A Study of weight change in cyclists competing in the 2006 Simpson Desert Cycle Challenge

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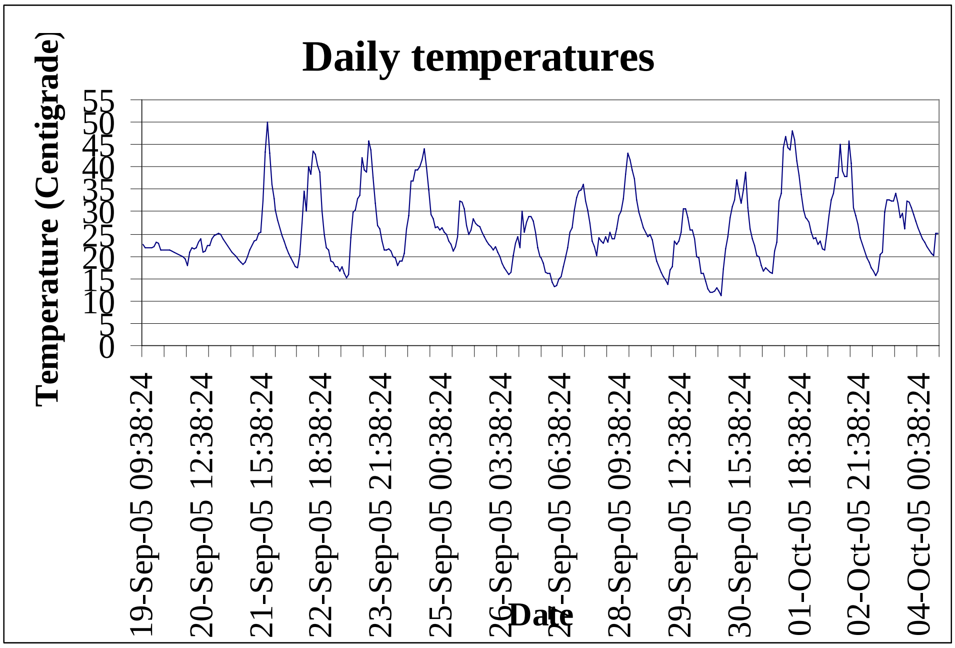
ABSTRACT

Objective: To assess whether statistical analysis of pre and post riding weights of competitors in the 2006 Simpson Desert Cycle Challenge (SDCC) confirms this to be an appropriate tool for monitoring dehydration in this endurance event.
Design: Weight was measured on all riders prior to, and immediately after completing a riding session over the nine sessions of this four and a half day event.
Participants: Eleven competitors (ten male and one female) in the Simpson Desert Cycle Challenge including the author.
Results: Statistical analyses of the measurements indicate a significant weight loss over all sessions. Afternoon sessions, although shorter, were associated with increased weight loss. Recovery between sessions was complete and there was no statistically significant weight change from pre event to post event.
Conclusions: Weight measurement is an appropriate and necessary tool for monitoring dehydration in the SDCC.
Keywords: Weight, dehydration, endurance, cycling

