DANONE NUTRICIA RESEARCH

The H4H Hydration for Health Initiative

65TH ACSM ANNUAL MEETING

HYDRATION FOR HEALTH ACADEMY:

historical perspectives and emerging evidence of the importance of hydration beyond performance

May 29th • 4:00-7:00PM • Room 102-EF
Minneapolis Convention Center, USA

AGENDA

Chairman: Stavros Kavouras, Ph.D., FACSM, F.E.C.S.S., University of Arkansas, USA.

Module 1: Historical perspectives and hydration biomarkers

Introduction

- History and evolution of hydration science
  Lawrence Armstrong, Ph.D., FACSM,
  University of Connecticut, USA.
- Hydration beyond performance: so what?
  Erica Perrier, Ph.D., C.S.C.S.,
  Danone Nutricia Research, France.
- Fluid Intake patterns worldwide
  Isabelle Guelinckx, Ph.D., R.D.,
  Danone Nutricia Research, France.

Questions & Answer

Break 30 minutes

Module 2: Hydration beyond performance

Introduction

- Mechanisms for dehydration-associated kidney disease
  Richard Johnson, M.D.,
  University of Colorado, USA.
- Combined dehydration, exercise and environmental heat stress increase lipid peroxidation and DNA damage
  Colleen Muñoz,Ph.D.,
  University of Hartford, USA.
- High Intensity Exercise, cardiac output & renal injury
  Evan Johnson, Ph.D.,
  University of Wyoming, USA.

Questions & Answer

Dr Stavros Kavouras

Ph.D., FACSM, FECSS,
Professor and
Director of the Hydration Science Lab,
Adjunct Professor in Medicine,
Division of Endocrinology,
University of Arkansas, USA

Dr Stavros Kavouras is a Professor and Director of the Hydration Science Lab at the University of Arkansas & Adjunct Professor in Medicine at the University of Arkansas Medical Sciences, Division of Endocrinology. His lab is studying the mechanisms by which water intake affects health and performance. His current research is focusing on the effect of water intake on glucose regulation and its implication on children's hydration and obesity. Dr Kavouras is the author of more than 100 peer review articles, 5,000 citations (h-index 36), and he has given lectures in 28 countries. He is a section Editor of the European Journal of Nutrition and program coordinator for the Exercise Science program. Dr Kavouras is a Fellow of the American College of Sports Medicine & the European College of Sports Science as well as elected member of the American Physiological Society, the American Society of Nutrition, and the Obesity Society.

Dr Lawrence Armstrong

Ph.D., FACSM,
Professor of physiology,
trained in Human Bioenergetics,
University of Connecticut, USA

Dr Lawrence Armstrong presently teaches undergraduate and graduate courses in Thermal Physiology, Exercise Physiology, Scientific Presentations, and Physiological Responses to Stressful Environments. His research interests include the effects of mild dehydration on cognitive performance of men and women, hydration status during pregnancy, water-electrolyte balance during exercise in hot environments, factors influencing thirst, human temperature regulation, and dietary interventions (i.e., low salt diets) as they apply to laborers, athletes and military personnel. He has authored/coauthored over 200 peer-reviewed scientific articles and has published three books, the most recent titled Research Methods. He formerly held the position of Research Physiologist at the Research Institute of Environmental Medicine, Natick, MA and is a past member of the U.S. National Research Council, Institute of Medicine, Committee on Military Nutrition Research. Dr Armstrong is a member of the Danone Research Scientific Advisory Board and formerly served as the President, American College of Sports Medicine.

HISTORY AND EVOLUTION OF HYDRATION SCIENCE

The need to consume water is inherently obvious because of the perception of thirst, which presumably has existed for as long as human history has been recorded. Recognition of the importance of drinking for optimal health, physiological function, and mental/physical performance rose to prominence during the 20th century. However, as a unique research specialty area that focuses on the general public during daily activities, Hydration Science began only during the past decade. It is important to know this history because past discoveries and failures provide direction for future research. Therefore, the purpose of this presentation is to review the clinical, physiological, military, sport, and epidemiological publications which led us to the present-day field of Hydration Science. Special emphasis is placed on the investigators, laboratories, world-wide events, and prevailing paradigms of each era.

Dr Erica Perrier

Ph.D., C.S.C.S.,
Hydration Physiology
and Metabolic Health Research Group,
Danone Nutricia Research, France

Dr Erica Perrier earned her MS and PhD in Exercise and Sport Science from Oregon State University. Her research group investigates the interrelationships between water intake, hydration biomarkers and the physiology of water balance, in order to understand the mechanisms and potential metabolic consequences of water balance regulation in adults and children. Prior to joining Danone Nutricia Research, Erica developed and taught undergraduate and graduate-level courses at the University of Portland, the University of Western States, and Clark College, Oregon State University, and was a research assistant at Oregon Health & Science University studying exercise, nutrition and health. Her teaching experience spanned the areas of exercise science and prescription, cardiovascular physiology, health and nutrition, and sports performance enhancement. She is also a NSCA Certified Strength and Conditioning Specialist, former personal trainer, and NCAA Division-I athlete, obtaining Academic All-American and Phi Beta Kappa honors while earning her BS from Duke University.

