



SAFETY

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Driving behaviour in people with chronic pain –
perspective of people with chronic pain
and health professionals





Improving the management of driving behaviour in people with chronic pain – perspective of people with chronic pain and health professionals

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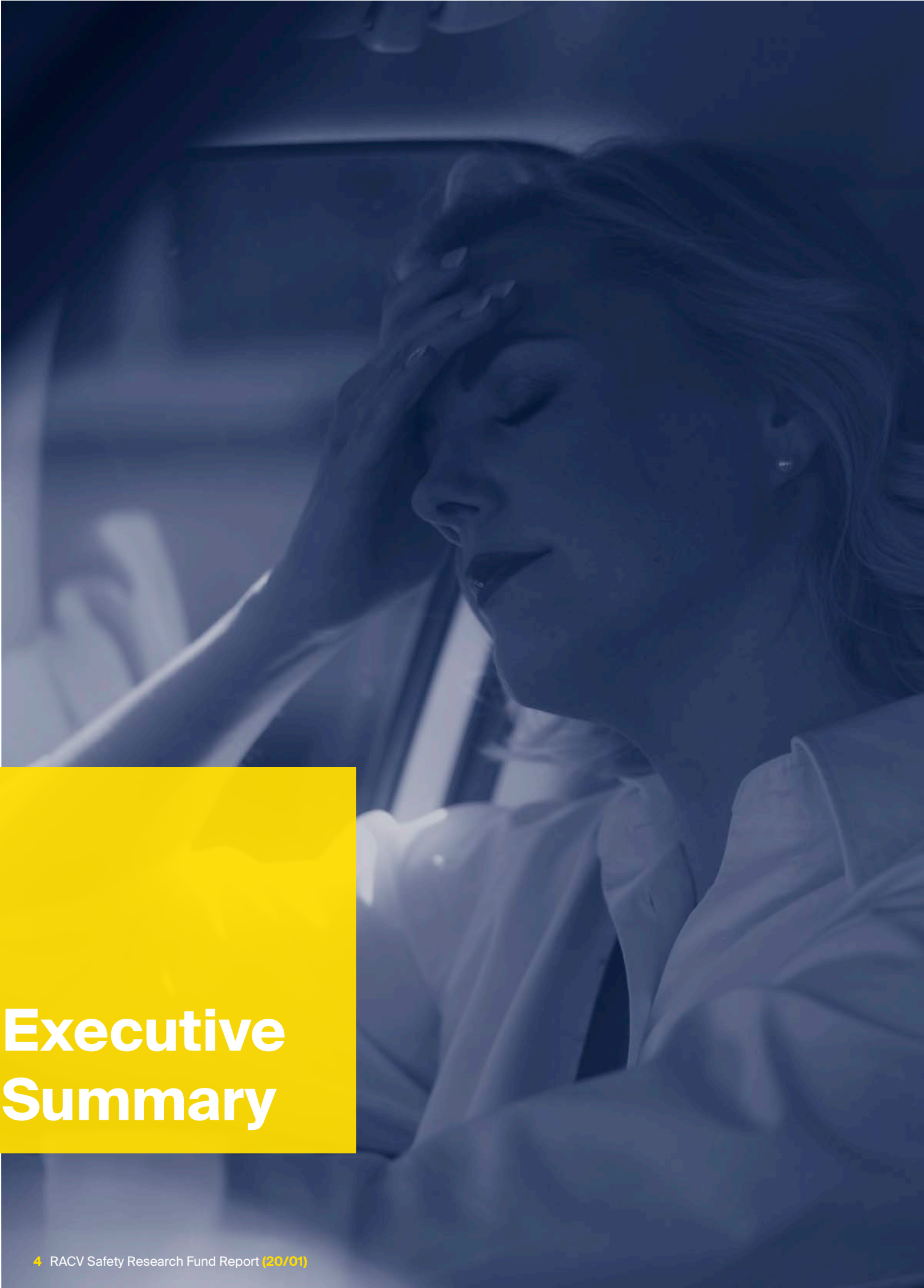
Abstract

Being able to drive is important, as driving cessation is associated with less independence, reduced social integration, lower levels of community participation and poorer quality of life. However, driving is a complex task which requires both the ability to rapidly identify potential hazards and appropriately react to driving situations to avoid crashing. To our knowledge, there is a lack of studies investigating the impact of chronic pain on driving behaviour. This study investigates the effect of chronic pain on driving behaviour using a mixed-method design involving (i) qualitative semi-structured interviews drawing upon the lived experience of individuals with chronic pain, as well as the knowledge of health professionals as subject matter experts, and (ii) quantitative cross-sectional component comparing driving behaviour between chronic pain and non-chronic pain (healthy) participant groups in Australia.

Emerging themes from the qualitative component highlight the need for clearer guidelines and educational materials on the impact of chronic pain on an individual's ability to drive. In addition, self-regulation strategies and current barriers and enablers for improving driving were identified from the perspective of individuals with chronic pain, as well as Australian health professionals. In the quantitative component, there was no significant difference observed in hazard perception response time test, self-reported attention-related error and self-reported driving behaviour; i.e. driving errors, ordinary violations and aggressive violation between participants were similar in the chronic pain group and the non-chronic pain control group. However, there were significant differences between the participant groups in the scores of driving lapses, mental demand, physical demand and frustration levels of the driving task. Overall, our findings contribute to the understanding of current driving behaviours, the challenges for people experiencing chronic pain, and the relationship between chronic pain and driving. Lastly, this report proposes recommendations and strategies to improve safe driving among people with chronic pain.

Keywords

Chronic pain, driving behaviour, hazard perception, driving self-regulation, driving assessment



Executive Summary

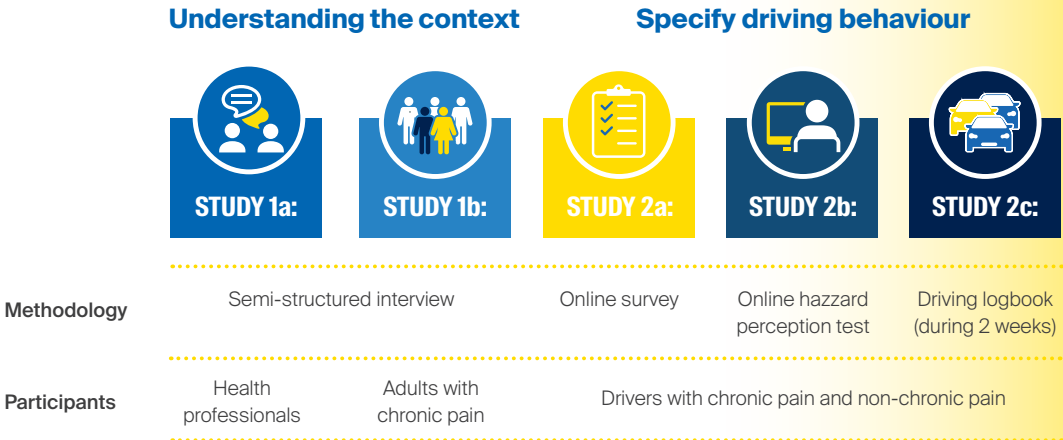
Background

Being able to drive is important, as driving cessation is associated with less independence, reduced social integration, lower levels of community participation and poorer quality of life. Driving is a complex task, which requires both the ability to rapidly identify potential hazards and appropriately react to driving situations to avoid crashing. Therefore, attention must be continuously directed towards the road environment as any source of distraction (e.g. talking on the mobile phone, driver pain) could increase the probability of a crash. This research aims to investigate the effect of chronic pain on driving behaviour in Australia, and in particular to:

- Identify barriers to safe driving among adults with chronic pain; i.e. current assessments and treatment offered for driving and the potential risks associated with chronic pain experience while driving (perspective of health professionals).
- Enhance our understanding of the needs and challenges associated with driving in adults experiencing chronic pain; i.e. hazard perception assessment which is linked to unsafe driving, the difficulties faced while driving, and self-reported driving crashes/near misses (perspective of adults with chronic pain).
- Provide recommendations and strategies to improve safe driving among people with chronic pain, and health professionals to improve the management of driving with chronic pain.

Methodology

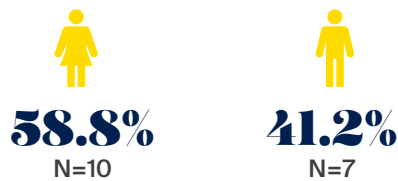
- To achieve the research objectives, a mixed-method design was conducted consisting of both qualitative and quantitative approaches. Figure below illustrates an overview of the study design.
- Qualitative semi-structured interviews drew upon the lived experience of individuals with chronic pain; conducted with twenty-three Australian drivers, and seventeen health professionals as subject matter experts (i.e. occupational therapists, pain specialists, general practitioners, a clinical psychologist and a researcher).
- A quantitative cross-sectional component compared self-reported driving behaviours between chronic pain and non-chronic pain (healthy) participant groups in Australia. Participants completed an anonymous online survey; i.e. participant demographics, driving experience, self-reported driving behaviour, pain characteristics, a computer-based response-time hazard perception and hazard prediction test, and a driving logbook experiment. The hazard perception and prediction test required drivers to view several traffic conflict videos and identify any road users likely to be involved in a traffic conflict as early as possible. For the driving logbook experiment, drivers were asked to keep a log of their driving over the course of two weeks and self-reported their driving experiences, such as driving work-load and near-crash events where the driver is required to suddenly manoeuvre the vehicle to avoid a crash.



Key findings (Study 1)



PERSPECTIVE OF HEALTH PROFESSIONALS

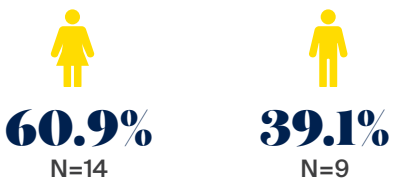


- Occupational Therapist (N=8, 47.1%)
- Pain Specialist (N=4, 23.5%)
- General Practitioner (N=3, 17.6%)
- Clinical Psychologist (N=1, 5.9%)
- Research Fellow (N=1, 5.9%)

- Participants highlighted the importance of driving in Australia, in particular driving was identified as a symbol of independence and engagement in the activities of daily living.
- Participants acknowledged chronic pain as a multi-faceted phenomenon and its effect on driving varied among individuals.



PERSPECTIVE OF ADULTS WITH CHRONIC PAIN



Mean age of sample
(SD = 12.7, range 24–68 yrs)

51.5 yrs

- Participants identified driving as a symbol of independence, which represents a sense of autonomy and control.
- Participants generally prefer to continue driving for the added convenience, despite the challenges they would experience during/after driving.



BARRIERS TO ADEQUATELY ASSESSING DRIVING

- Participants identified driving as a sensitive topic for some patients and raised concerns about the possibility of their patients avoiding discussing their challenges related to driving, given the stigma around possibly losing their licence.
- Participants commented on the subjective nature of pain and the complexity of driving which would be challenging to assess within the usual consultation time frame.
- The vast majority of participants stated that there is a lack of clear guidelines available for clinicians to refer to regarding chronic pain conditions. In particular, participants reported an absence of driving as a criterion or item on current assessment and outcome measures.
- Participants reported on the value of evidence-based research in relation to driving behaviour within the chronic pain cohort and the potential of improving assessment approaches with technologies such as driving simulators.
- Participants reported that it is challenging to provide patients with recommendations to assess alternative means of transport due to financial barriers and inadequate access to public transport for a large number of their cohort.
- Financial barriers may also hinder clinicians from providing referrals to private driving assessors if required.



BARRIERS TO ADEQUATELY ASSESSING DRIVING

- The vast majority of participants reported that health professionals inadequately addressed driving.
- Discussion about driving concerns or impact of medication was rarely initiated by health professionals during medical consultations or in pain rehabilitation programs.
- Participants broadly discussed the self-regulation strategies they use to overcome their difficulties with driving tasks. Thus, they stressed the importance of receiving practical and written education materials and resources through rehabilitation groups or treatment sessions.
- Most participants perceived many benefits from using driver assistance systems with the most commonly discussed being blind-spot monitors and reversing cameras. However, access to funding was a barrier frequently noted by participants in accessing driver assistance systems or in-car modifications.

DRIVING DIFFICULTIES

- The static posture and prolonged sitting during driving worsens pain.
- Chronic spinal pain restricts the range of movement and negatively affects tasks required for the driving tasks e.g. shoulder check, identifying blind-spot.
- Chronic pain could reduce cognitive demand required for driving task.
- The sensation of pain is a distraction in itself and could impact on maintaining sustained attention and reaction time.
- The complexity of polypharmacy and the effect of the medication, which varied person to person, and the high incidence of substance use disorders within the pain cohort could negatively impact on cognition and driving safety.
- Sleep apnoea, and poor sleep quality, which are often associated with chronic pain, could further impair the cognitive functions required for safe driving.

DRIVING DIFFICULTIES

- Prolonged sitting while driving resulted in pain flare-ups.
- Difficulties with twisting of the neck and back to check over the shoulder for blind spots or to reverse.
- The impact of pain on cognitive functions including reduced attention, reduced ability to focus, slower reaction time, and mood related changes translated into frustration, impatience and anger towards other road users. A small number of participants also queried their judgement and decision-making due to the impact of pain and medication.
- Directly following driving, participants reported decreased satisfaction in several life domains, e.g. ability to fully engage in household tasks, socialisation. Consequently, participants reported lower engagement in meaningful activity, increased aggression and frustration, which at times impacted their relationships.

Key findings (Study 2)

The quantitative component, a self-reported online survey and driving logbook (**Study 2, page 64**), involved ninety participants, including drivers experiencing chronic pain (N=45) and a non-chronic pain or otherwise healthy drivers comparison group (N=45). The chronic pain cohort reported moderate levels of difficulty when driving more than one hour, and a slight level of difficulty when reversing and checking blind spots. In addition, the level of difficulty experienced in certain driving situations; including driving in rush hour traffic, driving on high traffic roads, driving on a bumpy road, driving in rain and driving at dusk, was significantly higher compared to the non-chronic pain group. There were no significant differences between the groups observed in the hazard perception response time test, self-reported attention-related error and self-reported driving behaviour; i.e. errors, ordinary violations and aggressive violation. However, there were significant differences in the scores of driving lapses, which are defined as alterations or unexpected deviations from a properly conceived plan (drivers experiencing chronic pain scored higher on driving lapses compared to non-chronic group). These are different from mistakes that typically occur because of lack of experience (or expert knowledge) on a particular driving task.

In relation to the workload of the driving tasks during the two-week driving logbook data collection, there were significant differences in mental demand, physical demand and frustration levels between participant groups. Drivers experiencing chronic pain reported higher levels of perceived mental and physical workload compared to the non-chronic pain group. However, there were no significant differences observed in overall performance and temporal levels of driving tasks between groups. Interestingly, although participants in qualitative studies highlighted that the chronic pain cohort could benefit from driver assistance systems to minimise their difficulties with the driving task, our findings showed a limited number of participants have access to these features in their vehicles.

Conclusion

This research contributes to the understanding of current driving behaviours, the challenges for people with chronic pain, and the relationship between chronic pain and driving. In addition, this research provides recommendations and strategies for the management of driving with chronic pain, and future research in terms of public education and technological interventions to improve safe driving among people with chronic pain.

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Introduction

We wish to submit our final report to the Royal Automobile Club of Victoria (RACV), Safety Research Fund (2019/20), entitled *Improving the management of driving behaviour in people with chronic pain – perspective of people with chronic pain and health professionals*. This report is submitted by RECOVER Injury Research Centre, at The University of Queensland (UQ) in collaboration with the School of Psychology at UQ, the Centre for Accident Research and Road Safety – Queensland (CARRS-Q) at the Queensland University of Technology, the Professor Tess Cramond Multidisciplinary Pain Centre at the Royal Brisbane and Women’s Hospital, and the Univ Gustave Eiffel, Université de Paris, LaPEA, F-78000 Versailles, France.

RECOVER Injury Research Centre (RECOVER) is a joint initiative with the Queensland Motor Accident Insurance Commission (MAIC) and The UQ. RECOVER is a leading research centre committed to generating breakthrough research, which leads to better rehabilitation outcomes after injury, especially when caused by road traffic crashes.

This transdisciplinary research team (Dr Atiyeh Vaezipour, Dr Nicole Andrews, Professor Mark Horswill, Associate Professor Venerina Johnston and Dr Oscar Oviedo-Trespalacios), and international collaborator Professor Patricia Delhomme from France, brings together experts in key areas of driving behaviour, traffic psychology, and hazard perception with clinical expertise in chronic pain.

Research Background

Road crashes cause an estimated 1.3 million fatalities and approximately 50 million serious injuries each year worldwide [1]. In Australia in 2016, there were 1,295 road fatalities, at a rate of 5.4 deaths per 100,000 of the population [2]. Driving involves managing interactions with infrastructure and other road users travelling at different speeds with different levels of protection. Driving is therefore a complex task, requiring both the ability to rapidly identify potential hazards and appropriately react to driving situations to avoid crashing. Attention must be continuously directed towards the road environment as any source of distraction (e.g. talking on the mobile phone, driver pain) could increase the probability of a crash.

Tests of ‘on road’ driving performance reveal that patients with chronic, non-malignant pain perform poorly compared to healthy controls [3]. According to the International Association for the Study of Pain, chronic pain is defined as “any continuous or persistent intermittent pain experienced for a period longer than three months” [4]. Chronic pain affects one in five Australians and costs Australia \$73.2 billion dollars each year [5]. In a cross-sectional survey conducted by Fan and colleagues, 70% of chronic pain patients indicated that pain limited their driving in some way, with 41% experiencing either quite a bit of difficulty or a great deal of difficulty driving [6]. Despite this, research exploring the factors that influence safe driving behaviour for individuals with chronic pain is limited.

People experiencing chronic pain frequently report memory impairment and poor concentration. These characteristics disturb their normal functioning, impair their ability to cope with everyday life, and affect the way they relate to their immediate social environment [7]. Most studies have shown that intense pain significantly impairs cognitive performance [8-10]. In addition, chronic pain is associated with deficits in executive functioning [11]. These cognitive deficits have been linked to unsafe driving behaviour [7]. However, no known study has investigated the impact of altered cognition on safe driving within the chronic pain demographic.

Notably, research has found driving cessation is common among the chronic pain demographic. However, the reason for driving cessation has not been investigated. One study estimated that 79% of individuals with chronic pain are regular drivers, and 56% of these individuals stopped driving because of their pain [6]. It is unclear whether medication-related side effects, physical restriction, pain-related cognitive impairment or other mental health factors, such as anxiety, impact on one’s decision to cease driving. It is also uncertain whether individuals who were previously driving, but have since ceased, are more unsafe than current drivers, and if adequate driving training/strategies are being routinely offered to this demographic to enhance their safe driving behaviour.

Research Significance

Being able to drive is important, as driving cessation is associated with less independence, reduced social integration

and community participation, fewer job opportunities, depression and lower quality of life [12]. To our knowledge, there is a lack of studies investigating the impact of chronic pain on driving behaviour. This research project contributes to a more comprehensive understanding of the effect of chronic pain on safe driving behaviour. It also investigates the everyday challenges and barriers experienced by these drivers, as well as drivers’ requirements for ensuring their safety on the roads.

In addition, this research will inform decision making by health professionals and enable them to incorporate targeted driving recommendations as part of the rehabilitation process for individuals experiencing chronic pain. This research is innovative. It utilises a driver-centred approach to develop evidence-based recommendations and strategies to compensate for difficulties with driving experienced by these individuals.

Research Objectives

The overarching objective of this project was to identify strategies to improve safe driving among people with chronic pain. By understanding current driving behaviours and challenges for people with chronic pain, this research sought to improve the assessments of driver safety in chronic pain populations. Specifically, this research aimed to:

- i) Identify barriers to safe driving among adults with chronic

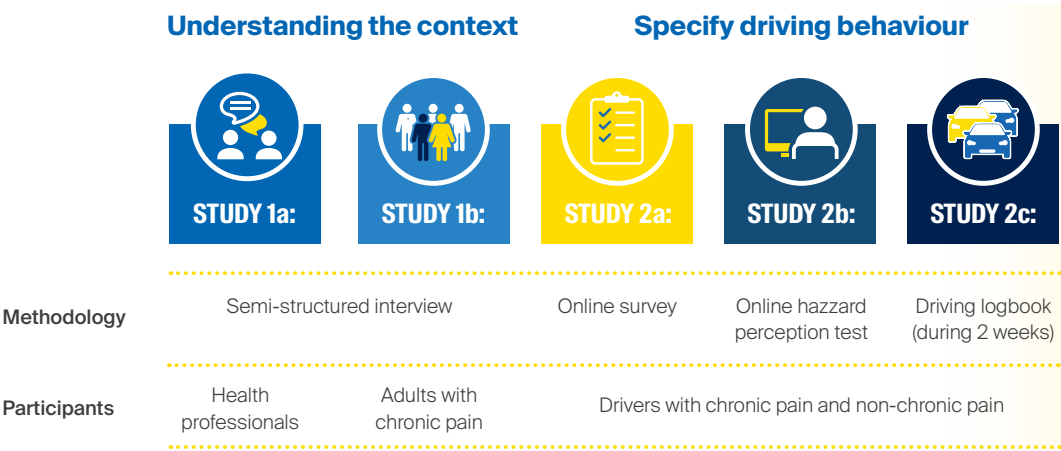
pain. That is, the current assessments and treatment offered for driving and the potential risks associated with chronic pain experienced while driving (***perspective of health professionals***).

- ii) Enhance the understanding of the needs and challenges associated with driving for adults experiencing chronic pain. That is, driving patterns, hazard perception assessment which is linked to unsafe driving, the difficulties faced while driving, and self-reported driving crashes/near misses (***perspective of adults with chronic pain***).
- iii) Provide **recommendations and strategies** to improve management of chronic pain for adults driving with chronic pain and health professionals.

Research Methodology

The methodology for this research was guided by a driver-centred design approach. It involved considering the needs, motivations and limitations of the intended end-users at each stage of the research design. These insights then informed the development of any new intervention. A mixed-method design combined both qualitative and quantitative approaches, drawing upon the lived experience of individuals with chronic pain, as well as the knowledge of health professionals as subject matter experts. **Figure 1** illustrates an overview of the study design and how it aligns with the research objectives.

Figure 1. Overview of research design



Study 1

Understanding the context

Study 1 involved both quantitative (demographic questionnaire) and qualitative (semi-structured interview) approaches, which included health professionals (Study 1a) and individuals experiencing chronic pain (Study 1b). Data collection was conducted in accordance with the Australian Code for Responsible Conduct of Research (Approval number HREC/2019/QRBW/57331).

Study 1a: Semi-structured interview with health professionals

Method

Study 1a aimed to investigate the challenges, current driving assessments/ treatments, and potential risks associated with driving with chronic pain from the perspective of the health professionals. Qualitative, semi-structured interviews were conducted with Australian health professionals over the phone or face-to-face, depending on their preference.

