THORZT

HYDRATING HARD WORK

WORKPLACE DEHYDRATION: MINIMISATION AND MANAGEMENT

WORKPLACE DEHYDRATION MINIMISATION AND MANAGEMENT

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WORKPLACE DEHYDRATION: MINIMISATION AND MANAGEMENT

WHY DO WE NEED FLUID?

Dehydration is a serious issue on Australian worksites that can lead to reduced productivity and morale along with increased dangers for everyone on site.

Essential to minimising risks is both the employer and employee developing an understanding of the signs, symptoms and risk factors of dehydration, as well as specific preventative measures that must be tailored to individuals and environmental conditions.

This white paper investigates dehydration prevention, management and monitoring methods and provides realistic and actionable guidelines for minimising its occurrence.

WHAT IS DEHYDRATION?

The average male body is made up of around 50-70% water, depending on health levels, with a lean and healthy 70kg male body containing around 60% or 42 litres of water. Around 2-4 litres (3-6% of body mass) is lost during a sedentary day through urination, faeces, in breathing or through the skin[1].

Physical activity substantially increases fluid loss through sweating. Workers performing physically demanding tasks in hot conditions while wearing heavy clothing and PPE can sweat out as much as 2 or even 3 litres an hour[2,10]. If a healthy 70kg male lost 10-12 litres of water through sweat - or around 15% of his body mass - and this was not at least partially replaced, death would be the likely result[27.]

MILD DEHYDRATION SYMPTOMS:
While 15% dehydration will likely cause death, even mild dehydration - classified as a loss of 1-4% of body mass in fluids - can cause serious safety issues on the worksite as well as reduced productivity and morale[6].

1% dehydration or around 0.7 of a litre in our 70kg subject will lead to reduced physical work capacity[3], while cognitive abilities including concentration, alertness and reaction times will suffer[4].

At 2% dehydration - the point at which we start to feel thirsty[5] - heart rate has already increased by around 8 beats per min and overall performance can be reduced by up to 30%[6]. If fluids are not replaced and the body continues to dehydrate to a loss of 3% of body mass, it will have a similar impact on cognitive ability as having a blood alcohol content (BAC) of 0.08. This has been found to slow down the response time of drivers by 17%6 and increase the chances of having a car accident by 5 times[7]. Dehydration to 4% further slows coordination and reaction times[6].

Australian mining workers have regularly been found to be mildly dehydrated at the start of their shift[8,9]. Research has found they are unlikely to recover during that shift[8] meaning they are working with reduced cognitive function, endangering themselves and their colleagues.

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WHO IS AT RISK OF DEHYDRATION?

Australian blue collar workers face a high risk of dehydration due to regularly performing physically demanding work in hot and humid conditions which exacerbates their sweat rates[10].

Moreover, high levels of personal protective equipment (PPE) required on many worksites further reduces the ability of the body too cool and subsequently increases sweat rates[10].

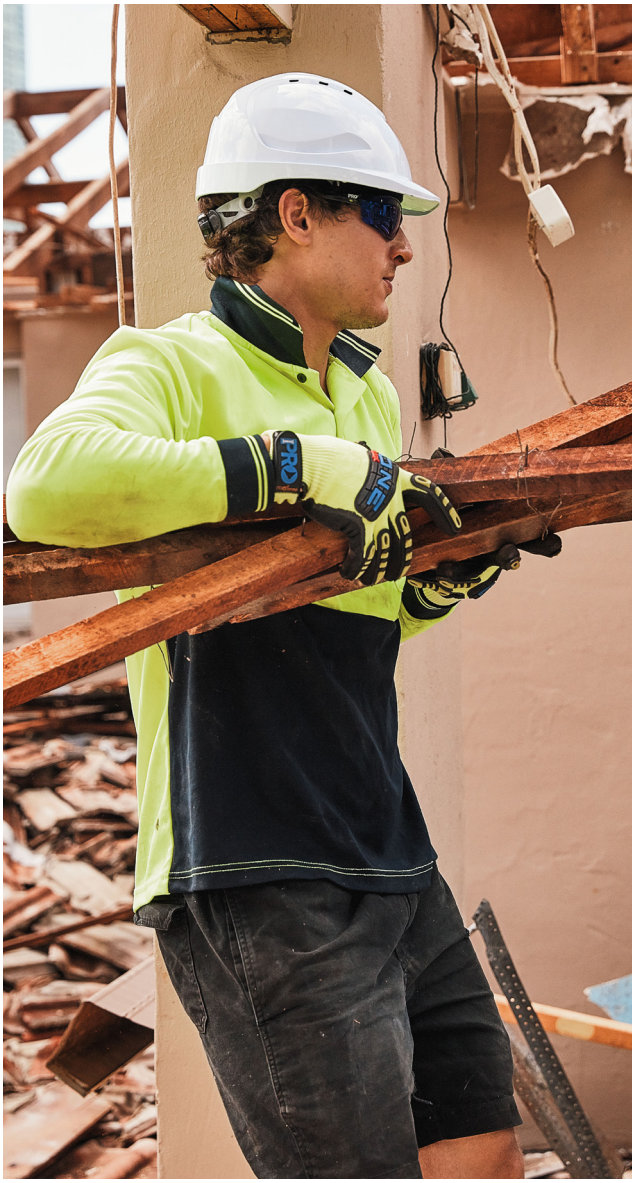
Those in professions with high ambient temperatures and humidity along with limited airflow - such as workers in underground mines - face significant risks[10].

