Effects of CAFFEINE AND SODIUM CHLORIDE on fluid balance after exercise induced dehydration

Anna-Maria Volanaki and **Charlie Simpson** investigated three drink formulations to see which type best restored fluid balance after exercise. How well did each formulation do? Find out below

After exercise, the composition of a rehydration beverage influences fluid-balance restoration.[1,2] For example, adding sodium to a fixed intake volume of water enhances fluid retention.[2–6] There is also confusion about the effects of certain drink ingredients such as caffeine, which although popular, is frequently assumed to be diuretic.

THE INVESTIGATION

We investigated the potential for three drink formulations to restore fluid balance after exercise-induced dehydration:

1 Flavoured water-placebo (P)
2 Flavoured water with added caffeine (6 mg/kg) (C)
3 Flavoured water with caffeine (6 mg/kg) and added sodium chloride (50 mmol/l) (SC)

Nine euhydrated volunteers participated in three experimental trials (randomised cross-over) and each trial included three phases:

- Phase 1 – Exercise-induced dehydration: subjects completed intermittent cycling in heat
- Phase 2 – Post-exercise rehydration phase (~1 hour): Subjects consumed 150% of individual sweat loss by ingesting the allocated drink
- Phase 3 – Recovery phase (~5 hours). Subjects rested

After exercise, the volunteers urinated and then ingested the allocated drink in three aliquots during a one hour recovery. Hourly urine samples were collected.

RESULTS

The volunteers' average exercise-induced weight loss was ~1.2kg (~2% of euhydrated weight). Urine volume varied widely over time after rehydration between the three trials.

Net fluid balance (whole body) was calculated from the sweat loss, drink volume ingested and urine output[6] (Figure 1). Average net fluid balance was positive in all trials for ~2.5h after rehydration. Between +3h and +5h average net fluid balance was negative in all trials but the fluid deficit at 5h was attenuated when the SC drink was ingested (Figure 1).

CONCLUSION

These results show that ingesting a large volume of plain water does not optimise fluid retention, whereas the addition of a moderate amount of sodium chloride (50 mmol/L or 5.2 grams for the 1.8 L) enhanced fluid retention.

We are aware that this amount of sodium chloride makes a significant contribution to the FSA's position that maximum daily salt intake should not exceed 6 grams in non-athletes.[7] The relevance of this target in highly active populations is less well-established.[7] This amount of sodium chloride is typically double the concentration of sodium chloride in sports drinks and might be approaching the upper limit of what humans will tolerate before palatability and taste concerns result in voluntary fluid intake reductions.

Our results also failed to find any diuretic effect from the ingestion of a large dose of caffeine (i.e. 6 mg/kg body mass). The SC drink attenuated urine production compared to the P and C drinks, which in turn yielded similar urine production providing further evidence that caffeine does not promote diuresis.

Practitioners may wish to encourage individuals to include sodium chloride in their food or drink choices as part of a rehydration strategy. This approach does not necessarily require an increase in daily salt intake since a greater proportion of the daily allowance can be allocated to the post-exercise period. Finally, providing a high fluid intake in the first hour after exercise did not prevent net fluid balance from returning to a negative state after three hours in our controlled experimental setting.

These results emphasise the need for practitioners to consider the current rehydration guidelines for athletes, which are underpinned by laboratory studies, alongside real patterns of food and drink. Ultimately, an informed practitioner can make reasonable adjustments to the composition and timing of food and drink intake that may enhance fluid balance and avoid needless removal of caffeinated beverages that are likely to assist in meeting daily fluid intake requirements.

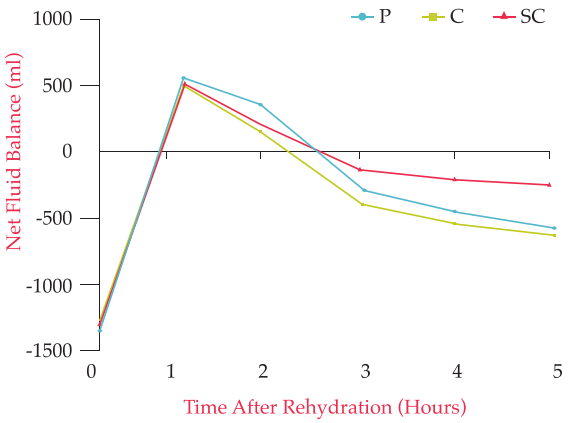

Figure 1. Average net fluid balance (ml) against time (N=9).

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SENr The Sport and Exercise Nutrition Register
BDA The Association of UK Dietitians

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