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#8

Driving Health

Determinants impacting health and performance of truck drivers

Telephone Survey

August
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This report uses data collected as part of an online survey. Receipt, use and disclosure of the data for this study was approved by Monash University Human Research Ethics Committee (MUHREC) on 12 June 2019 (Project ID:19191).

The authors would like to thank the professional drivers who took part in this study. Without their participation this research would not be possible.

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Executive Summary

The overarching goal of the Driving Health study is to develop evidence-based strategies to improve the health and wellbeing of Australian truck drivers. Previous reports from the study present results of the largest survey of the physical and mental health of Australian professional drivers and has confirmed that the profile of health of truck drivers in Australia is poor.

This report, the eighth in the Driving Health study, presents findings from a subsequent telephone survey in which drivers provided more detail on a range of factors predicted to influence their health and driving performance. Specifically, this report aims to:

1. Gather detailed information on the prevalence of risk factors for drivers in the personal, occupational, workplace environment, regulatory, lifestyle and health domains.
2. Examine the role of determinants from personal, occupational, workplace environment, regulatory, lifestyle, and health risk domains in truck driver physical health, mental health and driving performance.
3. Identify potential avenues for intervention to improve the health of Australian truck drivers.

Method

This was a cross-sectional study, using an initial short online survey and a follow up telephone survey with Australian truck drivers. The survey was designed to capture in depth information on six domains related to truck driver physical and mental health outcomes, including personal, occupational, workplace environment, regulation, lifestyle and health risk determinants. Study outcome data were collected prior to the telephone survey as part of the initial online survey. In this report, we focused on examining the contribution of determinants on four major study outcomes including psychological distress, general health, work ability and near misses. LASSO regression was used to identify the most relevant variables associated with study outcomes. Determinants selected by LASSO were then entered into hierarchical regression by introducing each domain in steps.

Major Findings

In total, the telephone survey was completed by 338 truck drivers, 6 of whom withdrew from the study leaving a final cohort of 332 for analysis. Of those, a diagnosis of a physical medical condition (e.g. back pain, cholesterol, diabetes) was reported by 74.7% of drivers, with 22.6% reporting diagnosis of a mental health condition (e.g. depression or anxiety).
Truck drivers tended to have lower levels of financial stress than general Australian households with 85% of our participants being able to raise $2000 in an emergency compared to 80% for general Australian households.

Over one fifth of drivers in our study reported high injury risk work tasks, with the most common risks experienced as repetitive movements, manually lifting and working in awkward postures. Drivers also reported a high prevalence of working in a poor environment which included dangerous motorists and poor road or weather conditions. Furthermore, nearly half of drivers had experienced at least one workplace violence incident in the past 12 months, with verbal abuse the most common violence they were facing on the road. Although drivers had a relatively good OHS training experience, only one fifth of drivers received stress management training.

The majority of drivers in our study did not meet the guidelines for a healthy and balanced diet, with an average of 1.5 and 1.3 serves of vegetables and fruit being consumed by drivers per day. In contrast, almost half of the drivers reported meeting recommended levels of physical activity. Most drivers were non-smokers (77.7%), but over two fifths (40.7%) were defined as being at high risk of alcohol misuse.

Consistent with Driving Health report #6, the majority of drivers were either classified as overweight (26.3%) or obese (55.7%). A third of the drivers (33.4%) reported struggling with pain. Experiencing fatigue whilst working was commonly reported by drivers (62.1%). One in ten drivers (11%) reported nodding off or falling asleep while driving. In total, 17.5% of our participants were defined as being at high risk of poor sleep. Unsurprisingly the majority of drivers reported spending their time working alone, however only 15% reported often or always feeling lonely. About one third (32.7%) of drivers in this study had used some form of medication to manage either sleep or fatigue.

LASSO regression identified the 13 most relevant determinants to work ability from the personal, occupational, workplace environment, regulatory, lifestyle, and health risk domains. The final step of the hierarchical regression analysis in our study showed that the six domains explained 28% of the variation in work ability, of which the personal and health risk domains explained the most variation in the outcome. When it comes to psychological distress, LASSO regression identified 17 most relevant determinants. The regression model revealed that the personal domain accounted for 37.5% of the variation in psychological distress, whilst the occupational domain also explained a further 6.8%.

Sixteen determinants were selected by LASSO regression for general health. The hierarchical multiple regression revealed that together the six domains accounted for 36.2% of the variation in general health. Determinants from the personal domain accounted for 17.3% and the health risk domain explained 11.3% of this variation. For near misses, the only outcome that did not include determinants for each of the six domains, LASSO identified six determinants from the personal, occupation, lifestyle and health risk domains.
The hierarchical logistical regression showed that family situation had a statistically significant relationship with near misses, and the model was significantly improved by adding the occupational domain. However, there was no statistically significant difference when adding risk of alcohol abuse and BMI to the model.

Implications

Our study revealed the complexity of determinants of driver physical and mental health and driving performance. To maintain and improve the longevity of the trucking workforce, programs and interventions should be targeted towards improving physical and mental health, decreasing physical workload and preventing pain. Weight loss interventions incorporating exercise are also likely to be beneficial based on our modelling, particularly considering the benefits of exercise for physical and mental health. The observed relationship between pre-existing mental health conditions, financial stress and occupational risks in a driver's workplace suggest that mental health promotion, assessment and treatment should be a priority in order to improve the overall trucking environment.

Several external determinants were found to contribute to driver health and driving performance that are beyond the driver's control. These include working hours, the type of payment structure and work schedules.
Our findings suggest there is clearly a role for interventions targeted at stakeholders in the transport industry other than drivers. In order to support drivers to be healthy and stay healthy at work, changes need to be addressed at an organisational and regulatory or government level.

Overview

Rationale

There are approximately 200,000 truck drivers in Australia, making truck driving the most common occupation for male Australians.[1] The nature of the occupation, time pressure, low levels of job control, long working hours and social isolation all contribute to the increased risk of poor physical and mental health. The overarching goal of the Driving Health study is to develop evidence-based strategies to improve the health and wellbeing of Australian truck drivers. Our previous work has confirmed and extended existing knowledge of workplace health and safety in the transport industry and established that the major burden of disease amongst truck drivers is due to chronic conditions rather than vehicle incidents and crashes.

A biopsychosocial model of health and wellness of long-haul truck drivers describes the interplay of occupational, personal and environmental determinants on their health.[2] These determinants may in isolation and in combination influence the presence, absence and magnitude of a range of health risk factors, health outcomes and driving performance. There is clear evidence that risk factors for chronic disease are highly prevalent in truck drivers. Sieber et al reported that over two thirds of commercial motor vehicle drivers had two or more risk factors for chronic disease such as hypertension, obesity, smoking and high cholesterol, which can lead to comorbidities (e.g. cardiovascular disorders) and adverse events (e.g. crashes).[3] There also appears to be a clear relationship between long working hours and obesity, as well as increased crash risk.[4] Risk factors of poor mental health, such as feelings of depression, loneliness and isolation are also commonly reported in truck drivers.[5] Due to the complexity of determinants influencing the health of drivers, discovering the role of modifiable factors in the risk factor/morbidity relationship is critical for intervention development.

Existing research into the determinants of drivers' health has been constrained by the ability to examine the contribution of a wider range of work, personal, environmental and regulatory determinants of driver health. To further understand the major health issues of concern among truck drivers and to identify key determinants that improve and impair health, the Driving Health Study performed a cross-sectional study using a series of two surveys and a qualitative study targeted at Australian truck drivers. The surveys were designed to capture in depth information on six domains related to truck driver physical and mental health outcomes, including personal, occupational, workplace environment, regulatory, lifestyle, and health risk domains. The first survey was a 10-minute online survey aimed to give an overview on the physical and mental health of Australian truck drivers. A subsequent telephone survey asked participants more detailed questions on a range of determinants hypothesised to have an impact on the health and driving performance of truck drivers.

The online survey has confirmed that the profile of physical health of truck drivers in Australia is poor.[6] Truck drivers are more likely to be overweight, report poor general health and be diagnosed with multiple chronic health conditions compared to the rest of the population. It also revealed that having multiple chronic health conditions was negatively associated with health, driving performance and self-reported work ability. This eighth report describes the results from the telephone survey to explore in depth information on six domains related to truck driver physical and mental health outcomes and driving performance.

OBJECTIVES

1. Gather detailed information on the prevalence of risk factors for drivers in the personal, occupational, workplace environment, regulatory, lifestyle and health domains.
2. Examine the role of determinants from personal, occupational, workplace environment, regulatory, lifestyle, and health risk domains in truck driver physical health, mental health and driving performance.
3. Identify potential avenues for intervention to improve the health of Australian truck drivers.

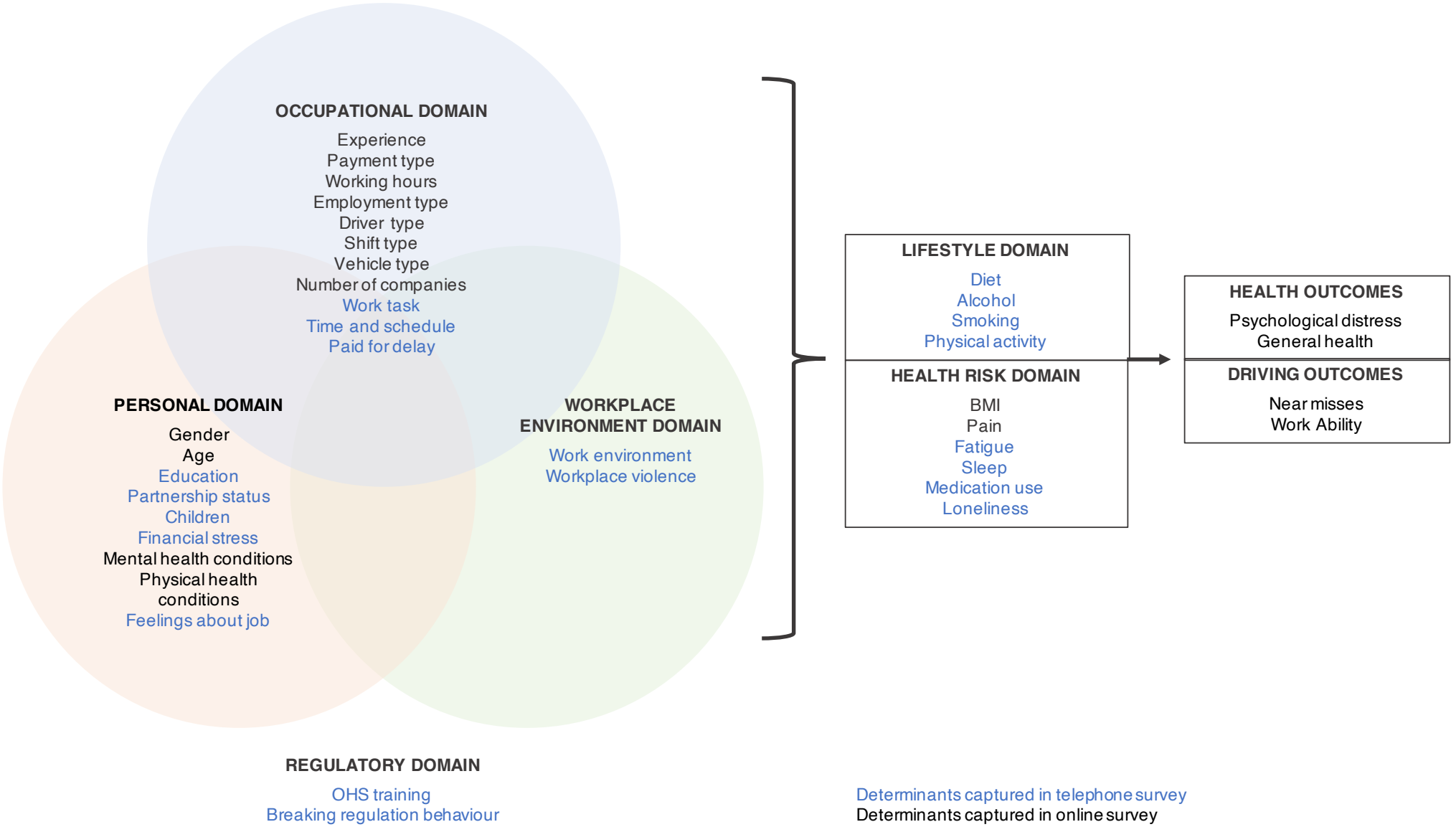
Methods

Research Framework and Questionnaire Design

The Driving Health telephone survey was designed to capture a greater depth of information related to a range of determinants of truck driver health and driving outcomes. Guided by the conceptual model adapted from Crizzle et al [2], questions included in the telephone survey were designed to examine an extended list of determinants from the personal, occupational, workplace environment, regulatory, lifestyle and health risk domains [Figure 1].
A copy of the telephone survey is provided in Appendix II.

Figure 1 Conceptual model for driving health

Determinants



PERSONAL DOMAIN

The personal domain refers to demographic, financial status and pre-existing diagnosed mental and physical health conditions. Demographic information collected during the initial online survey included age and gender, pre-existing physical and mental health conditions.[6] Level of education, family situation, number of dependent children and level of financial stress were collected during the telephone survey. Participants' financial status was determined with two items which were adapted from National Health Survey 2014/15 [7]; 1) asking their (or their household) ability to raise $2,000 within 2 days and 2) their level of financial stress on a scale of 1 to 10.

OCCUPATIONAL DOMAIN

The occupational domain refers to six determinants collected from the online survey and three determinants from the follow up telephone survey. The online survey collected information regarding participants' work characteristics including employment type, driver type, shift type, payment type, working hours and years of driving experience. The follow up telephone survey collected determinants regarding work tasks, work time and schedule, and payment for delays. The work task determinant was measured with 9 items adapted from an Occupational Health & Safety (OHS) vulnerability measurement developed by the Institute for Work & Health in Canada using a 5-point Likert scale (0=Never,1=Less than once a month, 2=Monthly, 3=Weekly,4= Daily/Almost daily).[8] A sample item is, "In the last 12 months, how often in your job did you manually lift, carry or push items heavier than 20 kg at least 10 times during the day?"

The work time and schedule determinant was determined with five questions designed to measure scheduling, timing and delays, using the same 5-point Likert scale described above. A sample item is, "In the last 12 months, in your experience, how often did you arrive on time but were forced to wait to enter a dock?" An additional question was developed to measure payment for delays using the same 5-point Likert scale.

WORKPLACE ENVIRONMENT DOMAIN

The workplace environment domain refers to work environment and workplace violence determinants collected in the telephone survey. Work environment was measured with 7 items adapted from the OHS Vulnerability Scale using a 5-point Likert scale (0=Never,1= Less than once a month, 2=Monthly, 3=Weekly, 4=Daily/Almost daily) (8). A sample item is, "In the last 12 months, how often in your job did you experience discomfort by mechanical vibration or shock in your work?" Four questions were developed to explore drivers' experience of workplace violence. A sample item is, "In the last 12 months, have you been verbally abused in workplace?" Participants responded yes or no to these four questions.

REGULATORY DOMAIN

The regulatory domain refers to OHS training and breaking regulation behaviour determinants collected in the telephone survey. Drivers were asked whether they have undertaken any formal training from a list of 9 OHS items (e.g. general OHS regulations and practices, site inductions and stress management). Four questions were developed to examine participants' breaking regulation behaviour using a 5-point Likert scale (0=Never, 1= Less than once a month, 2=Monthly, 3=Weekly,4= Daily/Almost daily). A sample item is, "In the last 12 months, how often in your job did you drive in excess of the speed limit?"

