounds that have been studied in this area, one can refer to almond oil, olive oil, cocoa butter, and various herbal extracts [19]. Clinical studies have not only investigated the effect of these compounds in preventing striae but also evaluated their safety and possible side effects.

Given the increasing use of herbal remedies and the need for scientific validation, a systematic review was conducted to evaluate their effectiveness in preventing striae gravidarum. A systematic review of the existing literature can help identify the best herbal methods, evaluate their effectiveness and safety, and provide suggestions based on the current evidence.

This systematic review evaluates the effectiveness of herbal remedies in preventing and managing stretch marks during pregnancy. This review will try to identify the best herbal remedies, evaluate their effectiveness, and provide suggestions based on the existing evidence.

2. Methods

2.1. Study registration

This systematic review was registered on November 2, 2024 with registration number: This study did not require ethical approval as it is a systematic review based on previously published studies. All included studies in this review had obtained ethical approval from their respective institutions.

2.2. Study design

This study evaluates the efficacy of herbal remedies in preventing stretch marks (striae gravidarum) during pregnancy. The objective is to compare the effectiveness of herbal treatments including Aloe vera gel, Sweet Almond oil and Sesame oil to a placebo or no therapy in terms of reducing the prevalence of stretch marks and easing their accompanying symptoms, such as erythema and itching.

Only studies that offered adequate information on the outcomes of interest were included in the meta-analysis; the other papers were chosen based on predetermined inclusion and exclusion criteria. To maintain methodological transparency and to minimize the risk of bias, this review complies with the PRISMA criteria

2.3. Search strategy

The initial search was conducted in the Cochrane database using the keywords "Stretch Marks," "Pregnancy," "Herbal Remedies," "Prevention," and "Randomized Controlled Trial."

Subsequently, a comprehensive review of English –Language databases, including PubMed, Embase, Cochrane Library, Scopus, and

Google Scholar, as well as the Persian SID database, was undertaken to identify human clinical trials published between January 1972 and May 2024.

2.4. Search strategy in PubMed

("Stretch Marks"[Mesh] OR "Striae Gravidarum"[All Fields] OR "Pregnancy Stretch Marks"[All Fields]) AND ("Pregnancy"[Mesh] OR "Pregnant Women"[All Fields]) AND ("Herbal Medicine"[Mesh] OR "Plant Extracts"[All Fields] OR "Herbal Oils"[All Fields] OR "Creams"[All Fields] OR "Lotions"[All Fields]) AND ("Randomized Controlled Trial"[Publication Type] OR "RCT"[All Fields]) AND ("1972/01/01"[PDAT]: "2024/05/31"[PDAT])

3. Eligibility criteria

3.1. Study types

Only randomized controlled trials (RCTs) were included. Observational studies, systematic reviews, single-arm trials, case reports, and studies without a control group were excluded.

3.2. Participants

Pregnant women in their second or third trimester were included. If gestational age was not explicitly mentioned, studies were included if the majority of participants were within this gestational range. Participants with pre-existing chronic dermatologic conditions (e.g., psoriasis, atopic dermatitis) or systemic illnesses known to affect skin integrity (e.g., uncontrolled diabetes, autoimmune diseases) were excluded.

3.3. Interventions

Interventions consisted exclusively of herbal products (including oils, creams, gels, extracts, or supplements) with no additional active pharmacological or synthetic ingredients. Studies combining herbal treatments with other therapies (e.g., massage, pharmaceuticals, or physical interventions) were excluded. Trials comparing two or more herbal-based products were eligible for inclusion.

3.4. Comparators

Included studies used placebo, a base cream/vehicle, or no intervention in the control group.

3.5. Outcome measures

The primary outcome was the prevention of striae gravidarum. Secondary outcomes included the incidence or severity of itching and erythema in striae-prone areas. Itching was most commonly assessed using the Kamini scale, while erythema was primarily evaluated using the Atwal scoring system. In some studies, erythema was assessed based on clinical observation without standardized scales.

3.6. Selection process

Study selection was conducted using EndNote X9 for systematic organization and duplicate removal. After conducting searches across relevant databases, all retrieved records were imported into the software. Duplicates were identified and removed automatically. The remaining unique articles were screened based on titles and abstracts, and those unrelated to the topic were excluded.

