

CLINICAL POSTER HIGHLIGHTS

Normal Sleep Patterns and a Healthy Skin Barrier in Infants and Children

INSIGHTS AND ADVANCES

INTRODUCTION BY:

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INTRODUCTION

Knowledge About Development and Maintenance of Normal Sleep and Healthy Skin in Infants and Children Continues to Evolve

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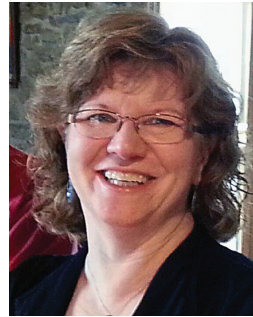
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Although seemingly disparate, normal sleep patterns and a healthy skin barrier are both critical elements contributing to the overall health and well-being of infants and children. This is underscored by the fact that problems involving sleep and the skin constitute some of the most common issues brought to the attention of pediatric health care providers. Our understanding of the causes, consequences, and treatment of these childhood conditions continues to evolve and it is important for clinicians to keep pace with the current state of knowledge to optimize the care that can be offered to patients.

The posters detailed in this supplement provide insight into a number of issues pertaining to young children's sleep patterns and the health of their skin and add to the current body of literature on these topics.

The importance of normal sleep patterns in infants and young children

Sleep plays an important role during infancy and early childhood, impacting mental, emotional, and physical development.¹ As shown in a study by Mindell and colleagues,² variations in the quality of infants' and toddlers' sleep from 3 to 12 months of age were found to be somewhat associated with variations in development observed at 12 months, as evidenced by measures of cognitive, language, motor, social, and emotional development.

Sleep problems occur in 20% to 30% of infants and toddlers and are a common concern of parents of young children.^{3,4} Cross-culturally, children's sleep varies markedly throughout the world, characterized by differences in sleep patterns and sleep problems. In another study by Mindell et al,⁵ striking differences in factors such as total sleep time and parental perceptions of sleep problems emerged between children in predominantly Asian and predominantly Caucasian countries. For example, survey results showed that children up to 3 years old obtain 12.7 to 13.1 hours of sleep each night in predominantly Caucasian countries, whereas this total ranges from 11.6 to 12.6 hours for children in predominantly Asian coun-

tries. Although we are only just beginning to understand the relationships between culture and children's sleep, examining such global differences may enable clinicians to promote better sleep, and hence better health, in children under their care.

Sleep concerns are one of the most common behavioral issues brought to the attention of pediatricians.^{6,7} Parents readily acknowledge that sleep is an important factor for the health of their children, but often feel uninformed about how to improve their child's sleep. Many parents turn to health care professionals for such information, yet such professionals may lack the necessary information to help parents address their children's sleep problems and improve their children's sleep behaviors due to inadequate medical training.^{6,7} A survey by Mindell et al⁸ revealed that pediatric residency programs across 10 countries devoted only 2 hours (median) of instruction time to pediatric sleep issues. Only 5% of the programs provided more than 10 hours of sleep-related education, whereas 23% provided no training on this subject. These findings reinforce the need to overcome such educational gaps and offer adequate training on childhood sleep disorders to better inform practicing clinicians.

When children's sleep problems go unaddressed, the adverse effects can extend beyond the child to negatively affect parents, particularly mothers. For example, investigators have found a higher prevalence of fatigue, stress, depressive symptoms, and postnatal depression in mothers of infants and toddlers experiencing problematic sleep disturbances.^{9,10} Other recent research from Mindell et al¹¹ adds to this literature by underscoring the strong ties between children's sleep and maternal sleep. In this study, 44% of mothers reported that their child's sleep affects their own sleep, and 30% felt that their child's sleep influences their ability to function throughout the day. In addition, nearly half of the mothers surveyed (47%) did not feel confident in their abilities to manage their child's sleep behaviors.

Evidence indicates that successful treatment of pediatric sleep problems with behavioral interventions improves parents' overall well-being.^{12,13} Behavioral therapy can be highly effective for correcting bedtime problems and night wakings.³ However, most behavioral interventions require personal contact with a trained professional and as a consequence, many children remain untreated. Web-based tools and information provide a viable alternative to office-based interactions between parents and providers. Indeed, the Internet is a resource widely utilized by parents and Internet-based interventions (ie, telehealth) for infant and toddler sleep disturbances have proven effective at improving children's sleep and, in turn, maternal sleep and mood.¹⁴ Telehealth through the JOHNSON'S® BEDTIME™ application for the iPhone®* and Android™† devices provides parents with a readily accessible and ef-

ficacious means of obtaining assistance and treatment for infant and toddler sleep disturbances. Nearly 90 000 individuals have used this application to date, mostly parents of newborns and infants. Recent data from Mindell and colleagues¹⁵ indicate that parents often use the application to seek sleep-related advice between 6:00 PM and 6:00 AM—times when access to health care providers is not readily available—thus attesting to the need for alternative sources of instantly accessible health-related information.

Protecting the infant skin barrier

The skin barrier provided by the stratum corneum, the top layer of the epidermis, is competent at birth in healthy, full-term neonates and continues to mature through the first year of life.¹⁶ Still, infant skin differs considerably from adult skin in terms of structure, function, and composition. Although recent research is beginning to inform our understanding of these differences,¹⁶ less is known about the development of the infant skin microbiome and the importance it plays in maintaining healthy skin.¹⁷

The role of the human skin microbiome in skin health and the overall well-being of an individual has recently garnered considerable attention.¹⁸⁻²¹ Most of this work has focused on adult skin, with relatively little attention paid to skin microbiology during the first weeks to years of life.^{17,22,23} A new study conducted by Capone and colleagues²⁴ provides insight into the changes in the skin microbiome from infancy to adulthood. Their work shows that the skin microbiome evolves with age, with *Staphylococcus* and *Streptococcus* species largely dominating during infancy, later followed by dominance of *Propionibacterium* species, together with *Staphylococcus*, during adulthood. Notably, evolution of the skin microbiome after birth has yet to reach an adult-like state by 12 years of age.