LIFESTYLE DOMAIN

The lifestyle domain refers to diet, alcohol, smoking and physical activity determinants collected in the telephone survey. Diet was measured as serves of vegetables and fruit consumed each day or week using questions from the National Health Survey (NHS) Module 13-Dietary behaviour.[7] Physical activity was measured by number of hours or minutes of moderate or vigorous exercise they completed in the past week, using the questions from NHS Module 10-exercise.[7] Smoking was measured by current behaviours related to smoking tobacco, e-cigarettes or other vaping devices.

Alcohol consumption was measured using three AUDIT-C 3 screening questions [9] designed to identify persons at risk of alcohol misuse and included questions:
1) How often do you have a drink containing alcohol? 2) How many drinks containing alcohol do you have on a typical day when you are drinking? 3) How often do you have six or more drinks on one occasion? Points were allocated to each response following the AUDIT-C 3 scoring system to determine a risk of problem alcohol use score.[9]

HEALTH RISK DOMAIN

The health risk domain refers to two determinants captured in the online survey including Body Mass Index (BMI) and pain, and four determinants from the telephone survey including sleep, fatigue, drug use and loneliness. The online survey recorded drivers' self-reported height and weight which enabled an estimation of their BMI, as well as questions on pain duration and severity. An additional question on the body location of pain was asked in the telephone survey.

Sleep was measured with five items using select questions from the sleep disorders screening questionnaire.[10] Poor sleep was measured by three questions:
1) In the past month, on average how many hours of sleep do you get in a 24-hour period? 2) In the past month, on average, how many nights a week have you had problems with your sleeping? 3) In the past month, did you nod off or fall asleep while you were driving, even just for a brief moment?

Fatigue was measured by 4 items drawn from previous surveys.[11], [12] Risk of fatigue was defined using the question "How often do you become fatigued while driving for work?" measured by a 5-point Likert scale (0=Never, 1=Less than once a month, 2=Monthly, 3=Weekly, 4= Daily or almost daily). To assess loneliness, drivers were asked, "During the past week, how often have you felt lonely?" on a 5-point Likert scale (0=Never, 1=Rarely, 2=Sometimes, 3=Very often, 4=Always).

OUTCOMES

Study outcome data were collected as part of the initial online survey. In this report, we have focused on examining the contribution of determinants on four major study outcomes including psychological distress, general health, work ability, and near misses. Psychological distress was measured using the Kessler 6 (K6) psychological distress scale.[13] Self-reported general health was measured using the first question from the Short Form-12 (SF12) health survey.[14] Near misses were measured by self-reported number of near misses experienced in the past month. Work ability was determined by one item from the Work Ability Index asking drivers to rate their work ability from 0 (completely unable to work) to 10 (work ability at its best).[15]

Data Sources and Recruitment

The telephone survey was conducted subsequent to an online survey of 1390 Australian truck drivers. A detailed description of participant recruitment and data sources for the initial online survey can be found in Driving Health report number #6.[6] Eligible participants completing the initial online survey were invited to take part in a follow-up telephone survey.

Eligible participants included those who were a) Employed in the transport of goods in the 12 months prior to taking the survey, and b) Drove a vehicle, including trucks and vans but not cars, for the main part of their job. At the end of the initial online survey, drivers provided consent to be contacted by telephone and provided their first name, telephone number and preferred time of call for contact. The Social Research Centre (SRC), a market research consultancy firm, conducted the telephone survey using Computer Assisted Telephone Interviewing (CATI) that take 25 minutes to complete, with the option to complete online if preferred. Calls were made between 9.00am and 8.30pm on weekdays and 11.00am to 5.00pm on weekends. Surveys were not completed while any participants were driving.

In total 471 eligible respondents were contacted and 338 completed the telephone survey. The overall response rates were 71.8%.

Study methods were approved by the Monash University Human Research Ethics Committee, Project ID: 19191.

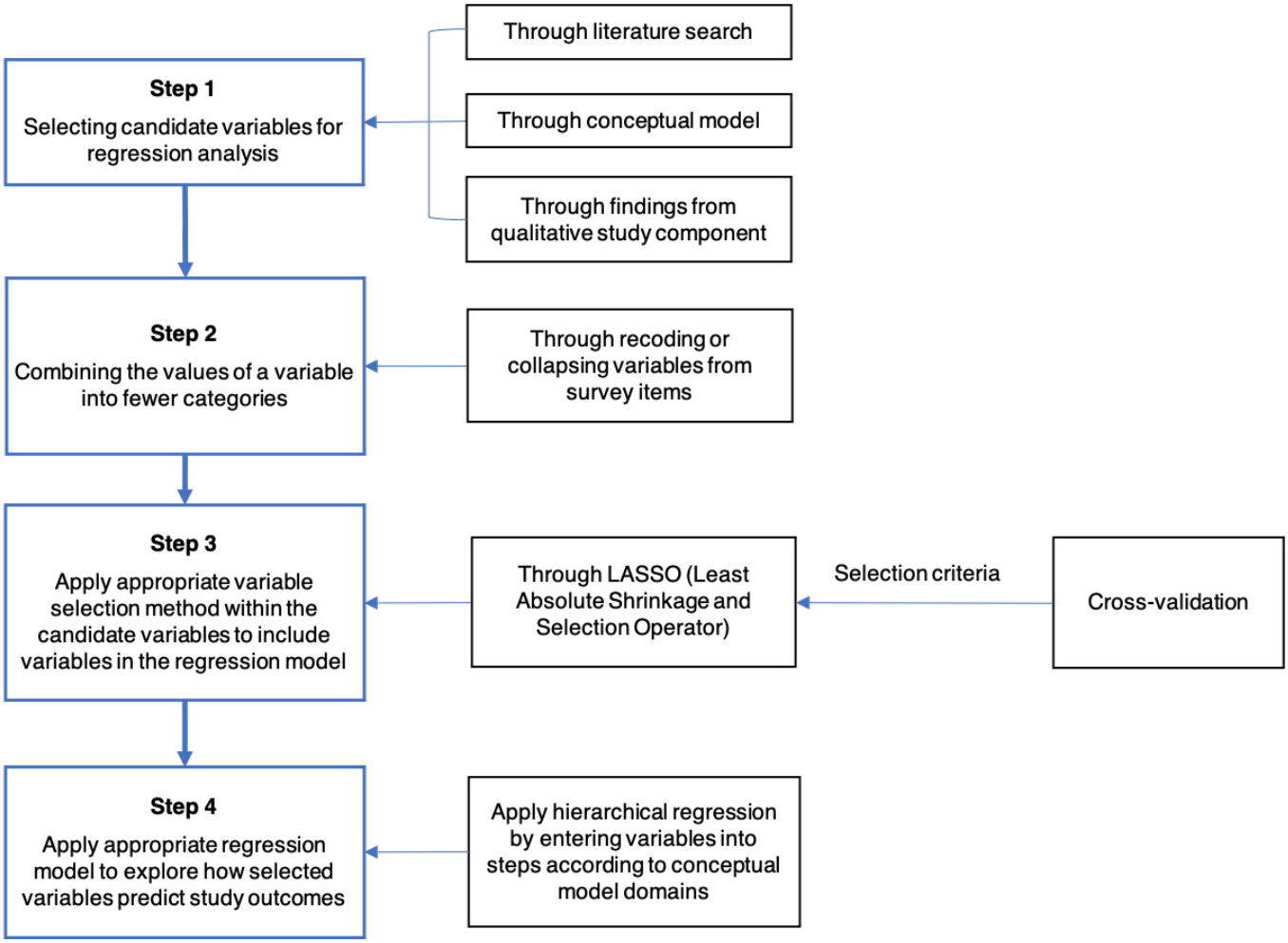
ANALYSIS

Data cleaning and analyses were conducted using STATA 16. Online and telephone survey respondents were matched, merged and analysed in one dataset. The number of missing and/or prefer not to say responses were assessed for each item. Descriptive analysis was used to report counts and percentages captured from the telephone survey and presented in figures. Descriptive results from the online survey can be found in Appendix I.

In the second phase, inferential statistical analyses were used to further explore the role of personal, occupational, workplace environment, regulatory, lifestyle and health risk domains in improving or impairing health, including determinants that are amenable to modification. Considering the relatively small sample of telephone survey completion, we adapted a mixed theory-driven and data-driven variable selection technique to reduce the covariates down to a manageable number for model building. Figure 2 summarises the approach to model building.

Figure 2 Conceptual overview of model building steps

Four steps were followed to build a statistical model to identify the influence of the six domains on outcomes of physical health, mental health and driving performance. The process ensured only the most relevant information was included in robust statistical models.



STEP 1

All survey items from both the online and telephone survey were screened in order to select potential determinants for analysis based on existing literature and the study conceptual model. [Figure 1] In addition, the qualitative study component interviewing truck drivers and family members identified a number of determinant as either supporting driver health or increasing the risk of ill-health.[16] These included how financial determinants contributed to stress overall, including the number of shifts worked, the unrealistic demands of completing some deliveries, and the constant fear of being fined for small discrepancies in log books. Healthy relationships with partners, co-workers and management supported driver health, or created a risk of ill-health when they were poor. Other concerns identified included sleep, not being able to self-manage fatigue and attitudes of others, including management and the general public. With this knowledge, we ensured determinants representing these variables were included in the model where possible. In total, 29 determinants from 6 domains were selected for inferential statistical analyses [Table 1]:

TABLE 1 DOMAINS AND DETERMINANTS

1: Personal domain	Age, family situation, education, mental health, physical health, financial stress
2: Occupational domain	Employment type, driver type, working hours, payment type, shift type, driver experience, work task, time and schedule and paid for delays
3: Work environment domain	Work environment, workplace violence
4: Regulation domain	OHS training and breaking regulation behaviour
5: Lifestyle domain	Diet, alcohol, smoking and physical activity
6: Health risk domain	Sleep, fatigue, pain, medication use, loneliness and BMI.

OHS: Occupational Health and Safety; BMI: Body Mass Index

STEP 2

In order to interpret the variables in a more intuitive and useful way, variables from the telephone survey were recoded and collapsed into fewer categories:

Education

Education was dichotomised into “High school or lower” and “Above high school” groups.

Family situation

Based on the questions regarding partnership status and dependent children, a new categorical variable was created to represent participants’ family situation, including “No partner, no dependent children” group, “No partner with dependent children” group, “Partnered with no dependent children” group and “Partnered with dependent children” group.

Financial stress

A binary variable was created for financial stress. Based on the distribution of the level of financial stress scale, “High financial stress” was defined as a score of 6 to 10, whilst “Low financial stress” was defined as score of 1 to 5.

Work task
All 5-point Likert scale responses were converted to dichotomous scales, referring to “Yes” (response of 3 or 4) and “No” (response of 0, 1 or 2). A categorical variable was created for work tasks to measure the levels of OHS vulnerability, namely a low risk group (if the participant was exposed to less than 4 risks from listed 9 OHS vulnerability items), a moderate risk group (if the participant was exposed to 4-6 risks from all risk items) and a high risk group (if the participant was exposed to 7-9 risks from all risk items). This risk classification was based on the approach used by Smith et al,[17] however it was necessary to adapt the classification to match the high incidence of risks reported in the survey.

Work time and schedule
Responses were dichotomised into “Yes” (response of 3 or 4) and “No” (response of 0, 1 or 2) to create a categorical work time and schedule variable with a low risk group (if the participant experienced less than 2 situations) and high-risk group (if the participant experienced 3-5 situations).

Paid for delay
A binary variable was created for payment for delays, indicating whether the participant was paid for delays or waiting time (3-4 from the 5-point Likert scale).

Workplace environment
Using the same risk classification approach as work tasks, responses were dichotomised into “Yes” (response of 3 or 4) and “No” (response of 0, 1 or 2). Work environment questions were then collapsed into a low risk group (if the participant was exposed to less than 5 risks from all risk items) and high risk group (if the participant was exposed to 5-7 risks from all risk items).

Workplace violence
A binary variable was created for workplace violence, indicating whether the participant experienced one or more of the listed situations or none of the listed situations.

OHS training
The OHS training determinant was further collapsed into two categories based on the distribution of total number of trainings, namely a “Fair” training group (if the participant had less than 5 types of OHS training), and a “Good” training group (if the participant had 5-7 types of OHS training).

Breaking regulation behaviour
A binary variable was created. Using our risk classification approach, responses were dichotomised into “Yes” (response of 3 or 4) and “No” (response of 0, 1 or 2). Having breaking regulation behaviour was defined as participants’ experience with any of listed situations using the same risk classification approach.

Diet
Diet was further dichotomised into two groups indicating whether the participant met the current guideline or not. Meeting the diet guideline was defined as having five or more serves of vegetables per day or having two or more serves of fruit per day.

Physical activity
Physical activity was dichotomised into two groups indicating whether the participant met the current guideline or not. Meeting the physical activity guideline was defined as having at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or doing at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week.

Smoking
Participants with any of the smoking behaviours were identified as a Smoker.

Alcohol
A binary variable was created for alcohol, indicating whether this participant was participating in problem drinking. The AUDIT-C score was summed, with possible scores ranging from 0 to 12. High risk alcohol use was defined as a score of 4 or greater.[18]

Sleep
A sleep score was determined based on the following: 1 point was allocated for responses of a sleep duration of less than 6 hours, four nights or more per week having problems with sleep, and a “yes” response to nodding off or falling asleep while driving. The total score was summed for a possible score of 0 to 3. Participants with a score of 2 to 3 were defined as being at High risk of poor sleep, and scores of 0 to 1 were defined as being Low risk.

Fatigue
Risk of fatigue was defined using the question “How often do you become fatigued while driving for work?” measured by a 5-point Likert scale (0=Never, 1=Less than once a month, 2=Monthly, 3=Weekly, 4= Daily or almost daily). Participants who scored 0 to 1 were categorised into the low risk fatigue group, whilst those with scores of 2 to 4 were categorised into the high risk fatigue group.

Medication use
A binary variable was created for medication use, indicating whether the participant took any medication to help sleep or combat fatigue.

Loneliness
Loneliness was dichotomised into No (never or rarely feel lonely) and Yes (sometimes or always feel lonely).

STEP 3

We applied a novel, modern statistical shrinkage technique, Logistic Least Absolute Shrinkage and Selection Operator (LASSO) regression, to identify the most relevant determinants associated with each of the study outcomes. The LASSO approach is considered most useful when a few out of many potential determinants could affect the outcome and it is important to include only the determinants that have an effect.[19] We utilised five-fold cross-validation and selected the penalty term λ. The STATA "lasso" cross-validation function chooses the model that minimizes the cross-validation. The final model produced by LASSO regression is a parsimonious model that includes only the determinants with non-zero coefficients. Two types of LASSO regressions were conducted for study outcomes. Linear LASSO regressions were performed for continuous dependent outcome variables including Work Ability Index, total Kessler 6 score, and self-reported general health, whilst logistic regression was performed for the near miss outcome. Twenty nine determinants were included into the LASSO regression for those four outcomes.

Lastly, we applied the conceptual model through the grouping of determinants selected by LASSO into domains and entered the domains in hierarchical regression model grouping: 1) Personal domain; 2) Occupational domain; 3) Workplace environment domain; 4) Regulation behaviour domain; 5) Lifestyle domain; and 6) Health risk domain. Adjusted R^2 was reported to account for the number of domain groups, and change in R^2 is reported to indicate the contribution of each domain to the predictive model. For hierarchical logistic regression, the hierarchical relationship is based on the reduction in error associated with the inclusion of the predictor variables. In our study, statistical significance was set at $p < 0.05$.

Results

In total, the telephone survey was completed by 338 truck drivers, 6 of whom withdrew from the study leaving a final cohort of 332 for analysis.