3.7. Data extraction

The extracted data included the study design, participants, sample

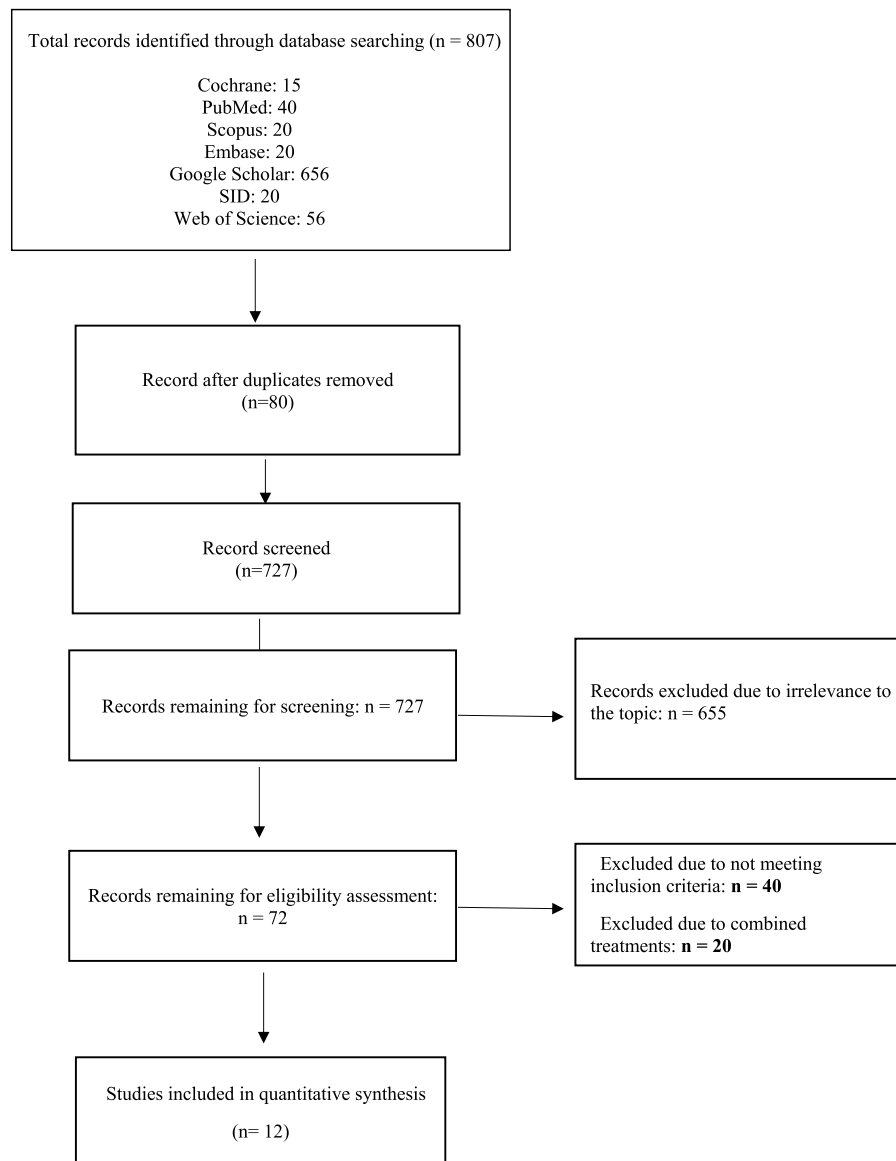


Fig. 1. PRISMA flow diagram of article selection progress.

size, details of the intervention and control, duration, method of blinding, outcome measures, assessment tools, and main findings including effect estimates by two reviewers (M.R. and K.H.) using a standardized data extraction.

3.8. Quality of evidence assessment

The quality of evidence for each outcome was evaluated based on the GRADE framework. Two reviewers (M.R. and K.H.) independently conducted the assessments.

3.9. Risk of bias assessment

Risk of bias in the included randomized controlled trials was evaluated using the Cochrane Risk of Bias Tool (ROB-1). Inconsistency was assessed by examining heterogeneity through both forest plots and the I^2 statistic, with values above 60 % indicating considerable heterogeneity. Indirectness was examined by ensuring that the population, interventions, comparators, and outcomes in the included studies aligned with the objectives.

Imprecision was judged by examining the width of the 95 %

confidence intervals and the number of participants contributing to each outcome. Publication bias was assessed using funnel plots for outcomes with ten or more studies; asymmetry in these plots was interpreted as possible evidence of bias. In cases where serious or very serious concerns were identified in any domain, the certainty of the evidence was downgraded accordingly.

3.10. Statistical analysis and data synthesis

Data were analyzed using RevMan software and meta-analysis was performed using fixed or random effect models depending on the heterogeneity of the studies. The researchers assessed the heterogeneity of the studies using I^2 statistics. In cases where the heterogeneity was high (75 %), random effect analysis was used. Similarly, subgroup analysis was performed based on the type of herbal remedies on incidence (primary outcome) and itching and erythema (secondary outcomes).

Table 1
A summary of the characteristics and results of the reviewed studies.

Author(s) & Year	Type of Study	Country (City)	Patient's Age	Intervention Groups	Dosage	Duration of Use	Groups Included in Meta-analysis	No. of patients in each group	Type of Blinding	Diagnosis method	Results ^d
Solt Kirca [20]	RCT ^a	Turkey (Istanbul)	20–30	G1 ^b : Olive oil G2 ^b : Control	10 cc twice daily, no massage	Week 28–37	Olive oil vs. Control	78 Intervention, 78 Control	Double	Davey ^c	Significant reduction in the incidence of striae
Hajhashemi [24]	RCT	Iran (Arak)	20–35	G1: Aloe vera G2: Sweet Almond Oil G3: Basic Cream G4: Control	1 cc twice daily, no massage	20 weeks (week 16–36)	Aloe vera vs. placebo; Almond oil vs. placebo	Out of 160 individuals, 149 completed the study	Double	–	Significant reduction in Itching and erythema
Osman [31]	RCT	Lebanon (Beirut & Tripoli)	Unspecified	G1: Cacao cream, 91 persons G2: Placebo, 84 persons	Applied daily	Week 12–18 to delivery	Cocoa butter vs. placebo	175 individuals out of 210 completed this study	Double	–	There was no significant difference in the incidence of striae
Buchanan [30]	RCT	Jamaica (Kingston)	–	G1: Cacao Cream G2: placebo	Half cap-full daily on abdomen	From < 16 weeks to delivery	Cocoa butter vs. placebo	300 female (150 in each group)	Double	–	Significant reduction of striae
Soltanipour, [22]	RCT	Iran (Tehran)	20–30	G1: Olive oil G2: Saj cream G3: Control	1 cc or 2 g twice daily, no massage	Week 18–20–38–40	Olive oil vs. control; Saj cream group not included in meta-analysis	150 females (50 in each group)	Double	Davey	There was no significant difference in the incidence of striae
Bagherian [27]	RCT	Iran (Tehran)	2–35	G1:Aloe vera Gel G2: Placebo G3: Control	3 tubes total (each 100 ml); used twice daily	From 20th week to 28th week of pregnancy	Aloe vera vs. placebo	90 individuals	Double	Davey	Significant reduction of striae
Jiropas [28]	–	Thailand	16–40	G1: Aloe vera; 81 individuals G2: Base cream; 68 individuals	Applied topically twice daily	From second trimester until delivery	Aloe vera vs. base cream	155 individuals out of 180 who randomly assigned into the groups	unknown	–	There was no significant difference in the incidence of striae
Sadat [26]	RCT	Iran (Kashan)	24.98 ± 4.75	G1: Sesame oil G2: Sweet almond oil G3: Placebo	1 ml twice daily with 5-min massage		Sesame oil vs. placebo; Almond oil vs. placebo	165 females (55 in each group)	Double	Davey	There was no significant difference in the incidence of striae
Mirzaei [29]	RCT	Iran (Arak)	18–35	G1: Sesame oil G2: Rose oil G3: Placebo	1 g, twice daily, topically (2 g/day)	From 16th to 36th week of pregnancy (20 weeks)	Sesame oil vs. placebo; Rose oil vs. placebo	150 females (50 in each group)	Double	Davey	There was no significant difference in the incidence of striae
Malakouti, [25]	RCT	Iran (Kashan)	18–35	G1: Sesame oil G2: Sweet almond oil G3: combination of Sesame oil&Sweet almond G4: Placebo	1 ml twice daily, no massage	From week 16 to week 36 of gestation	Sesame oil vs. placebo; Almond oil vs. placebo; Combination vs. placebo	200 females (50 in each group)	Double	Davey	There was no significant difference in the incidence of striae
Soltanipour, [21]	RCT	Iran (Tehran)	20–30	G1: Olive oil G2: Control	1 cc twice daily, no massage	Week 18–20 to delivery	Olive oil vs. placebo	100 first-time pregnant women	Double	Davey	There was no significant difference in the incidence of striae
Taavoni [23]	RCT	Iran (Tehran)	20–30	G1: Olive oil G2: Control	Twice daily topical application	Week 18–20–28	Olive oil vs. control	70 pregnant women	unknown	–	There was no significant difference in the incidence of striae

