Seminar on Climate Change and Health
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Prevalence and Associated Factors of Moderate to Severe Heat Related Illness Among Solid Waste Management Workers in Negeri Sembilan, Malaysia.

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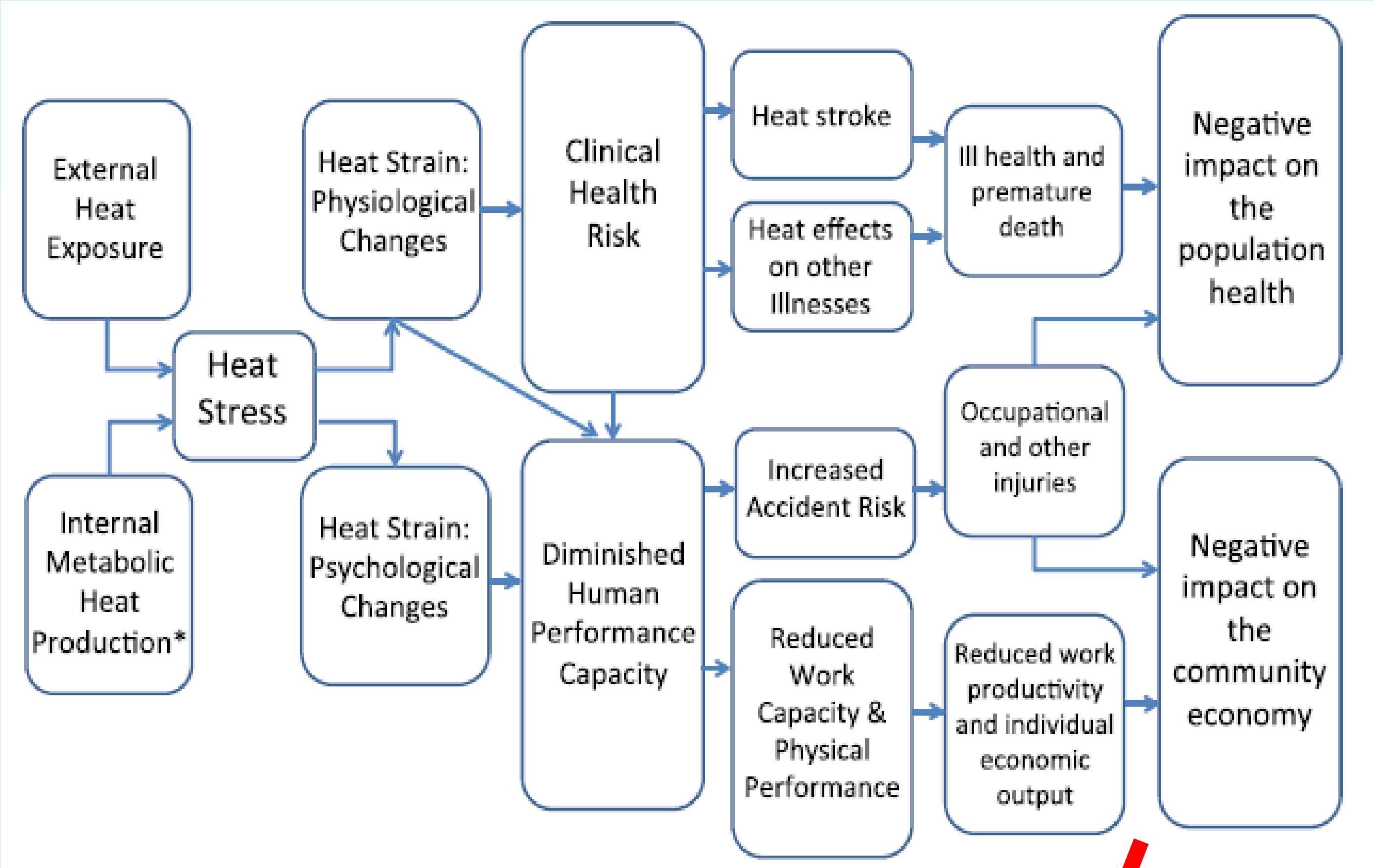
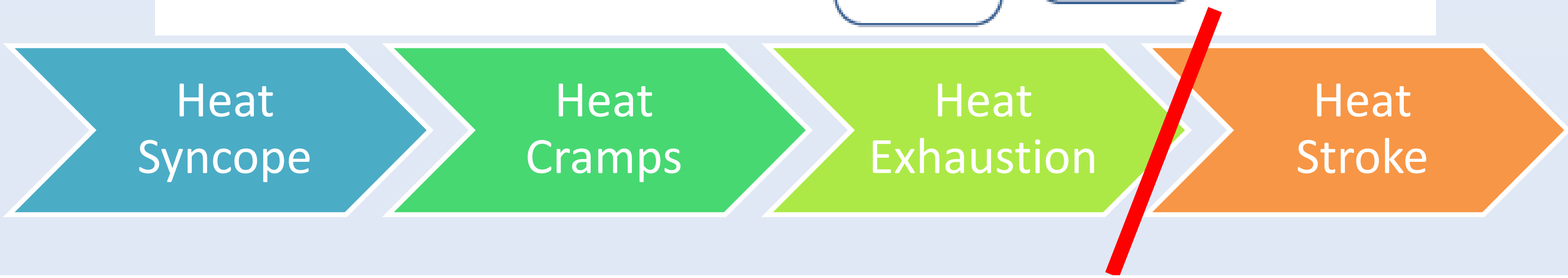
INTRODUCTION

- Intergovernmental Panel on Climate Change (IPCC) concern regarding the increment in average global temperature of 1.4^{o}C-3.1^{o}C (estimated average 3.0^{0}C) in year 2100

- Among occupational groups, higher risk of heat illness are :
  - ➢those who are working outdoor
  - ➢Indoor workers in factories or other workplaces with inadequate cooling facilities.