Determinants

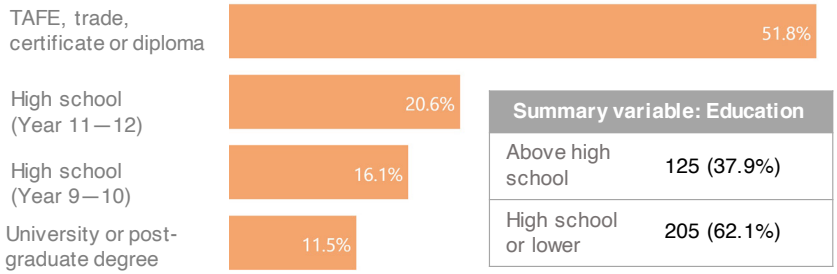
PERSONAL DOMAIN

The drivers completing the telephone survey were representative of the online survey cohort in gender, driver type and employment type but differed in age distribution. A larger proportion of drivers over 55 years (34.3% vs 27.6%) and fewer under 35 years (19.6% vs 28.6%) completed the telephone survey vs those completing the online survey only ($p < 0.01$) [6] [Appendix I]. Most drivers were educated at a level above high school (63.3%) with the majority (51.5%) having a TAFE degree, trade certificate or diploma [Figure 3A]. The majority of drivers were in some form of partnership (75.5%) with half married (53.6%) and 21.8% in a de facto relationship [Figure 3B]. Almost half of the drivers had dependent children (47.9%) [Figure 3C]. A diagnosis of a physical medical condition (e.g. back pain, cholesterol, diabetes) was reported by 74.7% of drivers, with 22.6% reporting diagnosis of a mental health condition (e.g. depression or anxiety) [Appendix I]. The truck drivers in our sample report lower levels of financial stress than Australian households generally, with about 85% of our participants being able to raise $2000 in an emergency [Figure 3E] compared to 80% for Australian households.[20] Recent trends show that wages are on the rise for truck drivers as logistics firms attempt to reduce staff turnover in the face of a growing shortage of drivers.[21]

Figure 3 Personal domain: Education, family, and financial stress

EDUCATION

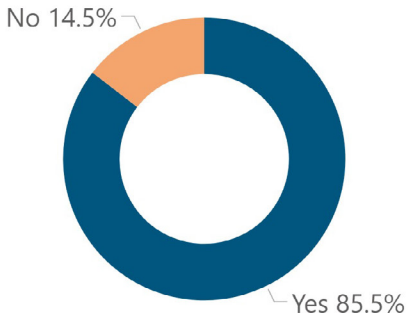
A. What is your highest level of education?



Summary variable: Education	
Above high school	125 (37.9%)
High school or lower	205 (62.1%)

FINANCIAL STRESS

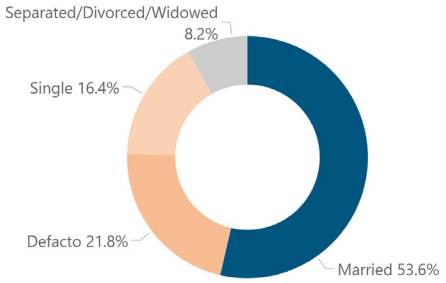
D. If needed, could you/your household raise $2000 in an emergency?



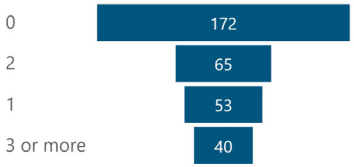
Summary variable: Financial stress	
Low stress	240 (72.7%)
High stress	90 (27.3%)

FAMILY SITUATION

B. Partnership status

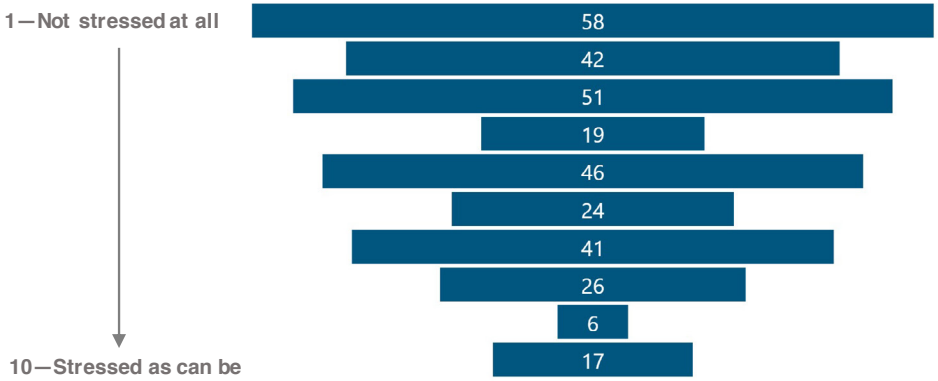


C. Number of dependent children



Summary variable: Family situation	
Partnered with dependent children	130 (39.2%)
Partnered with no dependent children	118 (35.5%)
No partner with no dependent children	52 (15.7%)
No partner with dependent children	28 (8.4%)

E. Level of financial stress



OCCUPATIONAL DOMAIN

Appendix I describes the occupational domain determinants collected in the online survey. Flat rate (29.0%) and single time pay (28.7%) represented the most common form of payment, followed by kilometre rate (20.8%) and per trip/delivery (11.8%). Drivers largely reported working between 41-60 hours (51.5%) and over 60 hours (36.7%) per week. The majority of drivers were employee drivers (84.6%), comparable to Australian workforce data showing 14% of transport workers working as independent contractors.[20] Short-haul (driving < 500km/shift) and long-haul (driving ≥ 500km/shift) drivers made up 59.8% and 40.2% of the cohort respectively. Working shifts consisted largely of multiple trips between the same location or "home base" (51.5%), followed by a long single trip between two locations (27.4%). Vehicles driven by respondents included B double (38.3%), articulated (29.8%) and rigid trucks (15.2%). Only 14.8% of drivers reported working for more than one company [Appendix I].

Figure 4 shows drivers' response to the work task OHS vulnerability items. Overall, most drivers were either placed into Moderate (45.8%) or High risk (22.3%) work task categories. The most common risks they experienced in the last 12 months were "Do repetitive movements with your hands or wrists", followed by "Manually lift, carry or push items heavier than 20 kg at least 10 times during the day" and "Work in a bent, twisted or awkward work posture". "Experience being bullied or harassed at work" or "performing work tasks you are unfamiliar with" was less commonly reported by our participants.

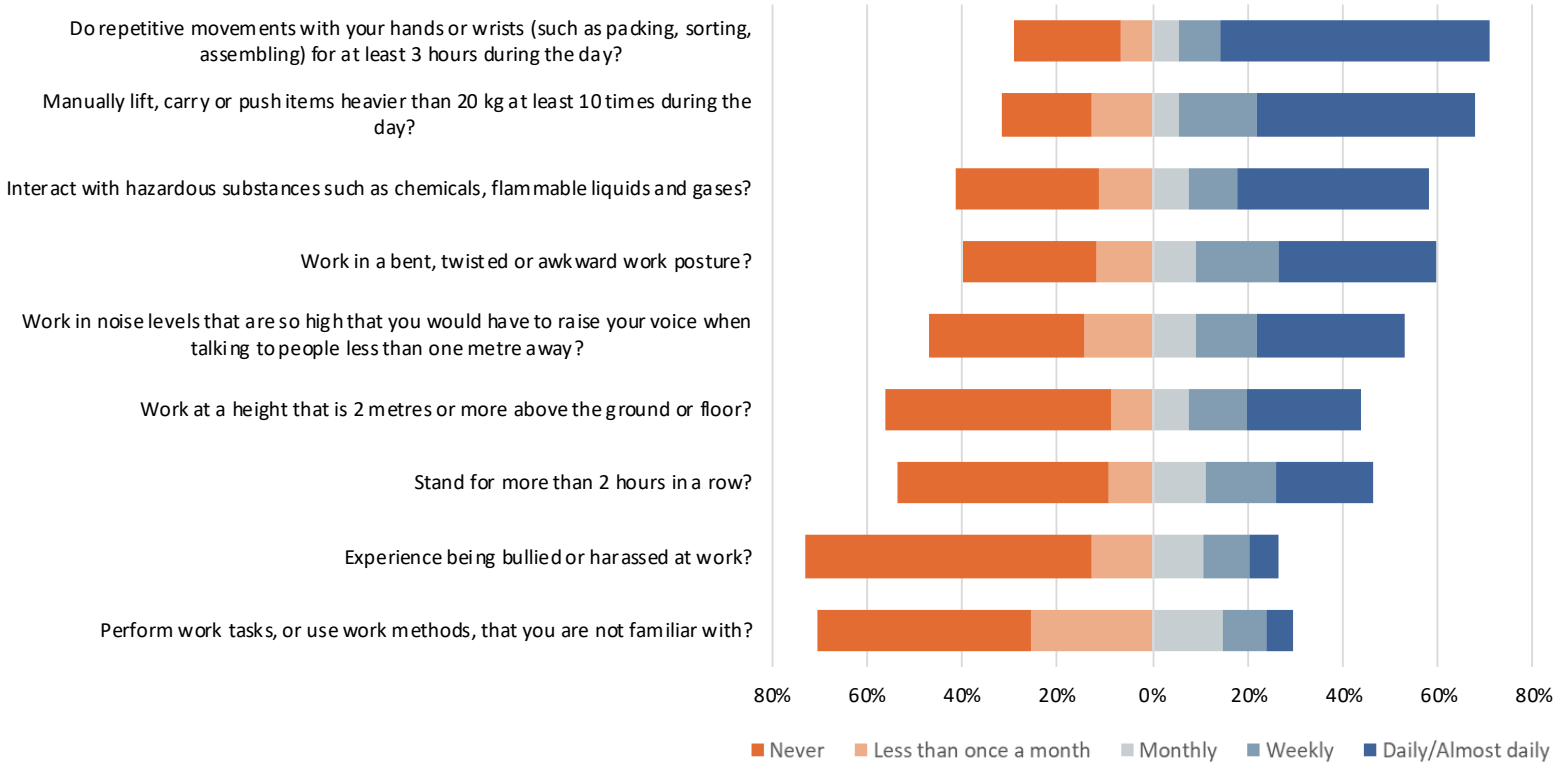
Assessing driver exposure to work time and schedule items [Figure 5A] indicated that 63.0% of drivers are at high risk of experiencing delays. Even though dispatchers frequently work with drivers to get them home as scheduled, delivery delays due to traffic congestion and waiting to enter a dock despite arriving on time occur often. In contrast, delays impacting driving hours occurred less frequently. Moreover, two fifths of drivers reported experiencing an unrealistically tight delivery schedule and this proportion was higher than a recent U.S. study (15.5%).[22]

When asked about their feelings about their job drivers largely agreed that they had freedom to decide how to do their work, a secure future in the job and get paid fairly [Figure 5B]. Lastly, 61.9% of drivers reported receiving payment for delays [Figure 5C].

Figure 4 Occupational domain: Work tasks

WORK TASKS

A. In the last 12 months, how often in your job did you..

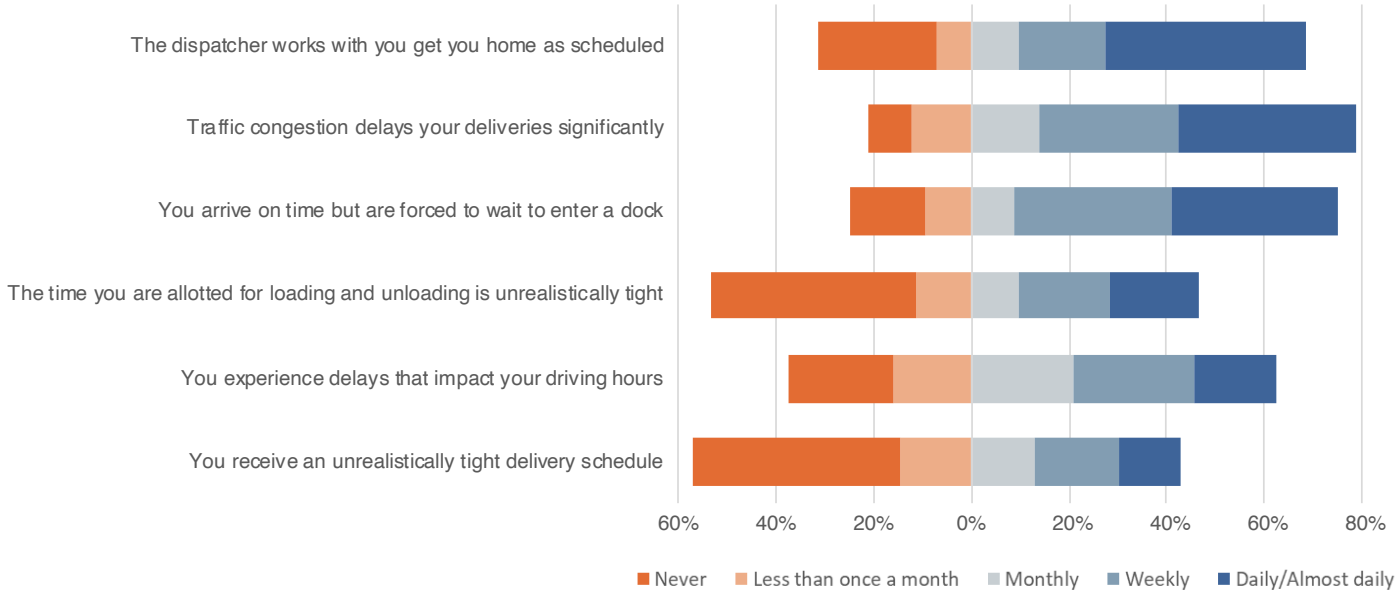


Summary variable: Work task	
Low risk	106 (31.9%)
Moderate risk	152 (45.8%)
High risk	74 (22.3%)

Figure 5 Occupational domain: Time and schedule, feelings about job and payment for delays

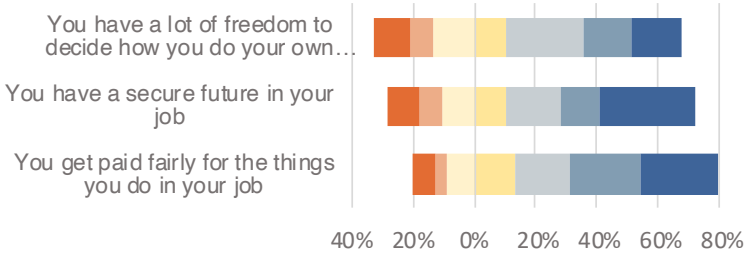
WORK TIME AND SCHEDULE

A. In the last 12 months, how often did the following situations occur…

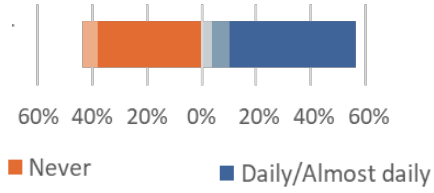


Summary variable: Time and schedule	
Low risk	123 (37.0%)
High risk	209 (63.0%)

B. Feelings about job



C. In the last 12 months, how often were you paid for delays?



Summary variable: Paid for delays	
Yes	195 (61.9%)
No	120 (38.1%)

WORKPLACE ENVIRONMENT DOMAIN

Questions on workplace harassment and abuse indicated that 30% of drivers had been verbally abused in the workplace, and 28% had experienced being bullied [Figure 6A]. In total, 44% of drivers had experienced at least one workplace violence situation listed in Figure 6A.

