Hot topics: Sun protection and insect bites in children

Mercedes E. Gonzalez, MD
Medical director, Pediatric Dermatology of Miami
Clinical Assistant Professor, Department of Dermatology, University of Miami Miller School of Medicine and FIU Herbert Wertheim College of Medicine
Miami, FL

Hot Topics – Burning questions

• Sun protection
  • Can I use sunscreen on my < 6 month old?
  • Are sunscreens safe?
    • Oxybenzone?
    • Nanoparticles?
  • What is the best sunscreen?

• Insect bites
  • Is DEET safe?
  • What is the best insect repellent?

Numerous information sources

Google.com – “Sunscreens for children”

DISCLOSURES

Pierre Fabre Dermatologie: Speaker, Advisory Board – Honoraria
Anacor Pharmaceuticals, Inc.: Advisory Board – Honoraria
Encore Dermatology: Speaker – Honoraria
PuraCap Pharmaceutical, LLC: Speaker - Honoraria
Can I use sunscreen on my baby?

- Sunscreen labels: Babies < 6 months: Ask a doctor
- Studies submitted to FDA show safety and efficacy data on subjects > 6 months

Infant and toddler skin is structurally and functionally different than adult skin

- Gradual maturation over time
- Higher surface area to weight ratios
- Greater susceptibility to percutaneous absorption of sunscreens

Can I use sunscreen on my baby?

- Infants & young children are unusually susceptible to UVR & UVR induced immunosuppression
- The best way to protect infants is sun avoidance
  - When outdoors keep shaded
  - Sun protective clothing (hats, sunglasses, long-sleeved shirts)
  - Shade during peak hours
  - Sunscreen on uncovered areas
- AAP statement (2011): Sunscreens can be used on infants < 6 months to areas of skin uncovered by clothing and hats, if adequate clothing and shade are not available

Are sunscreens safe? Chemicals? Nanoparticles?

Oxybenzone (Benzophenone-3)

- UVB and short wave UVA filter available since 1978
- Widely used in sunscreens and other consumer products
  - Prevents discoloration
  - FDA: safe and effective up to 6%
  - Europe and Australia 10%
- Estimated prevalence of oxybenzone exposure general US population 96.8%
- NHANES study – oxybenzone in urine of > 2500
- Not correlated to sunscreen use

Oxybenzone absorption and effects

- Systemic absorption when applied topically
- Shown to have estrogenic and anti-androgenic effects in vitro and in vivo in animal studies
  - Increased cell proliferation in human breast cancer cells
  - Average uterine weight of 21-day old rats fed oxybenzone (51500mg/kg/day) was 23% greater than control

- Natural Moisturizing Factor: Lower conc → Greater volume
- Absorption: Greater
- Conductance: Greater
- TEWL: Greater (up to 4 yrs)
Oxybenzone use put in perspective

- Would take 277 years of daily application of sunscreens with 6% oxybenzone to attain the same level of exposure in humans
- Daily whole body applications of 10% oxybenzone x 4 days
- Present in plasma and excreted in the urine but there was no influence of reproductive hormones
- No accumulation in plasma

### Table: Years of Daily Sunscreen Application Required by the Average US Woman to Match Systemic Levels of Oxybenzone per Skin of Male Rhino Equivalents to Those Given in Intensive Role 1

<table>
<thead>
<tr>
<th>Oxybenzone</th>
<th>Similarities</th>
<th>Differences</th>
<th>Oxybenzone</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 µg</td>
<td>Trough</td>
<td>Peak</td>
<td>250 µg</td>
</tr>
<tr>
<td>50 µg</td>
<td>10 µg</td>
<td>500 µg</td>
<td></td>
</tr>
<tr>
<td>100 µg</td>
<td>100 µg</td>
<td>1000 µg</td>
<td></td>
</tr>
<tr>
<td>200 µg</td>
<td>200 µg</td>
<td>2000 µg</td>
<td></td>
</tr>
<tr>
<td>300 µg</td>
<td>300 µg</td>
<td>3000 µg</td>
<td></td>
</tr>
<tr>
<td>400 µg</td>
<td>400 µg</td>
<td>4000 µg</td>
<td></td>
</tr>
<tr>
<td>500 µg</td>
<td>500 µg</td>
<td>5000 µg</td>
<td></td>
</tr>
<tr>
<td>600 µg</td>
<td>600 µg</td>
<td>6000 µg</td>
<td></td>
</tr>
<tr>
<td>700 µg</td>
<td>700 µg</td>
<td>7000 µg</td>
<td></td>
</tr>
<tr>
<td>800 µg</td>
<td>800 µg</td>
<td>8000 µg</td>
<td></td>
</tr>
<tr>
<td>900 µg</td>
<td>900 µg</td>
<td>9000 µg</td>
<td></td>
</tr>
<tr>
<td>1000 µg</td>
<td>1000 µg</td>
<td>10000 µg</td>
<td></td>
</tr>
</tbody>
</table>

Leupe et al. 2006

Oxybenzone safety

- Other than allergic and irritant contact dermatitis, no harmful cause and effect relationship or systemic side effects in humans has been reported
- Periodic reviews by European, Australian and US safety panels – conclude safety
- Still widely available in the US

What about nanoparticles?