Impact of Occupational Heat related Illness





WHAT THIS STUDY WILL ADD?

- Heat exposure at outdoor workplace.
- Heat related illness among solid waste workers
- Factors associated with heat related illness among workers.
- Prevention action that can protect workers from heat related illness.

General objective

- To determine moderate to severe heat related illness and factors affecting it among solid waste management workers in Negeri Sembilan.

Specific Objective

1. To determine the **environmental heat exposure level** in Seremban district, Negeri Sembilan.
2. To determine **prevalence of moderate to severe heat related illness** among solid waste management worker in Seremban, Negeri Sembilan.
3. To determine **factors associated with moderate to severe heat related illness** among solid waste management worker in Seremban, Negeri Sembilan.

METHODOLOGY

- Cross sectional study
- Solid waste workers in Seremban District, Negeri Sembilan
- March – April 2016

***Solid waste workers included : Sweeping roadside, drain cleaning & grass cutting only**

DATA COLLECTION

Environmental Assesment

Measurement of WBGT using 3M Quest Temp 34 at the workplace for 8 hours working shift (8.00 am-4pm)

Personal Assesment

Simple random sampling of respondent

Administration of Study Questionnaire,Heat Illness Screening Index Questionnaire

Physical examination (BMI)

Data analysis

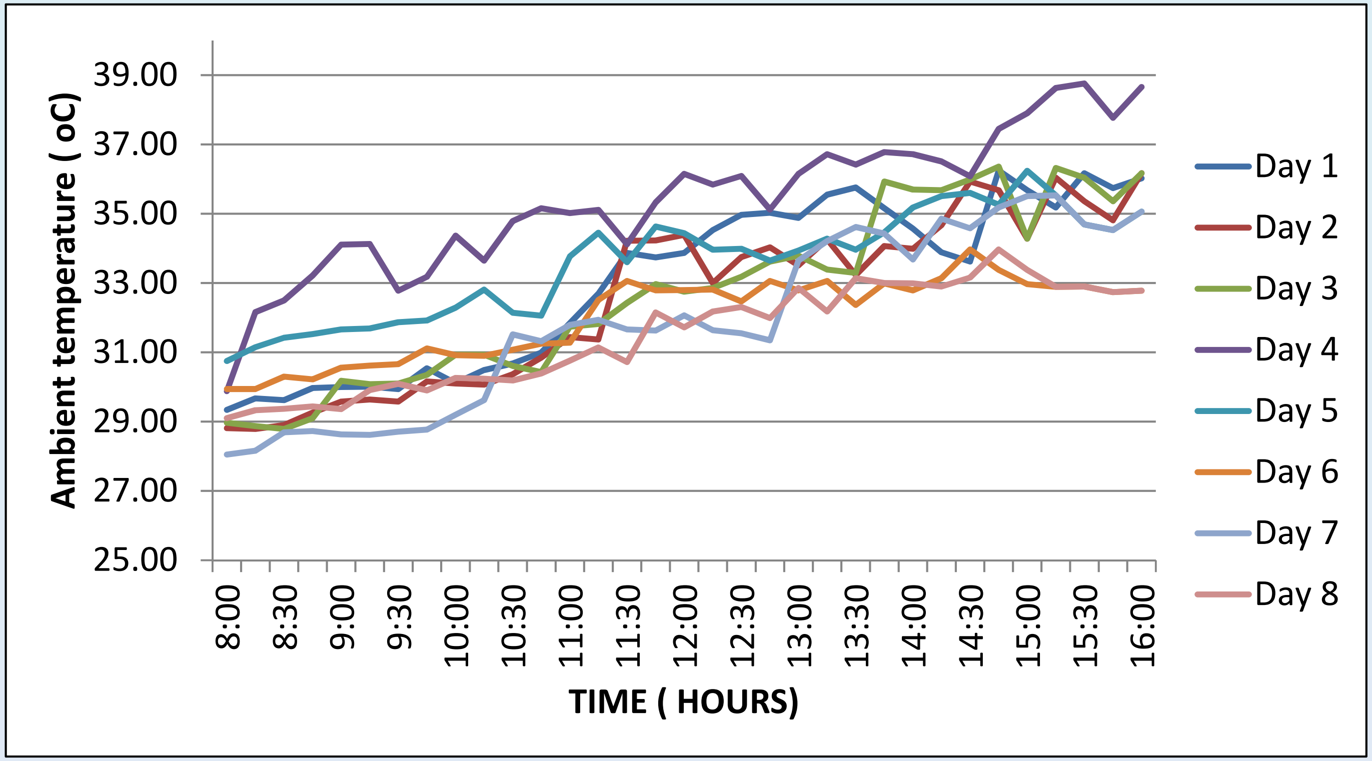
DATA ANALYSIS

Data were analyzed using

1. Rasch model analysis – to develop categorical dependant variable based on person- item variable map
2. Statistical Package for Service Solution (SPSS) version 22.0.