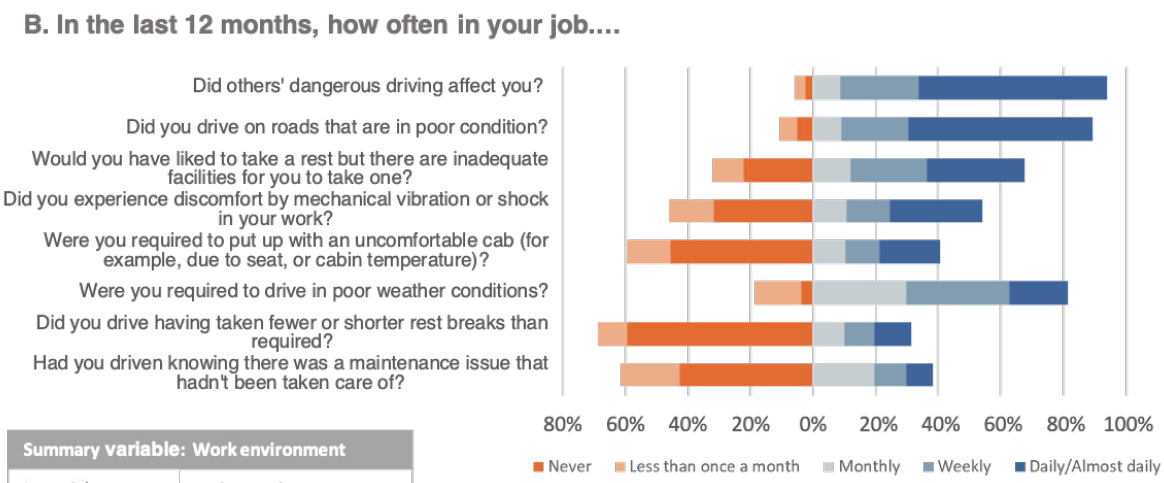
More than two thirds of drivers (75.6%) were classified as working in a high-risk environment in the past year [Figure 6B].

Over 80% of drivers had experienced dangerous driving from others, been required to drive in poor weather condition and driven on roads in poor condition.

The least common workplace environment issue was having to put up with an uncomfortable cab, driving with maintenance issue and experiencing discomfort by mechanical vibration.

Figure 6 Workplace environment domain: Harassment, abuse and work environment

Summary variable: Workplace violence	
Yes	146 (44.0%)
No	186 (56.0%)



Summary variable: Work environment	
Low risk	81 (24.4%)
High risk	251 (75.6%)

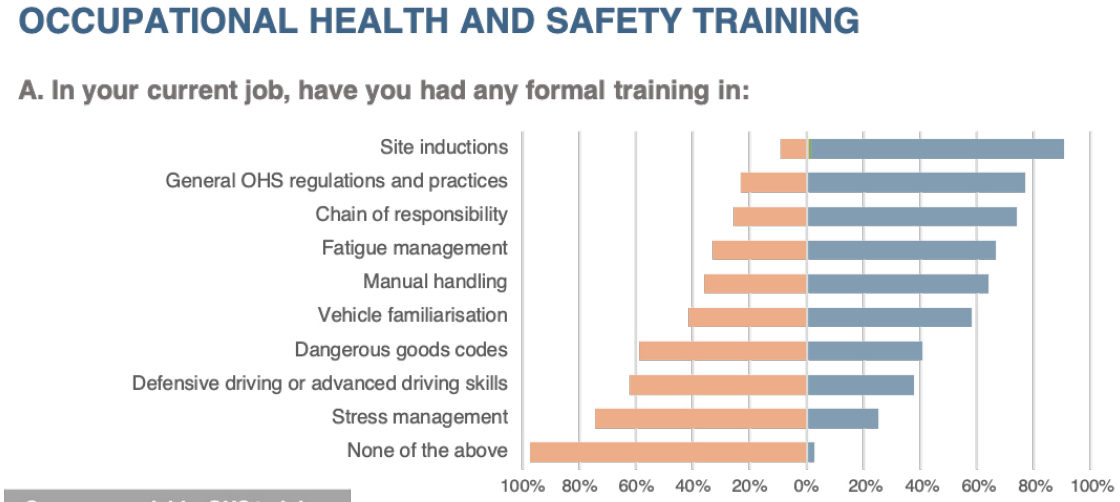
Just under half of the drivers (45.5%) were classified as having good training, whereas 54.5% had training in less than 5 of the OHS items listed [Figure 7A].

The most common OHS training drivers received was site inductions (91%), followed by general OHS regulations and practices (77%) and chain of responsibility training (74%).

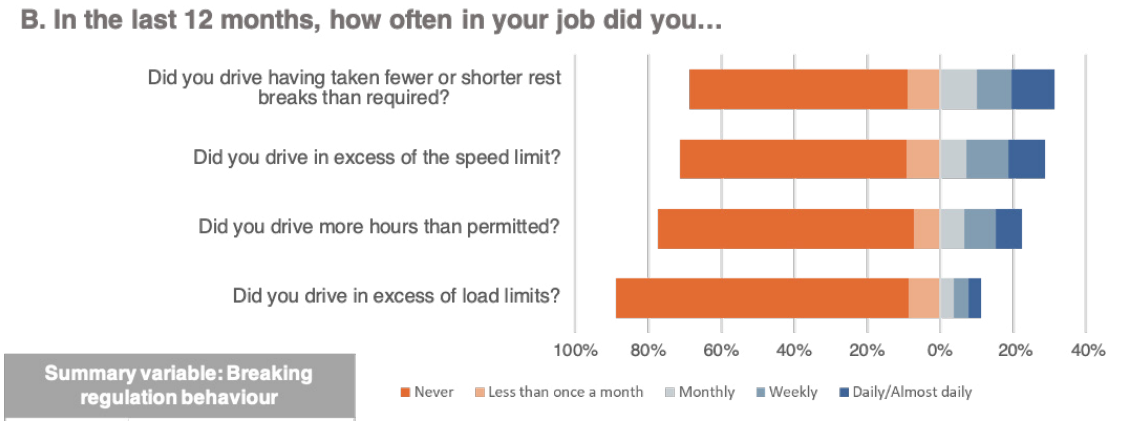
A large proportion of drivers were identified as having Breaking regulation behaviour (62.9%) [Figure 7B].

Over 25% of drivers reported having taken fewer or shorter rest breaks than required on at least a monthly basis, with 10% having to take fewer or shorter breaks daily/almost daily. Driving in excess of load limits occurred infrequently.

Figure 7 Regulatory domain: OHS Training and regulations



Summary variable: OHS training	
Fair training	181 (54.5%)
Good training	151 (45.5%)



Summary variable: Breaking regulation behaviour	
Yes	209 (62.9%)
No	123 (37.1%)

LIFESTYLE DOMAIN

The majority of drivers did not meet the guidelines for a healthy and balanced diet (68.1%) [Figure 8A], with an average of 1.5 and 1.3 serves of vegetables and fruit being consumed by drivers per day. This proportion was lower compared to the national average of persons (95.3%) and males (97.7%) aged 18-64 years that did not meet the dietary guidelines of fruit and vegetable consumption.[23] Furthermore, beverages like soda, cordial, sports drinks and caffeinated energy drinks were being consumed on average 2.7 days a week [Figure 8A]. When it comes to physical activity, almost half of the drivers (49.4%) met the guidelines of at least 150 minutes of moderate intensity aerobic exercise or 75 minutes of vigorous intensity exercise per week [Figure 8B]. This proportion was more than double that of the national average for the general Australian population (15.0%) and males (15.3%) between 18-64 years of age.[24] On average, survey respondents performed 223.7 and 85.3 minutes of moderate and vigorous intensity exercise per week respectively and 48.8% reported doing muscle strengthening or toning exercises in the week prior to taking the survey [Figure 8B].

Most drivers taking the survey were non-smokers (77.7%), with 22.3% classified as smokers [Figure 8C] which is somewhat higher than the national average proportion of smokers in the general population (14.6%) and males (17.6%) between 18-64 years of age.[25] Those who were smokers mainly used tobacco (20.8%) and smoked between 11-20 cigarettes per day (34.8%) [Figure 8C & D]. Our results were also in agreement with previous studies where truck drivers were more likely to be a current smoker than the general population. However, it seemed that the prevalence of smoking was generally lower for Australian truck drivers than it was for US truck drivers.[26] This might be due to the increased cost of tobacco in Australia which are highly taxed. In 2016, the Australian Government announced that it would implement annual increases in tobacco excise of 12.5% up to and including 2020, raising the cost of a pack of cigarettes to $A40, which lead to Australia having one of the highest prices of cigarettes in the world.

The majority of drivers have had their blood pressure (90.6%) and cholesterol (70.2%) checked in the last year and hearing problems were reported by 26.7% of drivers [Figure 8E]. Moreover, over two fifths of drivers (40.7%) were defined as being at high risk of alcohol misuse [Figure 9]. Drivers tended to have a drink containing alcohol 2-3 times per week (26.8%), followed by 2-4 times per month (22.6%) and Monthly or less (20.8%) [Figure 9A]. Drivers typically had 1-2 standard drinks on a day when drinking (40.6%), with a third (33.9%) having 3-4 standard drinks [Figure 9B]. Having 5 or more drinks on one occasion occurred less than once a month for 31.6% of drivers and never happened for 27.8% of drivers [Figure 9C].

Figure 8 Lifestyle domain: Diet, exercise and smoking

DIET

A. On average, survey respondents had

1.5 Serves of vegetables per day

1.3 Serves of fruit per day

2.7 Days per week consuming soft drinks, cordials, sport drinks or caffeinated energy drink

Summary variable: Diet	
Met the guidelines	105 (31.9%)
Did not meet guidelines	224 (68.1%)

EXERCISE

B. On average, in the past week survey respondents had performed:

223.7 Minutes of moderate exercise

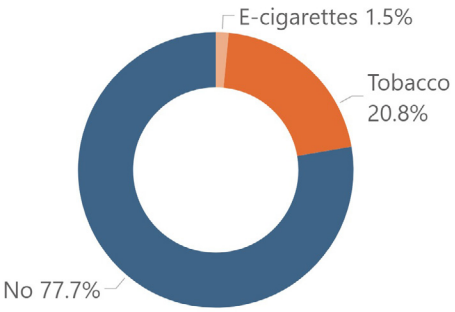
85.3 Minutes of vigorous exercise

48.8% Performing muscle strengthening or toning exercises

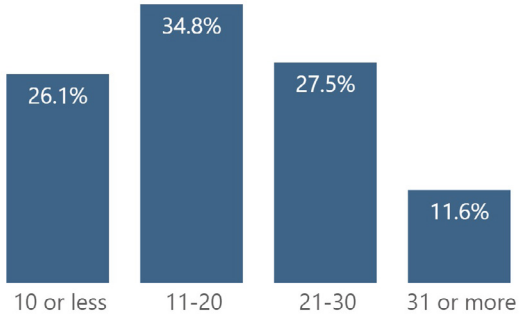
Summary variable: Physical activity	
Met the guidelines	161 (48.5%)
Did not meet guidelines	165 (49.7%)

SMOKING

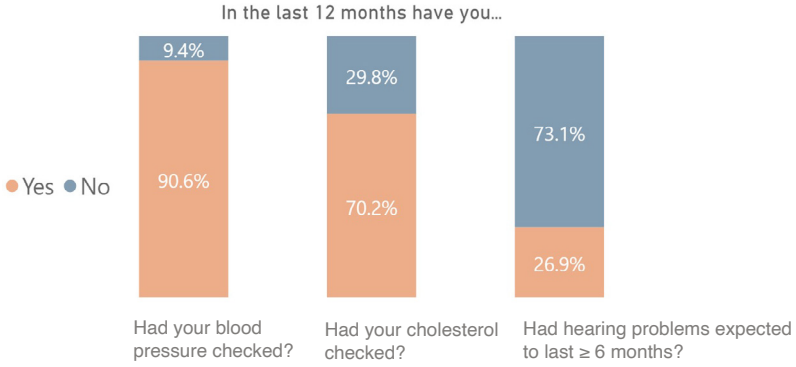
C. Do you currently smoke?



D. How many cigarettes do you smoke/day?



E. In the last 12 months, have you had the following health checks?



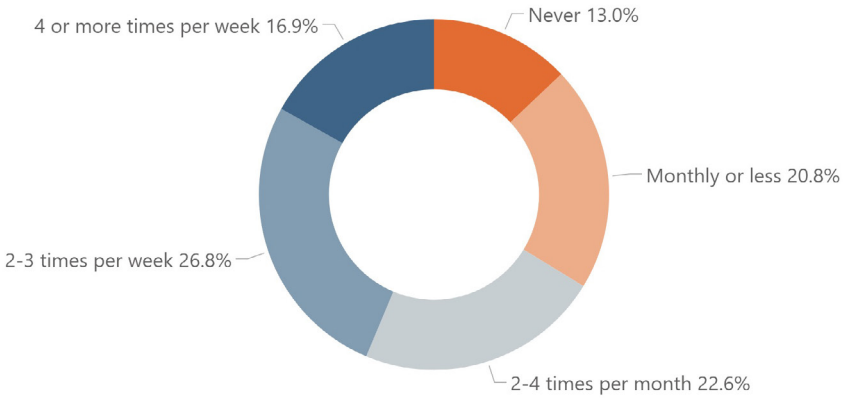
Summary variable: Smoking	
Non-smoker	258 (77.7%)
Smoker	74 (22.3%)

Figure 9 Lifestyle domain: Alcohol

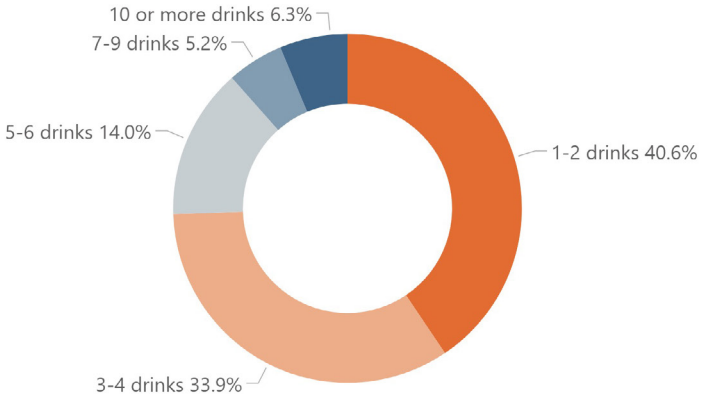
ALCOHOL

Summary variable: Alcohol	
Low risk drinking	197 (59.3%)
High risk drinking	135 (40.7%)

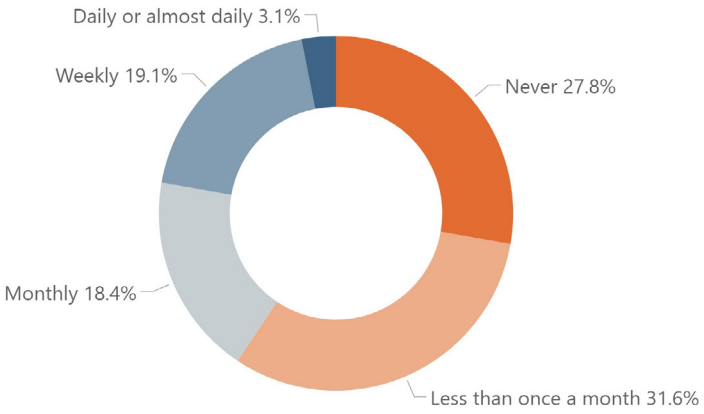
A. In the past 12 months, how often did you have a drink containing alcohol?



B. How many standard drink of alcohol do you drink on a typical day when you are drinking?



C. In the past 12 months, how often do you have 5 or more drinks on one occasion?



According to BMI, the majority of drivers were either overweight (26.3%) or obese (55.7%) [Appendix I]. A third of the drivers (33.4%) reported struggling with pain.

