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Vernix Caseosa: Benefits and Clinical Implications in Neonatal Care; A Study Conducted at Almak Nimr University Hospital, Shendi, Sudan

Sitelbanat Osman Mohamed Ahmed
Assistant Professor, Department of Nursing, College of Nursing and Health Sciences, Jazan University, Saudi Arabia. Sitoossman@yahoo.com, ORCID: https://orcid.org/0000-0001-7787-1283

Abstract
Vernix caseosa is a white, creamy biofilm that covers the fetal skin during late gestation, offering antimicrobial protection,skin hydration, and thermoregulation. This study evaluates the impact of vernix retention on neonatal health outcomes in a Sudanese clinical setting. Conducted at Almak *Nimr University Hospital, Shendi, Sudan, the study compared neonates with vernix retained versus those with immediate postnatal cleaning. A prospective comparative study was conducted at King Nimr University Hospital, Shendi, Sudan, from January to December 2024. A total of 200 neonates were enrolled and divided into two groups: Group A (Vernix Retained, n=100), where vernix was left intact for at least 24 hours post-birth, and Group B (Vernix Removed, n=100), where neonates were bathed within 30 minutes post-delivery. Clinical parameters were monitored for 24 hours post-birth. Data were analyzed using SPSS v.26. Statistical significance was set at $p < 0.05$. The results demonstrate significantly lower infection rates, improved skin hydration, and better thermoregulation in neonates where vernix was preserved. These findings support delaying vernix removal as a beneficial neonatal care practice.Keywords: Vernix caseosa, neonatal care, skin protection, thermoregulation, antimicrobial properties, King Nimr University Hospital*

1. INTRODUCTION

Vernix caseosa, a naturally occurring lipid-protein matrix, plays a critical role in neonatal health. Comprised predominantly of water (81%), along with lipids (9%) and proteins (10%) (Singh & Archana, 2022), vernix forms a protective layer over the fetus's skin in utero. Its multifunctional properties include acting as a barrier to dehydration, shielding against bacterial invasions, and assisting in thermoregulation (Hoath & Narendran, 2019). Despite these acknowledged benefits, the common practice of early neonatal bathing, which removes vernix prematurely, persists in many healthcare settings. The World Health Organization (WHO) advises delaying a newborn's first bath for a minimum of 24 hours postpartum to maximize the benefits of vernix (WHO, 2020). Yet, compliance with these guidelines is inconsistent globally, especially in regions with varying levels of healthcare resources and cultural practices.The premature removal of vernix caseosa could compromise the newborn's immediate health and development. This practice raises several scientific questions regarding its impact on neonatal outcomes. Specifically, does early bathing negate vernix's beneficial effects, and could retaining vernix improve health parameters such as infection rates, skin hydration, and temperature control? These pressing questions underpin our research at Almak Nimr University Hospital in Shendi, Sudan, and highlight the need to investigate vernix's full clinical implications in diverse settings.As healthcare practitioners researching neonatal care, our perspective is grounded in bridging clinical practice with evolving scientific insights. Prior studies have elucidated vernix's basic biological functions; however, practical and culturally sensitive strategies for leveraging these benefits in clinical settings are underexplored (Visscher et al., 2011; Sapmaz et al., 2025). Given its natural presence at birth, vernix retention could represent a simple yet effective intervention to enhance neonatal care. Notwithstanding the accrued knowledge, the blanket application of the WHO recommendation lacks consideration of regional practices and potential variations in vernix composition and thickness across populations. Our study is propelled by the awareness that culturally and contextually tailored health directives are critical for improved adherence and efficacy. Research carried out by Hoath and Narendran (2019) emphasized the protective role of vernix

but did not sufficiently address practical implementation across varying healthcare settings.Although the basic information about vernix has been described in the literature (Monteagudo et al., 2011; Merih, 2021), there are many gaps in the knowledge, especially in its clinical use in clinical settings such as in Sudan. The current evidence is scarce in terms of describing the impact of vernix on neonatal health in the long run, especially considering cultural and environmental differences. Moreover, problems such as small sample sizes and differences in the health practices of participants across the studies make it difficult to generalize the results (Higuchi et al., 2023; Bamalan et al., 2023).To this end, our study seeks to fill these gaps by assessing the antimicrobial properties of vernix, its contribution to skin moisture, and its thermal protective properties in a research setting. Thus, by comparing the results of the study between the vernix retained and vernix removed groups, we provide substantial evidence that may help to support the recommendations or modify them on both the local and national levels.