^a : RCT: Randomized Controlled Trial

^b : G1, G2, etc.: Group 1, Group 2, etc.

^c : Davey: A scoring system used to assess the severity of stretch marks

^d : "Results are based on statistical comparison of intervention groups with controls using odds ratios (OR) and 95 % confidence intervals (CI)."

Table 2
Effect of herbal medicine compared with a control group on the incidence of stretch mask.

Quality assessment								Certainty
1. Effect of herbal medicine compared with a control group on the incidence of stretch mask								
No. of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	OD (95 % CI)*	Certainty
Olive oil versus placebo								
4	Randomized Controlled Trials	Serious	No serious	No serious	No serious	Undetected	1.07 [0.71–1.61]	Moderate ⊕⊕⊕○
Almond oil versus placebo								
3	Randomized Controlled Trials	Serious	Serious	No serious	Serious	Undetected	0.29 [0.05–1.56]	Very low ⊕○○○
Aloe vera oil versus placebo								
3	Randomized Controlled Trials	Serious	Serious	No serious	Serious	Undetected	0.24 [0.04–1.26]	Very low ⊕○○○
Seasame oil versus placebo								
3	Randomized Controlled Trials	No serious	No serious	No serious	Serious	Undetected	0.37 [0.05–2.52]	Moderate ⊕⊕⊕○
Rose mil versus placebo								
1	Randomized Controlled Trials	No serious	No serious	No serious	Serious	Undetected	1.00 [0.43–2.32]	Moderate ⊕⊕⊕○
Sesame and almond oil versus placebo								
1	Randomized Controlled Trials	No serious	No serious	No serious	Serious	Undetected	0.04 [0.01–0.10]	Moderate ⊕⊕⊕○
Cocoa butter versus placebo								
2	Randomized Controlled Trials	No serious	No serious	No serious	No serious	Undetected	0.91 [0.61–1.36]	High ⊕⊕⊕⊕
2. - Effect of herbal medicine compared with control group on itching of stretch mask								
No. of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	OD (95 % CI)*	Certainty
Almond oil versus placebo								
2	Randomized Controlled Trials	Serious	Serious	No serious	Serious	Undetected	0.16 [0.08–0.31]	Very low ⊕○○○
Seasame and almond oil versus placebo								
1	Randomized Controlled Trials	No serious	No serious	No serious	Serious	Undetected	0.22 [0.09–0.53]	Moderate ⊕⊕⊕○
Seasame oil versus placebo								
2	Randomized Controlled Trials	No serious	No serious	No serious	Serious	Undetected	0.19 [0.11–0.35]	Moderate ⊕⊕⊕○
Aloe vera oil versus placebo								
2	Randomized Controlled Trials	Serious	Serious	No serious	Serious	Undetected	0.05 [0.02–0.12]	Very low ⊕○○○
3. - Effect of herbal medicine compared with control group on itching of stretch mask								
No. of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	OD (95 % CI)*	Certainty
Aloe vera and almond oil versus placebo								
2	Randomized Controlled Trials	Serious	No serious	No serious	Serious	Undetected	0.17 [0.07–0.38]	Low ⊕⊕○○

* Odds Ratio (95 % Confidence Interval)

4. Results

4.1. Study selection

The titles and abstracts of the identified articles were examined, and duplicate records were eliminated. Initially, a total of 807 articles were identified, of which 70 duplicates were excluded after importing them into Endnote. From the remaining 737 articles, 600 titles, 106 abstracts, and 31 full texts were thoroughly reviewed. As a result, 725 studies were excluded: 713 were irrelevant to the topic, and 12 did not satisfy the inclusion criteria. In conclusion, a total of 12 studies were incorporated into the meta-analysis (Fig. 1).