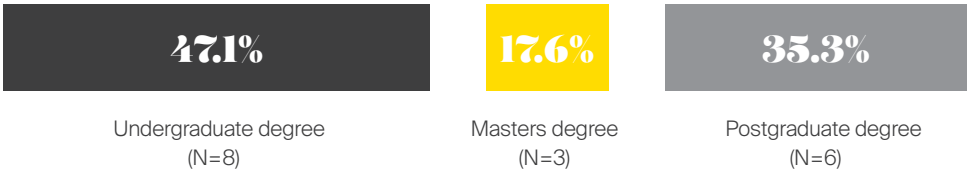
Participants were recruited via the RECOVER Injury Research Centre team and through snowballing (where health professionals forwarded the email onto potential participants). In addition, an advertisement was shared via social media to recruit a larger sample of health professionals across Australia. Participant eligibility was based on their occupation and experience working with individuals with chronic pain. Thus, the sample included health professionals from chronic pain clinics, general practitioners, and community-based occupational therapy driving assessors. Semi-structured interviews were conducted for approximately 45-60 minutes.

Demographic characteristics of sample

Seventeen individuals participated in this study, consisting of ten females and seven males (aged 31-72 years, M = 44.6, SD = 11.9). 70.6% (N=12) of participants held full-time employment, while 29.4% (N=5) were employed part-time. The sample consisted of occupational therapists (47.1%, N=8), pain specialists (23.5%, N=4), general practitioners (GPs) (17.6%, N=3), a clinical psychologist (5.9%, N=1) and a researcher (5.9%, N=1). Twelve participants were from regional Queensland, two from rural Queensland, two from Victoria and one from Australian Capital Territory. Furthermore, 47.1% (N=8) reported employment in the Australian public health system, 47.1% (N=8) in the private sector and 5.9% (N=1) in universities. Their average number of years professional experience was 19.4 years (SD = 12.1, range 4-46 years), and experience with chronic pain clients was 11.5 years (SD = 6.6, range 4-27 years). Finally, the sample reported consulting with a mean number of 14.7 chronic pain clients seen per week (SD = 11.8). **Figure 2** summarises the demographic characteristics of the sample in Study 1a.



Highest education



Employment

70%

N=12, Full-time

29.4%

N=5, Part-time

Occupation



- Occupational Therapist (N=8, 47.1%)
- Pain Specialist (N=4, 23.5%)
- General Practitioner (N=3, 17.6%)
- Clinical Psychologist (N=1, 5.9%)
- Research Fellow (N=1, 5.9%)

Employment sector



- Public health system - hospital (N=8, 47.1%)
- Private sector (N=8, 47.1%)
- University (N=1, 5.8%)

19.4 yrs

Mean experience in occupation of sample
(SD = 12.1, range 6-46 yrs)

11.5 yrs

Mean experience with chronic pain clients of sample
(SD = 6.6, range 4-27 yrs)

14.7 yrs

Mean number of chronic pain clients seen per week of sample (SD = 11.8)

“Average number of years... experience with chronic pain clients was 11.5 years...”



Figure 2. Summary of demographic characteristics of health professionals (Study 1a)

Study 1



Study 1b: Semi-structured interview with individuals experiencing chronic pain

Method

Study 1b aimed to enhance the understanding of the barriers and challenges experienced by adults driving with chronic pain, as well as the assessments/treatments available to them in the Australian health care system. Qualitative, semi-structured interviews were conducted over the phone with adults experiencing chronic pain.

Participants initially were recruited through chronic pain clinics, where representative clinicians provided potential participants with an information sheet explaining the study and sought permission to be contacted by a member of the research team by phone/email to discuss the study. In addition, participants were recruited via social media advertisements to ensure a more representative sample of the chronic pain population across Australia. Participants were selected if they met the following eligibility criteria:

- Over the age of 18 years old who held a valid Australian Driver licence.
- Had persistent non-cancer pain for at least three months.
- Had not been diagnosed with a condition affecting the vestibular, central nervous system, or visual acuity.

Semi-structured interviews were conducted for approximately 45-60 minutes. The sample size was determined by the point at which data saturation was reached (i.e. when there was limited additional information obtained through interviews).

Demographic characteristics of sample

Twenty-three individuals participated in this study, consisting of fourteen females and nine males (aged 24-68 years, M = 51.5, SD = 12.7). All participants held an open Australian Driver licence, with mean 30.9 years driving experience (SD = 12.9, range 5-50 years). In relation to education, 26.1% (N=6) had completed Year 10, 17.4% (N=4) completed Year 12, 21.7% (N=5) completed a trade qualification/TAFE, 21.7% (N=5) completed an undergraduate degree, and 13.1% (N=3) held a postgraduate degree. 43.5% (N=5) of the participants were not in paid employment, 26.1% (N=6) retired, 21.7% (N=5) employed full-time and 8.7% (N=2) were reported having part-time or casual employment. Participants estimated they drove 10,916 kilometres and 388.3 hours on average per year. Finally, the sample reported mean number of years with their chronic pain condition of 14.6 years (SD = 12.9). **Figure 3** summarises the demographic characteristics of the sample in Study 1b. The details of the pain characteristics and history of traffic crashes for individual participants are included in the Appendix.

Data analysis

All interviews (Study 1a and 1b) were audio recorded and transcribed. Transcriptions were imported into the NVivo 11 software program for qualitative data analysis. Interpretative phenomenological analysis (IPA) [13] was used to analyse the data. This qualitative analytical approach aimed to provide a detailed examination of a person's lived experience. Transcripts were analysed by the two members of the research team with experience in qualitative research. Researchers independently identified meaningful text from transcripts and formulated emergent themes from exploratory notes. The two analysts regularly discussed the emergent themes, and the coding evolved from these discussions. Following analysis of individual transcriptions, a cross-case analysis was conducted, identifying shared themes across all transcripts.



60.9%

N=14



39.1%

N=9

51.5 yrs

Mean age of sample
(SD = 12.7, range 24-68 yrs)

Drivers Licence

Australian Open

30.9 %

Mean driving experience of sample
(SD = 12.9, range 5-50 yrs)

Highest Education



- High school – Year 10 (N=6, 26.1%)
- High school – Year 12 (N=4, 17.4%)
- Trade qualification/TAFE (N=5, 21.7%)
- Undergraduate degree (N=5, 21.7%)
- Postgraduate degree (N=3, 13.1%)

Employment



- Currently not in paid employment (N=10, 43.5%)
- Retired (N=6, 26.1%)
- Employed full-time (N=5, 21.7%)
- Employed part-time/casual (N=2, 8.7%)

10,916 km

Mean driven per year of sample
(SD = 12,920)

388.3 hrs

Mean driven per year of sample
(SD = 485)

14.6 yrs

Mean chronic pain duration
of sample (SD = 12.9)

Figure 3. Summary of demographic characteristics of drivers with chronic pain (Study 1b)

Results

Study 1a Study 1b



Study 1a: Health professionals working with individuals with chronic pain

The sample produced a total of 660 response statements in the interviews with health professionals experienced in working with individuals with chronic pain. The results are organised in terms of the following major themes that emerged:

- Views on the importance of driving for individuals with chronic pain.
- Views on the impact of chronic pain on driving ability.
- Current strategies to assess driving in individuals experiencing chronic pain.
- Current strategies to address safe driving in individuals experiencing chronic pain.
- Barriers to adequately assess/address driving behaviour.
- Recommendations for improving assessment and addressing difficulties in individuals with chronic pain.

Subthemes were also identified, providing a more detailed description of the themes (see **Tables 1a-1d**). In addition, to retain the data anonymity, direct quotes from participants are labelled with a participant number (e.g. p1-p17). The details of the professional characteristics and professional experience of individual participants is included in **Figure 4**.

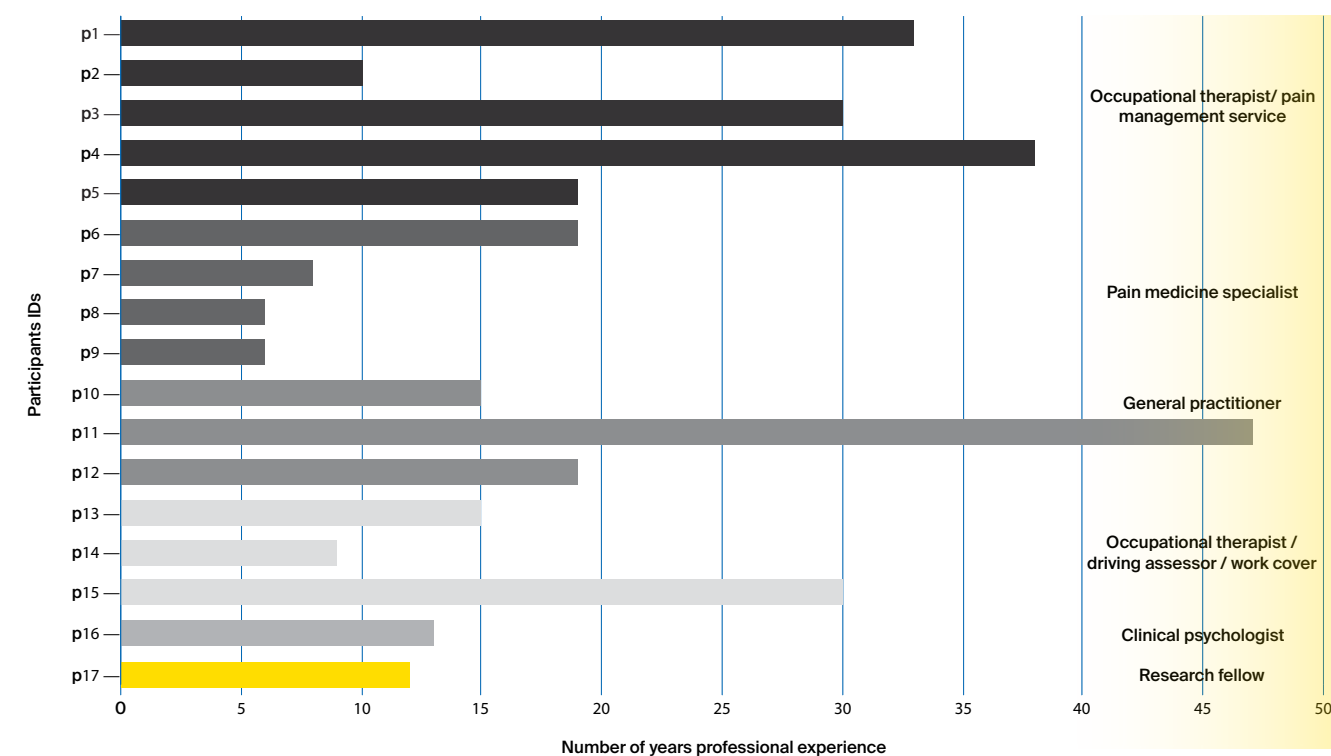


Figure 4. Characteristics and professional experience of individual participants in Study 1a

Study 1 results



Views on the importance of driving for individuals with chronic pain

All participants discussed their views on the importance of driving for individuals with chronic pain. Ten statements identified driving is a form of autonomy, a part of contemporary Australian lifestyle and an essential activity of daily living (ADL). Driving was a means to access the community and engage in day-to-day activities.

“Personally, I understand when you have a good quality of life, you’re able to do a lot of things, and driving is supposed to be one of the most important elements because everyone’s supposed to drive, especially in Australia since it’s a big land and public transport is not as efficient as any other industrialised countries.” (p17)

“It’s just part of the activities of daily living. It’s their ability to be independent, access to the community to do things like shopping, paying bills. It’s just part of the occupation that they may need to do within their life.” (p4)

“
It's their ability to be independent, access to the community... part of the occupation they may need to do... ”

Views on the impact of chronic pain on driving ability

Unpredictability and variability on how pain impacts individuals

The impacts of chronic pain on an individual was considered to be multi-factorial in nature, with a large range of variability. As a result, this created challenges for health professionals to determine the specific impact of chronic pain on driving.

“There’s a lot of individual variability around this. Like some people that will have a significant impact and some people will have very little impact.” (p5)

“It would depend on their mental state, their physical condition, or what medications they are taking, the side effects that they experience, their age... Lots of people with chronic pain who drive are okay, but then there are also those that struggle. It is very variable, I guess different case to case.” (p6)

Physical

The physical impact of chronic pain on driving was considered to be affected by prolonged sitting, which would have implications on the frequency and distances they chose to drive.

“Some will say, ‘I can’t drive for long periods of time’ and that comes up quite a bit. So, I guess that is an issue in terms of, you know, ‘It hurts more if I drive for long periods of time and flared up, so I won’t drive for long periods of time’.” (p16)

“So, we know that usually, the people with chronic pain will actually have lower back pain, and for the vast majority of people sustained sitting flares up. So, driving, of course, has potential implications with the worsening of their pain.” (p7)

In addition, ten statements reflected the reduced range of movement for individuals experiencing chronic neck pain, which would impact their ability to perform shoulder checks and reverse their vehicle.

“Someone who has neck pain may not be able to turn their head easily to perform shoulder checks.” (p12)

Ten statements also referred to physical and sensory impairments affecting the use of a steering wheel and pedals.

“The other aspect is looking at the physical side of things so, their sensory ability to pick up brake and accelerator, their range of movements sort of in the ankle and knee and hip...their ability to hold the steering wheel with two hands and their ability to actually turn the steering wheel well, and their ability to kind of manipulate sort of handbrake as well if required, or if they’re driving a manual their ability to use the clutch, and gear changes as well which is hand function.” (p1)

Two participants spoke about the implications of pain on accessing and transferring in and out of the vehicle.

“Just getting in and out of the car can be quite difficult. So, I guess it’s not just actual driving, it can be accessing, getting into the car as well as getting out of the car.” (p1)

“The other aspect is looking at the physical side of things so, their ability to get in and out of the car.” (p2)

Cognitive

Twelve participants raised concerns regarding diminished cognitive capacity as a side-effect of chronic pain. Notably, health professionals spoke about inattention and reduced reaction time while driving.

“Definitely, so it can impact quite significantly. It can impact on their attention and concentration, particularly if the pain levels are increasing during driving. Their cognitive functions; so certainly cognitively, pain will have an impact.” (p14)

“From the cognitive perspective the pain itself, depending on the severity, may reduce their cognitive abilities to focus while driving. It may increase the chance of driving without attention and without enough care, to the road to the signals... it may increase the chance of unsafe driving. For example, speeding or not indicating when turning. So, these are the sort of mistakes or errors that someone with chronic pain/back pain may cognitively do, and obviously affects their ability to drive safely.” (p10)

Nine statements related to the prevalence of sleep disorders among persistent pain patients, which could negatively influence cognitive, emotional and physical health effects.

“There’s also a higher prevalence of things like sleep apnoea in patients that have persistent pain... but a lot of it is sleep apnoea which can be undiagnosed, that can affect. ...I often say to patients, when I do talk to them about fatigue management, that it’s really often very multifaceted. That if they don’t have good sleep routines, their mood is low and pain is bad, and they don’t have engagement and activities throughout the day, and all of those contribute to fatiguing. Yeah, which could have a correlation to driving too.” (p16)

Seven statements referred to the experience of pain as an intrinsic distraction itself.

“There’s obviously a humanitarian impact to that. It sucks they are in pain, but probably more importantly, that pain is a distraction.” (p7)

Moreover, prolonged driving is likely to increase pain, which would inherently reduce concentration.

“So certainly, with pain, like I said, with chronic pain, ... the prolonged driving or you know, as they drive longer, they can get more if the pain builds up, they’re getting more distracted, they’re not able to concentrate as much and then you can start to see those cognitive demands of driving take in.” (p14)

Mental health

Health professionals identified mental health challenges among patients that potentially impact driving. For example, trauma related to previous motor vehicle crashes, and individual disposition to irritability, low mood or anxiety.

“...It’s an indirect impact, is that, a... some of my patients have a trauma, there’s quite a high prevalence of trauma. So, for example if there’s been like a motor vehicle crash, and their pain has been associated with that, there can be an anxiety component with returning to drive and a hypervigilance and things around driving, and that’s something I see with some patients. And, yeah, and I guess pain can also be distracting to an extent, you know, I think sometimes patients are quite internally distracted by not only pain but other things, such as anxiety and other things. So that could also affect.” (p16)

Study 1 results



Perceived effect of medication on driving

Twenty-five statements referred to the side-effects of commonly prescribed medications for the treatment of chronic pain. For example, drowsiness, slower reaction time, impaired concentration, hallucinations and diminished situational awareness. However, there exists variability concerning the effects of these medications and individual tolerance levels.

“Umm... so again it is quite variable for some people, some patients tolerate some medications differently. So, for some people for example, the gabapentin makes them very drowsy, whereas other people feel little effect. So, look you would say the opioids and the Gabapentinoids, the two most commonly used groups of medications to treat chronic pain and often have negative side effects affecting concentration. With the caveat that many patients taking them may not feel much of an effect at all. So, it's again a very individual thing.” (p6)

Furthermore, seven statements by participants suggest that Opioid side-effects diminish with prolonged usage.

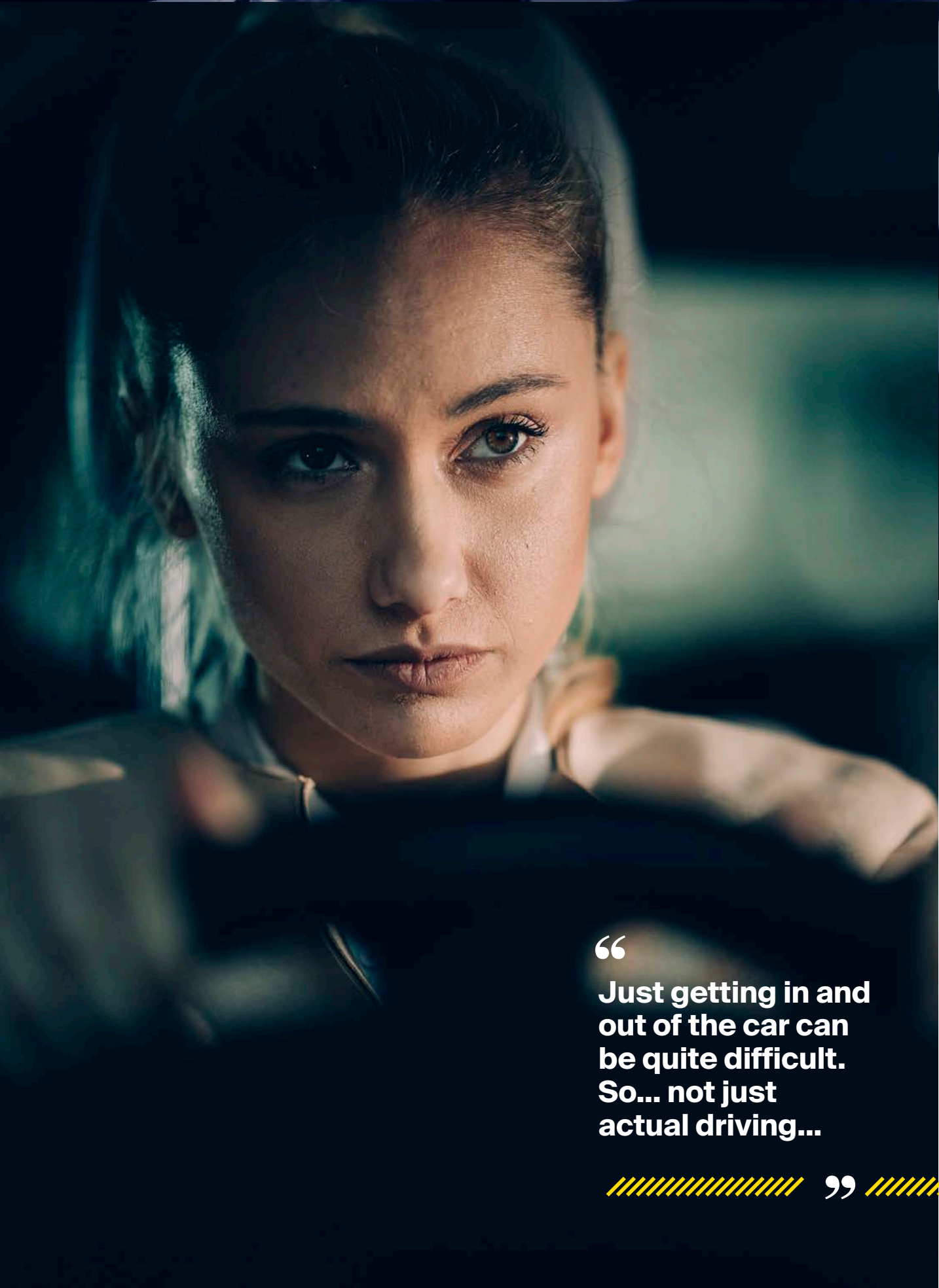
“I think the thing that we see tolerance with, probably the most commonly tolerant situation we see, would be with opioid analgesia. And you know, people feeling very groggy and sleepy when they first start taking it, but then after a few weeks to a few months seem quite normal again. They can perform their daily tasks. I guess then the benzodiazepines are another group that we see that with, but the opioids are definitely more common these days to see people on, you know opioid medication throughout today.” (p8)

More importantly, three statements by participants raised concerns regarding the prevalence of substance use disorders within the chronic pain cohort, as well as the cumulative effect of the prescribed drugs commonly used to treat chronic pain.

“I guess the other thing that can't be ignored is the cumulative effect of these drugs. Unfortunately, often people who have chronic pain prescribed an opioid, whatever that may be. And on top of that, they prescribe the drug called a benzodiazepine, and although each one of these drugs individually is quite sedation and problematic, they're more than the sum of their own parts really when combined. So, what we often see is this issue of polypharmacy, there are multiple drugs, which is just creating a multiplication of the sedation, or impairment the person has.” (p7)

Furthermore, two statements reflect the plausibility of medications heightening sleep apnoea, which in turn would impair cognitive functions correlated with driving.

“So, I think a lot of the cognitive effects of living with chronic pain are due to the medications that people are on, however, there was also the effect of lack of sleep, which is a problem that many people with chronic pain have. So, lack of sleep and the medications both have similar effects on alertness, judgement, reaction time.” (p8)



“
Just getting in and
out of the car can
be quite difficult.
So... not just
actual driving...”



Study 1 results

Current strategies to assess driving in individuals experiencing chronic pain

Health professionals experience with driving in chronic pain cohort

Five health professionals (p4, p7, p8, p13, p15) reported that some client’s had self-identify difficulties with driving due to their chronic pain.

“They usually identify it because they’re impaired because of their medication and that is quite often. People would often say ‘I am afraid to drive.’” (p7)

However, four participants (p1, p13, p16, p17) observed a proportion of their patients demonstrating self-awareness with respect to their ability to drive safely.

