






Hydration for Exercise Performance



Department of Sports Science and Physical Education
The Chinese University of Hong Kong


John O'Reilly, PhD, CSCS
27th July 2015




Contents

1. Importance of hydration
2. Electrolyte loss during exercise
3. Hydration guidelines – before, during & after
4. How to monitor hydration status
5. Take-home messages

2



Importance of Sports Science for Monitoring Exercise



1. Monitor & assess performance
 - Aerobic (VO_{2max} & Yo-Yo – “beep” tests)
 - Anaerobic (windgate, speed tests etc)
 - Strength & conditioning programmes
2. Nutrition assessment
3. Help prevent injury & improve recovery
4. Monitor thermoregulation and measure hydration.

3



Sports Science for



USOC

SPORTS NUTRITION

HYDRATION FACTSHEET

Hydration and the Body

Hydrated cells are critical to get the most out of daily training and facilitate recovery. The effects of significant dehydration can take hours and even days to recover from. Athletes should develop strategies to monitor and adapt an individual hydration plan according to changes in:

- Intensity of training
- Duration of training
- Frequency of training
- Fitness level
- Environmental conditions (e.g. heat, altitude, plane travel, surgery, illness, hard training)



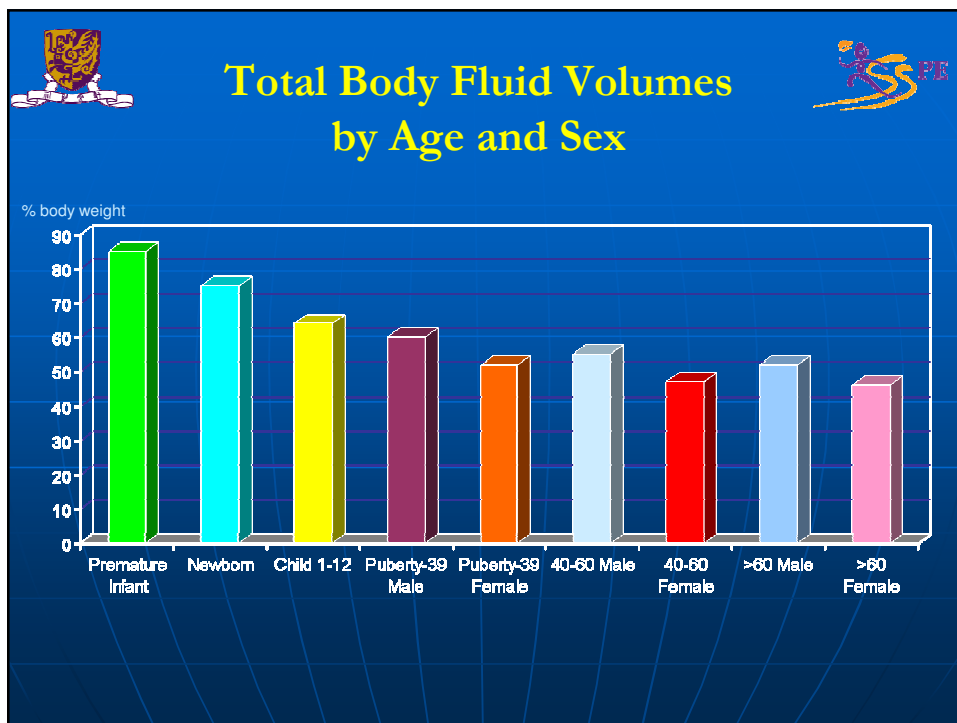
Importance of Hydration on Performance



- Enhances the body's ability to regulate temperature and cool efficiently while avoiding unnecessary elevation in heart rate
- Improves ability to recover quickly from training and competition

Just a small percentage of your body weight through sweat loss can negatively affect

Athletes don't do a good job replacing what they lose in sweat

The slide features three photographs of athletes. On the left, a triathlete in a black and grey singlet with 'VOLKERS AUS' and 'ZNU' on it is drinking from a water bottle. In the center, a soccer player in a green jersey is drinking from a water bottle. On the right, a soccer player in a red jersey with '10' on the back is spraying water from a bottle. The slide includes a crest in the top left and a logo in the top right. A small number '5' is in the bottom right corner.