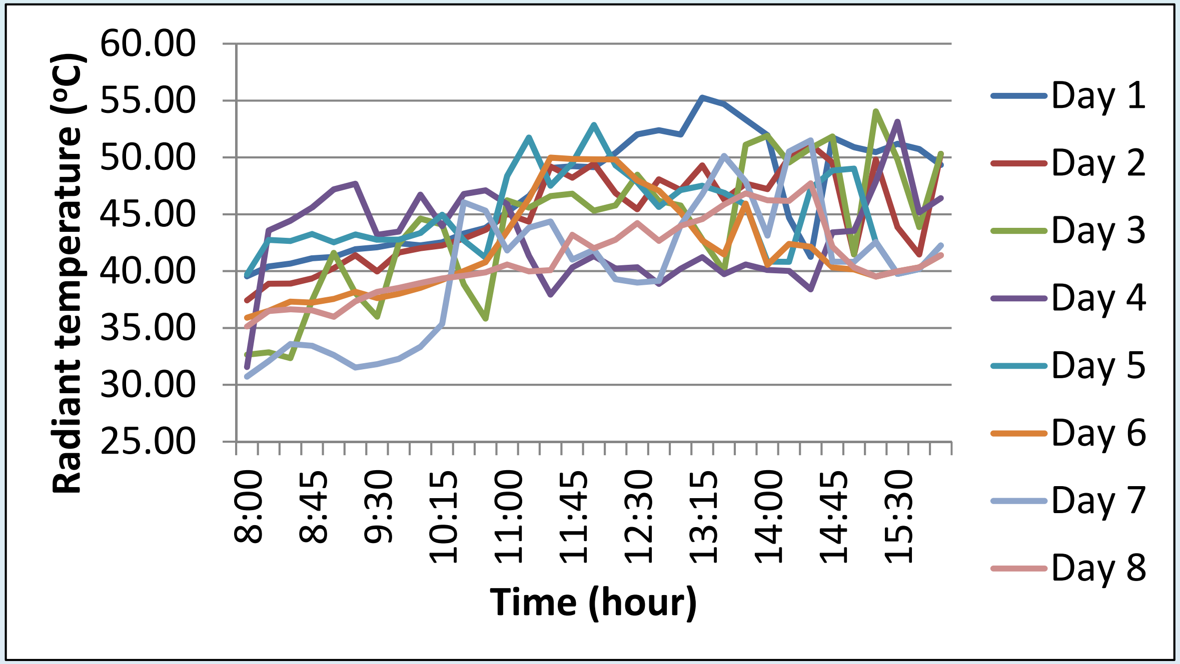
RESULT

HEAT EXPOSURE AT WORKPLACE



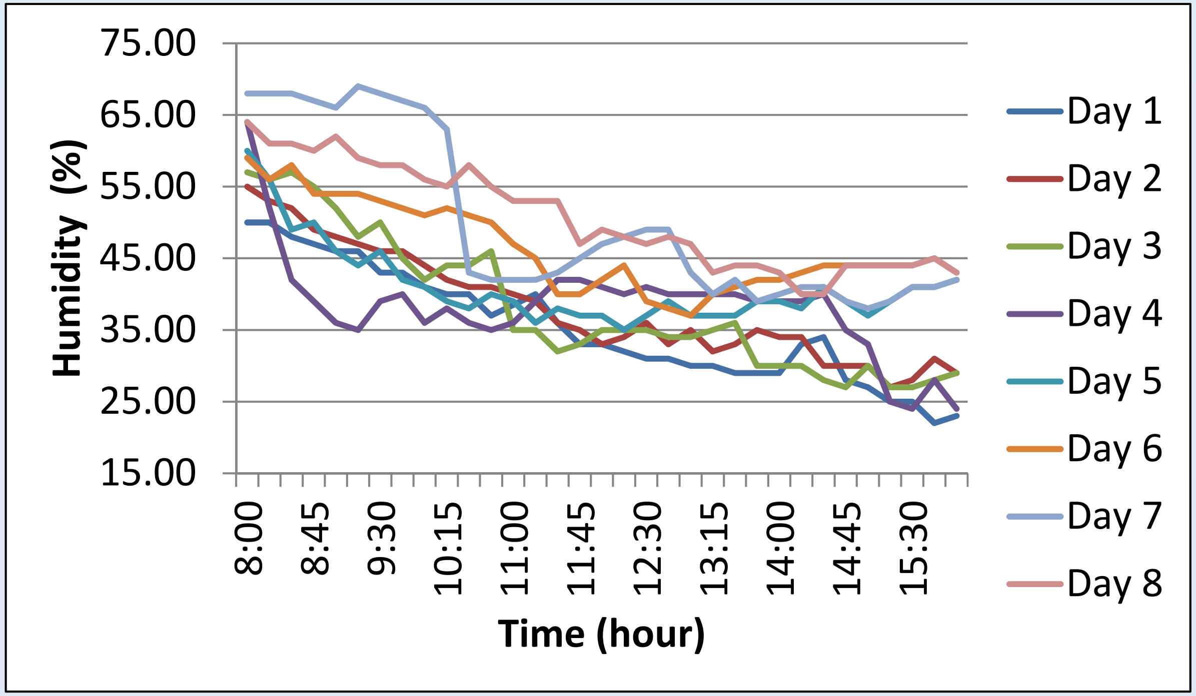
Ambient Temperature

- Mean: 32.84 ^{o}C (SD:1.21)
- Max : 38.76 ^{o}C (Day 4)
- Min: 28.05 ^{o}C (Day 7)



