Bathing Newborns within 36 Hours after Birth Temporarily Alters the Skin Barrier Function and May Increase the Risk of Atopic Dermatitis

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Abstract

Purpose: This study aimed to evaluate whether bathing newborns within 36 hours after birth has a temporary negative impact on skin barrier metrics and relates to atopic dermatitis (AD) development.

Methods: 55 newborns were bathed with water at 24-36 hours after birth, while 102 newborns did not have bath. Skin barrier metrics, including facial and underarm transepidermal water loss (TEWL), stratum corneum hydration (SCH), and skin humidity, were evaluated 1 hour before and after bath (T0 and T1, respectively), as well as on the next day (T2). A follow-up questionnaire via telephone was conducted 12-month later (T3). AD screening was determined based on the questionnaire.

Results: In the non-bathed newborns, no significant alteration in skin barrier function was observed. In the bathed newborns, the underarm SCH significantly deteriorated from 16.60±21.74 at T0 to 8.16±12.27 at T2 (51% deterioration, p=0.009). Deteriorations were also observed for the facial and underarm humidity right after bath (-5%, p=0.017 and -4%, p=0.012) as well as on the next day (-6%, p=0.003 and -5%, p=0.001). At T3, 5% non-bathed newborns were determined to have developed AD during the past 12-month, while this number increased by 4-fold (21%) in the bathed newborns (p=0.010).

Conclusion: This study demonstrated a temporary negative impact on newborn's skin barrier function caused by bathing within 36 hours after birth. Deteriorated skin barrier function in the temporary window may still leave the newborn susceptible to infection and allergy, increasing the risk of triggering AD onset.

Introduction

The skin is the first defender protecting human from outside threats. Besides maintaining proper hydration [1] and engaging in thermoregulation [2], skin plays an essential role as a protective barrier preventing harmful pathogens entering human body [3, 4]. Maintaining a healthy and competent skin barrier function is important, especially for the newborn infants. Although a healthy full-term infant is born with a competent skin barrier [5], during the first year of life, the skin is still developing and different in structure, function, and composition with the skin of an adult [6-8].

Bathing a newborn can clean the skin, removing irritants such as saliva, nasal secretions, urine, and feces. However, an inappropriate bath may alter the barrier function to the newborn's thin and tender skin, making the newborn vulnerable to infection and allergy [9]. Studies have demonstrated that the harmony of cutaneous microbiota is essential for an effective skin barrier function [10]. For a newborn, the skin microbial flora is still evolving at postpartum [11]. Bathing the newborn may disrupt the balance of the skin mircrobiota and deteriorate the skin barrier function [12]. In addition, the vernix caseosa is a multicomponent mixture, which can facilitate the skin barrier function by regulating skin temperature and preventing skin water loss [13]. Both World Health Organization (WHO) and Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN) skincare guidelines recommend drying and covering the newborn immediately after birth, while leaving vernix caseosa intact and allowing it to wear off naturally instead of washing or bathing it off [14, 15].

WHO recommends delaying the first bath for 6-24 hours after delivery [15]. However, it is still unclear whether bathing a newborn within a short-time window after birth has any form of negative impact on the skin barrier function, and whether it is related to AD development in later life time. The skin barrier function can be measured using a simple non-invasive device [16]. In this study, we evaluated newborns' skin barrier metrics measured by such device, including the transepidermal water loss (TEWL), stratum corneum hydration (SCH), and skin humidity, before and after bath, as well as one day after bath. We aimed to evaluate whether bathing the newborn within 36 hours after birth has a temporary negative impact on skin barrier metrics and relates to AD development.