However, workers performing physical activity in cold climates are also at risk of dehydration because cold weather can suppress the sensation for thirst by about 40%, even when the body requires fluids. Additionally, the kidneys receive weaker signals from the brain to conserve fluid when the body is dehydrated in the cold.

This is thought to occur because during cold exposure, blood moves to the body's core to decrease heat loss meaning the brain is less likely to detect the onset of dehydration and therefore less likely to release the hormones that stimulate thirst and fluid conservation[11].

Furthermore, bodily fluid losses can still be significant in cold conditions. When breathing cold air - which holds less moisture than warm air - it enters the body, is warmed and then "saturated with moisture" before being exhaled and replaced by more cold dry air[12].

Research simulating the load of construction workers found that mean sweat rates in a temperature range of 15-20 degrees Celsius is around 4.1 litres during a 10 hour shift compared to 4.7 litres at 30-35 degrees. Moreover, sweat-sodium concentrations were about 40% higher when exercise was performed in colder temperatures due to a lack of heat acclimatisation in participants[13].



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HEAT ACCLIMATISATION

The human body has the capacity to increase tolerance to hot and humid conditions through regular physical activity. Heat acclimatised and physically fit workers are able to work harder for longer[14, 27].

Those who are heat acclimatised have lower perceptions of effort, decreased heart rate, lower core body temperatures and increased sweat production (and therefore evaporative cooling function) than non-heat acclimatised workers[15,16]. These increased sweat rates increase fluid intake requirements[28, 29].

ELECTROLYTE LOSS

The body is made up of electrolytes including sodium chloride (which is critical for water absorption), potassium, calcium, and magnesium - the correct concentration and balance of which is vital to cellular communication, organ function and general health[17].

Sweat also contains many of these essential electrolytes - primarily sodium, with potassium, calcium and magnesium in smaller amounts. It is critical that sodium lost through sweat is replaced or there can be serious consequences13. The replacement of other electrolytes depleted during strenuous activity such as magnesium and potassium may provide increased cell function, muscle strength and overall performance as well as faster recovery times, especially among those whose dietary intake is inadequate[18,19].

As sweat rates increase, so does the sweat's concentration of sodium, however concentration levels vary with some people described as 'salty sweaters'. Furthermore, heat acclimatised people have around 50% lower sodium concentration in their sweat than nonacclimatised people[17].

2008 Australian research simulated sweat rates of construction workers and found that in moderately hot conditions (30-35 degrees Celsius) the average worker will lose between 4.8 - 6 grams of sodium during a 10 hour shift[13].

Eating during a work shift or prolonged exercise is important to help replenish carbohydrate and energy levels as well as sodium and electrolyte supplies. However a loss of appetite is common while undertaking physical activity20, especially when performed in the heat[22].

Resultantly, drinking specifically prepared electrolyte solutions can help maintain blood sugar and sodium levels, helping to maintain energy and cognitive function while reducing fatigue[13].

Furthermore, Australian research shows that cordials and overly sugary sports drinks are not suitable for carbohydrate replacement due to their containing an abundance of calories exceeding that which the body will use.

