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SCHOOL OF PUBLIC HEALTH

Proceedings of a National Workshop on Heat and Work Injury

Wednesday October 17, 2018

National Wine Centre, Adelaide

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SA Health

THE UNIVERSITY OF WESTERN AUSTRALIA

UNDERSTANDING AND PREVENTING INJURIES IN HOT WORKING CONDITIONS

The University of Adelaide

AUTHORS

Dino Pisaniello

Alana Hansen

Blesson Varghese

Susan Williams

Acknowledgement:

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The authors wish to thank the data custodians: Safe Work Australia, SafeWork South Australia, the Australian Bureau of Meteorology and SA Health. We are grateful to all the people and organisations who generously gave their time to contribute to this study by promoting or taking part in the surveys and interviews, and the attendees at the National Heat and Work Injury Workshop, many of whom came from interstate for the event. We also wish to thank all who helped in the organisation of the Workshop including the table scribes (Dr Scott Hanson-Easey, Dr Monika Nitschke, Dr Paul Rothmore, Ms Tanya Wilkins), and Dr Sharyn Gaskin for taking photographs.

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EXECUTIVE SUMMARY

Hot weather is a hazard that can lead to serious illness and increased risk of work-related injury. Preventive strategies are needed to address the risks to workers and potential losses in productivity, particularly in the context of Australia's warming climate.

The Heat and Work Injury project was undertaken to comprehensively investigate workers' health and safety at high temperatures, with the goal of providing new perspectives on injury prevention. The University of Adelaide research team coordinated the project, in collaboration with researchers from Monash University, Queensland University of Technology, and University of Western Australia. The Heat and Work Injury project has: (i) demonstrated the impact of heat exposure (maximum temperature and heatwave) on workers' compensation claims (injuries) in Adelaide, Melbourne, Brisbane and Perth; and (ii) examined stakeholder views to inform the development of more effective strategies for injury prevention during hot weather.

This document summarises the outcomes from a National Heat and Work Injury Workshop held in Adelaide, on October 17th 2018, as the final stage of the Heat and Work Injury project. The workshop commenced with presentations of the evidence generated during the project. These presentations provided a background for the subsequent group discussions to consider recommendations for risk assessment and preventive measures, policy and interagency collaboration, and awareness and training.

The workshop discussions endorsed a holistic approach to address the risks of heat injury in the workplace. Greater awareness of the hazard at all levels of management, and more broadly across the community is a priority. There was consensus that workers need to feel empowered to self-pace and take precautions as required, and that this can be facilitated through evidence, strong safety cultures, good leadership and awareness of regulatory policy. A step-up in work safety culture to meet the current guidelines for heat safety is required so that workers are confident to raise issues without concerns of job security. Addressing the hazard through higher levels of control, including design of places and systems, should be a clear priority. Risk assessment apps and wearable technologies can be powerful tools as part of broader preventive strategies.

Final Recommendations

- Promotional campaigns should be undertaken to increase awareness of the currently available heat and work safety guidance materials and to foster compliance.
- Information about heat-related health and safety risks should be included in risk communication material from all relevant agencies such as regulators, health departments, and industry-specific employee advocates.
- Assessments of PPE should include its suitability for hot weather.
- Risk assessment apps to measure predicted heat strain and thermal risk can be useful and their usability should be considered for certain workplace situations.
- Heat hazards should be addressed through workplace design and systems to minimize exposure risks; however, this does not obviate the need for training of employees and those in leadership roles, about the risk of heat induced illness and injury.

1. OBJECTIVES OF THE RESEARCH

1.1 Introduction

Approximately 530,000 Australians experience a work-related injury each year with the total estimated economic cost during the 2012-13 financial year alone being $61.8 billion [1]. Working in hot weather is a hazard that can lead to serious illness, but its role in injury causation is poorly characterised. Understanding more about heat-related work injuries and developing relevant preventive strategies will help to meet national injury reduction targets, and reduce losses in productivity. The need for such research is particularly relevant in the context of Australia's warming climate.

Building on previous research undertaken at the University of Adelaide [2-5], researchers began work on the current project in 2016, to comprehensively investigate workers' health and safety at high temperatures with the goal of providing new perspectives on injury prevention.

1.2 Aims and Objectives

The aims of the project were to (a) systematically examine the association between ambient heat and occupational injury in Australia; (b) investigate a range of stakeholder perceptions towards heat-related injury, its prevention and management; (c) generate new evidence to inform national injury prevention policy and guidance and (d) facilitate the development of practical resources for use in industries to aid in the prevention of heat-related injury.

Specific **Objectives** were:

1. To extend current data for Adelaide, investigating the association between ambient temperature and recorded work-related illnesses and injuries in a further three Australian cities.

2. To characterise the recognition and management of heat-related injury, using a mixed methods approach, incorporating a national online survey and a series of injury case studies.

3. To engage stakeholders and experts in the review and design of evidence-based preventive strategies.

The **research questions** to be addressed were:

- What is the epidemiology of heat-related injury and how does it compare across Australia?
- What are stakeholders and workers' perceptions and experiences?
- What policy, prevention, management, and educational insights can be gained from workers who have experienced a heat-related injury?
- What additional resources/tools/interventions are required or should be adapted for management in Australian SMEs?

2. RESEARCH ACTIVITIES

The research proceeded in a number of stages, namely: ethics approval, literature review, establishment of a Project Steering Committee, data acquisition for Part 1 (analysis of workers' compensation claims data), Part 2 (survey of stakeholders) and Part 3 (interviews) and data analyses to inform Part 4 (the National Heat and Work Injury Workshop) (Figure 1).