Maintaining the integrity of the developing skin barrier is essential to overall health in infants and children. Infant skin is sensitive and prone to inflammatory conditions, such as pediatric atopic dermatitis—a condition of particular concern given its increasing incidence. Estimates indicate that this common skin disease affects 17% of children in the United States,²⁵ whereas more recent data suggest that 45% to 85% of children show clinical symptoms of the disease in certain countries.²⁶ A key event in the onset of atopic dermatitis is breakdown of the skin barrier,²⁷ which can be countered by appropriate cleansing and moisturizing.^{28,29} Because infant skin continues to mature through the first years of life, it is important that skin care products used on babies and young children (eg, cleansers, emollients) be formulated appropriately. Ideally, such prod-

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ucts should not interfere with skin surface pH or perturb the skin barrier.¹⁶ Increased pH coincides with elevated chymotrypsin-like protease activity and with decreased skin barrier function, which is apparent in atopic dermatitis.³⁰ As shown in recent research by Danby et al,³¹ washing with soap, but not with mild baby cleansers, elevates skin surface pH and chymotrypsin-like protease activity in healthy individuals above the levels of activity observed in subjects with atopic dermatitis. This suggests that harsh detergents, with their high pH, may exacerbate atopic dermatitis by promoting proteolytic degradation of the skin barrier.

Formulation of appropriate cleansers can be achieved by choosing the right type of surfactant, by blending surfactants, or by blending hydrophobically-modified polymers with surfactants to increase product mildness.¹⁶ Similarly, choosing the right type of oil for emollients is also important.¹⁶ *Avena sativa* (oat) extracts, enriched with avenanthramides, feature moisturizing, soothing, and anti-itching benefits. In an 8-week study conducted by Volonakis and colleagues³² in children up to 16 years of age, a daily regimen consisting of a wash and cream containing *Avena sativa* extracts improved the clinical signs of atopic dermatitis and was well tolerated. In addition, 84% of the study subjects reported that they felt less need to use concomitant medications (eg, steroids, immunomodulators) by the end of the study and 88% wanted to continue using the regimen.

Summary

The 8 posters summarized in this supplement, along with our commentaries as practicing clinicians, highlight the expanding body of knowledge about how—and why—to facilitate the establishment of healthy sleep and healthy skin care practices in infants and children. Sharing this information with parents and caregivers can help them foster healthy development for the lifelong benefit of our young patients.

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Sleep and Development in Infants and Toddlers

Authors: J.A. Mindell, The Children's Hospital of Philadelphia and Saint Joseph's University, Philadelphia, PA, USA; C. DuMond, Upstate Golisano Children's Hospital, State University of New York, Syracuse, NY, USA; E. Gunn, Johnson & Johnson Consumer Companies, Inc., Skillman, NJ, USA

The investigators conducted a longitudinal study of 97 infants up to 12 months of age to evaluate the relationship between sleep and developmental outcomes. Infant sleep patterns at 3, 6, 9, and 12 months of age were determined based on maternal completion of the Brief Infant Sleep Questionnaire at each of these time points. Developmental outcomes were assessed using 2 different tools when infants reached 12 months of age: (1) the Bayley Scales of Infant Development (BSID-III), which includes measures of cognitive, language, and motor skills, and (2) the Infant-Toddler Social and Emotional Assessment (ITSEA), which evaluates competence (compliance, attention, peer relations), internalizing (anxiety, depression/withdrawal), and externalizing (activity, aggression).

The investigators found that maternal reports of infant sleep between 3 and 12 months of age somewhat correlated with developmental outcomes at 12 months of age (Table). When infants were 3 months old, only parent-initiated sleep factors (bedtime and same routine) predicted long-term developmental outcomes. However, by 9 months of age, primarily child-oriented sleep variables (sleep consolidation and nighttime sleep) predicted 12-month development. Notably,

Table. Sleep variables predicting 12-month developmental outcomes

Scale	Measure	Variance	Sleep predictors
3 months			
Bayley	Motor	25%	Same bedtime routine
ITSEA	Competence	13%	Bedtime, total sleep time
6 months			
Bayley	Language	30%	Same bedtime, bedtime routine, sleep onset latency
ITSEA	Externalizing	32%	Night wakings, total sleep time
	Internalizing	19%	Night wakings, daytime sleep
	Competence	13%	Waketime
9 months			
Bayley	Cognitive	20%	Night wakings
	Language	10%	Night wakings
	Motor	7%	Night wakings
ITSEA	Externalizing	15%	Night wakings, same routine
	Internalizing	8%	Daytime sleep
	Competence	13%	Night wakings, longest stretch asleep
12 months			
Bayley	Cognitive	12%	Night wakings, longest stretch asleep
	Motor	9%	Longest stretch asleep, total nighttime sleep
ITSEA	Internalizing	12%	Bedtime, wake time, total nighttime sleep

12-month developmental outcomes were better predicted by sleep at 6 and 9 months than by concurrent sleep.

Reference: Mindell JA, DuMond C, Gunn E. Sleep and development in infants and toddlers. Poster presented at: 27th Congress of the International Pediatric Association; August 24-29, 2013; Melbourne, Australia.

Commentary from Ms Rudy

This study takes maternal assessments of infant sleep patterns at various ages and correlates them to infant development at 12 months of age. From this perspective, I find it interesting that, in early infancy, parent-initiated sleep factors appear to be more predictive of overall development at 12 months of age, whereas by 9 months of age, child-oriented sleep variables were more predictive. This finding can add support to the idea that early infancy is an important touch point for parents' education about their child's sleep. Early initiation of parent teaching and support to help the child develop healthy sleeping patterns may have a greater impact than if it is initiated later, when sleep habits are already established.

Sleep is a basic and fundamental human need. Acquiring healthy sleep habits is one of the many developmental tasks of childhood that begins in infancy. In the first year of life, sleep patterns change dramatically in response to

the growth and development of the child. In early infancy, sleep is characterized by periods of sleep that are interrupted by the need to eat, have diapers changed, and interact with caregivers. As the child gets older, developmental needs change along with his or her sleep. At around 6 to 9 months, the child can go for longer periods of time between feedings and no longer needs to wake during the night to eat. However, other developmental changes, such as teething and separation anxiety, occur that can interfere with sleep.

Negotiating all of these changes and helping the child develop healthy sleeping patterns is one of the more challenging tasks of parenthood. Teaching parents about their child's sleep and what they can do to foster healthy habits should start in early infancy and should anticipate the developmental changes that infants and young children experience.