	HYPOTONIC	ISOTONIC	HYPERTONIC
% CARBOHYDRATES	Less than 4%	4 - 8%	Greater than 8%
OSMOTIC PRESSURE	Lower than bodily fluids	Same as bodily fluids	Greater than bodily fluids
RATE OF ABSORPTION	Faster than water	Same as water	Slower than water
BEST USED FOR	Rapid rehydration	Rehydration / Energy	Energy

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AMINO ACIDS

Described as the "building blocks of life", the body uses amino acids to make proteins for efficient bodily function. They can also be used as a source of energy by the body.

They are broken down into three groups, essential amino acids (also known as branch chain amino acids – BCAAs), nonessential amino acids and conditional amino acids. BCAAs are the most important and are classified as "essential" because the body cannot manufacture them and they must be ingested in food. The body can manufacture nonessential amino acids while conditional amino acids are usually not required except during times of illness or stress[22].

While a balanced diet should ensure the body has or can produce the required amino acids for most individuals[22], healthy eating is not always achieved.

Studies have found that BCAA supplements can improve physical performance and exercise capacity as well as general brain function[23,24].

Furthermore, the addition of amino acids to carbohydrate-electrolyte drinks has been shown to increase fluid retention 15% more than carbohydrate-electrolyte drinks without BCAAs, and 40% more than water[26].

SODIUM IMBALANCE CONSEQUENCES:

Hyponatremia and Hypernatremia With electrolyte balances in the body essential for correct cellular and bodily function - and water alone not replacing the electrolytes lost during sweating - excessive water consumption during and after physical activity may lead to the dangerous condition of hyponatremia[26].

Hyponatremia occurs when sodium levels in the blood are abnormally low. This may be caused by replacing heavy fluid losses from sweating with low sodium beverages such as water or soft drinks, or drinking more fluid than has been lost in sweat[26].

Symptoms of hyponatremia include confusion, nausea, headaches and the potentially fatal outcome of cerebral oedema[26].

Conversely, hypernatremia occurs when sodium levels in the blood are abnormally high, usually as a result of a water deficit in the body. Hypernatremia therefore often corresponds with dehydration and may be caused by extreme sweating or diarrhea. The body responds with a strong thirst sensation to correct the imbalance[27].

It is also possible that hypernatremia can result from an over consumption of salt, such as from the excessive use of salt tablets or extreme consumption of salty foods such as soy sauce[27].

Mild symptoms of Hypernatremia include muscle weakness, restlessness, nausea, and vomiting while more serious symptoms include an altered mental status, lethargy, irritability, stupor, or coma[27].

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FLUID AND ELECTROLYTE INTAKE REQUIREMENTS

Given the consequences of drinking too much or too little fluids, it is important to get fluid consumption right. While there are some recommendations on the amount of fluids and electrolytes that should be ingested during physical activity, there are many variables influencing intake requirements. Broad guidelines for fluid consumption when working in hot and humid conditions have been set at around 250-300ml of fluid every 15-20 minutes[6].

Influencing fluid and electrolyte intake requirements are individual differences in heat acclimatisation and fitness, metabolic rate, body mass, size and genetic variability along with environmental conditions such as temperature, humidity, wind, sun exposure and the amount and type of clothing worn[28].

Regardless of variables, it is important to ensure full hydration prior to any exercise or shift commencing and to consume as much fluid during and after a shift as has been lost[26]. Due to large variances in individual sweat rates and sweat-sodium composition, it is difficult to provide specific guidelines for sodium intake during physical activity. A tailored approach refined to match individual requirements is recommended.

WORKER HYDRATION ASSESSMENT AND MANAGEMENT

Given differing individual hydration requirements, regularly assessing and monitoring worker hydration levels is a key component in preventing and treating dehydration and ensuring worker education[27]. There are a number of measures that can be taken - some more simple than others - that contribute to hydration evaluation, a combination of which are best used to provide accuracy.

THIRST
Thirst is a fairly poor indicator of dehydration due to its onset after dehydration has already occurred and it being alleviated before full hydration is reached. However its onset at 2% dehydration is an early warning signal that sufficient fluids are not being consumed[26].

