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THE EFFECT OF EMOLLIENT OILS IN PRETERM INFANTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT
Premature infants have distinct physiological differences in their skin compared to full-term infants, characterized by thinner skin and subcutaneous tissue due to an underdeveloped stratum corneum. Several non-pharmacological therapies are implemented to improve the skin integrity of premature infants. However, the effectiveness of these therapies needs to be explored further to establish their role in enhancing skin care and overall health outcomes in this vulnerable population. Objective to identify the effectiveness of non-pharmacological interventions on the skin condition and health outcomes of preterm infants, and to determine which intervention is most effective in improving skin condition and health outcomes. In this meta-analysis, randomized controlled trials (RCTs) of emollient oil administration interventions were systematically searched across four databases including Pubmed, Science Direct, Oxford Academic, and Cochrane. The studies that met the eligibility criteria were independently assessed for methodological quality, and data extraction was performed by two investigators. A total of 8 trials were identified, encompassing 3637 participants. To analyze the data, a random-effects model was employed, along with subgroup analysis and meta-regression analysis to explore the effects of different intervention components. Coconut oil and sunflower seed oil were evaluated for their effects on skin condition using the NSCS. The results indicated that sunflower seed oil was significantly more effective in reducing the NSCS score, with a p-value of 0.001 (95% CI = 1.426 to -0.364). Liquid Vaseline in the control group also showed significant results, with a p-value of 0.001 (95% CI = -1.426 to -0.364). In terms of weight gain and the incidence of hypothermia, there were no significant differences between the two oils and the control group. Administration of the oils once a day for a longer duration proved to be more effective in improving the infants' skin condition. Evidence suggests that the use of coconut oil and sunflower seed oil is effective in increasing body weight and reducing the incidence of hypothermia and sepsis. Furthermore, sunflower seed oil appears to be more effective than coconut oil in improving skin condition. Based on these findings, it is recommended that policymakers and healthcare professionals consider incorporating coconut oil or sunflower seed oil emollients into the routine care of premature infants.

Keywords: emollients; hypothermia; infection; preterm infants; skin; weight gain

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INTRODUCTION

Currently, it is estimated that approximately 13.4 million infants are born prematurely (< 37 weeks) (World Health Organization, 2023). The rate of preterm births has remained relatively unchanged over the past decade, and in some countries, it continues to rise. Preterm birth is the leading contributor to mortality in children under five years of age. In 2020, it was estimated that nearly 1 million newborns died due to complications associated with preterm birth (one infant every 40 seconds), with millions more surviving with disabilities that affect them and their families throughout their lives (World Health Organization, 2023).

Premature infants require intensive care at birth in the Neonatal Intensive Care Unit (NICU), where they are often subjected to various treatments that may pose risks to their well-being. Care procedures, medical treatments, and the use of chemical agents, including medical dressings, adhesive electrode pads, disinfectant solutions, shampoos, soaps, and moisturizers,

can compromise the integrity of the infant's skin (Karakoc & Ekici, 2022). Research by Marufu et al. (2021) indicates that pressure from medical devices such as CPAP masks and pulse oximetry probes, as well as improper sleeping positions, can lead to skin damage in infants. Furthermore, Taplak & Polat (2022) highlight that the thin skin of premature infants is particularly vulnerable to injury from NICU procedures, including the removal of adhesive dressings, bathing, antimicrobial skin disinfection, friction, diaper use, and pressure ulcers (Waziry & Rashwan, 2018).

The skin of preterm infants is physiologically and developmentally distinct from that of full-term infants due to its immaturity. The skin and subcutaneous tissue of preterm infants are notably thin because the stratum corneum, the outermost layer of the epidermis, is still underdeveloped. Preterm infants are at high risk for transepidermal water loss, electrolyte imbalance, thermoregulation challenges, and skin injury (Sahin et al., 2024). The care environment in the Neonatal Intensive Care Unit (NICU) can negatively impact these infants. Medical devices are necessary to maintain vital functions and monitor treatment; however, their use may compromise the integrity of the infant's skin (Sahin et al., 2024). Factors such as lighting conditions, varying intensities of pressure from treatments, monitoring procedures, chemicals, adhesive electrode pads, disinfectant solutions, and certain products including soaps, shampoos, moisturizers, and adhesives used to secure medical devices contribute to an increased risk of skin integrity damage (Karakoç & Ekici, 2022).

Several strategies have been implemented, including the administration of topical products to preserve the integrity of the infant's skin. The application of emollients such as coconut oil and sunflower seed oil has been investigated in the care of premature infants (Getaneh et al., 2024). In addition to their effects on skin condition, some studies have indicated that these oils can contribute to increased infant weight, as well as prevent hypothermia and late-onset sepsis (Cleminson & McGuire, 2021). However, the studies utilizing coconut oil or sunflower seed oil have not consistently yielded significantly positive results. Consequently, given the variability in research findings, the authors are motivated to further explore this topic through a systematic review of the effects of coconut oil and sunflower seed oil administration in premature infants. The results of this study are anticipated to provide valuable insights aimed at enhancing the care of premature infants and improving their survival rates. The aim of this study is to assess the efficacy of non-pharmacological interventions on the skin condition and health outcomes of preterm infants, as well as to identify which intervention is most effective in enhancing these aspects.

