# National Office for Traffic Medicine

## Medical Fitness to Drive Literature Review

## Update

## 2022-2024

**National Office for Traffic Medicine**,

Centre for Innovative Human Systems,

Room 0.22D

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# Foreword

Dear colleagues,

Welcome to the latest edition of the literature review key to the review of the latest edition of the Irish guidelines on medical fitness to drive, Sláinte agus Tiomáint, now preparing its 12th edition. As you may know, a key feature of the Irish guidelines, developed in the only national advisory centre on medical fitness to drive in the world to be based in a higher educational institution, is to work on the basis of up-to-date evidence to the greatest extent possible, including regular literature reviews, in-house research, and overview of each new edition of the guidelines by an external expert[1]. Indeed, the National Office for Traffic Medicine was delighted to be a part of the group updating the Monash University guidelines on evidence-based review of recommendations on medical fitness to drive, the premier international resource on such evidence[2], as well the European Guidelines developed by CIECA, the international organisation of driver assessment organisations[3].

The literature review covers the period 2022 to 2024. It is divided into subject areas paralleling that of the guidelines, and the overall message is generally supportive of the content of the most recent editions of the guidelines. Over 500 items were reviewed, narrowed down to just under 300 papers. There is new data available in the area of syncope (Cardiology) and a very significant literature on the rapidly changing area of cannabis, alone and in combination with other substances (Substance Use Disorders). There are new studies providing information on acquired brain injury, stroke and Parkinson's disease (Neurology and Rehabilitation).

A word of caution is indicated for the voluminous material on older drivers, an ill-focused area overly concerned with potential risk in a relatively safe group of drivers[4] – if researchers were genuinely concerned about injury and death to older traffic users, they would focus on age-

[1] Rapoport MJ, Weegar K, Kadulina Y, Bédard M, Carr D, Charlton JL, Dow J, Gillespie IA, Hawley CA, Koppel S, McCullagh S. An international study of the quality of national-level guidelines on driving with medical illness. QJM: An International Journal of Medicine. 2015 Nov 1;108(11):859-69.

[2] Charlton JL, Di Stefano M, Dow J, Rapoport MJ, O'Neill D, Odell M, Darzins P, Koppel Influence of chronic Illness on crash involvement of motor vehicle drivers: 3rd edition. Monash University, Melbourne, 2022.

[3] Englund L, O'Neill D, Pisarek W, Ryan M, Wagner T, on behalf of Medical Fitness to Drive Subgroup of the CIECA Topical Group on Fitness to Drive. CIECA Report Medical Fitness to Drive. CIECA, Brussels, 2020.

[4] O'Neill D. More mad and more wise. Accident Analysis & Prevention. 2012 Nov 1;49:263-5.

attuned in-car safety features, junction design, acceleration/deceleration in public transport, and attention to pedestrians and cyclists. A key issue is to avoid focusing on measures which might suggest altered driving (as an apparent proxy for crash risk) but instead only to focus on actual crash risk in terms of guidelines development.

We hope this review is both supportive and stimulating in terms of a refresh on the latest research in medical fitness to drive and will support ever more authentic and useful edition of the Irish guidelines on medical fitness to drive, supporting patients and practitioners alike.

Prof Desmond O'Neill MD FRCPI FRCP(Glasg) FRCP FRCPEdin

Director 21st October 2024

# 1. General principles and assessment

**Establishing the Predictive Validity of the Assessment of Motor and Process Skills for Driving Performance Outcomes**

The AMPS Motor and Process Skills scores revealed significant differences between those who failed or had driving restrictions and with those who passed the driving evaluation (1).

**Advancing Traffic Safety Through the Safe System Approach: A Systematic Review**

The review provides insights into SSA's effectiveness in reducing road traffic fatalities and injuries, exploring implementation challenges and opportunities, including policy initiatives, institutional frameworks, and stakeholder collaborations. The findings highlight the potential for SSA to create a more forgiving and resilient transportation system, offering valuable guidance for policy decisions, future research, and interventions aimed at promoting safer road environments. SSA's comprehensive strategy for Safe Road Users encompasses considerations of road system design, behaviour modification, and tailored measures for vulnerable users, showcasing its versatility in addressing diverse challenges (2).

**Using Serial Trichotomization to Determine Fitness to Drive in Medically At-Risk Drivers**

Serial trichotomization of clinical tests increases the accuracy of making informed decisions and reduces the number of drivers undergoing unnecessary on-road assessments (3).

**Factors Influencing Changes in Medication-Taking and Driving Behaviour After Warnings About Prescription Medications That Prohibit Driving: An Online Survey**

Of the total respondents, 30% were taking medicine that “prohibited” driving. Of those taking prohibited medications, 25.7% did not receive a warning about driving from healthcare professionals. Japanese study (4).

**Driving Performance after Bedtime Administration of Daridorexant, Assessed in a Sensitive Simulator**

Daridorexant showed a lower self-rated driving quality and higher effort compared to placebo on day 2 but not on day 5. In non-insomnia subjects, daridorexant impaired simulated driving

after initial but not after repeated dosing. Subjects should be cautioned about driving until they know how daridorexant affects them (5).

**Relationships between Personality Traits and Brain Gray Matter are Different in Risky and Non-risky Drivers**

Researchers observed that the total grey matter volume varied as a function of risky driving tendencies, with higher risk individuals showing lower grey matter volumes. Similar results were found for volumes of brain areas involved in the reward and cognitive control networks, such as the frontotemporal, parietal, limbic, and cerebellar cortices. We have also shown that sensitivity to reward and punishment and impulsivity are differentially related to grey matter volumes as a function of risky driving tendencies. Highly risky individuals show lower absolute correlations with grey matter volumes than less risk-prone individuals. Taken together, the results show that risky drivers differ in the brain structure of the areas involved in reward processing, cognitive control, and behavioural modulation, which may lead to dysfunctional decision-making and riskier driving behaviour (6).

**Exploring Driving Behaviour from The Perspectives of Individuals with Chronic Pain and Health Professionals**

The themes emerging from the interviews highlighted the need for clearer guidelines and educational materials regarding the impact of chronic pain on an individual's ability to drive. These themes included the physical and cognitive challenges resulting from chronic pain, as well as the potential side effects of pain medications. In addition, participants identified a number of self-regulation strategies and driving assessments currently available for monitoring safe driving behaviour in Australia (7).