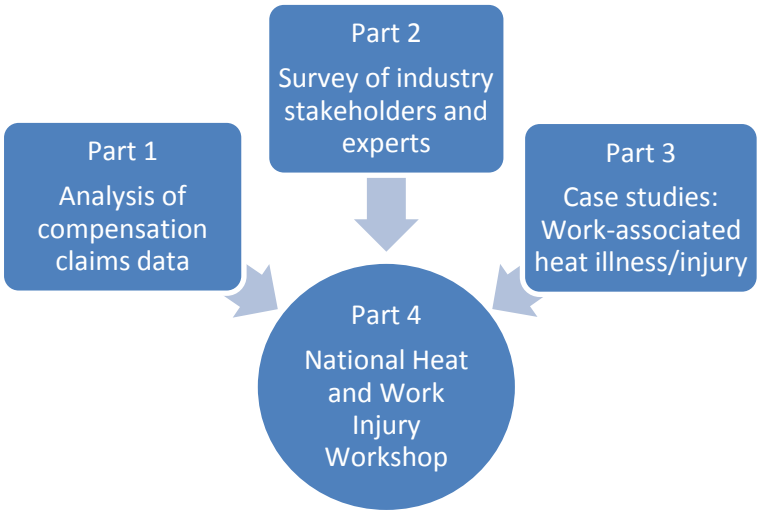


Figure 1: Study plan showing Parts 1-4 of the research project

2.1 Ethics approval

The lead organisation for this project was The University of Adelaide, in association with Monash University, Queensland University of Technology and The University of Western Australia. The partner organisations were SA Health and SafeWork SA. Ethics approval was received from all the relevant centres ensuring the study was conducted according to strict ethical guidelines.

2.2 Literature review

A review of published literature was conducted to summarise current knowledge regarding the association between heat exposure and workplace injuries/accidents. Bibliographic databases were used to search the peer-reviewed scientific literature with key words such as 'heat', 'heat stress', 'hot weather', 'injury', 'occupation' and 'work-related'. The search strategy also involved searching grey literature including reports from government departments, theses and conference presentations. For the full literature review please refer to the article by Varghese *et al.* (2018) published in the journal *Safety Science* [6].

In brief, the review yielded 26 relevant yet diverse articles from countries across the world, albeit mainly from those in the Northern Hemisphere. The evidence showed a clear relationship between hot weather (also heatwaves) and a range of occupational injuries, with contributing factors to injury risk being fatigue due to the heat, loss of concentration and alertness, and reduced psychomotor performance.

2.3 Project Steering Committee

Early in 2016 the Project Steering Committee was established. This group of chief investigators, partner investigators, experts and researchers ensured the project was conducted with academic integrity and methodological rigour.

The Committee consisted of:

Professor Dino Pisaniello (The University of Adelaide)

Professor Adrian Barnett (Queensland University of Technology)

Professor Malcolm Sim (Monash University)

Professor Jane Heyworth (University of Western Australia)

Professor Peng Bi (The University of Adelaide)

Dr Scott Hanson-Easey (The University of Adelaide)

Dr Monika Nitschke (SA Health)

Ms Shelley Rowett (SafeWork SA)

Associate Professor Ross Di Corleto (Australian Institute of Occupational Hygienists)

Dr Jianjun Xiang (The University of Adelaide)

Dr Alana Hansen (The University of Adelaide)

Mr Blesson Varghese (PhD candidate, The University of Adelaide)

2.4 Part 1 - Analysis of workers' compensation claims data

A group of four studies was conducted to investigate the effects of temperature exposure and heatwaves on the occurrence of workplace injury in Adelaide, Melbourne, Brisbane and Perth. Workers' compensation claims data were obtained from Safe Work SA for data pertaining to Adelaide (2003-2013), and from Safe Work Australia for interstate data (2006-2016). Weather data were obtained from the Bureau of Meteorology. Complex statistical methods (e.g. time stratified case-crossover design, and distributed lag non-linear models), were used to analyse the data.

2.4.1 Results

In Adelaide, the minimum number of claims occurred on days when the maximum temperature was 25^{o}C. Claims for injuries such as fractures, traumatic joint/ligament injuries, burns, wounds and lacerations increased as the temperature increased. Hot, but not extreme, temperatures occur more often and were therefore associated with high numbers of injuries. Outdoor industries were most at risk (there was a 9 fold increase in injuries in the electricity gas and water sector in extreme heat) and some indoor industries were also at risk. Compensation claims also increased during moderate intensity heatwaves (as defined by the Bureau of Meteorology) but not significantly for high intensity heatwaves. Claims for new workers increased 31% and for 21% labourers. Males, medium sized enterprises and indoor industries also particularly vulnerable.

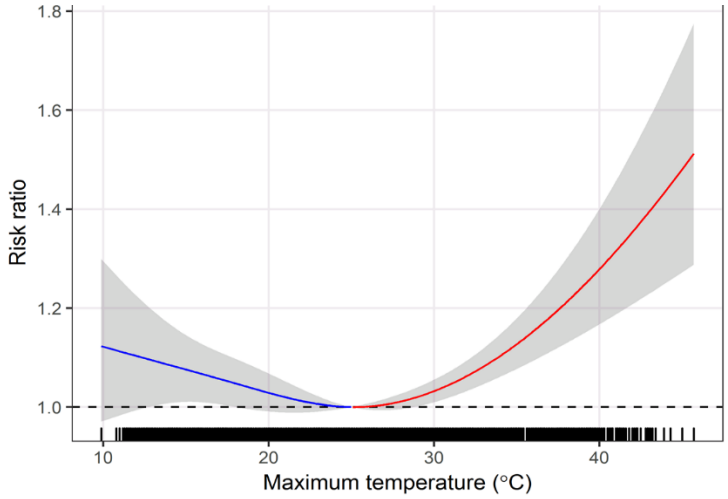


Figure 2: The association between temperature and workers compensation claims in Adelaide for 2003-2013. The risk ratio indicates the increased risk above 1.00 (i.e. no effect, which occurs when the daily maximum temperature is 25°C). At the highest temperature the risk ratio is 1.5 indicating a 50% increase in claims.