Materials And Methods

Study population

Data and information of mothers and newborns was obtained from the hospital record of the Affiliated Shenzhen Maternity & Child Healthcare Hospital, Southern Medical University (Shenzhen, Guangdong, China). The mother was admitted and gave childbirth in the Department of Obstetrics. Depending on whether the newborn was bathed at 24-36 hours after birth, the mother and newborn were assigned to a bathed group or a non-bathed group. The inclusion criteria was 1) the newborn was full-term born; 2) family history of allergies was available (including family members in 3 generations); 3) the mother and newborn stayed in the hospital for at least 3 days after childbirth; and 4) for the bathed group, skin barrier functions were measured 1 hour before and after bath (T0 and T1, respectively), as well as on the next day (T2); for the non-bathed group, skin barrier functions were measured at T0 and T2. The mother and newborn were excluded if 1) the mother had maternal chorioamnionitis, diabetes, or abnormal thyroid function during pregnancy; 2) the newborn had respiratory symptoms requiring oxygen, sepsis, immunodeficiency, congenital anomalies, or relevant skin maceration or inflammation; or 3) the newborn had admission to the newborn intensive care unit. This study was approved by the IRB of the Affiliated Shenzhen Maternity & Child Healthcare Hospital, Southern Medical University.

Bathing procedure

According to the recommendation of WHO [15], all bathed newborns in the Department of Obstetrics at the Affiliated Shenzhen Maternity & Child Healthcare Hospital, Southern Medical University were bathed with water (without any baby cleanser or other product) at 24-36 hours after birth. The water temperature was 37-38°C and pH was 7.9-8.2. All bathed and non-bathed newborns stayed in the hospital with same environmental temperature and humidity till discharge.

Clinical measures

Skin barrier metrics, including the TEWL, SCH, and skin humidity, were measured in two different regions, face and underarm, 1 hour before and after bath (T0 and T1, respectively), as well as on the next day (T2) in the bathed newborns using a non-invasive device (GPSKIN BARRIER, GPOWER Inc., Seoul, South Korea [16]). In the non-bathed newborns, same facial and underarm skin barrier metrics were measured at T0 and T2 using the same device. The TEWL is a sensitive indicator of the integrity of the stratum corneum (SC), which is the most important component of the skin barrier preventing excessive water loss from the body and maintaining homeostasis [17]. A lower TEWL value indicates a better skin barrier function. Another important function of the SC is to store water to maintain normal physiological functions of the skin [18]. The SCH directly shows the amount of water stored in the SC, with a higher value indicating a better skin barrier function. The skin humidity is another parameter indicating the barrier function, while a dry skin is usually associated with skin diseases such as atopic dermatitis, psoriasis, xerosis, and pruritus [19]. A higher skin humidity value indicates a better skin barrier function.

A follow-up questionnaire via telephone was conducted at 12-month (T3). The questionnaire collects related covariates and health conditions, such as during the past 12-month, whether the newborn had 1) itchy skin; 2) rash; 3) allergic rhinitis; 4) asthma; 5) allergic conjunctivitis; 6) urticaria; 7) repeated courses of health conditions; and 8) whether the family (3 generations) had a history of allergies. According to the Guidelines for Diagnosis and Treatment of Atopic Dermatitis in China [20, 21], newborns who simultaneously presented 1) itchy skin; 2) rash; and 3) repeated courses of health conditions or simultaneously presented 1) itchy skin; 2) rash; and 3) family history of allergies were determined to have developed AD during the 12-month after birth.

Statistical analysis

All quantitative data were presented as mean ± standard deviation. All categorical data were expressed as percentage. A Shapiro-Wilk test was applied for testing the normality of the data. Between-group differences for quantitative demographics and characteristics were compared using an independent t test. Between-group differences for categorical demographics, characteristics, 12-month follow-up questionnaire, and 12-month AD incidence rate were compared using a Chi-square test. The impact of bath or non-bath on the skin barrier function was evaluated using repeated measures comparing the facial and underarm TEWL, SCH, and skin humidity between T0, T1, and T2. The "group x time" interaction was evaluated. Statistical significance was accepted at $p<0.050$. All statistical analysis were performed using IBM Statistical Package for Social Sciences (SPSS Version 26; IBM, Chicago, IL, USA).