Sleep in Young Children: A Cross-Cultural Perspective

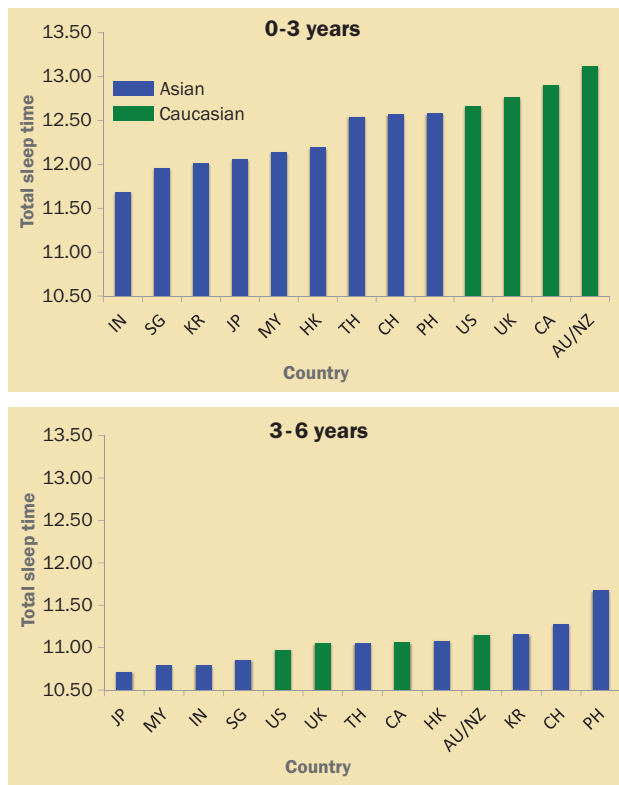
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This large-scale, cross-cultural survey sought to compare sleep patterns and problems among Asian and Caucasian children up to 6 years of age. The parents of 10 085 children from 14 countries participated by completing a modified version of the Brief Infant Sleep Questionnaire. This tool queries for information on daytime and nighttime sleep patterns, sleep-related behaviors, and parental perceptions of sleep problems.

The study findings revealed considerable differences in sleep patterns between children from predominantly Caucasian countries and predominantly Asian countries. For example, children aged 0 to 3 years from predominantly Asian countries obtained less total sleep (range: 11.6 to 12.6 hours) compared with children from predominantly Caucasian countries (range: 12.7 to 13.1 hours) (Figure). Much less variability in total sleep was observed across all countries for children aged 3 to 6 years (range: 10.7 to 11.7 hours).

Data on parent-perceived sleep problems were not as clearly divided between Caucasian and Asian countries. However, with a few exceptions, parents in predominantly Caucasian countries, as compared with parents in predominantly Asian countries, reported fewer perceived sleep problems among their children aged 0 to 3 years (21% to 25% versus 19% to 52%, respectively) and 3 to 6 years (15% to 21% versus 15% to 44%, respectively). Parents in China reported the highest rates of perceived sleep problems for both younger children (0 to 3 years: 52%) and older children (3 to 6 years: 44%).

Figure. Sleep in young children



AU, Australia; CA, Canada; CH, China; HK, Hong Kong; IN, India; KR, Korea; JP, Japan; MY, Malaysia; NZ, New Zealand; PH, Philippines; SG, Singapore; TH, Thailand; UK, United Kingdom; US, United States.

Across all countries, significant differences in sleep patterns were identified for infants and toddlers compared with preschool-aged children. Specifically, children aged 0 to 3 years had later bedtimes, a higher number of night wakings, earlier wake times, less nighttime sleep, more daytime sleep, and more total sleep overall compared with children aged 3 to 6 years (all P values <0.001).

Total overall sleep and parental perceptions of sleep problems differed markedly between children in predominantly Caucasian countries and predominantly Asian countries. In addition, clinically significant differences in sleep patterns were identified between younger and older children across all countries. Additional research is needed to understand the causes and influences of these various differences.

Reference: Mindell JA, Bartle A, Ahn Y, et al. Sleep in young children: a cross-cultural perspective. Poster presented at: 27th Congress of the International Pediatric Association; August 24-29, 2013; Melbourne, Australia.

Commentary from Dr Horowitz

Pediatricians are called upon to address and help manage a variety of sleep challenges faced by tired parents the world over. Sleep is one of the most common behavioral issues brought to the pediatrician and it is an important part of our anticipatory guidance at each visit. That parents are concerned about their infant's sleep suggests that they understand that sleep is important for children; even though they may not realize that it has an impact on memory consolidation, immune function, accidental injury, and more.

This poster, which presents data from parents of more than 10 000 young children, adds to our understanding of cultural differences in the amount of sleep and quality of sleep children get from birth to age 6 years. It splits out the age groups 0 to 3 years and 3 to 6 years and found that the wide variation in total hours of sleep seen in the 0- to 3-year-old group becomes smaller over the next 3 years. The study also verifies previous work by Mindell et al, which noted that children in

predominantly Asian countries go to sleep later and get less sleep in total than children from predominantly Caucasian countries.

Interestingly, although previous work suggested that parents of infants and children from predominantly Asian countries were more likely to identify their child's sleep as a problem, such a strong difference did not emerge from analysis of the data for preschool-aged children. For this age group, there were minimal differences in parent perception across cultures. However, sleep problems across all age groups were identified by 15% to 52% of mothers in each country/region. Thus, it is important for us to get a better understanding of what we can do to anticipate sleep problems since they are so common. We can thereby develop evidence-based guidance for our recommendations to families. Furthermore, we need to better understand cultural beliefs about sleep and help parents develop realistic expectations about sleep and what they can do to promote healthy sleep habits for their children.

Sleep Education in Pediatric Residency Programs

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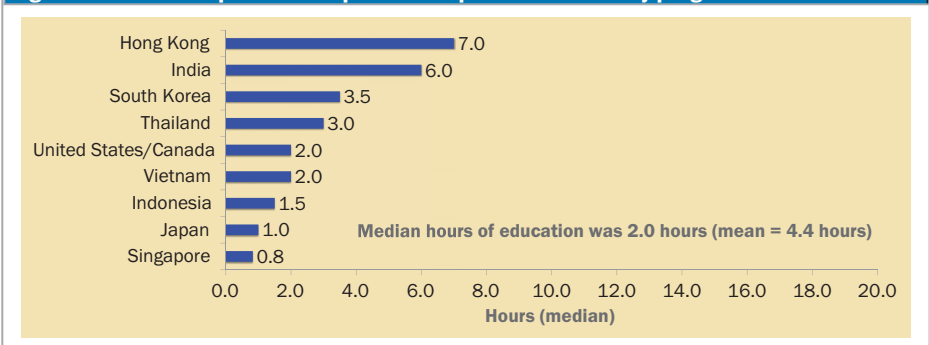
This cross-cultural investigation of pediatric residency programs aimed to evaluate the prevalence of education about sleep and sleep disorders, while also identifying the factors hindering such education. Surveys went out to 864 pediatric residency programs in 10 countries. A total of 17.6% of residency programs completed the questionnaire—a clear limitation—with participation rates

ranging from a low of 7% (Thailand, Japan) to a high of 100% (Singapore).

