



Fractured fairy tales: hyponatraemia and the American College of Sports Medicine fluid recommendations

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Br. J. Sports Med. 2007;41;109

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Lobbyists for the sports drink industry: an example of the rise of "contrarianism" in modern scientific debate

We welcome any discussion of our article which traces the emergence, especially in the United States of America, of exercise-associated hyponatraemia (EAH) as a novel disease, even though its aetiology had already been established by us. We appreciate that some may wish to distance themselves from involvement in this affair. But this is not a sound basis for an objective scientific debate. We choose to respond first to Dr Murray's letter.

In his position as Director of the Gatorade Sports Science Institute (GSSI), Dr Murray is a full-time employee of PepsiCo, which is a publicly listed company in the USA. The principal accountability of a publicly listed company like PepsiCo and its subsidiary, Gatorade, is to increase the wealth of its shareholders. This follows from the landmark case of Ford versus the Dodge Brothers heard in the Michigan Supreme Court in 1916.¹

In his otherwise uncritical review of the Gatorade phenomenon, Rovell² touches on this legal accountability: "This lack of change (in the Gatorade formulation) has caused some people to be sceptical as to the true function of the Gatorade Sports Science Institute (GSSI) which has funded more than 120 studies in the past 17 years. Is GSSI there to develop the latest and greatest sports drink formula for the masses, or is it there to use science to best defend the status quo? Is it really possible that nothing substantial has come along in sports drink science in the past four decades that would make Gatorade a better drink? There are, after all, very few product categories that fail to evolve over four decades" (pp 194-195). ".....But it is undeniable that GSSI was also created to be part of Gatorade's powerful marketing arm" (p 195). ".....Having the Gatorade Sports Science Institute does mean walking a fine line between educating the public on hydration and perhaps using GSSI to sell product. Gatorade brand managers will tell you that educating the public is the number-one goal, but it's impossible to ignore the fact

that GSSI is a part of Gatorade, which is part of Pepsi, which is a public company that is expected to make money" (p 206).

Thus although the publicly stated objectives of the GSSI may indeed be to "maintain the longstanding and extensive commitment to sports science research and education that we proudly support" as claimed by Dr Murray, the bottom line reality is that, if the GSSI does not increase the wealth of the shareholders of PepsiCo, it acts in contravention of the laws of the USA. For it is both "immoral" and illegal for a publicly listed company in the USA (and presumably elsewhere) to act charitably unless its philanthropic actions increase shareholders' wealth.¹

The content of the advertising material produced by the GSSI suggests that its identified commercial function is to maximise the sales of Gatorade by promoting any science which proves (1) that ingesting "more" Gatorade is better than drinking less, and (2) that Gatorade is superior especially to water (but also to all other sports drinks) for ingestion by athletes before, during and after exercise.

This legal requirement to pursue profit poses the greatest ethical challenge to those with scientific training employed by for-profit companies. For their defining responsibility becomes the defence of the company's profitability and not to seek the truth. In this position, each of them must replace the skepticism he or she has imbibed as a scientist with an attitude of "contrarianism", presenting only that evidence which supports the company's commercial objectives.³ To do this, Hansen concludes that the contrarian must act as a lobbyist ignoring the defining characteristic of the scientist as described by Nobel Laureate Richard Feynman: "The only way to have real success in science is to describe the evidence very carefully without regard to the way you feel it should be. If you have a theory, you must try to explain what's good about it and what's bad about it equally. In science you learn a sort of standard integrity and honesty".

The way in which lobbyists deal with such moral ambiguity is brilliantly caricatured by the actions of the charming Nick Naylor in the recent Hollywood production *Thank you for smoking*, based on the novel by Christopher Buckley.⁴ In his position as chief lobbyist for the fictitious Academy of Tobacco Studies, Naylor represents the interests of the tobacco industry in the USA. Naylor is successful because he understands that his duty is to "win" arguments, not to present or advance the truth.