“That they won’t take it if they’re going to be driving, and then they will limit what they’re taking, you know, very responsible in that regard. Other patients won’t mention it at all.” (p16)

Notably, three health professionals (p1, p8, p15) experienced patients voluntarily ceasing driving due to self-perceived physical and cognitive capacities. Moreover, one participant (p17) reported patients may have supports in place to assist them with driving should they need.

“And a lot of people say that they’re, they’re not driving. And that may be due to their inability to tolerate sitting in a car, or the fact that they don’t feel like they can physically manage to drive a car, or maybe due to the fact that ‘I feel too cognitively impaired by the medication’ to drive. And so those are all situations where people have said that they’re not currently driving because of their pain conditions.” (p8)

“For us the patients usually have someone to help them, so this is not an element of necessity.” (p17)

Health professionals experience with driving assessments

Health professionals reported mixed opinions when asked to discuss their level of confidence to assess the capacity to drive, for the continuum of certainty, within the chronic pain cohort. This was largely owing to individual scope of practise and experience in relation to driving rehabilitation. For example, twelve statements reflected participant’s low confidence due to a lack of adequate training and challenges with reliance on subjective information.

“I haven’t been specifically trained, because in the context of our consultation, there be some people here [health facility], I think, that definitely shouldn’t be driving. There are the other people who are being really in that grey area. They would be ‘Okay, I’m not sure. Maybe yes, maybe no’. And I wouldn’t feel confident to make an assessment of those people that are in this grey area.” (p6)

However, twelve statements indicated that some participants have moderate to high levels of confidence with ascertaining levels of physical and cognitive capacity of the person with chronic pain, in relation to driving task through assessment. However, they highlighted the importance of assessing the task of driving in order to develop a complete clinical picture of a patient’s capacity to drive safely.

“I feel confident in determining risk, really the full-on capacity, I think. You can’t really tell until you actually put them through a driving assessment. So, you know, and that’s obviously outside my expertise and what I tend to do. So, I would say I’m confident in my capacity to determine a risk. And then I’m confident to refer somebody on to actually determine their full-on driving capacity to some far more accurate measure through a driving assessment.” (p1)

Health professionals were asked to share their opinions regarding adequate evaluation of driving capacity within the chronic pain cohort. Six statements raised by participants indicated that more can be done to address driving within the population.

Table 1a. Themes and subthemes of interviews with health professionals

| THEMES AND SUBTHEMES | CODES | NO. OF PARTICIPANTS | FREQ. OF STATEMENTS (%) |
|--|---|---------------------|-------------------------|
| Views on the importance of driving for individuals with chronic pain | | | |
| | • Driving is a form of independence | 6 | 10 |
| | • Driving is a part of the instrumental activities of daily living (IADL) | | |
| | • Driving is a form of daily contemporary lifestyle especially in Australian culture | | |
| Views on the impact of chronic pain on driving ability | | | |
| Unpredictability and variability on how pain impacts individuals | | | |
| Physical | • Ability to do a shoulder check and reversing which requires a range of movements | 10 | 15 |
| | • Ability to sit in a car for a prolonged length of time | 9 | 10 |
| | • Ability to use a steering wheel and pedals effectively | 9 | 10 |
| | • Difficulties with getting in and out of the car | 2 | 2 |
| Cognitive | • Cognitive impairment/ability to concentrate/ slower reaction time due to pain | 12 | 18 |
| | • Cognitive impairment from lack of sleep and/or fatigue | 6 | 9 |
| | • The distraction of being in pain | 5 | 7 |
| | • Concentration reduces with prolonged driving | 1 | 1 |
| Mental Health | • Emotional irritability/anxiety/trauma from motor vehicle crash side effects | 7 | 9 |
| Perceived effect of medication on driving | • Some medication can cause drowsiness, hallucinations, and slower reaction time/ concentration | 13 | 25 |
| | • Effect of medication depends on the individual’s level of tolerance | 9 | 11 |
| | • Opioid side effects diminish with prolonged usage | 4 | 7 |
| | • Combination of substance use disorders and medication is a risk factor for traffic crashes | 1 | 3 |
| | • Effect of medication on sleep routine which could affect alertness, judgement, reaction time | 2 | 2 |

Study 1 results



General practitioners (GPs)

Health professionals were requested to discuss their scope of assessment to determine an individual's capacity to drive safely. Largely, the GPs discussed reviewing medical history which included physical, neurological, psychological and pain severity pertaining to someone's capacity to drive. One participant noted driving assessment would be conducted secondary to concerns raised by the patient, family member or a request for a commercial licence authorisation.

“Well, it has not become part of the routine checks that we do for chronic back pain. The reason being maybe for chronic back pain automatically, what we try to recommend is rest from the offending activities or triggers and during normal daily activities as tolerated... The only time we do a formal assessment is when someone is asking for a commercial driver's licence or whether the assessment is part of the employment checks. Apart from that, usually in daily practice no, no formal assessment.” (p10)

In addition, one participant reported referring to a driving assessor when clear warning signs are present and require further investigation.

“
If we don't get any
information or anything
that is brought up... it
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otherwise, it is more
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something happens.

//////////////////// ”

“Driving assessors are good but we need a clear warning sign to make such a referral. If we don't get any information or anything that is brought up, then it would be something we do. It is not a routine thing otherwise, it is more if there is a change or something happens.” (p8)

Pain clinic

Health care professionals within the pain clinic reported that assessments related to driving capacity are generally dependent on a case-by-case basis. Twenty-six statements reported that assessments typically consist of subjective information gathering to ascertain potential challenges, followed by physical examination to establish a holistic picture of the patient.

“In initial consultation, we have like a semi-structured interview assessment form that we fill out. There is a section in there about driving that we asked a few questions about driving; if they have any difficulties driving the type of car they have, what sort of licence they have, if they use public transport or how they get around if they don't drive... Um, so we don't have any kind of assessment that we really use. It's all sort of interview-based and observation.” (p2)

Fourteen statements indicated that participants used 'red flags' that would prompt the need for further assessment. For example, pain pathology, cognitive and emotional behaviours, and physical capacity.

“For instance, a couple of things, if somebody is physically challenged, say they can't move their legs too well, there would be a trigger there to say well, 'how do you drive, are you able to drive okay?' So these can be the physical trigger, like 'do you have neck pain?' means they aren't able to turn their head very well to look at traffic, would be one. If they're very drowsy during the consultation, you might be more prompted to ask about their driving. So, I think probably the triggers would be, a physical disability like neck pain or some other pain. Or they are drowsy during the consultations.” (p6)

Discussions pertaining to commonly sought-after information during an assessment included asking individuals their experience with side-effects and impact on driving ability.

“Well, there's a legal medical element to it. I don't want them to crash and die. Now if we are talking about the drugs, it is part of

that duty of care to have a conversation, particularly when the drug is being initiated or increased.” (p7)

In addition, five participants (p1, p2, p3, p7, p12) discussed referring onward to occupational therapy driving assessors if a patient's abilities could not be determined through their evaluation. One participant noted including family members to gain further information.

Community occupational therapist/ driving assessors

Eighteen statements by occupational therapist driving assessors indicated that driving evaluations included on-road and off-road assessments. Off-road assessments consisted of driver history, physical functional evaluation, vision-test and cognitive screening. On-road assessments included observations on similar components while the patient is driving. Participants highlighted they only assess the clients referred by a GP.

“... so if they have an injury like whiplash or a shoulder condition or something. Then we are looking at their ability to complete those movements, how much pain they are getting and looking at what aggravating factors are. With aggravating factors, what the frequency is, what time of day or what they are doing at the time that makes it worse. I would look at what they do to ease their pain, what self-management strategies they have. I would also do a standard assessment with any client, that includes a cognitive, physical function test, a vision test, but particularly from a chronic pain angle I would be looking at their cognition, making sure that it is at a good level, and that they are able to self-regulate their behaviour and that they are sensible about their behaviour; I would be assessing that in an off-road.” (p13)

Two participants (p13, p14) cited the Austroads guidelines to establish clinical management for the condition. One participant also noted gathering additional information from the patient's family member to extend upon the clinical picture.

“I'd always like to follow up with a family member, with permission, to see if they've got any concerns and you know, usually if they do that's kind of brought forwards.” (p14)

Current strategies to address safe driving in individuals experiencing chronic pain

Forty-four statements were related to the provision of self-regulation strategies to support patients reporting challenges with chronic pain and driving. These included:

- weaning off medications
- activity pacing
- task adaptation
- fatigue management
- ergonomic postures
- support cushions
- vehicle modifications
- hazard anticipation.

“Weaning off medications is one big one. Taking regular breaks from driving. Driving shorter distances, not undertaking long drives, sleeping well, taking naps if they're on a long drive, like maybe taking a nap while on the drive, so stopping having a nap then going on, then use of sleep masks, and for obstructive sleep apnoea, car modifications, and I guess with the technological advancements in cars that are starting to alert people about whether they're paying attention to the road and whether their hands are on the steering wheel and things like that.” (p8)

Twenty-nine statements by nineteen participants suggest that patients are referred to an appropriate clinician, such as a GP, occupational therapist driving assessor, or a pain management clinic as needed.

“Medications at it isn't my strong point, and basically, I don't have much of an opinion on that, because I don't know enough about the individual medications. And so, I'll usually just say, you should talk to your doctor about what is prescribed.” (p15)

In addition, health care professionals provide education on safety concerns around medications and warnings in relation to driving. This is also reviewed at the time of a new prescription or change in dosage.

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results

“
... I clearly explain the intended effects of medication on driving abilities, on focus and concentration...
”

“When someone is taking the medication, my usual norm is to discuss the effects of medication on driving and driving ability. Usually, I clearly explain the intended effects of medication on driving abilities, on focus and concentration to them and ask them not to drive on the effects of these medications or change the timing of taking the medications. For example, if they have to drive to work in the morning, I explain to them that they can skip the morning dose and then take it later during the day when they are no longer needing to drive. These are the norm I usually follow.” (p10)

Nine participants also recommended alternative transport options for accessing the community when patients are unsafe to drive. Furthermore, two health professionals (p8, p16)

discussed their concerns with the patients’ regular GP or the Department of Transport and Main Roads if they observed low compliance from the patient.

“I guess it’s also talking to the GP just about exploring, you know, whether that medication is the right fit for them, or do they have a discussion with the GP or with the doctor here, around that...” (p16)

Due to the multi-faceted nature of chronic pain, clinicians work with clients on various components to address safe driving, across a continuum of health. This could include attending to physical, cognitive and emotional barriers for patients. Moreover, two participants reported providing education and empowering patients through motivational interviewing and goal setting. This would increase patient insight and enable them to identify concerns relating to their driving behaviour.

“It’s mainly motivational kind of interviewing, and just feedback in terms of the strength in his arm from grip strength testing. And we sort of tell them, you know, like, there’s a certain sort of figure that you give to people, which is kind of like after you achieve this figure, you theoretically have the strength to hold a steering wheel, and all that kind of stuff.” (p2)

A small number of participants reported recommending driving lessons as part of driver rehabilitation.

“Sometimes the recommendation might be a couple of lessons to learn some of the driving adaptive techniques and strategies.” (p13)

Table 1b. Themes and subthemes of interviews with health professionals

| THEMES AND SUBTHEMES | CODES | NO. OF PARTICIPANTS | FREQ. OF STATEMENTS (%) |
|---|---|---------------------|-------------------------|
| Current strategies to assess driving in individuals experiencing chronic pain | | | |
| Health professionals experience with driving in chronic pain cohorts | • Some clients self-identify driving difficulties due to chronic pain | 5 | 6 |
| | • Clients normally have some self-awareness in assessing their ability to drive safely | 4 | 5 |
| | • Some clients voluntarily cease driving | 3 | 4 |
| | • Clients normally have access to other forms of transport/get someone else to drive them | 1 | 1 |
| Health professionals experience in driving assessment | • Does not feel confident in determining capacity to drive in a chronic pain cohort | 10 | 12 |
| | • Feels confident/moderately confident in determining capacity to drive in a chronic pain cohort | 8 | 12 |
| | • Believes driving difficulties in individuals with chronic pain is not addressed adequately | 5 | 6 |
| GPs | • Assesses medical history to determine someone’s capacity to drive | 6 | 15 |
| | • Does not routinely assess someone’s capacity to drive unless concern raised/commercial licence authorisation is requested | 1 | 3 |
| | • May ask a family member to get an overview of the clients driving performance | 2 | 2 |
| | • Refers to occupational therapy driving assessors if warning sign triggered and more investigation required | 1 | 1 |
| | | | |
| Pain clinic | • Assessment component depends on the individual’s circumstances | 7 | 26 |
| | • Does not routinely assess someone’s capacity to drive unless concern raised | 7 | 14 |
| | • Refers to occupational therapy driving assessor or GP if warning sign triggered and more investigation required | 5 | 7 |
| | • Regularly asks individuals about medication side effects and capacity to drive | 2 | 5 |
| | • Regularly refers to Austroads medical standard for licensing and clinical management guidelines | 2 | 2 |
| | • May ask a family member to get an overview of the clients driving performance | 1 | 1 |
| Community occupational therapist/ driving assessors | • Assessment component involves driving history, medical review, off-road and on-road assessment | 8 | 18 |
| | • Regularly refers to Austroads medical standard for licensing and clinical management guidelines | 2 | 4 |
| | • Asks family members to get an overview of the clients driving performance/family member raised concern | 1 | 3 |
| | • Reports back to Queensland Transport medial units if the client is non-compliant | 2 | 2 |
| | • Only assesses driving in clients that got referral by GP/ Work Cover | 2 | 2 |

Study 1 results



Barriers to adequately assess/ address driving behaviour

Health professionals discussed several barriers to addressing driving behaviour with chronic pain patients. Twenty-six statements by eleven participants reported a lack of clear guidelines or treatment pathways available to clinicians to address driving.

“It’s not very common, and the reason for that is again, being aware of the appropriate referral pathways of these driving assessors. It is interesting thinking about this. I am currently not very familiar with those pathways of referring someone onto a driving assessor and how to refer them for a driving assessment.” (p8)

“...I think unfamiliarity with the right set of questions to ask.” (p9)

Furthermore, eighteen statements centred on the additional barriers to assessing driving behaviour; such as the lack of driving assessment tools, absence of driving as a criterion measured on available tools, limited clinician training and knowledge within the area of driving, and uncertainty of a correlation between results from off-road and on-road assessments.

“The other barriers that I can think of is when people, when people come over for renewing the driving licence, either private or commercial. If I remember correctly the multiple questions and checklist on that form for us to check whether the person

has a history of stroke, acute myocardial infarction, diabetes, epilepsy, but I cannot recall any specific option about pain. There is an option about musculoskeletal disorders but that is something different, that doesn’t necessarily cover chronic pain. That could be another barrier.” (p10)

However, several health professionals (p2, p3, p6, p7, p9, p10, p12) also reported addressing driving secondary to observed or reported red flags. This was largely owing to time constraints and the referral priorities.

“I guess the time of the consultation, and the patient priorities around other functional areas of their lives, like sleep and housework, that kind of thing, and self-care and stuff. So, I think it’s a lot too, beyond that simple screening. It’s quite a lot, a lot to get through kind of formal assessment of driving.” (p12)

Twenty-four statements by eight participants also reported that routine practice does not consider assessing driving without a warranted trigger.

“Depends on what the difficulty was. So, if the difficulty was around sitting tolerances, neck pains, that sort of stuff I probably wouldn’t ... if the difficulties were around concentration and reaction times, I would probably raise that as an issue and discuss that with the team, with the medical staff at least.” (p5)

Sixteen statements referred to the health professionals concern about patients avoiding disclosure of driving abilities for fear of losing their licence.

“I think one of the key barriers is that driving is a key means of transport. So most people do not want doctors or other health care professionals to know how difficult it is for them to drive because they don’t want to lose their independence.” (p3)

A small number of participants (p2, p5, p14) discussed barriers to access driving assessors, such as limited driving assessors publicly funded and high out of pocket costs for private driving consultants.

“In the past getting access to driving assessors has been a barrier... Patients who I work with usually have limited resources wouldn’t be able to get a private driving assessment, and there are not enough public driving assessors.” (p5)

Five participants felt there is limited research evidence on the impact of chronic pain on driving, which creates a challenging situation for clinicians to assess driving as a priority for chronic pain patients. Clinicians reported inadequate awareness at time diminishes the importance of the area.

“I think maybe if there was more research around this, and the effectiveness or any strategies or tools used to address it. I haven’t come across it in the literature. I’m across a lot of pain literature, and I haven’t come across it. Probably if there is more out there about this topic, then it’d probably be more at the forefront of my mind and I would think I should be doing more.” (p5)

Four participants discussed the importance of driving as a sole means of accessing the community, in particular in rural and remote regions.

“I think a lot of our difficulties with our area [regional Queensland] is that we cover such a vast demographic that a lot of the patients live out in the middle of nowhere and there are no other options except driving.” (p4)

Lastly, a small number of participants (p8, p14, p16) reported ‘pain’ was highly subjective and complex in nature, therefore, assessing the impact on driving would be deemed equally challenging. Furthermore, one participant stated there was no clear-cut criteria or referral pathway, due to insufficient resources.

“I think it’s that driving is multifaceted. I think there are so many factors and I think everything in pain is very complicated, and there are many, many factors that can impact on that.” (p16)

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results

Recommendations for improving
assessment and addressing driving
difficulties in individuals with
chronic pain

Health professionals were asked to provide recommendations on improving driving assessments and addressing driving challenges within the chronic pain cohort. Participants discussed developing concise guidelines and updating current tools to incorporate driving. This would facilitate identifying clients at risk of driving difficulties and provide clinicians with an indication to pursue further assessment or treatment as required.

“Streamline it, just like if you have this score on the sleep apnoea test, you have to do ‘x, y, z’. I think if someone was to develop some sort of risk tool, these are the boxes you tick, consequently to have your licence renewed you need to have this assessment done. So, then it is not just left to the individual identifying it, it is an automatic mechanism that just happens.” (p7)

Eighteen statements referred to the benefits of multi-disciplinary team management to address driving

challenges within the chronic pain cohort. They discussed collaboration with the collective professionals involved in the patients’ care. Participants frequently suggested that this would include the multi-disciplinary team at a persistent pain management clinic and the clients’ GP.

“I’m trying to think. Maybe involvement of a multidisciplinary team can also sometimes prompt us to consider things like physiotherapy, they can bring up concerns about the patient not mobilizing independently. I can imagine they can also make an assessment saying they are not safe to drive, but that would be more relating to the physical restrictions encountered rather than manifestations of pain directly distracting them or whatever.” (p9)

“...The pain clinic is a really great place to do that because it is a multidisciplinary clinic and I feel like the problems with driving is a multi-faceted issue. So, there’s obviously a psychological aspect with anxiety, the medication aspect which is the doctors forte or pharmacists forte; and then like the modifications in a car, which is obviously occupational therapy, neck movements could be a physiotherapy intervention. So, I think a pain clinic is really suited to dealing with the issues that impact on driving... but you know, it would be nice to work together with GP’s to work out what might be the best system and who does what.” (p2)

Eleven statements refer to the need to educate patients and family members as a priority. Education should include self-assessment tools with cognitive and physical components for patients to evaluate whether they are safe to drive, as well as information on the impact of medication and pain on their abilities.

“I think patients need to be well educated; they need to know their legal obligation, what are my legal obligations in terms of if I’m on various medications, am I legally allowed to drive? I think highlighting to the patient that they are not only putting themselves at risk but also putting others at risk. This would be important knowledge to have, as well as an important part of education process.” (p6)

“Written information for the patient on things to look out for or specific deficits in motor function that would be an indication to restrict driving.” (p9)

“
... it would be nice to
work together... to
work out what might
be the best system
and who does what.
”

Table 1c. Themes and subthemes of interviews with health professionals

| THEMES AND SUBTHEMES | CODES | NO. OF PARTICIPANTS | FREQ. OF STATEMENTS (%) |
|---|---|---------------------|-------------------------|
| Current strategies to address safe driving in individuals experiencing chronic pain | | | |
| | • Recommends self-regulation strategies i.e. pacing, postural adaptations, support cushions, vehicle modifications, hazard anticipation | 17 | 44 |
| | • Refers to GP/pain management clinic/COT driving assessor/hand therapist depending on the individual circumstances for further follow-up | 19 | 29 |
| | • Advises clients to discuss with their GP/not to drive when prescribed new medication | 6 | 14 |
| | • Recommends other sources of transport instead of driving themselves | 9 | 9 |
| | • Discusses with other health professionals, GP, transport main road medical unit if warning sign triggered | 2 | 4 |
| | • Works with clients through different components i.e. physical, cognitive, emotional aspect required for safe driving | 3 | 3 |
| | • Awareness and education about the impact of chronic pain on driving/ motivational interviewing/strategies to increase client insight (Jet’s law)/ recommends driving lessons | 1 | 2 |
| Barriers to adequately assess/address driving behaviour | | | |
| | • Lack of clear guidelines for assessing driving in chronic pain cohort | 11 | 26 |
| | • Clients not routinely assessed or seen for driving safety or capacity to drive unless concern triggered | 8 | 24 |
| | • Lack of concern about driving/not a priority in our clinic/limited time available during consultations | 10 | 19 |
| | • Lack of validated driving assessment tools/current outcome measure tools do not include driving as an assessment component/ off-road cognitive assessment doesn’t always correlate with on-road assessment/limited knowledge on driving assessment and training | 7 | 8 |
| | • Clients may mask their driving difficulties, or rarely bring up driving difficulties, over concerns of losing their licence / clients may have limited insight into their driving behaviour | 11 | 16 |
| | • Limited access to the public pain clinic, driving assessor concerning cost and long waiting list/inadequate financial resources of the private driving assessor | 9 | 12 |
| | • Lack of research on chronic pain and driving/likelihood of adverse driving events experienced by chronic pain clients | 5 | 11 |
| | • Limitation of other forms of transport; in particular in rural and remote areas | 4 | 4 |
| | • The subjective nature of pain and complexity of driving task/the individual approach to treatment, not-one-size-fits-all/difficulty in accurately assessing driving safety in a short time | 3 | 3 |
| | • Chronic pain does not fit the criteria for a referral pathway for driving assessment services | 1 | 1 |

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Moreover, nine statements from clinicians discussed the importance of building capacity among family and carers for them to support informed decision-making around the client's safety to drive.

"I think it's really hard for family members because I think driving is a key means of independence for people, and your family members might question someone's capacity to drive. That can provoke a high level of anger and anxiety. And so, I think family members should ideally be supported to talk to their family member about driving, but then be able to speak to professionals and health professionals if they have concerns and to alert health professionals." (p3)

Six statements noted the importance of growing the evidence-based research body for clinicians to improve their understanding of the multi-faceted impact of chronic pain on driving for the chronic pain cohort.