METHOD

The study protocol was registered with PROSPERO under reference number CRD42024618129. This systematic review and meta-analysis were conducted in accordance with the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020). The inclusion criteria for this study were limited to randomized controlled trials (RCTs) published in English. The primary outcomes assessed were improvements in infant weight and skin condition, as well as the incidence of hypothermia and late-onset sepsis. In contrast, the exclusion criteria comprised preterm infants with congenital abnormalities, skin malformations, and severe medical conditions, including severe sepsis, necrotizing enterocolitis (NEC), hypoxic-ischemic encephalopathy (HIE), and intracranial haemorrhage.

Article searches were conducted across several databases, including PubMed, Science Direct, Oxford Academic, and Cochrane, supplemented by an independent search on Google Scholar. The search strategy utilized the PICO format and encompassed a publication period from 2018 to 2024. The elements of the PICO framework were defined as follows: Population (P)

consisted of preterm infants born at less than 37 weeks gestation; Intervention (I) involved the administration of emollients, specifically coconut oil and sunflower seed oil; Comparison (C) included routine care or other emollients; and Outcomes (O) focused on skin condition, weight gain, and the incidence of hypothermia and late-onset sepsis. The keywords employed in the searches included "emollients" AND "preterm infants" OR "premature infants" AND "skin" AND "weight gain" AND "hypothermia" AND "infection."

The initial search yielded a total of 204 articles from the databases, along with 4 additional articles retrieved through a self-search. Following this, 7 articles were excluded due to duplication. An additional 127 articles were excluded as they did not align with the study topic. Furthermore, 55 articles were removed because they did not meet the criteria regarding intervention, participants, study design, or outcomes. Eleven articles were excluded for specific reasons, including variations in the spelling of the researcher's name. After a thorough screening process, a total of 8 articles were identified for further analysis.

The quality of the articles included in this review was assessed using the Revised Cochrane Risk of Bias Tool for randomized trials (RoB 2). This framework is designed to evaluate the risk of bias in randomized trial research and comprises five domains that address various potential biases that may impact trial outcomes. Each question within these domains can be answered as "yes," "probably yes," "probably no," "no," or "no information." If all domains are assessed as low risk, the results are classified as low risk of bias. If at least one domain raises some concerns but lacks any high-risk assessments, the results are categorized as having some concerns. Conversely, results are deemed high risk if any domain is rated as high risk or if multiple domains show some concerns. The data in this study were analyzed through a systematic review and meta-analysis conducted in accordance with the PRISMA 2020 guidelines and registered in PROSPERO (CRD42024618129). Eight randomized controlled trials (RCTs) that met the inclusion criteria were analyzed to evaluate the effectiveness of emollient use (coconut oil and sunflower seed oil) in preterm infants, particularly in relation to weight gain, skin condition, and the incidence of hypothermia and late-onset sepsis.

RESULT

The figure outlines the systematic process of identifying studies for review through two primary methods: database searches and other methods. Initially, a total of 197 records were identified from various databases, including PubMed (n=78), Science Direct (n=49), Oxford Academic (n=26), and Cochrane (n=44). After removing 7 duplicate records, 190 records were available for screening. During the screening phase, 127 records were excluded for failing to meet study criteria, and 11 records were not retrieved, leaving 52 articles for further evaluation. These articles underwent an eligibility assessment, resulting in 44 records being deemed ineligible due to factors such as intervention criteria (n=4), participant criteria (n=9), study design (n=12), and outcome measures (n=18). Ultimately, 8 studies were included in the final review, demonstrating a rigorous selection process that ensured the incorporation of relevant and high-quality literature.

