CHILDHOOD COGNITION:

THE BENEFITS OF ADEQUATE HYDRATION & NUTRITION

Featuring :: Naiman Khan, PhD, RD

TRANSCRIPT

Maura: I sent my son off to practice with his sports team this afternoon. Here in Columbus, Ohio, we're having a heat wave, and we're still in the middle of a pandemic, so I've been lecturing him about how best to stay safe. This includes keeping six feet apart from his teammates, for example. Or, drinking as much water as he can manage. He's old enough to understand why both are important right now—at least to some extent. But when I hand him yet another glass of water to chug, pre-practice, he eyes me skeptically, because in his mind, what's the big deal?

Maura: Let's set the pandemic aside for a second and just focus on why, in general, it's wise to stay hydrated. Drinking enough water is important every day, and not just for kids, but for everyone. It regulates body temperature, helps to lubricate joints, keeps our organs in working order…these are all things a young athlete would want, right? And: Water can even help the synapses in our brains to fire, it helps us to sleep better, and to keep our moods in check. So hydration really is a big deal.

Maura: I'm Maura Bowen, podcasting for Abbott Nutrition Health Institute. I'm here today with Dr Naiman Khan (PhD, RD), an Assistant Professor in the Department of Kinesiology and Community Health at the University of Illinois at Urbana-Champaign. Dr Khan leads the Body Composition and Nutritional Neuroscience Lab which integrates knowledge in the disciplines of dietetics, body composition, and cognitive neuroscience to understand the interactions between lifestyle behaviors, abdominal adiposity, and cognitive and brain health in adults and children. He's here today to discuss a range of topics including how fluid status and nutrition can affect the body at large, and the brain specifically. And he'll share the results of his recent investigation into how hydration and nutrition impact cognitive performance.

Maura: One thing to note before we begin. This recording may sound a bit softer than you're used to hearing. That's because I'm still social-distancing from my home office rather than sitting in our recording studio, and Dr Khan is dialing in from the great state of Illinois.

Maura: Dr Khan, welcome!

Dr Khan: Hello Maura. Thank you for having me.

Maura: Dr. Khan, before we start, can you tell us a little bit about your research background and what inspired your current research interests?

Dr Khan: I am a Registered Dietitian and I've always been interested in food and how it can impact our health. My graduate training focused on diet and obesity in children. During my post graduate training, I developed an interest in how nutrition may influence children's cognitive health. This interest was inspired by some of my experiences working in school settings during grad school. Specifically, I was surprised at how school lunch and beverage policies were not informed by the evidence base in nutritional neuroscience or an understanding of specific nutrients and

foods that could support optimal learning among children. Since then, my work has focused on research questions that provide insights into what specific aspects of a healthy diet pattern can be leveraged to support learning and achievement in children.

Maura: Could you explain to our listeners, how your lab assesses brain health/performance in a research environment?

Dr Khan: Cognitive performance encompasses many abilities. Our laboratory is specifically interested in children's ability for executive function which is also known as cognitive control. This includes one's ability for inhibition, working memory, and cognitive flexibility or multi-tasking. These abilities provide the basis for higher-order or more complex abilities like reasoning, problem-solving, planning. We also know that these abilities support academic achievement in school as well as long-term success in jobs. Our laboratory studies children's cognitive control using computerized tasks that require children to employ inhibition, working memory, and cognitive flexibility to complete successfully complete. These are essentially not very exciting videogames, compared what children have at home. We typically measure accuracy, reaction times or how fast children complete the tasks. Tasks only vary on their level of demands so we can measure how well children pay attention or exhibit greater memory when faced with greater difficulty or what we call task demands.

Maura: What kind of lifestyle factors have you found to be associated with brain health/performance?

Dr Khan: We have a strong interest in both physical activity and diet as well as their related physiological factors such as aerobic fitness and obesity. These are of course interrelated factors that have been extensively studied for the implications for physical health and chronic disease risk. However, the effects of these health factors on cognitive health have received comparatively less attention.

Maura: So you've found that physical activity and dietary factors such as hydration can influence brain performance, speaking first about hydration, do we have an idea for how common suboptimal hydration is in children?

Dr Khan: Water consumption and hydration status are understudied, particularly among children. This is surprising since water comprises the largest proportion of our total body mass. We also know how essential water is for life and numerous physiological processes. However, some large studies indicate that over 50% of children in the United States have urine concentration values that suggest inadequate hydration. This pattern was also observed in our study sample where approximately 60% of the children in our study had urine osmolality over 800 which often used a cutoff for inadequate hydration status. Similar values have been observed in other countries as well so this is a global issue.

Maura: Okay so getting back to your research, what was the aim of your hydration research?

Dr Khan: We studied correlations between urine hydration markers and cognitive function and also conducted a cross-over control trial to assess how changes in water intake influence urine hydration markers and cognitive control abilities among school-aged children.

Maura: Can you review the methodology used to answer your research question? What types of participants were included and excluded?

Dr Khan: We recruited children between 9-11 years to undergo a cross-over control study where we collected 24-hour urine samples and assessed cognitive function without any changes in their intake patterns vs. when they were asked to drink more (2.5L/d) or less water (0.5L/d). The urine hydration markers included urine color, specific gravity, and osmolality. The cognitive tasks we used focused on measuring varying amounts of attention, inhibition, working memory and cognitive flexibility.