Dehydration

“Dehydration, if sufficiently severe, can impair performance in most events, particularly in warm and high-altitude environments. **Athletes should be well hydrated before exercise** and drink sufficient fluid during exercise to limit dehydration to less than about 2% of body mass. Chilled fluids may benefit performance in hot conditions”

(IOC Consensus Statement on Sports Nutrition, Lausanne, 2010)

7




Dangers of Dehydration



HOME PAGE | TODAY'S PAPER | VIDEO | MOST POPULAR | U.S. Edition ▾

The New York Times **Sports**

WORLD | U.S. | N.Y. / REGION | BUSINESS | TECHNOLOGY | SCIENCE | HEALTH | SPORTS | OPINION

BASEBALL | N.F.L. | COLLEGE FOOTBALL | N.B.A. | COLLEGE BASKETBALL | HOCKEY | SOCCER

PRO FOOTBALL

PRO FOOTBALL; Heat Kills a Pro Football Player; N.F.L. Orders a Training Review

By THOMAS O'GEORGE
Published: August 2, 2001

Korey Stringer, an offensive tackle for the Minnesota Vikings, died early yesterday, a day after collapsing from heatstroke at the Vikings' training camp in Mankato, Minn. His death sparked discussion and review of training camp procedures in extreme heat throughout the National Football League.

Stringer, 27, a 6-foot-4-inch, 335-pound league all-star who was entering his seventh professional season, complained of exhaustion after being unable to complete practice on Monday morning in the Vikings' first practice of training camp and was carted off the field. He did not practice Monday afternoon, and he vowed to return on Tuesday for the morning session, which he did. It lasted nearly two and a half hours, and players were in full pads.

Temperatures hovered above 90 degrees and the humidity was stifling. The heat index, combining the effects of temperature and humidity, hit 110. Stringer vomited three times in practice and walked to an air-conditioned shelter. There he complained of dizziness and

FACEBOOK

TWITTER



GOOGLE+

E-MAIL

SHARE

PRINT

REPRINTS

How Much to Drink?


THE STUDY APRIL 18, 2011

The Boston Marathon and Drinking Too Much Water

By James Downie


This morning, almost 27,000 entrants ran in the [115th annual Boston Marathon](#). Geoffrey Mutai of Kenya won the men's race in a world-record time of 2:03:01, denying American Ryan Hall, who finished 4th, the chance to become the first American to win the race in almost 30 years. (Mutai's time equates to around an astonishing 4:45 *per mile*.) On the women's side, New Zealand's Kim Smith led for much of the race, but had to fall back towards the back half of the course, and Kenya's Caroline Kilel won in 2:22:36. Yet while the attention was on the elite runners, thousands of entrants were far more ordinary: despite the marathon's qualifying standards, in 2010 [almost 6,000 runners were nonqualifying entrants](#), "who either bought entry numbers from foreign tour operators or were granted invitations by organizers, sponsors, vendors, licensees, consultants, municipal officials, or marketers peddling entries for profit." Of course, even most of these inexperienced entrants know to stay hydrated during the run. But is there a limit to hydration? Can you drink too many fluids?

USER EXPERIENCE DESIGN IMMERSIVE
10 weeks. Full-time. Begin a career in UX Design.





GA GENERAL ASSEMBLY [Learn More](#)

Most Popular Now ▼





My book said Obama "fumbled the


Electrolyte Loss in Athletics

- Sweat loss replaced with plain water can result in a prompt diuresis due to
 - ↓plasma sodium concentration
 - ↓plasma osmolality
 (Nose et al. 1988).
- Where rapid re-hydration is vital (eg. in marathon), CHO-electrolyte solutions have been found to be more appropriate for fluid replacement (Costill et al. 1973; Gonzalez-Alonso et al. 1992)



9

 **Electrolyte Loss in Athletics** 



- Level of electrolyte loss depends on sweat rate, sweat composition and fluid intake during exercise
- Sweat patch is more practical for measurement in a field setting (Shirreffs et al. 2005; Maughan et al. 2004)