The results revealed that the vast majority of pediatric residency programs (94.8%) offered less than 10 hours of instruction on sleep-related education (**Figure**). The median hours of education was 2.0 (mean: 4.4 hours), which falls far short of the duration provided for other educational areas (eg, median duration of breastfeeding education: 9.0 hours). In addition, 23% of pediatric residency programs that responded reported no sleep-related education.

When sleep education was provided, the most commonly covered topics included sleep apnea (83%), normal sleep (76%), parasomnias (72%), and childhood behavioral insomnia (69%). Other topics sometimes covered included hypnomania (52%), sleep-related rhythmic movements (49%),

Figure. Hours of sleep education provided in pediatric residency programs



insomnia (45%), delayed sleep-phase disorder (38%), and medical disorders (33%).

The most common barriers to sleep education cited among pediatric residency programs were lack of qualified staff to provide such education (53%), insufficient time to do so (47%), and lower priority compared with other educational topics (46%). Another 29% of programs cited lack of resources as a barrier. Consistent with the increased rec-

ognition of the importance of sleep and the underdiagnosis of sleep disorders in children and adolescents, the researchers concluded that greater emphasis on sleep education is needed in pediatric residency programs.

Reference: Mindell JA, Bartle A, Ahn Y, et al. Sleep education in pediatric residency programs. Poster presented at: 27th Congress of the International Pediatric Association; August 24-29, 2013; Melbourne, Australia.

Commentary from Ms Rudy

This study takes a cross-cultural look at sleep education in pediatric residency programs. Surprisingly, the results are fairly consistent worldwide across the programs that responded to the survey: 94% offer less than 10 hours of instruction over the course of the residency program, with the median being 2 hours. Given the increased recognition of the importance of sleep on growth and development and the high incidence of sleep disorders in children and adolescents, the study reinforces the need for increased education of pediatric residents on sleep and sleep disorders.

Clinicians will have great difficulty meeting the need for parent education in their practices if they themselves

lack the necessary information to help parents guide their children effectively through the development of healthy sleep patterns. In addition, it is well recognized that sleep disorders are underdiagnosed in pediatric practice. Despite the fact that core competencies for pediatric medical education about sleep were defined in 2003, this study provides additional evidence that there continues to be limited education on this topic.

Interestingly, the primary barrier identified by the programs surveyed was a lack of qualified staff. This barrier just reinforces the need for a greater emphasis on instruction about sleep and sleep disorders in children and adolescents as part of pediatric medical education.

The Impact of Young Children's Sleep on Maternal Sleep

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This international team of researchers undertook a large-scale, cross-cultural study to determine how young children's sleep patterns influence maternal sleep and daytime functioning. The study sample consisted of mothers of 10 085 children up to 6 years of age from 14 countries—Australia, Canada, China, Hong Kong, India, Korea, Japan, Malaysia, New

Zealand, Philippines, Singapore, Thailand, the United Kingdom, and the United States. The mothers were asked to complete a modified version of the Brief Infant Sleep Questionnaire designed to collect information for both children and parents on daytime and nighttime sleep patterns, sleep-related behaviors, and parental perceptions of sleep problems.

The investigators identified significant correlations between maternal sleep and child sleep for all sleep variables evaluated, including bedtime, number of night wakings, night waking duration, wake time, nighttime sleep, daytime sleep, and total sleep time (all, $P < .001$). Although significant across both child age groups evaluated (aged 0 to 3 years and 3 to 6 years), the relationships between maternal and child sleep were stronger for younger children than for older children.

Nearly half of mothers (44%) reported that their child's sleep affects their own sleep and nearly one-third (30%) felt that their child's sleep influences their ability to function throughout the day (Table). Moreover, approximately half of mothers (47%) did not feel confident in their abilities to manage their child's sleep. All of these issues were significantly more common among mothers of younger children (aged 0 to 3 years) than among mothers of older children (aged 3 to 6 years) (all, $P < .001$).

Table. Impact of child sleep on maternal sleep and functioning

Maternal perceptions	All	Children aged 0-3 years	Children aged 3-6 years
Child's sleep affects mother's sleep	44.2%	47.9%	33.7%
Child's sleep affects mother's daytime functioning	30.1%	33.1%	21.5%
Not confident managing child's sleep	46.7%	49.1%	39.8%

Additional analysis revealed that the number of night wakings was the strongest child sleep factor predictive of a perceived influence on maternal sleep and maternal daytime functioning. Among mothers of older children (aged 3 to

6 years), a modest relationship was identified between reports of early child sleep problems and current child sleep problems ($r = 0.10$; $P < .001$).

These cumulative findings point to a strong relationship between children's sleep and maternal sleep, with stronger ties observed with younger children (aged 0 to 3 years) than with preschool-aged children (3 to 6 years). As such, early interventions to improve children's sleep and develop good sleep habits may not only improve quality of life for children, but also for their mothers.

Reference: Mindell JA, Bartle A, Ahn Y, et al. The impact of young children's sleep on maternal sleep. Poster presented at: 27th Congress of the International Pediatric Association; August 24-29, 2013; Melbourne, Australia.

Commentary from Dr Horowitz

Family-centered care is a holistic approach to caring for children. Rather than thinking of a behavior or disease as having an impact on a particular organ or patient, consideration is given to the fact that the child lives within the structure of a family. Pediatricians must remain sensitive to how the child's condition, age, behavior, or illness is perceived by the family and, importantly, how it impacts the family.

This poster explores the relationship between the sleep habits of young children and their mothers' sleep. It is the result of a large cross-cultural survey including over 10 000 children and their mothers from 14 countries. Among this very diverse population, a mother's quality of sleep correlated with the sleep of her child. The authors note that the relationship is stronger in younger children (under 3 years) as compared to older children (3 to 6 years). This is to be expected, since the parents of younger children seem to focus more on the details of every activity in which their children engage.

A related question that the researchers did not explore is the effect, if any, of the number of children in the home on the mother's sleep. Does the mother of 2 or more children, awakened by an unsettled child, possess the experience and confidence to simply go back to sleep and allow the child – on his or her own – to do the same? Or does the mere presence of more than 1 child in the home mean that their mother's sleep is more likely to be interrupted?

There have been previous studies which indicate that successful treatment of children's sleep problems using behavioral interventions results in improvements in parental well-being. However, those interventions often require attention by trained professionals. If we can better identify influencers on sleep in the context of the family-centered care model, we will move closer to evidence-based guidelines for anticipatory guidance and primary care treatments that could influence sleep in the child and the parents and perhaps have far-reaching benefits, such as reducing rates of postpartum blues and depression.