Findings varied somewhat for the other cities. In Melbourne there was a 14% increase in claims in extremely hot temperatures compared to median temperature at which claims were lowest. Workers in regulated indoor climates and in vehicles/cabs had increased risk of injury; and claims attributed to 'heat, electricity and other environmental' factors increased in moderately hot temperatures whereas mental stress increased at extremely high temperatures. Similar patterns were not evident in Perth or Brisbane. Nevertheless, in all 3 cities there was a decreased injury risk at the coolest temperatures. During moderate/high severity heatwave days claims increased compared to non-heatwave days in each city with the highest effect in Brisbane. Amongst those most at risk were, males, new workers, and labour hire workers. Both outdoor and indoor work resulted in increased injury claims during heatwaves.

2.5 Part 2 - Surveys

Online surveys were conducted amongst three groups of stakeholders (i.e. 307 health and safety professionals, 222 health and safety representatives, and 387 workers) to investigate heat-related workplace injuries and preventive measures. Recruitment was through worker advocate groups, organisations and regulators across Australia who advertised the study website.

2.5.1 Results

More than two-thirds of the professionals reported heat-related injuries/incidents in workplaces; compared to 43% of the representatives. Hand injuries and musculoskeletal injuries were commonly seen together with fatigue, muscle/heat cramps and severe dehydration. The professionals felt that access to heat stress training and access to cool drinking water were the most important prevention measures for outdoor and indoor workers, respectively; whereas representatives believed that for outdoor workers ceasing work in extreme temperatures was most important and for indoor workers, access to air conditioning. Lack of training/awareness and personal protective equipment (PPE) leading to higher body temperature were barriers mentioned by both groups of survey respondents.

Workers from indoor and outdoor environments described detrimental effects on their health and safety due to heat exposure. Effects included heat exhaustion, dehydration, fatigue, effects on mood and concentration; and in some cases fatal, or near fatal incidents. Suggested prevention measures included keeping hydrated, having more rest breaks, better designed PPE, having cease-work temperatures, and more understanding by management.

2.6 Part 3 – Interviews

Interviews were conducted to gain a deeper understanding of the impacts of heat exposure on affected workers. As with the surveys, organisations, regulators and health and safety groups distributed information about the research and the associated study website to aid recruitment. Twenty one people from 5 states contacted the researchers and were willing to discuss their experiences. Many had backgrounds in high risk sectors such as construction, emergency service, manufacturing, transport and agriculture.

2.6.1 Results

Respondents spoke of minor to life threatening experiences associated with working in hot conditions. Among the reports were dehydration, blisters, fractures, lacerations, traffic accidents, severe heat cramps, fatal heat stroke in seasonal migrant workers, and severe brain injury (the latter due to dehydration and hyperthermia). Fatigue was a common contributing factor. It was said that often people are hesitant to have, or in some cases were denied, adequate work/rest regimes in the heat due to financial or productivity concerns, especially if on piece rates or self-employed. Recommendations included more awareness and training about heat risks, information for vulnerable workers, that having good supervision is important, and that workers keep hydrated, look out for each other, and take breaks as required.

2.7 Publications

There have been three publications thus far from this research.

- Varghese B, Hansen A, Bi P, Pisaniello D. Are workers at risk of occupational injuries due to heat exposure? A comprehensive literature review. Safety Science. 2018. doi.org/10.1016/j.ssci.2018.04.027

- Varghese BM, Hansen A, Nitschke M, Nairn J, Hanson-Easey S, Bi P, Pisaniello D. Heatwave and work-related injuries and illnesses in Adelaide, Australia: a case-crossover analysis using the Excess Heat Factor (EHF) as a universal heatwave index. 2018. International Archives of Occupational and Environmental Health. doi: 10.1007/s00420-018-1376-6

- Hansen A, Pisaniello D, Varghese B, Rowett S, Hanson-Easey S, Bi P, Nitschke M. What can we learn about workplace heat stress management from a safety regulator complaints database? International Journal of Environmental Research and Public Health 2018, 15, 459; doi:10.3390/ijerph15030459

Several other manuscripts are in preparation or currently under peer review.

3. NATIONAL HEAT AND WORK INJURY WORKSHOP

The National Heat and Work Injury Workshop was held on October 17 2018 at the National Wine Centre, Adelaide. Fifty two invited local and interstate stakeholders attended including academics, experts, and representatives from a variety of sectors including national, state and local government, regulators, worker's advocate groups, unions and professional bodies. See Appendix 1 for the full list of attendees.

The aims of the workshop were:

- To consult with a wide stakeholders group regarding the findings from the research, and the broader implications for workers, industry, professionals and government
- To assist in the development of evidence-based recommendations and to discuss how they might be implemented

The workshop was facilitated by Ms Wendy Tims (Wendy Tims Consulting Pty Ltd). Small group discussions were used to capture stakeholders' perspectives on specific themes, with the discussions recorded by table scribes. The synthesis of these notes is reported in the following sections.