Introduction

Dehydration is a major cause of heat illness such as heat exhaustion or heat stroke and has an associated morbidity and mortality. Lesser degrees of dehydration are now also being recognised as a major cause of reduced physical and cognitive performance in athletes (1, 2, 3, 9, 10, 11, 15, 17, 24, 25) although this is not confirmed by all researchers (22, 23). The level at which performance is effected seems to be variable with figures quoted from 1% to 3% dehydration (1, 8, 12, 27) with the average being 2%. Monitoring hydration of competitors in endurance events and managing dehydration and heat illness is a major role of medical officers supporting such events. The Simpson Desert Cycle Challenge (SDCC) is certainly an ideal research environment to assess dehydration. This annual Mountain Bike event is held over four and a half days in the last week of September and begins at Purni Bore and traverses the French Line, Rig Road, Birdsville Track and inside Birdsville Track, finishing in Birdsville. The total distance cycled is 580 kilometres that is covered in two sessions daily for the first four days and a single morning session on the fifth day. Morning sessions commence at 6.00am, finish at 12.30pm and cover about 80km. Afternoon sessions start at 2.00pm, finish by 6.00pm and cover about 50kms. There are Aid Stations each 20km in the morning and each 10-15 kms in the afternoon. These are manned by several people to assist with resupply of fluids and food to the riders. They also note down time of arrival and try to monitor the amount of fluids taken. There is usually a member of the medical team present which may be a Doctor, Nurse or First Aider. Weather conditions can vary but the average daily temperature for September in the two nearest towns, Oodnadatta (west) and Birdsville (east), are 26.4°C and 28.2°C with the maximum recorded 40.5°C and 42.4°C respectively (28, 29). Average humidity for September in the same two towns are 41% and 39% at 0900hrs and 23% and 21% at 1500hrs respectively (28, 29). Unfortunately, measures of temperature during this year's race could not be done as the equipment required was on a vehicle that suffered mechanical problems and did not make it to the start. I have included a graph of last years (2005) temperature measurements for interest only. Having ridden both years, 2006 was not quite as hot as 2005.

Graph 1
Date vs. temperature during the 2005 SDCC



A typical day in the life of a SDCC rider is to be woken at 0430 and start to prepare for the day. Support crews must get breakfast ready and pull down camp in readiness for the start of the race session. Support crews are divided into two main groups. The first, generally supporting the lead riders, must be packed and ready to leave at 0530 with the course marker, Aid Station teams and Medical teams. Their riders must now be self reliant, although there is camaraderie amongst riders and they may be able to get any last minute support from other teams still in camp. The riders take off at 0600 and are followed about an hour later by the "sweep" vehicle and the second group of support vehicles. The "sweep" maintains an average speed of 12kph and if he catches up to a rider, that rider is eliminated from that session. This ensures each session finishes on time and support is given to the "swept" rider. During the morning, the front convoy marks the course and establishes the Aid Stations and eventually sets up the finish line/lunch site. All riders should have finished by about 1230hrs. The process repeats itself in the afternoon.

Why is body weight important in such events? In humans, body water constitutes 60% of an individual's body weight with small variations related to variables such as sex, age, training status and percentage body fat (27). Water is lost via breathing, urine, faeces and sweat. During prolonged physical performance, most water is lost as sweat especially in hot environments when temps exceed 36-37 °C. Estimates of fluid loss and therefore dehydration can be made from the weight loss with one kilogram of weight loss representing one litre of fluid loss. Endurance athletes can lose up to 2 litres per hour of fluid from sweating but gastric emptying can be limited to 1 litre/hr. This leads to inevitable dehydration (27).
Several methods exist to assess hydration and these include measuring urine concentration, body weight, blood tests, absorptiometry and bioelectric impedance

analysis (7, 16). Some are more practical than others and the most commonly used is pre and post event measurements of weight. The change in weight can then be expressed as percentage dehydration on the presumption that one litre of fluid loss is equivalent to one kg of weight loss and other causes of weight loss are minimised or ignored. Acute changes of body mass are used as the gold standard for measuring dehydration (7). There is also evidence that body mass is a stable physiological marker for monitoring daily fluid balance (7). Over longer periods of time, changes in body composition (fat and lean mass) that occur with chronic energy imbalance are also reflected grossly as changes in body mass and the body mass method of assessing fluid balance becomes less accurate. General consensus is that body mass is an easy, rapid screening tool but can be confounded over time by changes in body composition (7).

Although there are a number of papers that look at dehydration as measured by weight loss, they concentrate on single long sessions (12, 22, 23) or several short sessions (4, 9, 15, 16) or look at performance effects with deliberate weight loss to meet weight classes (10, 11, 20, 24, 25). The other major aspects they analyse are relationships to types of fluids ingested, carbohydrate intake and sodium intake, metabolism and hyponatraemia (4, 6, 22, 23).

What I have attempted to do is to look purely at weight loss as an indicator of dehydration in a long-term endurance event over four and a half days. Some of the questions I have asked are: Is there a significant weight loss over a session? Is there a relationship with the length of a session and level of dehydration? Is there significant recovery between sessions and is there a difference from short recovery times (lunchtime) and long recovery times (overnight). Is there an overall weight loss over the full event? In the end, we would like to know if this is an accurate or important tool for monitoring dehydration in such events?