Radiant temperature

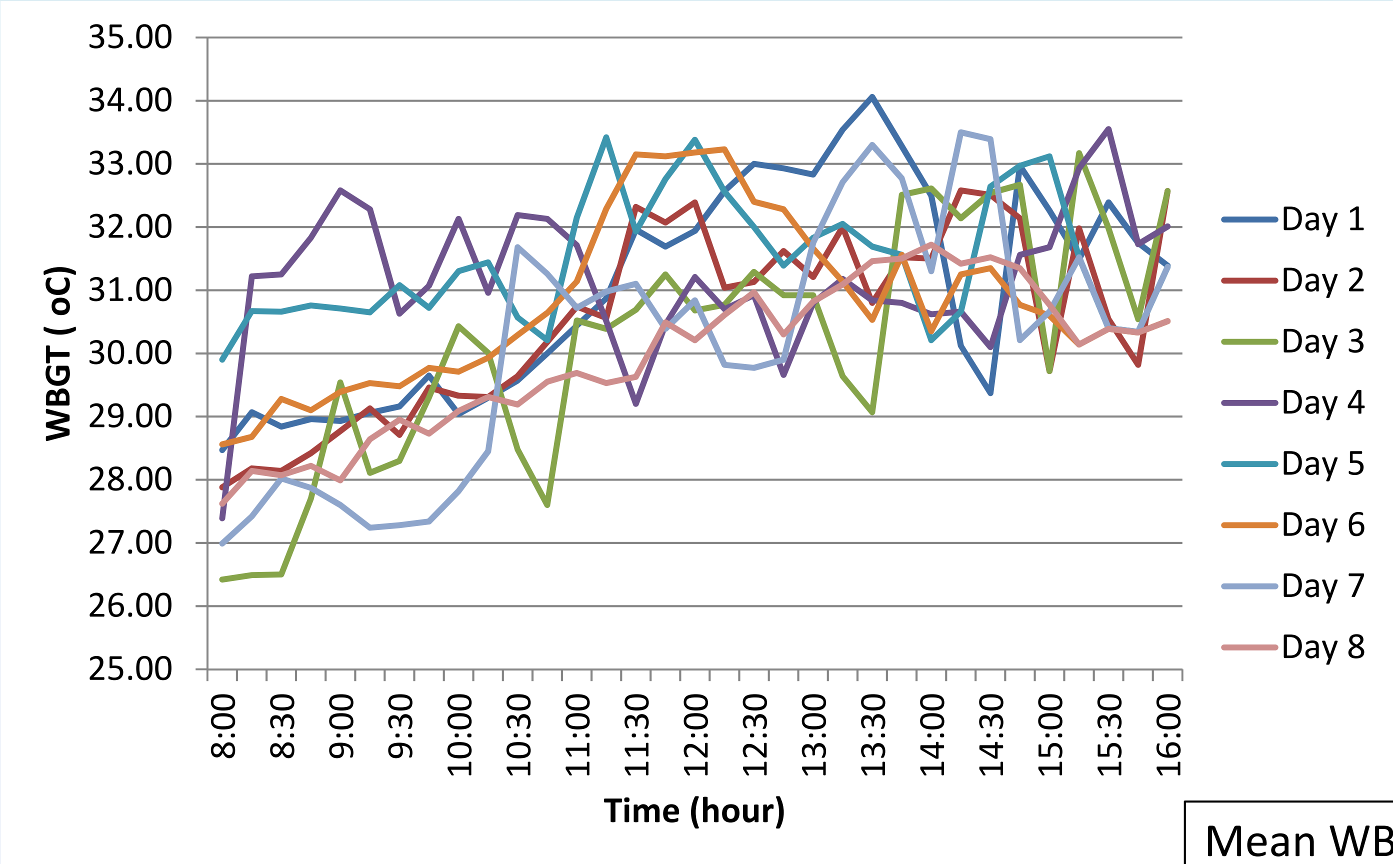
- Mean: 44.64 °C (SD:4.11)
- Max : 55.26 °C (Day 1)
- Min: 30.72 °C (Day 7)



Humidity

- Mean: 40.47% (SD:8.73)
- Max : 68.0 % (Day 7)
- Min: 22.0 °C % (Day 1)

