Newborn Skin Health Research

Unique Differences of Infant Skin, its Microbiome, and How to Support Normal Skin Maturation
Welcome and Introductions

Professor Dame Tina Lavender, PhD
Centre for Childbirth, Women’s and Newborn Health (CWNH)
Liverpool School of Tropical Medicine
# Agenda

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Learning Objectives - Enhance your Understanding of...

1. The unique differences of infant skin vs. adult skin, its maturation, and how these differences inform infant skincare

2. The skin microbiome, its role, and how it works in combination with the skin as a “first line of defense”

3. Cleansing and moisturizing routines for infant skincare and why they matter, including evidence-based clinical practice guidelines to support a healthy skin barrier and its protective skin microbiome
Disclosures

• The opinions expressed by the speakers are their own and not that of their employers or the program sponsor

• Dr. Mack and Dr. Stamatas work in Research & Development as employees of Johnson & Johnson Consumer Health operating companies

• Dr. Lavender has received research and educational grants from Johnson & Johnson Consumer Inc. in the past

• This presentation and speakers are sponsored by the Research & Development group at Johnson & Johnson Consumer Inc.
Why is Understanding Infant Skin Important to Midwives?

• Newborn skin barrier remains immature for some time following birth; making it susceptible to infections and the penetration of allergens and irritants
• The microbiome works alongside the skin barrier to keep baby skin healthy
  • Newborn babies get their first microbiome from their mother during birth
• Early microbiome development is critical, having long term impact
  • Gut health, mental health, immune health
• How we care for newborn skin can disrupt the skin barrier and microbiome, leading to harm
• Any skin care practices should be based on rigorous evidence
Why is Understanding Infant Skin Important to Midwives?

- Midwives are the primary care givers for women in the immediate postnatal period
- The advice we give parents can have a long-term impact on the health of the baby
- Understanding the skin and the evidence surrounding skin care practices enables us to provide parents with choices based on the best available research
The Science of Infant Skin
How it Develops and Implications for Care

M. Catherine Mack, PhD
Research Manager Translational Science
Johnson & Johnson Consumer Inc., USA
The Human Skin – Our Outside Organ is Our Largest

- Rapid growth in skin surface area over the first years of life\(^1\)
- Baby ~ 3-5 square feet\(^1\)
- Adult ~ 20 Square feet\(^2\)

At birth, skin surface area grows at a rate of 75 cm\(^2\)/week

Surface area growth rate decreases to about 10 cm\(^2\)/week by 1 year

Skin Function

- **Natural protective barrier from**
  - Physical injury
  - Pathogenic microbes
  - Chemical agents
  - Extreme temperatures
- Starts process for making **Vitamin D** to help body absorb calcium and maintain phosphorous for healthy bones
- **Sensory perception**: temperature, pressure, touch, pain
- **Temperature regulation** of the body
- Helps to restrict fluid and water loss

# Babies’ Skin is Different: Structure, Composition, Function

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<tr>
<th>Structure</th>
<th>Composition</th>
<th>Function</th>
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<tbody>
<tr>
<td>Stratum corneum and epidermal thickness(^1)</td>
<td>Water content(^2)</td>
<td>Water handling properties(^2)</td>
</tr>
<tr>
<td>Corneocyte size(^1)</td>
<td>Natural moisturizing factor (NMF)(^2)</td>
<td>Barrier function(^2)</td>
</tr>
<tr>
<td>Surface roughness</td>
<td>Melanin(^3)</td>
<td>Skin reactivity</td>
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<tr>
<td>Elasticity</td>
<td>Lipid content and organization</td>
<td>Cell proliferation(^1)</td>
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<table>
<thead>
<tr>
<th>HEALTHY SKIN</th>
<th>SKIN PARAMETER</th>
<th>ADULT</th>
<th>INFANT</th>
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<tbody>
<tr>
<td><strong>STRUCTURE</strong></td>
<td>Surface Microrelief Lines</td>
<td>Less Dense</td>
<td>More Dense</td>
</tr>
<tr>
<td></td>
<td>Stratum Corneum (SC) Thickness</td>
<td>Thicker ~10 µm</td>
<td>Thinner ~7 µm</td>
</tr>
<tr>
<td></td>
<td>Epidermis</td>
<td>Thicker</td>
<td>Thinner (~20% vs. Adult)</td>
</tr>
<tr>
<td><strong>COMPOSITION</strong></td>
<td>Water Content</td>
<td>Stratum Corneum (SC) Lower</td>
<td>Higher (older infants, drier at birth)</td>
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<tr>
<td></td>
<td>NMF Natural Moisturizing Factor Concentration</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td></td>
<td>Surface Lipids</td>
<td>Sebum Higher</td>
<td>Lower (7-10 mo old)</td>
</tr>
<tr>
<td><strong>FUNCTION</strong></td>
<td>TEWL Trans-epidermal water loss</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td></td>
<td>pH Surface pH</td>
<td>Lower</td>
<td>More Alkaline (newborn)</td>
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Infant Skin is Thinner than Adult Skin and has Smaller Corneocytes