4.2. Characteristics of included studies

Table 1 summarizes the characteristics of all studies included in this systematic review that investigated the use of herbal remedies for the prevention of stretch marks.

4.3. The overall certainty of the evidence

The evidence for the degree of outcome was moderate, so it is possible to recommend using herbal medicine for stretch masks (Table 2).

4.4. Risk of bias assessment

Only a single study exhibited a low risk of bias across all assessed domains. Around 50 % had an unclear risk related to the blinding of participants and staff, with about 15 % exhibiting a high risk. Additionally, some studies showed a high risk of bias in blinding and outcome evaluation. Nearly 85 % of the studies had a low risk of bias concerning outcome evaluation. Regarding selective reporting, the majority of studies (over 90 %) exhibited a low risk of bias (Figs. 2, 3). Fig. 4

4.5. Main findings

This study provides compelling evidence for the effectiveness of herbal remedies in the prevention of stretch marks, as well as alleviating associated symptoms such as itching and erythema. Key findings include:

4.6. Prevention of stretch marks

Herbal interventions significantly reduced the incidence of stretch marks compared to placebo (OR = 0.47; 95 % CI: 0.28–0.79; p = 0.004). This emphasizes the potential of natural remedies as effective alternatives to conventional treatments in managing this common pregnancy-related condition.

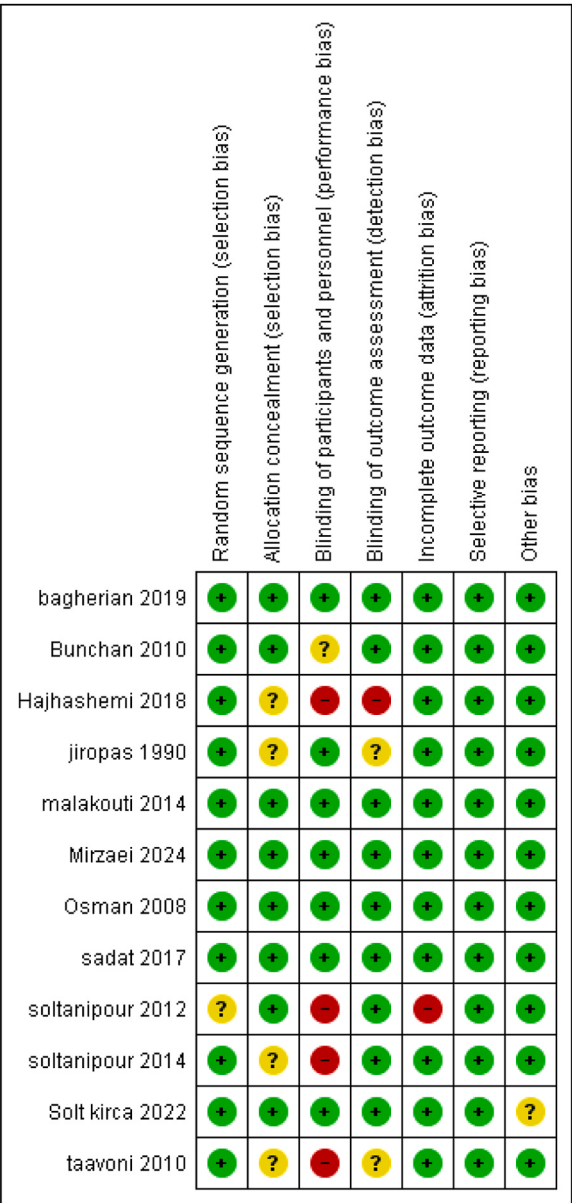


Fig. 2. Detailed visualization of bias domains in included studies, indicating the percentage of studies at low, unclear, and high risk for each type of bias, such as sequence generation, allocation concealment, blinding, incomplete outcome data, selective reporting, and others.

4.7. Secondary outcomes – itching and erythema

Itching: There was a statistically significant reduction in the incidence of itching among participants receiving herbal interventions compared to controls (OR = 0.09, 95 % CI: 0.03–0.30, $p < 0.00001$) (Fig. 5). This finding highlights the effectiveness of herbal remedies in improving comfort and reducing pruritus associated with striae gravidarum.

Erythema: Similarly, erythema was significantly reduced in the herbal treatment groups compared to control (OR = 0.17, 95 % CI: 0.07–0.38, $p < 0.0001$) (Fig. 6). These results suggest that herbal interventions provide not only preventive but also therapeutic benefits for managing skin inflammation related to stretch marks.

Effectiveness of Specific Interventions: Among the different herbal remedies evaluated, Aloe vera Gel demonstrated a statistically significant reduction in erythema (OR = 0.19; 95 % CI: 0.06–0.60; $p = 0.005$), confirming its effectiveness in alleviating skin inflammation

associated with striae gravidarum. Similarly, Sweet Almond Oil showed a significant effect in reducing erythema (OR = 0.14; 95 % CI: 0.04–0.48; $p = 0.002$). In terms of prevention, the combination of Sesame and Almond Oil exhibited remarkable effectiveness in reducing the incidence of stretch marks (OR = 0.03; 95 % CI: 0.01–0.10; $p < 0.001$), suggesting a possible synergistic effect. Additionally, Sweet Almond Oil used alone also significantly reduced the risk of developing striae gravidarum (OR = 0.16; 95 % CI: 0.08–0.31; $p < 0.001$), highlighting its preventive potential.