**Distracted Driving Among Patients with Trauma Attending Fracture Clinics in Canada: The Canadian Multicentre DRIVSAFE Study**

This survey-based study showed that driving distractions were near universally acknowledged. The pervasiveness of distractions held true even when only the more dangerous distractions were considered. One in 6 patients in MVCs reported being distracted in their current crash, and 1 in 3 patients disclosed being distracted in an MVC during their lifetime (8).

**Strong Evidence for Age as the Single Most Dominant Predictor of Medically Supervised Driving Test (MSDT) -Mini Mental Status Test Outcomes Provide Only Weak But Significant Moderate Additional Predictive Value**

The analysis provided strong evidence for age as the single most dominant predictor of MSDT outcomes. Adding MMST provides only weak additional predictive value for MSDT outcomes. Combining the results of four cognitive test used as standard screen in Swiss traffic medicine alone, proved to be of poor predictive value (9).

**Development of a Web-Based Mini-Driving Scene Screening Test (MDSST) for Clinical Practice in Driving Rehabilitation**

The web-based MDSST test developed in this study is a useful tool for detecting and understanding real-world driving situations faced by elderly drivers. It is hoped that the MDSST test can be applied more widely as a driving ability test that can be used in the clinical field of driving rehabilitation (10).

**Global Lessons Learned from Naturalistic Driving Studies to Advance Traffic Safety and Operation Research: A Systematic Review**

The proper deployment of Connected and Autonomous Vehicles (CAV) requires an appropriate level of human behaviour integration, especially at the intimal stages where both CAV and human-driven vehicles will interact and share the same roadways in a mixed traffic environment. In order to integrate the heterogeneous nature of human behaviour through behaviour cloning approach, real-time trajectory-level NDS data is essential. The insights from this study revealed that NDSs could be effectively leveraged to perfect the behaviour cloning to facilitate rapid and safe implementation of CAV (11).

**Association Between Suicidality and Risky Driving Among US Adolescents-Results From the 2019 Youth Risk Behaviour Survey**

Among the overall sample, 19% of participants self-reported suicidal ideation in the past 12 months, 16% of participants self-reported a suicide plan in the past 12 months, 9% of participants self-reported 1 or more suicide attempt in the past 12 months, and 3% of participants who self-reported a suicide attempt also self-reported a suicide-related injury. Adolescents who self-reported 1 or more suicide attempt in the past 12 months vs those who

reported none were 39% more likely to self-report infrequent seat belt use (PR, 1.39; 95% CI, 1.08-1.77; *P* < .01), 33% more likely to self-report driving with a drunk driver (PR, 1.33; 95% CI, 1.10-1.60; *P* = .003), and more than twice as likely to self-report driving drunk (PR, 2.02; 95% CI, 1.36-3.01; *P* < .001). Adolescents who self-reported a suicide injury in the past 12 months vs those who did not had the highest likelihood of reporting all 4 risky driving behaviours. For example, participants who self-reported a suicide injury were more than twice as likely to self-report driving drunk (PR, 2.50; 95% CI, 1.47-4.23) (12).

**Understanding Clinician Strategies for Discussing Driving Fitness with Patients: An Initiative to Improve Provider-Patient Discussions About Safe Driving**

The survey revealed that although most providers (68%) had high levels of perceived responsibility for counselling patients about driving, a minority regularly discussed driving issues with their patients (19% prior to discharge, 49% during clinic visits). In addition, only about half (54%) of providers reported having ever filed a report about a patient with the PennDOT, despite Pennsylvania's mandatory driver reporting law. Likelihood of PennDOT reporting was found to be strongly associated with provider knowledge of Pennsylvania unsafe driver reporting laws ($p < 0.001$) (13).

**Australian Bus Drivers' Modifiable and Contextual Risk Factors for Chronic Disease: A Workplace Study**

The quantitative results of this study reveal bus drivers have a cluster of poor health behaviours-limited physical activity, lower than recommended consumption of fruit and vegetables and high levels of sitting time during working-hours-which contribute to a high prevalence of overweight and obesity and a heightened risk of chronic disease. The qualitative findings suggest there are individual and structural barriers to improving drivers' modifiable health behaviours. Individual barriers include ingrained poor habits and more pressing life concerns, while structural barriers in the context of the workplace include time constraints, shift work, long days, a lack of work amenities and a general disconnect of drivers with their workplace (14).

**Impact of Chronic Pain (CP) on Driving Behaviour: A Systematic Review**

Findings suggest that drivers with CP engage in risk-compensatory strategies that are positive from a precautionary perspective. However, there is considerable variability in the use of such strategies across different samples, suggesting that there are significant barriers and facilitators involved in these decisions. Moreover, the findings provide some evidence that CP could increase crash risk and change driving behaviour. Evidence-based recommendations for practitioners and policymakers are proposed regarding the risks of driving in individuals experiencing CP (15)

**On-Road Driving Test Performance in Veterans: Effects of Age, Clinical Diagnosis and Cognitive Measures**

Referral diagnosis and age alone are not reliable predictors of Veterans' driving performance. Cognitive performance, specifically speed of processing and attention, may be helpful in screening Veterans' driving safety (16).

**Work, Physical Activity, And Metabolic Health: Understanding Insulin Sensitivity of Long-Haul Truck Drivers**

Long-haul truckers appear to represent a subset of the general population regarding the impact of physical activity and other metabolic risk factors on quantitative insulin sensitivity check index. Accordingly, comprehensive efforts which target these factors are needed to improve truckers' physical activity levels and other metabolic risks (17).

# 2. Neurology and Rehabilitation

## 2.1 General

**Learning To Drive with Neurological Conditions: Profile of Users of an Adapted Driver Training Program and Cognitive Factors Associated with Success**

Participants were aged between 15 and 56 years old (85% aged 15–25 years, 4% aged 26–35 years, 11% aged 36–56 years). 70% of participants had a primary diagnosis of a developmental or genetic condition, 23% of an acquired disorder, while the information was unknown for 7%. Several individuals had more than one individual diagnoses, including ADHD (*n* = 25), developmental language disorder (*n* = 17), dyspraxia (*n* = 10), ataxia (*n* = 6), cerebral palsy (*n* = 6), intellectual disability (*n* = 5), epilepsy (*n* = 4), traumatic brain injury (*n* = 4), and autism spectrum disorder (*n* = 4). These results suggest that approximately half of the persons enrolled in a driver training program designed for learners with neurological conditions, obtain a driver's license; and that attention, and to a lesser extent executive functioning and working memory, are related to driving program success (18).