URINE COLOUR
To help determine hydration levels a urine sample can be taken and its colour compared to an eight scale chart. Lighter or pale coloured urine generally indicates better levels of hydration than darker yellow or brown urine, which indicates dehydration[26]. However urine colour can be influenced by dietary factors such as the consumption of vitamin B or caratone, which may turn urine yellow or orange, while beetroot may give it a reddish tinge. Caffeine and some medications may also affect urine colour[30].

Testing should be done using a clear vial or cup and the colour assessed against a white background. Assessing urine mid-flow or when diluted in toilet water may provide inaccurate readings[26].

OPTIMAL HYDRATION:	CAUTION:	WARNING:
KEEP DRINKING	MILD DEHYDRATION. INCREASE FLUID	SEVERE DEHYDRATION. DRINK 800MLS OF THORZT + MAINTAIN STEADY FLUID INTAKE.

URINE SPECIFIC GRAVITY (USG):
More accurate than urine colour analysis is testing the urine for specific gravity which measures levels of molecules and solutes, also known as water-urine concentration and density[29].

USG testing is an inexpensive, fast, easily-implemented, painless and effective hydration status measurement tool that delivers a specific figure outlining urine density which is then assessed on a USG hydration scale[26]. While there are still some variables in USG testing, it is significantly more accurate at determining hydration status than urine colour analysis.

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WORKER HYDRATION ASSESSMENT AND MANAGEMENT

BODY MASS AND FLUID INTAKE MEASUREMENT:
Measuring changes in body mass from pre to post-shift, or night to morning, is another quick and easy method that can contribute to determining the hydration status of workers and if they are consuming enough fluids. Accuracy relies upon the initial test being conducted on a subject in a hydrated state[26].

Fluid intake should also be monitored and cross-referenced to provide insight into individual sweat rates and fluid intake requirements[27,31].

Refer to Fluid Intake Form on page 17 of the this Booklet.

The technique implies that 1g of lost mass is equivalent to 1mL of lost water and as long as proper controls are made, such as accounting for and factoring in variables such as food intake, toilet breaks, PPE, wet clothing or otherwise, it is an accurate hydration testing method[26,30].

A loss of body mass of 1-2% of the starting weight is a cause for concern and the subject should be encouraged to drink more fluids. Any weight gain (assuming the subject was hydrated to begin with) should be discouraged and could be an indication of over drinking which may lead to the potentially deadly hyponatremia[30].

Healthy people exercising regularly and eating a balanced diet should have sufficient body weight stability to allow body mass testing over one or two weeks, however an exercise-to-calorie intake imbalance or changes to fat and muscle composition over longer time frames do limit this method[26].

TEST, MONITOR AND TRACK:
While each of the above tests on their own are beneficial in their own right, combining multiple tests is the best method of determining hydration status and gaining a better understanding of individual sweat rates, sweat-salt ratios and fluid consumption requirements[6].

Given the large variables in individual sweat rates and sweat-sodium composition leading to differing individual fluid and electrolyte intake requirements, single measurements are of limited value and it is important to establish regular testing and track measurements over time to get valuable data[30].

PROGRAMMED DRINKING

Implementing a scheduled drinking program and tracking consumption is an important hydration management strategy and has been found to increase worker hydration levels[10].

Workers' drinking habits should be reviewed and they should carry fluids on them at all times. Providing a hydration backpack or 600ml drink bottle and tool belt attachment are easily implemented solutions.

These strategies will encourage fluid consumption and enable data that can be referenced against hydration test results, providing valuable information enabling the establishment of tailored fluid consumption requirements.

The level of electrolytes required will also vary depending on sweat-salt concentration and diet, with general recommendations of a 3:1 split between water and electrolytes. In hot and confined work conditions this ratio may be increased to 1:1 so as to replace what is being lost through sweat, however this higher electrolyte-to-water ratio should only mirror extreme conditions.

DEHYDRATION IS CALCULATED AS PERCENTAGE BODY WEIGHT LOSS (BWL), SUCH THAT 1% BWL = 1% DEHYDRATION.

Starting a shift hydrated is essential while post shift hydration is also critically important to ensure prompt recovery. In the event of extreme sweat losses greater than 4% of body weight, full hydration may not occur for up to 24 hours[6].