The point is that lobbyists like Naylor cannot act as usual scientists, according to the Feynman dictum. Rather, they must present, in the guise of an established scientific truth, a contrary position which is permanent and predetermined, and which has but one function—the advancement of the financial interests of the companies to whom they are accountable. To disguise their condition of compromise, lobbyists will usually assert that their exclusive interests are especially magnanimous, including, for example, the "welfare of athletes" and the "advancement of science", both of which they "proudly support". In fact, lobbyists should rather stick to their chosen jobs and leave benevolent actions to those who choose to be employed (at substantially more meagre salaries) specifically to serve humanity.

As the covert goal of the contrarian scientist-turned-lobbyist is neither humanitarian nor

the advancement of scientific truth, it is pointless for scientists to engage with them in scientific debate. Indeed, lobbyists retain their influence over the general public and the conduct of science, only for as long as their mission and mode of operation are not universally understood.⁴

As Dr Murray's response to our article does not fall within the scope of conventional scientific discourse, conducted respectfully and with dignity, according to venerated scientific traditions which aim to advance truth, we will restrict our response solely to the exposure of his most obvious distortions.

To begin with, we did not "manufacture" the three arguments which he has now created on our behalf. We presented a singular theory: that the evidence that EAH is owing to overdrinking was already established in 1986, and proved by us in 1991, but that this proof was not accepted for 20 years because, in our view, it "conflicted with the prevalent message that was being driven by the sports drink industry".

Were this purely a scientific debate, Dr Murray's duty would be to present the contrary evidence showing that the industry for which he acts as the principal lobbyist has, since 1986, done everything in its power to ensure that athletes do not overdrink during exercise. But his response fails to contest our core disputation. His silence proves that our contention is correct. Rather, using the skilful lobbyist's classic tactic, he creates three diversionary arguments which he claims we, not he, "manufactured". Thus, he changes the focus of the debate from one which his silence acknowledges he cannot win to another which he might "win" if he can distort the argument sufficiently to confuse those readers who are unaware of his tactics.

He is reluctant to enter into that debate as he knows that, as recently as January/February 2002 (ie, 11 years after EAH was proved to be due to overdrinking), the GSSI placed an advertisement in the *New York Runner* magazine, and presumably elsewhere, with the banner statement: "Research shows your body needs at least 40 oz. of fluid every hour (ie, 1200 ml per hour) or your performance could suffer". This conclusion is allegedly based on the results of "thousands of tests" conducted by the "scientists of the Gatorade Sports Science Institute" who have "studied it for over 15 years in research facilities all across the country".

But the advertisement fails to warn that this advice conflicts with the fluid replacement guidelines of the American College of Sports Medicine (ACSM), which states that athletes should drink "as much as tolerable" and not >1.2 l/h. Nor does that advertisement warn that such high rates of fluid intake are safe only for those athletes who have very high sweat rates because they are either very large or can run very fast in hot conditions. Rather, the athlete depicted in the advertisement appears to be a lean, light and small female runner, exactly the athlete at the greatest risk for developing EAH³ if she were to follow the command of the GSSI.

This advertisement certainly does not support Dr Murray's claim that the GSSI accepts the "widespread agreement that overdrinking is the root cause of most cases of exercise-associated hyponatraemia". Rather, in another classic sleight of the contrarian's keyboard, he makes Noakes the villain by accusing him of misrepresenting the ACSM guidelines. Perhaps if Dr Murray was more inclined to personal

introspection, he and indeed Dr Roberts would more easily identify the GSSI as the true villain in this distortion.