METHODS

The rules of the race are that all competitors must be weighed pre and post session. The same set of scales was used for both measurements and were transported between the start and finish points of a session by the Medical Director and/or the Race Director. There were eleven competitors in 2006. The scales used were the Tanita Body Fat Monitor Professional Model (26). These had a digital display with weight increments of 0.1kg and were considered to be accurate to +/- 0.05kg although I could not find a specific statement by the company confirming this. The process of weighing was that a flat base plate would be put on the ground and the scales place on top. The scales were zeroed and a weight measured. The scales would then be re-zeroed for the next weigh-in. All weights were entered into a logbook at the time of weighing. (Figure 1)
A measurement of the weight of each competitor was made in the half hour preceding the session and immediately after completing the session. It was optional to wear their cycling shoes, socks, knicks, jersey, gloves and helmet while being weighed but they must be wearing the same items at the second weigh-in after the session. Some elected to not wear their helmets or gloves. These items were acceptable as they were relatively constant weight except for any sweat they may absorb. This also allowed

for a quick turnover of weigh-ins. Their additional weight would not alter the loss of weight over a session but would alter slightly the percentage loss of weight. They were not allowed to carry any backpacks, water, foods or any item that had a variable weight. If all competitors were successful in finishing each session, there should be a total of 99 pre session and 99 post session weights logged for each competitor.
Any competitor not finishing a session would not have a second weigh-in as they were picked up by their support vehicle and had access to unlimited food and drink.

Figure 1- Weigh in post session

Calculation of results

Weights were written in as pre and post session. Weight difference was calculated by subtracting the pre session weight from the post session weight. This gave a negative result for weight loss and a positive result for weight gain. Percentage loss was calculated by multiplying the weight difference by 100 and dividing by the pre session weight. The entries were all noted down as a short (50km) or long (80km) session.

Statistical analysis

Data were analysed using the computer based statistical SPSS Student Edition program. Data was entered in two separate files allowing a number of statistical analyses to be completed. The first file data was entered with variables being ID (the number before the decimal point is the riders number and the number after the decimal point is the session number), weight1 (pre session weight), weight2 (post session weight), weight loss (weight lost or gained), percent (percentage weight loss) and session (1 represents a long session and 2, a short session). The first was a paired sample t-test to analyse differences between weight values obtained before and after each session. An independent t-test was used to analyse the differences between weight loss in the short and long sessions.
A second file was created and data entered in a different way. The variables were now the riders ID (riders number) and weight1 to weight18 (riders weight where odd numbers represent pre session weights and even numbers represents post session weights). A paired sample t-test was used to analyse the weight differences between the end of a session and the start of the next session. It was also used to do a paired t-test analysis between the initial weight on day one and subsequent weights at the start of each session.
Statistical significance for all analyses was accepted when $p<0.05$.

RESULTS

Twelve athletes were registered for the race but only eleven (ten males and one female) made it to the start line. One rider withdrew during the second session on day 1 and eventually required intravenous therapy and was transported to Birdsville. A second rider withdrew during the morning of day 3 but remained with his support team for the remainder of the ride. There were 66 pairs of pre and post session weights with the mean pre session weight being 81.0kg with a standard deviation of +/- 10.7kg and the mean post session weight being 80.2kg with a standard deviation of +/- 10.5kg (table 1). The mean loss of weight during a session was 0.8kg, which is a clinically significant difference (p = 0.000) (table 2).