Overall, experiencing fatigue whilst working was common among drivers (62.1%) [Figure 10], with nearly 50% becoming fatigued daily or weekly [Figure 10A]. Sixty-seven percent of drivers had received some form of fatigue management training, predominantly basic fatigue management (53.4%) [Figure 10B]. Of the 95 drivers (28.6%) that had used a substance to combat fatigue in the last year, 56.9% had used caffeine or energy drinks. A very small proportion used stimulants like amphetamines (3.1%) or other stimulant medication (1.5%) [Figure 10C].

Having trouble falling asleep occurred 0-1 nights per week for 49.2% of drivers, however 21.7% of drivers reported problems 5-7 nights per week [Figure 11A]. Drivers also reported falling asleep unintentionally during the day on average 2.3 days in the past month and 11.1% reported nodding off or falling asleep whilex driving [Figure 11B]. In total, 17.5% of our participants were defined as being at High risk of poor sleep. The majority of drivers reported that poor sleep had only troubled them a little (37.3%) or not at all (24.7%) [Figure 11C]. On average, drivers had 6.6 hours of sleep over a 24-hour period and 8.1% reported taking some form of medication to aid sleep [Figure 11D].

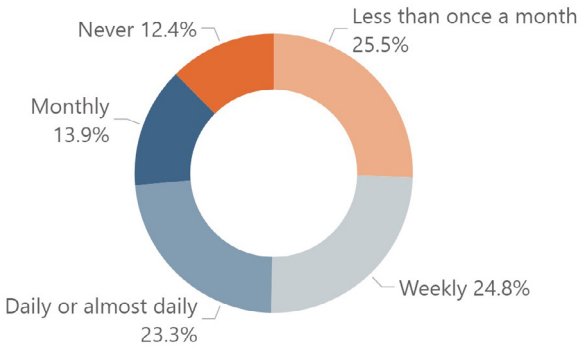
The majority of drivers reported spending their time working alone either always (51.8%) or very often (38.6%) [Figure 12]. Despite this, only 11.1% and 4.2% reported feeling lonely often or always, with most drivers never (42.5%) or rarely (17.5%) experiencing loneliness at work [Figure 12B]. Therefore, 40% of our participants was classified into “loneliness” group.

Accumulatively 32.7% of drivers had used some form of medication to manage either sleep or fatigue [Figure 12C]. Drivers with pain most commonly reported back pain (68%) [Figure 12].

Figure 10 Health risk domain: Fatigue

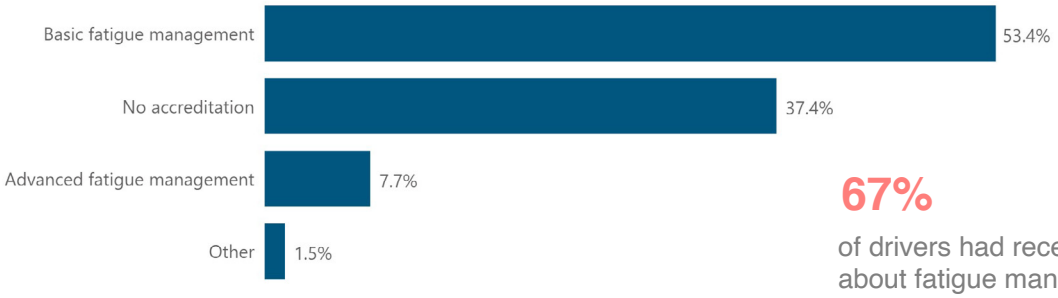
FATIGUE

A. How often do you become fatigued while driving for work?



Summary variable: Fatigue	
Low risk	125 (37.9%)
High risk	205 (62.1%)

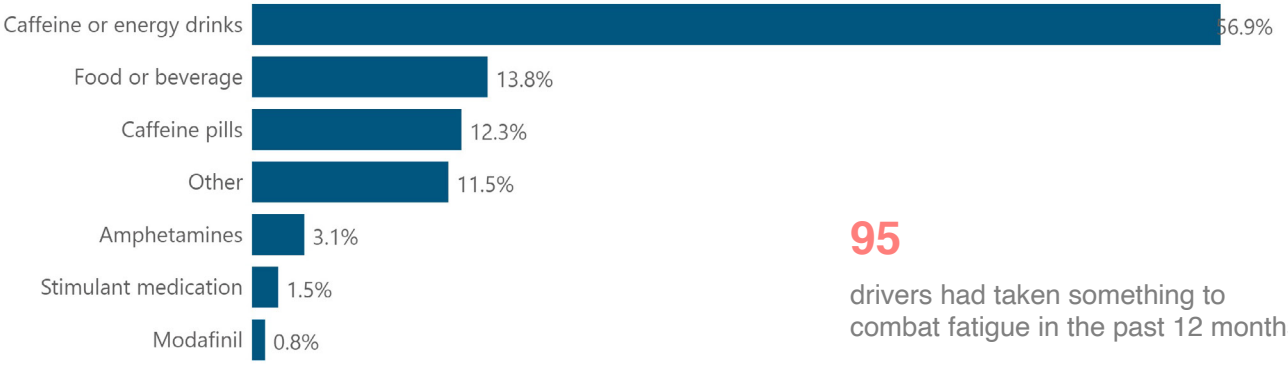
B. Type of fatigue management



67%

of drivers had received training about fatigue management

C. Description of medication used to combat fatigue



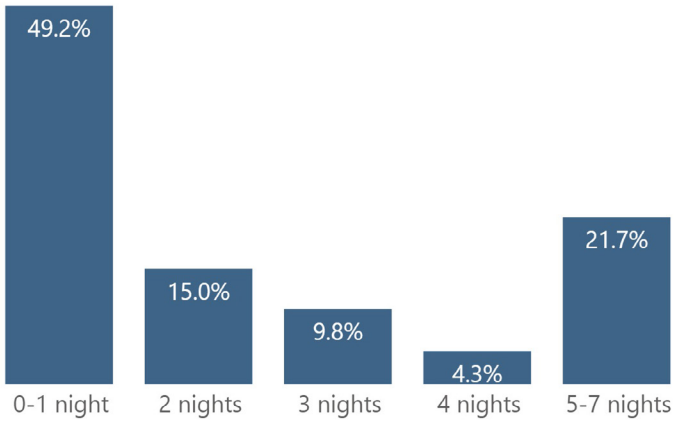
95

drivers had taken something to combat fatigue in the past 12 months

Figure 11 Health risk domain: Sleep

SLEEP

A. In the past month, how many nights per week have you had problems sleeping?



B.

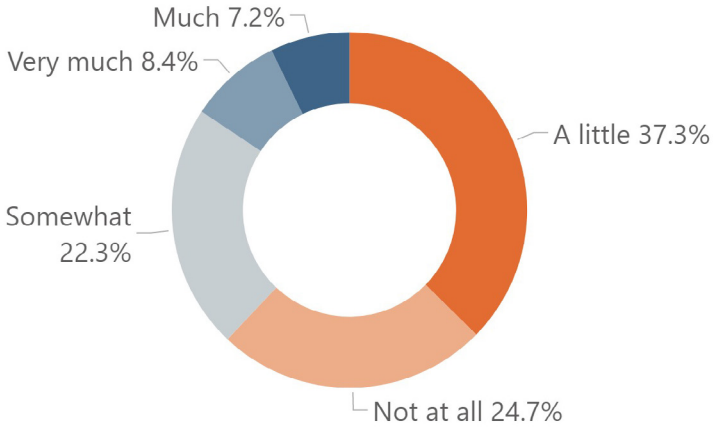
2.3

days of unintentionally falling asleep during the day in the past month

11.1%

of drivers have nodded off or fallen asleep while driving

C. In the past month, to what extent has poor sleep troubled you?



D.

6.6

hours of sleep on average in a 24-hour period in the past month

8.1%

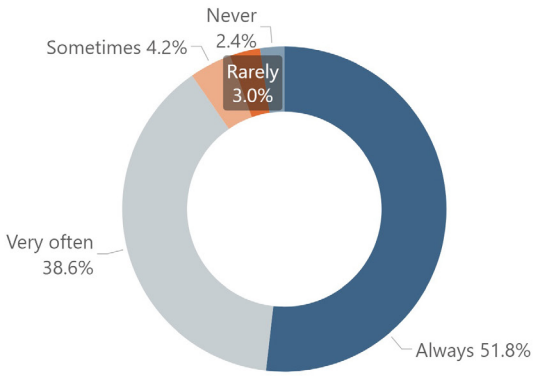
of drivers took some medication to help sleep

Summary variable: Sleep	
Low risk	274 (82.5%)
High risk	58 (17.5%)

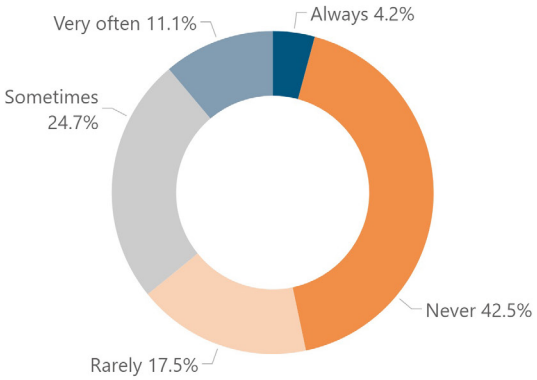
Figure 12 Health risk domain: Loneliness and medication use

LONELINESS

A. Over a typical work week, how much time do you spend working alone?



B. During the past week, how often have you felt lonely?

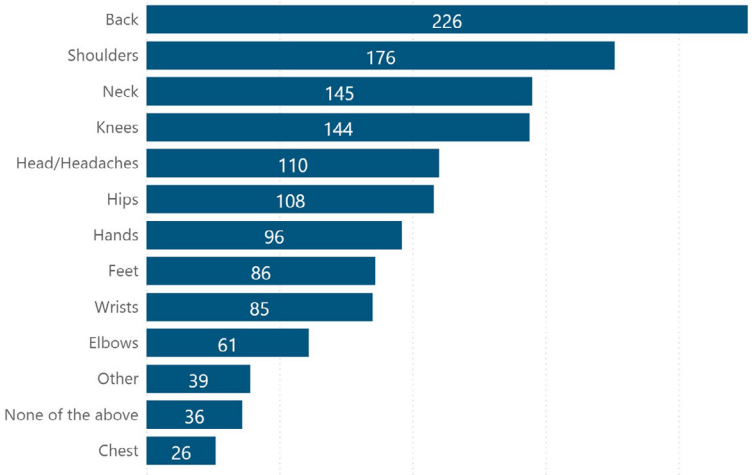


MEDICATION USE

C. **32.7%** Of drivers had used some form of medication to manage sleep or fatigue

Summary variable: Loneliness	
Yes	133 (40.0%)
No	199 (60.0%)

D. Pain location



Outcomes

TABLE 2 MEASUREMENT OF STUDY OUTCOMES			
		n	%
Whole cohort		332	100%
General Health	Excellent	15	4.5%
	Very Good	84	25.3%
	Good	117	35.2%
	Fair	90	27.1%
	Poor	26	7.8%
Near misses	Once per week	227	69.6%
	6-10 times/week	43	13.2%
	> 10 times in past month	56	17.2%
Psychological distress	None or low	165	50.5%
	Moderate	122	37.3%
	Severe	40	12.2%
Work ability	Poor	53	16.0%
	Moderate	54	16.3%
	Good	131	39.5%
	Excellent	94	28.3%
		mean	SD
Psychological distress (0-24)	5.58	5.17	
Work ability (0-10)	7.78	2.43	

The outcomes described in Table 2 were all collected in the online survey. Approximately half of the drivers reported having no or low psychological distress (50.5%), whereas 37.3% and 12.2% were experiencing moderate and severe levels of distress respectively. Two thirds of drivers reported being very good (29.8%) or good (35.2%) general health, However, 34.9% of drivers reported being in poor to fair health which is double the proportion of the general Australian population (15.2%) and that of Australian males (15.8%).[27] Near misses on the road were fairly common with 69.6% of drivers reporting a frequency of at least once per week. The majority of drivers reported having either good (35.2%) or very good (29.8%) work ability.

Determinants Associated with Work Ability

Thirteen determinants were selected by LASSO regression for assessing work ability. These determinants across the six domains were:

- **Personal domain**: Age, mental health condition, financial stress
- **Occupation domain**: Work task, work shift
- **Workplace environment domain**: Work environment, workplace violence
- **Regulatory domain**: OHS training
- **Lifestyle domain**: Diet
- **Health risk domain**: Medication use, loneliness, BMI, pain

Step 1 of the hierarchical multiple regression revealed that the personal domain contributed significantly to the regression model ($F(5,317) = 7.30$, $p < 0.001$) and accounted for 11.9% of the variation in increased work ability [Table 3]. Introducing the occupational domain at step 2 explained an additional 3.7% of variation in increased work ability, and this change in R^2 was significant ($F(9, 313) = 6.10$), $p < 0.05$) [Table 7]. Adding workplace environment domain at step 3 including work environment and workplace violence to the regression model explained an additional 1.5% of the variation but this change in R^2 was not significant ($F(11,311) = 5.80$, $p = 0.059$).

The addition of the regulatory (OHS training) and lifestyle domains (Diet), explained an additional 1.7% and 1.3% of the variation respectively and these changes in R^2 were significant ($F(12,310) = 6.1$, $p < 0.05$ & $F(13, 309) = 5.97$, $p < 0.05$)). Finally, adding the health risk domain at step 6 to the regression model explained an additional 8.0% of the variation and this change in R^2 was also significant ($F(18,304) = 8.55$, $p < 0.001$).

The most important determinants of work ability were the personal domain and health risk domain which explained 12% and 8% of the variation in work ability respectively. Together the six domains accounted for 28.0% of the variance in workability. The regression coefficients for the full model of predicting work ability are presented in Appendix III.

TABLE 3 HIERARCHICAL REGRESSION ANALYSIS SUMMARY FOR PREDICTING WORK ABILITY

Model	No. of variables included	R^2	F(df)	R^2 change	P
1: Personal domain	3	0.119	7.295 (5,317)	--	< 0.001
2: Occupation domain	2	0.155	6.092 (9,313)	0.037	0.010
3: Work environmental domain	2	0.171	5.795 (11,311)	0.015	0.059
4: Regulation domain	1	0.188	6.140 (12,310)	0.017	0.011
5: Lifestyle domain	1	0.200	5.968 (13,309)	0.013	0.028
6: Health risk domain	4	0.280	8.548 (18,304)	0.080	0.000

Determinants Associated with Psychological Distress

LASSO regression estimated non-zero coefficients for 17 out of 29 determinants assessed for psychological distress. The 17 non-zero determinants from the six domains were:

- **Personal domain**: Age, family situation, pre-existing mental health condition, pre-existing physical health condition, financial stress
- **Occupational domain**: Payment type, work task, work shift, driving experience, driver type
- **Workplace environment domain**: Work environment and workplace violence
- **Regulatory domain**: OHS training
- **Lifestyle domain**: Diet
- **Health risk domain**: Fatigue, loneliness, BMI

Step 1 showed that when the personal domain was entered first, it accounted for 37.5% of the variance for increased psychological distress; ($F (9, 304) = 19.44$, $p < 0.001$) [Table 4]. The five determinants representing the occupational domain, entered after the personal domain, contribute significantly to the prediction of increased psychological distress at 6.8%; ($F (20, 293) = 14.65$, $p < 0.001$).

Introducing the workplace environment domain at step 3 explained an additional 1.4% of variation, and this change in R^2 was significant ($F (22, 292) = 14.20$), $p < 0.05$). Adding workplace environment, regulation, lifestyle and health risk domains explained an additional 1.7%, 2.3%, 3.7 of variation in psychological distress respectively and these changes in R^2 were significant.