10

 **Electrolyte Loss in Athletics** 

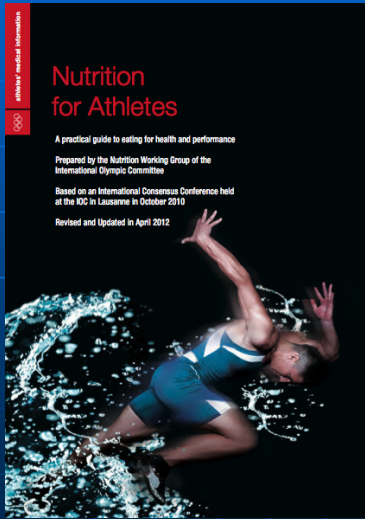
- Sodium (Na^+) is the most important electrolyte lost in sweat (Shirreffs and Maughan 1997)
- Maintenance of electrolyte balance can help to limit the deterioration of athletic performance (McGregor et al. 1999; Ostojic and Mazic 2002; Welsh et al. 2002)

11

Guidelines





Nutrition for Athletes
A practical guide to setting for health and performance
Prepared by the Nutrition Working Group of the International Olympic Committee
Based on an International Consensus Conference held at the IOC in Lausanne in October 2010
Revised and Updated in April 2012

International Olympic Committee “Nutrition for Athletes” (April 2012) based on the International Consensus Conference, Oct 2010


Susan M. Shirreffs & Michael N. Sawka (2011) Fluid and electrolyte needs for training, competition, and recovery, *Journal of Sports Sciences*, 29:sup1, S39-S46.

12






Fluid Intake Before Competition

- Athletes should drink sufficient fluid with meals on the day before training or competition to ensure adequate hydration on the morning of competition
- Athletes should continue drinking water or carbohydrate-containing fluids during the hours leading up to warm-up before training or competition




13






Fluid Intake Before Competition

- It is recommended that athletes have a final large drink **about 60 minutes** before the start of training or race
- Before training or race, athletes should having an extra drink during the **15 minute** period immediately before the start of the event




14

How Much to Drink?

- Drinking should “almost” equal sweating
- **Don't gain weight during exercise**
 - Measure body weight both before and after
- **Practice drinking (!!)** during the 15 minutes before training.





15




What to Drink?



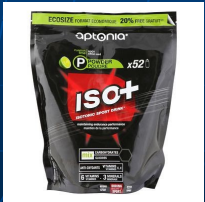


16

What to Drink?

- During training and competition, all drinks should contain some carbohydrate and sodium (salt)
- This helps to maintain **pace and concentration** instead of succumbing to fatigue