Results

Demographics and baseline characteristics

Based on the inclusion and exclusion criteria, 102 mothers and newborns were assigned to the non-bathed group, while 55 mothers and newborns were assigned to the bathed group. Table 1 summarizes demographics and characteristics of the newborns and mothers. There was no between-group difference in the mothers for demographics and clinical characteristics, including age and the prevalence of pregnancy complications, bacterial vaginosis, and placenta or amniotic membrane infections. A few mothers in the two groups took probiotics and/or prebiotics supplementations during the pregnancy, while most mothers took high protein diet as well as multi-vitamin, folic acid, calcium, and DHA supplementations. But still, there was no statistically significant difference between the non-bathed and bathed groups. No mother in either group had risk of harmful chemical agent exposure or drinking history during the pregnancy. But 25% mothers in the non-bathed group and 31% mothers in the bathed group had smoking history or exposed to secondhand smoking during the pregnancy, with no between-group difference. In the non-bathed group, 29% families reported history of allergies, while this number was slightly lower but not significant different in the bathed group (24%). The two groups had comparable average gestation and delivery method (p>0.050).

Table 1
Demographics and characteristics.

		Non-bathed Group (n=102)	Bathed Group (n=55)	*p*-value
Mother	Mother’s Age, year	31.7 ± 4.4	31.4 ± 4.0	0.738
	Pregnancy Complications, %	20%	17%	0.800
	Bacterial Vaginosis, %	14%	8%	0.329
	Placenta or Amniotic Membrane Infection, %	0	2%	0.645
	Probiotics and/or Prebiotics Supplementation, %	7%	14%	0.165
	Multi-vitamin Supplementation, %	70%	90%	0.102
	Folic Acid Supplementation, %	80%	75%	0.737
	Calcium Supplementation, %	90%	79%	0.427
	DHA Supplementation, %	80%	60%	0.241
	High Protein Diet, %	70%	65%	0.743
	Smoking or Secondhand Smoking Exposure, %	25%	31%	0.406
	Drinking, %	0	0	-
	Risk of Harmful Chemical Agent Exposure, %	0	0	-
	Family History of Allergies, %	29%	24%	0.439
	Gestation, day	274.6 ± 7.2	275.7 ± 7.0	0.392
	Delivery Method			
	Vaginal Delivery, %	68%	55%	0.105
	Cesarean Section, %	28%	40%	0.140
	Forceps or Vacuum, %	4%	5%	0.657
Newborn	Gender (Female), %	40%	47%	0.381
	Birth Weight, kg	3.31 ± 0.38	3.31 ± 0.39	0.965
	Vernix Caseosa, %	29%	33%	0.766

Newborns in the two groups had no difference in gender or birth weight. The difference of prevalence of vernix caseosa after birth did not reach statistical significance.

Transepidermal water loss

Figure 1A illustrates alterations of the facial TEWL for both groups with and without bath. Among the non-bathed newborns, the facial TEWL had a slight increase from T0 to T2 (15%), however the change did not reach statistical significance (p>0.050). Among the bathed newborns, the facial TEWL did not change right after bath. There was a slight decrease in the facial TEWL at T2 (11%), however the change did not reach statistical significance (p>0.050). Figure 1B illustrates alterations of the underarm TEWL. Similarly, no significant alteration was observed (p>0.050). There was no significant “group x time” interaction for the facial and underarm TEWL (p=0.141 and p=0.817).

Stratum corneum hydration

As shown in Figure 2A, there was no significant alteration in the facial SCH among either group (p>0.050). For the underarm SCH, the non-bathed newborns did not exhibit any alteration (p>0.050), while the bathed newborns had a 30% deterioration right after bath (Figure 2B). This deterioration continued and reached statistical significance on the next day (51% reduction, p=0.009). In addition, the alteration from T0 to T2 in the underarm SCH was significant when compared between the bathed and non-bathed groups (p=0.012, Figure 2B).