Workshop Session Plan

Welcome and overview of day

- Presentation of findings* from the 'Heat and Work Injury' Project
  (Prof Dino Pisaniello, The University of Adelaide)
- Examining injuries in relation to temperature and heatwave exposure – epidemiological evidence from 4 cities
  (Blesson Varghese – PhD Candidate, The University of Adelaide)
- Stakeholders and workers' perceptions and experiences
  (Dr Alana Hansen, The University of Adelaide)
- Discussion and questions

Morning tea

- Group discussions
  Theme 1 - Risk assessment/Preventive measures)
  Theme 2 - Policy/Legislation/Interagency collaboration
  Theme 3 - Awareness and training
- Latest technologies
  (Dr Ross Di Corleto)

Workshop Close & Lunch

*Slides from the presentations appear in Appendix 2

3.1 Synthesis of Group Discussions:

3.1.1 Theme 1: Risk assessment and preventive measures

What specific changes are required in risk assessment approaches to reduce injuries during hot weather?

How should we prioritise preventive measures to reduce injury risk during hot weather? (E.g. Fluid intake requirements, electrolyte requirements, modified PPE, altered work shifts)

There were several key messages from the discussion on this theme. Firstly, there was a strong view that education about the risk assessment process was needed throughout organisations, from management to crew leaders. Secondly, it was argued that risk assessments needed to be based on evidence and using real-time data to be valid, competent and understandable by the workplace, and to resonate with the workers. In other words, risk assessments should be tailored to the situation. It was thought that assessments are often too generic, not contemporary, and are written in an office environment.

Pictured: Prof. Dino Pisaniello. *Photo: Sharyn Gaskin*

Some organisations already have highly developed dynamic risk assessment procedures to meet the demands of constantly changing risks (e.g. fire services). Within this process, it is important that team leaders and workers are cognizant of individual risks, in other words that they 'know the team.' It was suggested that this might be more difficult in some situations, for example, with fly-in, fly-out workers. The merits of buddy systems were discussed in relation to some industries (mining, fire services).

A strong message was that prevention strategies are needed at a high level, for example, engineering controls to change the work environment, rather than changing individual behaviours to drink more water or electrolytes, for example. Workplace organisation is a key determinant, with strong management commitment needed to provide a supporting structure.

It was acknowledged that the use of personal protective equipment (PPE) could be problematic during hot weather. Further assessments of PPE were recommended. Defence was highlighted as a sector where the development of PPE for hot conditions was well advanced (thermally optimal and support venting efficiently).

There was a comprehensive discussion about the use of mobile phone risk assessment apps (see Appendix 3 for details on the 'Thermal Risk Assessment' app and the 'Predicted Heat Strain' app), which can provide a risk rating for working in the heat. Both apps are designed to incorporate the different contextual aspects of exposure and work, with the former designed for general use, and the latter for the health and safety professional. The 'Thermal Risk Assessment' app has been successfully implemented in many workplace settings, with expert opinion that it is 'quite powerful if used carefully and properly'. Other examples were described of wearable technology being used in the power sector

and NBN Co. In SA Power, this technology has been used to centrally monitor power crews, to determine when welfare calls may be needed.

In the broader discussion about the use of mobile phone apps there were a number of questions and issues raised: (i) a lack of awareness that apps are available, (ii) questions about their utility for emergency workers (due to the time pressures in emergency situations), (iii) whether management is likely to support the use of apps in some cases, (iv) the utility of apps for those workers who do not have access to mobile phones at work, and (iv) the potential advantages of apps to engage with younger workers. The take-home message was that apps can be very useful when used in a targeted fashion, and are a valuable tool to raise awareness and for training purposes, for example in tool-box talks.

RECOMMENDATIONS proposed for discussion:

1. Modify existing heat stress risk assessment tools to incorporate injury, occurring under moderately hot conditions, indoor and outdoor. (E.g. mobile phone, web-based)
2. More holistic frameworks for decision making about heat risk (to include increased injury risk from physical hazard/heat combination)
3. Assess the suitability of PPE in relation to the potential to increase heat load

There was general endorsement of these recommendations, particularly 2 and 3.

3.1.2 Theme 2: Policy legislation and interagency collaboration

How can we improve policy, legislation, and interagency collaboration to reduce injury burden in hot weather?

The importance of good policy and guidelines was universally recognised. Some particular points were raised in relation to policy. Firstly, there was some discussion about organisations being unaware of current policies, or not adhering to them. It was noted that policy alone would not change behaviour. A need for compliance campaigns by regulators was suggested. Sensitivities around the issue of regulatory burden were raised, particularly in relation to SMEs.

Pictured: Dr Alana Hansen *Photo: Sharyn Gaskin*

There was some discussion about the need for policies to address injury risks for specific industries and locations, preferably to be led by industry to attain maximal support. It was noted that, while industry associations are well placed to convey guidance information they lack authoritative power.

It was suggested that any updates to policies would need to come from 'the top' and focus on higher levels of control, design of the workplace and systems of work. Policies should not be dependent on arbitrary decisions by supervisors. It was suggested that working parties, involving heads of workplace safety, should be established to progress good policy for outdoor and indoor work.

In relation to guidance materials, it was considered that there are good materials available, but there may need to be better awareness of these resources, and the need for consistency was noted. A need

for industry step-up, rather than improvements in guidance materials, was indicated. In some cases, this requires a stronger HSR culture than currently exists.

Recommendations for cut-off temperatures were raised, with the suggestion that a negotiation point for stopping work is essential. Mandating that above a set temperature it be considered that 'you are potentially at risk'. This raises the issue of which temperature measure to use, a Bureau of Meteorology station or a workplace measurement that can account for specific aspects of solar radiation and humidity.