Together the six domains accounted for 53.7% of the variance in increased psychological distress. The regression coefficients for the full model of predicting psychological distress are presented in Appendix IV.

TABLE 4 HIERARCHICAL REGRESSION ANALYSIS SUMMARY FOR PREDICTING PSYCHOLOGICAL DISTRESS

Model	No. of variables included	R^2	F(df)	R^2 change	P
1: Personal domain	5	0.375	19.442 (9,304)	--	< 0.001
2: Occupation domain	5	0.444	14.651 (20,293)	0.068	< 0.001
3: Work environmental domain	2	0.458	14.146 (22,291)	0.014	0.027
4: Regulation domain	1	0.475	14.708 (23,290)	0.017	0.002
5: Lifestyle domain	2	0.5	16.213 (24,289)	0.023	< 0.001
6: Health risk domain	3	0.537	16.925 (29,285)	0.037	< 0.001

Determinants Associated with General Health

For general health, LASSO regression estimated non-zero coefficients for 16 out of 29 determinants from six domains:

- **Personal domain**: Age, family situation, pre-existing physical condition, financial stress
- **Occupational domain**: Work shift, driving experience, paid for delay
- **Workplace environment domain**: Work environment and workplace violence
- **Regulatory domain**: Regulation behaviour
- **Lifestyle domain**: Diet
- **Health risk domain**: Drug use, sleep, loneliness, BMI, pain

Step 1 revealed that the personal domain contributed significantly to the regression model ($F(8, 295) = 8.5$, $p < 0.001$) and accounted for 17.3% of the variation in general health [Table 5]. Adding the occupational and workplace environment domains at step 2 and 3 explained an additional 3.2% and 2.1% of variation, with significant R^2 changes ($F(13, 290) = 6.87$), $p < 0.05$) & ($F(15, 288) = 6.74$, $p < 0.05$).

The regulation behaviour determinant representing the regulatory domain entered in the model at step 4, only contributed to an additional 0.7% of the variation and was not significant ($F(16, 287) = 6.44$, $p = 0.117$). The lifestyle domain contributed significantly to the prediction of general health at 1.7% ($F(17,286) = 6.74$, $p < 0.05$). The health risk domain was considered as one of most important determinants of general health, uniquely explaining 11.3% of the variation ($F(23, 280) = 8.28$, $p < 0.001$).

Together the six domains accounted for 36.2% of the variance in general health. The regression coefficients for the full model of predicting general health are presented in Appendix V.

TABLE 5 HIERARCHICAL REGRESSION ANALYSIS SUMMARY FOR PREDICTING GENERAL HEALTH

Model	No. of variables included	R^2	F(df)	R^2 change	P
1: Personal domain	4	0.173	8.510 (8,295)	--	< 0.001
2: Occupation domain	3	0.205	6.863 (13,290)	0.032	0.042
3: Work environmental domain	2	0.226	6.744 (15,288)	0.021	0.021
4: Regulation domain	1	0.232	6.442 (16,287)	0.007	0.117
5: Lifestyle domain	1	0.249	6.739 (17,286)	0.017	0.011
6: Health risk domain	5	0.362	8.280 (23,280)	0.113	0.000

Determinants Associated with Near Misses

For near misses, LASSO regression estimated non-zero coefficients for 6 out of 29 determinants from four domains:

- **Personal domain**: Family situation
- **Occupation domain**: Working hours, payment type, time and schedule
- **Lifestyle domain**: Drinking
- **Health risk domain**: BMI

Step 1 showed that family situation had a statistically significant relationship with near misses [Table 6]. After the occupational domain was added, the difference between the step 1 and step 2 was significant at $p < 0$ .001. However, there was no statistically significant difference when lifestyle and health risk determinants to the model. The regression coefficients for the full model of predicting near misses are presented in Appendix VI.

TABLE 6 HIERARCHICAL REGRESSION ANALYSIS SUMMARY FOR PREDICTING NEAR MISSES

Model	Number variables included	Log likelihood (LL)	Likelihood ratio (LR)	P
1: Personal domain	1	-186.950	19.650	0.003
2: Occupation domain	3	-169.942	34.020	0.000
3: Lifestyle domain	1	-169.932	0.020	0.887
4: Health risk domain	1	-167.929	4.010	0.135

Overview of Determinants Across Outcomes

The relationship of specific determinants with study outcomes is visualised in Table 7. Determinants selected for the model by LASSO analysis are shaded. Green shading denotes positive and orange shading negative associations. For example, increased age is associated with decreased psychological distress, whereas increased age is associated with decreased work ability. Blue shading demonstrates categorical variables where a direction of effect cannot be assigned to each category. For example, family situation has an important effect on psychological distress, but the categories of this variable (i.e. not married with no dependents, not married with dependents, married with no dependents, married with dependents) are not in a ranked order. Darker colours denote determinants found to significantly contribute to the final model. For example, having a pre-existing mental health condition was a significant determinant in the work ability final model, but older age was not.

In each domain there were determinants that were selected across multiple outcomes. Having a high BMI was the only variable selected across all four outcomes, and was significant in the final model for work ability, general health and near misses.

TABLE 7 HEAT MAP SHOWING THE RELATIONSHIP OF SPECIFIC DETERMINANTS WITH STUDY OUTCOMES

		Better work ability	Less psychological distress	Better general health	Few near misses
Personal domain	Increased age				
	Family situation				
	Education				
	Having pre-existing mental health conditions				
	Having pre-existing physical conditions				
	High financial stress				
Occupational domain	Employment type				
	Driver type				
	Longer working hours				
	Payment type				
	Shift type				
	Longer driving experience				
	High risk work task				
	High risk time and schedule				
	Paid for delays				
Workplace environment domain	Poor work environment				
	Experienced workplace violence				
Regulatory domain	Breaking regulations				
	Good OHS training				
Lifestyle domain	Diet meeting the guideline				
	High risk drinking				
	Smoker				
	Physical activity meeting the guideline				
Health risk domain	High risk of poor sleep				
	Experiencing fatigue				
	Having pain				
	Having medication use				
	Experiencing loneliness				
	High BMI				

Negative association
Selected by Lasso model

Negative association
Selected by Lasso model and the final model

Positive association
Selected by Lasso model

Positive association
Selected by Lasso model and the final model

Association direction not applicable
Selected by Lasso model

Association direction not applicable
Selected by Lasso model and the final model

Discussion

To our knowledge, this is the first study to examine a wider range of determinants associated with truck drivers' physical health, mental health and driving performance. This report first describes Australian truck drivers' experience in their work tasks, work environment, work time and schedule, and workplace violence and then describes Australian truck drivers' sleep, fatigue, medication use and other lifestyle characteristics. This report also describes the role of personal, occupation, work, lifestyle, and health risk factors in explaining drivers' workability, psychological distress, general health and near misses.

In our study, nearly half of drivers had experienced at least one workplace violence incident in the past 12 months. There is growing recognition that those who work alone or in isolated areas are at greater risk of workplace violence due to poor access to emergency assistance compared with those who work in the much more closely monitored traditional workplace setting.[28] Truck driving is one of the higher risk lone worker occupations, despite drivers starting and leaving from depots. A study drawing on interviews with 158 truck drivers across the United States and Canada examined interpersonal and impersonal violence among truck drivers.[28] It seemed that rather than being able to rely on police services and safety regulations, truck drivers were primarily left to cope on their own with workplace violence by engaging in informal personal safety strategies. A past Australian study argued that occupational violence amongst long distance truck drivers was an endemic risk.[29] Three distinct facets of violence were identified by that study including road violence, violence at loading yards and violence from stressed customers. Therefore, research is needed to identify the key risks associated with workplace violence for drivers and, in turn, targeted intervention in the management of the issue at individual and workplace levels of the transportation system.

The majority of drivers in our study did not meet the guidelines for a healthy and balanced diet. This result is comparable to a previous Australian cross-sectional study on truck drivers' nutrition and physical activity conducted by Sendall et al.[30] Poor diet has been linked to weight issues, which in part could explain the high levels of obesity found in this cohort. Truck drivers commonly struggle to maintain a balanced diet due to a lack of time and access to healthy foods on the road.[16] However, a U.S. study found that truck drivers were aware of some healthy foods, but they lacked knowledge of appropriate energy intake and healthy weight standards.[31] Informing drivers about healthy food choices at a truck stop was found to improve healthier eating practices in commercial drivers.[32]
Here in Australia, efforts to help drivers achieve a healthy and balanced diet requires collaboration between several key stakeholders across the system, including government, regulators, and employers to provide the education and infrastructure to support drivers' individual efforts.

A similar collaborative approach could also target the physical health of drivers. Our study found that just under half of drivers met physical activity guidelines, a higher proportion compared to a previous Australian study.[30] Unhealthy diet and poor physical activity behaviours are both known risk factors for becoming overweight or obese. Findings from our study reveal that improvement initiatives for healthy eating might be more urgent than physical activity for Australian truck drivers.

Our study confirmed the conceptual model, suggesting that determinants from the personal, occupational, workplace environment, regulatory, lifestyle and health domains were all important predictors of a drivers' health and driving performance. However, these factors may interact differently in explaining our study outcomes. Previous research has suggested that work ability is associated with individual characteristics, lifestyle, demands at work, and physical condition.[31], [33], [34] The final step of the hierarchical regression analysis in our study showed that personal and health risk domains explained the majority of the variation, which implies that being in poor mental and physical health, being overweight and experiencing pain affects drivers' work ability. This finding is important to consider in programmes and interventions aimed at maintaining or improving the longevity of the trucking workforce. At the individual level, drivers may benefit from interventions targeted at improving mental health, decreasing physical work load and preventing pain. Weight loss intervention is also likely be beneficial based on our modelling. Examples of work-related health interventions shown to be effective for this cohort include weight loss and reduction of musculoskeletal pain. Among American commercial truck drivers, a multicomponent intervention produced significant weight loss among drivers and improved their fruit and vegetable consumption and physical activity.[35] A randomized controlled trial study demonstrated that an engineering intervention on truck seat can substantially reduce vibration exposures and appeared to be effective in reducing low back pain and improving other physical health outcomes.[36]

Our findings suggest that determinants from the personal domain had the biggest impact on the likelihood that a driver would suffer from psychological distress. There appears to be a clear relationship between driver pre-existing mental health conditions, financial stress and occupational characteristics with developing psychological distress. The Driving Health Study report #6 revealed that one in five drivers under 35 years reported having severe psychological distress compared to the national average of one in nine in the same age group.[6] The Driving Health report #7 also reported that drivers would at times transfer stress to their partners and family members, which was often already a fragile home situation.[16] Therefore, mental health promotion, assessment, and treatment must become a priority to improve the transport industry environment, particularly for younger drivers. However, the number of determinants identified in our analysis suggests a simple intervention is unlikely to be effective in improving the mental health of truck drivers. A system-based approach integrating self-care management, education on health partitioners, workplace health promotion and regulatory input to address the complex causes of psychological distress is needed. Interventions should initially focus on the determinants that can be modified and accomplished in the short term. For instance, OHS training was identified to be positively associated with decreased psychological distress in our study. Improving OHS training and support from management and supervisors may be an effective approach to achieve short-term outcomes.

Safety is consistently a top concern of trucking industry at all levels. Published data have determined the relationship between crashes and serious injuries related to tiredness, fatigue and sleeping.[37] In our study, over two fifths of drivers reported experiencing an unrealistically tight delivery schedule and this proportion was higher than a recent U.S. study (15.5%).[22] It is also worthy to note that drivers in our study who reported 'breaking regulations' often had to take fewer and shorter rest breaks than required, possibly due to time pressure. Taking fewer and shorter rest breaks can directly contribute to fatigued driving, estimated to contribute to 19.9% of fatal accidents involving trucks.[38]
Current safety interventions for the trucking industry general focus on fatigue and sleep management at an individual level. External factors contributing to fatigue and poor sleep can be beyond the driver's, control such as working hours, payment type and work time schedule. It is important that multiple stakeholders share responsibility to review fatigue guidelines, including employers, supply-chain, allocators, regulators and drivers.

It is known that determinants of health span social, ecological, political, commercial and cultural factors.[39] Our study suggested that determinants from personal, occupational, workplace environment, lifestyle and health risk domains all contribute to truck driver's general health. In Australia, a number of health and wellbeing programmes have been developed to target truck drivers. For instance, the OzHelp Foundation has developed a multi-component 'Health in Gear' program, which provides online resources, roadside health checks, and a support line for owner drivers and their immediate family members. The Healthy Heads in Trucks & Sheds Foundation has also been promoting prevention and understanding of mental health issues that exist across the road transport and logistics industries in Australia. Large private operators may provide employees with access to programs aiming at improving truck drivers' general health, mental wellbeing, nutrition, fitness and strength, such as the Healthy Fox program delivered to Linfox employees.
A scan of interventions currently in place across Australia suggests most are designed to influence behaviour on an individual level. Our findings suggest there is clearly a role for interventions targeted at other levels and stakeholders in the transport industry to support drivers to be healthy and stay healthy at work.

Strengths and Limitations

This is the first study to examine a wider range of determinants to truck drivers' health outcomes and driving performance. Our data were collected from a national survey of truck drivers in Australia, including drivers from all over Australia driving wide range of vehicles across various experience levels. Performing Lasso regressions enabled us to identify the most relevant covariates associated with study outcomes. However, this study does have some limitations. First, this study is cross-sectional in design, which does not identify causative factors related to driver health and performance. Second, the survey relies on self-report and may be influenced by the narrative and memory of the drivers themselves. Third, given that nearly two thirds of the drivers who participated in the online survey did not participate in the telephone survey, response-bias may be reflected in our results. Finally, considering the length of the survey, we could not use previously validated measurement tools in full to measure all determinants, such as sleep and fatigue. Therefore, comparison of the results to other populations may be limited.

Conclusion

The physical and mental health of truck drivers can be influenced by a wide range of determinants including personal, occupational, workplace environment, regulation, lifestyle, and health risk domains. This suggests that industry-based interventions should focus on those modifiable risks and address multiple domains. Our findings also suggest that some factors contributing to poor physical and mental health can be beyond the driver's control, therefore interventions should be targeted towards multiple levels and stakeholders in the transport industry to help drivers to be healthy and stay healthy at work.

References

1 Australian Bureau of Statistics. Employed persons by Age and Industry division of main job (ANZSIC), November 1984 onwards [Internet]. Australian Bureau of Statistics. 2017 [cited 16 Feburary 2018].

2 Crizzle AM, Bigelow P, Adams D, Gooderham S, Myers AM, Thiffault P. Health and wellness of long-haul truck and bus drivers: A systematic literature review and directions for future research. Journal of Transport & Health. 2017;7(Part A):90-109.

3 Sieber WK, Robinson CF, Birdsey J, Chen GX, Hitchcock EM, Lincoln JE, et al. Obesity and other risk factors: the national survey of US long-haul truck driver health and injury. American Journal of Industrial Medicine. 2014;57(6):615-26.

4 Anderson JE, Govada M, Steffen TK, Thorne CP, Varvarigou V, Kales SN, et al. Obesity is associated with the future risk of heavy truck crashes among newly recruited commercial drivers. Accident Analysis & Prevention. 2012;49:378-84.

5 Guest AJ, Chen Y-L, Pearson N, King JA, Paine NJ, Clemes SA. Cardiometabolic risk factors and mental health status among truck drivers: a systematic review. BMJ Open. 2020;10(10):e038993.

6 van Vreden C, Xia T, Pritchard E, Collie A, Newnam S, Rajaratnam S, et al. Driving Health Study Report No 6: Survey of the physical and mental health of Australian professional drivers. Insurance Work and Health Group, Faculty of Medicine, Nursing and Health Sciences, Monash University; 2020.