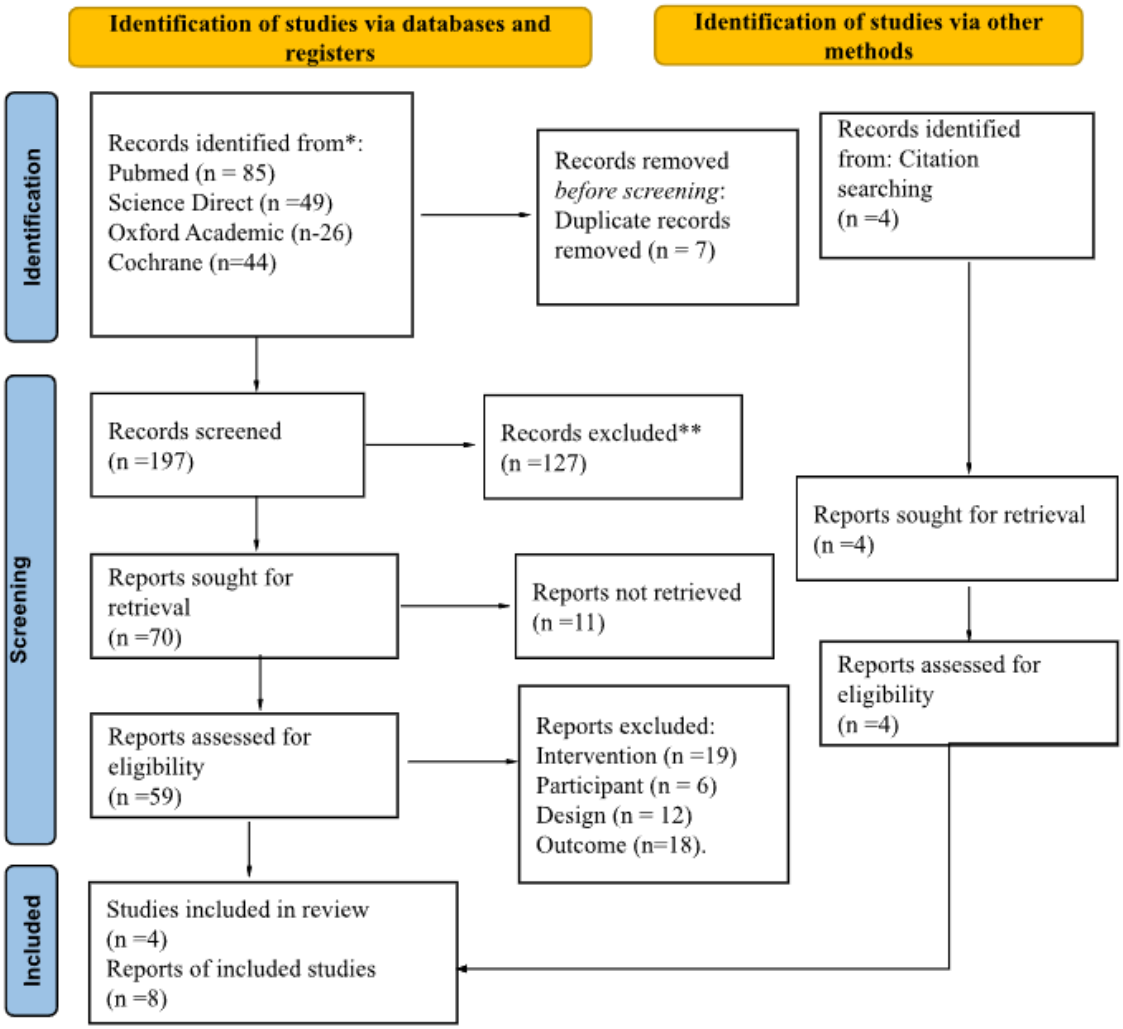

Figure 1. PRISMA Flow Diagram

The study involved a cohort of 3,637 premature infants, which included a control group of 1,851 babies, and was conducted across several countries, including India, Turkey, Australia, Pakistan, and Istanbul. Of the eight articles reviewed, two were conducted in community settings, one in an infant room, and five within neonatal intensive care units (NICUs). In the intervention group, five articles utilized sunflower seed oil, while three employed coconut oil; additionally, three articles evaluated other interventions, including almond oil, liquid Vaseline, and mustard oil.

The meta-analysis demonstrated that sunflower seed oil was significantly more effective than coconut oil in improving skin conditions, as evidenced by a reduction in Neonatal Skin Condition Scores (NSCS) with a p-value of 0.001 (95% CI = -1.426 to -0.364). Liquid Vaseline in the control group also yielded significant results, with a p-value of 0.001 (95% CI = -1.426 to -0.364). However, regarding weight gain, the analysis of four articles revealed no significant difference between the effects of coconut oil and sunflower seed oil. Moreover, the administration of coconut oil emollients did not significantly reduce the incidence of hypothermia compared to the control group, with a p-value of 0.537 (95% CI = -2.228 to 4.280). In the incidence of late-onset sepsis, coconut oil administration was not significantly different compared to the control group with p value of 0.640 (95% CI = -0.177 to 0.288). This study also analyzed the description of the duration of therapy, the frequency of therapy, the quality of the article study. Sub group analyses were conducted in response to the observed higher levels of heterogeneity among the study.