Table 1 - Paired Samples Statistics

Pre session weight (weight1) vs. Post session weight (weight2)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	weight1	*81.0*	*66*	*10.7*	*1.31323*
	weight2	*80.2*	*66*	*10.5*	*1.29639*

Table 1

Table 2 - Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed) P value
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	weight1 - weight2	*.79697*	*1.19871*	*.14755*	*.50229*	*1.09165*	*5.401*	*65*	*.000*

Of the 66 sessions that were completed by riders, approximately 20% of riders were up to 1% dehydrated, 18% up to 2%, 8% up to 3% and 6% greater than 3% dehydrated. 14% avoided any dehydration. (Table 3)

Table 3 – Fluid loss as a percentage of weight of riders finishing a session.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Percentage dehydration	*14*	*14.1*	*21.2*	*21.2*
	≤ 1%	*20*	*20.2*	*30.3*	*51.5*
	>1≤2%	*18*	*18.2*	*27.3*	*78.8*
	>2≥3%	*8*	*8.1*	*12.1*	*90.9*
	>4%	*6*	*6.1*	*9.1*	*100.0*
	Total	*66*	*66.7*	*100.0*	
Missing	System	*33*	*33.3*		
Total		*99*	*100.0*		

There were 39 post long session weights recorded and 27 post short sessions weights recorded. The long session mean loss was 0.5 kg with a standard deviation of +/- 1.3 kg. The short session mean loss was 1.2 kg with a standard deviation of +/- 1.0 kg (Table 4). The mean difference was 0.6 kg, which was significant (p=0.031) (Table 5)

Table 4 - Group Statistics

			N	Mean	Std. Deviation	Std. Error Mean
weightless	session	1	*39*	*-0.5*	*1.3*	*.20132*
		2	*27*	*-1.2*	*1.0*	*.19505*

Table 5 - Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed) (P)	Mean Difference	Std. Error Difference	Lower	Upper
weightloss	Equal variances assumed	*1.075*	*.304*	*2.211*	*64*	*.031*	*.6*	*.29152*	*.06208*	*1.22681*
	Equal variances not assumed			*2.299*	*62.428*	*.025*	*.6*	*.28031*	*.08419*	*1.20470*

The next comparisons were made on a second file where the pre and post session weights were grouped with each rider's number.
The results of the first analysis are as listed in table 6. Numbers of pairs in each analysis range between 4 and 9. The weight differences between morning and afternoon sessions were found to be significant with a weight gain at all of these times (p=0.009 on day 1, 0.004 on day 2, 0.01 on day 3, 0.038 on day 4). The weight change overnight was less. The only result of significance was on the last night (night 4) with a mean gain of 0.8kg (p=0.799 night 1, 0.696 night 2, 0.720 night 3, 0.028 night 4)

Table 6 - Paired Samples Statistics between post session weights (even numbered) and the following pre session weights (odd numbered)

		Mean	N	Std. Deviation	Std. Error Mean
Lunch	weight2	*81.4*	*9*	*10.0*	*3.31670*
Day 1	weight3	*82.5*	*9*	*10.0*	*3.32215*
Night	weight4	*81.0*	*8*	*11.5*	*4.06298*
Day 1	weight5	*81.1*	*8*	*11.3*	*3.99175*
Lunch	weight6	*81.5*	*6*	*9.8*	*4.00395*
Day 2	weight7	*82.3*	*6*	*9.9*	*4.02739*
Night	weight8	*77.3*	*6*	*11.9*	*4.87520*
Day 2	weight9	*77.0*	*6*	*12.2*	*4.98067*
Lunch	weight10	*79.6*	*7*	*12.3*	*4.65525*
Day 3	weight11	*80.2*	*7*	*12.2*	*4.61239*
Night	weight12	*74.7*	*4*	*13.8*	*6.90320*
Day 3	weight13	*74.8*	*4*	*14.5*	*7.23883*
Lunch	weight14	*80.6*	*9*	*11.2*	*3.74058*
Day 4	weight15	*81.5*	*9*	*11.1*	*3.69650*
Night	weight16	*80.1*	*9*	*10.9*	*3.61864*
Day 4	weight17	*80.9*	*9*	*11.1*	*3.68801*

Table 7 - Paired Samples Test between post session weights and the following pre session weights