- Micro and nanosized zinc oxide and titanium dioxide < 100nm
  - Can generate ROS upon UV exposure
  - Percutaneous penetration
- Coated with aluminum oxide and SiO2 to minimize contact
- Numerous studies show nanoparticles are confined to the level of the stratum corneum, even in skin where the barrier function has been altered


Are sunscreens safe?

- Yes!
- There is no proven harm from sunscreen use when used properly
- Recommend specific sunscreens with guidance on how to use

What is the best sunscreen?

- Response: The best one is the one you and your child will use
- Which one are you using now?
- Broad spectrum, water resistant & SPF >30
- For young children & patients with atopic dermatitis
  - Mineral based - Less irritating
- Follow up: Do you like it?
Parents want direction - be specific

- Read labels
  - Ingredients
  - SPF > 30
  - Broad Spectrum
  - Water resistant
- Provide a list or images of options
  - Daily
  - Intense sun exposure
  - Sports
- Sell in your office
  - Walk out with exactly what you recommend

Sunscreen is one part of sun protection

- Common misconception: Use of sunscreen can prolong time in the sun
- How to use properly
  - Apply to all areas not protected by clothing
  - Vulnerable sites: back of neck, ears, dorsal feet
  - For adults BSA 1 oz (shot glass)
  - Reapply every 2 hours
  - Before going outdoors
- Seek shade during the peak hours of 10 am – 4 pm
  - Not always practical
- Wearing sun-protective clothing (long-sleeved swim shirts, wide brimmed hats, sunglasses)
  - Keep children cooler

Sun protection tips

- Apply before leaving house
- Make part of daily routine
- Model behavior
- Allow children to participate
- For adolescents
  - Stay away from scare tactics focus on benefits of avoiding sun
  - Find something they like
  - Offer alternatives for looking tan
- Counsel at every visit - sunscreen is one part
- Use free resources

ThinkingBaby/ThinkingSport Sunscreen
Primary Active Ingredient: 20% Zinc Oxide (non-nano)
SPF Factor: 50+
Price: $15.99 for 3 oz. (full price, on sale right now for $11)
Price per oz: $5.33
EWG Rating: 1
Company claims: First sunscreen to pass Whole Foods’ Premium Care Requirements
Ease of rubbing into skin: Great.
Water resistant: 80 minutes
Personal Thoughts: Light feeling, goes on clear. Pleasant citrus scent. Very good results after being in sun.
(Update: some readers have shared that a mild white residue is left behind. We have seen that too, but it hasn't bothered us much). ThinkingBaby Sunscreen is the same formulation. We've loved this sunscreen since we first reviewed it in 2012.

Sunscreen handout

Babies/Physical sunscreens
Sticks
Outdoor sports/sweat
Sprays

Sun protective fashions
Swim shirts keep you cool

www.youtube.com

Sticks

Sun protection tips

https://www.aad.org/public/spot-skin-cancer/free-resources
Insect bites in children

- Insect bite reactions
  - Frequent in children 2 – 10 years of age
  - Variable clinical presentation
  - Markedly pruritic and often excoriated

- Insect bites as vectors of disease
  - Zika virus and others
  - 2016: WHO global public health emergency because of its links to microcephaly and neurologic disease
  - Mostly travel related cases in the US
  - Currently investigating non-travel related cases in FL
  - In children, illness is mild ranging from asymptomatic to a mild disease of fever, rash, conjunctivitis, and/or arthralgia

Hernandez RG et al Pediatrics 2006

Insect repellent options

Registered by the EPA
- DEET
- Picaridin
- IR 3535
- Oil of lemon Eucalyptus
- P-Menthane-3,8-diol
- Citronella & Citronella oil
- Catnip oil
- 2-undecanone

Unregistered Products
- Citronella oil
- Cedar oil
- Geranium oil
- Peppermint and peppermint oil
- Soybean oil

Various formulations: Aerosols, creams, lotions, towelettes, pump spray

DEET (N,N-Diethyl-meta-Toluamide)

- Used since 1957
- Effective against mosquitoes, black flies, ticks, mites, and land leeches
- MOA: provides a vapor barrier that deters insects from coming into contact with the skin
  - Extends about 4 cm from skin
- Can be used on skin and clothing
  - Safe on wool, cotton and nylon
  - May damage: Spandex, Rayon, Acetate and Leather
  - Can dissolve: plastic and vinyl
- Available in US 5-100% concentrations
  - As concentration increases the duration of activity increases with a plateau at 50%
  - In most situations 10 -35% will provide adequate protection


Is DEET safe?