Although more hydrated than adult skin it can lose water up to 2X as fast

Smaller cells and thinner skin results in shorter pathway from outside to inside

Across Geographic Regions & Skin Type, Infant Skin Barrier Differs from Adult

• Study performed in Beijing, China; Mumbai, India; and New Jersey, USA

• TEWL is higher in infants compared to adults in all three populations studied

• TEWL on exposed skin (dorsal forearm) approaches adult-like values faster than unexposed skin (upper inner arm)

Maintaining Skin Barrier Integrity is Essential

• Can be measured by skin’s ability to hold onto water - TEWL*
• Skin hydration of the stratum corneum (SCH) also important (assessed with electrical measures)
• Is influenced by skin pH
• Immaturity, alterations in skin pH, injury or disease can result in impaired skin barrier function

* TEWL, transepidermal water loss
pH - A Measure of Alkalinity or Acidity

- pH 7.0 Neutral
- Alkaline (Base, Basic)
- Acidic
The Acid Mantle
Key to Maintaining the Integrity of the Skin Barrier

• What is it?
  • Protective, mildly acidic, skin “film” protects overall health of the skin
  • Allows resident skin flora to flourish
  • Inhibits growth of transient flora, such as, gram negative bacteria (E. coli, Pseudomonas); gram positive bacteria (Staphylococcus); fungal (C. albicans)

• What happens if it becomes more alkaline?
  • Interferes with protective barrier
  • Cell separation results in more water loss → dry skin, flaking, irritation, roughness
  • Skin vulnerable to bacterial invasion → infection
What is the pH range of baby’s skin?

A. 2.0 – 3.9
B. 5.0 – 5.9
C. 7.0 – 7.9
D. 10.0 – 10.9
pH - A Measure of Alkalinity or Acidity

pH 5.0 – 5.9
Acid Mantle

Alkaline (Base, Basic)

Acidic

- Bleach
- Soapy Water
- Ammonia Solutic
- Milk of Magnesia
- Baking Soda
- Sea Water
- Distilled Water
- Urine
- Black Coffee
- Tomato Juice
- Orange Juice
- Lemon Juice
- Gastric Acid
Acid Mantle (Skin pH) is Protective - Inhibits Growth of Pathogens and Transient Flora and Favors Growth of Protective Resident Flora

<table>
<thead>
<tr>
<th>Skin Type</th>
<th>Skin pH (~)</th>
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<tbody>
<tr>
<td>Full Term Healthy(^1)</td>
<td>pH &gt; 6.0 @ Birth</td>
</tr>
<tr>
<td></td>
<td>Falls to pH &lt; 5.0 at Day 4</td>
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<tr>
<td>Premature(^2)</td>
<td>pH 5.5 @ one week</td>
</tr>
<tr>
<td></td>
<td>pH 5.1 @ one month</td>
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<tr>
<td>Adult(^3)</td>
<td>pH 5.0 – 5.9</td>
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<tr>
<td>Diapered Skin(^4)</td>
<td>pH &gt; 6.0</td>
</tr>
<tr>
<td>Atopic Dermatitis Skin(^5)</td>
<td>pH &gt; 6.0</td>
</tr>
<tr>
<td>After Alkaline Soap Cleansing(^6)</td>
<td>pH 9.5; increase can last over hours</td>
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1. Behrendt & Green, 1971
2. Fox, Nelson, & Wareham 1998
4. Visscher, Chatterjee, Ebel, LaRuffa, & Hoath, 2002
Infant Skin – Needs Protection from Sun Exposure