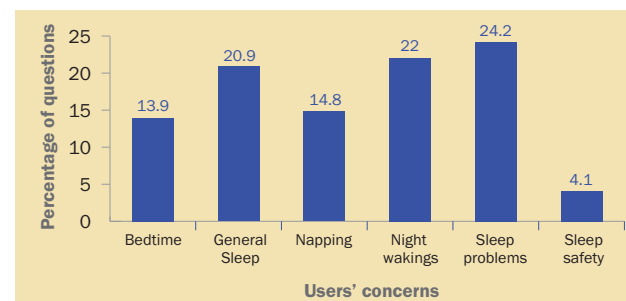
An iPhone®* Application for Infant and Toddler Sleep: Concerns of Users

Authors: J.A. Mindell, The Children's Hospital of Philadelphia and Saint Joseph's University, Philadelphia, PA, USA; E.S. Leichman, Lehigh University, Bethlehem, PA, USA; R. Walters, Johnson & Johnson Consumer Companies, Inc., Skillman, NJ, USA; B. Bhullar, Giant Sky, Philadelphia, PA, USA

Technology-based tools that address common sleep issues in children may provide much-needed education and guidance to parents facing sleep problems with their children. Using information submitted to the “Ask the Expert” feature of an iPhone®* application that addresses sleep issues in young children, the primary objective of the current study was to evaluate the key sleep concerns submitted by parents using the free application. Data were collected from 49 396 consecutive application users over a 10-month period, of whom 899 (2.0%) submitted 1286 valid questions to the “Ask the Expert” feature. These questions were primarily submitted by mothers (77.9%). Parents submitting questions most commonly had infants (3 to 11 months of age: 57.3%), followed by parents with newborns (0 to 2 months of age: 21.7%) and toddlers (12 to 36 months of age: 15.9%). The average age of the child was 10.4 months (± 21.60 months) and the questions were equally divided between parents of boys (49.3%) and girls (50.7%).

When submitting their questions, parents were asked to categorize their question into one of 6 subjects. As shown in the Figure, the questions were fairly well distributed across the 6 categories, with most questions (24.2%) related to sleep problems and the fewest (4.1%) related to sleep safety.

Figure. Primary concerns of parents submitting questions to the “Ask the Expert” feature of the iPhone®* application



The questions were most frequently submitted between 6:00 PM and midnight (38.5%), with an additional 16.4% of questions submitted between midnight and 6:00 AM.

Parents utilizing an iPhone®* application on sleep issues in young children often sought additional information regarding infant sleep issues, with nearly half of all questions pertaining to sleep problems and night wakings. Given that 55% of the questions were submitted between 6:00 PM and 6:00 AM, the researchers noted, “These findings may indicate that parents often seek sleep-related advice at times when information is not readily available, thus attesting to the need for accessibility of health-related information.”

Reference: Mindell JA, Leichman ES, Walters R, Bhullar B. An iPhone application for infant and toddler sleep: concerns of users. Poster presented at: 27th Congress of the International Pediatric Association; August 24-29, 2013; Melbourne, Australia.

*iPhone® is a registered trademark of Apple, Inc.

Commentary from Ms Rudy

This survey on parent usage of an “Ask the Expert” application for the iPhone®* for infant and toddler sleep demonstrates that parents are interested in using technology, like a smart phone “app”, for answers to questions about their child’s sleep problems. As we all do in this Internet age, parents frequently search for an answer from a source that can be readily accessed at the time when the problem is presenting itself. It is well recognized that those with Internet access overwhelmingly use it to gather information on health topics. According to this survey, this includes parents as well.

Several clinical reviews have documented that both parental education and behavioral interventions result in clinically significant improvement in children’s bedtime problems and night waking. Providing parents with easy

access to reliable, well established information about common sleep problems and useful interventions in a timely manner (in the case of sleep problems, during evening and nighttime hours when pediatricians’ offices are closed) has the potential to be highly effective. It can be particularly helpful during early infancy, when preventive measures can be taken to perhaps ward off more serious sleep problems in the future. An added bonus is that a reliable, accessible information source can help ease the education burden on a busy pediatric practice.

Of paramount importance, though, is that the information sources are evidence-based as well as reviewed and recommended by pediatric clinicians. This is vital to ensure their accuracy, effectiveness, and usefulness.

*iPhone® is a registered trademark of Apple, Inc.

Intra- and Interpersonal Changes in the Skin Microbiome from Infancy to Adulthood

Authors: K. Capone, F.J. Kirchner, Johnson & Johnson Consumer Companies, Inc., Skillman, NJ, USA; S.B. Cox, Research and Testing Laboratory, LLC, Lubbock, TX, USA; E. Zaleski, C.M. Correa, N. Batchvarova, Johnson & Johnson Consumer Companies, Inc., Skillman, NJ, USA; G.N. Stamatias, Johnson & Johnson Santé Beauté France, Issy-les-Moulineaux, France; J. Nikolovski, Johnson & Johnson Consumer Companies, Inc., Skillman, NJ, USA

Numerous types of bacteria reside on the human skin, many of which provide a beneficial role by helping the immune system mature, preventing the growth of pathogenic microbes, and maintaining overall skin health. Research has shown that the microflora present on the skin of adults differs markedly at different sites on each individual and also differs from individual to individual; but how the skin microbiome evolves over time with respect to body site and age has yet to be well defined. Little is also known about how beneficial bacteria on the skin's surface become established, particularly shortly after birth.