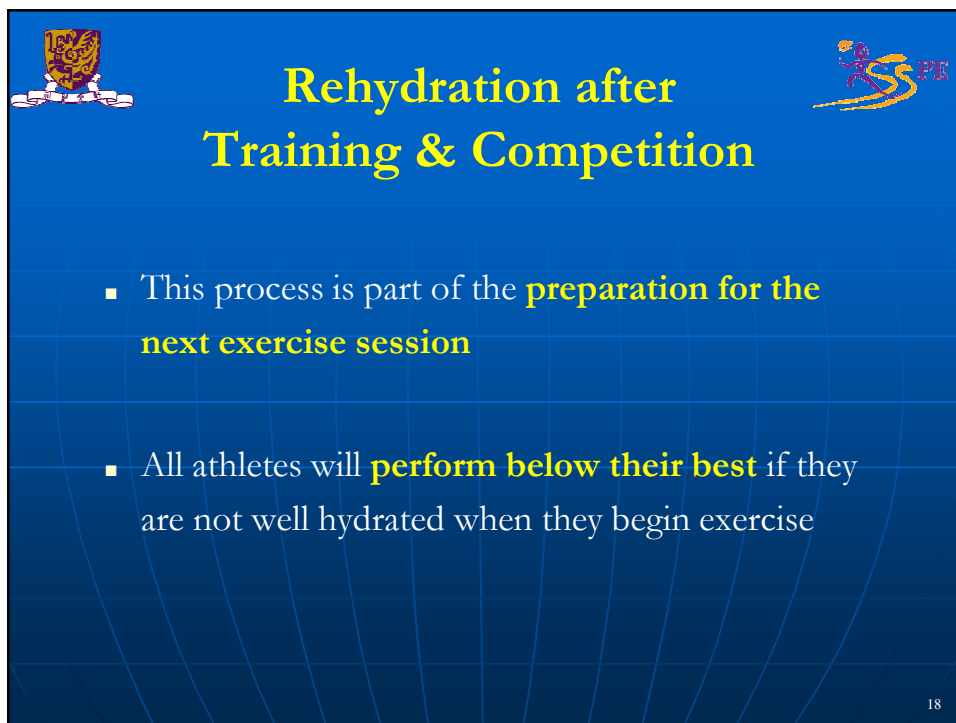
During Training & Competition

******Be Careful of Advertising!!******

vitaminwater
it works

GLACÉAU

DWIGHT HOWARD LOVES VITAMIN WATER



Rehydration after Training & Competition

- This process is part of the **preparation for the next exercise session**
- All athletes will **perform below their best** if they are not well hydrated when they begin exercise

18




Rehydration after Training & Games




- Aim to drink about 1.5 litres of fluid for each kg of weight loss in training or competition
- Drinks should contain sodium (**the main salt lost in sweat**) if no food is eaten at this time
- A little **extra salt may usually be added to meals** when sweat losses are high, but salt tablets should be used with caution



19




Urine Colour




1	Pale Yellow
2	Straw
3	Golden Yellow
4	Golden Orange
5	Pale Amber
6	Amber
7	Rich Golden Amber
8	Copper Brown
9	Orange Brown
10	Mid Brown
11	Ruby Brown

- If you are **passing urine less often** than normal, you may be dehydrated
- If urine colour **becomes darker than what is normal** for you, then you may not be drinking enough. Check your urine colour against the chart

20




How to Monitor Hydration Status




- How did you feel?
- How did you perform?
- What was your weight loss over the session?
 - This should generally not exceed about 1-2% of body mass.
- Did it make you feel uncomfortable?
- Did you take time out to drink?

21




Take Home Messages (1)




- Maintaining hydration is important for performance
- Fluid intake **before, during (where appropriate) and after** exercise is especially important in Hong Kong
- Salt replacement is important when sweat losses are high

45




Take Home Messages (2)




- For athletes in Hong Kong, fluid should be **freely provided** when they exercise in the heat regardless of the flavor of the drinks.
- Athletes should to take a water break after exercising for **every 30-40 minutes**.
- Clothing should be lightweight and limited to one layer of absorbent material to facilitate evaporation of sweat

44



Take Home Messages (3)



- Drinking too much can be harmful or uncomfortable
- **Every athlete is different** because they have different sweat losses
- A **personal hydration plan** would work best
- Temperature of drink is recommended to keep at 10°C-15°C

46





Acknowledgements

CUHK	Others
Department of Sports Science and Physical Education;	Dr. Ajmol Ali, Massey University, NZ;
Research Group for Physical Activity and Sport Nutrition;	Dr. Ric Lovell, University of Western Sydney;
Student helpers.	Prof. Ron Maughan, Loughborough University;
	Dr. Helen O'Connor, University of Sydney;
	Players & Coaches, Hong Kong Football Association;
	Jockeys & Stewards, The Hong Kong Jockey Club.



Thank you!





References

- Ali A, Williams C, Hulse M, et al. Reliability and validity of two tests of soccer skill. *J Sports Sci* 2007; 13: 1461-70
- Aragón-Vargas LF, Moncada-Jiménez J, Hernández-Elizondo J, et al. Evaluation of pre-game hydration status, heat stress, and fluid balance during professional soccer competition in the heat. *Eur J Sp Sci* 2009; 5: 269-76
- Armstrong LE, Casa DJ, Millard-Stafford M, et al. American College of Sports Medicine position stand. Exertional heat illness during training and competition. *Med Sci Sports Exerc* 2007; 3: 556-72
- Armstrong LE, Maughan RJ, Senay LC, et al. Limitations to the use of plasma osmolality as a hydration biomarker. *Am J Clin Nutr* 2013; 2: 503-4