Perhaps it is not surprising that a few months after the publication of that advertisement encouraging all athletes to drink "at least" 1200 ml/h "or your performance could suffer", the 2002 Boston Marathon, a race for which Gatorade was the official sports drink, "suffered" the world's leading distinction of a 13% incidence of EAH at a marathon,⁶ including the death of Dr Cynthia Lucero apparently because she had "ingested too much Gatorade" according to a report of the official autopsy findings.⁷ One would presume that if the GSSI had been committed to avoiding EAH by warning runners in the USA not to overdrink, the incidence of EAH would have been nil in the Boston and other marathons, as is the case in marathons held in our respective countries, South Africa and New Zealand, and in which, for more than a decade, athletes have been specifically warned of the potentially fatal dangers of drinking "at least 40 oz of fluid every hour".⁸⁻¹⁰

Indeed, given the resources available to the GSSI, it is remarkable how ineffective their educational programme has been, which has "annually produced and distributed educational materials that have gone directly to hundreds of thousands of marathoners, Ironman-distance triathletes, and ultradistance competitors, the athletes most at risk of hyponatraemia". Unless of course the focus of that material was not really to discourage athletes from overdrinking, Dr Murray cannot distort one decisive statistic: that only in the USA did the incidence of EAH reach epidemic proportions.⁹ Thus, any preventive interventions that the GSSI now wish to claim were utterly useless.

Dr Murray's next distortion is to state that one of us (TDN) cannot now criticise the 1996 ACSM drinking guidelines as he acted as a consultant to those guidelines. The reality, as described above, is that it was the GSSI that first distorted the ACSM message by encouraging athletes to drink "at least" 1200 ml/h (or according to the information provided by the GSSI to competitors at the 1999 Hawaiian Ironman Triathlon at rates of up to 2000 ml/h for "heavy sweaters") without mentioning the provisos included in the ACSM guidelines and which TDN had approved. Perhaps TDN's sole error was that he incorrectly blamed the ACSM for a distortion perpetuated by the GSSI.

Elsewhere,¹¹⁻¹⁴ TDN has detailed the full extent of his current criticisms of the failings of the ACSM guidelines and of which he was unaware when he first reviewed those guidelines more than 10 years ago. In the context of this response, the major failing of the ACSM was that it did not discipline the GSSI when it began to distort their guidelines, including the erroneous claim³ that the ingestion of sports drinks can prevent the development of EAH. Nor did the ACSM do enough to aggressively warn the athletes of the dangers of overdrinking during exercise.

In his next distortion, Dr Murray accuses us of "unsubstantiated insinuations of impropriety". We apparently implied that "members of the ACSM writing committee of the 1996 position stand were either duped or willingly forsook their professional integrity to please a corporate interest. This is a serious inference (etc)". We have read and re-read the article (as, obviously, did the legal advisors to the *British Journal of Sports Medicine* before its

publication), and we are completely unable to find anything in the article that remotely supports Dr Murray's distortion. We merely pointed out that the ACSM had (until recently) only two platinum sponsors, Gatorade and the GSSI, and that the GSSI was very active in promoting the concept that athletes should drink "as much as tolerable" (as evidenced by their 2002 *New York Runner* advertisement and their advice to competitors in the 1999 Hawaiian Ironman Triathlon and presumably to competitors in other races as well). We also pointed out that a novel theory of thermoregulation during exercise has emerged in the period since Dr Cade developed Gatorade in 1965. Dr Murray's claim that we implied that all these resulted from the influence of the sports drink industry solely on a small cadre of scientists who advise the ACSM is a figment of his own highly creative thinking.

Of course, Dr Murray is one of the few people who knows the full extent (if any) of the financial interaction between Gatorade and the GSSI and those sports physicians and exercise scientists who serve those companies in a variety of roles and some of whom have occupied important leadership roles in the ACSM. Thus, it is only he, not we, who could ever provide that information. Given (1) the current concerns about the potential control that the pharmaceutical industry exerts over many influential scientists who compose guidelines influencing drug-prescribing patterns which directly benefit the companies exerting those covert controls¹⁵⁻¹⁷ and (2) Dr Murray's assurance that the sports drink industry exerts no such covert influence, we believe that, in the interests of transparency, it would be desirable for the GSSI to indicate the extent to which those individuals, listed on the GSSI website as members of one or more of the seven GSSI advisory boards, as well as any others with whom the Institute works, benefit in any way from this relationship. As this group potentially forms one of the most influential groupings in the science of exercise, this information would be especially helpful in confirming publicly that its objectivity is beyond reproach. We are sure that Dr Murray, the GSSI and indeed the ACSM would welcome actions to effect this "burden of proof", as DrMurray calls it or, as we prefer, the "burden of transparency".