**Investigating the Relationship Between Multiple Sclerosis Disability and Driving Performance: A Comparative Study of The Multiple Sclerosis Functional Composite and Expanded Disability Status Scale**

Cognitive dysfunction impacts driving performance more than physical dysfunction. The Multiple Sclerosis Functional Composite may provide valuable insights into the driving abilities of MS patients, potentially offering advantages over the Expanded Disability Status Scale in predicting driving performance (on ‘driving-related’ off-road tests) (19).

**Influence of Neurological Diseases on Mobility and Ability to Drive**

General overview of neurological illness and driving, in German (20).

**Car Accidents in Drivers with Parkinson's Disease or Multiple Sclerosis: A Swedish Nationwide Study**

Drivers with PD had more than twice the odds of a single-car accident than drivers with MS or ulcerative colitis (UC), but no differences were observed between MS and UC.

**Hazard Perception Skill and Driver Behaviour in Patients with Functional Neurologic Disorders**

The findings suggest that the ability of drivers with FND to predict traffic hazards in between attacks or flares is not worse than that of healthy individuals, with the possibility that it might even be better under some circumstances (21).

**Migraine Headaches Are Associated with Motor Vehicle Crashes and Driving Habits Among Older Drivers: Prospective Cohort Study**

Prevalent migraine was not associated with MVCs in the subsequent 2 years (adjusted OR (aOR) = 0.98; 95% CI: 0.72, 1.35), whereas incident migraine significantly increased the odds of having an MVC within 1 year (aOR = 3.27; 1.21, 8.82). Prevalent migraine was associated with small reductions in driving days and trips per month and increases in hard braking events in adjusted models (22).

**Relationship Between Self-Perceived Driving Ability and Neuropsychological Performance in Neurological and Psychiatric Patients**

Results suggested an overall agreement between self-reported and caregiver-referred driving behaviour; moreover, a relationship between self-referred driving behaviour and impulsiveness was found. However, neuropsychological performances were not related to self-perceived driving ability (23).

## 2.2. Acquired Brain Injury

**Difficulty Resuming Driving in Acute Acquired Brain Injury: Retrospective Observational Study Using Discriminant Analysis**

Patients with advanced age, history of falls, delayed TMT Part B, and poor ROCF outcomes may face challenges in resuming driving after ABI (24).

**The Impact of Age on Outcome 2 Years After Traumatic Brain Injury: Case Control Study**

Those who were older in age were disproportionately less likely to be independent in light domestic activities, shopping, and driving; and participated less in occupational activities relative to controls (25).

**(Simulated) Driving Performance Acutely After Mtbi Among Young Drivers**

The preliminary findings indicated that mTBI drivers tended to maintain more distance to the car in front of them than healthy controls. High cognitive load was associated with slower reaction time regardless of TBI status (26).

**Crash Risk Following Return to Driving After Moderate-To-Severe TBI: A TBI Model Systems Study**

Compared with national statistics, crash risk is higher following TBI based on self-report. Older age and less time since resuming driving were associated with lower crash risk. When driving was resumed was not associated with crash risk. These results do not justify restricting people from driving after TBI, given that the most who resumed driving did not report experiencing any crashes. However, there is a need to identify and address factors that increase crash risk after TBI (27).

**Fitness To Drive After Acquired Brain Injury: Results from Patient Cognitive Screening and On-Road Assessment Compared to Age-Adjusted Norm Values**

A binary regression analysis for the patient group showed an explained value for fit to drive/unfit to drive of 88%, including results for the Nordic Stroke Driver Screening Assessment total score, Useful Field of View total score and the final outcome from an on-road assessment (28).

**On-Road Driving Remediation Following Acquired Brain Injury: A Scoping Review**

Emerging evidence indicates a level of support for the use of on-road driving remediation as a rehabilitation tool following acquired brain injury. Further research is required to define which goals are suited to on-road remediation as a return to driving intervention and explore the capacity of participants to sustain any gains made through on-road driving remediation at follow-up (29).

**Return-To-Driving Following Acquired Brain Injury: A Neuropsychological Perspective**

39 of 200 individuals (approximately 20%) treated at an outpatient neurorehabilitation facility, who performed satisfactorily on a pre-driving cognitive screening, completed a behind-the-wheel driving test. RESULTS: Of the 200 individuals, 34 (87%) passed the road test.

Among the remaining five individuals who did not pass the road test, primary reasons for their failure included inability to follow or retain examiner directions primarily about lane position, speed, and vehicle control. The errors were attributable to cognitive difficulties with information processing, memory, attention regulation, and dual tasking (30).

**Driving Patterns, Confidence, and Perception of Abilities Following Moderate to Severe Traumatic Brain Injury: A TBI Model System Study**

Most respondents reported driving daily, although 41% reported driving less than before their injury. Driving patterns were primarily associated with employment, family income, sex, residence, and time since injury, but not injury severity. Confidence in driving was high for most participants and was associated with a perception that the TBI had not diminished driving ability. Lower confidence and perceived loss of ability were associated with altered driving patterns (31).

## 2.3 Stroke

**Fitness-To-Drive Recommendations in Post-Stroke Patients: A Retrospective Study**

Findings showed that 64% of stroke patients received a favourable fitness-to-drive recommendation. Across all demographics, clinical, and driving characteristics, the time interval between stroke and assessment was significantly longer for patients designated as unfit to drive than for those designated as fit to drive (P = .004). Furthermore, the proportion of instrumental sequelae was higher in patients designated as unfit to drive than in those designated as fit to drive (P = .022) (32).

**Implications For Driving Based on The Risk of Seizures After Ischaemic Stroke**

Seizure risks in the next year were mainly influenced by the baseline risk-stratified according to the SeLECT(2.0) score and, to a lesser extent, by the poststroke seizure-free interval (SFI). Those without acute symptomatic seizures (SeLECT(2.0) 0-6 points) had low COSY (0.7%-11%) immediately after stroke, not requiring an SFI. In stroke survivors with acute symptomatic seizures (SeLECT(2.0) 3-13 points), COSY after a 3-month SFI ranged from 2% to 92%, showing substantial interindividual variability. Stroke survivors with acute symptomatic status

epilepticus (SeLECT(2.0) 7-13 points) had the highest risk (14%-92%).(33) and commentary (34).