It was considered that problems among vulnerable workers (e.g. seasonal, migrants, young workers) demanded policies with a broader focus, to tackle the core issue of job insecurity. It was noted that targeted campaigns for seasonal workers have already been conducted in some locations, with heat exposure being incorporated.

Finally, there was a case made for greater interagency collaboration, to share resources and provide a one-stop shop for consistent information (from public health, work safety agencies, emergency services).

RECOMMENDATIONS proposed for discussion:

1. Model heat stress policies (for use by industry)
2. Modified codes of practice and guidance notes
3. Guidance for workplace inspectors
4. Risks to vulnerable workers should be addressed (especially seasonal migrant workers)

While there was overall endorsement of these recommendations as valid and useful, some stakeholders indicated that they are already being addressed in some jurisdictions. More technical information would be beneficial to incorporate injury specific risks into industry policies or guidance materials. The risks to vulnerable workers were considered to be part of a broader issue

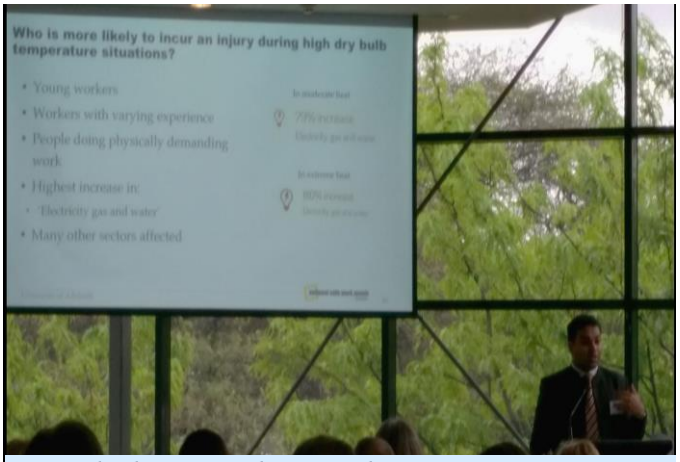
Pictured: Workshop attendees discussion. *Photo: Sharyn Gaskin*

3.1.3 Theme 3: Awareness and Training

What changes, if any, are needed in heat stress awareness and training to incorporate injury risks? (Type, learning outcome, content, delivery platform?)

The need for education and good quality information was a clear message throughout the workshop discussions. There was a view that different agencies could collaborate more closely to share resources and provide a one-stop shop for consistent information (public health, work safety agencies, emergency services). This could include a greater awareness that heat affects all daily activities, including sleep, and that these overall effects compound the problems related to work exposure. Similarly, awareness and training should extend to the continuum of heat effects, rather than focusing on the more severe end of the spectrum. Furthermore, there needs to be recognition that there is a considerable burden of effects on moderately hot days (not just extremes or heatwaves). It was noted that community risk perceptions for heat are still quite low, and that this has import for workplaces as well.

There was a strong view that workers need to feel empowered to speak up, to self-pace in the heat, or to take other precautions as required, without fear of repercussions. Evidence can help empower workers, but a stronger safety culture is also required in some cases. Workers may be aware of the adverse effects of heat, but if they are not able to take protective actions, this awareness is not providing any benefit. It was argued that guidance material for heat is already available but there needs to be industry step-up to achieve coherence with relevant guidance. Good quality information has been the key for successful prevention programs in some sectors.



Pictured: Blesson Mathew Varghese. *Photo: Sharyn Gaskin*

The accessibility of resources should be considered, particularly for workers with literacy or language barriers, or those with limited access to mobile phone or computers at work. The utility of simple graphical guides was discussed. It was also stressed that businesses (SMEs) need short ready-to-go training resources because they do not have the capacity to develop or implement sophisticated training programs. It was noted that effective training models are audience driven, with the target audience considered first, and the teaching points developed to suit. The utility of mobile phone apps for awareness and training was also raised.

In relation to training, there was a strong view that this is the lowest level in the hierarchy of control, and that heat risks should be addressed at higher levels – the design of places and systems. In other words, awareness and training should not be a 'band-aid' fix for poor design and policy. Consistent with this, was the view that the responsibility should not fall entirely to the workers to address the risks through hydration and other personal measures.

The role of strong leadership and management was a consistent message throughout the discussions. It may be that the need for awareness and training is greater at this level – to equip leadership with an

understanding of the importance of design of place and systems, the responsibilities to workers, and the economic impact of reduced productivity through poor management of risks.

RECOMMENDATIONS proposed for discussion:

1. Promote awareness through industry associations
2. That more training resources be developed
3. Promote awareness of broad range of resources
4. That mass media be used as a platform

These recommendations were not specifically addressed in detail.

3.1.4 Summary of Workshop Discussions

Workshop participants advocated for a holistic approach to address the risks of heat injury in the workplace. Greater awareness of the hazard at all levels of management, and more broadly across the community is a priority. There was consensus that workers need to feel empowered to self-pace and take precautions as required, and that this can be facilitated through evidence, strong safety cultures, good leadership and awareness of regulatory policy. A step-up in work safety culture to meet the current guidelines for heat safety is required so that workers are confident to raise issues without concerns of job security. Addressing the hazard through higher levels of control, including design of places and systems, should be a clear priority. Heat training should involve consultation with workers, adaptable to different workplaces, and accessible to a diverse workforce. Risk assessment apps and wearable technologies can be powerful tools as part of broader preventive strategies.