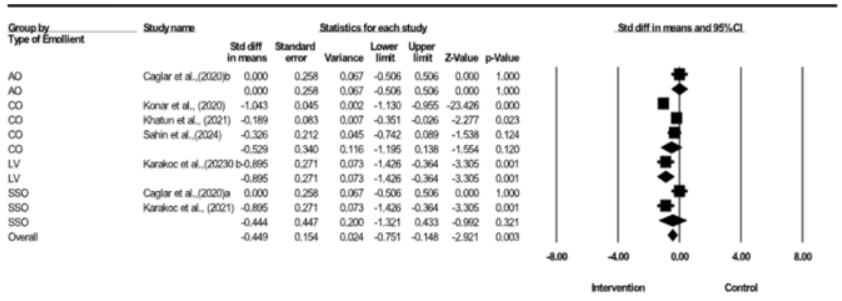

figure 2a Forest Plot of the type of emollients on skin condition

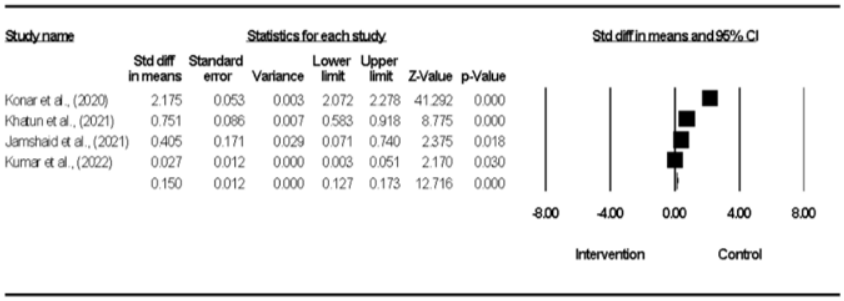

Figure 2b. Forest plot of sunflower seed oil on weight gain

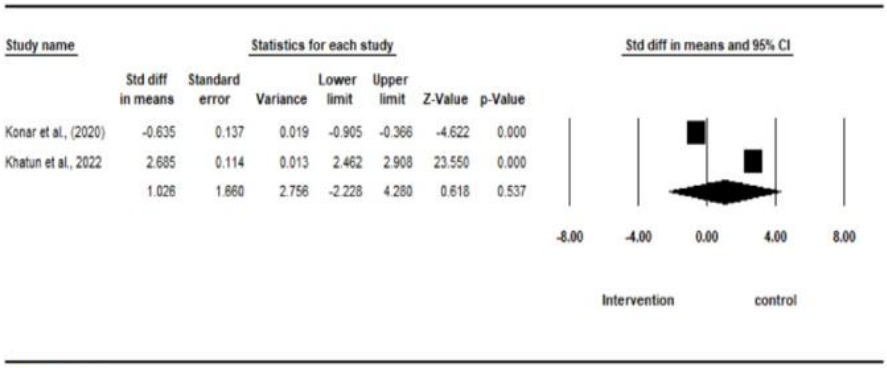

figure 2c. Forest Plot of coconut oil on the incidence of hypothermia

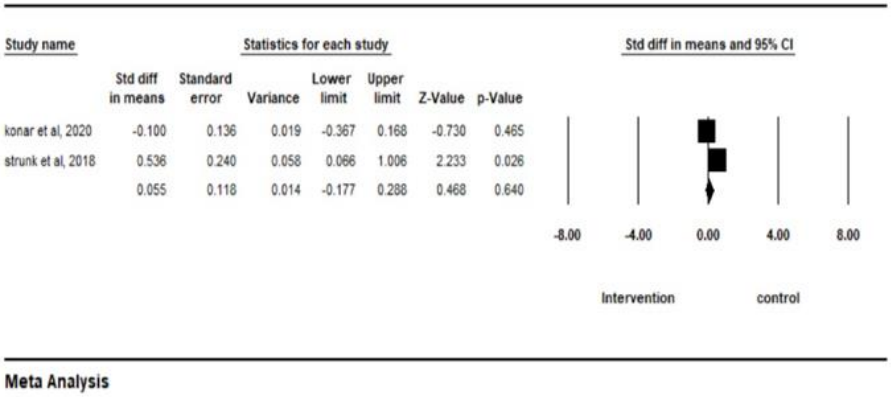

figure 2d. Forest Plot of incidence of late onset sepsis.

The table presents a subgroup analysis examining the effectiveness of various emollients on skin condition. In terms of the type of emollient, Liquid Vaseline emerged as the most effective, with a mean difference of -1.03 and a significant p-value of 0.007, indicating a

meaningful improvement in skin condition. Sunflower seed oil also demonstrated a significant impact, showing a mean difference of -0.86 (p-value = 0.001). In contrast, coconut oil had a mean difference of -0.53 (p-value = 0.12), suggesting no significant effect, while almond oil yielded inconclusive results due to its wide confidence interval. Regarding dosage, the 10 ml application indicated an adverse effect with a mean difference of 1.455, but the results were less definitive due to the wide confidence interval. The duration of treatment appeared to influence outcomes, as those treated for less than 15 days had a mean difference of -0.743, suggesting significant improvement, whereas treatments extending beyond 15 days showed no effect. Frequency of application also played a role, with 24-hour and 12-hour frequencies indicating significant positive effects, while the 8-hour application showed a less pronounced impact. Finally, the quality of studies varied, with those classified as high risk revealing a significant mean difference of -1.043, while low-risk studies indicated no significant effect.

Table 1.
Subgroup Analysis

Variable	Category	Number of studies	Mean difference	95% CI	p-value
Type of emollient	Coconut Oil	3	-0.53	-1.19 - 0.14	0.12
	Sunflower Seed Oil	5	-0.44	-1.32- 0.43	0.32
	Liquid Vaseline	1	-0.89	-1.43 - -0.36	0.001
	Almond Oil	1	0.00	-0.51 - 0.51	1.00
Dosage	5 ml	2	1.455	0.069 - 2.860	0.040
	10 ml	2	0.178	-0.186 - 0.541	0.338
Duration	Less than 15 days	3	-0.139	-0.410 - 0.132	0.316
	More than 15 days	4	-0.743	-1.306 - -0.180	0.01
Frequency	24 h	3	-0.592	-1.186 - 0.002	0.05
	12 h	1	0.405	0.071 - 0.740	0.018
	8 h	1	0.027	0.003 - 0.051	0.030
	6 h	5	-0.433	-1.137 - 0.271	0.228
Quality Study	Low risk	3	-1.39	-0.41- -0.132	0.316
	Some concerns	3	-0.613	-1.17- -0.06	0.031
	High risk	2	-1.043	-1130 s/d -0.955	0.000