**Knowing Me, Knowing You-A Study on Top-Down Requirements for Compensatory Scanning in Drivers with Homonymous Visual Field Loss**

Participants with an overestimation of their visual field size tended to prioritize their seeing side over their blind side both in subjective and objective measures. The mental model of the driving scene showed close relations to the subjective and actual attention allocation. While participants with homonymous visual field loss were less anticipatory in their usage of the visual precursors and showed poorer performances compared to participants with normal vision, the results indicate a stronger reliance on top-down mechanism for drivers with visual impairments. A subjective focus on the seeing side or on near peripheries more frequently led to bad performances in terms of collisions with crossing cyclists (35).

**Motor-Cognitive Functions Required for Driving in Post-Stroke Individuals Identified Via Machine-Learning Analysis**

Authors propose a machine-learning algorithm that introduces sparse regularization to automatically select driving aptitude-related indices from 65 input indices obtained from 10 tests of motor-cognitive function conducted on 55 participants with stroke. The experimental results showed that the proposed method achieved predictive evaluation of the presence or absence of driving aptitude with high accuracy (area under curve 0.946) and identified a group of indices of motor-cognitive function tests that are strongly related to driving aptitude (36).

**Is It Safe to Control the Car Pedal With The Lower Limb Of The Unaffected Side In Patients With Stroke?**

Patients with hemiplegia exhibited poor control of pedal switching using their unaffected side throughout the pedal-switching task (37).

**The Effects of Visual Field Loss from Stroke on Performance in a Driving Simulator**

Sixty-five percent of the stroke participants passed the simulator test (95% confidence interval, 57 to 72%). Younger patients were more successful than older. However, classification by neither type of homonymous visual field loss nor side of visual field loss was

predictive of driver safety. Participants with hemianopia had their lateral lane position dislocated to the nonaffected side of the visual field. None of the participants with a regained license were involved in motor vehicle accidents 3 to 6 years after the test (38).

**Rethinking Driving Against Medical Advice: The Situated Nature of Driving After Stroke**

Any jurisdictions mandate a 30-day period of driving restriction post-stroke. However, between 26% and 38% of clients drive against medical advice during this period. Re-conceptualizing driving after stroke as a transactional occupational choice provides a productive basis for understanding and addressing driving within practice and research (39).

**Recovery of Driving Fitness After Stroke: A Matter of Time?**

Overall, the data do not allow the definition of a generally valid length of a driving break that guarantees driving safety poststroke. When it is safe to drive again, should rather be a person-centred decision based upon a formal on-road driving evaluation (40).

## 2.4 Developmental disorders

**The Self-Reported Driving and Pedestrian Behaviour of Adults with Developmental Coordination Disorder**

Adults with DCD felt less confident and reported more lapses in attention (e.g., forgetting where their car was parked) and errors (e.g., failing to check their mirrors prior to a manoeuvre) when driving compared to typically developed (TD) adults. Adults with DCD also reported feeling less confident and reported less adherence to road traffic laws (e.g., not waiting for a green crossing signal before crossing the road) when walking as pedestrians (41).

**Cervical Spondylotic Myelopathy and Driving Abilities: Defining the Prevalence and Long-Term Postoperative Outcomes Using the Quality Outcomes Database**

Nearly one-third of patients with CSM report impaired driving ability at presentation. Seventy-two percent of these patients reported improvements in their driving ability within 24 months of surgery. Surgical management of CSM can significantly improve patients' driving abilities at 24 months and hence patients' quality of life (42).

## 2.5 Parkinson's

**Parkinson's Disease and Driving Fitness: A Systematic Review of the Existing Guidelines**

Neurological aspects of driving fitness evaluation of PD patients are recognized in most of the guidelines. Motor, neuropsychological, visual, and sleep assessment and medication review are key components. Clear-cut instructions regarding motor, neuropsychological, and visual tests and relative cutoff values are lacking. Conditional licenses and periodical re-evaluation of driving fitness are important safety measures (43).

**Clinical Factors Predicting Voluntary Driving Cessation among Patients with Parkinson's Disease**

Patients who decided on driving cessation had a higher prevalence of freezing of gait (FOG) (D vs. RD, 25.0% vs. 87.5%; P = 0.001) and tended to have lower scores for attention in the MoCA-J (D vs. RD, 5.0 ± 1.2 vs. 4.1 ± 1.4; P = 0.086). Multivariable analysis showed that FOG was independently associated with driving cessation (odds ratio: 14.46, 95% confidence interval: 1.91-303.74). FOG was associated with voluntary driving cessation in patients with PD without dementia or severe motor impairment (44).

**Parkinson's Disease Affects Gaze Behaviour and Performance of Drivers in Simulated Task**

Parkinson's disease (PD) and ageing process caused a drop in driving performance. Drivers with PD made fewer fixations on task-relevant information and showed higher visual entropy than young adults. Older drivers restricted their visual search to the lane than other areas of interest (45).

**Driving and Parkinson's Disease: A Survey of the Patient's Perspective**

Authors found that the loss of a driving licence had an adverse impact on employment, socialisation, travel costs and spontaneous lifestyle choices. Multiple changes in driving ability related to PD were described, including that impulse control disorders can have an adverse impact on driving. Changes in driving ability caused people to change their driving practices including taking shorter journeys and being less likely to drive at night. Participants advised managing changes in driving ability through planning, vehicle adaptions, maintaining skills and self-assessment (46).

## 2.6 Epilepsy

**Impact of Antiepileptic Drugs (Aeds) On Simulated Driving in Patients With Epilepsy (PWE)**

The present results demonstrated that the driving performance of PWE taking AEDs was not different from that of healthy volunteers (47).

**Clearance For Driving in Genetic Generalized Epilepsy**

Child neurologists and paediatric epileptologists were surveyed on key questions that practitioners should ask prior to providing clearance for driving. The results showed a wide variability of practice among responders. We propose a likely appropriate process necessary to determine seizure control (48).