4 FINAL RECOMMENDATIONS

The final recommendations arising from the workshop discussions and the project findings are:

- **Promotional campaigns should be undertaken to increase awareness of the currently available heat and work safety guidance materials and to foster compliance.**
- **Information about heat-related health and safety risks should be included in risk communication material from all relevant agencies such as regulators, health departments, and industry-specific employee advocates.**
- **Assessments of PPE should include its suitability for hot weather.**
- **Risk assessment apps to measure predicted heat strain and thermal risk can be useful and their usability should be considered for certain workplace situations.**
- **Heat hazards should be addressed through workplace design and systems to minimize exposure risks; however, this does not obviate the need for training of employees and those in leadership roles, about the risk of heat induced illness and injury**.

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6. Varghese, B., et al., *Are workers at risk of occupational injuries due to heat exposure? A comprehensive literature review.* Safety Science, 2018. **110** p. 380-392.

APPENDIX 1: Workshop attendees

Attendee	Organisation
Adrian Barnett	Queensland University of Technology
Alana Hansen	University of Adelaide
Andrea Fox	Office of Industrial Relations, Qld
Andrew Graves	Comcare
Angela Jolic	Worksafe, Victoria
Ben Simpson	National Electrical and Communications Association, SA
Bernie Doyle	National Safety Council of Australia
Blesson Varghese	University of Adelaide
Carolyn Dunn	Department of Jobs and Small Business, ACT
Christopher Ginever	Master Builders Association, SA
Chris Beattie	SA State Emergency Service
Chris Wicks	WorkSafe, NT
Deb Vallance	Australian Council of Trade Unions
Dino Pisaniello	University of Adelaide
Francesca da Rimini	University of Technology Sydney
George Karlis	SA Power Networks
Glenn Farrell	SafeWork SA
Ingrid Westra	Safework Australia
Ivor Roberts	Western Australia
John Nairn	SA Bureau of Meteorology
Jacqui Quarton	SafeWork SA
James Goodman	University of Technology Sydney
James Harrison	Research Centre for Injury Studies, Flinders University
Jane Heyworth	University of Western Australia
Jennifer Low	Australian Chamber of Commerce and Industry
Judy McInnes	Monash University
Keith Dear	University of Adelaide
Kellie Collins	Adelaide Brighton Ltd
Kristy Charlton	SafeWork NSW
Malcolm Sim	Monash University
Shanan Lawler	Comcare, SA
Michael Morgan	SA Metropolitan Fire Service
Monika Nitschke	SA Health
Neil Mangelsdorf	United Firefighters Union Australia
Paul Dickinson	SafeWork SA
Paul Rothmore	University of Adelaide
Paul Ploenges	Business SA
Peng Bi	University of Adelaide
Peta Miller	University of New South Wales
Richard Gun	University of Adelaide
Robin Marlin	Country Fire Service, SA
Ross Di Corleto	Australian Institute of Occupational Hygienists
Sandra Dann	Working Women's Centre SA
Scott Hanson-Easey	University of Adelaide
Sean Faulkner	City of Norwood, Payneham, St Peters, SA
Sharyn Gaskin	University of Adelaide
Shelley Rowett	SafeWork SA
Stephanie Creagh	Safework Australia
Steve Pavlich	SA Metropolitan Fire Service
Sue Williams	University of Adelaide
Tanya Wilkins	SafeWork SA
Tony Magliaro	NBN Co Ltd
Wendy Tims	Facilitator

APPENDIX 2: Presentations

Heat and Work Injury Workshop

10.00 Presentations
10.50 Morning tea
11.05 Group Discussion
12.30 Final session
13.00 Lunch (Vines Room, ground floor)
14.00 Q&A session (Vines room)

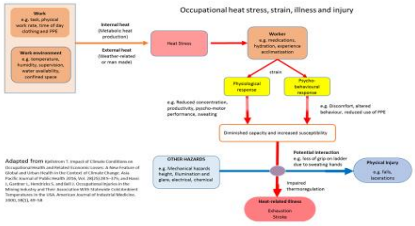
Overview:
Heat and Work Injury Project

Prof Dino Pisaniello

Background

- It has long been recognised that excessive heat exposure can cause harm to workers – illness and, potentially, injury
- Australian research is at the forefront of international efforts in understanding heat-related occupational injury
  - We acknowledge the work of others including researchers in the audience
- We acknowledge the help of Safe Work Australia and the jurisdictional authorities, and data custodians

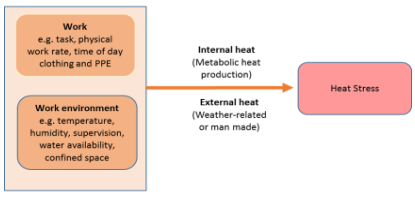
How could heat exposure result in injuries?



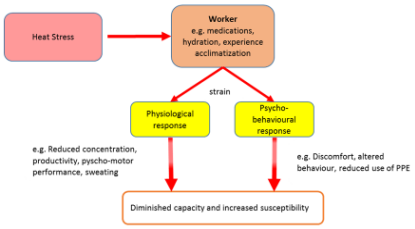
Adapted from Kjellstrom T. Impact of Climate Conditions on Occupational Health and Related Economic Losses: A New Feature of Global Change Research Tasks and Methods in the Asia Pacific Region. Asian Pacific Journal of Public Health. 2016; Vol. 28(2):113S – 57S; and Nunes I, Gunther L, Hendricks S, and Bell C. Occupational Injuries in the Mining Industry and Their Association With Ambient Cold and Hot Temperatures in the USA. American Journal of Industrial Medicine. 1993; 49:1-8.