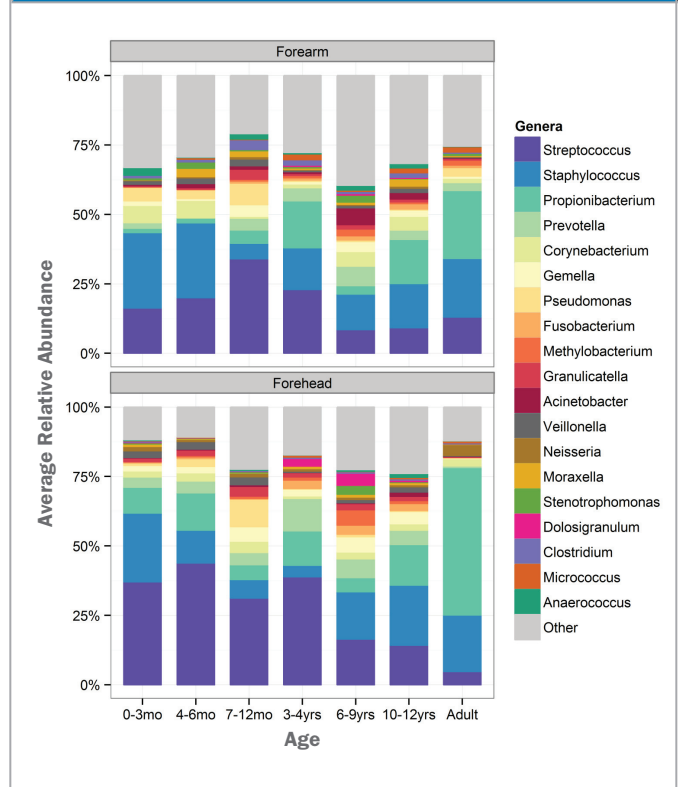
The investigators of the current study sought to identify changes in the skin microbiome from infancy to adulthood. A cross-sectional sampling approach was applied at a routine clinical setting in New Jersey to capture data from individuals across the age spectrum. A total of 117 healthy individuals, including 31 infants, 55 children aged 6 to 12 years, and 31 adults, participated in the study. Of the 31 infants initially evaluated, 23 were subsequently reevaluated at the age of 3 to 4 years. Skin swabs from the forearm and forehead were taken from all subjects and also from the cheek and volar forearm from the 6- to 12-year-olds. These swabs were analyzed for DNA markers from more than 800 species of bacteria using bacterial tag-encoded FLX amplicon pyrosequencing (bTEFAP) and the results were compared with previously identified bacterial DNA markers.

The skin samples showed significant variation in bacterial diversity according to skin site and age (Figure). The most common bacterial genera comprising more than 50% of the total skin microbiome on infants and children were *Streptococcus*, *Staphylococcus*, *Propionibacterium*, *Prevotella*, and *Corynebacterium*, whereas *Propionibacterium*, *Staphylococcus*, and *Streptococcus* comprised more than 60% of the total skin microbiome on adults.

More refined analysis of the change in the microbiome over time revealed the following:

- *Staphylococcus* and *Streptococcus* on the arm and forehead are

Figure. Changes in microbiome diversity with age and skin site



abundant at birth but decrease throughout the first year of life, leading to greater diversity and evenness of the microbial populations throughout childhood.

- *Streptococcus* species that initially dominate on the forehead eventually become outnumbered by either *Propionibacterium* species or *Staphylococcus* species—patterns that are not evident when only average abundance is considered.
- Although *Propionibacterium* species become more dominant on the forearm by 10 to 12 years of age and into adulthood, dominance by *Staphylococcus* or *Streptococcus* species persists in some individuals. In general, the forearm microbiome remains more diverse than the forehead microbiome.
- *Propionibacterium* and *Staphylococcus* species tend to dominate on both the forehead and forearm in adults. The forearm shows a relatively even distribution of the 2 genera, whereas *Propionibacterium* species represent more than 50% of the microbiome on the forehead.

These findings illustrate that the skin microbiome evolves considerably throughout life, with differing patterns of evolution at different body sites and based on age. Notably, the skin microbiome has yet to reach adult-like states in individuals aged 10 to 12 years. The investigators

noted that better characterization and understanding of the bacteria comprising the skin microbiome in childhood and the evolution to adulthood may provide insight into the etiology and pathophysiology of a number of skin disorders, including eczema, cellulitis, and impetigo.

Reference: Capone K, Kirchner FJ, Cox SB, et al. Intra- and interpersonal changes in the skin microbiome from infancy to adulthood. Poster presented at: 27th Congress of the International Pediatric Association; August 24-29, 2013; Melbourne, Australia.

Commentary from Dr Horowitz

Much more than a simple barrier to the external environment, human skin has been found to play important roles in immune function, thermoregulation, and hydration. For generations, we have understood that germs live on our skin, but we have only recently begun to understand the benefits of a diverse microbiome colonizing our skin; we have yet to fully understand how that microbiome affects the barrier/immune function of the skin and how this contributes to healthy skin overall. It stands to reason that characterizing the evolution of the skin's microbiome from birth to adulthood could advance our understanding of normal healthy skin development and eventually, our understanding about pathological skin conditions that remain poorly understood.

While recent research has added to our understanding of how the structural, functional, and compositional differences in skin changes from childhood to adulthood, this

study assessed the diversity of bacterial populations on the skin in growing infants and children and some important trends were identified. It turns out that the characteristic microbiome of adult skin, with a relative abundance of *Propionibacterium* and *Staphylococcus* species, doesn't fully develop until later than 12 years of age.

The patient population was from a single clinic. Further research should look at larger, more diverse populations and assess the impact of various environmental influences on the microbiome, such as skin care practices, cultural beliefs about hygiene, local water composition (hardness) and quality (absence or presence of pesticides), and diet. Ideally, a larger study would also allow for more data collection to better identify skin care practices that promote a diverse "pro-skin-health" microbiome. This may include providing conditions that result in more colonization of what are generally considered "healthier" bacteria in the hope that this will result in healthier skin.

Chymotrypsin-Like Protease Activity in the Stratum Corneum is Increased in Atopic Dermatitis and Upon Washing with Soap

Authors: S. Danby, University of Sheffield Medical School, Sheffield, UK; M.J. Cork, University of Sheffield Medical School and Sheffield Children's Hospital, Sheffield, UK; J. Chittock, University of Sheffield Medical School, Sheffield, UK; K.M. Martin, N.K. Tierney, Johnson & Johnson Consumer Companies, Inc., Skillman, NJ, USA

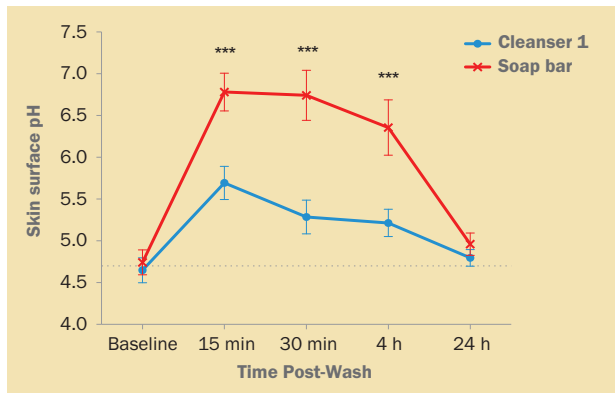
A critical event in the development of atopic dermatitis is breakdown of the skin barrier formed by the intact stratum corneum. Under normal conditions, the stratum corneum is continuously renewed through desquamation, during which mature corneocytes on the surface of the skin are lost and replaced by new corneocytes. Desquamation requires the degradation of the corneodesmosomal junctions between corneocytes by various proteases, including serine proteases, which are tightly regulated by protease inhibitors and by the pH of

the stratum corneum. The pH of the skin surface normally falls between 4.5 and 5.5. However, the pH of the skin surface becomes elevated during the acute phase of atopic dermatitis due to genetic factors and environmental factors, such as washing the skin with soap and harsh detergents. This increase in skin surface pH elevates protease activity and is hypothesized to promote skin barrier breakdown in atopic dermatitis.