**Seizure a Social Outcomes in Patients with Juvenile Myoclonic Epilepsy (JME)**

One hundred and thirty-five patients were studied (92 women (68.1%) and 43 men (31.9%)). Fifty-three patients (39.3%) were seizure-free (of all seizure types) during the past 12 months; 91 patients (67.4%) reported to be free of generalized tonic-clonic seizures. At the time of the follow-up call, 71 patients (52.6%) reported having a college education, 56 patients (41.5%) were employed, 87 patients (64.4%) were married, and 57 patients (42.2%) reported driving a motor vehicle in their routine daily lives. In total, 101 patients (74.8%) reported that their status (generally, and considering all the variables) was better than that it used to be five years ago (49).

# 3.Substance use and abuse

## 3.1 Cannabis

**Cannabis-Based Medicines and Medical Fitness-To-Drive: Current Legal Issues in Switzerland**

It has been observed that there is little evidence to justify the differential treatment of patients taking cannabis-based medicines compared with those taking other medications potentially impairing driving performances (50).

**Factors Related to The Low-Risk Perception of Driving After Cannabis Use**

Lower risk perception of DACU was associated with identifying as male, weekly to daily cannabis use, engagement in DACU, general risky driving behaviours, being a passenger of a driver who engages in DACU, number of friends who engage in DACU, and peer approval of DACU (51).

**Perceptions and Attitudes Related to Driving after Cannabis Use in Canadian and US Adults**

Compared to US participants, Canadians perceived driving within two hours of cannabis use as more dangerous ($P < 0.001$, $\eta(p)(2) = 0.013$) and reported more of their friends would disapprove of DACU ($P = 0.03$, $\eta(p)(2) = 0.006$), (52).

**Cannabis Legalization and Driving Under the Influence of Cannabis and Driving Under the Influence of Alcohol Among Adult and Adolescent Drivers in Ontario, Canada (2001-2019)**

An increased likelihood of driving under the influence of cannabis among adults ≥55 years of age was detected in the year following cannabis legalization, suggesting the need for greater public awareness and education and police monitoring and enforcement concerning driving under the influence of cannabis, particularly among older adults (53).

**Can Inhaled Cannabis Users Accurately Evaluate Impaired Driving Ability? A Randomized Controlled Trial**

Cannabis consumption leads to a rapid reduction in driving confidence which is related to reduced ability on a driving simulator (54).

**A Semi-Naturalistic Open-Label Study Examining the Effect of Prescribed Medical Cannabis Use on Simulated Driving Performance**

This semi-naturalistic study suggests that the consumption of medical cannabis containing THC (1.13-39.18 mg/dose) has a negligible impact on driving performance when used as prescribed (55).

**Driving Under the Influence of Cannabis: A 5-Year Retrospective Italian Study**

The present research discussed the main difficulties in the toxicological evaluation of drivers under the influence of Cannabis. Issues related to the time between RTA and sample collection, the laws, and legal limits in force in various Countries were presented (56).

**Enhancing the Standardised Field Sobriety Test to Detect Cannabis Impairment: An Observational Study**

The results of this study support supplementing the SFST with the Finger-to-Nose test and observations of HMJ to assist in the detection of drivers who are adversely affected by the use of cannabis (57).

**Trends in Drivers Testing Positive for Drugs of Abuse in Oral Fluid From 2018 To 2021 in France**

Cannabis was the most prevalent drug of abuse identified, suggesting that a general prevention program might be useful. The results also highlight the need for LC-MS/MS confirmation when screening oral fluid for drugs of abuse (58).

**Synthetic Cannabinoids in Hair-Prevalence of Use in Abstinence Control Programs for Driver's License Regranting in Germany**

The analysis of 5097 hair samples resulted in 181 SC detections (3.6%), showing a wide range of 44 SCs, with up to 13 different compounds found in a single sample. The most prevalent compounds were 5F-MDMB-PICA and MDMB-4en-PINACA; furthermore, 10 new substances not initially covered by LC-MS/MS analysis were detected by LC-qTOF/MS, (59).

**Effect of Vaporizing Cannabis Rich in Cannabidiol on Cannabinoid Levels in Blood and on Driving Ability - A Randomized Clinical Trial**

After single consumption THC dropped below 1.5 µg/L after 1.5 h but was detected in some participants up to 5 h. Pairwise comparison of driving-related ability revealed no significant differences between low-THC/CBD-rich products (P1, P2) and placebo. Detection of THC after consumption of low-THC/CBD-rich cannabis might have legal consequences for drivers (60).

**Associations Of Cannabis Use with Motor Vehicle Crashes and Traffic Stops Among Older Drivers: AAA Long Road Study**

We did not find a statistically significant association of past-year cannabis use with MVC, (61).

**The Association Between Vaping and Driving Under the Influence of Cannabis Among U.S. Young Adults**

This study found positive associations between past-year vaping, cannabis use, and cannabis driving under the influence among U.S. young adults, indicating that vaping was positively associated with cannabis use (62).

**Effects of Cannabis Legalization on Road Safety: A Literature Review**

It can be concluded that the legalization of medical and/or recreational cannabis has negative effects on road safety when considering the number of jobs that affect the number of fatalities (63).

**Self-Reported Impacts of Recreational and Medicinal Cannabis Use on Driving Ability and Amount of Wait Time Before Driving**

Cannabis users may not wait before driving even if they think it has a negative impact on their driving ability (64).

**The "Next Day" Effects of Cannabis Use: A Systematic Review**

Some lower quality studies have reported "next day" effects of THC on cognitive function and safety-sensitive tasks. However, most studies, including some of higher quality, have found no such effect. Overall, it appears that there is limited scientific evidence to support the assertion that cannabis use impairs "next day" performance (65).

**Perceived Safety, Not Perceived Legality, Mediates the Relationship Between Cannabis Legalization and Drugged Driving**

The study found that perceived safety (risk ratio (RR) = 2.60, 95% CI (1.88, 3.58)), but not perceived legality (RR = 0.96, 95% CI (0.67, 1.37)), was significantly associated with DUIC. Perceived safety mediated the relationship between legalization and DUIC (Coeff: -0.12, 95% CI (-0.23, -0.01)), (66).

