Evaluating cardiovascular associations to affective states in Professional Drivers: A study of Australian truck and train drivers

by Doctor Taryn Chalmers
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Doctor of Philosophy (Science)

Under the supervision of
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Thesis Declaration

I, Taryn Chalmers, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Life Science at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis. This document has not been submitted for qualifications at any other academic institution.

This research is supported by the Australian Government Research Training Program.

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Thesis Publication Declaration

The following thesis papers have been submitted, are under review, or currently in press.

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Evaluating associations between workplace factors and stress, depression and anxiety in Australian train drivers. *Under review* – Industrial Health.

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Assessing cardiovascular links to affective/anxious states in Australian Professional drivers. *In Press* - Journal of Integrative Neuroscience

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Co-author signatures

I hereby declare the above information regarding papers, authors and author contributions to be correct.

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Publications, Presentations and Awards

Publications relevant to thesis

Journal articles

Chalmers, T., & Lal, S. (2022). Assessing cardiovascular links to depression and anxiety in Australian professional drivers. Journal of integrative neuroscience, 21(1), e43-e43.

Chalmers, T., Maharaj, S., & Lal, S. (2021). Associations between workplace factors and depression and anxiety in Australian heavy vehicle truck drivers. Annals of work exposures and health, 65(5), 581-590.

Chalmers, T., Lal, S. (2016). Prevalence of affective states in Australian truck and train drivers. Journal of the Australasian College of Road Safety. Vol 27, No 1, pg. 13-18.

Chalmers, T., Lal, S. (2014). Assessing cardiovascular associations to affective states in Australian truck drivers. Journal of the Australasian College of Road Safety. Vol 25, No 3, pg. 23-30

Conference abstracts

Chalmers, T., Lal. S., 2016. The prevalence of negative mood states within a population of Australian professional drivers. Publication date: Oct 2016. 21st International Council on Alcohol, Drugs and Traffic Safety Conference.

Chalmers, T., Lal. S., 2015. The prevalence of affective and anxious states within a population of Australian professional drivers. Publication date: Oct 2015. Australasian College of Road Safety Conference.

Chalmers, T., Lal. S., 2013. Assessing cardiovascular associations to affective states in Australian truck drivers. Publication date: Nov 2013. Australasian College of Road Safety Conference.

Chalmers, T., Lal. S., 2013. Assessing cardiovascular associations to mood states in professional drivers. Publication date: Nov 2013. Royal North Shore Hospital New Horizons Conference.

Other Publications

Journal articles

Chalmers, T., Hickey, B. A, Newton, P., Lin, C. T., Sibbritt, D., McLachlan, C. S., Clifton-Bligh, R., Morley, J.W., & Lal, S. (2022). Associations between sleep quality and heart rate variability; implications for a biological model of stress detection using wearable technology. Accepted. IJERPH May 2022.

Chalmers, T., Maharaj, S., Lees, T., Lin, C.T., Newton, P., Clifton-Bligh, R., McLachlan, C.S., Gustin, S.M. and Lal, S., **(**2022**)**. The relationship between neurocognitive performance and HRV parameters in nurses and non-healthcare participants. Brain and Behaviour. 22 February 2022.

Chalmers, T., Hickey, B. A., Newton, P., Lin, C. T., Sibbritt, D., McLachlan, C. S., ... & Lal, S. (2022). Stress Watch: The Use of Heart Rate and Heart Rate Variability to Detect Stress: A Pilot Study Using Smart Watch Wearables. Sensors, 22(1), 151.

Hickey, B. A., Chalmers, T., Newton, P., Lin, C. T., Sibbritt, D., McLachlan, C. S., ... & Lal, S. (2021). Smart Devices and Wearable Technologies to Detect and Monitor Mental Health Conditions and Stress: A Systematic Review. Sensors, 21(10), 3461.

Lees, T*., Chalmers, T.*, Burton, D., Zilberg, E., Penzel, T., Lal, S., & Lal, S. (2021). Electrophysiological brain-cardiac coupling in train drivers during monotonous driving. International journal of environmental research and public health, 18(7), 3741.

*indicates first joint author contribution

Chalmers, T., Maharaj, S., Lees, T., Lin, C.T., Newton, P., Clifton-Bligh, R., McLachlan, C.S., Gustin, S.M. and Lal, S., (2020). Impact of acute stress on cortical electrical activity and cardiac autonomic coupling. Journal of Integrative Neuroscience, 19(2), pp.239-248.

Lees, T.*, Chalmers, T.*, Burton, D., Zilberg, E., Penzel, T., & Lal, S., (2018). Electroencephalography as a predictor of self-report fatigue/sleepiness during monotonous driving in train drivers. Physiological measurement, 39(10), pp.105012.

*indicates first joint author contribution

Conference presentations

Chalmers, T., Lal. S., 2016. The prevalence of negative mood states within a population of Australian professional drivers. Publication date: October 2016. 21st International Council on Alcohol, Drugs and Traffic Safety Conference.