HYDRATION BEYOND PERFORMANCE: SO WHAT?

Over the past decade, the literature on hydration has evolved considerably – from (de)hydration assessment, performance and safety, towards a more global exploration of hydration in daily life. This shift in thinking about the role of hydration in the general population was largely driven by examining physiological differences between otherwise healthy individuals whose habitual, ad libitum drinking habits differed, in order to identify markers that may better discriminate low- and high-volume drinkers. Aside from obvious differences in urinary volume and concentration, an emergingbody of evidence links differences in fluid intake with small, but biologically significant, differences in vasopressin (copeptin), glomerular filtration rate, and risk for diabetes, metabolic syndrome, and markers of metabolic health. These findings suggest a need to reexamine what we consider to be 'well hydrated', from the perspective of long-term health outcomes. Reasonable targets will be proposed for urine osmolality, specific gravity, and color that may be used by researchers, clinicians, and individuals, as well as perspectives for further research.

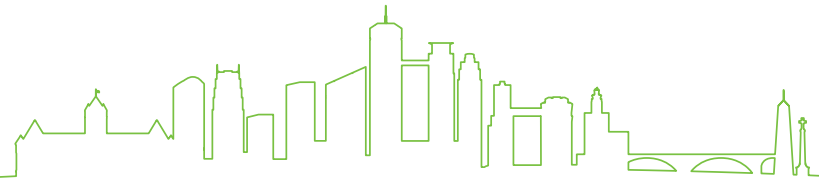
Dr Isabelle Guelinckx

Ph.D., R.D.,
Fluid Intake Scientist,
Danone Nutricia Research France

Dr Isabelle Guelinckx obtained her MS and PhD in Biomedical Sciences at the Catholic university of Leuven, Belgium. She specialized into nutrition with a second MS at the University of Maastricht, the Netherlands and a professional bachelor in Dietetics and Nutrition at the Catholic College Leuven, Belgium. This knowledge was put into practice during the clinical research of her doctoral thesis, which aimed to assess the impact of lifestyle advice on gestational weight gain of obese pregnant women. In 2011 Isabelle joined Danone Nutricia Research where she began managing research projects investigating the short term health impact of dehydration. Her current research focus is the nutritional assessment of fluid intake, with over 30 scientific articles dedicated to the results of the Liq.In7 surveys. These surveys among a nationally representative sample of children and adults are performed with a fluid-specific 7-day record validated for water.

Liq.in7

To access online the statistics of Fluid Intake data worldwide, use the Liq.In7 Interactive Map :
http://www.h4hinitiative.com/hydration-science/liqin7



FLUID INTAKE PATTERNS WORLDWIDE

In the last decade recent evidence has emerged associating a low fluid intake, water intake and low urine volume with increased risk of chronic diseases such as diabetes, metabolic syndrome and the progression of chronic kidney disease [1]. A daily sugar sweetened beverages (SSB; sum of carbonated and non-carbonated soft drinks, juices and flavored water) intake has been linked to an increased risk for metabolic diseases diabetes risk [2]. However, only few and sparse data on total fluid intake (TFI; sum of drinking water and all other beverages) are available in the general population. Therefor the public health importance of this recent search is rarely put forward. This presentation aims to report the proportion of individuals in a large international sample, who potentially are based on their low total fluid intake at risk of negative hydration related health outcomes. The international sample of 8 339 female and 7 227 male adults (≥18yr; 39.6 ± 14 yr) analyzed for this presentation was recruited in the Liq.In7 cross sectional survey in 13 countries in Asia, Europe and South America [3, 4]. All participants completed the validated 7 day fluid specific record [5]. The data estimated the median TFI, water and SSB intake to be respectively 1,8 l/d, 0,6 l/d and 0,2 l/d with no significant gender difference for TFI (p=0.5760) and SSB (p=0.6431)(6). However median drinking water intake of women (median (95 % CI): 0,64 (0,82-0,86) L/d) was higher than that of men (0,61 l/d (0,76-0,79) L/d; p<0.0001). On one hand 22 % of woman and 24 % of men consumed less than 1 serving/d of water, and on the other hand one fourth of female and male sample consumed respectively more than 1,18 l/d and 1,09 l/d of water. 39 % of female and 57 % of male sample has mean intake below the AI for fluid intake, and a low intake among 20 % of the sample. One fourth of the sample had a mean TFI higher than 2,5 l/day, and 5 % even higher than 3,8 l/d. 49 % of the sample consumed ≥ 1 serving of SSB/day and one fourth of sample consumed more than 0,56 l/d of SSB. These results suggest that a relatively large proportion of the adults in this sample could benefit from the harmless action of increasing their water intake.