Skin humidity

As illustrated in Figure 3, the non-bathed newborns did not exhibit any alteration from T0 to T2 in the facial or underarm humidity (p>0.050). On the other hand, the bathed newborns had significant deteriorations right after bath in the facial humidity (5% reduction, p=0.017) and underarm humidity (4% reduction, p=0.012). On the next day, these two parameters further deteriorated by 6% (p=0.003) and 5% (p=0.001) when compared to T0. In addition, when compared between the two groups, alterations from T0 to T2 in both facial and underarm humidity reached statistical significance (p=0.006 and p=0.003, respectively).

12-month follow-up

The 12-month follow-up questionnaire was successfully performed by 125 families, including 101 in the non-bathed group and 24 in the bathed group. Results were summarized in Table 2. For covariates including newborns’ feeding type, the prevalence of taking probiotics and/or prebiotics supplementations, history of taking antibiotics, the prevalence of having pets in house, and having risk of harmful chemical agent exposure, the two groups presented comparable numbers (p>0.050).

Table 2
Results of 12-month follow-up questionnaire.

		Non-bathed Group (n=101)	**Bathed Group (n=24)**	***p*-value**
Covariates	Feeding Types			
	Breast Feeding, %	57%	50%	0.562
	Formula Feeding, %	11%	21%	0.204
	Combination Feeding, %	32%	29%	0.766
	Probiotics and/or Prebiotics Supplementations, %	54%	75%	0.398
	Antibiotics, %	20%	13%	0.418
	Pets in House, %	12%	4%	0.281
	Risk of Harmful Chemical Agent Exposure, %	16%	17%	0.946
Health Conditions	Itchy Skin, %	29%	29%	0.954
	Rash, %	25%	42%	0.114
	Allergic Rhinitis, %	18%	20%	0.902
	Asthma, %	0	0	-
	Allergic Conjunctivitis, %	0	0	-
	Urticaria, %	4%	0	0.634
	Repeated Courses of Health Conditions, %	29%	50%	0.234
	Family History of Allergies, %	29%	37%	0.400
	Atopic Dermatitis, %	5%	21%	**0.010**

There was no significant difference between the two groups in the incidence rate of itchy skin, rash, allergic rhinitis, asthma, allergic conjunctivitis, urticaria, repeated courses of health conditions, or family history of allergies. However, the bathed newborns were screened at a 4-fold higher incidence rate than the non-bathed newborns to have developed AD in the past 12-month (21% vs. 5%, p=0.010).

Discussion

To our knowledge, this is the first study to evaluate the temporary impact of early bathing on the skin barrier function in newborns and explore the potential association between bathing and AD development.

Our results demonstrated a deterioration in the skin barrier function after early bath, including decreased underarm SCH as well as decreased facial and underarm humidity. In addition, via a 12-month follow-up questionnaire, we found that newborns bathed within 36 hours after birth having a prevalence of AD development 4 times higher than those without bath.

Early studies suggesting bathing, as early as 1 hour of age, is safe for full-term newborns only evaluated axillary or rectal temperature, arterial blood saturations, and other vital signs [22-25]. In these studies, scholars demonstrated axillary and rectal temperature, blood pressure, respiration rate, heart rate, and early neonatal complications do not alter after early bathing or do not differ between groups with and without bath [22-25]. However, recent studies evaluating skin barrier metrics show controversies. Lund et al. recruited 100 newborns and randomized them into two groups to receive their first bath with water or with water and a liquid baby cleanser [26]. Both groups exhibited a significant decrease in the SCH after bath, while the TEWL and skin pH also altered [26]. In this study, there was no difference for any related covariate in the mother or newborn between the bathed group and non-bathed group. Although we did not observe significant TEWL alterations, significant SCH and skin humidity reductions were observed in bath newborns. Previous studies have demonstrated defective skin barrier function, such as impaired skin hydration, enables and enhances penetration of environmental allergens into the skin, causing allergies, inflammations, and infections [27, 28]. Atopic skin disease, such as AD, has been proved to be associated with skin infection and allergy [29]. Our results are consistent with previous literature. In this study, newborns bathed within 36 hours after birth had a prevalence of developing AD in 12-month 4-fold higher than those without bath, while there was not significant difference in related covariates, including the family history of allergies. This suggests the potential association between early bathing and AD development.