29

References

- Astorino TA, Martin BJ, Schachtsiek L, et al. Minimal effect of acute caffeine ingestion on intense resistance training performance. *J Strength Cond Res* 2011; 6: 1752-8
- Astrand PO, Rodahl K. Textbook of work physiology. (ed). In: McGraw-Hill. New York. 2002, 312-495
- Broad EM, Burke LM, Cox GR, et al. Body weight changes and voluntary fluid intakes during training and competition sessions in team sports. *Int J Sport Nutr* 1996; 3: 307-20
- Davey PR, Thorpe RD, Williams C. Fatigue decreases skilled tennis performance. *J Sports Sci* 2002; 4: 311-8
- Gant N, Leiper JB, Williams C. Gastric emptying of fluids during variable-intensity running in the heat. *Int J Sport Nutr Exerc Metab* 2007; 3: 270-83



30

References

- Kirkendall DT. Issues in training the female player. Br J Sports Med 2007; i64-7
- McGregor SJ, Nicholas CW, Lakomy HK, et al. The influence of intermittent high-intensity shuttle running and fluid ingestion on the performance of a soccer skill. J Sports Sci 1999; 11: 895-903
- McMorris T, Rayment T. Short-duration, high-intensity exercise and performance of a sports-specific skill: a preliminary study. Percept Mot Skills 2007; 2: 523-30
- Mohr M, Krstrup P, Bangsbo J. Match performance of high-standard soccer players with special reference to development of fatigue. J Sports Sci 2003; 7: 519-28



31

References

- Mohr M, Krstrup P, Nybo L, et al. Muscle temperature and sprint performance during soccer matches--beneficial effect of re-warm-up at half-time. Scand J Med Sci Sports 2004; 3: 156-62
- Rampinini E, Bishop D, Marcora SM, et al. Validity of simple field tests as indicators of match-related physical performance in top-level professional soccer players. Int J Sports Med 2007; 3: 228-35
- Royal KA, Farrow D, Mujika I, et al. The effects of fatigue on decision making and shooting skill performance in water polo players. J Sports Sci 2006; 8: 807-15
- Sawka MN, Burke LM, Eichner ER, et al. American College of Sports Medicine position stand. Exercise and fluid replacement. Med Sci Sports Exerc 2007; 2: 377-90



32

References

- Small K, McNaughton L, Greig M, et al. The effects of multidirectional soccer-specific fatigue on markers of hamstring injury risk. *J Sci Med Sport* 2010; 1: 120-5
- Tomporowski PD. Effects of acute bouts of exercise on cognition. *Acta psychologica* 2003; 3: 297-324
- Eichner ER. The role of sodium in 'heat cramping'. *Sports Med* 2007; 4-5: 368-70
- Maughan RJ, Shirreffs SM. Development of hydration strategies to optimize performance for athletes in high-intensity sports and in sports with repeated intense efforts. *Scand J Med Sci Sports* 2010; 59-69



33

References

- Maughan RJ, Watson P, Evans GH, et al. Water balance and salt losses in competitive football. *Int J Sport Nutr Exerc Metab* 2007; 6: 583-94
- Schwellnus MP. Skeletal muscle cramps during exercise. *Physician Sportsmed* 1999; 12: 109-15
- Shirreffs SM, Maughan RJ. Whole body sweat collection in humans: an improved method with preliminary data on electrolyte content. *J Appl Physiol* (1985) 1997; 1: 336-41
- Stofan JR, Zachwieja JJ, Horswill CA, et al. Sweat and sodium losses in NCAA football players: a precursor to heat cramps? *Int J Sport Nutr Exerc Metab* 2005; 6: 641-52

34



References

- Stone MB, Edwards JE, Stemmans CL, et al. Certified Athletic Trainers' Perceptions of Exercise-Associated Muscle Cramps. *J Sp Rehab* 2003 4: 333-42
- Stofan J, Nicksich D, Horswill CA, et al. Sweat and sodium losses in cramp-prone professional football players. *Med Sci Sports Exerc* 2001; S256
- Wong P, Hong Y. Soccer injury in the lower extremities. *Br J Sports Med* 2005; 8: 473-82

35