Vanghese BM et al. Are workers at risk of occupational injuries due to heat exposure? A comprehensive literature review. *Safety Science*. 2018; 110: 380-392

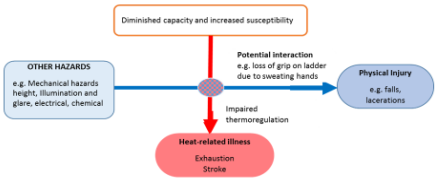
Factors leading to Heat Stress



Factors leading to Heat Strain



Factors leading to Illness and Injury





Effects of heat on productivity, injury risk and health

ARC Heat and Work Injury Research Project

Australian Government
Australian Research Council

Aims:

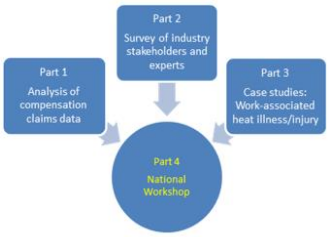
(a) examine the association between ambient heat and occupational injury in Australia;

(b) investigate stakeholder perceptions towards heat-related injury, its prevention & management;

(c) generate new evidence to inform injury prevention policy and guidance;

(d) facilitate the development of practical resources for use in industries to aid the prevention of heat-related injury

The ARC Heat and Work Injury Research Project



Multiple lines of quantitative and qualitative evidence

Part 1

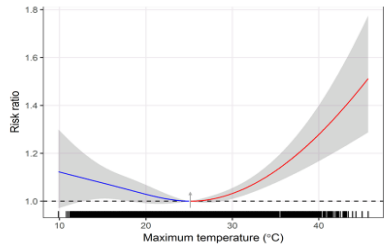
Associations of temperature & heat waves with workers compensation claims

Blesson Mathew Varghese

Aim

- To examine the relationship between **heat exposure** and work-related injuries
  - Using 2 BOM metrics (dry bulb temperature and EHF-defined heatwaves)
  - Using statistical analysis of workers' compensation claims data
  - ~ 90% of claims are for occupational injuries
- To identify vulnerable sub-populations, industries and types of injuries

Results for Adelaide



Claims for injuries and illnesses increase in hot temperatures

Compared to 25°C the risk increases by:
8% at 33°C
30% at 40°C

Indoor & outdoor workers affected

Who is more likely to incur an injury during high dry bulb temperature situations?

- Young workers
- Workers with varying experience
- People doing physically demanding work
- Highest increase in:
  - 'Electricity gas and water'
- Many other sectors affected

In moderate heat
79% increase
Electricity, gas and water

In extreme heat
810% increase
Electricity, gas and water

Types of injuries?

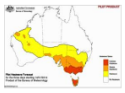
- **Injuries:**
  - Typically affecting arms, legs, hands
  - Involving - e.g. non-powered and powered tools, appliances, machinery
- **Associated with:**

Moderate heat	Extreme heat
39% heat & electricity	140% vehicle incidents
24% chemicals & other substances	120% heat & electricity

- **Especially:**

Extreme heat
130% Burns
30% Wounds, lacerations, amputations & internal organ damage
24% Traumatic joint/ligament & muscle/tendon injury

During heatwaves ...



- **Used definition of a heatwave developed by the Bureau of Meteorology - Excess Heat Factor**
  - EHF is a measure of heatwave severity relative to location

Results:

- **During heatwaves in Adelaide:**
  - Compensations claims increased - e.g. 21% ↑ labourers, 31% ↑ new workers
  - Work-related ambulance callouts also increased
- **Similar impacts in other cities even during moderate heatwaves**

Parts 2 & 3

Stakeholder perspectives - survey responses

Survey findings (1)

	Injury experiences	
Heat-related injuries or incidents occur in workplaces	HSPs (n=307) 75%	HSRs (n=222) 43%
Types of injuries or incidents	Musculoskeletal injuries, hand injuries, wounds or lacerations	
Also	Fatigue, heat cramps, severe dehydration	
How?	Slips, trips or falls, Not wearing PPE, Fogged safety glasses, Loss of control of tools	
Who?	New workers, those whose first language was not English (HSPs)	
Why?	No shade, PPE → higher body temperature, Rushed activity, Lack of training Poor supervision (HSPs), Inadequate resources and facilities (HSRs)	

Parts 2 & 3

Stakeholder perspectives - qualitative data

Alana Hansen

Survey of workers *(n=387)*

- **Experiences in hot weather most often reported:**
  - Heat exhaustion, dehydration, fatigue, feeling unwell, lowered mental awareness
- **Workers thought loss of concentration or fatigue led to increased risk of injury**
- **Strategies suggested by workers to prevent injuries in the heat:**
  - Keep hydrated
  - More rest breaks
  - Planning/scheduling work to suit the conditions
  - Better designed PPE
  - Management need to be more understanding

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University of Adelaide national safe work month October 23

SWSA 'Help Centre' dataset *(n=118)*

SafeWork SA
information > advice > support
Help Centre 1300 365 255

- **In 2009 SWSA establish a 'Help Centre'**
  - Details of telephone calls are compiled in a database
- **We analysed data on heat-related calls:**

Results

- > 50% related to indoor work
- Minor to more serious health effects
- Organisational issues (unvalidated) included:
  - *Requests for extra breaks denied*
  - *Management "pushing people to work past their capacity"*
  - *No drinking water, no PPE provided by employer*

"The thermometer in the shed was reading 55 C"

"The kitchen thermostat is reading at between 60 C-70 C"

"... The foreman's attitude was that if he stops work, don't bother coming back the next day."

