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Effect of electrolyte consumption on fluid and electrolyte balance during 24 h energy restriction

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Long-term energy restriction (ER) results in a reduction in body mass caused by losses of body fat and muscle stores[1]. Over the initial 48 h of complete or severe ER a large body mass loss is observed as a result of a loss of body water stores, resulting in hypohydration and decreased endurance exercise performance[2]. During complete ER continued urinary excretion of Na^+ and K^+ despite no intake results in net negative balance of these electrolytes[1], which might play a key role in regulating fluid balance. The present study has investigated whether consuming Na^+ and K^+ during 24 h ER could maintain fluid and electrolyte balance.

Ten healthy volunteers (five male, five female; age 23 (SD 3) years, body mass 66.3 (SD 9.01) kg, height 1.70 (SD 0.09) m) completed a familiarisation trial followed by two experimental trials separated by 7 d, each consisting of 24 h ER (1.65 (SD 0.24) MJ/day). Subjects attended the laboratory in the morning (0 h) and 6, 12 and 24 h later. The 0 h visit was after an overnight fast, except for 500 ml tap water consumed 2 h before arrival. Approximately 0.55 MJ, 300 ml tap water and capsules containing either 3.05 g NaCl and 2.29 g KCl (E) or 3 g glucose (P) were consumed at 0, 6, and 12 h. Additional water was consumed whilst outside the laboratory (700 ml from 0 h to 5 h and 6 h to 11 h, 500 ml between 12 h and going to bed). A total of 2800 ml was consumed during each trial. Blood samples were taken at 0, 12 and 24 h and all urine produced was collected.

By 24 h subjects' body mass was reduced by 0.71 (SD 0.43) kg ($P<0.001$) and 1.54 (SD 0.45) kg ($P<0.001$) for trials E and P respectively. By 24 h estimated change in plasma volume was not different (0 (SD 4) %) during trial E, but was decreased (5 (SD 3) %) during trial P compared with baseline ($P<0.01$). The 24 h urine volume was greater during trial P (3230 (SD 216) ml) than trial E (2441 (SD 280) ml; $P<0.001$). At 24 h subjects' Na^+ and K^+ balance (Table) was less negative on trial E compared with trial P ($P<0.01$).

	Na^+ balance (mmol)				K^+ balance (mmol)			
	Trial E		Trial P		Trial E		Trial P	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
0 h	0[a]	0	0[a]	0	0[a]	0	0[a]	0
12 h	−19[a]*	40	−94[b]	42	−38[b]*	18	−60[b]	19
24 h	−65[b]*	52	−146[b]	50	−55[b]*	26	−94[b]	25

[a,b]Values in columns with unlike superscript letters were significantly different ($P<0.05$). Values were significantly different from those for trial P: *$P<0.05$.

If the assumption is put in place that all Na^+ lost is from the extracellular space and all K^+ lost from the intracellular space and assuming an extracellular Na^+ concentration of 140 mmol/l and an intracellular K^+ concentration of 150 mmol/l, the difference in Na^+ and K^+ balance between the two trials would mean 577 (SD 412) ml and 258 (SD 224) ml more water would have been lost from the extra- and intracellular fluid respectively during trial P compared with trial E. This total of 835 (SD 529) ml is similar to the mean difference in body mass (825 (SD 351) g) and urine output (789 (SD 310) ml) between the trials. These results suggest that consuming 3.6 g Na^+ and 3.6 g K^+ during 24 h ER reduces the amount of body mass lost via a decrease in urine output, resulting in a less-negative fluid balance, possibly as a result of a less-negative Na^+ and K^+ balance.

1. Runchie J (1971) *Br Med J* **2**, 22–25.
2. Oliver SJ, Laing SJ, Wilson S, Bilson JLJ & Walsh N (2007) *Med Sci Sports Exerc* **39**, 316–312.

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