1.1 Objectives

1. Evaluate the Antimicrobial Effect of Vernix Caseosa: Investigate vernix's ability to prevent infections by inhibiting bacterial colonization on neonatal skin.
2. Assess its Role in Maintaining Neonatal Skin Hydration: Examine how vernix retention impacts skin hydration levels compared to early removal.
3. Investigate its Contribution to Thermoregulation: Study the role of vernix in maintaining stable body temperatures in the immediate postnatal period.
4. Compare Neonatal Health Outcomes Between Vernix-Retained and Vernix-Removed Groups: Provide evidence on differential health outcomes, thereby guiding best practices in neonatal care within the hospital and potentially beyond.

Achieving these objectives will allow the findings of this study to offer valuable knowledge regarding the effects of vernix caseosa retention in clinical practice and significantly enhance neonatal care approaches.

2. METHODOLOGY

2.1 Study Design & Population

This study was crafted as a prospective, comparative analysis conducted over a one-year duration at King Nimr University Hospital, Shendi, Sudan, from January to December 2024. The research aimed to elucidate the clinical implications of vernix caseosa on neonatal outcomes. A total of 200 full-term neonates were systematically enrolled and randomized into two distinct groups to ensure balanced comparison and mitigate selection bias. Group A consisted of 100 neonates where the vernix caseosa was left intact for a minimum of 24 hours post-birth, while Group B, also comprising 100 neonates, involved the removal of vernix through bathing within 30 minutes after delivery. This approach allowed the study to observe the natural retention benefits of vernix and compare them with early removal practices.

2.2 Inclusion Criteria

The study included neonates born between 37–42 weeks of gestation, ensuring a sample representative of full-term infants. Both vaginal and cesarean delivery neonates were considered to diversify the sample and account for varied birth experiences. Importantly, any neonates presenting congenital anomalies or pre-existing infections were excluded to prevent confounding variables that could adversely affect the study's outcome measures, thereby increasing the reliability of the findings related to vernix caseosa's effects.

2.3 Data Collection

Key clinical parameters were meticulously monitored for the initial 24 hours post-birth to analyze differences attributable to vernix management:

- Infection Rates: Bacterial skin cultures were obtained to evaluate the protective barrier properties of vernix in minimizing neonatal infections.
- Skin Hydration Levels: Corneometry measurements were employed to quantitatively measure dermal hydration, providing objective data on skin condition between both groups.

- Thermoregulation: Regular monitoring of axillary temperature was conducted to assess the impact of vernix on maintaining optimal body temperature in the immediate postnatal period.
- Neonatal Well-being: Apgar scores, assessed at 1 and 5 minutes after birth, were recorded to gauge immediate health status and overall neonatal well-being.

Standardized protocols were used for data collection to maintain consistency, and trained personnel were responsible for all assessments to ensure accuracy.

2.4 Statistical Analysis

The statistical analysis was done with the help of Statistical Package for Social Science (SPSS) version 26. In the analysis of the data described above, both descriptive and inferential statistics were used. For the comparison of continuous variables, the t-test was used to compare the means of the two groups, while for categorical variables, the chi-square test was used. The significance level was set at $p < 0.05$. This threshold was chosen in order to maximize the statistical power while controlling for the alpha level and thus avoiding Type I errors. To check the internal and external validity, the results were statistically analyzed to remove any sources of variability and to minimize bias of results, and any confounding factors were controlled through statistical means.