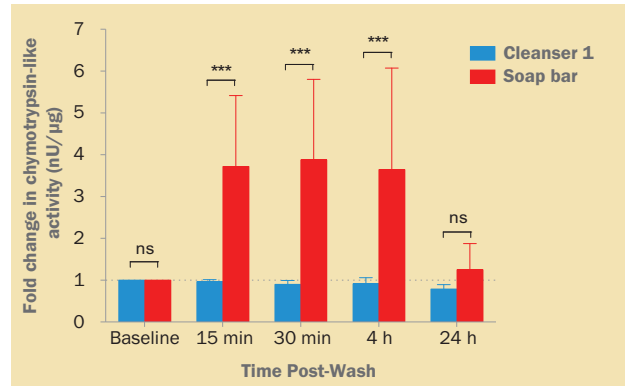
The current study featured 2 aims:

1. To quantify the activity of proteases in the stratum corneum of individuals with atopic dermatitis.
2. To evaluate how washing with soap and alternate cleansers influences protease activity.

To address the first aim, 29 volunteers with healthy skin and 20 volunteers with self-reported active atopic dermatitis were subjected to several skin assessments made on the volar side of each individual's forearm (each assessment repeated twice in each volunteer). Comparison of the

Figure 1. Change in skin surface pH following a single wash with cleanser 1 versus bar soap

A cohort of 12 volunteers each washed their forearm skin once with either soap or a specially formulated synthetic baby cleanser (forearm randomized). Skin surface pH was significantly elevated on the site washed with soap compared with cleanser 1 ($P < 0.001$, using a repeated-measures 2-way ANOVA). Asterisks indicate the results of the Bonferroni posttest ($P < 0.001$).

Figure 2. Change in chymotrypsin-like protease activity at the skin surface following a single wash with cleanser 1 versus bar soap

A cohort of 12 volunteers each washed their forearm skin once with either soap or a specially formulated synthetic cleanser (forearm randomized). Chymotrypsin-like protease activity was significantly elevated on the site washed with soap ($P < 0.001$, using a repeated-measures 2-way ANOVA). Asterisks indicate the results of the Bonferroni posttest ($P < 0.001$).

2 groups revealed that chymotrypsin-like protease activity was significantly elevated in individuals with atopic dermatitis, but not in those with healthy skin (7.33 versus 4.23 nU/ μ g; $P < .05$). This increase in protease activity coincided with decreased skin barrier function in individuals with atopic dermatitis versus those with healthy skin, as measured by transepidermal water loss (18.03 versus 12.33 g/ m^2/h ; $P < .05$). Stratum corneum hydration and skin surface pH did not differ between the 2 groups. Additional analysis of the adults with healthy skin found that skin surface pH ranged from 4.0 to 5.99 and that increased pH was significantly associated with elevated chymotrypsin-like protease activity ($P < .05$).

For the second aim, 2 cohorts of adult volunteers with healthy skin (either 6 or 12 adults per cohort) were instructed to wash their volar forearm with water alone, bar soap, cleanser 1 (synthetic liquid baby cleanser), cleanser 2 (synthetic liquid baby cleanser), or cleanser 3 (soap-based liquid baby cleanser). Skin surface pH increased by more than 1 unit following a single wash with bar soap, but not after a wash with a synthetic liquid baby cleanser, and remained elevated for over 4 hours (Figure 1). In tandem, chymotrypsin-like protease activity increased more than 3-fold over the 4 hours following a single wash with bar soap, but not after a wash with a synthetic liquid baby

cleanser (Figure 2). Similar findings were observed when water and the 3 different cleansers were compared: whereas the 2 synthetic liquid baby cleansers had minimal effect on skin surface pH and did not increase chymotrypsin-like protease activity compared to water alone, the soap-based liquid baby cleanser significantly increased skin surface pH by more than 1 unit above water alone over the first 4 hours after washing ($P < .001$). Chymotrypsin-like protease activity after a single wash with the soap-based liquid baby cleanser fluctuated, but with levels below those observed at baseline.

The findings indicate that the skin of patients with atopic dermatitis is characterized by increased chymotrypsin-like protease activity, consistent with increased skin barrier breakdown. In addition, washing with soap, but not with mild synthetic baby cleansers, increases pH and chymotrypsin-like activity at the skin surface in healthy subjects, well above typical levels observed in subjects with atopic dermatitis. As such, the data suggest that soap and harsh detergents may exacerbate atopic dermatitis by facilitating proteolytic degradation of the skin barrier.

Reference: Danby S, Cork MJ, Chittock J, Martin KM, Tierney NK. Chymotrypsin-like protease activity in the stratum corneum is increased in atopic dermatitis upon washing with soap. Poster presented at: 27th Congress of the International Pediatric Association; August 24-29, 2013; Melbourne, Australia.

Commentary from Ms Rudy

This poster by Danby and associates offers a likely mechanism for what is frequently seen clinically with atopic dermatitis patients: the use of bar soap and harsh detergents exacerbates their symptoms.

Part 1 of the study demonstrates that atopic skin has a decreased barrier function when compared to non-atopic skin. These differences are significant in that higher levels of both transepidermal water loss and chymotrypsin-like protease activity occur in atopic skin. Part 2 of the study demonstrates that the use of bar soap on normal, non-atopic skin causes a significant increase in skin pH and chymotrypsin-like protease activity as compared to the use of a mild synthetic cleanser. Both of these effects are associated with impaired barrier function of the skin. I find it interesting that the effect of increased pH and elevated chymotrypsin-like protease activity from the use of soap

remained present on the skin for over 4 hours afterward, demonstrating that this effect is not short-lived.

These are extremely useful findings for clinical practice and can help guide our cleanser recommendations for use in children. They are particularly applicable for children with impaired skin integrity, such as those with atopic dermatitis, and in infants whose skin is still developing and maturing. Products that cleanse the skin but do not impair the barrier function are ideal. This means choosing cleansers with mild surfactant systems that do not have a negative impact on the barrier capacity of the skin, but which still provide adequate cleansing to maintain good hygiene. Furthermore, these findings may prove valuable for future testing of other products, such as emollients and sunscreens, that are applied to children's skin, to ensure that they protect, support, and maintain skin integrity.