"... I feel like it's a very neglected area in clinical practice; not just here, but I feel like in other places around the world, it would be pretty similar and is a very neglected area and research. So, it's good that something is being done about it." (p2)

Clinicians also discussed the potential role of in-car driving assistant technologies in supporting patients with chronic pain. These technologies could support patients to identify cognitive effects such as fatigue and attention, as well reducing the impact of physical challenges restricting their range of movements, such as the blind spot warning and reverse camera.

"We just bought a new vehicle ourselves. It's got a reverse camera, which is a massive help for people with a neck injury. It has lane departure warnings, blind-spot detectors... also has a built-in seat vibration so if somebody is walking behind me, or a car is about to approach behind me, while I am on the reverse the seat will vibrate. So that particular tool is very handy for someone with a pain condition. I think the blind spot detectors would also be very handy for someone with a pain condition. If I am preparing to change lanes, the light would be on so that would reduce the frequency at which I have to keep looking myself if I didn't have that device." (p13)

“
...I think family members should ideally be supported to talk to their family member about driving...

”



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results

“

It would be nice if it could be done in a non-threatening way. I think because everybody's scared if they go for a driving assessment, they view it as a way of taking away their licence...

”

Two participants (p2, p8) also added that assessment processes could be improved using technology such as a driving simulator. In addition, one participant (p10) spoke about the importance of campaigns to raise awareness in relation to driving while experiencing chronic pain and medication intake. Another participant (p8) discussed encouraging clinicians to change their approach to encourage safe driving strategies when addressing driving difficulties with patients.

“Well, in my opinion, the very first step would be raising awareness of the importance of the issue to be explored further. And the fact that chronic pain is becoming more and more common, more and more frequent and many people are

living with it and it affects people's quality of life and usual daily activity and driving, and safe driving is part of that...and so that is one strategy increasing awareness.” (p2)

“It would be nice if it could be done in a non-threatening way. I think because everybody's scared if they go for a driving assessment, they view it as a way of taking away their licence.... So, I think they could be more succinct, less threatening, focused on enabling the person rather than disabling them. I think they should probably be spread across multiple people if possible, so spread across a team as possible.” (p8)

One participant discussed incorporating driving into the patient's recovery plan, in order to ensure it was adequately addressed.

“I believe a recovery plan would be great, great. And articulating the driving as part of the recovery ability, you know, when you're trying to recover, this is a thing that you need to do, going back to work and you know, getting your sleep and driving should be one of the elements as well.” (p17)

A few participants (p7, p8, p15) noted the importance of addressing public health funding deficits, to facilitate addressing multiple concerns relating to a patient's chronic pain condition.

“GP's are meant to talk about this, but GPs have 15-minute appointments and Medicare crawls down their necks, shouting at them to say if they ever go beyond that. So, the other thing to do would then be to create infrastructure within Medicare. Where driving discussions or driving safety are subsidised or reimbursed with an item number.” (p7)

“The financial support by Medicare or government or other resources. So, to give a particular item number for assessment to make it a requirement as we have for many other issues or illnesses.” (p8)

Table 1d. Themes and subthemes of interviews with health professionals

| THEMES AND SUBTHEMES | CODES | NO. OF PARTICIPANTS | FREQ. OF STATEMENTS (%) |
|---|--|---------------------|-------------------------|
| Recommendations for improving assessment and addressing driving difficulties in individuals with chronic pain | | | |
| | • Guidelines on improving driving assessment, treatment and standardised and validated tool | 14 | 40 |
| | • Involving multidisciplinary team of health professionals i.e. pain clinic, GP, COT | 10 | 18 |
| | • Upskilling clinicians on the potential impact of pain and medications on safe driving behaviour | 9 | 16 |
| | • Educating patients/family members about core abilities required for driving and strategies to increase physical and cognitive tolerance of driving task. Creating self-assessment checklist for when it is safe or unsafe to drive | 7 | 11 |
| | • Enhancing the role of family members to support clients to make informed decisions around driving/involving family members during driving assessment | 9 | 9 |
| | • More access to evidence-based research about driving behaviour in individuals with chronic pain | 4 | 6 |
| | • Potential use of in-car driver assistance technology | 5 | 5 |
| | • Improving driving assessment using technology and over the period of time | 2 | 3 |
| | • Campaigning for raising awareness in relation to driving while experiencing chronic pain and medication intake/positive angel in addressing driving difficulties | 1 | 3 |
| | • Incorporating driving into individuals' recovery plan and quality of life outcome measures | 2 | 3 |
| | • Financial support from government to access the driving assessment in the public health system | 3 | 5 |
| | • Collaboration between health professionals and Transport Main Road to identify the drivers at risk and special consideration for learner drivers experiencing chronic pain | 1 | 1 |

Finally, another participant highlighted the importance of increasing the collaborative efforts with GPs and the transport authorities in order to increase identification of the chronic pain drivers at risk of traffic crash.

“Probably more collaboration between motor vehicle registry or authorities that provide driving licences and GP's. If, for example, they are notified of someone that has had a crash, or has been reported as to having a chronic condition, we don't usually get notification... And also, it's not mandatory for GP to report someone with chronic back pain who is not able to drive or who is not safe to drive. It is not mandatory for us to report to a registry or whoever the authority is. So, for example, having more, more robust or more focused regulation around this issue; identifying the need to flag the individual or to invite the individual to self-identify himself or herself as not being a safe driver, temporarily or for a length of time, because of chronic pain, this would also be helpful. This is something that happens for diabetes, for acute myocardial infarction or a stroke, for epilepsy. People who are diagnosed with these conditions they have to, according to the law, they have to self-identify themselves, but there's no such thing for chronic pain.” (p10)

Study 1 results



Study 1b: Individuals experiencing chronic pain

Analysis of the data from individuals experiencing chronic pain produced a total of 724 response statements (quotes). The results were organised in terms of the following major themes that emerged:

- Transportation habits.
- Views on driving compared to other forms of transportation.
- Self-reported difficulties associated with driving.
- Self-reported strategies to manage driving difficulties.
- Views on the impact of chronic pain on safe driving behaviour.
- Experience with the health care system in relation to driving with chronic pain.
- Recommendations for improving driving behaviour in individuals with chronic pain.

Subthemes were also identified, providing a more detailed picture of the themes (see **Tables 2a-2f**). In addition, in the following sections direct quotes from participants are labelled with the corresponding gender, i.e. Female (F) or Male (M) and their age.

Transportation habits

Mode of transportation

Participants were asked about their preferred mode of transportation with 78.2% reporting that driving their own vehicle was preferred over the use of alternative transport options. However, for circumstantial reasons (e.g. personal health or geographic location), participants would occasionally use public transport such as the bus, ferry or train to access the community.

“Regularly I just drive myself, occasionally if I’m not feeling the best I will take public transport.” (F52)

“I mostly drive everywhere, unless I have to go into the city, then I drive to train station and catch the train.” (F68)

Two participants reported never having used public transport and one participant stated using the train as a primary means of transport.

“Car. I only drive, because of my limitations.” (F43)

Purpose of most trips

A vast majority of participants (91.3%) reported the purpose of their driving was to engage in their instrumental activities of daily living (IADL’s). These included commuting to and from work, engaging in leisure activities, going shopping, attending doctors’ appointments and driving other family members, while one participant also reported driving as part of work, as a school bus driver.

“Dad’s Taxi service [laugh]. You know if my daughter doesn’t want to drive or my wife, or someone, then I do the driving and pick them up, that sort of thing. I am the family taxi service.” (M63)

Changes in driving due to chronic pain

Twenty-four statements by 60.8% of participants addressed the impact of chronic pain on driving patterns when compared to an individual’s pre-morbid state. Notably, participants reported driving less frequently, driving shorter distances and avoiding night-time driving when possible.

“I don’t go out as much. Some days I don’t go anywhere if I’m in pain. I don’t drive. Like, I won’t drive as much in one day.” (F33)

“Only daytime and drive a lot less now, only if I have to you know.” (F65)

Participants also identified decreased physical comfort while driving. This included seating position and steering wheel grip.

“There’s differences in how I like physically drive, like holding the wheel...but as far as my actual driving behaviour I wouldn’t say that is any different.” (F43)

However, five participants believed that their chronic pain condition did not influence their driving based on their individual pain pathology, the longevity of the condition, or experience as a driver.

“Probably not. I don’t think it really affects my driving at all.” (F28)

“Umm no not really. I mean it’s one of those things that even though I live in the country and there’s no traffic here, I mean, I am a very experienced driver...” (M58)

Table 2a. Themes and subthemes of interviews with individuals with chronic pain

| THEMES AND SUBTHEMES | CODES | NO. OF PARTICIPANTS | FREQ. OF STATEMENTS (%) |
|--|---|---------------------|-------------------------|
| Transportation habits | | | |
| Mode of transportation | • Always drives, never takes public transport | 18 | 27 |
| | • Drives frequently, takes public transport rarely | 2 | 2 |
| | • Drives rarely, uses public transport regularly | 1 | 2 |
| Purpose of most trips | • Activities of daily living | 21 | 23 |
| | • Drive as a part of work | 1 | 1 |
| Changes in driving due to chronic pain | • Drives less frequently due to chronic pain | 14 | 24 |
| | • Doesn’t believe chronic pain affects driving | 4 | 5 |
| | • Believes chronic pain changed sitting position in the car | 2 | 3 |
| Views on driving compared to other forms of transportation | | | |
| Advantage of driving | • Driving is more convenient | 19 | 29 |
| | • Driving is a form of independence | 7 | 8 |
| Disadvantage of driving | • Distance from car parks to location | 1 | 1 |
| Advantage of public transport | • Acknowledge that public transport is safer | 11 | 13 |
| | • Not needing to park the car | 1 | 1 |
| | • Cost efficiency | 1 | 1 |
| Disadvantage of public transport | • Walking to and from public transport | 12 | 14 |
| | • Inability to mobilise pace in public transport | 1 | 2 |
| | • Inability to carry loads | 1 | 1 |
| | • External factors e.g. bus timetable | 1 | 1 |
| Would still drive even if public transport improved | | 7 | 7 |
| Would use public transport more if it is improved | | 5 | 6 |
| Would use ride-share if it was more financially viable | | 4 | 6 |
| Prefers public transport as it’s adequate for my needs | | 1 | 1 |

Study 1 results



Self-reported difficulties associated with driving

Performance in the driving task

Participants were questioned about the challenges they experienced with the tasks involved in preparing to drive and with driving. Twenty-eight statements discussed the discomfort and pain flare-ups caused by prolonged sitting and remaining in a static position, which is required for driving.

“Only the sitting for long periods of time in the car becomes an issue with my back.” (F52)

“Just shorter trips now, I just can’t really be in the car that long.” (M53)

Nineteen statements related to finding it challenging to twist to look over the shoulder for safety checks, and to reverse. Therefore in some cases compensated for by complete reliance on mirrors.

“It would be turning sometimes with my neck to look right over my shoulder, you know to look when you are changing lanes. Shoulder checking to look right, it is probably the biggest, biggest problem I have noticed. To give way, to change lanes. Like not constantly. I do remember many, you know, many times when my neck has been sore....” (F43)

Fourteen statements indicated self-awareness about pain-related mood changes, where participants reported feelings of agitation, impatience, low mood, fatigue, stress, anxiety and anger. Participants broadly reported these feelings translated negatively to their on-road behaviour while driving and impacted their decision-making capacity. For some, the effect of these feelings was compounded by the amount of time spent on the road and the traffic patterns (e.g. rush hour).

“Sometimes my pain is bad, and I will become more irritable and yeah might not be like the safest driver. I could probably become a bit pushy.” (F33)

“The more I drive, the more stressed I become, the more fatigued I become, so I become less patient. So, yes, it very much does affect my driving.” (F38)

Thirteen statements raised concerns about the impact of chronic pain on cognition, particularly level of concentration while driving. Participants noted slower reaction times during high demand traffic situations, especially after a long day or when experiencing high levels of pain.

“I have been a lot more aware, and I have had to slow down. Like I drive 10km always under the speed limit...I have to concentrate a lot harder. My reaction time is a lot slower than it used to be.” (M64)

“Just the concentration side of it. You gotta be alert all the time, and sometimes your concentration level drops because you fight the pain constantly.” (M61)

In addition, participants reported challenges with performing basic vehicle maintenance and loading/unloading items from the vehicle.

“... I guess the things it impacts me with is changing tyres, or putting air in the tyres, maintenance of the car with the bending. I get my partner to do that.” (F36)

“...Yeah, putting stuff in the car. Yeah, I have to be careful about how much I lift, getting things in and out of the car...” (F33)

Three participants stated weather conditions impacted driving ability. In these instances, they noted the necessity to adjust their seated position (e.g. leaning forward) to accommodate for reduced vision during rain and fog, which aggravated their back pain.

“Heavy rain. Or fog, where the car is misting up, you tend to lean toward the steering wheel more so that puts more stress on the back ...” (M63)

One participant expressed challenges with altered sensation in their arm, which required them to compensate with a stronger grip on the steering wheel for control. In addition, another participant reported the force required to brake could trigger the onset of pain.

Consequences of driving

Twenty-three statements largely indicated pain flare-ups after driving that affected other activities; in particular overall quality of life domains, because of consequently decreased participation in other required and valued activities.

“...I’m usually in a lot of pain afterwards, and I need a lie down... Well, like I guess anything that involves sitting or standing, socialising.” (F33)

Moreover, one participant reported that driving promoted mental exhaustion and prevented engagement in cognitively demanding activities afterwards, while seven participants stated pain flare-ups due to driving can impact their engagement in even simple activities, and in cases render them inactive for a length of time.

“I get home and have chores to do. I can’t and don’t feel like I can walk around the house and do it.” (M24)

Fourteen statements discussed pain flare up’s impacting negatively on mood and impulse control. Participants noted feelings of aggression, agitation, anxiety and depression.

“I think it causes a bit of anxiety and stress. Because it’s like it’s continuous and it affected my ability to go back to work as well. Like, I couldn’t go back to work in Brisbane because I can’t drive. ... you know, it causes, I think, depression to be honest.” (F38)

Study 1 results

“Yeah, definitely my mood. When you are experiencing a lot of pain you can’t possibly be in a good mood...” (F48)

Participant’s also mentioned that one of the negative consequences was driving avoidance, which in turn impacted on social engagement.

“Yes, it affects my ability to work, my enjoyment in life, my relationships... It is hard for the people around me too, like my wife, to see me suffer. My friends also see me suffering, especially when I get those peaks of pain. It’s also I don’t like to be seen suffering, so it’s self-image, I don’t like others to see that pain...” (M56)

Finally, adverse effects of prolonged driving led individuals to seek additional health care input.

“...it will cause my back to seize up and then I am in pain and I will have to go to the chiropractor.” (F68)

Self-reported strategies to manage driving difficulties

Accept the impact of chronic pain and make changes in life

Two participants reported that driving was essential to uphold vocational or family commitments, and as such they had limited flexibility to change their driving patterns.

“In my work ... you’ve got to do what you have to do, so you’ve got no choice... Whereas in private life, if I don’t feel like going somewhere...and I’m under no pressure to do that...” (M56).

“I have to pace myself and decide, you know how much of any given activity I can do in any given day.” (F58)

Self-regulation strategies

Participants discussed self-management and self-regulation strategies used to compensate for the challenges they experienced due to their pain condition while driving. Forty-eight statements referred to pacing and postural adaptations to prevent pain flare-ups while driving. Participants discussed breaking up their journey, taking stretch breaks and using add-on back supports to increase comfort while driving.

“If I have to do a long trip I’ll try and pull over and stop somewhere on the way, anything more than 20 minutes.” (F33)

Twenty statements referred to requesting support from family members to drive, or having a spouse accompany them for added support.

“I just have someone beside me as often as I can. My wife is sitting beside me so then if I do something or have missed something, and then I guess I have the opportunity to assess my behaviour.” (M64)

Eleven statements considered intrinsically increasing attentiveness and vigilance on the road, and the use of relaxation techniques such as deep breathing, mindfulness and positive thinking to improve attention and focus on the driving task.

“I use breathing techniques and stretching before I go into the car. Being mindful of my surroundings, keeping my attention focused. It’s all a bit trivial but the breathing does help you stay focused.” (F50)

A small proportion of participants stated driving less frequently and for shorter distances.

“Definitely driving shorter distances.” (M63)

A number of participants reported driving under the speed limit as a precautionary measure, anticipating lane changes by checking mirrors more often and well in advance, and performing safety checks by physically turning their body around rather than twisting their neck.

“If I take the medication, I will drive slower and leave more distance in front when driving.” (M58)

“Sometimes if I have to stop and turn my head, like I will physically turn my body around rather than turn my head all the way around.” (M64)

Table 2b. Themes and subthemes of interviews with individuals with chronic pain

| THEMES AND SUBTHEMES | CODES | NO. OF PARTICIPANTS | FREQ. OF STATEMENTS (%) |
|--|--|---------------------|-------------------------|
| Self-reported difficulties associated with driving | | | |
| Performance in the driving task | • Prolonged sitting in a car flare up pain/ Uncomfortable car seat | 20 | 28 |
| | • Twisting for shoulder check and reversing | 14 | 19 |
| | • Cognitive difficulty/slower reaction time due to pain | 8 | 13 |
| | • Difficulties with car maintenance and loading the car | 6 | 6 |
| | • Getting in and out of the car | 3 | 6 |
| | • Difficulties driving in heavy rain/fog flares up pain | 2 | 3 |
| | • Feels uncomfortable sometimes and gets impatient with other drivers | 2 | 3 |
| | • Gripping steering wheel | 1 | 1 |
| | • Braking hard can flare up pain | 1 | 1 |
| Consequences of driving | • Driving can flare up pain and negatively impact on other quality of life domain | 14 | 23 |
| | • Driving can flare up pain and negatively impact on the mood (e.g. more prone to aggression/ gets anxious about having to react suddenly) | 10 | 14 |
| | • Driving can flare up pain and impact on other simple tasks | 7 | 7 |
| | • Negative effects of pain while driving lead to driving avoidance, impacting on social activities | 4 | 6 |
| | • Driving can lead to mental exhaustion and prevent engagement in cognitively demanding activities afterwards | 1 | 1 |
| | • Driving can flare up pain and increase health care utilisation | 1 | 1 |

Study 1 results



Five statements referred to the use of driver assistance systems (e.g. cruise control to adhere to the speed limit and a blind spot detector to help with shoulder checks), one referred to driving an automatic to reduce leg-work required while driving, and one to purchasing a higher vehicle to ease transfers.

"In long distances, I use cruise control, so I can move my foot around more often and I don't have to have it stuck to the accelerator and I can maintain the speed limit..." (F68)

"... I drive an automatic most of the time, so I just straighten [my leg] when I don't really need it." (M58)

"Well, that's why I bought a car that was a little bit higher to make that easier." (F52)

In addition, two participants reported using a TENS (transcutaneous electrical nerve stimulation) machine – method of pain relief through the application of superficially placed electrodes – to minimise pain while driving.

"I bought a TENS machine. I used to use this quite a bit when driving and in the plane, for all long journeys to avoid taking medications." (F48)

One participant reported using distraction techniques such as listening to loud music and singing along to avoid thinking of the pain.

"I guess I would play music really loudly because I'm distracted by singing the song as I did last night." (F28)

Avoidance strategies

Participants also discussed the use of avoidance strategies to compensate for their pain. Twenty statements broadly stated avoiding driving when feeling unwell or during pain flare-ups.

"If I am in pain, I just say I don't want to drive, and I will avoid driving totally." (F68)

F68 also reported avoiding conversing with passengers in order to maintain focus on the road.

"That responsibility of someone else would stress me. I would avoid going with people who talk a lot. The friends that I take, I would just say look I got to watch the road. In the past it never bothered me, I could watch the road and talk but I have to be more conscious of watching the road now." (F68)

Fourteen statements noted avoiding driving during peak traffic hours, on unfamiliar roads, during the rain and at night.

"Stress increases my pain, it makes it worse. That's why I avoid peak hour traffic." (M56)

A small number of participants avoided lane changes and car parks to increase convenience.

"I just stick to the one-lane as well, as much as I can, so I don't really swap lanes like I used to because one is moving faster, you know, so then I have to be stuck in that slower flow." (F67)



“
Stress
increases my
pain, it makes
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traffic.

”

Study 1 results



Views on the impact of chronic pain on safe driving behaviour

Attitudes towards safe driving

Participants discussed their views on the impact of chronic pain on safe driving behaviours. Six statements referred to conscious decision-making when driving, out of concern for the other road users.

“I was being careful and responsible because I don’t want to kill or injure anyone else either, having been through what I’ve been through due to someone else’s negligence.” (M56)

In contrast, another participant believed there to be a correlation between safe-driving and length of time as a driver.

“No, not for someone like me. I have been driving so long that it is second nature to me. I know my own reaction time and changes since I have had chronic pain. Maybe for someone who hasn’t been driving for very long.” (F58)

Fifteen statements indicated the degree of confidence in conducting self-assessments in relation to individual ability to drive based on physical, cognitive and emotional cues.

“If I am feeling dreadful, I will not get into the car to drive.” (F68)

Two participants reported not regularly self-assessing their safety to drive, irrespective of their current state.

“Well, if I am honest, I will say I don’t. I don’t think about whether I’m safe or not, I just drive.” (F38)

Nine statements related to previous crashes/near-misses which they were involved in, however, participants attributed these situations to being age-related or the fault of others and/

or related to the road conditions at the time.

“As you get older your reaction speed is affected, but I don’t think it has anything to do with the pain.” (F68)

“I was driving on a rural road, the location and bad roads caused it.” (M44)

Perceived effect of chronic pain on driving safety

Participants discussed the impact of chronic pain on safe driving. Four participants raised concerns regarding safety, specifically near-misses while lane changing. This was a consequence of reliance on their mirrors and the inability to physically check their blind spot.

“That is a case of people speeding up when changing lanes; you know I saw a gap and go to change lanes and someone cut me off, that sort of thing. Then there was merging as well. Two occasions, one where there was a short merge, the final one was where someone ran the red light and I umm...had to brake very suddenly. After that, I had to pull over and let someone else drive because my back was out.” (M63)

Furthermore, four participants noted the impact of pain on cognitive factors, such as decision-making and judgement, to be a contributing factor in driving crashes, and inattention due to their pain increased their tendency to miss road signs and signals.