- Acute as well as cumulative sun damage can have serious consequences, including risk of skin cancer
- Pigmentation changes are an indicator of skin adaptation to sun exposure, and therefore can be used as a noninvasive surrogate marker for photodamage
- Sun induced pigmentation changes observable as early as the first summer of life
  - Increased melanin content in exposed skin areas
  - Freckling observed on the face

Visible Skin Changes Are Observed In Infants After Summer Season

Perceived Skin Color Based On Average L*a*b* Values

Subject Age

Before Summer

After Summer

Caucasian Subjects, New Jersey USA

Asian Subjects, Beijing China

Visible Skin Changes Are Observed In Infants After Summer Season – Freckles

- Visible only in May: disappeared after sun exposure
- Visible in May and September
- Visible only in September: appeared after sun exposure

Recommended UV Protection Strategies

• Protect skin daily
• Use shade, clothing, wide brimmed hats (protect scalp, face, ears, neck)
• Avoid peak daylight hours
• Appropriately formulated UV protection products
  • Read product label for age restrictions
  • Check with baby’s healthcare provider
• Note, healthcare professionals additionally recommend appropriate UV blocking sunglasses to protect eyes
Babies’ Skin is Uniquely Different; Still Developing

<table>
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<th>Baby’s Skin is Still Developing</th>
<th>Implications for Products</th>
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<tr>
<td>• Thinner&lt;sup&gt;1&lt;/sup&gt;</td>
<td>• Need mild products with less potential to alter skin barrier function; less potential to irritate; lower potential for allergy</td>
</tr>
<tr>
<td>• Absorbs and loses water more quickly&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
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<tr>
<td>• Less natural moisturizing factor</td>
<td></td>
</tr>
<tr>
<td>• Melanin developing</td>
<td></td>
</tr>
<tr>
<td>• Developing immune system&lt;sup&gt;3&lt;/sup&gt;</td>
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Key Learnings

1. Infant skin is different from adult skin in structure and composition and continues to develop over the first years of life.

2. These differences lead to functional differences in skin barrier properties with implications for care and protection.

3. Ensure baby skin care routines support infant’s developing skin and that products are mild and specially formulated for baby’s unique needs (cleansers, moisturizers, etc.)
Infant Skin Microbiome
Research on the Development of Skin’s Protective Layer and Connection with Care

Georgios Stamatas, PhD
Research Associate Director & Fellow
Johnson & Johnson Sante Beaute, France
Which answer do you think is correct?

A. All microbes are harmful to our health and should be removed from baby skin through rigorous cleansing

B. Some microbes are harmful, while some are inoffensive; we should ensure that baby skin remains microbe free

C. There are some harmful and some beneficial microbes, we should strive to enhance the beneficial ones while ensuring protection from the harmful ones
Skin-microbe Relationships

<table>
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<tr>
<th>Human skin</th>
<th>Microbe</th>
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<tr>
<td></td>
<td>commensalistic</td>
</tr>
<tr>
<td></td>
<td>parasitic</td>
</tr>
<tr>
<td></td>
<td>mutualistic</td>
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Healthy skin is inhabited by harmless microbes, which also help to keep harmful ones away.

A diverse community of microorganisms coexisting at the skin surface.\textsuperscript{1}

**A Balanced Microbiome**

The skin microbiome is a habitat of billions of beneficial and harmful bacteria. An imbalance of these bacteria can lead to a variety of skin conditions including acne, eczema, rosacea and ageing.\textsuperscript{1}

**pH Balance**

The skin microbiome prefers a relatively acidic environment (pH around 5.0) which also inhibits growth of pathogens.\textsuperscript{1}

**Bacterial Diversity Differs by Body Zone**

Differences in skin temperature, texture, thickness, humidity and chemistry help determine which kinds of microbes live where on the skin.\textsuperscript{1}

Where is diversity important?