7 Australian Bureau of Statistics. National Health Survey 2014-15 [Internet]. Australian Bureau of Statistics. 2015.

8 Institute for Work & Health. Benchmarking organizational leading indicators for the prevention and management of injuries and illnesses. Toronto, Ontario Institute for Work & Health; 2011.

9 Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA, Project ACQI. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Archives of Internal Medicine. 1998;158(16):1789-95.

10 Netzer NC, Stoohs RA, Netzer CM, Clark K, Strohl KP. Using the Berlin Questionnaire to identify patients at risk for the sleep apnea syndrome. Annals of Internal Medicine. 1999;131(7):485-91.

11 Dunn N, Friswell R, Williamson A, editors. Work and fatigue among light truck and short haul drivers in NSW. Australasian Road Safety Research Policing and Education Conference; 2006; Surfers Paradise, Queensland, Australia.

12 Williamson A, Friswell R, Dunn N. Company perspectives on work, fatigue and occupational health and safety in the light and short haul road transport sector: University of New South Wales, NSW Injury Risk Management Research Centre; 2006.

13 Kessler RC, Andrews G, Colpe LJ, Hiripi E, Mroczek DK, Normand SLT, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. Psychological Medicine. 2002;32(6):959.

14 Ware Jr JE, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. Medical Care. 1996:220-33.

15 Ilmarinen J. The work ability index (WAI). Occupational Medicine. 2007;57(2):160-.

References

16 Pritchard E, van Vreden C, Iles R. Driving Health Study Report No 7: Uneven wear: Health and wellbeing of truck drivers. Insurance Work and Health Group, Faculty of Medicine, Nursing and Health Sciences, Monash University; 2020.

17 Smith PM, Saunders R, Lifshen M, Black O, Lay M, Breslin FC, et al. The development of a conceptual model and self-reported measure of occupational health and safety vulnerability. Accident Analysis & Prevention. 2015;82:234-43.

18 Khadjesari Z, White IR, McCambridge J, Marston L, Wallace P, Godfrey C, et al. Validation of the AUDIT-C in adults seeking help with their drinking online. Addiction Science & Clinical Practice. 2017;12(1):2.

19 Heinze G, Wallisch C, Dunkler D. Variable selection–a review and recommendations for the practicing statistician. Biometrical Journal. 2018;60(3):431-49.

20 General Social Survey: Summary Results, Australia [Internet]. Australian Bureau of Statistics. 2019.

21 Williams Jr DF, Thomas SP, Liao-Troth S. The truck driver experience: identifying psychological stressors from the voice of the driver. Transportation journal. 2017;56(1):54-76.

22 Chen GX, Sieber WK, Collins JW, Hitchcock EM, Lincoln JE, Pratt SG, et al. Truck driver reported unrealistically tight delivery schedules linked to their opinions of maximum speed limits and hours-of-service rules and their compliance with these safety laws and regulations. Safety Science. 2021;133:105003.

23 Australian Bureau of Statistics. National Health Survey First Results, 2017-2018: Table 12: Consumption of fruit, vegetables, and sugar sweetened and diet drinks-Australia [Internet]. Australian Bureau of Statistics, 2018.

24 Australian Bureau of Statistics. National Health Survey First Results, 2017-2018: Table 13: Physical activity - Australia. Canberra Australian Bureau of Statistics, 2018.

25 Australian Bureau of Statistics. National Health Survey First Results, 2017-2018: Table 9: Smoking - Australia [Internet]. Australian Bureau of Statistics,2018.

26 Kagabo R, Thiese MS, Eden E, Thatcher AC, Gonzalez M, Okuyemi K. Truck Drivers' Cigarette Smoking and Preferred Smoking Cessation Methods. Substance Abuse: Research and Treatment. 2020;14:1178221820949262.

27 Australian Bureau of Statistics. National Health Survey: first results, 2017-18. Canberra, ACT: Australian Bureau of Statistics; 2019.

28 Gray G, Lindsay K. Workplace Violence: Examining Interpersonal and Impersonal Violence among Truck Drivers. Law & Policy. 2019;41(3):271-85.

29 Mayhew C, Quinlan M. Occupational violence in long distance road transport: A study of 300 Australian truck drivers. Current Issues in Criminal Justice. 2001;13(1):36-46.

30 Sendall MC, McCosker LK, Ahmed R, Crane P. Truckies' nutrition and physical activity: a cross-sectional survey in Queensland, Australia. The International Journal of Occupational and Environmental Medicine. 2019;10(3):145.

References

31 Passey DG, Robbins R, Hegmann KT, Ott U, Thiese M, Garg A, et al. Long haul truck drivers' views on the barriers and facilitators to healthy eating and physical activity. International Journal of Workplace Health Management. 2014.

32 Gill PE, Wijk K. Case study of a healthy eating intervention for Swedish lorry drivers. Health Education Research. 2004;19(3):306-15.

33 Alavinia SM, Molenaar D, Burdorf A. Productivity loss in the workforce: associations with health, work demands, and individual characteristics. American Journal of Industrial Medicine. 2009;52(1):49-56.

34 van den Berg TI, Alavinia SM, Bredt FJ, Lindeboom D, Elders LA, Burdorf A. The influence of psychosocial factors at work and life style on health and work ability among professional workers. International Archives of Occupational and Environmental Health. 2008;81(8):1029-36.

35 Olson R, Wipfli B, Thompson SV, Elliot DL, Anger WK, Bodner T, et al. Weight control intervention for truck drivers: the shift randomized controlled trial, United States. American Journal of Public Health. 2016;106(9):1698-706.

36 Kim JH, Zigman M, Dennerlein JT, Johnson PW. A Randomized controlled trial of a truck seat intervention: part 2—associations between whole-body vibration exposures and health outcomes. Annals of Work Exposures and Health. 2018;62(8):1000-11.

37 Bener A, Yildirim E, Özkan T, Lajunen T. Driver sleepiness, fatigue, careless behavior and risk of motor vehicle crash and injury: Population based case and control study. Journal of Traffic and Transportation engineering (English edition). 2017;4(5):496-502.

38 Haworth NL, Heffernan CJ, Horne EJ. Fatigue in truck accidents. Monash University Accident Research Centre; 1989. Report No.: 3.

39 Wilkinson R, Marmot M. The social determinants of health: the solid facts, 2nd edn: Copenhagen: World Health Organization Europe; 2003.

Appendix I

TABLE A1 DATA COLLECTED IN ONLINE SURVEY			
		n	%
Whole cohort		332	100%
Personal domain			
Sex	Male	323	97.90%
	Female	7	2.10%
Age	< 35 years	65	19.60%
	35-44 years	67	20.20%
	45-54 years	86	25.90%
	> 55 years	114	34.30%
	Partnered	249	75.50%
Diagnosed medical condition	Mental Health	75	22.60%
	Physical Health	248	74.70%
Occupational domain			
Experience	< 5 years	45	13.60%
	5-20 years	116	34.90%
	> 20 years	171	51.50%
Payment type	Flat rate	96	29.00%
	Per trip/delivery	39	11.80%
	Single time pay	95	28.70%
	Kilometre rate	69	20.80%
	Other	32	9.70%
Working hours	≤ 40 hours	39	11.70%
	41-60 hours	171	51.50%
	> 60 hours	122	36.70%
Employment type	Owner driver	51	15.40%
	Employee driver	280	84.60%

TABLE A1 DATA COLLECTED IN ONLINE SURVEY			
		n	%
Driver type	Short-haul driver	198	59.80%
	Long-haul driver	133	40.20%
Shift type	Multiple trips between same location	171	51.50%
	Single long trip between 2 locations	91	27.40%
	Multiple trips between 2 locations	70	21.10%
Vehicle type	B double	126	38.30%
	Articulated truck	98	29.80%
	Rigid truck	50	15.20%
	Road train	40	12.20%
	Other	15	4.60%
Working for more than one company		49	14.80%
Health Risk domain			
BMI	Under or normal weight	58	18.00%
	Overweight	85	26.30%
	Obese	180	55.70%
Pain	Yes	111	33.40%
	No	221	66.60%

Appendix II

TABLE A2 TELEPHONE SURVEY

1. For the next three statements, on a scale of 1 to 7 where 1 is strongly disagree and 7 is strongly agree, would you say that….

- **a.** You have a lot of freedom to decide how you do your own work
- **b.** You have a secure future in your job
- **c.** You get paid fairly for the things you do in your job

2. The next section relates to the tasks you do at work. In the last 12 months, how often in your job did you…

- **a.** Manually lift, carry or push items heavier than 20 kg at least 10 times during the day?
- **b.** Do repetitive movements with your hands or wrists (such as packing, sorting, assembling, cleaning, pulling, pushing, typing) for at least 3 hours during the day?
- **c.** Perform work tasks, or use work methods, that you are not familiar with?
- **d.** Interact with hazardous substances such as chemicals, flammable liquids and gases?
- **e.** Work in a bent, twisted or awkward work posture?
- **f.** Work at a height that is 2 metres or more above the ground or floor?
- **g.** Work in noise levels that are so high that you would have to raise your voice when talking to people less than one metre away?
- **h.** Experience being bullied or harassed at work?
- **i.** Stand for more than 2 hours in a row?

1. Never
2. Less than once a month
3. Monthly
4. Weekly
5. Daily or almost daily
98. (Don't know)
99. (Refused)

3. The next questions are about your work environment. In the last 12 months, how often in your job…

- **a.** Did you experience discomfort by mechanical vibration or shock in your work?
- **b.** Did others' dangerous driving affect you? (for example, having to apply a defensive manoeuvre in response to another driver's dangerous action)
- **c.** Did you drive on roads that are in poor condition?
- **d.** Were you required to drive in poor weather conditions?
- **e.** Were you required to put up with an uncomfortable cab (for example, due to seat, or cabin temperature)?
- **f.** Would you have liked to take a rest but there were inadequate facilities for you to take one?
- **g.** Did you drive in excess of the speed limit?
- **h.** Did you drive in excess of load limits?
- **i.** Did you drive more hours than permitted?
- **j.** Did you drive having taken fewer or shorter rest breaks than required?
- **k.** Had you driven knowing there was a maintenance issue that hadn't been taken care of?

1. Never
2. Less than once a month
3. Monthly
4. Weekly
5. Daily or almost daily
98. (Don't know)
99. (Refused)

4. The next section relates to your work schedule and waiting times. Thinking about the last 12 months, in your experience, how often did the following situations occur?

- **a.** You arrived on time but were forced to wait to enter a dock
- **b.** The time you were allotted for loading and unloading was unrealistically tight
- **c.** The dispatcher worked with you to get you home as scheduled
- **d.** Traffic congestion delayed your deliveries significantly
- **e.** You received an unrealistically tight delivery schedule
- **f.** You experienced delays that impacted your driving hours
- **g.** You were paid for delays or waiting time

1. Never
2. Less than once a month
3. Monthly
4. Weekly
5. Daily or almost daily
98. (Don't know)
99. (Refused)

TABLE A2 TELEPHONE SURVEY

5. Now thinking about your workplace… By workplace we mean anywhere when you are on shift, while driving, at a home depot or visiting another site. In your current job, have you undertaken any formal training in any of the following OHS matters (Yes or No)?

- **a.** General OHS regulations and practices
- **b.** Site inductions (the process of ensuring workers are fully informed about the organisation and operation of the site, in particular the safety aspect of the site)
- **c.** Manual handling
- **d.** Defensive driving or advanced driving skills
- **e.** Vehicle familiarisation
- **f.** Dangerous goods codes (the purpose of these is to provide consistent technical requirements for the land transport of dangerous goods across Australia)
- **g.** Stress management
- **h.** Chain of responsibility (the aim of COR is to make sure everyone in the supply chain shares responsibility for ensuring breaches of the Heavy Vehicle National Law do not occur
- **i.** None of the above

6. In the past month, have you experienced or witnessed incidents of physical violence in your workplace?

1. Yes
2. No

98. (Don't know)
99. (Refused)

7. In the past month, have you been verbally abused in your workplace?

1. Yes
2. No

98. (Don't know)
99. (Refused)

8. In the past month, have you felt like you have been bullied in your workplace?

1. Yes
2. No

98. (Don't know)
99. (Refused)

9. In the past month, have you been racially harassed in your workplace?

1. Yes
2. No

98. (Don't know)
99. (Refused)

10. Fatigue: How often do you become fatigued while driving for work?

1. Never
2. Less than once a month
3. Monthly
4. Weekly
5. Daily or almost daily

98. (Don't know)
99. (Refused)

11. Have you received or undertaken any training about managing driver fatigue?

1. Yes
2. No

98. (Don't know)
99. (Refused)

12. Do you hold Basic Fatigue Management (BFM), or Advance Fatigue Management, (AFM accreditation), or no fatigue management accreditation?

1. Yes – Basic Fatigue Management (BFM)
2. Yes – Advanced Fatigue Management (AFM)
3. No fatigue management accreditation (PROGRAMMER: EXCLUSIVE CODE)

98. (Don't know)
99. (Refused)

TABLE A2 TELEPHONE SURVEY

13. IIn the past 12 months, did you take anything to combat fatigue?

1. Yes
2. No

98. (Don't know)
99. (Refused)

14. What do you take to combat fatigue?

1. Amphetamines or methamphetamine (ice, speed, base)
2. Armodafinil
3. Caffeine or energy drinks
4. Caffeine pills
5. Modafinil
6. Stimulant medications
7. Other1 (SPECIFY)
8. Other2 (SPECIFY)
9. Other3 (SPECIFY)

98. (Don't know)
99. (Refused)

15. How often do you take <INSERT RESPONSE FROM 14> to combat fatigue? Would you say…

1. Less than once a month
2. Monthly
3. Weekly
4. Daily or almost daily

98. (Don't know)
99. (Refused)

16. In the past 12 months, have you ever taken a stimulant like amphetamine or methamphetamine (e.g. ice, speed) to combat fatigue?

1. Yes
2. No

98. (Don't know)
99. (Refused)

17. Was the stimulant medication you took prescribed to you by a health professional?

1. Yes
2. No

98. (Don't know)
99. (Refused)

18. Now, thinking about sleep. In the past month, on average how many hours of sleep do you get in a 24-hour period?

1. Hours of sleep

98. (Don't know)
99. (Refused)

19. In the past month, for about how many days did you find yourself unintentionally falling asleep during the day?

1. How many days

98. (Don't know)
99. (Refused)

20. In the past month, did you nod off or fall asleep while you were driving? Even just for a brief moment?

1. Yes
2. No

98. (Don't know)
99. (Refused)

21. Thinking about the past month, to what extent has poor sleep troubled you in general? Would you say…

1. Not at all
2. A little
3. Somewhat
4. Much
5. Very much

98. (Don't know)
99. (Refused)

TABLE A2 TELEPHONE SURVEY

22. In the past month, on average, how many nights a week have you had problems with your sleeping?

1. 0-1
2. 2
3. 3
4. 4
5. 5-7

98. (Don't know)
99. (Refused)

23. Do you take any medication to help you get to sleep?

1. Yes
2. No

98. (Don't know)
99. (Refused)

24. What do you take to help you get to sleep?

1. Antihistamines
2 Benzodiazepines
3. Melatonin
4. Rohypnol
5. Valium
6. Xanax
7. Serapax
8. Stilnox
9. Other1 (SPECIFY)
10. Other2 (SPECIFY)
11. Other3 (SPECIFY)

98. (Don't know)
99. (Refused)

25. How often do you take <INSERT RESPONSE FROM 25> to get to sleep? Would you say…

1. Less than once a month
2. Monthly
3. Weekly
4. Daily or almost daily

98. (Don't know)
99. (Refused)

26. The next section contains some questions about your health. In the last 12 months, have you had any pain in the following parts of your body that you think has been caused by work?