“So, the thing is with the chronic pain, you lack good sleep and you are constantly fatigued then. Your concentration also is not 100% because of the pain, and your body is limited compared to before. So, it is just different factors to be honest.” (F38)

Table 2c. Themes and subthemes of interviews with individuals with chronic pain

| THEMES AND SUBTHEMES | CODES | NO. OF PARTICIPANTS | FREQ. OF STATEMENTS (%) |
|--|--|---------------------|-------------------------|
| Self-reported strategies associated with driving | | | |
| Accept the impact of chronic pain and make changes in life | <ul style="list-style-type: none">• Can’t avoid driving due to work and family responsibilities | 10 | 10 |
| Self-regulation strategies | <ul style="list-style-type: none">• Uses pacing strategies/postural adaptations to prevent pain flares up while driving | 19 | 48 |
| | <ul style="list-style-type: none">• Asks others to drive | 13 | 20 |
| | <ul style="list-style-type: none">• Tries to be more attentive and vigilant | 8 | 11 |
| | <ul style="list-style-type: none">• Uses driver assistance systems i.e. cruise control to adhere with speed limits, blind spot detectors to help with a shoulder check | 4 | 4 |
| | <ul style="list-style-type: none">• Relaxation strategies to assist with the cognitive aspect of driving | 4 | 5 |
| | <ul style="list-style-type: none">• Drives less frequently/shorter distances | 3 | 4 |
| | <ul style="list-style-type: none">• Drives slower | 3 | 4 |
| | <ul style="list-style-type: none">• Previously used TENS machine while driving to minimise pain | 2 | 2 |
| | <ul style="list-style-type: none">• Uses the whole body to perform a shoulder check | 3 | 3 |
| | <ul style="list-style-type: none">• More frequent use of mirrors to avoid shoulder check | 1 | 2 |
| | <ul style="list-style-type: none">• Buying a higher car to make getting in the car easier | 1 | 1 |
| | <ul style="list-style-type: none">• Drives an automatic car most of the time | 1 | 1 |
| | <ul style="list-style-type: none">• Listen to loud music and sing to distract oneself from pain | 1 | 1 |
| Avoidance strategies | <ul style="list-style-type: none">• Avoids driving in a high volume of traffic/unfamiliar roads/at night | 15 | 20 |
| | <ul style="list-style-type: none">• Avoids driving during pain flare-ups or when feeling unwell | 13 | 20 |
| | <ul style="list-style-type: none">• Avoids certain carparks/takes more time when reversing/changing lanes | 4 | 4 |



“
The medications have done a number on my memory as well, which is quite scary. I get very distracted easily, but my wife is always beside me...

//////////////////// ”

Driving concern raised by family members

Nine statements referred to the role of family members influencing their decisions about choosing to drive.

“My wife, she told me to reduce driving... she felt I was disoriented and had low concentration, also that I was always fatigued.” (M53)

“It is a decision my husband and I made together, that I should reduce driving, so no more going to work in Brisbane or searching for work there, where I used to work before.” (F38)

Perceived effect of medication on driving

Participants discussed their perception on the effects of medication on driving. There were twelve statements about medications not impacting their ability to drive. Some participants reported having developed a tolerance, therefore, the medications have minimal affect.

“No, I don’t think the medications affect my ability to drive.” (M58)

However, eleven statements reflected some participants were concerned about medications affecting their cognitive capacity to sustain attention and focus, as well as noted the impact on physical coordination.

“The medications have done a number on my memory as well, which is quite scary. I get very distracted easily, but my wife is always beside me...” (M53)

Furthermore, fourteen statements suggested that some participants refrained from driving when experiencing side-effects from higher doses or strength of medications.

“Umm...if I have taken too much medication during the day, then I wouldn’t drive that day.” (M64)

Twelve statements raised by seven participants discussed having awareness regarding the effects of medication on driving. These participants reported the ability to discern whether the side-effects of a particular medication impaired their driving ability by evaluating physiological signs, and their pain levels.

“Just as soon as I get in my car, I feel light-headed and dizzy. So, I know I can’t drive so my wife drives.” (M53)

One participant raised concerns regarding the compounding effect of medications and the unpredictable nature of pain impacting on their driving safety.

“So, I was taking the boys to school, and I got that really heavy head feeling, and I swerved out of the lane and nearly into the island in the middle of the road and had that fuzzy feeling when I turned my head. So, I pulled into Macca’s and I rang my husband and said I can’t finish the drive. So, he came, picked us up, and then we went and got the car later... Like I can’t be certain what medication it is from because I take a whole lot of medications as well apart from the pain ones.” (F43)

One participant notably utilised alcohol consumption as an analogy to describe plausible impaired judgment relating to medication effects on cognition.

“I’ve taken all these tablets so I can’t really say well you know, like what do I know, like an alcoholic saying I have had these drinks and I feel fine.” (F43)

Another participant stated the interaction with medication and alcohol enhanced the medications side-effects.

“But I don’t experience drowsiness from the medication anymore, the only thing is the interaction with alcohol. For example, if I drink two beers, which isn’t much and wouldn’t impact on one’s ability to drive, and for me it does. It is just kind of a compounding effect with the medications. It makes the beer work better.” (M56)

“
I don't take the stronger medications I got prescribed, because I'm the sole driver of my kids.

//////////////////// ”

Finally, two participants reported ceasing medications that impact upon their driving ability.
“I don't take the stronger medications which I got prescribed, because I'm the sole driver of my kids. So, I stopped it for now. I rather just not take them.” (F36)

Experience with the health care system in relation to driving with chronic pain

Driving difficulties not adequately addressed by health care system

Seventeen statements were related to driving challenges not being adequately addressed by the health care professionals along the continuum of participant's rehabilitation journeys. Participants stated that driving was mainly brought up in the context of a medical procedure or if the patient raised concerns about his or her driving.
“I don't think anyone has asked me about my driving, so I would say no.” (F38)

Driving difficulties haven't been addressed because it doesn't affect me

Five participants reported driving challenges were not addressed by health care professionals because it was not pertinent to their needs.
“It's not an issue because the pain doesn't affect my driving, and it has never got that bad.” (F60)

Table 2d. Themes and subthemes of interviews with individuals with chronic pain

| THEMES AND SUBTHEMES | CODES | NO. OF PARTICIPANTS | FREQ. OF STATEMENTS (%) |
|---|---|---------------------|-------------------------|
| Views on the impact of chronic pain on safe driving behaviour | | | |
| Attitudes towards safe driving | • Feels able to confidently assess if it is safe to drive using physical and emotional cues | 12 | 15 |
| | • Attributed previous crashes/near-misses to the fault of others | 8 | 9 |
| | • Uses safe driving strategies out of concern for other road users | 4 | 6 |
| | • More likely to attribute cognitive difficulties in relation to driving with age | 2 | 2 |
| | • Does not regularly assess if it is safe to drive regardless of how one is feeling at the time | 2 | 2 |
| | • Ensures safety out of concern of losing licence as a main source of income | 1 | 1 |
| | • Believes does not need assistance to overcome barriers to safe driving | 1 | 1 |
| | • Still drives even when feels someone else would be better driving | 1 | 1 |
| | • Attributes previous crashes to the road condition | 1 | 1 |
| | • Believes the impact of pain on cognition can be a contributing factor in driving crashes | 3 | 3 |
| Effect of chronic pain on driving safety | • Near-misses when merging in traffic/unable to shoulder check/identify the blind spot | 1 | 4 |
| | • Tendency to speed/cross red traffic lights due to lack of attention | 2 | 2 |
| | • Believes if judgement is affected then it is unsafe to drive | 1 | 1 |
| | • Less likely to stay in the centre of the road | 1 | 1 |
| | | | |
| Driving concern raised by family members | | 3 | 9 |

Study 1
results

“
...my medications,
they have told me
to be cautious and
not drive if I am not
feeling okay.

”

Driving difficulties previously addressed

Participants generally reported improved pain management through multidisciplinary team input as a part of their rehabilitation journey. As a result, they could participate more readily in their chosen activities such as driving. Notably, 26% of participants reported GPs provided advice regarding medication warnings and operating a vehicle.

“About my medications, they have told me to be cautious and not drive if I am not feeling okay. They always say, ‘be careful’.” (M56)

One participant raised concerns about driving and the GP encouraged self-assessment in relation to medication and driving.

“I have brought it up a few times with my doctor, and he’s come back and told me that I am intelligent enough to make my own assessment, and I guess also basing it off my driving record... and it’s been around the medications.” (M64)

Table 2e. Themes and subthemes of interviews with individuals with chronic pain

| THEMES AND SUBTHEMES | CODES | NO. OF PARTICIPANTS | FREQ. OF STATEMENTS (%) |
|--|---|---------------------|-------------------------|
| Perceived effect of medication on driving | • Doesn't drive when experiencing the side effects of medications | 9 | 4 |
| | • Doesn't believe medication effects driving | 9 | 12 |
| | • Some medications effect cognition/attention/ability to focus/coordination | 8 | 11 |
| | • Aware and can assess the effect of medication on driving/can cope with side effects | 7 | 12 |
| | • Doesn't take medication/stronger medications before driving | 6 | 8 |
| | • Previously medication effected driving, but I am used to it now | 5 | 9 |
| | • Alcohol consumption can enhance the effect of medications | 1 | 3 |
| | • Unable to accurately judge how much medication effects cognition | 2 | 2 |
| | • Valium negatively impacts on driving ability | 2 | 2 |
| | • Tramadol can impair vision and level of patience | 1 | 1 |
| | • Unpredictable nature of medication/combination of medications | 1 | 1 |
| Experience with the health care system in relation to driving with chronic pain | | | |
| Driving difficulties not adequately addressed by the health care system | | 13 | 17 |
| Driving difficulties previously addressed | | 6 | 8 |
| Driving difficulties haven't been addressed because it doesn't affect me | | 5 | 6 |
| Has not discussed driving difficulties with health professionals, fear of limiting driving | | 3 | 4 |

Study 1 results



Has not discussed driving difficulties with health professionals, fear of limiting driving

Participants were asked if they would raise driving-related concerns with their health care providers and four statements referred to fear about imposed driving restrictions or the possibility of losing their licence.

“Umm [pause] look probably not. But it’s hard you know, in saying that like you don’t want to be restricted to drive, you know. I guess [pause] but yeah, like I have said to you, I have had times where my medication affected and I had to pull over, whether it was my pain meds or other medications I can’t be sure. But I can’t be the only one you know.” (F43)

Recommendations for improving driving behaviour in individuals with chronic pain

Assisting individuals with chronic pain to overcome barriers to driving

Twelve statements discussed the importance of approaching the conversation about driving during consultations with health professionals, among support groups or pain rehabilitation programs. Participants expressed that discussions about driving would provide them with the opportunity to reflect on their potential challenges, as well as a chance for health professionals to provide tailored strategies to overcome any challenges they may experience with driving. In addition, participants shared their views on accessing the community more often through alternative means, such as carpooling, if provided the opportunity to network and create connections among those sharing similar experiences.

“No one has sat down and asked me these kinds of questions; this is the first time I have had to analyse and think about my driving history in such detail. And that could be something that health professionals could do, is ask questions like these.” (M56)

“Maybe just asking patients if their pain affects them when they are driving, and then talking about strategies to how you can manage that. I guess stopping, taking regular breaks on a long journey and maybe something you can put in your seat to make it more comfortable.” (F33)

Participants conveyed the importance around education on the influences of chronic pain on their physical function in relation to their driving, as well as the benefits of personalised occupational therapy and physiotherapy recommendations on vehicle ergonomics.

“Well what I would certainly recommend is the education around whatever pain it might be that influences driving; to really educate how our positioning is, how someone sits in their seat, you know, how far away that steering wheel, where they position their arms, all those things you know. Rather than saying, ‘oh you know you can’t drive’, they are working on ways to, you know, to manage your chronic pain and driving, and provide you with the tools to continue to facilitate driving.” (F48)

“
No one has sat down and asked me these kinds of questions; this is the first time I have had to analyse and think about my driving history in such detail... that could be something that health professionals could do, is ask questions like these.

”

Study 1 results



Strategies to improve judgment about safe driving

Participants were asked about strategies they used to support self-assessment about road safety. Two participants reported on the importance of self-awareness and cognizance about strategies to improve individual judgement about safe-driving.

“Yeah, otherwise if you suffer from chronic pain you have to know if you are safe or not, and how safe others are from you and otherwise just have someone else drive you.” (M64)

Belief that more could be done to address medication and driving

Three participants reported that increased awareness around medications and the impact they have on driving was required. Moreover, clarity and relatable comparisons to other consumables such as alcohol would provide more understanding about the influence of common chronic pain medications on driving.

“I think making us aware of the impacts the medication can have...Like I don't really know... Like they're bringing all these tests for illegal things, but sometimes it's that people think they're safe driving because it's a prescription medication. But I think that not many would consider a car as operating heavy machinery, you know. I just think it can be addressed overall. As a note I never ever, never ever had a doctor say to me, 'This medication might impair your driving'. Never!” (F52)

Educational materials

Participants were asked about their thoughts on educational materials and resources. Five statements by participants indicated that awareness and discussion on what is available would be beneficial. In addition, participants stated that education or an assessment on physical strategies relating to optimal biomechanics would be useful to optimise their driving performance.

“I think there is a place for them, possibly once you are stronger. Sitting with you in the car, checking your posture, your ability, like my neck doesn't turn very well, so checking things like that to do with driving.” (F67)

Participants also expressed views on educational pamphlets as a stand-alone may be insufficient, but rather should be used as a supplementary to functional assessments or to frame discussion.

“I think they should be a supplement to the functional assessment. Some discussion and then adding on by providing a leaflet. I think people who are in true chronic pain will read the material because they are all looking for something that will help. I think when someone is wanting to get back driving, or their goal is being able to drive with minimal pain, I think anything would be good to help them. I just feel the more hands-on functional assessment can be tailored for that person according to their pain condition.” (F48)

Table 2f. Themes and subthemes of interviews with individuals with chronic pain

| THEMES AND SUBTHEMES | CODES | NO. OF PARTICIPANTS | FREQ. OF STATEMENTS (%) |
|--|---|---------------------|-------------------------|
| Recommendations for improving driving behaviour by individuals with chronic pain | | | |
| Assisting individuals with chronic pain to overcome barriers to driving | • Bringing up driving during consultations and support group | 7 | 12 |
| | • Education around the influence of pain on driving | 2 | 5 |
| Strategies to improve judgment about safe driving | | 2 | 2 |
| Belief that more could be done to address medication and driving | | 3 | 4 |
| Educational materials | • Provide educational materials and resources | 4 | 5 |
| | • Education on physical strategies to manage driving | 4 | 5 |
| | • Believes treatment should entail more than just providing a handout | 2 | 2 |
| Vehicle adaptations/Driver Assistance Systems (DAS) | • Believes blind spot and reverse cameras helpful | 20 | 37 |
| | • Affordable vehicle adaptations, financial assistance to get modern cars | 7 | 8 |
| | • Believes don't need DAS as a professional driver, can be annoying | 3 | 7 |
| | • Doesn't trust DAS | 2 | 2 |
| | • Believes technology that assists with pacing would be beneficial | 1 | 1 |
| Transport authorities | • Believes in the potential role of access to defensive driving course and simulated driving to build confidence/assisted functional driving assessment | 14 | 16 |
| | • Slow driver sign | 2 | 3 |
| | • Community-based strategies/policy | 1 | 1 |

Study 1 results



Vehicle adaptations/ Driver Assistance Systems

Participants were asked about the benefits and experiences they had with vehicle adaptations and driver assistance systems in modern cars. Seven participants agreed that such technologies or adaptations could enhance their experience with driving, but they noted that the high cost and lack of financial assistance were commonly perceived as barriers for access.

"I think probably most people probably need financial assistance more than anything to get more modern cars that are easy to drive, and to switch from manual to automatic for instance and that sort of thing, so I don't know whether the medical professionals can really do anything about that." (F58)

One participant expressed views on the potential benefits of technology providing prompts to assist with activity pacing in relation to driving.

"I think one to add on would be something like a fit bit. For example, my fit bit will tell me when I need to get up and stretch. So, if there was something for driving like that, so people knew they had to take a rest break." (F48)

Participants were asked about their thoughts and experiences on a range of driver assistance systems available. Thirty statements indicated the general usefulness of automated features within vehicles. Participants expressed the helpfulness of reverse cameras and blind-spot detectors as supports in

relation to their pain condition.

"I think the blind spot and reverse cameras can help for sure with anyone who has back problems and gets really sore." (F48)

Transport authorities

Participants expressed views on how they believed transport authorities could be involved with improving road safety for drivers with chronic pain. Some examples include providing access to defensive driving courses to improve confidence, or simulated driving experiences as an alternative to functional driving assessments.

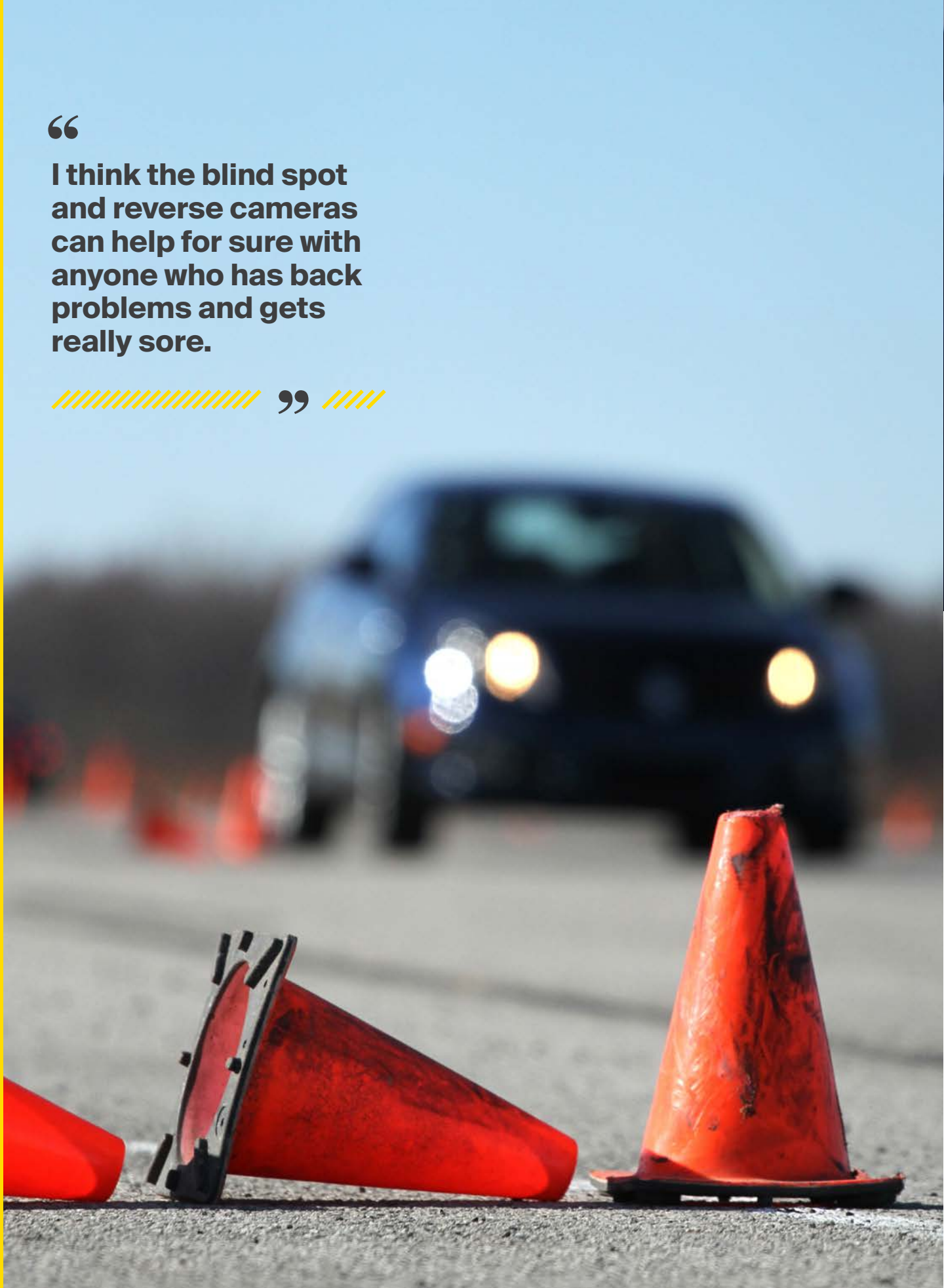
"I think even defensive driving could help improve confidence for people with chronic pain. I do think people who drive with chronic pain are nervous. I think with modifications or classes people would get more confidence and help them with their anxiety. This way they can drive even further." (F50)

In addition, one participant suggested that Transport Main Road could have a warning sign for drivers with chronic pain to use, indicating that they may be slower than the regular flow of traffic.

"...So, I was thinking it would be good to have a sign that says slow driver, that way people are more likely to slow down and not harass you. So, if the department of transport could have that for people with chronic pain that would be helpful. I think that would be helpful for others too and make it safer." (M56)

“
I think the blind spot
and reverse cameras
can help for sure with
anyone who has back
problems and gets
really sore.

”





Summary

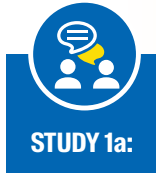


Study 1a: Health professionals working with individuals with chronic pain

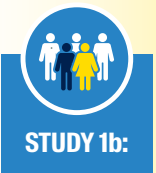
The overall study findings are summarised below:

- Seventeen individuals participated in Study 1a, including occupational therapists (47.1%), pain specialists (23.5%), GPs (17.6%), a clinical psychologist (5.9%) and a researcher (5.9%).
- Overall, the health professional participant group agreed on the importance of driving within Australian culture. Driving was broadly discussed as a form of independence and accessibility to engage in the activities of daily living.
- When sharing their views on the impact of chronic pain on driving, a recurring theme was that pain is a multi-faceted phenomenon of great variability. Therefore, the effects of chronic pain varied vastly from person to person, and the consequences of pain on driving were classified into four categories; physical, cognitive, mental health and the effects of medication on driving.
 - The physical impact of pain on the individual included exacerbated pain as a result of prolonged sitting while driving and reduced capabilities for shoulder-checking due to the restricted range of movement (e.g. neck).
 - Reduced cognition was emphasised as a consequence of the chronic pain experience, which may negatively impact driving. For example, participants stated that the sensation of pain could be a distraction in itself and could impact on maintaining sustained attention and having quick reaction times.
 - Patients' mental health was thought to impact on self-regulation of one's mood and inhibition control.
 - A noteworthy concern raised by participants was the complexity of polypharmacy and the effect of the medication, which varied person to person. To corroborate the concerns of participants, clinicians raised concerns regarding the high incidence of substance use disorders within the pain cohort, and the compounding effects of medication. Sleep apnoea was also of interest given the possibility of medications negatively affecting this condition. Globally, the side effects of medication use were reported to impair the cognitive functions required for safe driving.

Understanding the context



STUDY 1a:



STUDY 1b:

Methodology

semi-structured interview

Participants

Health professionals

Adults with chronic pain

Summary

“

The subjective nature of pain and the complexity of driving requires individualised treatment.