4.8. Subgroup analysis

4.8.1. Incidence of stretch marks (Fig. 4)

Olive oil: Solt Kirca et al. [20] conducted a randomized controlled trial with 156 pregnant women and reported that although the incidence of striae gravidarum was lower in the olive oil group compared to the control group, there was no statistically significant difference between the two groups (OR = 1.67; 95 % CI: 0.68–4.08). Similarly, Soltanipour et al. [21] evaluated 100 pregnant women and found no statistically significant difference in the incidence of striae gravidarum between the intervention group using olive oil and the control group (OR = 0.84; 95 % CI: 0.38–1.89). Another trial by Soltanipour et al. [22] on 150 primiparous women compared olive oil, Saj cream, and placebo, and found no significant difference among the three groups in either the incidence or severity of striae gravidarum (OR = 1.19; 95 % CI: 0.53–2.66). Likewise, Taavoni et al. [23] conducted a study on 70 pregnant women and found no statistically significant difference in the occurrence of striae gravidarum between the olive oil group and the control group (OR = 1.07; 95 % CI: 0.71–1.61). Taken together, the pooled analysis (Fig. 4) confirmed that olive oil did not significantly reduce the incidence of striae gravidarum (pooled OR = 1.07; 95 % CI: 0.71–1.61; $p = 0.76$), indicating that it may not be an effective intervention for preventing stretch marks during pregnancy.

4.8.2. Almond Oil

Hajhashemi et al. [24] reported that sweet almond oil was significantly more effective than base cream in preventing the development of striae gravidarum (OR = 0.04; 95 % CI: 0.01–0.21), indicating a strong protective effect. Similarly, Malakouti et al. [25] demonstrated a statistically significant reduction in the incidence of striae gravidarum among participants using sweet almond oil compared to placebo (OR = 0.30; 95 % CI: 0.12–0.76). In contrast, Sadat et al. [26] evaluated 165 pregnant women and found no statistically significant difference in the incidence of striae gravidarum between the almond oil group and the control group (OR = 1.26; 95 % CI: 0.58–2.71). Thus, while some individual studies have shown statistically significant benefits of sweet almond oil in preventing stretch marks, the pooled analysis (Fig. 4) revealed that the overall effect was not statistically significant (OR = 0.29; 95 % CI: 0.05–1.56; $p = 0.15$), suggesting that further high-quality studies are needed to confirm its efficacy.

4.8.3. Aloe vera gel

Bagherian et al. [27] found that Aloe vera gel was significantly more effective than placebo in preventing pregnancy-related striae (OR = 0.23; 95 % CI: 0.08–0.71), indicating a clear preventive effect. Similarly, Hajhashemi et al. [24] reported a strong protective effect of Aloe vera gel compared to placebo (OR = 0.04; 95 % CI: 0.01–0.21), although it did not significantly affect the number or size of stretch marks. In contrast, Jiropas et al. [28] observed no statistically significant difference in the prevention of striae between the Aloe vera gel and base cream groups (OR = 1.07; 95 % CI: 0.48–2.38). Therefore, although some individual studies support the preventive potential of Aloe vera gel, the pooled estimate from the meta-analysis (Fig. 4) showed no statistically significant reduction in the incidence of striae gravidarum (OR = 0.24; 95 % CI: 0.04–1.26; $p = 0.09$), suggesting that additional high-quality studies are needed to confirm these findings.

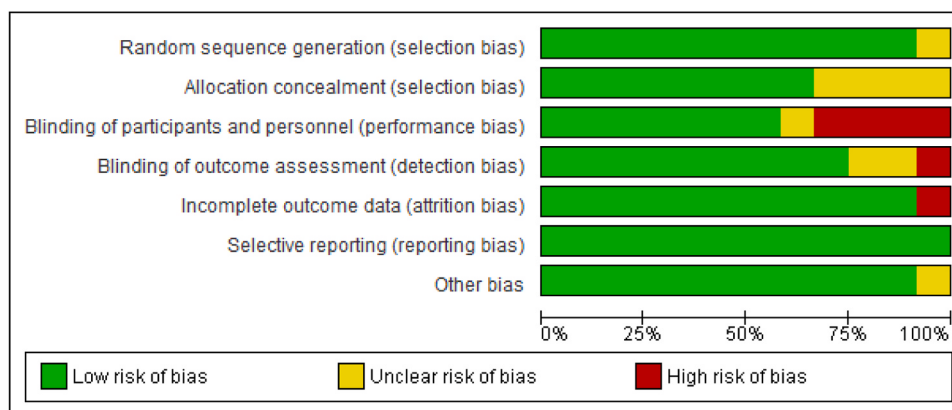


Fig. 3. Summary of the risk of bias assessment across different domains for the included studies. The chart displays the proportion of studies categorized under low risk (green), unclear risk (yellow), and high risk (red) for selection bias, performance bias, detection bias, attrition bias, reporting bias, and other potential biases.

4.8.4. Sesame oil

Malakouti et al. [25] reported that sesame oil was highly effective in preventing striae gravidarum (OR = 0.04; 95 % CI: 0.01–0.10), demonstrating a strong protective effect.

In contrast, Mirzaei et al. [29] did not observe a statistically significant difference between the sesame oil and placebo groups (OR = 1.00; 95 % CI: 0.47–2.44). Although some evidence suggests a potential benefit, the pooled analysis (Fig. 4) showed no statistically significant reduction in the incidence of striae gravidarum with sesame oil (OR = 0.37; 95 % CI: 0.05–2.52; $p = 0.31$), indicating that further trials are needed to confirm these findings.

4.8.5. Rose oil

Mirzaei et al. [29] found no statistically significant difference in the incidence of striae gravidarum between the intervention group (rosemary oil) and the control group (OR = 1.00, 95 % CI = 0.43–2.32). This suggests that rose oil has no significant effect on preventing striae gravidarum.