Therefore, a delayed bathing is suggested to maintain the skin barrier function in newborns. In one study, Bartels et al. recruited 57 healthy full-term newborns and demonstrated significant increases in the SCH at variant body regions from postnatal day-2 to day-7 by only washing newborns with a wet cotton washcloth twice weekly [30]. This study also suggested if healthy full-term newborns received the first bathing after the 7th postnatal day, there would be no harm to the skin barrier function [30]. Based on these evidences and findings in our current study, we suggest to dry and cover the newborn immediately after birth. Then, wash the newborn using a wet towel or cotton washcloth twice weekly for the first postnatal week, while delaying the first bathing to the second week after delivery.

Previous studies also demonstrated benefits of applying proper emollient in newborns to protect the integrity of the skin barrier function [31, 32]. Emollient can facilitate the SC to maintain proper hydration and decrease the TEWL [31, 33]. It can be used to treat post-bathing or post-washing skin changes including dryness, erythema, irritation, and other barrier alterations [34-36]. In addition, by maintain skin moisture, repairing or enhancing skin barrier, and reducing the need of anti-inflammatory measures, emollient also contributes in preventing or modifying the development of AD [37, 38]. Therefore, we recommend a routine emollient application in newborns, especially after bathing or washing.

In this study, we only evaluated temporary alterations in the skin barrier function after newborns taking the early bath. A future study is needed for evaluating a relatively long-term impact of bathing and monitoring the change of skin microbiota.

In conclusion, bathing a newborn within 36 hours after birth has a temporary negative impact on the SCH and skin humidity. We also found a positive correlation between early bathing and AD development. Deteriorated skin barrier function may leave the newborn susceptible to infection and allergy, increasing the risk of triggering AD onset.

Declarations

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Declaration of Interest Statement

The authors report no conflicts of interest.

