SESSION 4

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Do minor changes in hydration status influence mood and cognition?

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Although at some point severe dehydration inevitably disrupts bodily functioning there have been many popular suggestions that it is common for even mild dehydration to disrupt the functioning of the brain, with adverse consequences for mood and mental performance. Therefore the evidence that minor levels of dehydration are disruptive was considered – a topic that has been to date little studied. Children are a potentially vulnerable group that has produced the most consistent findings. Children in particular are said to be at risk of dehydration as they are often dependent upon others for the provision of fluid, they are more active and they have a greater surface-to-mass ratio than adults. Four intervention studies have reported improved performance in children aged 7 to 9 years. In these studies children, eating and drinking as normal, have been tested on occasions when they have and not have consumed a drink. After a drink both memory and attention have been found to be improved.

In young adults, given the efficiency of homeostatic mechanisms, it would seem a priori unlikely that failing to drink for relatively short periods, in a temperate climate, would disrupt bodily functioning. The topic is, however, difficult to study as there is a need to measure rapid and small changes in hydration status. It is argued that the most accurate index of hydration status in real time, when serial measurements are made in close proximity, is to consider changes in weight. Studies are reported where electronic scales were used to establish changes of a few grams in body weight, sensitive enough to measure the minor losses of fluid associated with breathing and perspiration. Young adults sat at 30 degrees Celsius for four hours during which they lost 0.65% of body weight although it was only 0.40% if they had drunk 200 mls of water during the morning. In those who had not drunk water better memory and mood were associated with a smaller fall in body weight and a greater rise in body temperature. In those who had drunk water better memory and mood was associated with a greater fall in body weight and a smaller increase in body temperature; that is a greater intake and excretion of water was associated with better functioning. The data were consistent with the view that even a small degree of dehydration is disruptive and that avoiding a loss of fluid is associated with better functioning.

Key words: children, body weight, minor dehydration, memory, mood.

Impact of mild or moderate dehydration on cognitive performance

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The European Food Safety Authority in its 2011 report claimed that an adequate hydration contributes to the maintenance of normal physical and cognitive functions. This refers not only to groups more vulnerable to dehydration, such as children and the elderly, but also to young adults. Healthy young adults are also at risk of a decrease in their cognitive performance when hydration is not adequate. However, few studies have examined the impact of mild or moderate dehydration on cognitive performance. This is an emerging area of research, that requires a solid base of new evidence in the future from the study of large samples of participants of both genders, with suitable control of factors that are known to lead to biased results.

Changes in the amount of electrolytes in the body that occur when dehydrated can alter brain activity and the functioning of the monoaminergic and cholinergic neurotransmitter systems involved in cognitive processing. It has also been found that dehydration is associated with changes in blood-brain barrier permeability and decreases in the blood flow in some areas of the brain. A state of dehydration leads to the activation of the hypothalamic-pituitary-adrenocortical axis and to the subsequent production of stress hormones with negative effects on perception, spatial ability and memory.
The principal findings from published studies examining the impact of dehydration on cognitive skills allow to state that being dehydrated by just 2% impairs performance in tasks that require attention, psychomotor and immediate memory skills. A level of dehydration of more than 2% also resulted in marked decreases in alertness and concentration ability and increased fatigue, tiredness and drowsiness in young subjects. In contrast, the performance of long-term and working memory tasks and executive functions is more preserved, especially if the cause of dehydration is moderate physical exercise.

The lack of consistency in the evidence published to date is largely due to the different methodology applied and an attempt should be made to standardize methods for future studies. These differences relate to the method used to cause dehydration and the type of drink used to rehydrate, as well as to the characteristics of the participants (i.e. gender, circadian typology). Regarding the gender, the impact of mild to moderate states of dehydration on cognitive performance is greater on women than on men. However, most studies include either men only in their samples or participants of both genders, without studying them separately and

without controlling the menstrual cycle in women. Another important aspect is the assessment of cognitive performance taking into account the type of task, measures of response, and time of day when recordings were carried out. The use of very simple experimental tasks could not lead to sensible results, while the most complex neuropsychologic tasks have been designed to evaluate patients' deficiencies and not always provide significant results in healthy subjects evaluated for capacity of performance under different conditions. The use of the functional magnetic resonance imaging technique, which allows the evaluation of brain activity during cognitive performance, has shown a higher neuronal activity in healthy participants dehydrated in order to achieve the same performance level in executive functions (such as planning and visuo-spatial processing). This pattern suggests that there is an inefficient use of brain metabolic activity following a mild dehydration state compared to an adequate hydration state.

Key words: cognitive performance, dehydration, attention, memory, functional magnetic resonance imaging.

Headache and hydration: scientific evidence

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Non-experimental evidence has suggested a positive effect of increased water intake on headache, but most of the provided evidence has been based on case reports and few epidemiological studies. Two randomized clinical trials assessing the effect of increasing water intake on headache have been published to date (Spigt et al, 2005 & 2011) and at least one experiment on the effect of fluid restriction on headache incidence has been performed (Shirreffs et al, 2004).

The study carried out by Spigt et al. (2005) on 18 migraine patients examined the effects of regular water intake on migraine. An average reduction of 21 hours of headache time in 2 weeks was observed at the end of the 3 month follow-up period. Authors recognized some potential biases (mainly due to a small sample size) in their pilot study. As a result, five years later authors conducted a second randomized controlled trial in primary care with two groups including a follow-up period of 3 months to study the effects of increased water intake on headache (Spigt et al., 2011). Fifty (50) patients were randomized to the control group and 52 patients to the intervention group. Inclusion criteria included patients who had had at least two episodes of moderately intense headache or at least five mildly intense episodes per month and a total fluid intake of less than 2.5 l/day. The subjects in the intervention group were instructed to increase the daily water intake by 1.5 l. The main outcome measures were Migraine-Specific Quality of Life (MSQOL) and number of days with at least one moderate headache per month. Drinking more water resulted in a statistically significant improvement of 4.5 (confidence interval: 1.3-7.8) points on MSQOL. In addition, 47% patients in the water group reported significant improvement (6 or higher on a 10-point scale) on perceived intervention effect against 25% in the control group. However, drinking more water did not result in relevant changes in the number of days with at least one moderate headache, as observed in the pilot study. On the other hand, Shirreffs et al. (2004) investigated the physiological responses and subjective feelings resulting from 13, 24 and 37 h of fluid restriction (FR) and compared the results with a euhydration (EU) trial of the same duration in fifteen healthy volunteers. The subjects reported feelings of headache during the FR trial and also that their ability to concentrate and their alertness were reduced.

Considering the positive effects observed on the participants, it seems reasonable to recommend headache patients to increase their daily intake of water and fluids for a short period of time to assess whether they experience improvement; particularly in those patients with liquid intakes below recommendations.

Key words: hydration, headache, evidence.