Table 2.
Characteristic of the studies

No	Researcher, year, country	Objectives	Research Design	Sample	Treatment	Outcome	Measurement Tools	Result	Location	Limitation	RoB2
1..	Strunk et al.,2018 Australia	To evaluate the feasibility, safety, and effects of topical coconut oil on the skin of very preterm infants	An open label randomized controlled trial	I: 36 C: 36 Gestation,week I: 27,9(26, 3-29.3) C: 27.9(25. 4-29.1) (p value 0.77) Birth weight I: 1.070(879-1.202) C: 950(726-1.155) p value 0.2	I: CO C: routine care Dosage 5 ml/12h Area: the whole body except the face, head, and around the catheter/drain area Method: gentle touch without massage Duration: 21 days	- Skin irritation - Maximum weight loss - Time to regain birth weight - Time to full enteral feeds - Weight at discharge - Time to grade out of incubator - Episodes of abnormal temperature - Mortality - EOS	- NSCS - REDCap (Research Electronic Data Capture) electronic data capture tool	NSCS I: 25%, C: 22.2% p=0.779 Maximum weight loss I: 5(0.9-8.3) C: 2(0-8.2) Time to regain birth weight, Median (IQR) I: 5(2-8) C: 5(2-10) Time to full enteral feeds, Median (IQR) I: 8(6-14) C: 10(6-15) Weight at discharge Median (IQR) I: 3.042(2.528-3.693) C: 2.988(2.728-3.441)	- NICU	- Lack of an appropriate placebo as there currently are no topical emollients recommended for routine neonatal skin care in Australia	High risk

No	Researcher, year, country	Objectives	Research Design	Sample	Treatment	Outcome	Measurement Tools	Result	Location	Limitation	RoB2
						- LOS overall - NEC - Chronic lung disease - PDA - Any ROP - ROP requiri		Time to grade out of incubator I: 32(23-46) C: 31(24-44) Episodes of abnormal temperature I: 3(2-4) C: 3(2-3) Mortality I: 0(0) C: 4(11.1) EOS I: 0(0) C: 0(0) LOS overall I: 2(5.6) ; C: 5(13.9) NEC I: 0(0) ; C: 2(5.6) Chronic lung disease I: 14(38.9); C:15(41.7) PDA I: 19(52.8); C: 20(61.1) Any ROP I: 9(25); C: 16(44.4) ROP requiring treatment - I: 4(44.4); C: 4(25)			
2.	Konar et al., 2020 India	To find out the effectiveness of VCO application for skin maturity, prevention of sepsis, hypothermia and apnea, its effect on long-term neurodevelopmental and side effects if any.	A randomized controlled trial	I: 1146 C: 1148 GA n (%) I: 794 (69.3%) C: 801 (69.8%)	I: VCO C: Usual care Dosage: 5ml/6h Area: whole gody except face and hand Duration: 28days Method: gentle massage	- Skin condition - Weight loss - Weight gain - Hypothermia - apnea - Kadar Serum vitamin D3 - Neurodevelopmental score(motor) - Neurodevelopmental outcome(mental) - Late onset sepsis (LOS) - Rash	Neonatal Skin Condition Score (NSCS). Weight scale (HITES, Class III). Immunoassay analyzer DASII scale Clinical symptoms	Day 28 Mean (SD) I: 3.9(0.7) C: 4.8(1.0) Weight lost Mean (SD) I: 4.71(0.39) C: 7.82(0.55) Weight gain Mean (SD) I: 1.21(0.17) C: 0.89(0.12) Hypothermia n (%) I: 22(1.9%) C: 67(5.8%) Apnea n (%) I: 14 (1.2%) C: 58(5.1%) Serum Vit D3 Mean (SD) I: 32.3(1.2) C: 24.6(0.8) Neurodevelopmental score (motor) 12th moonth Mean (SD) I: 0.96(0.08) C: 0.92(0.07) Neurodevelopmental outcome(mental) 12th month Mean (SD)	NICU	Trials can be blinded by the specific odor of coconut oil -	Some concerns

No	Researcher, year, country	Objectives	Research Design	Sample	Treatment	Outcome	Measurement Tools	Result	Location	Limitation	RoB2
						Accidental slippage cumbersome method -		I: 0.97(0.09) C: 0.93(0.06) Late onset sepsis n (%) I: 31(2.7) C: 37(3.2) Rash n (%) I: 21(1.8) C: 23(2.0) Accidental slippage n (%) I: 3(0.3) C: 1(0.1) Cumbersome methode n (%) I: 23(2.0) C: 4(0.3)			
3.	Khatun et al., 2022 India	To detect the effects of massage with coconut oil on infants during the period of weight gain, skin maturity, neurodevelopment and brain growth.	Randomized controlled trial	I = 291 C = 294 GA Mean (SD) aterm I=38.9(3.1) C=38.4(3.5) Preterm Mean (SD) I=119(40.9) C=128(43.5) Birth weight (kg) mean (SD) I=2.560 (0.220) C=2.580 (0.270) Low birth weight Mean (SD) I=136(46.7) C=144(49.0)	I = CO C = usual care Dosage: 5ml/6h Area: whole body except face and head Method: massage 6-8m minutes Duration: 30 days	- weight gain/day - Weight loss - hipotermia, - sepsis - kadar serum 25-hydroxy vitamin D - Skin maturity - Lingkar kepala - Neurodevelopmental outcome Brain volume	- Weight scale - Thermometer - - Clinical symtomps and positive sepsis screen - NSCS - DASII. - MRI	Weight loss(g) Mean (SD) I: 223.5(35.5) C: 238.7(40.2) Weight gain(g/day) Mean (SD) I: 21.5(4.6) C: 18.3(3.9) Hypothermia Mean (SD) I: 11(3.4) C: 34(11.6) Sepsis Mean (SD) I: 17(5.8) C: 41(13.9) NSCS hr-28 Mean (SD) I: 3.5(1.2) C: 3.7(0.9) DQme bulan 24 Mean (SD) I: 0.95(0.19) C: 0.94(0.16) HC 24th month (Head Circumference) Mean (SD) I: 49.1(4.1) C: 48.9(4.7) GMV (gray matter volume) Mean (SD) I: 726.3(51.2) C: 715.8(45.7) WMV (white matter volume) Mean (SD) I: 414.8(22.9) C: 404.3(25.2)	comunity	Care giver cannot be blinded by the nature of the trial Neuro imaging is not performed on all children due to financial constraints.	High risk
4.	Caglar et al., 2020	To investigate	A randomized	I1: 30 I2: 30 C: 30	I1: sunflower seed oil (SSO)	SCH (Stratum Corneum	Skin moisture meter	SCH Abdomen Mean (SD)	NICU	- limited sample - short intervention	Low risk