WBGT VALUE AT WORKPLACE

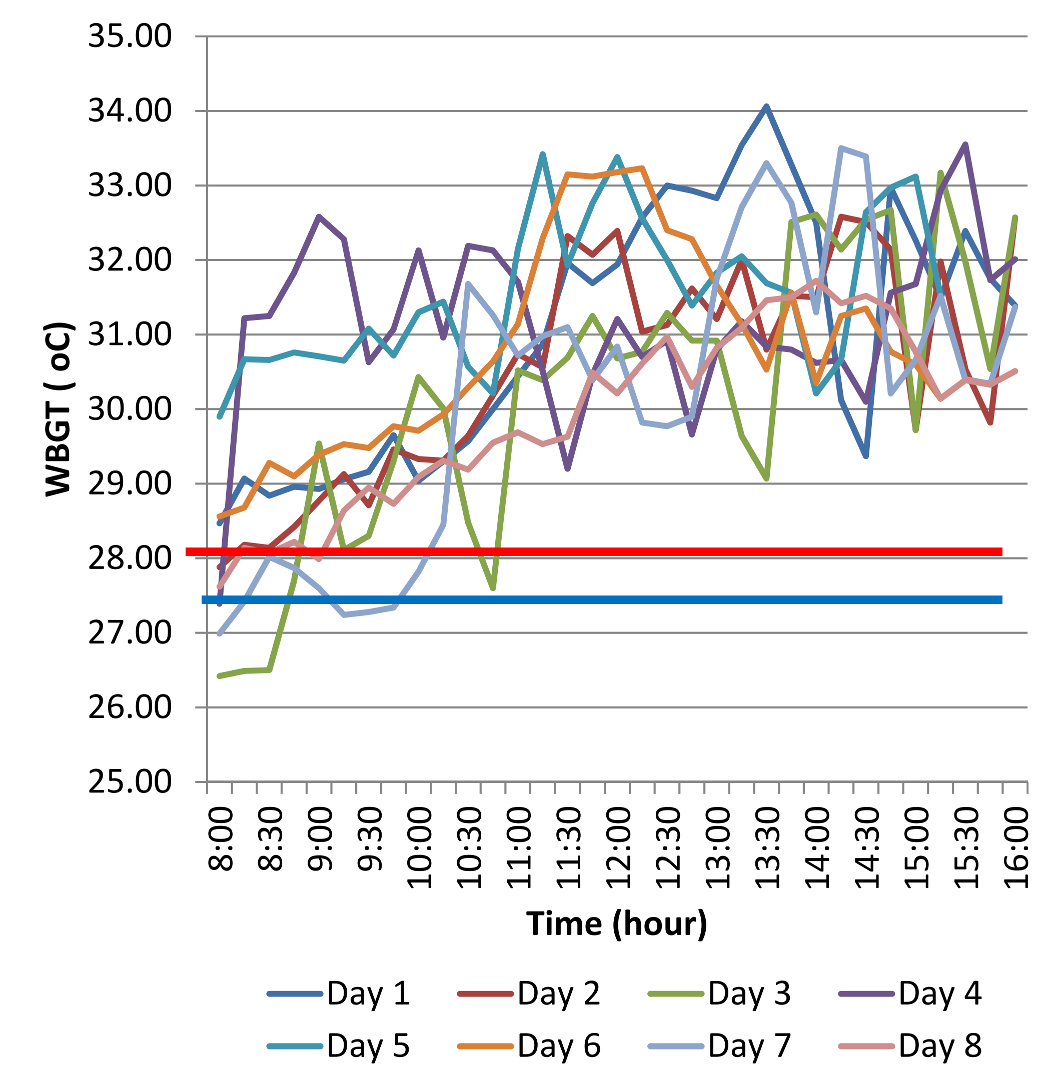


WBGT (outdoor) $=0.7T_w+0.1T_a+0.2T_g$

Mean WBGT

- Mean: 30.5°C (SD:0.5)
- Max : 34.06 °C (Day 1)
- Min: 26.42 °C (Day 3)

WBGT VALUE AND THRESHOLD BY ACGIH 2006



	TLV® (WBGT values in °C)		
Allocation of work in a cycle of work and recovery	Light	Moderate	Heavy
75 to 100%	31.0	28.0	-
50 to 75%	31.0	29.0	27.5
25 to 50%	32.0	30.0	29.0
0 to 25%	32.5	31.5	30.5

- Moderate : sweeping roadside & drain cleaning
- Heavy : Grass cutting

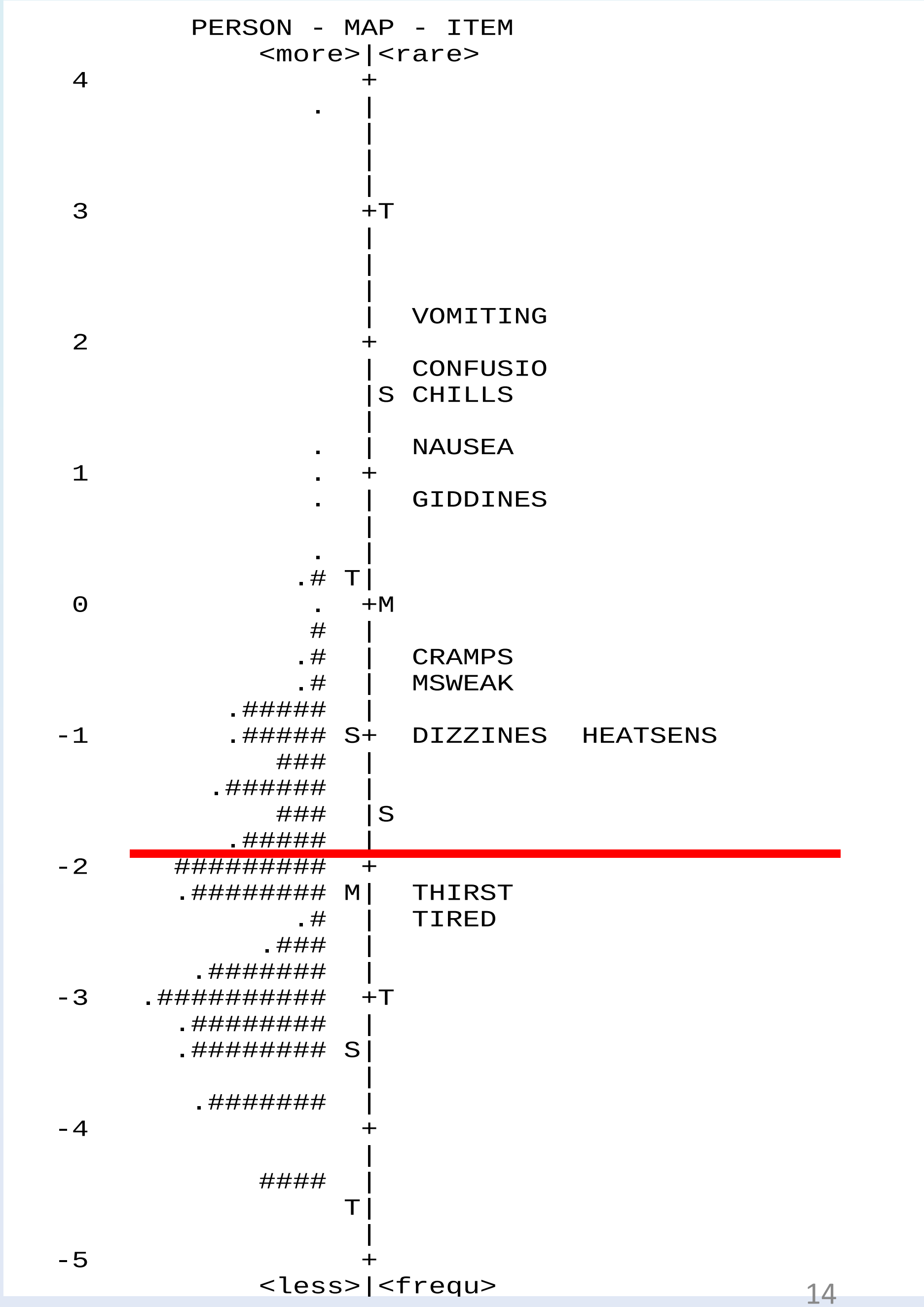
Conclusion:
Respondent exposed to above TLV since early hour of working shift → high risk of heat illness.