**Influence of Cannabis Use History on the Impact of Acute Cannabis Smoking on Simulated Driving Performance During a Distraction Task**

Those with a pattern of occasional use were significantly more likely to experience a lane departure during distraction periods after acute cannabis use relative to baseline (OR = 3.71, p = 0.04, CI = 1.04, 13.17), while those with daily use did not exhibit a similar increase (OR = 1.56, p = 0.43, CI = 0.52, 4.64). Changes in departure risk were significantly greater for the occasional use group compared to no-use (p = 0.02), but not for the daily use group compared to no-use (p = 0.18), (67).

**Mobile-Based Brief Interventions Targeting Cannabis-Impaired Driving Among Youth: A Delphi Study**

Findings can inform the development of mobile-based brief interventions for youth, an essential step in reducing DUIC among youth and addressing this public health concern (68).

**Typologies Of Canadian Young Adults Who Drive After Cannabis Use (DACU): A Two-Step Cluster Analysis**

The identified subgroups were: (1) frequent cannabis users who regularly DACU; (2) individuals with generalized deviance with diverse risky road behaviours and high levels of psychological distress; (3) alcohol and drug-impaired drivers who were also heavy frequent drinkers; and (4) well-adjusted youths with mild depressive-anxious symptoms. Individuals who engaged in DACU were not a homogenous group. When required, prevention and treatment need to be tailored according to the different profiles (69).

**Perceptions of the Health Risks of Cannabis: Estimates from National Surveys in Canada and the United States, 2018-2019**

Overall, the findings demonstrate a substantial deficit in knowledge of the health risks of cannabis, particularly among frequent consumers (70).

**Are Blood And Oral Fluid Δ (9)-Tetrahydrocannabinol (THC) and Metabolite Concentrations Related To Impairment? A Meta-Regression Analysis**

Blood and oral fluid THC concentrations are relatively poor indicators of cannabis/THC-induced impairment (71).

**Self-Regulation of Driving Behaviour Under the Influence of Cannabis: The Role of Driving Complexity and Driver Vision**

Visual function was significantly impaired after cannabis use. Recreational cannabis use did not result in self-regulation, although some road features such as curved roads did determine self-regulation (72).

**Influence of Personality on Acute Smoked Cannabis Effects on Simulated Driving**

Higher trait impulsivity was significantly associated with greater reductions in driving speed after cannabis use, which may reflect greater sensitivity to drug effects and a stronger compensatory response (73).

**Estimating Cannabis Involvement in Fatal Crashes in Washington State Before and After the Legalisation of Recreational Cannabis Consumption Using Multiple Imputation of Missing Values**

In the combined observed and imputed data, the proportion of drivers positive for THC was 9.3% before and 19.1% after legalization (adjusted prevalence ratio: 2.3, 95% confidence interval: 1.3, 4.1). The proportion of drivers with high THC concentrations increased substantially (adjusted prevalence ratio: 4.7, 95% confidence interval: 1.5, 15.1), (74).

**Medicinal Cannabis and Driving: The Intersection of Health and Road Safety Policy**

Road safety risks associated with medicinal cannabis appear similar or lower than numerous other potentially impairing prescription medications (75).

## 3.2 Alcohol

**Modelling of Drinking and Driving Behaviours Among Adolescents and Young Adults in the United States: Complexities and Intervention Outcomes**

We developed a system dynamics simulation model of drinking and driving behaviours among adolescents and young adults (76).

**Driving Under the Influence of Alcohol and Alcohol Use Disorder: The Relevance of Early Identification from an Italian Retrospective Outpatient Study**

Forty-eight (6.4%) of DUI subjects who had their driving license suspended, presented a diagnosis of AUD, after one month they showed a statistically significant reduction of carbohydrate-deficient transferrin (CDT) ($p<0.0001$); however, none were following a program for the treatment of AUD (77).

**Drinking And Driving: A Systematic Review of the Impacts of Alcohol Consumption on Manual and Automated Driving Performance**

The literature indicates that different Blood Alcohol Concentration (BAC) levels affect driving skills essential for traffic safety at various information processing stages, such as delayed reacting time, impaired cognitive abilities, and hindered execution of driving tasks. Additionally, the driver's driving experience, drinking habits, and external driving environment play important roles in influencing driving performance (78).

**Evaluation of Harmful Drinking Among Professional Drivers by Direct Ethanol Biomarkers and its Relationship with Psychological Distress**

A noteworthy proportion of drivers engaging in regular alcohol consumption alongside a demanding workload. Notably, PEth measurements highlighted an underreporting within the AUDIT-C self-reports. These results lend robust support for the utilization of biomarkers in assessing alcohol consumption patterns among drivers (79).

**Drink…Then Drive Away: The Effects of Lowering the Blood Alcohol Concentration in Utah**

Results show the policy (changing from 0.8 to 0.5) appears to temporarily decrease the total number of accidents, limited primarily to property damage- only accidents. We believe these

results may be partially explained by drivers who, after the policy is enacted, avoid reporting property damage-only accidents if possible (80).

**Impact of Alcohol Driving-While-Impaired License Suspension Duration on Future Alcohol-Related License Events and Motor Vehicle Crash Involvement in North Carolina, 2007 To 2016**

The authors found that compared to those with an initial suspension, those with repeat suspensions had a lower incidence of future license (aHR: 0.49; 95 % CI: 0.42, 0.57) and crash outcomes (aHR: 0.67; 95 % CI: 0.60, 0.75), (81).

**The Relative Risk of Alcohol-Involved Crashes as a Function of Time of Day**

Authors observed significantly greater risk of crash during the night versus the day at blood alcohol concentrations (BACs) between approximately .04 and .12 g/dl. Based on fitted point estimates, at .08 g/dl, the risk of crash at night was three times the risk of crash during the day (82).

**Vision Zero and Impaired Driving: Near and Longer-Term Opportunities for Preventing Death and Injuries**

Zero fatalities or serious injuries in motor vehicle crashes is possible with a systems approach that accommodates human errors and mistakes that occur with the normal driving envelope and incorporates effective responses to deliberate risk-taking outside of this envelope (83).

**Association of an Alcohol Abstinence Program with Mortality in Individuals Arrested for Driving While Alcohol Impaired**

These findings add a public health dimension to the growing evidence that 24/7 sobriety improves public safety by reducing rearrest. To the authors knowledge, this is the first evidence from individual-level data that such programs may also improve health outcomes (84).

**Place of Last Drink Enforcement: Effects on Alcohol-Related Traffic Crashes**

This study found little evidence that the POLD initiative, as currently implemented, was associated with reductions in traffic crashes across communities in Minnesota (85).