4.8.6. Sesame and almond oil combination

Malakouti et al. [25] assessed a combined intervention using sesame oil and sweet almond oil, and found a highly significant preventive effect against the development of striae gravidarum. The study reported an odds ratio of OR = 0.04 with a 95 % confidence interval of 0.01–0.10, and the effect was statistically significant ($p < 0.00001$). This suggests a robust reduction in the risk of stretch marks with this combination treatment. While the finding is based on a single trial, the high level of significance highlights its potential and warrants further confirmation through additional high-quality studies.

4.8.7. Cocoa butter cream

Bunchan et al. [30] examined the effectiveness of cocoa butter cream in preventing striae gravidarum and reported no statistically significant benefit (OR = 0.84; 95 % CI: 0.52–1.35). Similarly, Osman et al. [31] found no significant difference between the cocoa butter and control groups (OR = 1.11; 95 % CI: 0.54–2.27). The pooled analysis of these two trials (Fig. 4) confirmed the lack of significant effect, with a combined odds ratio of OR = 0.91 (95 % CI: 0.61–1.36) and a non-significant p -value ($p = 0.65$). These findings suggest that cocoa butter cream is not effective in preventing the development of stretch marks during pregnancy.

4.9. Incidence of Itching (Fig. 5)

4.9.1. Almond oil

Hajhashemi et al. [24] and Malakouti et al. [25] both investigated the effect of sweet almond oil on itching caused by striae gravidarum.

Hajhashemi et al. reported an odds ratio (OR) of 0.04 (95 % CI: 0.00–16.30), and Malakouti et al. found an OR of 0.22 (95 % CI: 0.09–0.53). Although the effect estimates differed in magnitude, both studies indicated a reduction in itching. No subgroup meta-analysis was conducted exclusively for almond oil, so no pooled OR or p -value is available. Nonetheless, the consistent direction of effect suggests a potential benefit.

4.9.2. Sesame & almond oil

Malakouti et al. [25] studied the combination of sesame oil and sweet almond oil for reducing itching and found a significant reduction in itching in the intervention group (OR = 0.22, 95 % CI = 0.09–0.53). This combination appears effective in reducing itching.

4.9.3. Sesame oil

Malakouti et al. [25] found that sesame oil was significantly effective in reducing itching caused by stretch marks (OR = 0.03, 95 % CI = 0.01–0.10). However, Mirzaei et al. [29] did not find a significant effect of sesame oil on reducing itching (OR = 0.52, 95 % CI = 0.24–1.16). While some studies report a positive effect of sesame oil in reducing itching, the results are generally mixed (OR = 0.14, 95 % CI = 0.01–2.04).

4.9.4. Aloe vera gel

Bagherian et al. [27] and Hajhashemi et al. [24] both investigated the effect of Aloe vera gel on itching associated with striae gravidarum. Although both studies reported a reduction in itching, the pooled result did not reach statistical significance (OR = 0.02, 95 % CI: 0.00–1.94). These findings suggest a potential benefit, but further studies are needed to confirm the effectiveness of Aloe vera gel.

4.9.5. Erythema incidence (Fig. 6)

Both Bagherian et al. [27] and Hajhashemi et al. [24] evaluated the effect of Aloe vera gel on erythema associated with striae gravidarum. Bagherian et al. reported a significant reduction in erythema compared to placebo (OR = 0.14, 95 % CI: 0.04–0.48), and Hajhashemi et al. found similar results (OR = 0.19, 95 % CI: 0.06–0.60). It is noteworthy that only Aloe vera gel was assessed for erythema in these studies, and not other herbal products.

The funnel plot used in this study showed that there was no significant publication bias, which helps to increase the validity of the results of this study (Fig. 7).

5. Discussion

This systematic review evaluated the effectiveness of herbal products such as olive oil, Aloe vera gel, sweet almond oil, and sesame oil in