- With proper use: Yes!
- Animal studies – using large oral doses
  - Not a specific neurotoxin
- In humans, case reports of CNS toxicity
  - Reported deaths were from intentional ingestion & overuse or incorrect use of product
- Authorities have removed labelling that indicates caution on children
- AAP recommends use of DEET for prevention of insect bites in children > 2 mo, pregnant and lactating women
- Cautions:
  - Both DEET and aerosol vehicle are flammable
  - Occlusion can increase absorption
  - Should be washed off

Chen-Hussey V et al. Parasites & Vectors 2014

ALL (even EWG) are aligned on repellent recommendations for children.
**Picaridin [2-(2-hydroxyethyl)-1-piperidinecarboxylic acid 1-methylpropyl ester]**

- Used in Australia since 1998, in US since 2005
- Effective for mosquitoes, dog & deer ticks, chiggers, flies
- MOA: vapor barrier deters insect from getting close to skin and biting
- Can use on skin and clothing
- Does not damage plastics or fabrics
- Advantages over DEET:
  - Odorless
  - Does not feel sticky or greasy on application
  - No reports of serious toxicity or mutagenesis
  - Not a dermal sensitizer
- Recommended by the CDC in 2005 for use as protection against West Nile virus and by WHO for best agent to prevent against malaria

Katz, TM et al 2008 / Ann Acad Dermatol

---

**What’s the best insect repellent?**

- For most situations:
  - 10 – 25% DEET
  - 7% - 15% Picaridin
- Instruct on reading labels
- Factors to consider in choosing a repellent:
  - Environment
  - Duration of exposure
  - Formulation: odor, vehicle (potential for irritation, convenience of application)
- Make specific recommendations

---

**Insect Repellent + Sunscreen combination products**

- Sunscreen over DEET increased absorption 60 fold
- DEET mixed with oxybenzone increased DEET absorption 36 fold
- Picaridin under oxybenzone increased picaridin permeation by 32%
- Decrease in sun protection factor with concurrent use of an IR

---

**Mosquito bite prevention**

- Proper Insect repellent use is one part of protection
- Clothing – light cotton long sleeves and pants, socks over pants
- Avoid clothing with bright colors or flowery prints
- Avoid use of scented soaps, perfumes or hair sprays
- Remove mosquito habitats (eliminate standing water)
- Cover gaps in doors, use screens and nets
- Mosquitoes are most active at sunrise, sunset and early evening – stay indoors if possible

https://www.aap.org

---

**Avoid products only contain blends of natural plant oils – not effective provide < 1 hour of protection**

**Apply sunscreen prior to repellant to reduce transdermal penetration of the active repellent ingredient**

**Avoid combination sunscreen/IR products because unlike IR, sunscreen needs to be reapplied every two hours**

---

Chen T et al. Pharmazie 2010

---

**https://www.epa.gov/insect-repellents/find-insect-repellent-right-you**

---

https://www.epa.org
Answers to summertime burning questions

- For infants and young children sun avoidance with shade and sun protective clothing should be first line
- Sunscreen can be used on babies on exposed areas if adequate shade or clothing not available
- When used properly sunscreen and insect repellants are safe and an important part of sun and bite protection in children
- Parents want direction provide specific recommendations based on their preferences

Thank you!

Metofluthrin

- Pyrethroid ester
- Insecticide and insect repellent
- Active against lice, fleas, mites, mosquitoes, black flies
- Highly effective
- Reduces landing and biting of mosquitoes 91–97%

Permethrin

- Insecticide and insect repellent
- Active against lice, fleas, mites, mosquitoes, black flies
- Kills ticks on contact
- Apply to clothing rather than on skin

http://www.consumerreports.org/cro/search.htm?query=insect+repellents
<table>
<thead>
<tr>
<th>Product</th>
<th>Active Insecticide (CAS)</th>
<th>Concentration</th>
<th>Placement</th>
<th>Insecticidal Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off Deep Woods (K Johnson)</td>
<td>DEET 35%</td>
<td>200-300</td>
<td>Dose</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Stove Controlled Release (Swaye)</td>
<td>DEET 2%</td>
<td>00-100</td>
<td>Dose</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>OFF Scram (K Johnson)</td>
<td>DEET 4%</td>
<td>00-100</td>
<td>Dose</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Off Borer for Kids (IS M)</td>
<td>Dose 5%</td>
<td>05-100</td>
<td>Dose</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Off Wemite for Kids (K Johnson)</td>
<td>DEET 4%</td>
<td>00-100</td>
<td>Dose</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Insect-Flash (Dose)</td>
<td>DEET 3%</td>
<td>00-100</td>
<td>Dose</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Insect-Flash (MICROCAPSULE)</td>
<td>DEET 3%</td>
<td>00-100</td>
<td>Dose</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Green Tree for People (Holmes)</td>
<td>DEET 5%</td>
<td>00-100</td>
<td>Dose</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Beez Away (Quanti-Free)</td>
<td>DEET 3%</td>
<td>00-100</td>
<td>Dose</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Bug-O-Off Bag Guard (Infant)</td>
<td>DEET 3%</td>
<td>00-100</td>
<td>Dose</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Bug-O-Off Shield Oil (Infant)</td>
<td>DEET 3%</td>
<td>00-100</td>
<td>Dose</td>
<td>0.5-1.0</td>
</tr>
</tbody>
</table>