”

• Participants were requested to discuss their role in assessing and addressing driving difficulties within the pain cohort. Clinicians were grouped in three sub-categories; general practitioner (GP), multidisciplinary pain clinic, and community occupational therapy (COT) driving assessors. Participants described the GP's role as collecting comprehensive patient information on physical, cognitive, psychological and neurological conditions. However, driving would only be addressed if deemed a concern by the patient or family member, or if the GP had identified patient circumstances during their assessment that could impact driving. If identified by the GP, the person would be referred to a COT driving assessor for further assessment. Participants reported similarities between the GP's and the pain clinic's role in information gathering, however, the pain clinic had the capacity to provide added specialised multidisciplinary assessment and input to the patient. Driving assessment referrals were infrequent and only occurred in the event the patient's concerns were out of the scope of the primary care clinician's responsibilities. The COT driving assessor's role was explained

as providing a comprehensive on and off-road assessment in order to formulate a holistic picture of the patient's driving ability. Based on the outcomes of the assessment, patients were provided with strategies, driving lessons and recommendations for modifications.

• To address driving-related concerns within the chronic pain cohort, health professionals worked with patients to address the physical, cognitive and emotional aspects related to safe driving. The health professionals would provide several self-regulation strategies for patients according to the challenges identified. These included utilising activity pacing principals for driving, providing biomechanical and postural adaptations, provision of cushions and vehicle modifications, and coaching drivers to adopt an anticipatory scanning method for early identification of road hazards. In addition, clinicians encouraged patients to be cautious with medications, in particular new medications or a change in dosage. If driving concerns were out of their scope of practice, patients were referred to their GP, a driving assessor, or a pain management clinic. Furthermore, a small number of clinicians aimed to educate patients on chronic pain and utilised interviewing strategies to increase patient awareness and insight regarding the challenges they may be facing.

• A number of barriers were identified in relation to adequately assessing driving among the chronic pain cohort. The majority of participants stated there was a lack of clear guidelines available for clinicians to refer to, as well as definitive referral pathways for driving assessment services. In addition, participants reported an absence of driving as a criterion on current assessment and outcome measure tools. They also queried the validity of standalone off-road cognitive screens and their correlation with a patient's ability to drive.

• The subjective nature of pain and the complexity of driving requires individualised treatment. As a result, it was reported to be challenging to assess within a short time frame. In addition, participants raised concerns about the possibility of their patients avoiding discussing their challenges related to driving, given the stigma around possibly losing their licence. Clinicians noted that it was challenging to provide patients with recommendations to access alternative means of transport due to financial barriers and inadequate access to public

transport for many of their patients. Patients' financial barriers also hindered clinicians from providing referrals to private driving assessors if required.

• Participants provided a few recommendations to improve the assessment and management of driving concerns among the chronic pain cohort. Most participants highlighted the importance of having clear and concise guidelines for driving assessment and treatment plans. They reported on the value of collaboration between pain clinics and GP's to ensure continuity of care for the patients. Clinicians noted the importance of training and upskilling in order to better address driving-related concerns and understand the impact of medication on driving behaviour.


• The role of the patient's family was deemed important to assess a patient's capacity to drive. Participant's spoke about the need to provide education to the support network of the individual. Additionally, a checklist to assess physical, emotional and cognitive components would help the person with chronic pain and/or the family member make informed decisions regarding their safety to drive.

• Addressing driving was a sensitive topic for patients. As a result, clinicians suggested raising awareness on the impact and to take a positive approach when broaching the topic. Participants also discussed the potential for improving assessment approaches with technologies such as virtual reality and driving simulators. In addition, more research evidence relating to driving behaviour within the chronic pain cohort was suggested as valuable for enhancing the clinician's knowledge-base in addressing this complex issue.


• Participants also spoke about the funding issues within public health, which impact on the clinician's ability to address the multiple challenges faced by chronic pain patients. Furthermore, co-operative relationships between health care providers and transport authorities would boost identification and timely treatment for patients at risk of unsafe driving behaviour.

• The value of driver assisting technologies was thought to enhance driver safety and mitigate common challenges within this patient cohort.

Understanding the context



STUDY 1a:



STUDY 1b:

Methodology

semi-structured interview

Participants

Health professionals

Adults with chronic pain

Summary



Study 1b: Individuals experiencing chronic pain

The overall study findings are summarised below:

- Twenty-three individuals participated in Study 1b; including adults who hold a valid Australian Driver licence, had persistent non-cancer pain for at least three months, and had not been diagnosed with a condition affecting the vestibular, central nervous system, or visual acuity.
- Participants expressed their views on preferred transport modalities, challenges experienced with the task of driving, impact of chronic pain on driving, strategies used to overcome difficulties associated with chronic pain and shared interactions with the health care system. Participants also provided recommendations for areas perceived as requiring attention to improve driving safety for those with a chronic pain condition.
- Driving was viewed as a form of independence, providing individuals with a sense of autonomy and control. Participants generally had a preference to continue driving for the added convenience, despite the pain flare-ups they would experience as a result. Public transport and ride shares were occasionally used by most of the participants; however, those modalities came along with challenges such as increased time requirements, lack of routes to preferred locations and participants' physical restraints creating a barrier (e.g. walking to/from bus stop) for access.
- Most participants stated that prolonged sitting resulted in pain flare-ups. In addition, twisting of the neck and back to check over the shoulder for blind spots or to reverse was also difficult. Participants also noted that their pain impacted their cognitive function. Other reported impacts of pain on driving included reduced attention and focus, and slower reaction time. Furthermore, participants noted mood-related changes such as agitation, frustration, impatience and anger towards other road users. A small number of participants also queried their judgement and decision-making due to the impact of pain and medication.
- After driving participants increasingly reported lower satisfaction in several life domains. For example, participants were unable to engage fully in household tasks, socialisation

or have a restful sleep. Consequently, lower engagement in meaningful activity also impacted mood. Participants reported increased agitation, aggression and frustration, which at times impacted their relationships.

- Most participants were resourceful enough to use self-regulation strategies, either self-taught or acquired through rehabilitation programs. These strategies included asking family members to drive or accompany them, utilising pacing strategies to break up the journey, adding postural supports to increase comfort, using driver assistance systems such as reversing cameras, cruise control and blind-spot monitors, and using mindfulness and distraction techniques to overcome the pain. In addition, a small number of participants would scan more frequently, maintain larger spaces between cars and use whole body movements to perform safety checks.
- Participants also utilised avoidance strategies; these included avoiding driving due to pain flare-ups, unnecessary lane changes, high volume traffic, heavy rain and night-time driving. Notably, a group of participants demonstrated acceptance of the limitations imposed by their pain and made lifestyle changes including reducing the length of time they drove.
- Attitudes towards safe driving behaviour were discussed, and more than half of the participants reported confidence in their self-assessment by monitoring physical and emotional cues. A smaller number of participants did not feel that pain negatively impacted their driving safety and did not routinely check whether it was safe for them to drive. However, all participants expressed interest in gaining more awareness about tools and strategies they can use to gauge their driving safety. Four participants raised concerns about the potential impact on other road users and were mindful of their capacity before driving.
- There were mixed perceptions of the impact medications had on driving. A large portion of the participants reported self-awareness regarding potential side-effects attributable to their medications. Side-effects were mostly cognitive and included fatigue, reduced concentration and sustained attention. In addition, participants reported diminished coordination and vision issues. A small number of people reported Tramadol and Valium impaired driving capacity. As

such, participants discussed management strategies to overcome side effects such as reducing the dosage, avoiding driving while taking stronger medications or pulling over if required. Participants also reported the unpredictable nature of the side-effects, which may manifest as a sudden onset of drowsiness while driving, for example.

- Most participants reported that health professionals inadequately addressed driving. Discussion about driving concerns or impact of medication were rarely initiated by health professionals during medical consultations or in pain rehabilitation programs. A small number of people believed their concerns about driving difficulties would be addressed if it was pertinent to them. Nonetheless, most participants were in favour of having driving addressed as part of their rehabilitation, given its importance.
- Participants broadly discussed recommendations to improve driving assessment and interventions for people experiencing chronic pain. They stressed the importance of receiving practical and written education materials and resources through rehabilitation groups or treatment sessions. In addition, participants discussed the importance of clinicians broaching the topic of driving in the context of their pain pathology and medications.
- Participants also believed that transport authorities could play a role in the assessment of driving safety in chronic pain individuals. One example was the formation of policies that recognise chronic pain among other chronic conditions that require regular assessment to maintain licensure with age. In addition, participants voiced interest in having access to defensive driving courses and simulated driving experiences as part of their rehabilitation. These strategies would serve to meet the requirements of both assessment and treatment.
- Most participants perceived many benefits to driver assistance systems, with the most commonly discussed being blind-spot monitors and reversing cameras. Access to funding was a barrier frequently noted by participants in accessing driver assistance systems or in-car modifications.

Understanding the context



STUDY 1a:



STUDY 1b:

Methodology

semi-structured interview

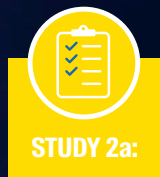
Participants

Health professionals

Adults with chronic pain

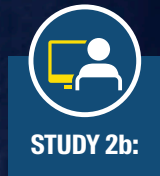
Study 2

Driving behaviours



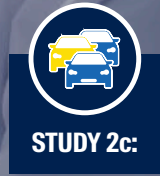
STUDY 2a:

Online survey



STUDY 2b:

Online hazard perception test



STUDY 2c:

Two-week driving logbook

Driving behaviours

Study 2 involved three phases of data collection. Australian drivers experiencing chronic pain (N=45) and a non-chronic pain or otherwise healthy drivers comparison group (N=45) participated in these three phases.

Participants in the chronic pain group were invited to participate if they met the following eligibility criteria:

- Were over the age of 18 years old and held a valid Australian Driver's licence.
- Drove at least three times a week in Australia and own a smartphone.
- Have experienced persistent non-cancer pain for at least three months.
- Have not been diagnosed with conditions affecting their vestibular, central nervous system, or visual acuity.
- Were able to read and write English.

Participants in the healthy control group were matched with the chronic pain group based on age and gender. They also fulfilled the following eligibility criteria:

- Were over the age of 18 years old and held a valid Australian Driver licence.
- Drove at least three times a week in Australia and own a smartphone.
- NOT have had persistent non-cancer pain for at least three months.
- Have not been diagnosed with conditions affecting the vestibular, central nervous system, or visual acuity.
- Were able to read and write English.

Participant recruitment was conducted via social media advertisements on various RECOVER Injury Research Centre platforms (i.e. the RECOVER website, Facebook, Twitter). Additionally, snowball sampling through flyer distribution facilitated recruiting a more representative sample. Interested prospective participants were requested to contact the research team by email/phone to clarify any queries regarding their participation in the study, as well as to ensure eligibility. If deemed eligible, they had a one-week cool-off period to consider their participation, before a team member requested informed consent.

Data collection of the study was conducted in accordance with the Australian Code for Responsible Conduct of Research (University of Queensland Human Research Ethics Committee, approval number 2019002720).

Study 2



Study 2a: Online survey

Method

Study 2a involved a quantitative cross-sectional online survey to identify driving behaviour in both chronic pain and non-chronic pain (healthy) participant groups in Australia.

Eligible participants were invited via email to complete an anonymous online survey that took approximately 30 minutes to complete. The survey included questions exploring the following areas of interest:

- Participant demographics which focussed on the factors known to influence cognitive function (i.e. age, gender, educational level).
- Driving experience (i.e. the number of years with a valid driver's licence, kilometres driven per year, number of kilometres driven per year since experiencing chronic pain, number of traffic crashes).
- Self-reported driving behaviour.
- Type of pain (i.e. intensity, duration, and localization of the pain). Survey questions were based on well-established scales.

Data Analysis

Data collected from the survey was processed using the Statistical Package for Social Sciences (SPSS) to conduct statistical analyses. Descriptive statistics were used to describe demographic data and general characteristic of the sample. To assess differences in self-reported behaviour variables between the two groups, an independent-samples t-test was conducted with alpha set at $p < .05$.

Result

Demographic characteristics of the sample

Ninety individuals participated in this study which consisted of sixty-two females and twenty-eight males (aged 22-70 years, $M=44.32$, $SD=13.81$). In relation to education, 1.1% had no formal education, 7.8% completed Year 10, 6.7% completed Year 12, 15.6% completed a trade qualification/TAFE, 34.4% completed an undergraduate degree, and 34.4% held a postgraduate degree. 35.6% of the participants were not in paid employment, 25.6% had part-time or casual employment and 38.9% were employed full-time. **Table 3** summarises the demographic characteristics of the sample in Study 2.

Table 3. Demographic characteristics

| VARIABLE | ALL PARTICIPANTS (N=90) | CHRONIC PAIN (N=45) | NON-CHRONIC PAIN (N=45) |
|--|----------------------------|------------------------|----------------------------|
| Mean age (SD), years | 44.32 (13.81) | 44.96 (13.46) | 42.69 (14.28) |
| Gender | | | |
| Female | 62 (68.9%) | 31 (68.9%) | 31 (68.9%) |
| Male | 28 (31.1%) | 14 (31.1%) | 14 (31.1%) |
| Education | | | |
| No formal education | 1 (1.1%) | 1 (2.2%) | - |
| High school (Year 10) | 7 (7.8%) | 6 (13.3%) | 1 (2.2%) |
| High school (Year 12) | 6 (6.7%) | 4 (8.9%) | 2 (4.4%) |
| Trade qualification/TAFE | 14 (15.6%) | 10 (22.2%) | 4 (8.9%) |
| Undergraduate degree | 31 (34.4%) | 17 (37.8%) | 14 (31.1%) |
| Postgraduate degree | 31 (34.4%) | 7 (15.6%) | 24 (53.3%) |
| Employment | | | |
| Full-time | 35 (38.9%) | 10 (22.2%) | 25 (55.6%) |
| Part-time/casual | 23 (25.6%) | 11 (24.4%) | 12 (26.7%) |
| Currently not in paid employment/study | 32 (35.6%) | 24 (53.3%) | 8 (17.8%) |
| Marital status | | | |
| Never married | 28 (31.1%) | 16 (35.6%) | 12 (26.7%) |
| Married or de facto | 49 (54.4%) | 21 (46.7%) | 28 (62.2%) |
| Separated | 4 (4.4%) | 2 (4.4%) | 2 (4.4%) |
| Divorced | 8 (8.9%) | 5 (11.1%) | 3 (6.7%) |
| Widowed | 1 (1.1%) | 1 (2.2%) | - |

“
90 participants
agreed to this
study... 62 females
and 28 males (aged
22-70 years)...
”

Study 2

Transport and travel characteristics

All participants held a valid Australian Driver licence with a mean 26.52 years driving experience (SD=14.25, range 1-55 years). Participants reported driving 227.2 km and 8.4 hours on average per week. **Table 4** shows a detailed breakdown of the transport and travel characteristic and licence type of the sample.

Table 4. Descriptive analysis of transport and travel characteristics

| VARIABLE | ALL PARTICIPANTS (N=81) | | CHRONIC PAIN (N=36) | | NON-CHRONIC PAIN (N=45) | |
|----------------------------------|----------------------------|---------|------------------------|---------|----------------------------|---------|
| Licence type | | | | | | |
| Learner (L) | 1 | (1.1%) | - | | 1 | (1.1%) |
| Provisional (P) | 1 | (1.1%) | 1 | (2.8%) | - | |
| Open | 78 | (86.7%) | 35 | (97.2%) | 43 | (95.6%) |
| International | 1 | (1.1%) | - | | 1 | (2.2%) |
| Vehicle transmission type | | | | | | |
| Manual | 15 | (18.5%) | 8 | (22.2%) | 7 | (15.6%) |
| Automatic | 66 | (81.5%) | 28 | (77.8%) | 38 | (84.4%) |
| Driving purpose | | | | | | |
| Driving to/from work/study | 39 | (48.1%) | 11 | (30.6%) | 28 | (62.2%) |
| Driving as a part of work | 9 | (11.1%) | 3 | (8.3%) | 6 | (13.3%) |
| Mostly personal | 33 | (40.7%) | 22 | (61.1%) | 11 | (24.4%) |
| Mean Km driving per week (SD) | 227.2 | (228.1) | 214.7 | (281.5) | 237.1 | (18.2) |
| Mean hours driving per week (SD) | 8.4 | (12.4) | 9.72 | (18.2) | 7.53 | (5.5) |
| Most common road drive | | | | | | |
| Urban | 63.8% | | 62.5% | | 64.8% | |
| Rural | 11.3% | | 15.2% | | 8.2% | |
| Motorway | 24.8% | | 22.2% | | 26.9% | |
| Crash involment | | | | | | |
| Yes | 75.3% | | 69.4% | | 80% | |
| No | 24.7% | | 30.6% | | 20% | |

Driver assistance systems usage

Participants were asked about their current use of available driver assistance systems in the Australian car market, using a 5-point scale from ‘never’ to ‘frequently’. The results showed on average 79.3% of participants never used any type of driver assistance system. Interestingly, rear-view cameras were reported as the most frequent driver assistance system (26.7%) followed by in-car display (12.2%), and cruise control (8.9%). **Figure 5** shows the self-reported frequency of driver assistance system use among participants.

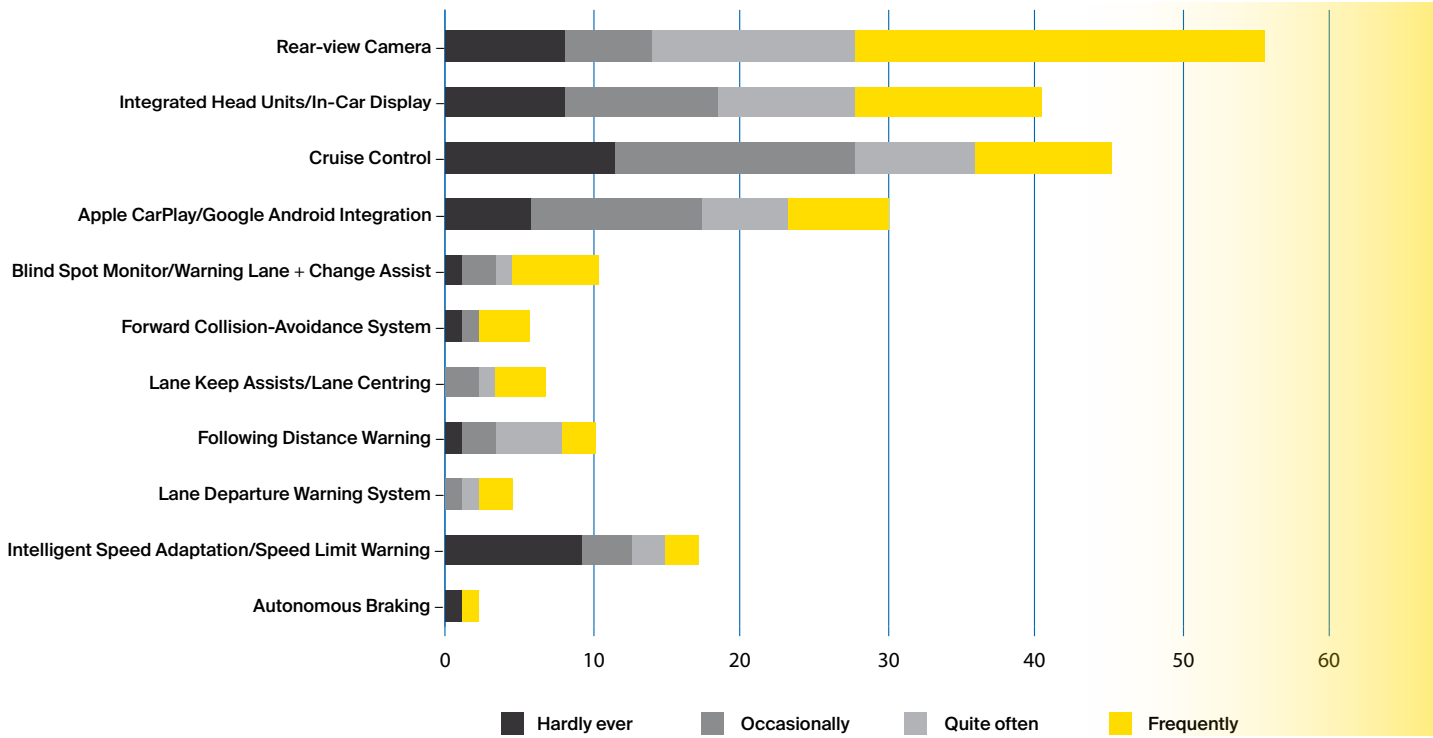


Figure 5. Self-reported driver assistance system use

Study 2



Driver state

General health characteristics of the sample

Participants were asked to report on their general level of health (*Table 5*), level of fatigue (*Table 6*), and pain characteristics (*Table 7*). General health was assessed using the referral questionnaire commonly used in the Australian health care system.

Table 5. The general health of the sample

| VARIABLE | CHRONIC PAIN N (%) | | NON-CHRONIC PAIN N (%) | |
|------------------------------------|-----------------------|---------|---------------------------|---------|
| Difficulty sitting for a long time | 36 | (80%) | 4 | (8.6%) |
| Restricted movement | 35 | (77.8%) | 2 | (4.4%) |
| Fatigue | 34 | (75.6%) | 4 | (8.9%) |
| Anxiety | 32 | (71.1%) | 8 | (17.8%) |
| Depression | 27 | (60%) | 5 | (11.1%) |
| Sleep deprivation | 26 | (57.8%) | 3 | (6.7%) |
| Difficulty concentrating | 23 | (51.1%) | 5 | (11.1%) |

Fatigue assessment

Fatigue has identified as one of the common factors in individuals experiencing chronic pain. Thus, participants were asked to measure their level of fatigue using the Fatigue Assessment Scale (FAS), a 10-item scale evaluating symptoms of chronic fatigue including the physical and mental symptoms [14]. Each item of the FAS is answered using a 5-point, Likert-type scale ranging from 1 (never) to 5 (always). *Table 6* represents the details of subscale and the mean and standard deviations of the sample.