BWL	% DEHYDRATION	FLUID DEFICIT
0.8kg	1%	0.8L
1.6kg	2%	1.6L
2.4kg	3%	2.4L
3.2kg	4%	3.2L

Fig.1 Percentage Dehydration calculated based on an 80kg Male

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WORK RATE

Given the influence heat acclimatisation and physical fitness have on working in the heat, allowing workers to self-pace the intensity of their workload is an appropriate strategy, particularly for those who are not heat acclimatised such as FIFO workers in the first two to four days of a work swing.

To effectively self pace, workers require an understanding of their work schedule and time frame for completion, number of staff and equipment available and the anticipated environmental conditions. Workers should also factor in their personal experience, physical fitness and wellbeing on the day.[31,32]

Furthermore, setting work-to-rest ratios reflective of environmental conditions and heat acclimatisation status of workers is also recommended.

DIET AND NUTRITION

Given the role food plays in maintaining and replenishing lost sodium, electrolytes and amino acids, as well as encouraging fluid consumption, it is important that workers have a healthy balanced diet and eat regular meals to ensure their dietary intake is sufficient.

Alcohol consumption contributes to dehydration and consumption post-shift is ill advised due to it acting as a diuretic and increasing urine output when rehydration is the goal[26].

Caffeine consumption in relatively small doses (<180mg/day) or among regular users who have developed a tolerance is not thought to lead to dehydration, provided general fluid intake is sufficient[26,28] and it may actually sustain exercise performance[32].

SUBSTANCE	CAFFEINE CONTENT
Instant coffee	60 – 80mg/cup
Percolated coffee	60 – 120mg/cup
Espresso coffee	90mg/150ml
Decaffeinated	2 – 4 mg/cup
Tea	10 – 50 mg/cup
Decaffeinated tea	1mg/200ml
Herbal tea	0mg/200ml
Cola drinks	20 – 35mg/250ml
Energy drinks	35 – 150mg/250ml
Cocoa and hot chocolate	10 – 70mg/cup
Chocolate bars	Chocolate bars 20 – 60mg/200g bar
Prescription and ver-the-counter medicines	Prescription and over-the-counter medicines 20 – 100mg/dose

Working in hot conditions can inhibit appetite in which case consuming a low sugar electrolyte drink is an easy way to replenish sodium and other essential electrolytes lost while exercising. A sugar free electrolyte drink with BCAAs provides the essentials while minimising calorie intake, while a low-sugar electrolyte drink with BCAAs will also provide carbohydrates the body can easily convert to energy, without overloading the body with sugar.

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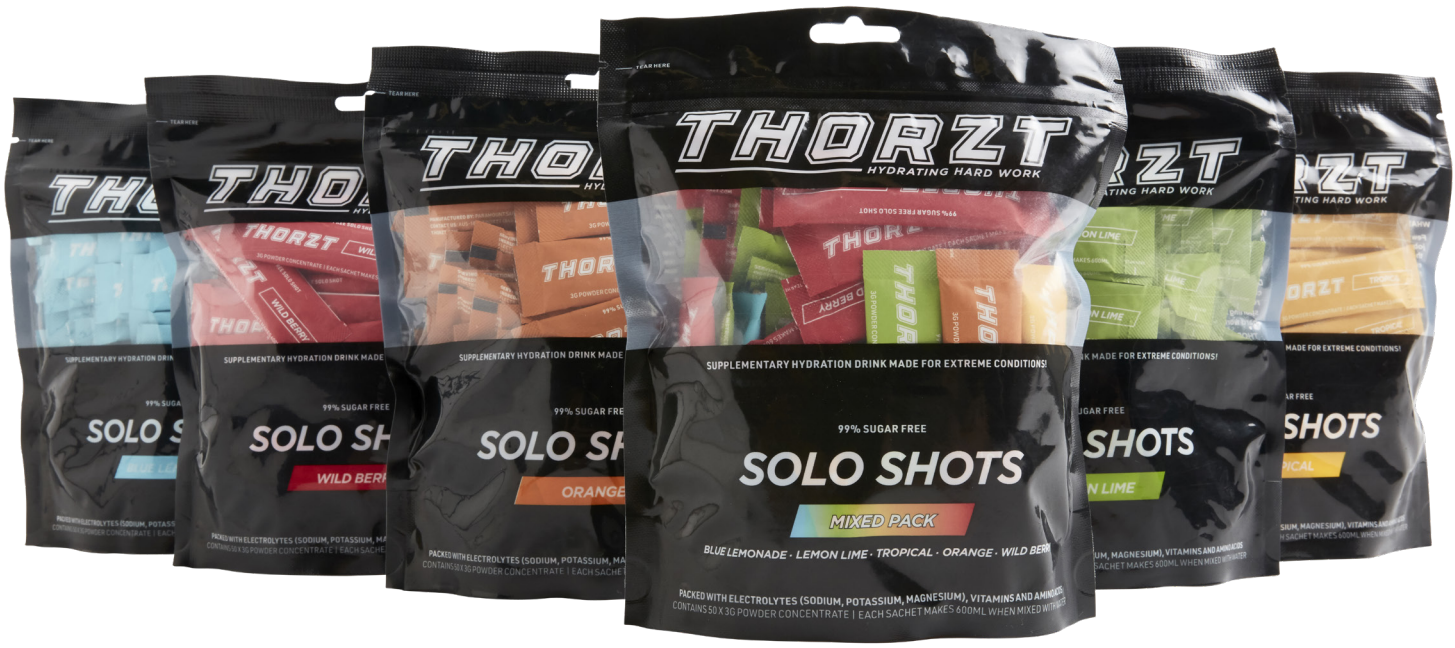
WHAT IS YOUR FOOD?