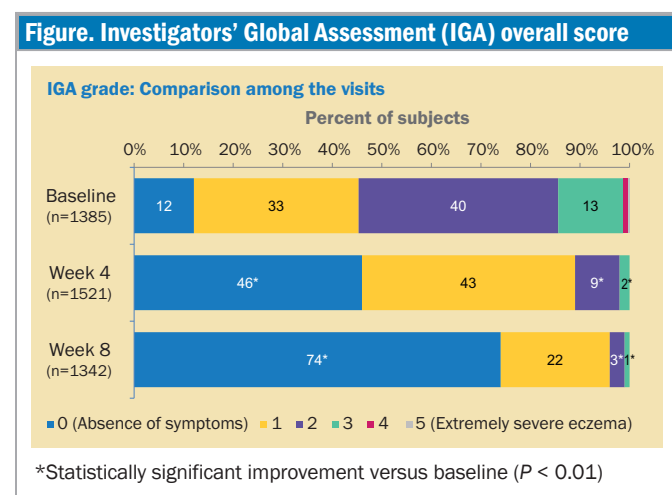
Avena sativa Extracts in Atopic Eczema: A Two-Month Observational Study in Greece

Authors: K. Volonakis, Mitera General Maternity, Gyn/Cal and Children's Hospital, Athens, Greece; N. Kostaridis, Johnson & Johnson Greece, Athens, Greece; V. Nollent, C. Bertin, Johnson & Johnson Santé Beauté France, Issy-les-Moulineaux, France

Atopic dermatitis is a chronic inflammatory skin condition characterized by dry skin, scaling, intense itching, and erythema. Daily moisturizing is a cornerstone of effective treatment of the disorder and can reduce the need for steroids and immunomodulators. *Avena sativa* (oat) extracts (ASE) enriched with avenanthramides have the ability to moisturize, soothe, and reduce itching when applied topically.

This observational study evaluated the efficacy and tolerability of a daily ASE wash and cream regimen among 1607 individuals with mild-to-moderate atopic dermatitis. The subjects ranged in age from 2 months to 16 years and were recruited from the private practices of 46 pediatricians in Greece. Each subject followed a daily regimen of ASE body wash (once a day) and body cream (twice a day) for a total of 8 weeks between September 2011 and March 2012, with assessments performed at baseline, week 4, and week 8.

Participants were primarily 0 to 10 years of age (0 to 2 years: 45%; 3 to 10 years: 45%; 11 to 16 years: 10%), with an equal distribution between males (52%) and females (48%). Thirty-seven percent of patients were using steroids



or immunomodulators at baseline to manage their atopic dermatitis.

Use of the ASE regimen conferred significant improvement in the clinical signs of atopic dermatitis (Figure). Compared with baseline, the proportion of subjects with severe symptoms (score of 2 to 3) on the Investigator Global Assessment (IGA) tool decreased significantly over time and the proportion of subjects with no symptoms (score of 0) increased significantly. Nearly 75% of subjects showed no signs of atopic dermatitis at week 8, as compared with only 12% at baseline ($P < .01$). Moreover, no subjects received IGA scores of 4 or 5, indicative of extremely severe eczema, at weeks 4 and 8.

At the 8-week self-assessment (a self-assessment efficacy questionnaire was administered to participants at weeks 4 and 8), more than 90% of subjects agreed with 9 of the 10 efficacy statements listed (eg, “It improves the signs of eczema,” “The skin is less dry”), indicating a statistically significant improvement from baseline (all, $P < 0.05$). For the last item, 84% of subjects felt that the ASE regimen enabled them to use less concomitant medication (steroids or immunomodulators), which was also a significant increase from baseline ($P < .01$). By weeks 4 and 8, at least 85% of subjects reported that they wanted to use the ASE regimen, including each of its components, all the time. Only 4% to 9% of subjects reported that their eczema worsened over the course of the study, which could be due to environmental factors, noncompliance, or individual instances of exacerbation and/or remission and not necessarily to the ASE regimen.

With regard to tolerability, 2.4% of subjects (39/1607) reported adverse events, none of which were deemed to be product-related. The most commonly reported adverse events were itching (1.3%) and redness (1.2%), which could have been due to the underlying skin condition.

This study found that a daily regimen consisting of an ASE wash and cream improved the clinical signs of atopic dermatitis over the course of 8 weeks and proved to be well tolerated. Eighty-four percent of participants felt that they needed to use less concomitant medication to control their eczema by the end of the study. Given the favorable outcomes, the majority of study participants stated that they wanted to continue the regimen.

Reference: Volonakis K, Kostaridis N, Nollent V, Bertin C. *Avena sativa* extracts in atopic eczema: two-month observational study in Greece. Poster presented at: 27th Congress of the International Pediatric Association; August 24-29, 2013; Melbourne, Australia.

Commentary from Dr Horowitz

As a general pediatrician, I often find myself trying to coach families struggling to help their children who have itchy, inflamed skin. Oat and oat products have been used on the skin since the time of the ancient Egyptians. Colloidal oatmeal is the hulled oat kernel ground to a fine powder and dispersed in water. The oat proteins are known to have high hydration properties which theoretically make oat and oat extracts ideal ingredients in treating children with atopic dermatitis whose condition is characterized by itchy, inflamed skin. However, the tolerability of a regimen that is rich in oat extract for atopic dermatitis remains debated.

This poster describes more than 1600 children with mild-to-moderate atopic dermatitis in Greece who were observed over a period of 8 weeks to determine if the regimen containing oat extract in the cleanser, as well as in the emollient, was well tolerated. Infant skin is thinner than adult skin and because the skin of infants and young children

is still developing, it is more vulnerable to environmental insults. Therefore, only products containing ingredients shown not to irritate should be selected for use on these populations. In addition to showing that the regimen was well-tolerated, this study demonstrated significant improvement in the atopic dermatitis symptoms, as evaluated by both caregivers and medical professionals, of the children using the regimen. The investigators identified that 88% of the children had symptoms at the beginning of the study and by the end, only 26% had symptoms.

Although this was designed to be a study of tolerance, it actually showed substantial clinical improvement in atopic dermatitis, one of the most common skin conditions that pediatricians help families manage. Products containing oat extract have withstood the test of time and this study shows why. In addition to the treatments that represent our standard management of atopic dermatitis, such as emollients, steroids, and immune modulators, oat extracts have a place in our therapeutic armamentarium as well.



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