1. Head or headaches
2. Neck
3. Shoulders
4. Chest
5. Back
6. Hips
7. Knees
8. Feet
9. Elbows
10. Wrists
11. Hands
12. Other (specify)

98. (Don't know)
99. (Refused)

27. Do you currently take any medication to manage pain?

1. Yes
2. No

98. (Don't know)
99. (Refused)

TABLE A2 TELEPHONE SURVEY

28. What do you take to manage pain? Including medication and any other stimulants.

1. Panadol (paracetamol)
2. Nurofen (ibuprofen)
3. Medications containing codeine
4. Stronger opiates
5. Marijuana
6. Other1 (SPECIFY)
7. Other2 (SPECIFY)
8. Other3 (SPECIFY)

98. (Don't know)
99. (Refused)

29. How often do you take <INSERT RESPONSE FROM 29> to manage pain? Would you say…

1. Less than once a month
2. Monthly
3. Weekly
4. Daily or almost daily

98. (Don't know)
99. (Refused)

30. How often do you take pain medication above the recommended dosage to manage your pain? Would you say…

1. Never
2. Less than once a month
3. Monthly
4. Weekly
5. Daily or almost daily

98. (Don't know)
99. (Refused)

31. Do you have any hearing problems or problems with your ears that have lasted, or are expected to last, for 6 months or more?

1. Yes
2. No

98. (Don't know)
99. (Refused)

32. Have you had your cholesterol checked in the last 12 months?

1. Yes
2. No

98. (Don't know)
99. (Refused)

33. Have you had your blood pressure checked in the last 12 months?

1. Yes
2. No

98. (Don't know)
99. (Refused)

34. Next are some questions about your consumption of food and drink. Thinking about your usual consumption of vegetables, including fresh, frozen and tinned vegetables. How many serves of vegetables do you usually eat each day? A serve is half a cup of cooked vegetables or one cup of salad vegetables.

1. Serves per day
2. Serves per week
3. Don't eat vegetables

98. (Don't know)
99. (Refused)

35. Now, thinking about your usual consumption of fruit, including fresh, dried, frozen and tinned fruit. How many serves of fruit do you usually eat each day? A serve is 1 medium piece or 2 small pieces of fruit or 1 cup of diced fruit.

1. Serves per day
2. Serves per week
3. Don't eat fruit

98. (Don't know)
99. (Refused)

TABLE A2 TELEPHONE SURVEY

36. On average, on how many days per week do you usually drink soft drink, cordials, sports drinks or caffeinated energy drinks? Please do not include diet varieties.

1. Days per week

98. (Don't know)
99. (Refused)

37. Thinking about the past 12 months, how often did you have a drink containing alcohol? Would you say…

1. Never
2. Monthly or less
3. 2 to 4 times per month
4. 2 to 3 times per week
5· 4 or more times per week

98. (Don't know)
99. (Refused)

38. Thinking about the past 12 months, how many standard drinks of alcohol do you drink on a typical day when you are drinking? A standard drink is equal to 1 middy or pot of full-strength beer, 1 schooner of light beer, 1 small glass of wine or 1 pub-sized nip of spirits.

1. 1 to 2
2· 3 to 4
3· 5 to 6
4· 7 to 9
5. 10 or more

98. (Don't know)
99. (Refused)

39. Thinking about the past year, how often do you have 5 or more drinks on one occasion? Would you say…

1. Never
2. Less than once a month
3. Monthly
4. Weekly
5. Daily or almost daily

98. (Don't know)
99. (Refused)

40. How often do you use alcohol to help you get to sleep?

1. Never
2. Less than once a month
3. Monthly
4. Weekly
5. Daily or almost daily

98. (Don't know)
99. (Refused)

41. Do you currently smoke tobacco or e-cigarettes or other vaping devices?

1. Tobacco
2. E-cigarettes
3. Both
4. No

98. (Don't know)
99. (Refused)

42. How many cigarettes a day do you currently smoke?

1. 10 or less
2· 11-20
3· 21-30
4· 31 or more

98. (Don't know)
99. (Refused)

TABLE A2 TELEPHONE SURVEY

43. How often do you currently use an electronic cigarette or other vaping device?

1. Daily
2. Less than daily but at least once a week
3. Less than weekly but at least once a month
4. Less than monthly

98. (Don't know)
99. (Refused)

44. How many times per day (one time consists of around 15 puffs or lasts around 10 minutes) do you use the e-cigarette or other vaping device?

1. Times per day

98. (Don't know)
99. (Refused)

45. The next few questions are about exercise. Moderate exercise refers to things that cause a moderate increase in your heart rate or breathing, but still allow you to hold a conversation (for example, brisk walking, gentle swimming, social tennis, golf). Thinking about the past week, if you added up all the times you did moderate exercise, how many hours or minutes of moderate exercise did you do?

1. Time given in hours
2. Time given in minutes

98. (Don't know)
99. (Refused)

46. Vigorous exercise refers to activities that cause a large increase in your heart rate or breathing so you puff and pant (e.g. jogging, cycling, aerobics, competitive sports). Thinking about the past week, if you added up all the times you did vigorous exercise, how many hours or minutes of vigorous exercise did you do?

1. Time given in hours
2. Time given in minutes

98. (Don't know)
99. (Refused)

47. Muscle strengthening or toning exercises are usually counted in reps or sets, and include activities such as push ups, sit ups and lifting weights. It could also include activities that involve stepping and jumping, lifting heavy objects (such as heavy gardening) and yoga. Thinking about the past week, on how many days did you perform muscle strengthening or toning exercises?

1. 0
2. 1
3. 2
4. 3
5. 4
6. 5 or more days

98. (Don't know)
99. (Refused)

48. What is the highest level of education and training you have completed?

1. University, or other tertiary (i.e degree, Masters, post graduate diploma, PhD)
2. TAFE / trade certificate / diploma
3. High school / equivalent year 11 or 12
4. High school / equivalent year 9 or 10
5. High school / equivalent year 7 or 8
6. Primary school
7. Never attended school / some primary school

98. (Don't know)
99. (Refused)

TABLE A2 TELEPHONE SURVEY

49. Which of the following best describes you?

1. Single
2. In a defacto relationship, living with partner
3. Married
4. Separated but not divorced
5. Divorced
6. Widowed

98. (Don't know)
99. (Refused)

50. How many dependent children do you have?

1. Number of children

98. (Don't know)
99. (Refused)

51. Hypothetically, if you needed to, could you or your household raise $2,000 within 2 days in an emergency? This includes accessing 'own' savings, borrowing money, or using a credit card / bank card.

1. Yes
2. No

98. (Don't know)
99. (Refused)

52. What do you feel is the level of your financial stress today, on a scale of 1 to 10 where 1 is not at all stressed and 10 is as stressed as can be?

1. ENTER VALUE

98. (Don't know)
99. (Refused)

53. Over a typical work week, how much time would you spend working alone?

1. Never
2. Rarely
3. Sometimes
4. Very often
5. Always

98. (Don't know)
99. (Refused)

54. During the past week, how often have you felt lonely?

1. Never
2. Rarely
3. Sometimes
4. Very often
5. Always

98. (Don't know)
99. (Refused)

Appendix III

TABLE A3 HIERARCHICAL REGRESSION ANALYSIS OF PREDICTORS OF WORK ABILITY

	β					
Independent variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Step 1: Personal domain						
Age (< 35 years as reference)						
35-44 years	0.263	0.177	0.168	0.098	0.067	-0.062
45-54 years	0.218	0.046	0.001	-0.074	-0.048	-0.078
> 55 years	-0.388	-0.592	-0.692	-0.739*	-0.752*	-0.729
Mental health conditions (no vs. yes)	-1.667**	-1.474**	-1.382**	-1.241**	-1.223**	-0.944*
Financial stress (low vs. high)	-0.607*	-0.498	-0.425	-0.397	-0.371	-0.263
Step 2: Occupational domain						
Work task (Low risk group as reference)						
Moderate risk group		-0.969**	-0.778**	-0.721**	-0.767**	-0.642*
High risk group		-1.116**	-0.807*	-0.743	-0.752	-0.733
Work shift (Multiple trips between same location as reference)						
A single long trip between two destinations		0.067	0.16	0.214	0.204	0.201
Multiple trips between two destinations		0.052	0.088	0.155	0.16	0.186
Step 3: Workplace environment domain						
Work environment (low risk vs. high risk)			-0.59	-0.502	-0.464	-0.141
Workplace violence (no vs. yes)			-0.341*	-0.364	-0.348	-0.134

TABLE A3 HIERARCHICAL REGRESSION ANALYSIS OF PREDICTORS OF WORK ABILITY

	β					
Independent variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Step 4: Regulatory domain						
OHS training (fair vs. good)				0.661*	0.616*	0.535*
Step 5: Lifestyle domain						
Diet (Did not meet the guidelines vs. meet the guidelines)					0.589*	0.369
Step 6: Health risk domain						
Drug use (no vs. yes)					-0.199	-0.199
Loneliness (no vs. yes)					-0.284	-0.025
BMI (under and normal weight as reference)						
Overweight						0.04
Obese						-0.720**
Pain (no vs. yes)						-1.114**

Appendix IV

TABLE A4 Hierarchical regression analysis of predictors of psychological distress

	β					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Step 1: Personal domain						
Age (< 35 years as reference)						
35-44 years	-1.844*	-1.708*	-1.592*	-1.554*	-1.343*	-1.27
45-54 years	-0.872	-0.579	-0.5	-0.623	-0.543	-0.482
> 55 years	-1.465	-0.947	-0.806	-1.041	-0.808	-0.83
Family situation (No partner, no dependent children as reference)						
No partner with dependent children	-0.33	-0.362	-0.421	-0.53	-0.313	-0.003
Partnered with no dependent children	-3.227**	-2.709**	-2.351**	-2.090**	-1.884**	-1.499*
Partnered with dependent children	-2.072**	-2.011**	-1.825*	-1.723*	-1.496*	-1.148
Mental health conditions (no vs. yes)	5.481**	4.873**	4.705**	4.385**	4.338**	4.099**
Physical conditions (no vs. yes)	1.170*	0.984	0.812	0.776	0.777	0.676
Financial stress (low vs. high)	1.848**	1.770**	1.670**	1.674**	1.587**	1.324*
Step 2: Occupational domain						
Payment type (flat rate as reference)						
Per trip/delivery		-0.655	-0.85	-1.041	-1.006	-0.882
Single time pay		0.085	-0.101	0.019	0.055	0.013
Kilometre rate		-0.637	-0.461	-0.573	-0.539	-0.727
Other		1.125	0.989	1.054	1.035	1.05
Work task (Low risk group as reference)						
Moderate risk group		1.376**	0.972	0.858	0.955	0.764
High risk group		3.073**	2.449**	2.331**	2.311**	2.072*

TABLE A4 Hierarchical regression analysis of predictors of psychological distress

	β				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Shift type (Multiple trips between same location as reference)						
A single long trip between two destinations	-0.201	-0.376	-0.379	-0.43	-0.412
Multiple trips between two destinations	0.452	0.407	0.321	0.265	0.156
Driver type (short-haul vs. long-haul)	-0.151	-0.327	-0.359	-0.292	-0.316
Driving experience (< 5 years as reference)						
5-20 years	1.255	1.055	1.303	1.122	0.77
> 20 years	0.457	0.41	0.826	0.562	0.57
Step 3: Workplace environment domain						
Work environment (low risk vs. high risk)		1.067	0.869	0.793	0.421
Workplace violence (no vs. yes)		0.952	1.039*	1.058*	0.828
Step 4: Regulatory domain						
OHS training (fair vs. good)			-1.449**	-1.307**	-0.917*
Step 5: Lifestyle domain						
Diet (Did not meet the guideline vs. meet the guideline)				-1.676**	-1.261
Step 6: Health risk domain						
Fatigue (not often vs. often)					0.715
BMI (under and normal weight as reference)						
Overweight					-0.357
Obese					0.442
Loneliness (no vs. yes)					1.850**

Appendix V

TABLE A5 HIERARCHICAL REGRESSION ANALYSIS OF PREDICTORS OF GENERAL HEALTH

	β					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Step 1: Personal domain						
Age (< 35 years as reference)						
35-44 years	-0.208	-0.123	-0.142	-0.165	-0.193	-0.247
45-54 years	-0.089	-0.059	-0.091	-0.097	-0.106	-0.127
> 55 years	0.035	0.058	0.025	0.013	-0.007	-0.008
Partnership and children (No partner, no dependent children as reference)						
No partner with dependent children	0.236	0.267	0.292	0.344	0.333	0.275
Partnered with no dependent children	0.278	0.266	0.163	0.145	0.107	0.105
Partnered with dependent children	0.269	0.310*	0.261	0.273	0.241	0.229
Physical conditions (no vs. yes)	-0.712**	-0.674**	-0.628**	-0.613**	-0.621**	-0.360**
Financial stress (low vs. high)	-0.483**	-0.476**	-0.419**	-0.424	-0.405**	-0.352**
Step 2: Occupational domain						
Driving experience (< 5 years as reference)						
5-20 years		-0.352*	-0.284	-0.287	-0.254	-0.058
> 20 years		-0.146	-0.129	-0.125	-0.084	0.026
Shift type (Multiple trips between same location as reference)						
A single long trip between two destinations		-0.042	-0.018	-0.006	-0.008	0.017
Multiple trips between two destinations		-0.258	-0.261	-0.268	-0.262	-0.232
Pay for delay (no vs. yes)		-0.168	-0.127	-0.101	-0.092	-0.064

TABLE A5 HIERARCHICAL REGRESSION ANALYSIS OF PREDICTORS OF GENERAL HEALTH

	β				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Step 3: Workplace environment domain						
Work environment (low risk vs. high risk)			-0.229	-0.198	-0.186	-0.036
Workplace violence (no vs. yes)			-0.223*	-0.21	-0.223*	-0.109
Step 4: Regulatory domain						
Breaking regulation behaviour (no vs. yes)				-0.183	-0.175	-0.168
Step 5: Lifestyle domain						
Diet (Did not meet the guideline vs. meet the guideline)					0.284**	0.157
Step 6: Health risk domain						
Drug use (no vs. yes)						-0.192
Loneliness (no vs. yes)						-0.106
BMI (under and normal weight as reference group)						
Overweight						-0.352*
Obese						-0.579**
Pain (no vs. yes)						-0.428**
Sleep (low risk vs. high risk)						-0.225

Appendix VI

TABLE A6 HIERARCHICAL REGRESSION ANALYSIS OF PREDICTORS OF NEAR MISSES

	β			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Step 1: Personal domain				
Partnership and children (No partner, no dependent children as reference)				
No partner with dependent children	1.066	0.948	0.947	0.88
Partnered with no dependent children	0.371**	0.386**	0.384**	0.359*
Partnered with dependent children	0.851	0.838	0.838	0.81
Step 2: Occupation domain				
Working hours (≤ 40 hours per week as reference)				
41-60 hours per week		4.304*	4.321*	4.403*
> 60 hours per week		6.475**	6.466**	6.318**
Payment type (flat rate as reference)				
Per trip/delivery		0.82	0.821	0.822
Single time pay		2.249**	2.247**	2.363*
Kilometre rate		0.792	0.793	0.833
Other		0.967	0.966	0.988
Time and schedule (low risk vs. high risk)		2.797**	2.799**	2.961**
Step 3: Lifestyle domain				
Drinking (low risk drinking vs. high risk drinking)			1.037	1.06
Step 4: Health risk domain				
BMI (under and normal weight as reference group)				
Overweight				0.715
Obese				0.465*