	200g Chicken	200g Fish	100g Mixed Nuts	200g Cooked Veggies	One Large Orange	On Large Apple	200ml Low Sugar THORZT	200ml Sugar Free THORZT
Water (g)	128.8	153.1	2.29	163.28	159.62	190.8		
Energy (kcal)	322	246	609	154	86	116	30	1.66
Protein (g)	58.64	34.02	19.14	5.56	1.73	0.58	0.05	0.003
Fat, total (g)	8.4	11.48	54.39	3.34	0.22	0.38	0.01	0.0005
Carbohydrate (g)	0	0.16	21.29	25.42	21.62	30.8	7.41	0.41
Sugars, total (g)	0	0.06	4.2	6.04	17.2	23.17	6.74	0.13
Magnesium (mg)	54	44	233	42	18	11	12.5	12.5
Potassium (mg)	684	564	614	330	333	239	29.5	29.5
Sodium (mg)	1002	734	280	496	0	2	67.5	67.5

Average nutritional information of common foods[34]. Cooking method not accounted for. Actual values may vary.



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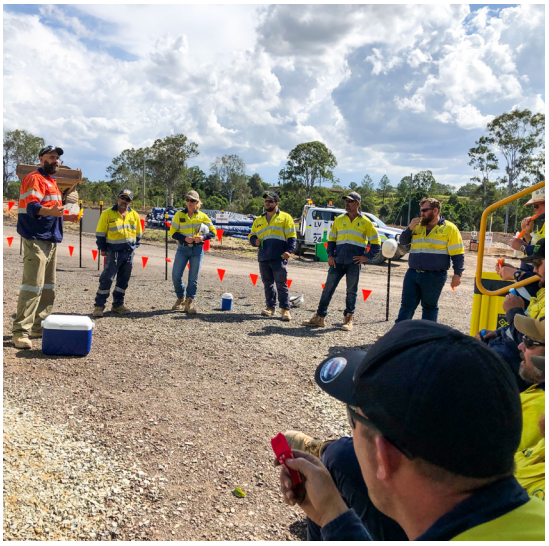
WORKER EDUCATION

The importance of educating workers about hydration management cannot be overstated, especially those working in a hot environment6. Having workers understand hydration assessment methods along with the signs, symptoms and dangers of dehydration is critical to having them starting and ending their shift appropriately hydrated[6].



The importance of food consumption should be emphasised due to it containing sodium and other essential electrolytes lost during sweating as well as encouraging fluid intake. In the absence of adequate food intake, a low sugar or sugar free electrolyte drink that also contains magnesium and branch chain amino acids should be recommended and the dangers of hyponatremia outlined along with its symptoms and causes.

Establishing programmed drinking schedules and allowing workers to self-pace will lead to better hydration maintenance[10] and it is recommended this be implemented as part of a greater hydration management policy tailored to workers and based on the key points discussed in this white paper.