Finally, we are sincerely flattered that such an influential lobbyist should consider us so threatening to the interests of his company that, before the scientific community and all those with access to the internet, we must be dismissed as "painfully uninformed" scientists, who "stumble over basic thermoregulatory physiology", who ignore "over 50 years of scientific endeavor", who "enthusiastically manufacture" a "self-professed claim of 'case proven'" in an article which suffers from "an absence of novel finding (and) does not qualify as science", which is also "rife with factual errors and unfounded inferences", and which includes "blatant misrepresentation" and "unsubstantiated insinuations of impropriety" while presenting claims that are "ludicrous and without basis". We especially appreciate his claims that it was our erroneous idea that dehydration makes "heat illness inevitable" and that the GSSI, not ourselves,⁵ was the creative force that developed the global consensus of the factors causing EAH. In the process, he skillfully projects us as two psychotic imposters who act without concern for either science or the welfare of athletes.

Those who know us personally or who have studied our work^{8-14 18-23} will find all these claims absurd.

We are left to conclude that even Nick Naylor at his very best⁴ could not have crafted a more extraordinary work of fiction.

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Competing interests: TDN's research unit receives an annual research grant from Bromor Pty Ltd, the manufacturers of the South African sports drink Energade. TDN receives no personal financial benefit, either at present or promised in the future, as a result of this relationship. DS has no conflicts of interest.

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Fractured fairy tales: hyponatraemia and the American College of Sports Medicine fluid recommendations

Noakes and Speedy,¹ in the article "Case proven: exercise associated hyponatremia is due to overdrinking," deliver a shot at the 1996 American College of Sports Medicine (ACSM) exercise and fluid replacement position stand² that is off the mark. Much as the popular 1960s' television cartoon series Rocky and Bullwinkle Show presented Aesop's fables in "Fractured fairy tales" a key element of the story is missing. The ACSM position stand recommends that athletes should "consume the maximal amount of fluids during exercise that can be tolerated without gastrointestinal discomfort "up to a rate equal to that lost from sweating", not "drink as much as you can," as stated in the text of "Case proven." The recommendation is briefly summarised in the abstract of the position stand, which creates a possibility for misunderstanding or misquoting if one reads only the abstract and not the position stand itself. Reading the entire document is required to avoid a "fractured" message. Attributing "drink as much as you can" to the 1996 ACSM exercise and fluid replacement position stand is a recurring theme in the works of a few authors, but the problem is simply misapplication of the ACSM advice. I have copied the pertinent section of the ACSM position stand to illustrate the recommendations:

"As such, individuals participating in prolonged intense exercise must rely on strategies such as monitoring body weight loss and ingesting volumes of fluid during exercise at a rate equal to that lost from sweating, i.e., body weight reduction, to ensure complete fluid replacement. This can be accomplished by ingesting beverages that enhance drinking at a rate of one pint of fluid per pound of body weight reduction. While gastrointestinal discomfort has been reported by individuals who have attempted to drink at rates equal to their sweat rates, especially in excess of 1 l/h, this response appears to be individual and there is no clear association between the volume of ingested fluid and symptoms of gastrointestinal distress. Further, failure to maintain

hydration during exercise by drinking appropriate amounts of fluid may contribute to gastrointestinal symptoms. Therefore, individuals should be encouraged to consume the maximal amount of fluids during exercise that can be tolerated without gastrointestinal discomfort to a rate equal to that lost from sweating."

