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Hydration, mood, and cognition in primary aged school children in the United Kingdom

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Children are at increased risk of dehydration[1–3], which can adversely impact cognition and mood[4–6]. Many children begin their school day dehydrated and fail to replenish fluids adequately throughout the day[7–11], however, these findings have not been confirmed using objective measures of hydration[12,13]. This study aimed to confirm hydration status of primary school-aged children across the school day using objective hydration assessments and to examine if changes in hydration are associated with cognition and mood.

Thirty children (mean age 9.4 ± 0.5 years old, stature 1.4 ± 0.5m, body mass 36.5 ± 4.2kg, and body mass index 18.9 ± 1.7 kg/m^2) were recruited from a local primary school. Food and fluid intake were tracked via nutritional analysis of photographs. Urine osmolality (Uosm), serum osmolality (Sosm), urine specific gravity (USG) and self-reported urine colour (Ucol) were assessed at first void (Uosm only) or the start (9:00) and end (16:00) of the school day. Children's self-reported mood were obtained via Visual Analogue Scales(100mm) (9:00, 10:30, 13:30, 16:00). Children completed cognitive assessments using the Computerised Mental Performance Assessment System (15:3016:00).

Mean total water intake was 759.9 ± 240.7 mL. Children consumed more fluid at mealtimes than from water bottle (Mean Difference (MD) 154.3mL, $t(29) = -5.763$, $p<0.001$). From the start to the end of the day, significant increases in Sosm (MD 3.3mOsm/kg, $t(21) = 4.011$, $p = 0.002$), USG (MD 0.0066, $t(29) = 8.514$, $p = 0.005$) and Ucol (MD 1.2, $t(26) = 15.558$, $p = <0.001$), indicated reduced hydration. The prevalence of dehydration (Sosm >290mOsm/kg USG >1.030) increased from the start (17%) to the end of school (40%). A series of ANOVAs from the start to the end of the day showed feelings of boredom, hunger, tiredness, and thirst increased, and focus, and happiness decreased (p's <0.05). Hydration measures were significantly associated with long term memory (LTM) (changes in Sosm, $r = 0.437$, $p = 0.042$) and working memory (WM) (changes in Sosm $r = 0.462$, $p = 0.031$, and USG, $r = 0.403$, $p = 0.033$).

Children were less hydrated at the end of the school day suggesting inadequate fluid replacement during the school hours. Changes in hydration status across the school day were associated with subjective mood states. Furthermore, a decrease in hydration resulted in decreased performance in the memory tasks which could potentially hold implications on school performance. Children in this study had access to water throughout the day, however, most fluids were consumed at breakfast and lunch, suggesting interventions promoting sustained drinking throughout the day are required. For example, measures could be taken to educate parents and school staff on the importance of adequate hydration, and the need to remind children to drink throughout the day. For this to be effective, action needs to be taken across lesson time, meals, and break times.

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