Table 6. Fatigue assessment of the sample

| VARIABLE | CHRONIC PAIN M (SD) | | NON-CHRONIC PAIN M (SD) | |
|--|------------------------|-------|----------------------------|-------|
| I am bothered by fatigue | 3 | (1) | 2.4 | (0.8) |
| I get tired very quickly | 2.9 | (1) | 1.8 | (0.8) |
| I don't do much during the day | 2.3 | (1) | 1.6 | (0.8) |
| Physically, I feel exhausted | 3 | (1) | 2 | (0.7) |
| I have a problem starting things | 2.3 | (1.1) | 1.9 | (0.6) |
| I have a problem thinking clearly | 2.4 | (0.9) | 1.7 | (0.6) |
| I feel no desire to do anything | 2.4 | (1) | 1.6 | (0.6) |
| Mentally, I feel exhausted | 2.8 | (1.1) | 2.1 | (0.7) |
| When I am doing something, I concentrate quite well ^a | 2.8 | (1.1) | 2.2 | (0.7) |
| I have enough energy for everyday life ^a | 3.7 | (1) | 2.2 | (0.9) |

^a Item reverse coded

Study 2



Pain characteristics of chronic pain sample

Participants were asked to report the origin of their pain as:

- Motor vehicle crash (31.1%)
- Medical condition other than cancer (17.8%)
- Injury (at home 4.4%, at work/school 6.7%, in another setting 24.4%)
- No obvious reason (11.1%)
- After surgery (2.2%)
- Other (2.2%)

Characteristics of the pain described by participants experiencing chronic pain include:

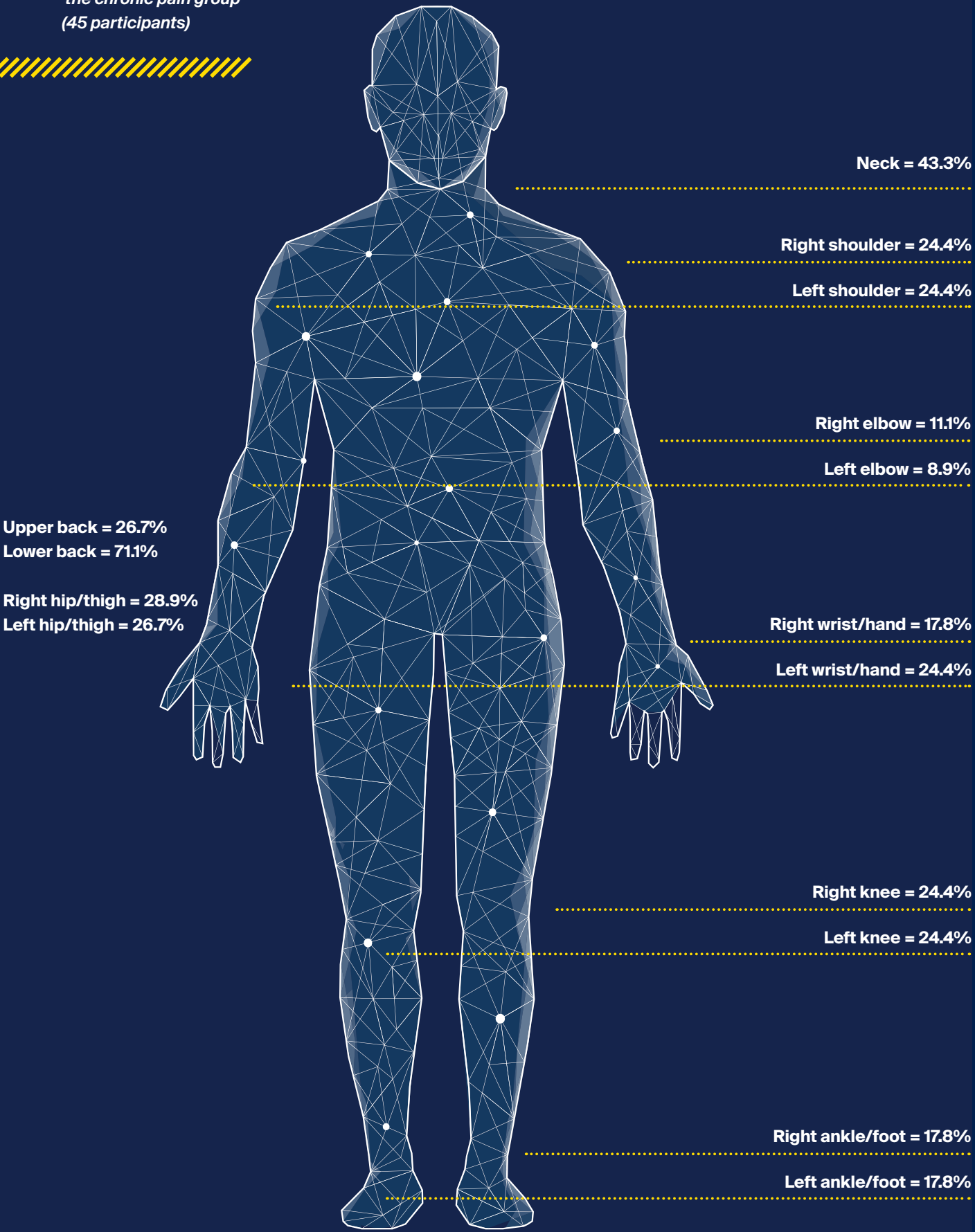
- Always present – always the same intensity (1, 2.2%)

- Always present – level of pain varies (31, 68.9%)
 - Often present – pain-free periods last less than six hours (3, 6.7%)
 - Occasionally present – pain occurs once to several times per day, lasting up to an hour (8, 17.8%)
 - Rarely present – pain occurs every few days or weeks (2, 4.4%)
- In addition, 80% of participants reported taking medication for pain management. **Table 7** outlines the details of pain scores and **Figure 6** shows the areas of pain of the sample based on validated clinical measures [15].

Table 7. Pain scores of the chronic pain sample

| VARIABLE | N | MEAN | SD | RANGE |
|--|----|-------|-------|-------|
| Pain duration, months | 45 | 148.7 | 131.2 | 6-504 |
| Sum of pain scores (current + worst + least + average pain over past 24 hours) | 45 | 19.6 | 5.8 | 9-32 |
| Pain interference (0-10) | | | | |
| General activity | 45 | 5 | 2.1 | 0-10 |
| Driving | 45 | 3.6 | 2.2 | 0-9 |
| Mood | 45 | 5.2 | 2.7 | 0-10 |
| Walking ability | 45 | 4.2 | 3.1 | 0-10 |
| Normal work (house-work/outside home) | 45 | 5.1 | 2.6 | 0-10 |
| Relationship with others | 45 | 4 | 2.8 | 0-10 |
| Sleep | 45 | 4.7 | 2.8 | 0-10 |
| Enjoyment of life | 45 | 5 | 2.5 | 0-10 |
| Pain relief from medication (0-100) | 45 | 54.9 | 22 | 0-89 |

Figure 6.
Area of most pain of
the chronic pain group
(45 participants)



Study 2



Self-reported behavioural performance in the driving task

Self-reported driving behaviour measures

To explore participants' self-reported driving behaviour the following four validated scales were used:

i) Driving Behaviour Questionnaire (DBQ) where sum score was calculated for individual categories of aggressive violations, ordinary violations, errors, and lapses [16]. Higher values represent a higher degree of unsafe driving behaviours. There were no significant differences in errors, ordinary violations and aggressive violations between participant groups. The only significant difference observed was in the score of lapses, $t(88.47)=2.07$, $p = 0.041$. *Cohen's d = 0.04*.

ii) Susceptibility to Driver Distraction Questionnaire (SDDQ) [17] where an average score was calculated for each subsection of engagement distraction and involuntary distraction. There were no significant differences in involuntary distraction between participant groups. However, there were significant differences in the engagement distraction, $t(88)=-2.08$, $p = 0.04$. *Cohen's d = 0.04*.

iii) Attention Related Error When Driving (ARDES) [18] where sum score was calculated by assessing driving attention-related errors. There were no significant differences in the ARDES measure between participant groups.

iv) Driver Anger Expression (DAE) [19] where an average score was calculated for each subsection of adaptive/constructive, personal physical aggressive expression, verbal aggressive expression, and the use of the vehicle to express anger. Overall, participants reported low aggressive responses to anger while driving and there was no significant difference in DAE measure between participant groups.

“Overall, participants reported low aggressive responses to anger while driving...”



Table 8. Mean and standard deviation of the self-reported driving behaviour

| MEASURE | | NO. OF ITEMS | ALL PARTICIPANTS M (SD) | CHRONIC PAIN M (SD) | NON-CHRONIC PAIN M (SD) |
|--------------------|---|--------------|-------------------------|---------------------|-------------------------|
| DBQ ^a | Errors | 11 | 14.9 (3.8) | 15 (4.2) | 14.8 (3.4) |
| | Lapses* | 6 | 11.6 (3.4) | 12.37 (3.6) | 10.91 (3) |
| | Ordinary violations | 8 | 14.2 (4.2) | 14.31 (4.6) | 14.2 (3.8) |
| | Aggressive violations | 3 | 5.1 (2) | 5.26 (2.1) | 4.97 (1.9) |
| SDDQ ^b | Distraction engagement* | 7 | 2.6 (0.7) | 2.46 (0.7) | 2.76 (0.6) |
| | Involuntary distraction | 8 | 2.8 (0.7) | 2.78 (0.8) | 2.76 (0.7) |
| ARDES ^c | | 19 | 28.1 (6.7) | 28.73 (7.5) | 27.57 (6) |
| DAE ^d | Adaptive/constructive | 5 | 2.8 (0.6) | 2.28 (0.6) | 2.88 (0.5) |
| | Personal physical aggressive expression | 4 | 1.1 (0.2) | 1.12 (0.2) | 1.06 (0.1) |
| | Verbal aggressive expression | 3 | 1.6 (0.2) | 1.62 (0.6) | 1.61 (0.7) |
| | Use of vehicle to express anger | 3 | 1.2 (0.3) | 1.20 (0.3) | 1.29 (0.4) |

N = 90 valid responses; * $p < .05$
a = Driver Behaviour Questionnaire; range 1 (never) - 6 (all the time)
b = Susceptibility to Driver Distraction Questionnaire; range 1 (never) - 5 (very often)
c = Attention Related Error When Driving; range 1 (never) - 5 (almost always)
d = Driver Anger Expression; range 1 (almost never) - 5 (almost always)

Study 2

Self-reported driving difficulties

Participants were asked to measure their driving difficulties in three levels; (i) strategic, (ii) tactical, and (iii) operational [20]. Significant findings are highlighted with bold in **Table 9**. Results show that 46.7% of the chronic pain group experienced moderate levels of difficulty when driving more than one hour, and a slight difficulty in reversing (48.9%), checking blind spot (42.2%), and slight difficulty in particular driving situations including driving in rush hour traffic (44.4%), driving on high traffic roads (42.2%), driving on a bumpy road (40%), driving in rain (40%) and driving at dusk (40%).

Table 9. Frequency of self-reported driving difficulties

| DRIVING DIFFICULTIES | NO DIFFICULTY | | SLIGHT DIFFICULTY | | MODERATE DIFFICULTY | | GREAT DIFFICULTY | |
|------------------------------------|---------------|------------------|-------------------|-------------------|---------------------|------------------|------------------|------------------|
| | CHRONIC PAIN | NON-CHRONIC PAIN | CHRONIC PAIN | NON-CHRONIC PAIN | CHRONIC PAIN | NON-CHRONIC PAIN | CHRONIC PAIN | NON-CHRONIC PAIN |
| Strategic level | | | | | | | | |
| Driving at dusk | 18 (40%) | 29 (64.4%) | 18 (40%) | 10 (22.2%) | 2 (4.4%) | 1 (2.2%) | - | - |
| Driving in rain | 18 (40%) | 23 (51.1%) | 18 (40%) | 11 (24.4%) | 4 (8.9%) | 8 (17.8%) | 1 (2.2%) | - |
| Driving for more than one hour | 3 (6.7%) | 29 (64.4%) | 12 (26.7%) | 10 (22.2%) | 21 (46.7%) | 1 (2.2%) | 5 (11.1%) | - |
| Driving on a bumpy road | 3 (6.7%) | 26 (57.8%) | 18 (40%) | 8 (17.8%) | 12 (26.7%) | - | 6 (13.3%) | - |
| Driving on high-traffic roads | 16 (35.6%) | 32 (71.1%) | 19 (42.2%) | 9 (20%) | 5 (11.1%) | 1 (2.2%) | - | - |
| Driving in rush-hour traffic | 14 (31.1%) | 27 (60%) | 20 (44.4%) | 12 (26.7%) | 7 (15.6%) | 1 (2.2%) | 1 (2.2%) | - |
| Tactical level | | | | | | | | |
| Changing lanes | 22 (48.9%) | 37 (82.2%) | 16 (35.6%) | 6 (13.3%) | 1 (2.2%) | - | - | - |
| Checking blind spots | 16 (35.6%) | 35 (77.8%) | 19 (42.2%) | 8 (17.8%) | 5 (11.1%) | - | - | - |
| Merging on motorway | 22 (48.9%) | 36 (80%) | 16 (35.6%) | 5 (11.1%) | 2 (4.4%) | 2 (4.4%) | - | - |
| Reversing | 16 (35.6%) | 35 (77.8%) | 22 (48.9%) | 5 (11.1%) | 3 (6.7%) | 1 (2.2%) | 1 (2.2%) | - |
| Operational level | | | | | | | | |
| Braking suddenly | 24 (53.3%) | 27 (60%) | 8 (17.8%) | 4 (8.9%) | 6 (13.3%) | 1 (2.2%) | 1 (2.2%) | - |
| Turning the steering wheel quickly | 19 (42.2%) | 17 (37.8%) | 14 (31.1%) | 26 (57.8%) | 2 (4.4%) | 2 (4.4%) | - | - |

Self-reported perceived risk

Risk perception of driving while experiencing chronic pain and under the influence of pain medications

Risk perception was explored by asking the participants about both their own and the average driver’s probability of having a crash, as a result of experiencing chronic pain while driving and driving under the influence of medication, adapted from the work of White and colleagues [21]. **Tables 9** and **10** present the data from participants in the chronic pain group and the non-chronic pain control group.

Table 10. Mean and standard deviation of risk perception of driving while experiencing chronic pain

| QUESTIONS | VARIABLES | CHRONIC PAIN M (SD) | | NON-CHRONIC PAIN M (SD) | |
|--|------------------------|------------------------|-------|-------------------------------|-------|
| To what extent do you agree with the following statements about the potential safety risks from experiencing pain while driving? | | | | | |
| 1 (strongly disagree) – 5 (agree) | Risk dimensions | | | | |
| It is easy for someone to tell if their driving has been affected | Detectability | 3 | (0.9) | 2.98 | (0.9) |
| I would need a lot of convincing to believe it is dangerous | Danger threshold | 2.4 | (1) | 2.27 | (0.8) |
| The effects on driving ability are likely to be only very minor | Severity ^a | 3.42 | (1) | 3.75 | (0.8) |
| The only people at risk are those who are experiencing pain while driving | Equitability* | 2.22 | (1) | 1.73 | (0.7) |
| Any distracting effects will last even after the pain passes | Immediacy ^a | 2.97 | (0.9) | 2.82 | (0.7) |
| How likely do you think it is that experiencing pain while driving would increase the chances of having an accident/crash for ...? | | | | | |
| 1 (very unlikely) – 5 (very likely) | Risk probability | | | | |
| You personally | Self* | 3 | (1.1) | 3.93 | (0.5) |
| The average driver of your age and sex | Others* | 3.36 | (1) | 3.91 | (0.4) |

^a Scores reversed so that higher scores reflect higher perceived severity; **p* < .01

Study 2



Table 11. Mean and standard deviation of risk perception of driving under the influence of pain medications

| QUESTIONS | VARIABLES | CHRONIC PAIN M (SD) | | NON-CHRONIC PAIN M (SD) | |
|---|-------------------------|------------------------|--------|----------------------------|-------|
| To what extent do you agree with the following statements about the potential safety risks from driving while being under the influence of high doses of pain medication? | | | | | |
| 1 (strongly disagree) – 5 (agree) | Risk dimensions | | | | |
| It is easy for someone to tell if their driving has been affected | Detectability | 2.9 | (1.13) | 2.38 | (0.9) |
| I would need a lot of convincing to believe it is dangerous | Danger threshold | 1.9 | (0.9) | 2.13 | (1.1) |
| The effects on driving ability are likely to be only very minor | Severity ^a | 3.9 | (1) | 4.2 | (0.7) |
| The only people at risk are those who are driving while being under the influence of high dose opioids | Equitability | 1.7 | (0.8) | 1.6 | (0.8) |
| Any distracting effects will last even after the pain passes | Immediacy* ^a | 2.5 | (1.1) | 3 | (1) |
| How likely do you think it is that driving while being under the influence of a high dose of pain medication would increase the chances of having an accident/crash for ...? | | | | | |
| 1 (very unlikely) – 5 (very likely) | Risk probability | | | | |
| You personally | Self | 3.9 | (1) | 4.09 | (0.7) |
| The average driver of your age and sex | Others | 4.1 | (1) | 4.13 | (0.6) |

^a Scores reversed so that higher scores reflect higher perceived severity; **p* < .05



Study 2b:
Hazard perception test

Method

Study 2b involved two validated measures of drivers' hazard perception ability [22, 23], which is a driving skill that has been linked to unsafe driving behaviour [22]. The first measure was a previously validated response-time hazard perception test, in which drivers viewed a series of video clips of traffic filmed from the driver's perspective. The clips depicted thirty traffic conflicts (events in which the car with the camera had to take evasive action to avoid a collision with another road user). Participants were asked to click as early as possible on any road users likely to be involved in a traffic conflict with the camera car. The test score was participant's mean response time to predict the conflicts. Test scores have been found to distinguish high risk (young novice) and low risk (older experienced) driver groups, as well as being associated with heavy braking frequency during real driving [23]. In addition, different versions of this test have been found to predict crash involvement [24]. This evidence supports the validity of the test.

The second measure was a hazard prediction test, in which drivers also viewed video clips of hazardous situations [25]. In this test there were six clips which cut to black just before a potential traffic conflict. Test-takers were asked to predict what

might happen after the cut point and make as many predictions as possible. Participants' verbal predictions were recorded and scored by an experienced rater not involved in the testing, who was blind to each participant's group. Participants received a point for every valid prediction they made that corresponded to a checklist of expert predictions (generated using a panel of driving examiners). The overall test score was the sum of valid responses across all clips (out of twenty-six). The hazard prediction test score has been linked with high/low risk group differences and crash involvement, indicating test validity [25].

To control for individual differences in the computer mouse skill, participants also completed a Simple Spatial Reaction Time (SSRT) test [26], designed to mimic the response mode of the hazard perception test, independent of the traffic context. This test involved fifteen high contrast rectangles appearing at random locations and time intervals on the computer monitor. Participants were told to use the computer mouse to click on these rectangles as soon as they appeared. The test score was participants' average reaction time to the rectangles.

Study 2



The same group from Study 2a were invited to complete the hazard perception test and the hazard prediction test face-to-face at RECOVER Injury Research Centre or from their home computer, depending on their preference. The two tests took approximately 30 minutes to complete in total.

Data analysis

The scores from the hazard perception test and the hazard prediction test were used to examine the proposal that drivers experiencing chronic pain were worse at hazard perception than a non-chronic pain control group. For the hazard perception test an ANCOVA was conducted; with the group as the independent variable, hazard perception test response time as the dependent variable, and simple spatial reaction time as a covariate (in order to adjust for individual differences in response mode skill independent of driving). For the hazard prediction test an independent-samples t-test was conducted, with the group as the independent variable and a total number of predictions as the dependent variable.

Hazard perception test and hazard prediction test results

A square root transformation was used on the hazard perception test response time score to achieve normality. Other assumptions of ANCOVA were met. There were no significant differences between participants (chronic pain and non-chronic pain control group) in hazard perception test response time, $F(1,84)=1.41$, $p = .238$, $h^2 = .02$, controlling for simple spatial reaction time (the pattern of results remained the same without controlling for simple spatial reaction time). There was also no significant difference between the groups in number of predictions made in the hazard prediction test, $t(85)=.68$, $p = .499$, $Cohen's d = .15$.



Study 2c: Driving logbook

Method

Study 2c was conducted as a follow-up study with the same group of drivers who had participated in Study 2a and 2b. This study incorporated a logbook-based approach [27, 28], where participants were asked to keep a log of their pain intensity and driving patterns over the course of two weeks. The data collected was self-reported and addressed drivers experiences such as near-crash events where the driver is required to suddenly manoeuvre the vehicle to avoid a crash, instances where drivers felt unsafe on the road and the contextual details surrounding this event; time and date of occurrence, location of where it occurred, the speed at which he/she was driving at that moment, the other road users involved, weather conditions, familiarity with the route if there were passengers in his/her vehicle at the time, the purpose of their trip, and how the situation was managed to avoid a crash.

Participants were required to download a free mobile app on their smartphone – compatible with iOS and Android – which contained the daily logbook questionnaire. The app was programmed to send out daily notifications to the participants. Each logbook entry took approximately 10 minutes to complete.

Data analysis

The Statistical Package for Social Sciences (SPSS) was used to conduct statistical analyses of the quantitative data and a thematic analysis was conducted to develop a typology of near-crashes and manoeuvres used to manage driving situations reported in the driver logbook [27, 28].

Driving logbook result

Descriptive analysis for the driving workload

Participants were asked to complete the NASA Task Load Index (TLX) scale [29] which measures the following six components in relation to driving behaviour:

- Mental demand – how mentally demanding the drive.
- Physical demand – how physically demanding the drive.
- Temporal demand – how hurried or rushed the pace of the drive.
- Performance – how successful in accomplishing the driving trip/aim.
- Effort – how hard to accomplish the level of performance on the drive.
- Frustration level – how insecure, discouraged, irritated, distressed and/or annoyed on the drive.

Participants were asked to respond to each item on a scale

of 1 (low) to 100 (high). Descriptive statistics of the items in the scale are presented in **Figure 7**. Analyses showed that during the two weeks of driving there were significant differences between the groups relating to the following driving tasks:

- Mental demand $t(85)=4.24$, $p = .00$, $Cohen's d = .91$
- Physical demand $t(77.5)=4.86$, $p = .00$, $Cohen's d = 1.04$
- Effort $t(77.38)=4.04$, $*p = .00$, $Cohen's d = .86$
- Frustration levels $t(75.95)=3.77$, $p = .00$, $Cohen's d = .80$

However, there were no significant differences observed in overall performance and temporal levels of driving tasks.

Self-reported near misses

Overall, participants reported forty-two near misses over the two weeks of driving – twenty-four chronic pain group compared to eighteen non-chronic group. There were no significant differences in self-reported number of near-misses during the two-week data collection between both group participants.