Chalmers, T., Lal. S., 2015. The prevalence of affective and anxious states within a population of Australian professional drivers. Publication date: Oct 2015. Australasian College of Road Safety Conference.

Invited presentations

Invited Panellist – Safework Forum – Brisbane, Australia 2018. Depression in the professional driving industry.

Invited Keynote Speaker – Viva Energy Forum – Sydney, Australia 2018. Depression in truck driving: Does depression drive you?

Invited speaker - CSIRO Pint of Science event, 2017. The prevalence of affective and anxious states within a population of Australian professional drivers.

Invited speaker – Australian Transport Meeting – Melbourne 2016. The prevalence of negative mood states within a population of Australian professional drivers.

Invited keynote panellist - National Road Safety Partnership Program, 2016. The prevalence of negative mood states within a population of Australian professional drivers.

Invited contributions

Invited contributor – National Road Safety Partnership Program Leadership Program – Online Factsheet, 2017. Response to common brain condition is a ‘no brainer’.

Radio interviewee – 2SER, Sydney Australia, 2017. Mental health problems in the road freight industry.

Expert interviewee – The WIRE radio – Sydney, 2017. Depression in our Truck Drivers.

Awards

Intern of the Year – 2020. Bankstown-Lidcombe-Campbelltown Hospitals.

Young Researcher Stipend 2016 - 21st International Council on Alcohol, Drugs and Traffic Safety Conference, Gramado, Brazil.

Winner of the Best Poster (Junior), 30th Combined Health Science Conference; New Horizons 2013. Sydney, Australia.

Australian Postgraduate Award recipient.

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List of Abbreviations

ABS = Australian Bureau of Statistics

ANS = Autonomic nervous system

BITRE = Bureau of Infrastructure, Transport and Regional Economics

BMI = Body mass index

Blood pressure = BP

CVD = Cardiovascular disease

DBP = Diastolic blood pressure

DFAT = Department of Foreign Affairs and Trade

ECG = Electrocardiogram

FFT = Fast Fourier Transform

GVA = Gross value added

HF = High frequency

HPA = Hypothalamic-pituitary-adrenal

HR = Hazard ratio

HR = Heart rate

HRV = Heart rate variability

Hz = Hertz

km = Kilometre

LAQ = Lifestyle Appraisal Questionnaire

LBP = Lower back pain

LBS = Lower back symptoms

LF = Low frequency

LF:HF = Low frequency to high frequency ratio (sympathovagal balance)

MAO-A = Monoamine-oxidase A

NZ = New Zealand

OR = Odds ratio

PNS = Parasympathetic nervous system

POMS = Profile of Mood States

SBP = Systolic blood pressure

SNS = Sympathetic nervous system

TP = Total Power

UK = United Kingdom

USA = United States of America

UTS HREC = University of Technology Sydney Human Research Ethics Committee

WCH = White coat hypertension

WHO = World Health Organisation

Abstract

Introduction: Train and truck drivers experience a myriad of unique occupational workplace factors, such as monotonous driving conditions, long hours spent sitting, the necessity of strict mental alertness, workplace social isolation and the potential for “person under vehicle” events. These conditions have been postulated to contribute to a high incidence of health conditions such as depression, anxiety and cardiovascular disease (CVD) amongst this population. Although often occurring independently of one another, the link between depression and cardiovascular risk is well established.

Methods: 120 professional drivers (60 truck drivers, 60 train drivers) were recruited from the local community. Participants complete a battery of mood state questionnaires to assess levels of negative mood states such as depressive and anxious symptomology, and questionnaires to quantitate lifestyle and workplace risk factors. Participants then completed a baseline (resting) and active (driving) task while concurrent ECG data was collected to obtain HRV parameters.

Results: Truck drivers reported significantly more risk factors for chronic diseases, such as smoking, alcohol use, sedentary activity levels and stress, than the train driving cohort. Truck drivers also reported higher levels of all negative states, including depressive and anxious symptomology, stress, fatigue and anger.

Conclusion: This study highlights important workplace factors that may be linked with negative mental states, and their potential implications within the workplace. The

promotion of improved mental health within this occupation would not only improve the health of the individual drivers but may also mitigate mental health associated absenteeism and improve commuter safety. Buddy driving systems, regular workplace ToolBox talks and forums and a commitment to mental awareness are strategies that have been successfully employed in other industries. Given the societal responsibility of professional drivers, protecting and promoting the psychosocial health of these individuals is paramount to not only a healthy workforce, but a safe community. This study is important, as the psychophysiological health of Australia's professional drivers has been somewhat overlooked in the past. Given the large number of workers employed within this industry, and the potential personal and public implications of a suddenly unwell driver, it is vital that policies and workplace practices are designed to optimise the health of these individuals. Collectively, the findings from the present study provide a novel perspective on the physiological and psychological health of Australian professional drivers.