No	Researcher, year, country	Objectives	Research Design	Sample	Treatment	Outcome	Measurement Tools	Result	Location	Limitation	RoB2
	Istanbul	the effects of sunflower seed oil (SSO) and Almond oil (AO) on stratum corneum hydration and Neonatal Skin Condition Scores (NSCS) in preterm infants.	controlled trial	Gestational age Mean (SD) I1: 34.33(1.24) I2: 33.87(1.38) C: 34.70(1.60) Birth weight Mean (SD) I1: 2375.67(571.96) I2: 2158.50(564.06) C: 2584.50(649.01)	I2: almond oil C: standard care Dosage: 4ml/6h Area: whole the body except face and head Duration: 5 days Method: gentle touch without massage 2-3 minutes.	hydration) - Skin integrity	NSCS	Pre: I1: 30.46(2.83) I2: 32.22(3.70) C: 31.68(1.85) Post: I1: 33.71(2.67) I2: 34.58(2.79) C: 29.61(3.00) Lateral surface of the upper leg Mean (SD) Pre: I1: 29.17(3.09) I2: 30.79(3.32) C: 31.20(1.71) Post: I1: 32.23(2.63) I2: 33.18(3.10) C: 29.56(3.06) Upper outer quadrant of the tigh Mean (SD) Pre: I1: 35.04(4.51) I2: 35.47(5.63) C: 38.38(4.48) Post: I1: 38.36(3.93) I2: 38.23(4.61) C: 36.11(5.66) Skin condition Mean (SD) Pre: I1: 3.03(0.18) I2: 3.07(0.25) C: 3.00(0.00) Post: I1: 3.00(0.00) I2: 3.00(0.00) C: 3.70(0.65)		period	
5.	Sahin et al.,2024 Turkey	To compare the effectiveness of Sunflower Oil (SO) with Silicone-based Spray for adhesive removal on OGT	Prospective,single-blind,randomized controlled trial	I1: 45 I2: 45 Gestation week Mean (SD) I1: 34.02(1.47) I2: 34.51(1.36) Birth weight Mean (SD) I1: 1997.56(464.77) I2: 2121.05(491.66)	I1: SO I2: Silicone-based spray Dosage: --- Area: removal adhesive from orogastric tube. Duration: -- Method: applied to remove adhesive	Skin condition	NSCS	Skin condition score After remove OGT fixation Mean (SD) I1: 3.40(0.62) I2: 3.63(0.78) Skin condition score 3 hours later Mean (SD) I1: 3.07(0.25) I2: 3.17(0.37)	NICU	OGT is released 24 h, while it can be maintained 48-72 h Evaluation of skin condition by nurses is still limited	Low risk
6.	Karakoc et al.,2022 Turkey	To determine the effectiveness of SSO (Sunflower seed oil) and Liquid Vaseline (LV)	Prospective randomized controlled design	I1: 30 I2: 30 C: 30 Gestational age Median (Range) I1: 36.5(36.0-38.0) I2: 37(35.0-39.0) C: 37.0(36.0-39.0)	I1: SSO I2: LV C: standard care Dosage: Preterm 3-4ml/24h Aterm: 5-6ml/24h Area: whole the body except face, head, and diaper area Duration: 16	Skin integrity	NSCS	Pre intervention Median (range) I1: 5.0(4.0-5.0) I2: 5.5(5.0-6.0) C: 5.0(4.0-6.0) 48h Median (range) I1: 5.0(4.0-5.0) I2: 5.0(5.0-6.0) C: 5.0(4.0-6.0) 3th measurement Median (range) I1: 4.5(4.0-5.0) I2: 5.0(5.0-6.0) C: 5.0(4.0-6.0)	NICU	- Lack of blinding - Vital sign not evaluated during and after intervention	Some concerns