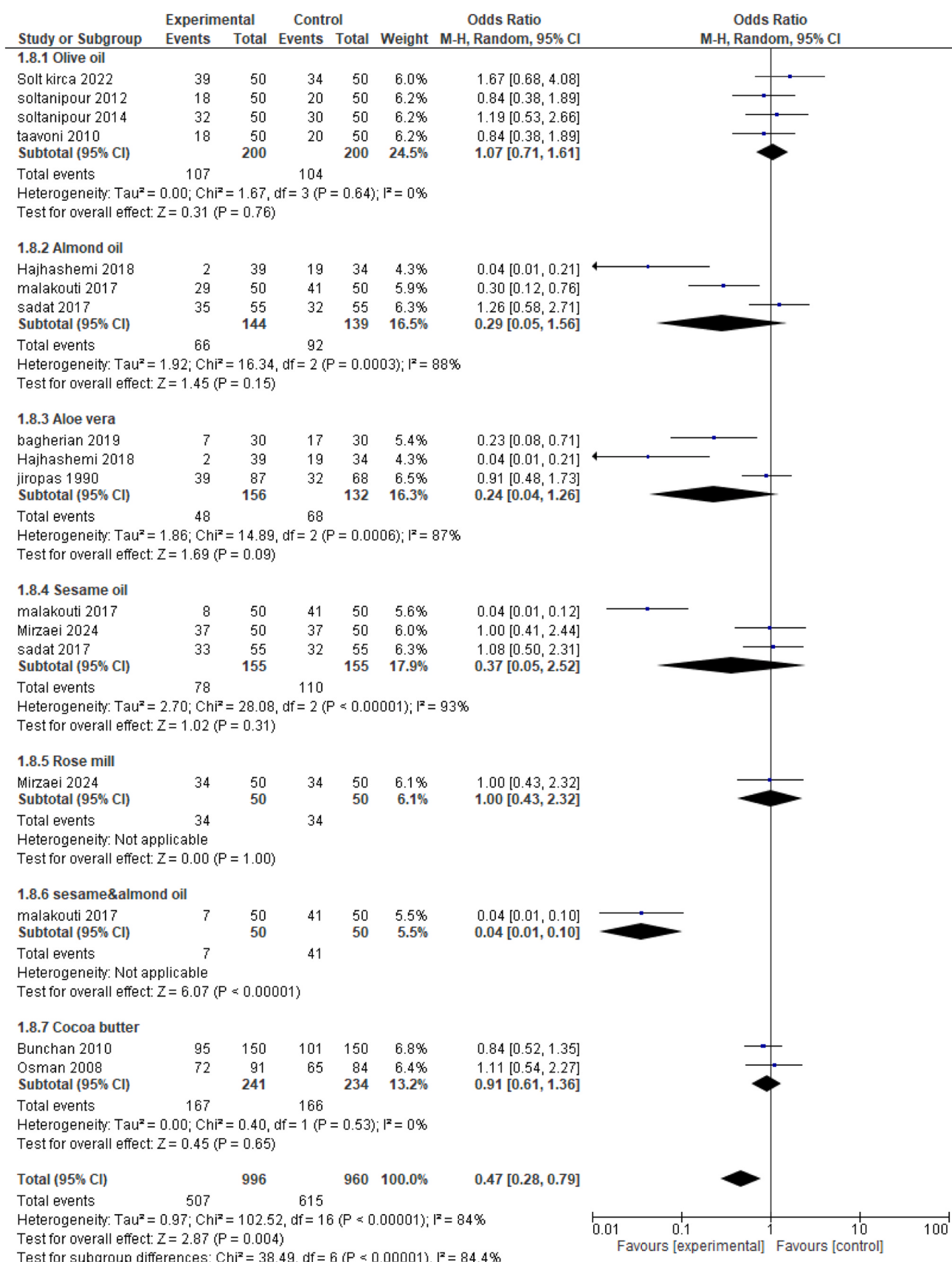


Fig. 4. Forest plot of included study- Effect of herbal medicine compared with control group on incidence of stretch mark.

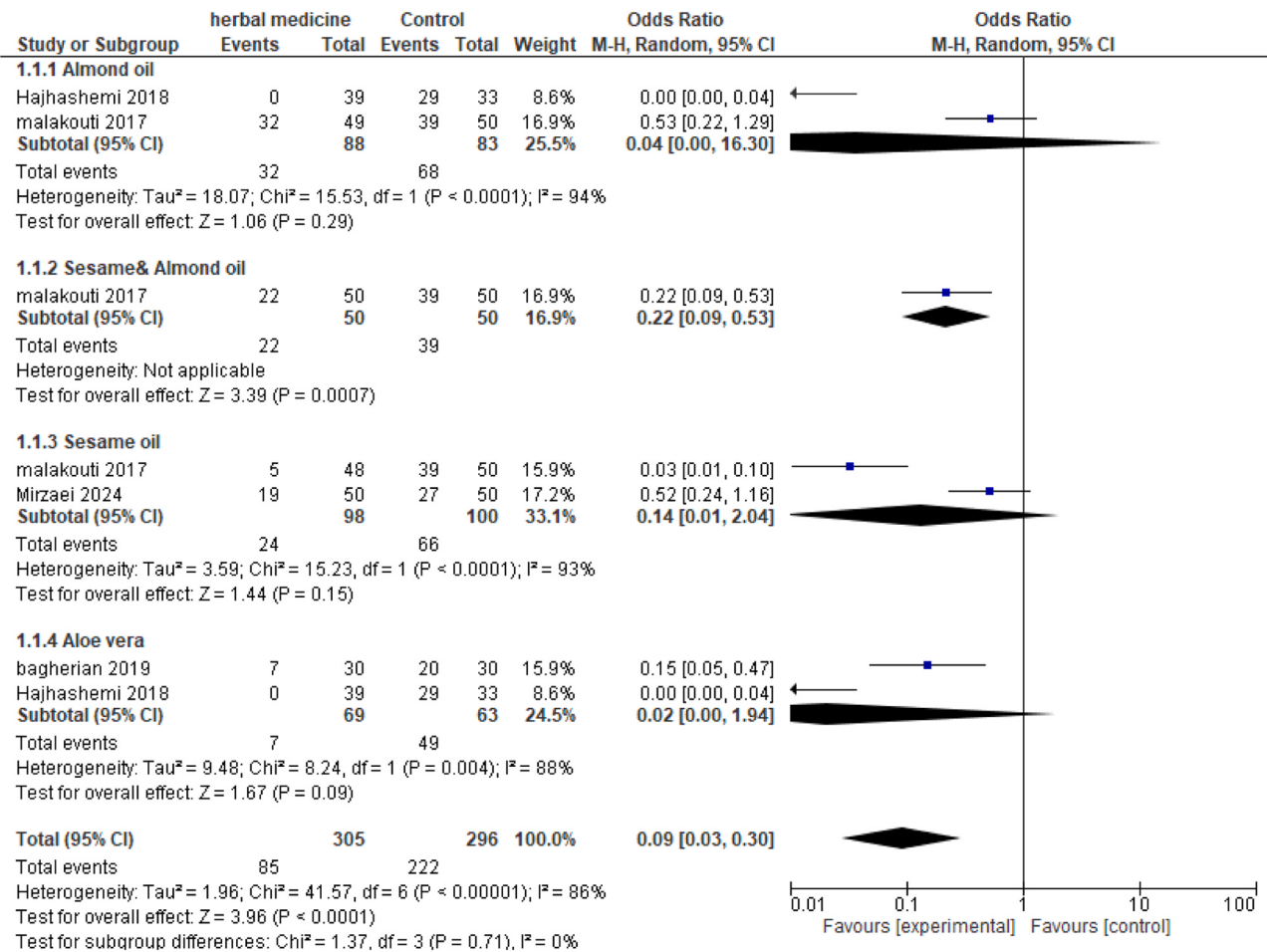


Fig. 5. Forest plot of included study- Effect of herbal medicine compared with control group on incidence of itching of stretch marks.