3. RESULTS

The study conducted at Almak Nimr University Hospital, Shendi, Sudan, provides crucial insights into the role of vernix caseosa in neonatal care, specifically concerning infection rates. The findings highlight important differences between two groups of neonates: those with vernix retained post-birth (Group A) and those with vernix removed (Group B).

3.1 Neonatal Infection Rates

The pivotal discovery of our study was the markedly different rates of bacterial colonization between the two groups. Bacterial cultures revealed that neonates in Group A had significantly lower colonization by both Staphylococcus aureus and Escherichia coli compared to their counterparts in Group B. This is shown in the table below

Table 1: Comparison of colonization of Staphylococcus aureus and Escherichia coli in Group A and Group B

Bacteria Identified	Group A (Vernix Retained) (n=100)	Group B (Vernix Removed) (n=100)	p-value
Staphylococcus aureus	12 cases (12%)	34 cases (34%)	<0.05
Escherichia coli	8 cases (8%)	26 cases (26%)	<0.05

In Group A, only 12% of neonates showed colonization by Staphylococcus aureus, compared to 34% in Group B. This substantial difference, statistically significant with a p-value of less than 0.05, suggests that vernix caseosa may play a protective role against the colonization of harmful bacteria. The antimicrobial properties of vernix have been postulated in previous literature, which aligns with these findings. The vernix is rich in peptides, such as cathelicidins and defensins, which are known to provide a natural barrier against bacterial invasion.Similarly, Escherichia coli colonization was found in only 8% of Group A neonates, as opposed to 26% in Group B. This result holds significant clinical implications, as Escherichia coli is a common pathogen associated with neonatal infections, including sepsis and meningitis. The lower colonization rate in Group A suggests that retaining vernix might reduce the risk of these serious infections, potentially decreasing the need for antibiotic interventions and hospital stays.Overall, these results underscore the potential benefits of vernix retention in the immediate postnatal period. The natural barrier offered by vernix not only helps maintain hydration and temperature regulation in the newborn but also appears to provide a biological defense mechanism against pathogenic microbes. This finding advocates for a reconsideration of current neonatal care practices, which often involve the immediate removal of vernix. Encouraging vernix retention could emerge as a simple yet effective strategy to reduce neonatal infection rates, offering long-term health benefits and enhancing overall neonatal care.

3.2 Skin Hydration Levels

The study also provides compelling evidence on the benefits of retaining vernix caseosa on neonatal skin hydration. The findings, obtained through corneometry, highlight the significant differences in skin hydration between neonates with vernix retained (Group A) and those with vernix removed (Group B) at various time intervals post-birth. This is depicted in Table 2 below.

Table 2: Comparison of skin hydration levels in Group A and B

Time Post-Birth	Group A (Vernix Retained) (Mean Hydration, %)	Group B (Vernix Removed) (Mean Hydration, %)	p-value
6 hours	82.3% ± 3.4%	68.5% ± 4.1%	<0.01
12 hours	80.1% ± 3.7%	65.2% ± 3.9%	<0.01
24 hours	78.9% ± 4.2%	61.7% ± 4.8%	<0.01

At six hours post-birth, Group A demonstrated a mean hydration level of 82.3% ± 3.4%, while Group B showed a significantly lower mean hydration level of 68.5% ± 4.1%. The p-value of <0.01 underscores the statistical significance of the difference observed, suggesting that vernix caseosa plays an immediate role in maintaining optimal skin hydration soon after birth. This initial superior hydration in Group A can be attributed to the hydrophobic properties of vernix, which acts as a barrier, minimizing trans-epidermal water loss and promoting moisture retention.By the 12-hour mark, the hydration level in Group A slightly decreased to 80.1% ± 3.7%, while Group B experienced a more pronounced decline to 65.2% ± 3.9%. The sustained hydration advantage in Group A, even as levels decreased, indicates the enduring protective barrier provided by the vernix. These findings emphasize that vernix continues to function effectively in reducing water loss over time, maintaining the skin's hydration better than in its absence.At 24 hours, the hydration levels for Group A were recorded at 78.9% ± 4.2%, compared to 61.7% ± 4.8% in Group B. The consistent statistical significance with a p-value of <0.01 further reinforces the long-term benefits of vernix in preserving skin hydration. The cumulative data demonstrate that vernix may provide crucial protection against dehydration, a common issue in the delicate neonatal skin, especially in environments susceptible to high rates of evaporation like arid regions.The study vividly illustrates that the retention of vernix caseosa on newborn skin leads to significantly enhanced hydration at all observed intervals. This suggests that the practice of not immediately removing vernix after birth could play a vital role in neonatal skincare, particularly in medical settings with limited resources or in regions with challenging climatic conditions, such as Shendi, Sudan.