		Paired Differences					t	df	Sig. (2-tailed) (p)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Lunch Day 1	weight2 - weight3	*-1.1*	*.10*	*.32650*	*-1.87514*	*-.36930*	*-3.437*	*8*	*.009*
Night Day 1	weight4 - weight5	*-.1*	*1.2*	*.42487*	*-1.11715*	*.89215*	*-.265*	*7*	*.799*
Lunch Day2	weight6 - weight7	*-.7*	*.4*	*.14298*	*-1.10089*	*-.36578*	*-5.129*	*5*	*.004*
Night Day 2	weight8 - weight9	*.3*	*1.9*	*.76569*	*-1.65160*	*2.28493*	*.414*	*5*	*.696*
Lunch Day 3	weight10 - weight11	*-.6*	*.4*	*.15801*	*-.97234*	*-.19909*	*-3.707*	*6*	*.010*
Night Day 3	weight12 - weight13	*-.2*	*.9*	*.44418*	*-1.58856*	*1.23856*	*-.394*	*3*	*.720*
Lunch Day 4	weight14 - weight15	*-.9*	*1.1*	*.35268*	*-1.69106*	*-.06450*	*-2.489*	*8*	*.038*
Night Day 4	weight16 - weight17	*-.9*	*.9*	*.31002*	*-1.54824*	*-.11843*	*-2.688*	*8*	*.028*

The second analysis is shown in tables 8 and 9. The findings are that the weight on the beginning of day 3 (weight9) is significantly different to day 1 (weight1) with a mean difference of 1.3kg. All other weights at the start of session do not significantly differ from the original starting weight.

Table 8 - Paired Samples Statistics

Weight prior to session (weight1) vs. weights at the start of all other sessions (weight with odd numbers)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	weight1	80.9	11	11.1	3.33320
	weight3	81.2	11	10.6	3.18500
Pair 2	weight1	82.2	10	10.6	3.35296
	weight5	81.7	10	10.1	3.19778
Pair 3	weight1	82.0	9	11.2	3.73884
	weight7	82.1	9	11.0	3.68018
Pair 4	weight1	82.0	9	11.2	3.73884
	weight9	80.7	9	11.4	3.80354
Pair 5	weight1	81.2	8	11.7	4.14935
	weight11	81.0	8	11.5	4.05907
Pair 6	weight1	82.0	9	11.2	3.73884
	weight13	81.2	9	11.3	3.75727
Pair 7	weight1	82.0	9	11.2	3.73884
	weight15	81.5	9	11.1	3.69650
Pair 8	weight1	82.0	9	11.2	3.73884
	weight17	80.9	9	11.1	3.68801
Pair 9	weight1	82.7	6	11.7	4.76175
	weight18	81.8	6	11.2	4.58617

Table 9 - Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed) (p)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	weight1 - weight3	*-.33636*	*.96465*	*.29085*	*-.98442*	*.31170*	*-1.156*	*10*	*.274*
Pair 2	weight1 - weight5	*.51000*	*1.46473*	*.46319*	*-.53781*	*1.55781*	*1.101*	*9*	*.299*
Pair 3	weight1 - weight7	*-.12222*	*1.65210*	*.55070*	*-1.39214*	*1.14770*	*-.222*	*8*	*.830*
Pair 4	weight1 - weight9	*1.26667*	*1.57956*	*.52652*	*.05251*	*2.48082*	*2.406*	*8*	*.043*
Pair 5	weight1 - weight11	*.25000*	*1.09935*	*.38868*	*-.66908*	*1.16908*	*.643*	*7*	*.541*
Pair 6	weight1 - weight13	*.77778*	*1.41136*	*.47045*	*-.30709*	*1.86265*	*1.653*	*8*	*.137*
Pair 7	weight1 - weight15	*.44444*	*1.68457*	*.56152*	*-.85043*	*1.73932*	*.791*	*8*	*.451*
Pair 8	weight1 - weight17	*1.02222*	*1.88400*	*.62800*	*-.42595*	*2.47039*	*1.628*	*8*	*.142*
Pair 9	weight1 - weight18	*.86667*	*1.20775*	*.49306*	*-.40079*	*2.13413*	*1.758*	*5*	*.139*

DISCUSSION

There were some interesting findings in this study. The first was that there was a statistically significant loss of weight indicating dehydration over all race sessions. This is despite all efforts by organisers and medical officers to encourage fluid intake and riders trying to keep up oral intake. Although percentage dehydration results are potentially confounded due to the additional weight of riding gear such as clothing and helmets adding value to the pre session weights, they are interesting to observe. 14% of riders over all sessions had a dehydration level greater than 2%. This has implications for performance if we accept the general consensus that 2% (8) is the level where detrimental effects start to occur although Burke and Deakin (5) suggest the data behind these values is somewhat obscure.