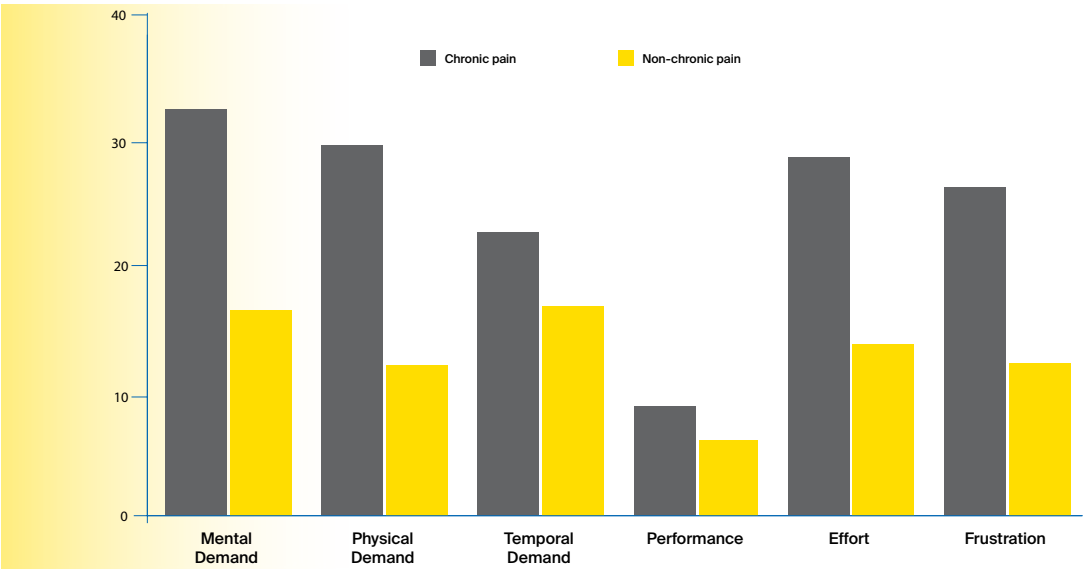


Figure 7. Mean and standard deviation of workload

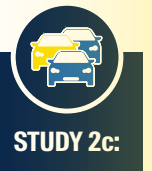
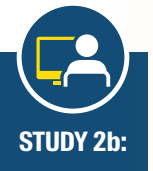
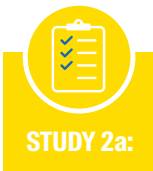
Summary

Summary

The overall study findings are summarised below:

- Ninety individuals participated in Study 2 including drivers experiencing chronic pain (N=45) and a comparison group of non-chronic pain or otherwise healthy drivers (N=45).
- Results show that 46.7% of the chronic pain group experienced moderate levels of difficulty when driving more than one hour. They experience slight levels of difficulty in reversing (48.9%), checking blind spot (42.2%), driving in rush hour traffic (44.4%), driving on high traffic roads (42.2%), driving on a bumpy road (40%), driving in rain (40%) and driving at dusk (40%). These self-reported difficulties were significantly higher compared to the non-chronic pain group.
- Self-reported driver assistance system use by participants shows that rear-view cameras were the most frequent (26.7%), followed by in-car display (12.2%), and cruise control (8.9%).
- There were no significant differences in self-reported driving behaviour. That is, errors, ordinary violations and aggressive violation between participant groups. The only significant difference observed was in the score of lapses.
- There were no significant differences in self-reported susceptibility to driver distraction scale. That is, involuntary distractions between the chronic pain group and the non-chronic pain control group. However, there were significant differences in the engagement distraction.
- There were no significant differences in self-reported attention-related error when driving between participant groups.
- Overall, participants in this study reported low aggressive responses to anger while driving and there were no significant differences in self-reported driver anger expression between the chronic pain and non-chronic pain group. That is, adaptive/constructive, personal physical aggressive expression, verbal aggressive expression, and the use of the vehicle to express anger.
- There were no significant differences in hazard perception test response times between participant groups. In addition, there were no significant differences between the groups in a number of predictions made in the hazard prediction test.
- In relation to the workload of the driving tasks during the two-week data collection, there were significant differences between participant groups in mental demand, physical demand and frustration levels. However, there were no significant differences observed in overall performance and temporal levels of driving tasks.
- Lastly, there were no significant differences in self-reported number of near misses during the two-week data collection between participant groups.

Specify driving behaviour



Methodology

online survey online hazard perception test driving logbook (during 2 weeks)

Participants

Drivers with chronic pain and non-chronic pain

Study 3

Collaborative Workshop

Collaborative Workshop

A collaborative workshop was conducted to discuss the findings of Study 1 and Study 2. These workshops included members of the research team – an occupational therapist, health professionals, road safety experts in Australia, an international road safety expert (Professor Patricia Delhomme), and a knowledge translation officer, two consumer representatives with the lived experience of chronic pain, and RACV representatives. These discussions further supported the validation of the research findings, and through this, the RECOVER team was able to develop recommendations for improving the management of driving behaviour for adults experiencing chronic pain in Australia.

Discussion & Conclusion

Pain could be a source of inattention among drivers, where drivers experiencing pain may present psychological states which could reduce the attentional resources needed to complete the driving task safely. In addition, the type and location of pain could impair functional outcomes such as the movements or reactions needed to control the vehicle safely. However, there is a lack of studies investigating the impact of chronic pain on driving behaviour and, more importantly, there is no evidence to inform evidence-based practice to increase safety among drivers experiencing pain. To the best of our knowledge, this study is the first in Australia to seek strategies to improve safe driving among individuals with chronic pain by drawing upon the lived experience of individuals with chronic pain, as well as the knowledge of health professionals as subject matter experts.

Perspectives of health professionals

In the qualitative study involving health professionals (Study 1a), participants highlighted the importance of driving in Australia. In particular driving was identified as a form of independence and engagement in the activities of daily living. This is consistent with the car-centric planning in Australia which has been reported in major cities such as Melbourne and Sydney [30]. Car throughput is prioritised at the expense of active travel and public transport. Thus, the lack of transport alternatives creates inequities for drivers with chronic pain.

Participants acknowledged chronic pain as a multi-faceted phenomenon and its potential impact on driving seems to vary among individuals. However, the main concerns for those chronic pain cohorts who choose to drive include:

- The static posture and prolonged sitting during driving could significantly worsen pain both during and directly after driving.
- Spinal pain could restrict the range of movement and adversely affect tasks required for driving, e.g. shoulder check, identifying blind spot.
- Reduced cognition was emphasised as a consequence of the chronic pain experience which may negatively impact driving. In particular, the sensation of pain could be a distraction itself and could impact on maintaining sustained attention and having a quick reaction time.
- The complexity of polypharmacy and the effect of the medication, which varied person to person, and the high incidence of substance use disorders within the pain cohort, could impact on cognitive function and driving safety.
- Sleep apnoea and poor sleep quality, which are commonly associated with chronic pain, could further impair the cognitive functions required for safe driving.

Discussion & Conclusion



Participants discussed their role in assessing and addressing driving difficulties within the chronic pain cohort; those being general practitioner (GP), multidisciplinary pain clinic and community occupational therapy (COT) driving assessor. Participants described the GP's role as collecting comprehensive patient information on physical, cognitive, psychological and neurological conditions. However, driving would only be addressed if deemed a concern by the patient or family member, or if the GP had identified patient circumstances during their assessment that could impact driving. If identified by the GP, the person would be referred to a COT driving assessor for further assessment.

Participants reported similarities between the GP's and the pain clinic's role in information gathering, however, the pain clinic had the additional capacity to provide specialised multidisciplinary assessment and input to the patient if required. Driving assessment referrals were infrequent and only occurred if the patient's concerns were out of the scope of the primary care clinician's responsibilities. The COT's role was explained as providing a comprehensive on and off-road assessment in order to formulate a holistic picture of the patient's driving ability. Based on the outcomes of the assessment, patients were provided with strategies, driving lessons and recommendations for modifications.

If driving-related concerns were raised by a patient with chronic pain, health professionals worked with them to address the physical, cognitive and emotional aspects related to safe driving. The health professionals would provide several self-regulation strategies according to the challenges identified. These included utilising activity pacing principals for driving, providing biomechanical and postural adaptations, provision of cushions and vehicle modifications, and coaching drivers to adopt an anticipatory scanning method for early identification of road hazards. In addition, clinicians encouraged patients to be cautious with medications, particularly new medications or a change in dosage. Furthermore, a small number of clinicians aimed to educate patients on chronic pain and utilised interviewing strategies to increase patient awareness and insight regarding the challenges they may be facing. If driving concerns were out of their scope of practice, patients were referred to their GP, a COT, or a pain management clinic.

The following barriers and enablers were identified in relation to adequately assessing driving among the chronic pain cohort:

- Participants identified driving as a sensitive topic for some patients and raised concerns about the possibility of their patients avoiding discussing their challenges related to driving, given the stigma around possibly losing their licence. Participants suggested taking a positive approach to raising awareness of the factors that potentially impact on driving safety and management strategies.
- Most participants stated that there is a lack of clear guidelines available for clinicians to refer to regarding chronic pain conditions. In particular, an absence of driving as a criterion or item on current assessment and outcome measures. They also noted the importance of training and upskilling of clinicians in order to better address driving-related concerns and understand the impacts of various medication on driving behaviour.
- Participants commented on the subjective nature of pain and the complexity of driving which would be challenging to assess within a short time frame. It is therefore suggested to embrace the value of a collaboration between pain clinics, GP's and transport authorities to identify at-risk drivers and continuity of care for the individuals. In addition, participants reported on the value of evidence-based research in relation to driving behaviour within the chronic pain cohort and the potential of improving assessment approaches with technologies such as virtual reality driving simulators.
- Participants reported that it was challenging to provide patients with recommendations to access alternative means of transport due to financial barriers and inadequate access to public transport for many of their patients. Patients' financial barriers also hindered clinicians from providing referrals to private driving assessors if required. Participants also spoke about the importance of addressing funding issues within public health, which impact on the clinician's ability to address the multiple challenges faced by chronic pain patients.
- The role of the patient's family was deemed important to assess a patient's capacity to drive. Participants spoke about the need to provide education to the support network of the individual. Additionally, a checklist to assess physical,

emotional and cognitive components would help the person with chronic pain and/or the family member make informed decisions regarding their safety to drive.

- Lastly, the value of driver assisting technologies was thought to enhance driver safety and mitigate common challenges within this patient cohort.

Perspectives of chronic pain cohorts

In the qualitative study involving individuals with chronic pain, overall participants viewed driving as a form of independence, which provided a sense of autonomy and control. Participants generally prefer to continue driving for the added convenience, despite the challenges they would experience during/after driving.

Overall, the chronic pain cohort's reported difficulties with driving include:

- Prolonged sitting resulted in pain flare-ups.
 - Difficulties with twisting of the neck and back to check over the shoulder for blind spots or to reverse.
 - Impaired cognitive function due to pain including; reduced attention, poorer focus, slower reaction time, and mood-related changes which translated into agitation, frustration, impatience and anger towards other road users. A small number of participants also queried their judgement and decision-making due to the impact of pain and medication.
 - Following driving, participants increasingly reported lower satisfaction in several life domains, e.g. being unable to engage fully in household tasks, socialisation or have a restful sleep. Consequently, participants reported lower engagement in meaningful activity, increased agitation, aggression and frustration, which at times impacted their relationships.
- Chronic pain cohort self-regulation strategies include:
- Acceptance of the limitations imposed by their pain and made lifestyle changes including reducing the length of time they drove.
 - Asking family members to drive or accompany them.

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... a small number of clinicians aimed to educate patients on chronic pain and ... increase patient awareness and insight regarding the challenges they may be facing.

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Discussion & Conclusion



- Utilising pacing strategies to break up the journey.
- Adding postural supports to increase comfort.
- Using driver assistance systems such as reversing cameras, cruise control and blind spot monitors.
- Using mindfulness and distraction techniques to overcome the pain.
- Scanning more frequently, maintaining larger spaces between cars and using whole body movements to perform safety checks.
- Utilising avoidance strategies such as avoiding driving due to pain flare-ups, avoiding unnecessary lane changes, high volume traffic, heavy rain and night-time driving.

Overall, more than half of the participants reported confidence in their self-assessment by monitoring physical and emotional cues. In addition, four participants raised concerns about the potential impact on other road users and were mindful of their capacity before driving. A smaller number of participants did not feel that pain negatively impacted their driving safety and did not routinely check whether it was safe for them to drive. However, all participants expressed interest in gaining more awareness about tools and strategies they can use to gauge their driving safety.

There were mixed perceptions of the impact medications had on driving. A large portion of the participants reported self-awareness regarding potential side-effects attributable to their medications. Side-effects were mostly cognitive and included fatigue, reduced concentration and difficulties with sustained attention. In addition, participants reported diminished coordination and vision issues. A small number of people reported Tramadol and Valium impaired driving capacity. As such, participants discussed management strategies to overcome side effects such as reducing the dosage, avoiding driving while taking stronger medications or pulling over if required. Participants also reported the unpredictable nature of the side-effects, which may manifest as a sudden onset of drowsiness while driving, for example.

A number of barriers and enablers were identified in relation to adequately assessing driving among the chronic pain

cohort. Most participants reported that health professionals inadequately addressed driving. Discussion about driving concerns or impact of medication was rarely initiated by health professionals during medical consultations or in pain rehabilitation programs. A small number of people believed their concerns about driving difficulties would be addressed if it was pertinent to them. Nonetheless, most participants were in favour of having driving addressed as part of their rehabilitation, given its importance.

Participants broadly discussed recommendations to improve driving assessment and interventions for people experiencing chronic pain. They stressed the importance of receiving practical and written education materials and resources through rehabilitation groups or treatment sessions. In addition, participants discussed the importance of clinicians broaching the topic of driving in the context of their pain pathology and medications. Most participants perceived many benefits to driver assistance systems, with the most commonly discussed being blind-spot monitors and reversing cameras. Access to funding was frequently noted as a barrier in accessing driver assistance systems or in-car modifications. Participants also believed that transport authorities could play a role in the assessment of driving safety in chronic pain individuals. One example was the formation of policies that recognise chronic pain among other chronic conditions that require regular assessment to maintain licensure with age. In addition, participants voiced interest in having access to defensive driving courses and simulated driving experiences as part of their rehabilitation. These strategies would serve to meet the requirements of both assessment and treatment.

Driving behaviour

In the self-reported online survey and driving logbook, the chronic pain cohort reported moderate levels of difficulty when driving more than one hour, and a slight level of difficulty in reversing and checking blind spots. They also reported difficulties in certain driving situations including driving in rush hour traffic, driving on high traffic roads, driving on a bumpy road, driving in rain and driving at dusk. These self-reported difficulties were significantly higher compared to the

non-chronic pain group. Findings are in-line with the previous research by Fan, et al., [6] where the chronic pain cohort reported on similar activities related to driving that caused difficulty. Moreover, some other findings concerning driver behaviour include:

- There were no significant differences between participant groups for self-reported driving behaviour, i.e. errors, ordinary violations and aggressive violations. The only significant difference observed was in the score of lapses which are defined as alterations or unexpected deviations from a properly conceived plan. These are different from mistakes which typically occur because of lack of experience (or expert knowledge) on a driving task. In this research, drivers experiencing chronic pain reported more lapses. This is consistent with previous research showing that lapses are generally a consequence of attention-related errors [18]. As explained earlier, pain could result in different cognitive states which could reduce attention related to the driving task.
- In relation to the workload of the driving tasks during the two-week driving logbook data collection, there were significant differences in **mental demand**, **physical demand** and **frustration levels** between participant groups. However, there were no significant differences observed in **overall performance** and **temporal levels** of driving tasks. In this research, drivers experiencing chronic pain reported higher levels of perceived mental and physical workload compared to non-chronic pain group. This can be seen as consistent with the expectation that pain could influence psychological and functional outcomes of individuals [31, 32].
- There were no significant differences between participant groups in self-reported susceptibility to driver distraction scale, i.e. involuntary distraction. However, there were significant differences in the engagement distraction. Drivers experiencing chronic pain reported less engagement in distracted driving. This further confirms that pain could be a distraction itself, which decreases drivers' capability to deal with driving demands. Drivers who engage in distracted driving generally negotiate their capability and the driving demands to reduce risks [33, 34]. Therefore, drivers with chronic pain are less likely to engage in additional distractions. Driver inattention

taxonomies have consistently reported that mental state can serve as a source of internal distraction, which might make it challenging for the driver to meet the demands of the driving task [35].

- There were no significant differences between participant groups in self-reported attention-related errors when driving. These findings can be explained based on the nature of the attention-related errors. These are personality trait-like variables, i.e. a distinguishable feature of an individual, and seem to reflect on enduring behaviour patterns [36]. Therefore, it is reasonable to think that the presence of chronic pain would have not influenced them.

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... drivers experiencing chronic pain reported higher levels of perceived mental and physical workload...
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Discussion & Conclusion



- Participant groups in this study reported low aggressive responses to anger while driving and there were no significant differences in self-reported driver anger expression. That is, adaptive/constructive, personal physical aggressive expression, verbal aggressive expression, and the use of the vehicle to express anger.
- There were no significant differences in hazard perception test response times [23] between participant groups. In addition, there were no significant differences between the groups in a number of predictions made in the hazard prediction test [25].
- Lastly, there were no significant differences between participant groups in the self-reported number of near misses during the two-week data collection. This could be a consequence of the use of self-regulatory strategies or the fact that driving patterns has been changed as a response to the COVID-19 pandemic.
- Interestingly, although participants in Study 1 highlighted importance of the driver assistance system use for chronic pain cohort, our findings showed limited number of participants own these features in their vehicle. Rear-view cameras were the most frequent driver assistance system (26.7%) followed by in-car display (12.2%), and cruise control (8.9%). Clearly there is a need to study acceptability and barriers for the uptake of advanced driver assistant technologies among at-risk groups of drivers.

Limitations

While the findings of this research are potentially useful for improving driving safety in chronic pain cohorts, one limitation includes potential biases in self-reported data. In particular, the need to continue driving due to the lack of transport alternatives in Australia could have contributed to response bias. Future research involving an on-road experiment with real-time monitoring of the driving behaviour would have been desirable to validate the findings of the current study. Another limitation is the driving logbook component of the study was conducted during the COVID-19 pandemic, where driving patterns could be different due to self-isolation recommendation of the health authorities.

Recommendations

- Most participants stated there is a lack of clear guidelines available for clinicians regarding individuals experiencing chronic pain driving. It is therefore suggested **health professionals would benefit from establishing clear and evidence-based guidelines (i.e. the National Fitness to Drive) specific for chronic pain as a stand-alone recognised health condition. This could support clinicians with clear recommendations and intervention pathways.**
- Participants commented on the subjective nature of pain and the complexity of driving which would be challenging to assess within the usual consultation timeframe. It is therefore suggested **health professionals would benefit from training and upskilling to better address patient driving-related concerns within the medical, physical, emotional and cognitive domains within the consultation timeframe.** This would likely increase clinician confidence to raise the topic with patients and could help with addressing driving difficulties and/or consult other allied health professionals (e.g. occupational therapy driving assessors) if further expertise is required.
- Participants in this research identified driving as a sensitive topic for some patients, raising concerns about the possibility their patients avoid discussing their challenges related to driving due to the fear of possibly losing their licence. It is therefore suggested that **health professionals take a positive approach to raising awareness among individuals experiencing chronic pain on the factors that potentially impact on driving safety (i.e. medications, physical, cognitive, emotional) and management strategies/options to address these factors.**
- Participants broadly discussed the self-regulation strategies they use to overcome their difficulties with driving tasks. However, patients could benefit from **personalised occupational therapy and physiotherapy recommendations on vehicle ergonomics, an ergonomic assessment of their car seating, and educational strategies to reduce pain flare-ups while driving.**
- Health care professionals could encourage the inclusion of family members in discussions about driving, particularly when a patient displays red-flags for unsafe driving. This could help

facilitate open discussion and problem-solving among the clinician, patient and family member.

- It is advisable for the chronic pain cohort to consider liaising with their regular GP or pharmacist to review their medications, to reduce the harm or compounding effect as a result of polypharmacy. In addition, patients should be encouraged to track side effects experienced with the introduction of new medications (e.g. using a diary) and contact their health care provider with concerns.
- Where possible, if feeling unsafe to drive, it would be advisable to utilise supports from family/friends or alternatives to driving, e.g. public transport or ride-sharing. However, road authorities should also continue working towards a more equitable transport system (i.e. accessible public transport, better active travel infrastructure, etc.).

Future research

- Future research involving an on-road experiment with real-time monitoring of the driving behaviour would be desirable to validate the findings of the current study.
- Future research would be beneficial to create a positive campaign related to chronic pain and driving, to raise awareness about plausible solutions and to reduce the stigma around losing one's licence.
- Future research should evaluate the benefit of hazard perception training in chronic pain cohorts who have some concerns about their cognitive function while driving.
- Future research should investigate the use of driver assistant technologies (e.g. blind spot monitor, reverse camera) in the chronic pain cohort to assist with driving tasks and develop strategies to prevent overreliance and potential misuse of these technologies.
- Future research would be beneficial to grow the body of evidence for driving-related studies, for example, the potential of improving assessment approaches with technologies such as computer-based or virtual reality driving simulators.
- Future research would be beneficial to address funding issues within the public health system pertaining to assessments related to fitness to drive for the chronic pain cohort.

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Future research should evaluate the benefit of hazard perception training in chronic pain cohorts...

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Appendix



Appendix I. Pain characteristics and history of traffic crashes for individual participants in Study 1b

| GENDER, AGE | PAIN LOCATION | PAIN DURATION | SELF-REPORTED MOTOR VEHICLE CRASHES BEFORE / AFTER ONSET OF PAIN | CRASH RELATION TO PAIN (YES/NO) |
|-------------|--|---------------|--|---------------------------------|
| Female, 28 | Right shoulder, left buttocks | 5 | 1/0 | No |
| Female, 33 | Lower back | 12 | 0/2 | No |
| Female, 36 | Lower back | 7 | 4/0 | No |
| Female, 38 | Lower back, right knee | 1.5 | 0 | No |
| Female, 43 | Neck region, right shoulder and arm, left lower back | 6 | 1/1 | No |
| Female, 48 | Lower back | 3 | 0 | No |
| Female, 50 | Occipital, neck, right/left shoulders, lower back, buttocks, right/left hip girdle, right/left thigh, knees and ankles | 1 | 0 | No |
| Female, 52 | Lumbar region/pelvic | 36 | 0 | No |
| Female, 58 | Lower back | 38 | 0 | No |
| Female, 60 | Mid neck, mid to lower back | 10 | 0/2 | No |
| Female, 65 | Lower back | 6 | 0 | No |
| Female, 67 | Mid neck, right/left shoulders, lower back, right/left leg and right foot | 22 | 0 | No |
| Female, 68 | Mid neck, right/left shoulders, lower back, right/left knees, ankles and hands | 13 | 1/0 | No |
| Male, 24 | Lower back, coccyx area | 5 | 0 | No |
| Male, 44 | Right leg | 1 | 1/0 | Yes |
| Male, 53 | Neck region, right/left shoulders and arms, lower back | 10 | 1/2 | Yes |
| Male, 56 | Lower back, right shoulder | 1 | 1/0 | Yes |
| Male, 56 | Left arm and hand | 27 | 3/3 | Yes |
| Male, 58 | Spinal, L4-L5 (predominantly left side), left leg | 25 | 0 | No |
| Male, 59 | Spinal, L3-S1, right/left leg | 16 | 0 | No |
| Male, 61 | Right arm phantom pain | 37 | 1/1 | No |
| Male, 63 | Mid to low back, right/left knees and ankles | 38 | 1/2 | Yes |
| Male, 64 | Left shoulder, lower back, left hip | 15 | 1/2 | No |



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