Some confusion may arise from reading only the abstract, which states, "During exercise, athletes should start drinking early and at regular intervals in an attempt to consume fluids at a rate sufficient to replace all the water lost through sweating (ie, body weight loss), or consume the maximal amount that can be tolerated." In light of the main text, this statement was intended to mean "replace up to sweat losses". The abstract summary statement apparently opened the door to misinterpretation. The point is clearly stated and correct in the body of the document and leads to the moral of the tale. First, read the entire document, and second, ACSM has cautioned its position stand authors to make absolutely sure their abstracts represent clearly and accurately the main conclusions, because summaries by their nature are incomplete and can lead to confusion or worse. As Noakes was a reviewer of the 1996 ACSM fluid position stand, he should be familiar with the entire position stand.

Although most involved in the care and study of athletes agree that ingesting too much hypotonic fluid, either water or a sports drink, predisposes certain athletes to hypervolaemic hypernatraemic encephalopathy and pulmonary oedema, the exercise-associated hyponatraemia case is not closed. As Dancaster³ demonstrates in his 1971 publication, hypovolaemic hyponatraemia did, and from my clinical experience still does, occur in long duration events, probably as a combined result of sweat sodium and water losses. Eight hyponatraemic cases with 4-7% decreases in body weight in one race, as Dancaster outlines from a relatively cool Comrades Marathon, would be a rarity today, probably because we have changed the culture of fluid replacement since the 1960s and early 1970s when replacement fluids on the sidelines and at races were non-existent. Now fluids are freely available to athletes and there are less cases of severe dehydration than in the past. Fluid availability is good to a point as Noakes and Speedy¹ outline in their paper, but too much of a good thing can be disastrous for a select few.

Although the number of hyponatraemic cases has increased since 1971, mostly from the hypervolaemic class, replacing only your sweat losses remains the best advice today. When giving ranges, whether it is 600-1200 ml/h in the ACSM position stand or 400-800 ml/h as suggested by Noakes, the individual variability in sweat rates leaves some underhydrated and others overhydrated. A prime example is the case presented by Dugas and Noakes⁴ of a woman who repeatedly developed hyponatraemia during prolonged activities and had a sweat rate of 270 ml/h. She was destined to overhydrate with any of the published volume recommendations because she had a sweat rate that fell far below the usual sweat rate ranges during exercise. Replacing sweat losses is her safest

route to successful participation, because her kidneys do not respond with appropriate diuresis during activity. The wide variation in fluid requirements across the entire athlete population makes it nearly impossible to give a precise recommendation that includes specific fluid volumes. The best advice still remains to "replace the sweat losses" as outlined in the 1996 ACSM position stand. We are all interested in athlete safety and a fractured misunderstood or mis-stated message does not advance that goal.

ACSM's exercise and fluid replacement position stand is currently in revision and should be published in the near future with updates that reflect changes in the subject since 1996.

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Competing interests: I have no financial or advisory ties to any water or sports drink companies. I did receive an honorarium from the Gatorade company for appearing on an educational film clip regarding exertional heat stroke in 2003.

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Time for the American College of Sports Medicine to acknowledge that humans, like all other earthly creatures, do not need to be told how much to drink during exercise

In the light of our response to Dr Murray and our suggestion that there should be greater transparency about the nature (if any) of the financial interactions among Gatorade, the Gatorade Sports Science Institute (GSSI) and leading exercise scientists and sports physicians, we find it interesting that Dr Roberts, a former President of the American College of Sports Medicine (ACSM), should feel it necessary to stress that he draws no personal financial benefit from the sports drink industry (other than a single moment of weakness). Dr Roberts' credentials are indeed impeccable; he is an honourable and independent sports physician who has made substantive contributions to the understanding of, especially, exercise-associated collapse.¹ But his reference to the fractured fairy tale is misguided.

Like Dr Murray, Dr Roberts accuses us of misrepresenting the ACSM guidelines by selectively quoting from those guidelines. The point, as made in our response to Dr Murray, is that when the GSSI began to advertise the ACSM guidelines, it conveniently forgot to include some of the qualifications included in those guidelines and that might have reduced the