Interviews *(21 people across 5 states, different sectors)*

- **People reported a range of heat-related symptoms and injuries**
  - Many relatively minor, some serious:
    - *Fatal heat stroke in seasonal migrant horticulture workers, quadriplegia, severe cerebrovascular injury**
- **Why?**
  - "No work no pay", dehydration, fatigue, attitudes to work breaks, PPE ↑ heat load
- **Recommendations:**
  - Awareness & training about heat risks
  - More information for vulnerable workers
  - Keep hydrated
  - Look out for each other, take breaks
  - Good supervision

"... but an understanding from a boss' perspective, that we're not, we're not machines, that we're humans and humans have limitations"

* Case study on poster

Acknowledgements:

Project team

- Prof Dino Pisaniello (UofA)
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- Prof Malcolm Sim (Monash University)
- Prof Jane Heyworth (UWA)
- Dr Scott Hanson-Easey (UofA)
- Dr Monika Nitschke (SA Health)
- Ms. Shelley Rowett (Safe Work SA)
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- Dr Jianjun Xiang (UofA)

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- **SafeWork SA and other state jurisdictions**
- **Bureau of Meteorology (John Nairn)**
- **SA Health (Monika Nitschke)**
- **Organisations who promoted the surveys and interviews**
- **Survey respondents**
- **Interview participants**

Key messages..

- **Occupational injuries increase during hot conditions**
- **At risk: young workers, both *indoor* & outdoor workers, both new and *experienced* workers**

- **Dehydration and fatigue are contributing factors to injury**
- **The concurrent use of PPE is considered a factor**
- **Lack of awareness is considered a factor**
- **Heat stress training considered available in <50% of workplaces**
- **Effective heat safety leadership lacking in some workplaces**

How can technology advance the prevention of heat-related injuries?

Assoc Prof Ross Di Corleto

Introduction

Assessing the work environment in relation to thermal risks has often been seen as a complex process.

Numerous tools, methods and concepts to consider.

But is it really that difficult?

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Monitoring in the Past (The good old days)

Ross Di Corleto

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Now one instrument does it all!

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And don't forget Physiological Monitoring

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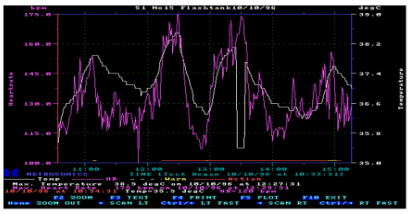
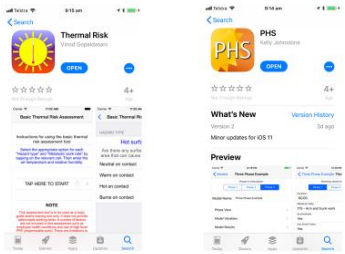
A "sample" of Heat Stress Technologies

Environmental	Physiological	Not yet released Physiological
Basic Thermal Risk Assessment (BTRA) app	Moisturemetre Epidermal Hydration Measurement	Sixty (unsure of release)
Predicted Heat Strain (PHS) app	Healbe GoBe 2 Life Band	Nobo B60
Romteck Heat Stress Monitor	BioStamp - MC10	LVL One fitness tracker
Kestrel 5400 Heat Stress Tracker	Hot Dot	Nix Biosensor
Centre 317- Humidity Temperature Meter	Masimo- Finger Pulse Oximeter	LVL Fitness/Hydration Tracker
Calor meter	Refractometer	Kenzen Patch
Scarlet TWL-1s	Hydration Strips (Hydratrend)	
	e-Celsius pill and monitor	

Physiological Monitoring



Heat Stress Apps



Ross Di Corleto

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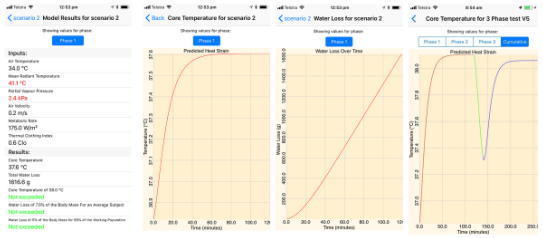
App Appearance

Format and appearance

PHS Output Results



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Where to from here?

More research is required on many of these technologies as they are as yet unproven in the field (accuracy?).

Education is crucial in order to:

- **Understand the limitations of the available technology (thus guides selection of technology)**
- **Understand the use and interpretation of the information collected.**

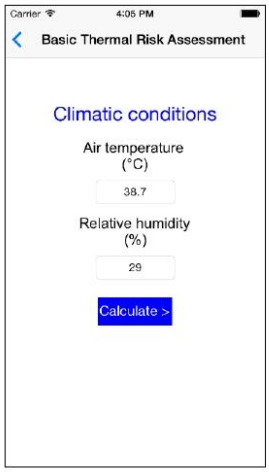
Technology can be a very powerful tool in the management of heat stress but it is not the silver bullet.

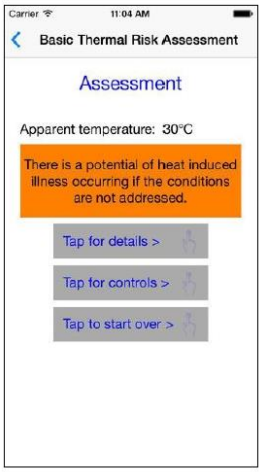
Questions & Discussion
Final wrap up

APPENDIX 3: Risk assessment apps

Basic Thermal Risk Assessment

(http://www.thethermalenvironment.com/the-heat-stress-risk-phone-app/





Predicted Heat Strain

(http://www.thethermalenvironment.com/the-predicted-heat-strain-mobile-application/)