1. Guelinckx I, Vecchio M, Perrier ET, Lemetais G. Fluid Intake and Vasopressin: Connecting the Dots. Ann Nutr Metab. 2016;68 Suppl 2:6-11.
2. Malik VS, Popkin BM, Bray GA, Despres JP, Hu FB. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. Circulation. 2010;121(11):1356-64.
3. Ferreira-Pego C, Guelinckx I, Moreno LA, Kavouras SA, Gandy J, Martinez H, et al. Total fluid intake and its determinants: cross-sectional surveys among adults in 13 countries worldwide. Eur J Nutr. 2015;54 Suppl 2:35-43.
4. Guelinckx I, Ferreira-Pego C, Moreno LA, Kavouras SA, Gandy J, Martinez H, et al. Intake of water and different beverages in adults across 13 countries. European Journal of Nutrition. 2015;54 Suppl(2):S45-S55.
5. Johnson EC, Peronnet F, Jansen LT, Capitan-Jimenez C, Adams JD, Guelinckx I, et al. Validation Testing Demonstrates Efficacy of a 7-Day Fluid Record to Estimate Daily Water Intake in Adult Men and Women When Compared with Total Body Water Turnover Measurement. J Nutr. 2017;147(10):2001-7.
6. Guelinckx I, Vecchio M, Perrier ET, Morin C. Total Fluid Intake, Water and Sweet Beverages Intake: From a Median Intake to Identifying the Proportion of Individuals potential at Risk. The FASEB Journal. 2017;31(1 Supplement):446.4.

Dr Richard Johnson

M.D.,
Professor, School of Medicine,
Renal Diseases and Hypertension,
University of Colorado, USA.

Dr Richard Johnson is a Professor and Chief of the Division of Renal Diseases and Hypertension at the University of Colorado, in Denver, USA. Dr Johnson is well known as a clinician, teacher and researcher, and is one of the founding editors of Comprehensive Clinical Nephrology, a popular textbook. Dr Johnson is especially known for his research on the pathogenesis of kidney diseases, including glomerulonephritis, diabetic nephropathy, and chronic kidney disease Dr Johnson's research has examined the role of subtle renal injury in salt sensitive hypertension and uric acid and fructose in the pathogenesis of hypertension, metabolic syndrome, and diabetic kidney disease. More recently Dr Johnson has had an interest in the etiology of the epidemics of chronic kidney disease that have emerged in Central America, India and Sri Lanka, and he has been a proponent for a role for heat stress and dehydration as contributory factors. Dr Johnson is a prolific and highly cited author with over 500 publications and a number of books in the field of nephrology. Dr Johnson has served on the International Society of Nephrology (ISN) Executive Committee and has been an ISN Councilor for the United State. In 2017 he received the David Hume Award from the National Kidney Foundation in the USA.

MECHANISMS FOR DEHYDRATION-ASSOCIATED KIDNEY DISEASE

Acute dehydration is well known to be associated with a "pre-renal" type of dysfunction, in which urea is retained out of proportion to serum creatinine due to enhanced reabsorption of water, urea, and electrolytes. Typically, this type of dehydration induced renal dysfunction is not thought to be associated with tubular injury per se, and it is considered completely reversible. However, there is now increasing evidence that the processes associated with urinary concentration come at a cost of some oxidative stress and injury, and that this may lead to the development of chronic kidney disease over time. Two major mechanisms are linked primarily with water depletion—those being the effects of hyperosmolarity to induce vasopressin, which by acting via the vasopressin 2 receptors mediates both glomerular and tubular injury; and second is the induction of the polyol-endogenous fructose pathway that can lead to proximal tubular injury. Other mechanisms causing renal damage may also result from chronic heat stress and dehydration, including the effects of subclinical rhabdomyolysis, salt loss and extracellular volume depletion, hyperuricemia and uricosuria/crystal formation, and heat stroke. Dehydration may also potentiate the effect of toxins and nephrotoxic agents on the kidney. Indeed, understanding the mechanisms by which dehydration can contribute to chronic kidney disease reveals a new and previously unrecognized mechanism by which inadequate hydration may accelerated kidney disease of any etiology. Thus, increased hydration should be viewed as a possible therapeutic intervention in all subjects with chronic kidney disease.