The next finding relates to significant differences between the short and long sessions with the finding that dehydration was more marked in the shorts sessions. This initially seems to be surprising but if we look at this in more detail we can suggest a possible explanation. The morning session starts at sunrise in the coolest part of the day. The temperature does not tend to get warm until about 0900 hrs. Humidity slowly rises during the day but sweat rates are at their lowest level in the first few hours and build up in the latter morning. Ingested fluids are also more palatable in these conditions as the temperature is not yet high enough to warm up drinks rapidly. This would enhance oral intake. In contrast, during the afternoon, the temperature and humidity are already at their maximums making conditions difficult and leading to high sweat rates. The sun is high most of this session and drinks warm up quickly making them unpalatable. Higher sweat rates combined with decreased drinking due to unpalatable fluids leads to higher levels of dehydration. The temperature can remain high well into the evening and potentially effect recovery.
The next finding of note was that the rider's voluntary recovery at lunchtime and overnight was good with results indicating that they had a significant increase in weight over both of these recovery sessions and that the weight at the start of the next session was not significantly different from their initial weight at the start of the event. This indicates that the riders managed to get adequate oral intake in the recovery sessions so that they would not be disadvantaged at the start of the next session. The indications from this research are that riders on the SDCC do effectively rehydrate themselves at lunchtime and overnight riding intervals and this seems to be quite effective. Anecdotally, this is usually done with a fluid load immediately post session of some cold, sweet fluids with some solid intake of carbohydrate and sodium containing foods.

In terms of maintaining hydration or minimising dehydration, we must ensure losses are compensated by adequate oral intake The major source of fluid loss is that in sweat. Sweat rates will vary between different people and other factors such as acclimatisation will play a part. Von Duvillard (27) in his review of fluids and hydration in prolonged endurance performance quotes levels of sweat rates in elite endurance athletes of 1.5litres/hr with the ACSM paper (1) stating up to 1.8kg/hr is possible. These losses can only be replaced orally and the important factors that affect bioavailability of ingested fluids are palatability, gastric volume, gastric emptying and intestinal absorption. General recommendations for prolonged events are that fluids contain up to 7% carbohydrate with some sodium and other electrolytes (1, 8, 13, 18, 19, 21, 23, 27). It is also recommended this fluid is kept cool at a temperature between 15°C - 20°. Unfortunately, this is not possible in the environment of the Simpson Desert as they lose palatability when warm and can cause nausea and vomiting in some riders. Using water bidons that are mounted on the frame are subjected to all forms of heat transfer and warm up quickly. Having fluids in an insulated backpack may be advantageous and can be easier to drink thereby encouraging higher fluid intakes.
It is considered that the most important factor influencing stomach emptying is the fluid volume in the stomach. When gastric volume is maintained at 600ml or more, most individuals will empty more than 1 litre/hr. People differ in their gastric emptying rates as well as their tolerance to gastric volumes but it has been shown that the ability to tolerate high gastric volumes can be improved by practising drinking during training. Rehrer (21) also suggest that gastric emptying can be promoted by increasing the volume of ingested fluid and by having a low CHO concentrate under

7% to assist intestinal adsorption. Sodium also assists to keep rates of gastric emptying at higher levels of 1 litre/hr. GIT discomfort has been reported in some athletes but seems to be an individual effect with no clear association between volume of ingested fluid and symptoms of GIT distress (30).

Once in the intestine, there seems to be conflicting information about intestinal adsorption. The ACSM suggest intestinal adsorptive capacity is generally adequate to cope with even the most extreme demands during exercise. Noakes (23) on the other hand, in his review of fluid replacement, suggests rates of fluid ingestion needed to offset higher sweat rates may exceed the maximum intestinal adsorptive capacity for water. It seems likely that intestinal absorption will cope with gastric emptying rates of up to 1 litre/hr without any trouble.