No	Researcher, year, country	Objectives	Research Design	Sample	Treatment	Outcome	Measurement Tools	Result	Location	Limitation	RoB2
				Weight Median (Range) I1: 2.755(2.460-3.320) I2: 3.060(2.450-3.500) C: 2.875(2.490-3.470)	days Method: gentle touch without massage			Fourth measurement Median (Range) I1: 4.0(3.0-5.0) I2: 4.0(4.0-5.0) C: 5.0(4.0-6.0) Fifth measurement Median (Range) I1: 4.0(3.0-5.0) I2: 4.0(4.0-5.0) C: 5.0(4.0-6.0)			
7.	Jamshaid et al.,2021 Pakistan	To determine the impact of emollient therapy on weight gain and body length of premature and low birth weight babies	A randomized controlled trial	I: 70 C: 70 Mean Age I: 16.8±5.5 days C: 18.4±5.2 day P=0.078	I: sunflower oil C: routine care Dosage: 10ml/12h Area: whole the body Duration: 2 months Method: massage	Weight gain length	Digital weighing scale Infant length scale	Weight gain(g) Mean (SD) I: 489.84(297.48) C: 373.43(276.31) Length increase Mean (SD) I: 6.59(1.10) C: 4.80(1.33)	Department of pediatric	This study included specific inclusion criteria, so the results cannot be generalized to other groups.	High risk
8.	Kumar et al.,2022 India	To determine whether sunflower seed oil (SSO) improves infant growth and reduces morbidity	A cluster randomized, open label, controlled trial	I: 138 cluster (13.478 babies) C: 138 cluster (13.109 babies)	I: SSO C: usual care Dosage 10gr/8h Area: Duration: Method: massage	Weight gain morbidity		Weight gain daily I; 13.60(12.98,14.22) C: 12.65(12.04,13.27) Mean difference 0.94(0.07,1.82), p=0.03 Hospitalitation I: 75(1.8) C: 136(2.9) P=0.022 Any illness I: 262(6.8) C: 441(10.4) P=0.176 Skin infection I: 109(2.7) C: 167(3.5) P=0.764 Umbilical disorder I: 232(6.1) C: 304(7.2) P=0.073	community	Treatment adherence of the sample	Low risk

DISCUSSION

This study highlited that sunflower seed oil was significantly more effective than coconut oil in improving skin conditions. This is in-line with the study from Caglar et al. (2020) that reported that the use of sunflower seed oil resulted in improved skin condition scores compared to the control group. Similarly, research by Karakoc and Ekici (2022) indicated that both sunflower seed oil and liquid Vaseline yielded significantly lower Neonatal Skin Condition Scores (NSCS) on the third day post-intervention when compared to the control group. Sunflower seed oil can significantly improve skin condition in preterm infants due to

several beneficial properties (Caglar et al., 2020). Rich in linoleic acid, an essential fatty acid, the oil helps maintain the skin barrier, preventing trans-epidermal water loss and keeping the skin hydrated. Its emollient nature forms a protective layer that retains moisture, which is particularly crucial for the fragile skin of preterm infants (Caglar et al., 2020). Additionally, sunflower seed oil contains antioxidants and anti-inflammatory compounds that soothe irritated skin and reduce inflammation. This promotes the maturation of the skin barrier, essential for protecting against infections and environmental stressors (Aksucu et al., 2022). Moreover, the oil is a good source of vitamin E, known for its skin-protective properties, enhancing skin healing and reducing oxidative stress. Together, these factors contribute to the overall improvement of skin condition in preterm infants.

The findings of this study indicate that sunflower seed oil contributes to increased body weight. This outcome aligns with the research conducted by Jamshaid et al. (2021), which demonstrated that the administration of sunflower seed oil resulted in greater weight gain compared to the control group by day 28. Similarly, Kumar et al. (2022) reported enhanced weight gain and lower morbidity rates associated with the exclusive use of sunflower seed oil in community settings. Sunflower seed oil contributes to increased body weight for several reasons. Firstly, its high caloric content makes it calorie-dense, providing a significant amount of energy per serving, which is essential for weight gain (Getaneh et al., 2024). Additionally, the oil is rich in healthy polyunsaturated and monounsaturated fats that support growth and development. The inclusion of fats in the diet also enhances the absorption of fat-soluble vitamins (A, D, E, and K), which are crucial for various bodily functions and can promote healthy growth in infants. Moreover, the fatty acids in sunflower seed oil can help induce a feeling of fullness, potentially encouraging greater food intake over time. Lastly, the oil contains essential fatty acids, such as linoleic acid, that play a role in metabolic processes and optimize energy utilization in the body. Together, these factors enable sunflower seed oil to effectively support weight gain, particularly in vulnerable populations like preterm infants (Darmstadt et al., 2021).

We also found that all three studies utilizing coconut oil reported favorable outcomes concerning skin condition. Strunk et al. (2018) indicated that coconut oil use effectively maintained improved skin condition with no additional adverse events compared to the routine care group. Supporting this, Konar et al. (2020) found that the application of coconut oil enhanced both dermal and neurodevelopmental maturity, leading to significantly greater weight gain and a reduced incidence of hypothermia and apnea compared to the control group. Similarly, Khatun et al. (2022) noted that skin condition scores were lower in the coconut oil group than in the control group, along with better weight gain and a decreased incidence of hypothermia and sepsis. Coconut oil is beneficial for improving skin condition due to its unique composition and properties. Rich in medium-chain fatty acids, particularly lauric acid, coconut oil possesses antimicrobial and anti-inflammatory qualities that help protect the skin from infections and soothe irritation Konar et al., 2020). Its emollient nature provides deep hydration, forming a barrier that locks in moisture and prevents dryness, making it especially effective for sensitive or dehydrated skin. Additionally, coconut oil is known to enhance the skin's natural lipid barrier, promoting overall skin health and resilience. The presence of antioxidants also aids in combating oxidative stress and promoting healing, further improving skin texture and appearance (Khatun et al., 2022). Together, these attributes make coconut oil a valuable ingredient for maintaining and enhancing skin condition.