Author Contribution

Y Xiong: Project development, Data analysis, Manuscript writing and editing

H Zhou: Project development, Data analysis, Manuscript writing and editing

L Chen: Project development, Data analysis, Manuscript writing and editing

S Zhu: Data collection and management

T Chen: Result interpretation, Manuscript editing

X Yang: Data collection, Data Management

W Sun: Data collection, Data Management

S Li: Protocol and project development, Manuscript editing

B Wu: Protocol and project development, Manuscript editing

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Figures

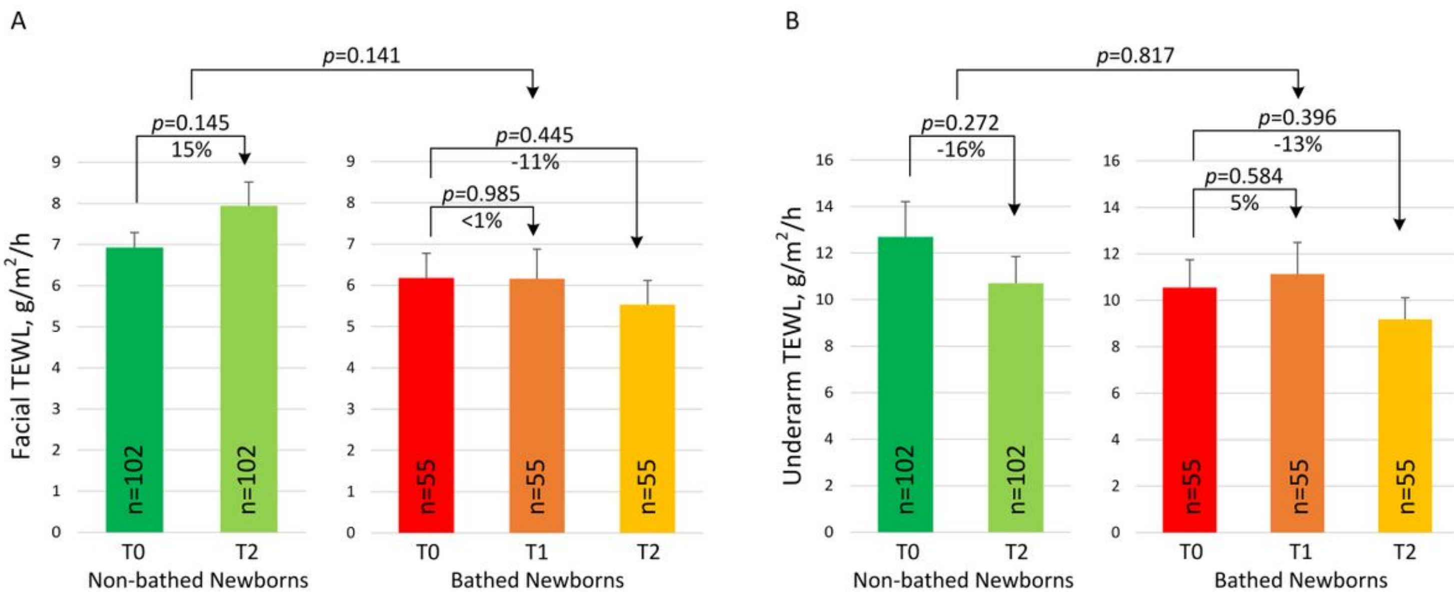

Figure 1

Alterations of A) the facial TEWL and B) the underarm TEWL for the bathed and non-bathed newborns. The error bar indicates standard error.