PERSONAL HEAT STRESS MANAGEMENT DAILY CHECKLIST

Ensure each point is understood and has been checked off prior to work commencing. If you are unsure please ask your supervisor/employer or simply call THORZT on 1800 THORZT (846 798).

- ☑ Come to work adequately hydrated. Ensure fluid has been consumed well before work starts.
- ☑ Maintain hydration state during work (urine colour and volume).
- ☑ Carry drink bottle at all times and drink while commuting to and from worksite.
- ☑ Understand the effects of pre-existing medical conditions and personal habits (e.g. overweight, excessive alcohol consumption) on susceptibility to heat stress/heat illness.
- ☑ Drink fluid consistently throughout the day. Recommended volume is 250ml every 20 minutes.[1,6,12]
- ☑ Consume food at regular meal breaks in order to maintain energy and replace electrolytes.
- ☑ Reduce consumption of caffeinated drinks before or during work due to dehydrating effects.
- ☑ Know the importance of adequate sleep and rest. Fatigue can be fatal. Refer to pages 8 and 9.

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WORKPLACE DEHYDRATION: MINIMISATION AND MANAGEMENT

FLUID MANAGEMENT FORM

Name: _____ Role/Activities: _____

Weigh in: _____ Weigh Out: _____

FLUID CONSUMED ON SHIFT

Hour 1:	_____ mls	Hour 5:	_____ mls	Hour 9:	_____ mls
Hour 2:	_____ mls	Hour 6:	_____ mls	Hour 10:	_____ mls
Hour 3:	_____ mls	Hour 7:	_____ mls	Hour 11:	_____ mls
Hour 4:	_____ mls	Hour 8:	_____ mls	Hour 12:	_____ mls

Dehydration is calculated as Percentage **Body Weight Loss (BWL)**, such that **1% BWL = 1% Dehydration**
The example in FIG 1 (right) shows calculations based on an 80kg adult male.

BWL	% DEHYDRATION	FLUID DEFICIT
0.8kg	1%	0.8L
1.6kg	2%	1.6L
2.4kg	3%	2.4L
3.2kg	4%	3.2L

Fig.1 Percentage Dehydration calculated based on an 80kg Male

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REFERENCES

1) Maughan RJ, Impact of mild dehydration on wellness and on exercise performance, European Journal of Clinical Nutrition, 57 Suppl 2:S19-23, Dec 2003.

2) Bishop PA, Pieroni RE, Smith JF, Constable SH: Limitations to heavy work at 21 degrees Cº of personnel wearing the US Military chemical defense Aviation Space & Environmental Medicine, 62:216-220, 1991.

3) Wasterlund DS, Chaseling J, Burstrom L: The effect of fluid consumption on the forest workers' performance strategy, Applied Ergonomics, 35:29-36, 2004.

4) Ganio, MS & Armstrong, LE. Mild dehydration impairs cognitive performance and mood of men, British Journal of Nutrition, Vol 106;10, Nov 2011.

5) Sawka MN, Hydration Effects of thermoregulation and performance in the heat. In: Lau W M, ed. Proceedings of the International Conference on Physioloigical and Cognitive Performance in Extreme Environments, Defence Scientific and Technology Organisation, Australian Department of Defence, Canberra, 2000.

6) Kenefick RW, PhD. Hydration at the Worksite, American College of Nutrition, Vol.26 No.5, 597S-603S, 2007.

7) Drinkwise Australia: www.drinkwise.org.au/you-alcohol/alcohol-facts/drink-driving/

8) Polkinghorne BG, Gopaldasani V, Furber S, Davies B, Flood VM. Hydration status of underground miners in a temperate Australian region, BMC Public Health, vol. 13, pp. 426-1-426-8. 2013.

9) Brake R, Fluid Consumption Sweat Rates and Hydration Status of Thermally Stressed Underground Miners and the Implications for Heat Illness and Shortened Shifts, QLD Mining Industry Health and Safety Conference, AUG 2001

10) Brake DJ, Bates GP, Fluid losses and hydration status of industrial workers under thermal stress working extended shifts, Occup Environ Med, 60(2):90-6, Feb 2003.