The findings of the study revealed that there was no significant difference in skin condition between the groups treated with coconut oil and sunflower seed oil. Both oils demonstrated similar efficacy in improving skin health, indicating that they may offer comparable benefits for skin hydration and barrier function. However, the group that received Liquid Vaseline

exhibited more pronounced improvements in skin condition, as evidenced by a greater reduction in Neonatal Skin Condition Scores (NSCS). This difference was statistically significant, suggesting a strong likelihood that the observed effects were not due to chance. The result further supports the conclusion that Liquid Vaseline was more effective than both coconut oil and sunflower seed oil in enhancing skin condition. These results highlight the potential of Liquid Vaseline as a superior option for managing skin health in the studied population, while also suggesting that coconut oil and sunflower seed oil may be equally effective alternatives (Karakoc and Ekici., 2022).

The analysis highlights the complex relationship between dosage, duration, frequency, and study quality in evaluating emollient effectiveness for skin condition. The adverse effect associated with the 10 ml application, indicated by a mean difference of 1.455, raises questions about optimal dosage. The wide confidence interval suggests significant variability in individual responses, necessitating further research to refine dosage guidelines. This adverse effect may stem from the 10 ml volume being too high for effective absorption, potentially overwhelming the skin's barrier and causing irritation. Factors such as skin type, pre-existing conditions, and formulation differences can influence reactions, leading to mixed outcomes (Marissen et al., 2023). Additionally, application timing and concurrent product use may impact results. These considerations underscore the importance of personalized dosage approaches, as what benefits one individual may not suit another (Getaneh et al., 2024). Further investigation is essential to clarify these dynamics and improve dosage recommendations.

The duration of treatment significantly affects outcomes due to the skin's varying responsiveness over time. Treatments lasting less than 15 days showed a significant mean difference of -0.743, suggesting that shorter durations may optimize the skin's initial responsiveness to emollients. During this period, the skin is actively engaged in the barrier repair process, making it more receptive to the benefits of moisturizing agents (Pupala et al., 2019). In contrast, the lack of effect seen with treatments extending beyond 15 days may indicate a plateau in benefits. This could occur if the skin adapts to the emollient, reducing its effectiveness over time, or if prolonged use leads to diminishing returns as the skin reaches its optimal hydration and barrier function (Rahma & Lane, 2022). Such dynamics highlight the need for further investigation into the long-term efficacy of emollients and the potential for adjusting treatment protocols to maximize benefits while minimizing the risk of adaptation.

Frequency of application is vital for the effectiveness of emollients in improving skin condition. Both 24-hour and 12-hour regimens yielded positive outcomes, indicating that more frequent applications enhance the emollient's ability to maintain hydration and support barrier function (Zidni et al., 2022). Conversely, the less favorable results from the 8-hour frequency suggest that longer intervals may lead to inadequate moisture retention, exacerbating dryness and irritation. These findings emphasize the need for tailored application schedules, particularly for individuals with severe skin conditions requiring intensive moisture management (Getaneh et al., 2024). Overall, establishing optimal application frequencies can enhance efficacy, highlighting the importance of personalized skincare approaches. Further research is needed to determine ideal frequencies for various skin types and conditions, refining treatment recommendations.

The quality of the studies reviewed had a significant impact on the findings regarding emollient effectiveness. High-risk studies showed a substantial mean difference of -1.043, underscoring the importance of rigorous methodologies for obtaining valid results. In contrast, low-risk studies did not demonstrate significant effects, highlighting that the design and execution of research are critical for drawing reliable conclusions. These disparities

emphasize the necessity for well-structured clinical trials that account for various factors influencing treatment outcomes. Improved study designs can help optimize treatment strategies for skin conditions, ensuring that recommendations are based on robust evidence. Ultimately, prioritizing high-quality research is essential for advancing our understanding of emollient efficacy and enhancing patient care.

Limitation

This study encountered several limitations that warrant consideration. Firstly, the absence of primary studies significantly restricts the generalizability of the data analysis. Without robust, original research, the findings may not accurately reflect the broader population or varied clinical settings. Moreover, we included articles categorized as having a high risk of bias, which raises concerns about the reliability of the results. This highlights the urgent need for additional studies on the same topic, particularly those that adhere to rigorous methodological standards. Furthermore, the inclusion of various interventions and differing durations of administration complicates the establishment of definitive guidelines for treatment. The diversity in approaches can lead to inconsistencies in outcomes, making it challenging to draw clear conclusions about the most effective strategies for skin care. Consequently, further research is imperative to explore these variables more comprehensively, allowing for the development of standardized interventions that can be reliably applied in clinical practice. Addressing these limitations will not only strengthen future studies but also enhance the overall understanding of emollient efficacy and its implications for skin health.

CONCLUSION

The review examined studies highlighting the beneficial effects of coconut oil and sunflower seed oil in the skin care of premature infants, demonstrating their effectiveness in improving various skin conditions. Notably, these oils have been associated with additional benefits, such as promoting weight gain in infants. This dual advantage underscores their potential as valuable components in neonatal care, offering both skin protection and nutritional support. Despite these promising findings, the application of coconut oil and sunflower seed oil in infant care remains limited in Indonesia. This gap suggests a need for increased awareness and education among healthcare professionals and caregivers regarding the advantages of these natural oils. By integrating such practices into standard care routines, we could significantly enhance the overall health and well-being of premature infants.

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