WHAT IS MEANT BY THIRST AND WHY DO WE NOT FEEL THE DRIVE TO DRINK WHEN WE ARE PHYSIOLOGICALLY THIRSTY.

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There is a growing interest in the press and in the scientific literature about what is the most appropriate amount of water to drink in a day in order to feel good and to be healthy. Furthermore, it is often said that you should let thirst be your guide but what does it mean to be thirsty, a sensation that is often talked about but which few people can say they actually feel. There are several ways to discuss these points but perhaps the most appropriate is to start with thirst. There have been a number of reviews in the scientific literature about the physiological regulation of thirst, fluid intake and body fluids (Ramsay, 1989; McKinley & Johnson, 2004; Stricker & Hoffmann, 2007; Noakes, 2010; Thornton, 2010; Millard-Stafford et al., 2012). Many of the authors talk about the body being composed of a certain percentage of water, 70% when a baby going down to around 55% or lower when aged. This water is distributed between two major compartments, that inside the cells (two thirds) and that outside the cells (one third) of the body. It was thus suggested that dehydration, or loss of body fluid, could be from the intracellular compartment and/or from the extracellular compartment (Fitzsimons, 1968). Animals lose water from both compartments continuously through breathing (exhaled water vapour), transpiration and urine production. These losses are replaced from fluid, mainly water, consumed, water in the food eaten, and a small amount from the metabolism of the food eaten. Any loss of water greater than that replaced through drinking and feeding produces dehydration.

Investigation of dehydration in research work using animals as well as from human studies has lead to a number of conclusions. First of all, that movement of water between the two major compartments occurs depending on the concentration gradient between them. This means that when there is a difference in the concentration of the ions inside the cells from that outside, then water will move from the area of lower concentration until both areas are of the same concentration. Secondly, that the ideal solute concentration inside our bodies is around 300 mosmol/l which is equivalent to 9g of sodium in a litre of water (e.g. similar to a solution of physiological saline that can be bought in any pharmacy). As sodium is the principal ion in the extracellular compartment this gives a reasonably accurate picture of what can happen inside the body.

A loss of water in the body or an increased salt intake with eating produces an increase in the concentration of sodium in the extracellular compartment and so water leaves the cells down the concentration gradient. Specialised cells in the brain, called osmoreceptors, detect this decrease in cell water and stimulate the thirst mechanism (i.e. the process of searching for and ingesting water) as well as the release into the blood of antidiuretic hormone (ADH or vasopressin). As its name suggests ADH acts in the kidney to reduce the loss of water in the urine (an antidiuresis). If water is drunk it then enters the blood supply via absorption in the gut and reduces the concentration gradient thus re-establishing the normal concentration in both compartments. This reduces the levels of ADH and allows the cells of the body to function normally and the kidney to produce urine again. If drinking does not occur rapidly, or not enough is consumed, then more and more ADH is released thus reducing more and more the production of urine. This usually can be seen in the smaller volumes of urine voided (i.e. going to the toilet less often) and this urine is often darker in colour than normal (Armstrong et al., 2010).

Loss of water specifically from the extracellular compartment can occur also (extreme examples with haemorrhage or vomiting). This produces a decrease in blood volume and specialised cells in various parts of the cardiovascular system detect this decrease in volume and signal the brain to release ADH, to stimulate the searching for and consumption of water, as well as to increase levels of another hormone called angiotensin. This hormone has several actions: it is vasoactive (i.e. it produces a decrease in the diameter of the blood vessels); it stimulates the release of ADH and the searching for and the consumption of water; and it stimulates the release of yet another hormone aldosterone. The main action of aldosterone is to decrease the amount of sodium excreted in the urine (by reabsorbtion of sodium). All the actions of the volume receptors and of angiotensin are to try and ensure that water and sodium are retained so that the blood volume will not decrease to a level that is dangerous to health. If drinking of water is initiated then the volume will be returned to normal values rapidly and the hormone levels will decrease as well, allowing the cells of the body to function normally and the kidneys to produce urine normally. If drinking does not occur, or not enough is drunk, then, as described above, more and more ADH, angiotensin and aldosterone are released thus reducing more and more the production of urine. Once again this usually can be seen in the smaller volumes of urine voided (i.e. going to the toilet less often) and this urine is often darker in colour than normal.

Thus even though the physiology appears to be the same for animals who drink in response to the physiological signals of thirst and humans who do not, why is it that humans do not appear to respond to the physiological signs of thirst ? This is a complex issue (Millard-Stafford et al., 2012) and may depend on several factors such as "not knowing the benefits of fluid or not remembering to drink; or disliking the taste of water, lack of thirst and lack of availability; and finally the need to void frequently and related workplace disruptions" (McCauley et al., 2012). Recent studies showing high urine osmolality, a sign of dehydration, in school children as they arrive at school suggests that limited access to the toilet could be one of the factors that influence children as to when they drink (Bonnet et al., 2012; Fadda et al., 2012; Stookey et al., 2012). It could be suggested that in humans there appears to be a form of cognitive control on responding to the thirst signals and perhaps this ability to override the signals leads in the long term to an inability to perceive correctly thirst, causing some individuals to stay hypohydrated for long periods throughout life. Cognitive assessment of toilet availability could play a role also in decisions about when and where to drink despite the presence of physiological thirst signals.

It has not been shown scientifically if long term mild dehydration or hypohydration (not drinking sufficient water every day) can lead to any specific health problems but medications that are designed to block the production of angiotensin and/or to inhibit its specific receptor make up over 80% of treatments for hypertension and heart failure. Furthermore, these same medications can be used to treat other modern problems like obesity, diabetes, cancer and even Alzheimer's disease (for references see Thornton 2011). The release of angiotensin into the blood is the physiological response to dehydration of the extracellular compartment (Damkjær et al., 2012) so there could be a link between long term mild dehydration and these modern health problems.

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