**Confectionary Containing Alcohol and Their Effect on Breath Analyser Results: A Preliminary Study**

This preliminary study interprets false positivity of the breath test after consumption over-the-counter confectionery (86).

**Reduced Alcohol Use Increases Drink-Refusal Self-Efficacy (DRSE): Evidence from a Contingency Management Study for DWI Arrestees**

While there were no differences in baseline DRSE between the three trajectory groups, participants in the low- and moderate-frequency drinking behaviour groups significantly increased DRSE across the study (87).

**Should We Throw the Book At 'Em? Charge Combinations and Conviction Rates Among Alcohol-Influenced Drivers Involved in Motorcycle Crashes**

After adjusting for BAC, drivers with a combination of Alcohol, Administrative, and Moving Violation charges had more than three times the odds of conviction of any charge compared to drivers with alcohol only charges (OR = 3.21, 95% CI = 1.00-10.26). However, charge combinations had little impact on alcohol-related convictions (88).

**New Evidence of High Association Between Carbohydrate Deficient Transferrin (CDT) and Alcohol-Related Road Traffic Accidents. A Retrospective Study On 929 Injured Drivers**

The reported data strongly support the use of CDT as a biomarker of increased risk of alcohol-related traffic accidents in the procedures of re-granting of the driving license upon confiscation for "drink driving" (89).

**Trend in Alcohol-related Crashes Before and After the Introduction of Mandatory Breath Testing Among Commercial Truck Drivers**

The effect of mandatory alcohol breath testing on reducing alcohol-related crashes among commercial truck drivers was not evident (90).

**What Determines the Success of States in Reducing Alcohol Related Crash Fatalities? A Longitudinal Analysis of Alcohol Related Crashes in The U.S. From 1985 To 2019**

The findings suggest that states which have more restrictive laws and enforce them are more likely to significantly reduce alcohol-related crash fatalities (91).

**An Extra Hour Wasted? Bar Closing Hours and Traffic Accidents in Norway**

Extensions in closing hours in populous municipalities decrease accidents, whereas the opposite is true for rural municipalities (92).

**Predicting Drunk Driving Using a Variant of the Implicit Association Test**

The P-DUI-IAT is a promising tool for identifying which individuals are at risk of drunk driving. The application of this measure could especially be valuable for identifying young novice drivers at risk for drunk driving-related accidents (93).

**The Prevalence of Alcohol-Involved Crashes Across High and Low Complexity Road Environments: Does Knowing Where Drinking Drivers Crash Help Explain Why They Crash?**

Across multiple models, controlling for time of day and type of road, alcohol-involved crashes were significantly underrepresented in crashes at intersections, with moving objects, and other vehicles. Most strikingly, alcohol-involved crashes were 24 percentage points more likely to be with a stationary object than a moving object (94).

**Ethyl Glucuronide in Hair: A 5-Year Retrospective Cohort Study in Subjects Sanctioned for Driving Under the Influence of Alcohol and Psychoactive Substances**

A general decreasing trend over time in hEtG values was observed. Being male, age ≥ 55 years, and coming from rural areas are potential risk factors related to alcohol drinking habits among drivers. Ethyl glucuronide in hair test in the driving license reissuing protocol contributed to decrease alcohol misuse behaviours (95).

**Examining the Role of Trauma in Alcohol Interlock (IID) Performance: A Structural Pathway Analysis**

Traumatic experiences are in of themselves insufficient to impact IID performance directly, but it may indirectly impact IID performance through increasing alcohol use (96).

**The Alcohol Industry's Involvement with Road Safety Ngos**

The study showed a clear effort on behalf of the alcohol industry to partner with road safety NGOs around the world. Findings underscore the need for the road safety community to generate consensus on involvement of the alcohol industry and suggest the need for more transparency on details of partnerships involving road safety. Findings also highlight the importance of local and national government support of road safety initiatives and road safety NGOs to avoid dependence on controversial funding from the alcohol industry (97).

**Decision Strategies While Intoxicated Relate to Alcohol-Impaired Driving (AID) Attitudes and Intentions**

Results suggest that risk for engaging in AID is higher for those using a cost-sensitive, compensatory strategy when making AID decisions under intoxication. Future research is needed to test whether AID countermeasures (e.g., subsidized ride services) are differentially effective according to decision strategy type (98).

**Reassessing Fitness-to-Drive in Drinker Drivers: The Role of Cognition and Personality**

Personality measures should be assessed with particular attention in a forensic context because they are more prone to be feigned than cognitive ones. Overall, the present study confirmed the relevance of integrating different driving-related psychological dimensions in the evaluation of fitness-to-drive showing the usefulness of standardized tools for the reassessment of drinker drivers (99).

**The Hazardous (Mis)Perception of Self-Estimated Alcohol Intoxication and Fitness to Drive-an Avoidable Health Risk: The SAFE Randomised Trial**

Social drinkers are commonly unaware of exceeding the legal driving limit when consuming alcohol. Self-estimating alcohol intoxication can be improved through awareness (100).

**Alcohol-Related Deaths Among Young Passengers: An Analysis of National Alcohol-Related Fatal Crashes**

Most 15-20 y/o riding with an impaired driver fatalities occurred on weekends, at night, when the driver was a young peer with a high BAC, and the passenger and driver were male. The

high prevalence of fatalities in these high-risk situations suggests that young driver-passenger dynamics may contribute to alcohol-related fatalities. Practical Applications: To curb RWI fatalities among underage passengers, countermeasures should focus not only on underage drinking drivers and riders, but also on drinking drivers of all ages. Prevention should increase focus on situations in which both the young passenger and young driver are males (101).

**In-Vehicle Alcohol Detection Using Low-Cost Sensors and Genetic Algorithms to Aid in the Drinking and Driving Detection**

The experiments yielded 7200 samples, 80% of which were used to train the model. The rest were used to evaluate the performance of the model, which obtained an area under the ROC curve of 0.98 and a sensitivity of 0.979. These results suggest that the proposed methodology can be used to detect the presence of alcohol and enforce prevention actions (102).

**Global Estimates of The Attributable Risk of Alcohol Consumption on Road Injuries**

PAR for alcohol and road injuries is not homogenous. Large PAR for alcohol and road deaths was found in Europe, among men, young adults, and motorcyclists. These results could help public health agencies, law enforcement, and the public guide efforts to reduce these deaths (103).

