Prevalence of Dehydration among School-Aged Children in Eastern Province, Zambia with a Comparison of Field Hydration Measures

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INTRODUCTION

Sub-Saharan Africa has the lowest rates of safe water access of any region in the world with less than half of schools, on average, in Southern Africa having access to adequate water facilities[1]. Dehydration has been linked to poor physical and cognitive outcomes in children[2,3]. We partnered with Schools Promoting Learning through Sanitation and Hygiene (SPLASH) to measure hydration status of pupils in Eastern Province, Zambia. There is no agreed upon gold standard to measure hydration status. We used two field measures of hydration, urine specific gravity (USG) and urine color. USG is a more objective measure than urine color, but is more expensive and requires technical training.

Staff member greeting children at a participating school

OBJECTIVES

1. Assess prevalence of dehydration among school-aged children in Eastern Province, Zambia
2. Compare urine specific gravity and urine color as field measures of dehydration

METHODS

A total of 293 participants were recruited from grades 3-6 at 4 schools that did not have any water access point within 0.5 km of school grounds. At the start of school, pupils were randomly selected from a class roster, and assenting pupils were given a sterile container in which to provide a urine sample. Water and soap was made available for hand-washing. Trained enumerators used an 8-point scale to assign a color score to the urine. Handheld, portable refractometers were used to measure urine specific gravity. Higher USG is indicative of worsened dehydration.

Following the morning urine collection, pupils were randomly allocated to either the water group or the control group. Pupils in the water group received a bottle of water that they could refill throughout the day. Pupils in the control group were not provided with supplemental water, but were not discouraged from accessing any water normally available to them during the day. At the conclusion of school, pupils in the control group were provided with a bottle of water.

Pupils provided a second urine sample in the afternoon following the same protocol used in the morning.

RESULTS

Table 1. Participant dehydration (USG>1.010) in morning and afternoon by study arm

	Dehydrated morning, n (%)	Dehydrated afternoon, n (%)
Water group	130 (87.8%)	35 (2.3%)
Control group	128 (89.5%)	125 (91.9%)

Table 2. Mean urine specific gravity (USG), by study group

	Morning USG	Afternoon USG	Change	p-value
Water group	1.018	1.006	-0.012	<.0001
Control group	1.018	1.022	0.004	<.0001

We found that nearly 90% of the pupils in our study population were in a state of mild to severe dehydration during morning urine collection. In the control group, prevalence of dehydration increased slightly to 91.9% and mean USG increased by 0.004 points. Among pupils who received supplemental water, we observed a reduction in number of pupils who were dehydrated from 87.8% to 2.3%, as well as a decrease in mean USG, from 1.018 to 1.006.

Table 3. Correlation coefficients comparing urine specific gravity and urine color

	Urine color, am	Urine color, pm	p-value
Urine specific gravity, am	0.79376	-	<0.01
Urine specific gravity, pm	-	0.902056	<0.01

We found strong correlation between urine color and urine specific gravity.

CONCLUSIONS

With as many as 90% of children in arid Southern Africa experiencing dehydration during the school day, provision of safe water in schools must be a global priority for governments and NGOs. Providing water to school children can result in significant decreases in dehydration prevalence and severity. We also found that urine color provides a simple, inexpensive measure of hydration status with results comparable to USG and can be used as a simple, quick measure of hydration status.

Children preparing to begin school

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