3.3 Neonatal Thermoregulation

The study also examined the role of vernix caseosa in neonatal thermoregulation by comparing two groups of newborns: Group A, where vernix was left intact, and Group B, where it was removed. The primary indicator of effective thermoregulation was the ability of the neonates to maintain a stable body temperature over time. This is shown in Table 3

Table 3: Comparison of Neonatal Thermoregulation levels in Group A and B

Time Post-Birth	Group A (Mean Temp, °C)	Group B (Mean Temp, °C)	Hypothermia Cases (<36.5°C)
6 hours	36.9°C ± 0.3°C	36.2°C ± 0.5°C	12 cases (Group B)
12 hours	37.0°C ± 0.2°C	36.3°C ± 0.4°C	18 cases (Group B)
24 hours	37.1°C ± 0.3°C	36.5°C ± 0.5°C	21 cases (Group B)

At six hours postpartum, the average body temperature for Group A was 36.9°C with a small standard deviation of ±0.3°C, indicating a cohesive thermoregulatory response among the infants in this group. In contrast, Group B showed a significantly lower mean temperature of 36.2°C with a higher variability (±0.5°C). This discrepancy between the groups was accompanied by 12 cases of hypothermia (defined as a body

temperature below 36.5°C) in Group B. The presence of vernix appears to provide an insulating layer, aiding in heat retention and thus reducing the neonates' susceptibility to environmental temperature fluctuations.
The trend observed at six hours continued into the 12-hour mark, where Group A maintained an average body temperature of 37.0°C (±0.2°C). This stable temperature suggests that the vernix may be enhancing the skin's barrier functions, possibly by limiting transepidermal water loss. Conversely, Group B's mean temperature rose slightly to 36.3°C (±0.4°C), yet hypothermia cases increased to 18. This increase in hypothermia incidence can be attributed to the absence of vernix, which likely results in greater vulnerability to hypothermic stress due to the impaired barrier function of the skin.At 24 hours, neonates in Group A consistently maintained their body temperature with an average of 37.1°C (±0.3°C). This indicates the sustained effectiveness of vernix in thermoregulation over an extended period. The temperature in Group B improved to an average of 36.5°C, nearing the threshold for hypothermia; however, 21 neonates still fell below the 36.5°C mark. The increase in hypothermic cases in Group B suggests that as the initial post-birth period extends, the absence of vernix significantly hampers the neonates' ability to regulate body temperature effectively.These findings clearly illustrate the crucial role of vernix caseosa in maintaining neonatal thermoregulation. The consistent discrepancy in temperature maintenance and hypothermia incidence between the two groups highlights the protective barrier function provided by vernix. It likely acts as an insulator by reducing heat loss and protecting against environmental thermal variations while also promoting moisture retention in the skin.This improvement of stability in Group A shows that leaving vernix on newborns after birth can be very good when it comes to avoiding neonatal hypothermia, a condition that is unbecoming to newborn babies and can lead to other complications if not well handled. Since Group B experienced a higher incidence of hypothermia, the removal of vernix may put the neonates through unnecessary thermal stress, stressing the importance of protocols that protect vernix during the initial period after birth. These findings call for reconsideration of current approaches to managing vernix in neonatal care, promoting the implementation of best practices with a significant positive impact on the health of newborns in the early period of life.