Rasch Analysis

Person-item variable map

HEAT ILLNESS CATEGORY	Logit score
Mild	≤ 2.18
Moderate to severe	> 2.18

- *Mild : Thirst and /or tired only*
- *Moderate to severe : Thirst and/or tired **plus** other symptoms*



Profile	Mean (SD)	n	%
Heat illness category			
Mild		179	55.9
Moderate to severe		141	44.1
Age group (years)	43 (9.49)		
<29		29	9.1
30-39		78	24.4
40-49		121	37.8
50+		92	28.8
Gender			
Male		148	46.3
Female		172	53.8
Race			
Malay		95	29.7
Chinese		6	1.9
Indian		216	67.5
Others		3	.9
Education level			
No formal education		20	6.3
Primary education		120	37.5
Secondary education		180	56.3
Type of work			
Sweeping roadside		232	72.5
Grass cutting		46	14.4
Drain cleaning		42	13.1
Duration of service (months)	51 (42)		

Prevalence

Characteristic	Mean (SD)	n	%
WBGT (°C)	30.5 (0.53)		
Metabolic rate			
Moderate		274	85.6
Heavy		46	14.4
History of heat illness			
Yes		152	47.5
No		168	52.5
Medical illness			
Present		98	30.6
Absent		222	69.4
Medication intake			
Yes		105	32.8
No		215	67.2
Alcohol intake			
Yes		6	1.9
No		314	98.1
Total volume of water intake during working shift. (mL)	2150.50 (953.09)		
Time of water intake			
When feeling thirsty		286	89.4
Fixed timing		34	10.6
Type of drink			
Plain water		258	80.6
Sweetened drink		13	4.1
Tea/coffee		49	15.3
Hydration status			
Adequate hydration		181	56.6
Dehydrated		139	43.4
Body mass index			
Underweight		20	6.3
Normal		62	19.4
Overweight		106	33.1
Obese		132	41.3

Variable	Heat illness category		Type of analysis	P value
	Light(%)	Moderate to severe (%)		
Age group				
<29	20(69.0%)	9(31.0%)	χ2 =11.17	0.011
30-39	44(56.4%)	34(43.6%)		
40-49	76(62.8%)	45 (37.2%)		
50+	39(42.4%)	53(57.6%)		
Gender				
Male	7 (50.0%)	74 (50.0%)	χ2 =3.94	0.047
Female	105 (61.0%)	67 (39.0%)		
History of heat illness				
Yes	69 (45.4%)	83 (54.6%)	χ2 =13.06	0.0001
No	110(65.5%)	58 (34.5%)		
Time of water intake				
When feeling thirsty	148 (51.7%)	138 (48.3%)	χ2 =19.17	0.0001
Fixed timing	31(91.2%)	3(8.8%)		
Type of drink				
Plain water	163(63.2%)	95 (36.8%)	χ2 =30.52	0.0001
Sweetened drinks	1(7.7%)	12(92.3%)		
Tea/ coffee	15(30.6%)	34(69.4%)		
Hydration status				
Adequate hydration	127(70.2%)	54(29.8%)	χ2 =34.23	0.0001
Dehydration	52(37.4%)	87(62.6%)		