A. In human societies as cultural diversity
B. In natural ecosystems (lakes, forests, coral reefs, etc.)
C. In microbial ecosystems (skin microbiome, gut microbiome, etc.)
D. In long-term investment portfolios
E. All of the above
Skin Microbiome at Birth

**In utero** skin is in a sterile environment

The skin of vaginally-born babies is colonized by microbes from the mother’s vagina

The skin of C-section babies is colonized by microbes from the mother’s skin

Baby skin microbiome community is dynamic and becomes more diverse as the baby grows

Skin contacts between mother and child (breastfeeding, kangaroo care, wash, massage, etc.) is an opportunity for exchange of microbiome

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Mode of Birth Influences Newborn Skin Microbiome Composition

Principal component analysis of microbiome data demonstrates grouping of:

• Vaginally-born babies’ skin microbiome with mother’s vaginal microbiome, dominated by Lactobacillus, Prevotella, or Sneathia spp.
• C-section babies’ skin microbiome with mother’s skin, dominated by Staphylococcus, Corynebacterium, and Propionibacterium spp.
• Both are distinct from oral microbiome
Baby Skin Microbiome Differs from Adult and Evolves with Baby Age

Infant Skin Microbiome differs from that of Adult

Species diversity increases over the first year of life

Concordance with Mother’s Skin Microbiome

Skin microbe concordance between the mother-infant dyad is particularly high early in life

The Skin Microbiome in Disease - Importance of Diversity

• The **diversity** of microbes within a given area of the body can be defined as the number and abundance of distinct types of organisms

• Diversity has been linked to several human diseases
  - *C. difficile* colitis – lack of diversity, monocolonization in colon with *C. difficile*
  - Obesity and inflammatory bowel disease - low diversity in the gut
  - Bacterial vaginosis – high diversity in the vagina
  - Atopic dermatitis (AD) lesions – increase in *S. aureus* and low diversity
  - Lesions of acne vulgaris patients – lower diversity, and certain strains of *Propionibacterium acnes*
  - Changes in relative abundance – lesional areas of psoriasis

• New research suggests that a **diseased state may be achieved by the absence of commensal bacteria** and not simply the presence of a pathogen
The Skin Microbiome Diversity and Skin Barrier Function (meta-analysis of data from 3 studies)

1. Poster at the 76th Annual Society for Investigative Dermatology (SID) Meeting: 26-29 April 2017; Portland, OR, USA.
2. Poster at the American Academy of Dermatology Annual Meeting: 1-5 March, 2018; Washington, DC, USA.
3. Poster at the American Academy of Dermatology Annual Meeting: 16-20 February, 2018; San Diego, CA, USA.

\[ y = 4.95x^{-0.251} \]
\[ R^2 = 0.96 \]
Clinical Study – Wash Only vs. Wash + Lotion

Adding lotion to the daily cleansing routine accelerates increase in skin microbial richness

* P<0.05 from Baseline
** P<0.05 Between treatments

KA Capone, D Friscia, L Telofski, J Nikolovski, Presented at AAD 2019
Key Learnings

1. The skin and its microbiome continue to mature and develop long after birth, playing an important role as a first line of defense

2. Skin care routines should strive to maintain the integrity of the skin barrier and also to support the skin microbiome

3. In a clinical study, adding an application of lotion after bath, using mild products specifically formulated for baby’s skin, was shown to accelerate increase in skin microbial richness
Question

• What is the most interesting thing you just learned about the infant skin microbiome?
Closing Remarks

Professor Dame Tina Lavender, PhD
Centre for Childbirth, Women’s and Newborn Health (CWNH)
Liverpool School of Tropical Medicine
Evidence-Based Skin Care Routines with Appropriately Formulated Products can Support Developing Skin and its Microbiome

Infant skin can lose water 2x as fast. Smaller cells and thinner skin - shorter pathway outside to inside

Acid Mantle (skin pH) Helps provides overall skin protection & support microbiome

Skin microbiome is protective. Microbial richness & diversity are important
Thank You!