Dr Colleen Muñoz

Ph.D.,
Assistant Professor,
University of Hartford, USA

Dr Colleen X Muñoz, Ph.D., completed her master's work in the Department of Kinesiology at California State University, Fullerton, and her doctoral work in the Department of Kinesiology at the University of Connecticut. She is currently an Assistant Professor in the Department of Health Sciences and Nursing at the University of Hartford. Dr Muñoz has published laboratory and field research in the areas of hydration, exercise, and stress physiology. Her most recent work explores the roles of acute and chronic low water intake on hydration biomarkers, fluid regulatory hormones, and mood state. She was the recipient of the New England American College of Sports Medicine 2014 Doctoral Student Investigator Award, and Hydration For Health Initiative 2016 Young Researcher Award. Dr Muñoz serves the scientific community regionally as Co-Chair of the New England American College of Sports Medicine Membership Committee and Sponsorship Committee, and nationally as Co-Chair of the Exercise is Medicine Ambassador Program.

COMBINED DEHYDRATION, EXERCISE AND ENVIRONMENTAL HEAT STRESS INCREASE LIPID PEROXIDATION AND DNA DAMAGE

Production of damaging reactive oxygen species during osmotic stress can induce molecular/cellular damage, which impacts function and organismal health. Little is known about the effects of whole body dehydration and heat stress on a measurable oxidative stress and antioxidant response in circulation. PURPOSE: We aimed to quantify the effect of dehydration, exercise, and environmental heat stress on circulating markers of oxidative stress induced DNA damage, lipid peroxidation, and protective antioxidant response. METHODS: Healthy male (n=30, age=21±3y) subjects completed fluid deprivation (16h; body mass=-2.0±0.9%) before completing 2h of cycling (38°C, 40 % RH; body mass=-4.2±0.9%). Subjects then rehydrated and returned 24h later (body mass=-0.3±0.8%). We measured (via ELISA) circulating 8-hydroxydeoxyguanosine (8-OHdG), malondialdehyde (MDA), ethenoadducts, pro-oxidant enzyme xanthine oxidase (XO), and antioxidant enzymes superoxide dismutase (SOD), glutathione peroxidase (GPx), and catalase (CAT). RESULTS: Overnight fluid deprivation did not result in measurable increases in circulating 8-OHdG or MDA from baseline (ng·mL-1; 1.10±0.43, 0.15±0.04, respectively). However, post 2h of exercise, dehydration, and environmental heat stress, circulating levels of 8-OHdG and MDA were elevated (ng·mL-1; 1.27±0.42, 0.17±0.04, respectively) ($p<0.05$). After 24h of recovery, these markers of oxidative stress-induced damage returned to near baseline levels (1.15±0.43, 0.15±0.04, respectively). Circulating enzyme concentrations did not suggest a robust antioxidant response. CONCLUSION: Fluid deprivation leading to mild hypohydration (~ -2 %) did not induce measurable oxidative stress in circulation, but combined stressors resulted in increased presence of DNA damage and lipid peroxidation markers in circulation. Ongoing research will determine the isolated effects of extreme dehydration vs. heat/exercise stress.

Dr Evan Johnson

Ph.D.,
Assistant Professor,
Division of Kinesiology and Health,
University of Wyoming, USA

Dr Evan Johnson is currently an assistant professor at the University of Wyoming within the Division of Kinesiology and Health. His research centers on the accurate measurement of fluid intake in the free-living population as well as the relationships between water intake and health outcomes such as chronic kidney disease and diabetes. Previously, he completed a post-doctoral fellowship at the University of Arkansas, and his doctoral and master's degrees at the University of Connecticut. Evan has also worked as a researcher within Science Applications International Cooperation (SAIC) at the Naval Health Research Center in San Diego, California where he worked on projects designed to maximize the performance of Navy SEALs and to minimize risk during training. Outside of hydration and health related research Evan participates in the Environmental and Occupational Physiology Interested Group of ACSM where he is the chair of the Scientific Dissemination subcommittee. His goal with this role is to maximize the engagement of ACSM researcher's findings in print and during oral presentations.

HIGH INTENSITY EXERCISE, CARDIAC OUTPUT & RENAL INJURY

The kidneys are integral to maintenance of homeostasis. In response to numerous hormonal and physical signals, filtration of the blood plasma is regulated, allowing for adequate water retention, waste removal, electrolyte balance, and acid-base stability. Within the hospital setting kidney dysfunction is most often the result of chronic insults, commonly associated with the increased pressure within the renal nephron as seen during hypertension, or high volume glucose reabsorption in the case of diabetes. However, in otherwise healthy populations, acute kidney injury is a specific reduction in kidney function that occurs following short-term reductions in renal blood flow, direct kidney damage, or blockage of the urinary tract. Exercise and the changes in cardiac output that are concurrent, alter renal plasma flow and glomerular filtration rate. Generally, these changes are advantageous for exercise performance and have little to no impact on kidney function. However, in certain circumstances acute kidney injury can result. This lecture will serve as a primer to introduce the physiology of kidney function before, during, and following exercise of different modalities and its relationship to cardiac output.