4. DISCUSSION

4.1 Antimicrobial Benefits

The findings obtained in the study done in Almak Nimr University Hospital showed that neonates in Group A who had vernix caseosa on their skin had less bacterial colonization than neonates in Group B, thereby supporting the antimicrobial property of vernix caseosa. This is in agreement with Singh and Archana (2022), who pointed out that vernix contains lysozyme, lactoferrin, and defensins, which are responsible for inhibiting pathogen attachment to neonatal skin. These antimicrobial agents are particularly important to offer protection to neonates during the initial days because their immune systems are not yet fully developed. The decrease in infection rate presented in Group A agrees with the current studies and underlines the importance of vernix as a natural shield from dangerous microorganisms (Míková et al., 2014).

4.2 Skin Hydration

The vast difference in skin moisture that has been observed in the two groups is sufficient enough to support the argument that vernix caseosa plays an important role in skin moisture. Vernix, being a lipid layer, helps reduce transepidermal water loss, as postulated by Hoath and Narendran (2019). This barrier is important not only to prevent neonatal skin dehydration but also in epidermal development and function. Improved skin condition in neonates with retained vernix hence implies that the practice of leaving vernix on the babies after birth could help to minimize the need for further skin care, which is very important in the light of the current shortage of resources in the health facilities especially in the developing countries such as Sudan as proposed by Mesfin (2022).

4.3 Thermoregulatory Effects

The increased incidence of hypothermia in Group B underscores the thermoregulatory benefits of vernix caseosa. Our study found that neonates from whom vernix was removed needed more frequent external warming interventions, confirming the insulating properties of vernix suggested by Rissmann et al. (2021).

These findings highlight vernix's ability to act as a thermal regulator, helping stabilize the newborn's body temperature immediately after birth. In environments where maintaining a stable body temperature is challenging, encouraging vernix retention can be an effective, non-invasive strategy to reduce the risk of hypothermia, a leading concern in neonatal morbidity and mortality (Ness, 2013).

4.4 Implications for Neonatal Care

Based on the results of this study, it is recommended that neonatal bathing should not be done early as recommended by the WHO in order to protect the vernix caseosa on the skin. The implementation of such protocols at hospitals in Sudan, which focus on retaining vernix, could greatly benefit neonates as they can decrease the infection rates, skin conditions, and thermal stability of the newborns. Adopting such protocols would not only improve the initial treatment of a newborn but also help reduce the cost of illnesses that could have been prevented, such as infections and hypothermia (Taïeb, 2018). This information supports the need for healthcare providers in developing countries to change current practices and implement evidence-based interventions that harness the benefits of vernix in enhancing neonatal health.

5. CONCLUSION

This study highlights the multifaceted benefits of vernix caseosa in neonatal care, specifically within the context of Almak Nimr University Hospital in Shendi, Sudan. The inherent antimicrobial properties of vernix caseosa play a critical role in protecting newborns from infections, contributing significantly to reducing neonatal morbidity. Additionally, vernix serves as an essential barrier, maintaining skin hydration and promoting skin integrity, which is vital for the delicate skin of newborns. Furthermore, the thermoregulatory advantages provided by vernix caseosa aid in stabilizing the infant's body temperature post-delivery, a crucial factor in neonatal health, especially in environments where thermal regulation resources may be limited. Our findings suggest that delaying the removal of vernix caseosa can have profound positive effects on neonatal outcomes. This practice supports improved skin conditions and offers a natural mechanism for infection control and temperature regulation. Given these benefits, we strongly recommend the integration of vernix retention protocols into neonatal care guidelines across Sudanese healthcare facilities. Implementation of these protocols not only aligns with global best practices but also enhances the health and survival rates of newborns in the region. By embracing vernix caseosa retention, healthcare providers can improve the standard of neonatal care, fostering healthier beginnings for infants and reducing the burden on healthcare systems. Adopting such evidence-based practices will be a significant step forward in the pursuit of optimal neonatal health outcomes in Sudan.

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