In extreme conditions like the SDCC, we can expect to have to replace sweat at a rate of 1.5 litres/hr. High rates of fluid intake (>1litre/hr) are difficult to achieve during this event, especially when cycling up and down sand dunes in very rough and hot conditions. Most athletes are reluctant drinkers and can only replace up to two thirds of their sweat losses during prolonged exercise and therefore develop voluntary dehydration (37).

The ACSM (1) in its position stand on fluid replacement in exercise, recommend that athletes have a set drinking program starting maintaining proper hydration in the 24 hrs prior to the event, drink adequate volumes pre exercise to maintain stomach dilatation, continue drinking at regular intervals during exercise at a sufficient rate to replace all the water lost through sweating or consume the maximal amount that can be tolerated and rehydrate adequately post session. In regard to the initial volume of fluid prior to an event, it is suggested that this should be about 500ml to 600ml and taken about two hours prior to the start of the event to allow absorption and distribution in the body. During prolonged exercise, as thirst perception is an inadequate index of magnitude of fluid loss and cannot be relied upon to provide for restoration of fluid loss, frequent consumption (every 15-20 mins) of moderate (150ml) to large (350ml) volumes is recommended.

The suggested methods of reducing dehydration discussed above are not always easy to put into practise. The riders of the SDCC get up at 0430 and in effect must be ready to ride from 0530 as their support vehicle may be with the first convoy out. They must try to get a fluid load, take in carbohydrate and make sure their equipment is set to go prior to competing and only have ninety minutes to do so. Sports drinks may be a way to do this but the amount of carbohydrate may not be adequate. Some solid food with a mixed high and low glycaemic index is what most riders aim for. There is a potential for feeling bloated and unwell as this is done over a short period of time. Once riding, riders should be and are encouraged to drink regularly. The problem that can occur is that in the early morning, as conditions are pleasant, rider’s delay their drinking and suddenly realise, as they come into an Aid Station, that they need to drink fluids. This generally has one of two effects. The rider will try to drink too much volume and at best, feel bloated, but at worst, be nauseated and may vomit. The other effect is to not drink and dispose of the fluid leading to increased risk of dehydration.

Can we reduce the levels of dehydration and improve performance in such long endurance events? With sweat rates at maximums and limits to gastric emptying, it may not be possible for riders in this event to remain euvolaemic while riding. It may be that the only active management is to limit the degree of dehydration to easily recoverable levels rather than try and eliminate it. Accurate weighing of riders pre and post riding session is essential to provide information to organisers, medical officers and competitors of hydration status. I would also suggest that education of riders of the ACSM (1) guidelines (most major sport associations including Sports Medicine Australia, have guidelines for this purpose) is an important component in limiting dehydration. These guidelines can then be put into practise by encouraging volume load and carbohydrate/electrolytes in the ninety minutes prior to the start of morning sessions, the interval over lunch and overnight. This can be accomplished with a mixture of sports drinks, water and various food items. Aim to have a stomach with a load of about 500 to 600ml prior to beginning a session. While riding, continue presenting volume to the stomach by regularly drinking 200 to 300ml each 15 to 20 minutes. This keeps the volume at a level that can be tolerated by the GIT. If more is tolerated, this should be taken. The type of fluid is that which is most tolerable. This may be water or dilute sports drinks in very hot conditions or full strength sports drinks in cooler conditions. If drinking only water, this must be accompanied with a carbohydrate/electrolyte source (14). Riders can expect to become dehydrated and so recovery is very important. This can be accomplished over the interval by drinking 1.5 lires per kg of weight lost. Again, sports drinks or water with accompanying carbohydrate/electrolyte can be used. Riders effectively did this in 2006.

In conclusion, my observations of weight change as a reflection of dehydration in riders on the 2006 SDCC indicate that weighing of riders is an integral part of this race. It allows for organisers, medical officers and competitors to monitor dehydration so as to effectively minimise it.

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