Maura: What did your results show?

Dr Khan: There was a significant difference in hydration across all 3 conditions where by all hydration markers showed a significant improvement in the High water intake condition and reduction in hydration following water restriction. Further, benefits of the high intervention were observed during the switch task, whereby participants exhibited 34% lower working memory cost relative to the low intervention. No significant changes in cognition were observed for the cognitive tasks assessing attention and inhibition. Therefore, the benefits appeared to be selective for children's cognitive flexibility or multi-tasking.

Maura: Did anything surprise you about these findings?

Dr Khan: What was especially surprising to us was that the majority of the children participating in our study had poor hydration even in the habitual state. In fact, their urine hydration markers indicated that several children had concentrated urine levels that put them into risk for dehydration. This told us that children are habitually poorly hydrated and it was a challenge for us to reduce their hydration status any further.

Maura: What learnings from this research can clinicians apply to their practice?

Dr Khan: According to the DRIs, the fluid needs for infants are 0.7/0.8L/d until 12 months. The needs then increase with age. Among 9-13yo, the AI is 2.4L/d for males and 2.1L/d for females. I think it is important to first emphasize that when we discuss a healthy lifestyle, water is part of that discussion. It is also important to recognize that children are a high risk group for dehydration because they depend on adults to create an environment or opportunities for adequate water consumption. They also have higher metabolic rates which impact water losses and may have poorer sensitivity to the thirst mechanism that would encourage them to seek water when they experience severe fluid losses. Therefore, we need to appreciate that water is an integral part of a healthy diet pattern and that this is can be especially challenging for children. As far specific lessons for clinicians from our study, the key takeaway is that regular water consumption or improving hydration in children is especially important for particular cognitive functions. This was evident in our study since the benefits were selective for multi-tasking only, which indicates that improving status may selectively benefit mental processes when tasks become more demanding or difficult.

Maura: What other nutrients have emerged to improve cognitive development in children?

Dr Khan: I think one of the most wonderful things about nutrition is that you can study it at different levels. In terms of nutrients, I think the literature supports the idea that a healthy diet for cognitive health is comprised of multiple nutrients with neurocognitive potential. The work we have conducted in lutein and water consumption are only 2 pieces of the puzzle. Other researchers have demonstrated that several nutrients play important roles in brain development and cognitive function in children including choline, DHA, natural vitamin A, and micronutrients like iron. There is also emerging evidence that combinations of nutrients or foods in the form of dietary patterns are also important. This has been increasingly evident from epidemiological studies in nutrient pattern analyses that indicate that multiple nutrients in combination may support brain and cognition to a greater extent than single nutrients.

Maura: Could you tell us a bit more about your lutein research and what role lutein plays in cognitive performance?
Dr Khan: Lutein is a carotenoid that is found in large quantities in green leafy vegetables and in small but highly bioavailable forms in eggs and avocados. Interestingly, lutein preferentially accumulates in the macula of the eye where it is protective against photooxidative stress and serves as a blue light filter. Lutein also preferentially accumulates in the brain and increasing work has shown that persons with greater lutein in eye – which is correlated with brain lutein – exhibit greater cognitive function. Our laboratory, in collaboration with our colleagues at the University of Georgia, was the first to demonstrate that we can reliably measure macular pigment optical density or carotenoids in the macula in children. Subsequent work from our laboratory has linked cognitive control functions as

well as academic achievement with higher MPOD among children. This work has extended knowledge from adult studies to school-aged populations.

Maura: How might clinicians apply these findings to their practice?

Dr Khan: There are no specific dietary guidelines for lutein intake. We are hoping that our work will inform future guidance on lutein. However, based on previous clinical trials, we know that most people can improve their lutein status in the macula using dietary approaches within 2-3 months simply by adding a serving of lutein-rich vegetables or daily egg or avocado consumption. We also know that supplementation can also be an effective approach to improving lutein status. As far as cognitive benefits, the literature is still limited. However, recent clinical trials have successfully improved cognitive function using lutein dose of 12mg which is equivalent to what you could find in a serving (1/2 cup) of cooked spinach.

Maura: What additional research should be done that could be helpful in this space?

Dr Khan: We definitely need randomized controlled trials among children to better understand the specificity of the effects of lutein consumption on cognitive abilities. Additional studies would also help us answer important questions about the specific dose and types of foods or supplements that could be efficacious in improving lutein status and cognitive function in children.

Maura: Great! Dr Khan, thank you so much for your time today. This was fabulous information. You're welcome on our podcast anytime, and I hope you'll come back.

Dr Khan: It was a pleasure speaking with you. Thank you for highlighting our work.

Maura: And for our listeners, thank you for joining us today. Be sure to visit anhi.org for more nutrition science education and resources, including more podcasts, which you can find on anhi.org under RESOURCES, and the PODCASTS & VIDEOS…or, by clicking the "COMMUNITY" link on the ANHI.org homepage to find podcasts there, as well.

Maura: Thanks everyone.