Editorial

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Hydration Conference Spans Many Research Areas

The eighth annual Hydration for Health Conference, convened in Évian-les-Bains, France, exemplified the breadth of water research which has been conducted during the past decade. Consistent with the previous 7 conferences, the 2016 program topics represented the fields of medicine, kidney health, renal physiology, pregnancy and breastfeeding, cell biology, self-assessment of hydration status, international drinking habits, and obesity management. Consequently, this unique conference was the only scientific meeting during 2016, to my knowledge, that concentrated only on water and its relevance to health.

Providing a foundation for the entire conference, Dr. Perrier opened the conference with an overview of the health implications of water research. Her paper adroitly describes (pages 4–12) the growing body of evidence that links differences in fluid intake (i.e., daily low volume vs. high volume intake) with small, but biologically significant, differences in vasopressin (copeptin), kidney filtration rate, and indicators of metabolic dysfunction or disease. She also describes which urinary hydration biomarkers are valid and assess personal hydration status simply, throughout the day.

Three of the manuscripts that appear in the 2016 Conference Proceedings focus on pregnancy and breastfeeding. First, Dr. Bardosono et al. (pages 13–17) report their findings from a cross-sectional survey of 299 pregnant and 296 breastfeeding women who reside in Indonesia. Their goal was to compare the daily total water intake (fluids + solid foods) of these women to the Adequate Intake (AI) recommendation for water. As approximately half of the pregnant and breastfeeding (P&B) women did not reach the recommended AI for water, these researchers advocate for continued production of educational materials and surveys of P&B women in other countries. Second, Dr. McKenzie (pages 18–22) summarizes her longitudinal observations of 18 women, from early in their first trimester of pregnancy through 2 months of breastfeeding as compared to 18 pair-matched non-pregnant control subjects. The goals of her 11-month investigation are to determine (a) if urine color (U_{COL}), an inexpensive and practical tool, is a valid means of monitoring body water balance and (b) if U_{COL} in 24 h and single samples accurately determines urine concentration. Utilizing a receiver operating characteristic statistical analysis, she reports that 24-h U_{COL} has excellent diagnostic accuracy, when applied to P&B women. Third, in recognition of the usefulness of U_{COL} as a hydration biomarker, Dr. Boesen-Mariani and colleagues (pages 23–29) describe their efforts to validate a user-friendly tool based on the 8-category U_{COL} scale, using only images or illustrations, which can be understood by users of various nationalities and spoken languages. More than 1200 P&B women from Brazil, Mexico, and Poland viewed 3 versions of the tool, and then completed an online survey which measured their understanding, appreciation, simplicity, and their

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intent to use. One tool emerged as the most understood and appreciated; also, 83% of women reported that they were likely or very likely to use this tool in daily life. These results suggest that a simple tool, based on the U_{COL} scale, can help P&B women to consume an adequate volume of water each day.

Dr. Pross (pages 30–36) reviews the scientific literature regarding the effects of dehydration on cognitive function and mood in children, adolescents, healthy adults, and older adults. She concludes that dehydration impairs the cognitive performance of children and older adults, and degrades the mood state of children. In contrast, mild dehydration has no impact on the performance of mental tasks by healthy young adults, but impairs their mood considerably. Her review clearly shows differential effects of dehydration across the lifespan.

The movement of water between cells was not well understood until 1992, when channels were discovered within the fragile cell membranes that encase all animal cells. Known as aquaporins (literally, "water pores"), these channels are involved in many cellular processes, including the concentration of urine, body fluid homeostasis, skin hydration, brain function, glandular secretions, hearing, and vision. Dr. Brown (pages 37–42) describes these facts in an interesting review of (a) the important role played by aquaporins in maintaining body water balance via the kidneys and (b) diseases that result from malfunction or mutations of aquaporin channels such as eye cataracts, stroke, wound healing, and inability of the kidneys to concentrate urine (i.e., in nephrogenic diabetes insipidus patients). The research of Torres and van Gastel (pages 43–50) focuses on a different renal disorder – polycystic kidney disease (PKD). Caused by a genetic mutation, PKD involves cyst formation, excessive fluid secretion, and inability to concentrate urine. Plasma vasopressin (see above) is elevated in patients with PKD and directly related to the rate of cyst growth. Copeptin, a surrogate of vasopressin, is associated with both disease severity and longitudinal disease progression. Thus, lowering the effect of vasopressin on the kidneys may modify the disease course of PKD. This could be accomplished by medications which block the effects of vasopressin in the kidney with a specific pharmacologic antagonist, or could be accomplished by lowering the blood vasopressin concentration via lifestyle changes (i.e., increased daily water intake or lowered sodium intake). The human and animal research to date is strong but not conclusive. The authors recommend that future studies evaluate the relationship between increased daily water intake, and lowering dietary osmolar/sodium intake, on vasopressin concentration and the progression of PKD. If modifying vasopressin concentration leads to slower PKD progression, this will encourage clinical intervention trials which explore other lifestyle factors (e.g., smoking and obesity) that are associated with increased vasopressin concentrations.

Dr. Bankir, an internationally renowned renal physiologist, received the first Tribute to Hydration award of the Hydration for Health Conference, which allowed her to propose the topic of her article. She and her colleagues review numerous controlled laboratory investigations (pages 51–61) that address the mechanisms by which kidneys handle water, in response to salt intake and loss. Her review is based on re-analysis of previously published human studies, in which salt intake was adjusted to different levels, and on epidemiologic studies involving individuals who consumed ad libitum diets. Her conclusions illustrate the dynamic relationship between urine volume and urinary salt excretion, within a 24-h period and across several days. As such, this manuscript provides new insights into the accepted principles of human kidney function.

The final article, written by Dr. Stookey, is unique among the topics presented above. She advances questions about childhood obesity (pages 62–67) by examining which interventions (e.g., parental involvement, educational materials, improved water availability) have successfully reduced the body weight of children. Her goals are to (a) provide advice about local conditions, for administrators and researchers who design water interventions, to create and sustain effective programs in communities and (b) describe the success of an exemplary drinking water program in the schools of New York City. This review ends on a very positive note, that is, school-based drinking water interventions have the potential to efficiently benefit millions of children who are at risk of obesity worldwide.

As described above, the robust scientific content of the 2016 Hydration for Health Conference exemplifies the growth of water research and its relevance to health. Importantly, this research can be viewed from the perspective of modifiable behaviors. Specifically, the simple action of drinking adequately and self-assessing hydration status are supported by the papers which appear in this issue of *Annals of Nutrition and Metabolism*. These positive habits also are supported by published clinical research, in that low daily water intake has been associated with coronary heart disease, bladder cancer [1, 2], and colon cancer [3, 4]. Furthermore, epidemiological studies and controlled laboratory investigations link elevated

plasma AVP (i.e., a hormone that is elevated when daily water intake is low) with an increased risk of developing hyperglycemia or type 2 diabetes, the metabolic syndrome, cardiovascular disease, and premature death [5–8]. These research findings agree with the increased water intake (2.5–3.0 L/day) that is prescribed by physicians [9] to reduce the risk of chronic kidney disease [10, 11] and the recurrence of kidney stones [12]. Thus, the simple behaviors of increasing water intake and self-assessing hydration status appear to be safe, cost-effective, healthy behaviors that everyone can adopt [5, 6].

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