Variable	Simple Logistic Regression			Multiple Logistic Regression			
	Crude OR	95%CI	p value	Adj. OR	95%CI	X2 stat (df)[a]	P value
WBGT	1.19	(0.78;1.80)	0.421	1.76	(1.04;2.97)	4.61	0.034
Age group			0.012			13.85 (3) [b]	0.003
30-39	1.72	(0.70;4.25) [b]	0.242	3.00	(0.96;9.40))	4.21(1) [b]	0.059
40-49	1.32	(0.55;3.14) [b]	0.536	2.69	(0.88;8.11)	3.06(1) [b]	0.080
50+	3.02	(1.24;7.35) [b]	0.015	6.77	(2.15;21.29)	10.68 (1) [b]	0.001
<29	1.00			1.00			
Gender							
Male	1.57	(1.01;2.45)	0.047	-	-	-	-
Female	1.00						
History of heat illness							
Yes	2.28	(1.45;3.58)	0.001	2.25	(1.31;3.87)	8.76(1)	0.003
No	1.00			1.00			
Time of water intake							
When feeling thirsty	9.64	(2.88;32.23)	0.001	14.76	(3.89;55.94)	23.09(1)	<0.001
Fixed timing	1.00			1.00			
Type of drink			<0.001			17.30(2) [b]	<0.001
Sweetened drink	20.59	(2.64;160.84) [b]	0.004	27.23	(2.80;264.49)	8.11(1) [b]	0.004
Tea/Coffee	3.89	(2.01;7.51) [b]	<0.001	3.77	(1.76;8.09)	11.65(1) [b]	0.001
Plain water	1.00			1.00			
Hydration status							
Dehydrated	3.94	(2.46;6.27)	<0.001	3.51	(2.04;6.07)	21.26(1)	<0.001
Adequate hydration	1.00			1.00			

a : Likelihood ratio b : Wald test Adj OR : Adjusted odd ratio
Backward LR method used for multiple logistic regression
(r2=0.38; the model is reasonably fits well; model assumptions are met; no multicolinearity problem)

DISCUSSION

- Solid waste workers in Negeri Sembilan was exposed to heat above TLV and at high risk of developing heat related illness.
- Prevalence of heat related illness among solid waste workers was 44%. It was higher than other studies among outdoor workers in other studies (Mirabelli et al 2010, Tawatsupa et al 2012, Xiang et al 2016)

DISCUSSION

- WBGT, heat illness history, hydration status, type of drink and time of fluid intake associated with occurrence of heat illness was similar with previous study (Bethel et al (2014), Deghan et. al (2012), Lundgren et al(2013), Montazer et al (2013))

- Soft drinks, sweetened drink and caffeinated drinks will result in hyperosmolarity which will increase metabolic rate and additional body heat and increase the risk of having heat illness (Tonelli et al, 2011) .

DISCUSSION

- Paced fluid replacement need to be emphasized in hydration practice at workplace rather than responding to thirst sensation (Brake, D. J., & Bates, G. P, 2003).
- American Conference of Governmental Industrial Hygienists (ACGIH) recommend replacing fluids frequently when exposed to heat stress, such as one cup (250 ml) every 20 minutes when working in warm environments.

CONCLUSION

- This study adds to the knowledge of heat exposure among outdoor workers in Malaysia.
- Predicting factors such as age group and heat illness history can be used to identify high risk individual of having heat illness at workplace.
- Fluid intake at workplace (type of fluid and time of intake) and monitoring of hydration status based on urine colour need to be emphasized in education and prevention of heat related illness among workers who expose to heat stress environment.

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Thank you

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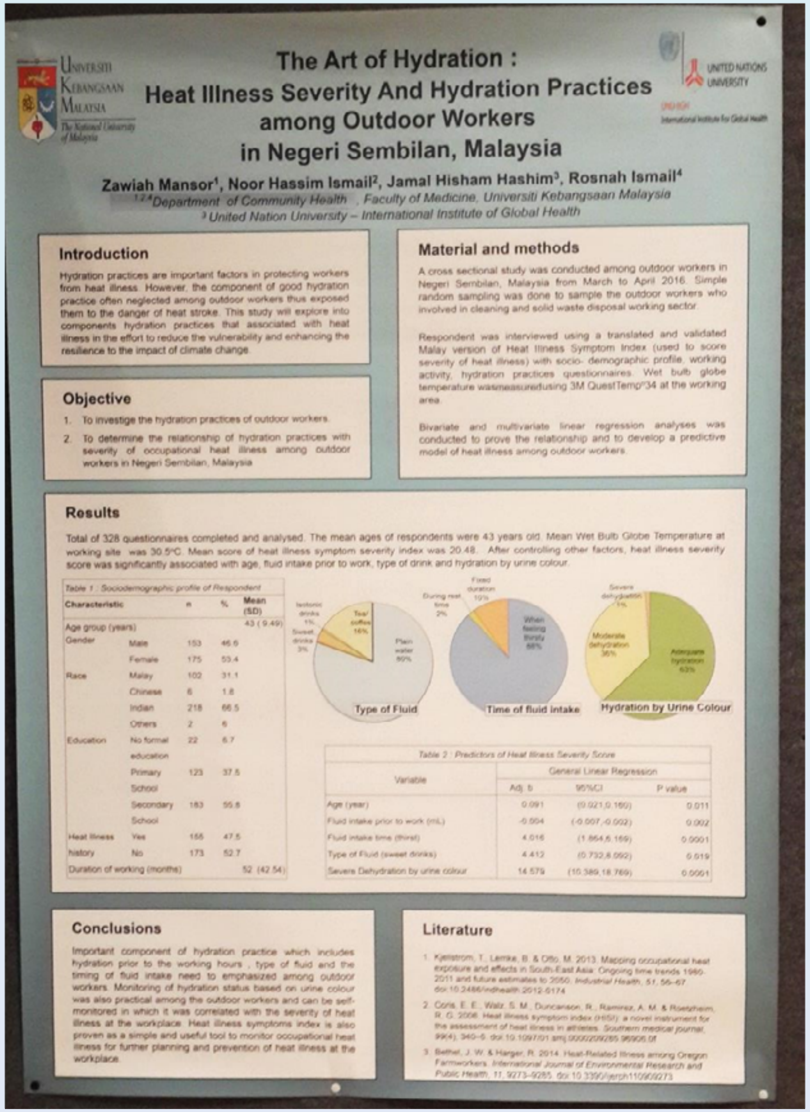