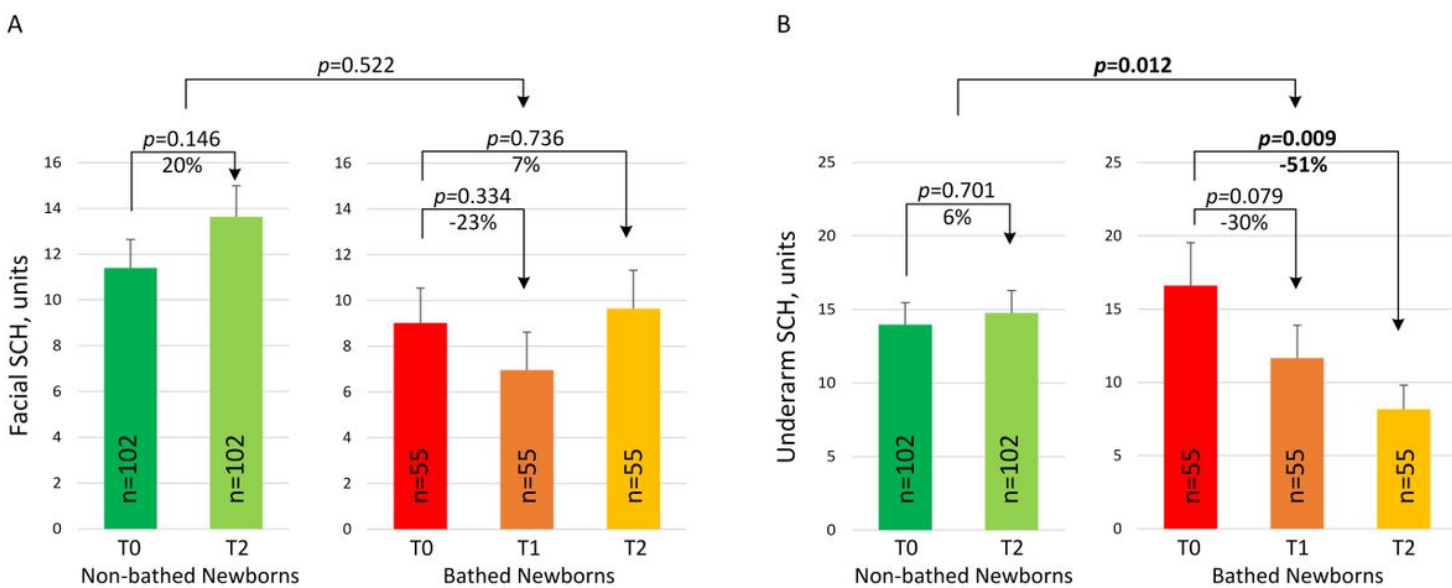

Figure 2

Alterations of A) the facial SCH and B) the underarm SCH for the bathed and non-bathed newborns. The error bar indicates standard error. Statistical significance is marked in bold.

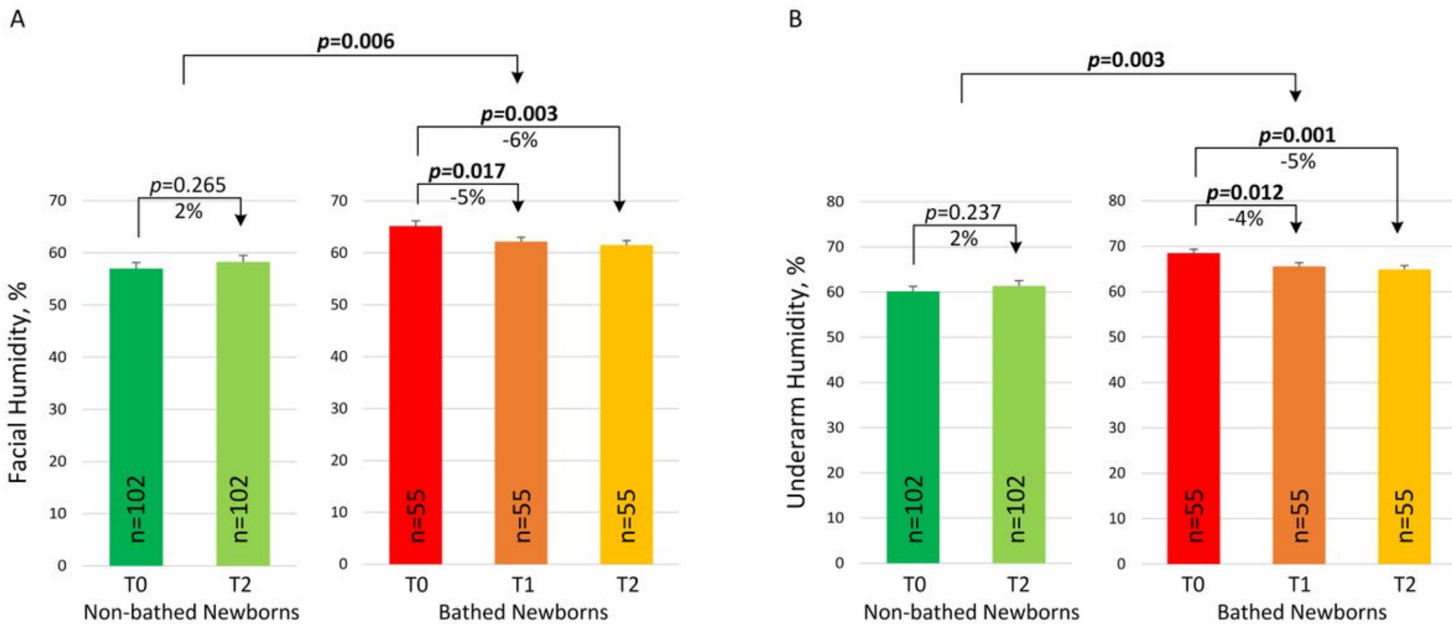

Figure 3

Alterations of A) the facial humidity and B) the underarm humidity for the bathed and non-bathed newborns. The error bar indicates standard error. Statistical significance is marked in bold.