11) Kenefick, RW, Hazzard MP, Mahood NV, and Castellani JW, Thirst sensations and avp responses at rest and during exercise-cold exposure. Med. Sci. Sports Exerc., Vol. 36, No. 9, Pp. 1528–1534, 2004

12) Phetteplace, G, Integrating cold weather impacts on human performance into army M&S applications, Simulation Conference, Proceedings. vol.1, 2000

13) Graham PB, Veronica SM, Sweat rate and sodium loss during work in the heat, Journal of Occupational Medicine and Toxicology, 2008

14) Brearley M, Norton I, Rush D, Hutton M, Smith S, Fuentes H, Urban Search and Rescue Operations in Tropical Climates. Australasian Fire and Emergency Services Council Conference. Wellington, New Zealand Sep 2014

15) Kampmann B, Bröde P, Schütte M, Griefahn B, Lowering of resting core temperature during acclimation is influenced by exercise stimulus. Eur J Appl Physiol, 104(2):321-7, sep 2008.

16) Armstrong CG, Kenney WL, Effects of age and acclimation on responses to passive heat exposure. J Appl Physiol, 75(5):2162-7, Nov 1993.

17) Sawka MN, Montain SJ, Fluid and electrolyte supplementation for exercise heat stress Am J Clin Nutr, vol. 72 no. 2, Aug 2000

18) Warburton D, Welsh R, Haykowsky M, Taylor D, Humen D, Biochemical changes as a result of prolonged strenuous exercise, Br J Sports Med, 36(4): 301–303, Aug 2002

19) Lukaski H, Micronutrients (Magnesium, Zinc and Copper): Are mineral supplements needed for athletes? Int J Sport Nutr, 5 Suppl:S74-83, Jun 1995

20) King J, Miyashita M, Wasse L, Stensel D, Influence of prolonged treadmill running on appetite, energy intake and circulating concentrations of acylated ghrelin, Appetite; 54(3):492-8, Jun 2010

21) Maughan R, Shirreffs S, Exercise in the heat: challenges and opportunities, J Sports Sci;22(10):917-27, Oct 2004

22) US National Library of Medicine, Amino Acids, www.nlm.nih.gov/medlineplus/ency/article/002222.htm

23) Fernstrom J, Branched-Chain Amino Acids and Brain Function, J Nutr, 135 6 Suppl:1539S-46S, Jun 2005

24) Gualano A, Bozza T, Campos-Ferraz P, Roschel H, Costa A, Marqueze M, Branched-chain amino acids supplementation enhances exercise capacity and lipid oxidation during endurance exercise after muscle glycogen depletion. J Sports Med Phys Fitness;51(1):82-8, Mar 2011

25) Seifert J, Harmon J, DeClercq P, Protein added to a sports drink improved fluid retention, Int J Sports Nutr Exerc Metab. 16, 16, 420-429, 2006,

26) Kenefick R, Cheuvront S, Leon L, O'Brien K, Dehydration and rehydration, Wilderness Medicine Textbook, U.S. Army Research Institute of Environmental Medicine

27) Reynolds R, Padfield P, Seckl J, Disorders of sodium balance, BMJ, 25;332(7543): 702-705, Mar 2005

28) Casa D, Clarkson P, Roberts W, American College of Sports Medicine Roundtable on Hydration and Physical Activity: Consensus Statements, 2005

29) Urinary indices during dehydration, exercise, and rehydration, Armstrong L, Soto J, Hacker F, Casa D, Kavouras S, Maresh C, Int J Sport Nutr;8(4):345-55, Dec 1998

30) Development of Individual Hydration Strategies for Athletes, Maughan R, Shirreffs S, Int J Sport Nutr Exerc Metab;18(5):457-72, Oct 2008

31) Edwards A, Bentley M, Mann M, Seaholme T, Self-pacing in interval training: a teleoanticipatory approach. Psychophysiology;48(1):136-41, 2011

32) Faulkner J, Parfitt G, and Eston R, The rating of perceived exertion during competitive running scales with time, Psychophysiology;45(6):977-85, 2008

33) West Australian Drug and Alcohol Office, Caffeine: The Facts, 2006 www.dao.health.wa.gov.au

34) United States Department of Agriculture, What's in the foods you eat Search Tool 2011-12, www.ars.usda.gov/ Services/docs.htm?docid=17032

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