CONCEPTUAL FRAMEWORK

Environmental factors
- Radiant temperature*
- Ambient Temperature*
- Humidity*
- Air Movement*

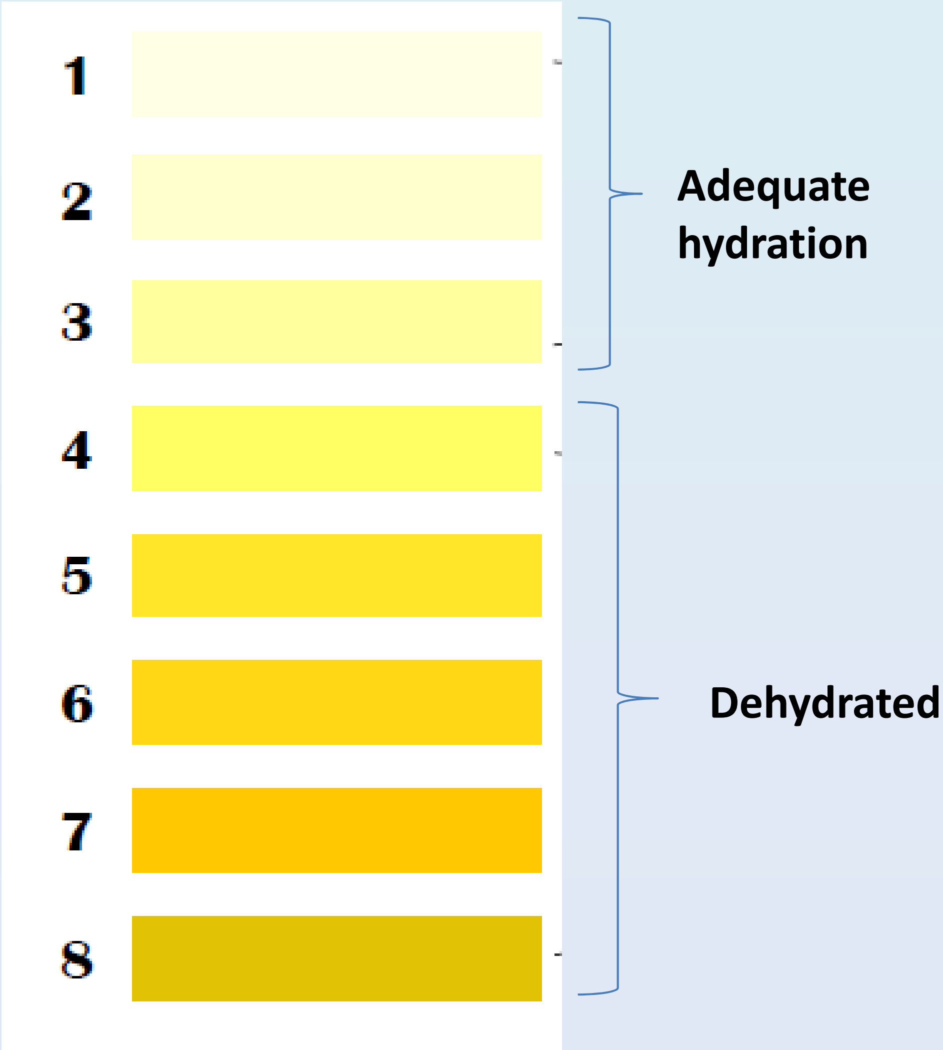
Socio-demographic factors
- Age *
- Gender*
- Ethnic*
- Migrant status
- Location (urban)

Behavioural Factors
- Clothing *
- Metabolic rate*
- Alcohol consumption*
- Fluid intake*
- Type of fluid intake
- Timing of fluid intake
- Medication intake*
- Knowledge of Heat illness

Physiological factors
- Body morphology *
- Hydration status*
- Medical illness*
- History of heat illness*
- Aerobic capacity
- Acclimatization status

HEAT RELATED ILLNESS

8 scale Urine Colour Chart



- Developed by Armstrong et al. in 1994 to assess hydration status
- Had significant linear relationship with urine osmolality and urine specific gravity
- Specificity (97%) and specificity (81%)

Symptom or Sensation	None	Mild, did not interfere with work	Moderate, slowed my work down	Significant enough to take a break	Severe enough to stop work
Tired	❒	❒	❒	❒	❒
Muscle Cramps	❒	❒	❒	❒	❒
Nausea	❒	❒	❒	❒	❒
Dizziness	❒	❒	❒	❒	❒
Thirst	❒	❒	☼	❒	❒
Vomiting	❒	❒	❒	❒	❒
Confusion	❒	❒	❒	❒	❒
Muscle Weakness	❒	❒	❒	❒	❒
Heat Sensation on Head or Neck	❒	❒	❒	❒	❒
Chills	❒	❒	❒	❒	❒
Lightheaded	❒	❒	❒	❒	❒

RESEARCH JUSTIFICATION

- Heat exposure level in outdoor setting in Malaysia
- Solid waste management workers
- Predictors of heat related illness
- Heat Illness Screening tools
- Heat stress prevention in Malaysia and globally