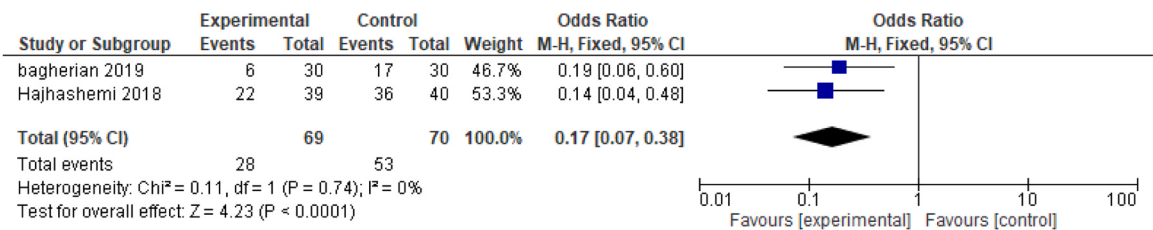


Fig. 6. Forest plot of included study- Effect of herbal medicine compared with control group on incidence of erythema of stretch marks.

preventing striae gravidarum and reducing symptoms like itching and erythema. All the reviewed studies were randomized clinical trials (RCTs) with blinding methods. However, there is insufficient evidence to directly compare these herbal remedies with other preventive treatments such as chemical medicines in systematic reviews or meta-analyses.

A meta-analysis of the reviewed data revealed that the use of herbal products significantly reduced the incidence of striae gravidarum compared to placebo, with particular emphasis on the effectiveness of Aloe vera gel and sweet almond oil. However, there was no systematic review comparing these products to other topical methods or chemical supplements. Some studies have investigated the effectiveness of these herbal products separately. For instance, Aloe vera gel and sweet almond oil were shown to significantly reduce itching and erythema. On the other hand, while sesame oil has been shown to reduce the incidence of striae gravidarum, no significant difference was reported in the severity of striae between the intervention and control groups.

Brennan et al. [14] also reported no statistically significant difference between topical products containing active ingredients (such as creams containing vitamin E, hyaluronic acid, and Centella asiatica) and placebo in the prevention of stretch marks. This finding aligns with several studies in our review that did not report a significant difference between the intervention and control groups. The diversity in the types of topical products, the amount of active ingredients, and usage patterns may contribute to the heterogeneity observed in the study results.

Korgavkar et al. [19] also showed that some topical products might reduce the severity of striae, but effective and reliable methods for preventing striae gravidarum have yet to be fully confirmed. Additionally, these studies emphasize the lack of large, controlled studies that accurately evaluate the dosage and duration of these interventions. The heterogeneity in research methodologies, such as the type and quantity of the product, the timing of intervention, and participants' characteristics (such as age, body mass index, and family history of striae) may also affect the final outcomes.

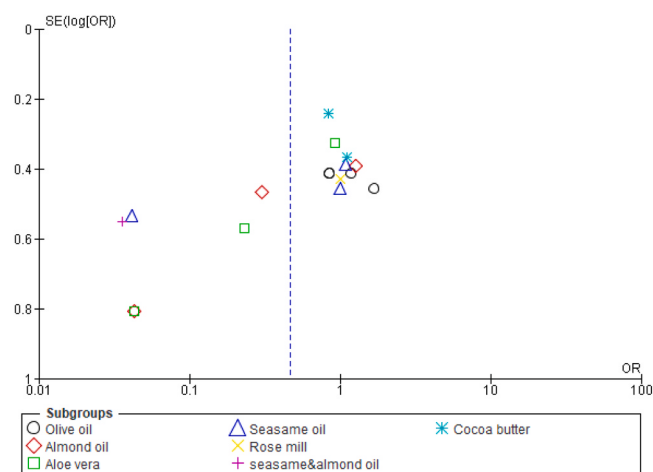


Fig. 7. Funnel plot of incidence.

The observed differences between studies might be attributed to the type of herbal product used. For example, while some studies, such as Sadat et al. [26], showed that sweet almond and sesame oil did not significantly reduce the incidence of striae, others have found these products to be effective. This discrepancy highlights the need for further research to determine the appropriate dosage and optimal methods of using these herbal treatments.

Lastly, although herbal products are commonly regarded as low-risk and natural, a detailed evaluation of the long-term adverse effects of these products has not been adequately conducted in many studies. Therefore, to confirm the effectiveness and safety of these remedies, future research should include more detailed study designs with larger sample sizes.

6. Conclusion

The present systematic review found that herbal products, such as Aloe vera gel, sweet almond oil, and sesame oil, can significantly reduce the incidence of striae gravidarum and its associated symptoms (such as itching and erythema). Although several studies indicate the positive effects of these products, the heterogeneity in study methods, participant differences, and variations in the application of herbal remedies have led to mixed results.

For this reason, it is recommended that future studies adopt a more standardized design and utilize more valid measurement tools. These studies should also include a detailed comparison between the effectiveness of herbal products and modern pharmaceutical treatments to yield more reliable conclusions regarding the efficacy of these remedies. Additionally, as most of the studies reviewed in this work were conducted in Iran, it is advisable for future studies to consider diverse societies and cultures to investigate the influence of cultural and traditional medical beliefs on treatment preferences, which should be properly assessed.

CRedit authorship contribution statement

razavi masoumeh: Writing – review & editing. **Khadije Hajizadeh:** Writing – review & editing. **shahnazi mahnaz:** Writing – review & editing. **Mirghafourvand mojgan:** Writing – review & editing.

Declaration of Competing Interest

The authors have no conflicts of interest to declare.

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Data availability

Not applicable

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