**Alcohol-Impaired Driving (AID) Among Adults-USA, 2014-2018**

Although AID episodes declined from 2016 to 2018, AID was still prevalent and more common among men and those who binge drink. Most reporting AID received routine healthcare. Proven AID-reducing strategies exist (104).

**State Alcohol Ignition Interlock Laws and Fatal Crashes**

All-offender laws were associated with 26% fewer drivers with 0.08+ BAC involved in fatal crashes, compared with no law. Repeat-offender laws were associated with a 9% reduction in impaired drivers, compared with no law. Repeat and high-BAC laws were associated with a 20% reduction in impaired drivers in fatal crashes, compared with no law (105).

**Cigarette Smoking as a Predictor of Male DUI Recidivism**

In a model including age at DUI, education, and smoking habit as independent variables, higher educational levels (high school, bachelor's) and older age protected against recidivism, whereas smoking >20 cigarettes/day was an independent risk factor for recidivism (106).

**The Effectiveness of Alcohol Monitoring as a Treatment for Driving-While-Intoxicated (DWI) Offenders: A Literature Review and Synthesis**

The literature shows that there is promising to strong evidence that alcohol monitoring is an effective component in treating DUI offenders and reducing recidivism rates (107).

**CDT Vs. GGT For the Certification of the Fitness to Hold the Driving License. A Comparison Based on the Association for Incremented Values with the Occurrence of Alcohol-Related Road Traffic Accidents**

Both GGT and CDT provide objective evidence of an association with the occurrence of alcohol-related severe traffic accidents, but CDT shows superior association with these events. Therefore, CDT, notwithstanding higher costs, should be preferred in a forensic/certification context (108).

**Evaluating 24/7 Sobriety Program Participant Re-Offense Risk**

Older drivers were 6.31 times more likely to reoffend than the younger driver cohort of 18-35-years. The survival curve slope showed the fastest decline in the 361-day to 730-day interval. Neither gender nor residence region was a significant predictor in DUI re-offense over the three-year monitoring interval. Preliminary work suggests re-offense was more likely if an individual had program history prior to this court mandated 360-day term in the 24/7 Sobriety Program for a second DUI (109).

**Driving License Regranting in DUI Subjects: Road Accident Variables and Predictive Factors of Substance Use Disorder**

Parameters such as psychoactive substances and BAC at the time of the road crash/DUI and the day of the week, when subjects were involved in the road accident or found DUI, resulted in significant differences ($p < 0.01$) between groups. The model's independent variables of BAC > 1.5 g/L ($p = 0.013$), BAC > 2.5 g/L ($p < 0.001$), and concurrent alcohol and psychoactive

substance use ($p < 0.001$) were independent risk factors for an accident. Smoking >20 cigarettes/day was an independent risk factor for unfitness to drive ($p < 0.01$). Unfitness to drive was based primarily on ethyl glucuronide levels >30 pg/mg. The results suggest a detailed assessment of DUI subjects with variables associated with accidents (BAC > 1.5 g/L and concurrent intake of psychoactive substances). Hair analysis, including ethylglucuronide (EtG) concentration, should be always performed. Based on the results, nicotine use should be investigated in cases of driving license regranting (110).

**Longitudinal Effects of Social Network Changes on Drinking Outcomes for Individuals with A First-Time DUI**

These results suggest that individuals receiving services in DUI programs significantly reduced risky network members over time and that these social network changes were associated with reduced drinking and other indicators of risk for DUI recidivism. Clinical interventions that target reductions in risky network members may improve outcomes for those enrolled in a DUI program (111).

**Examining the Relationship Between Impaired Driving and Past Crash Involvement in Europe: Insights from the ESRA Study**

Binary logistic analysis indicated that components involving overall personal and communal acceptance of impaired driving, overall and past year personal behaviour towards impaired driving and frequency of typical journey checks by traffic police were all quantities positively correlated with past crash involvement (112).

## 3.3 Combined cannabis and alcohol

**Trends in Cannabis Involvement and Risk of Alcohol Involvement in Motor Vehicle Crash Fatalities in the United States, 2000–2018**

The percentage of fatalities involving cannabis and co-involving cannabis and alcohol doubled from 2000 to 2018, and cannabis was associated with alcohol co-involvement (113).

**The Role of Parenting Behaviours and Their Influence on Adolescent Drunk and Drugged Driving: 2016-2019, USA**

Differences were found in specific parenting behaviours and adolescent drugged/drunk driving, with parents not checking homework and not telling their children they are proud of them being the most influential (114).

**Young Adult Alcohol and Cannabis Impaired Driving After the Opening of Cannabis Retail Stores in Washington State**

Prevalence of DUIA decreased overall (AOR = 0.93, 95% CI 0.90, 0.97) and among drinkers (AOR = 0.95, 95% CI 0.91, 0.99) but remained at concerning levels in 2019 (10% overall; 16% among drinkers). Overall DUIC did not change significantly (AOR = 0.99, 95% CI 0.96, 1.03; 11% by 2019) but decreased among those who used cannabis (AOR = 0.91, 95% CI 0.86, 0.96; 33% by 2019). DUIAC decreased but not significantly (overall: AOR = 0.89, 95% CI 0.78, 1.01; those who used alcohol and cannabis: AOR = 0.84, 95% CI 0.74, 1.04), (115).

**The Association Between Single and Dual Use of Cannabis and Alcohol and Driving Under the Influence and Riding with an Impaired Driver in a Large Sample of Canadian Adolescents**

Gender diverse, older, and students with lower socioeconomic status exhibited a higher likelihood of reporting alcohol-cannabis-IDR. Dual use was significantly associated with 9.5 times higher odds of alcohol-cannabis-IDR compared to alcohol-only use, and 3.0 times higher odds compared to cannabis-only use. Dual use was also associated with an increased likelihood of either alcohol- or cannabis-IDR (116).

**Delays in Blood Collection and Drug Toxicology Results Among Crash-Involved Drivers Arrested for Impaired Driving – Alcohol, Cannabis**

Crash severity and the time of day at which a crash occurs can result in delays in the collection of blood specimens after impaired driving arrests. Because drugs often continue to be metabolized and eliminated between arrest and biological specimen collection, measured concentrations may not represent the concentrations of drugs that were present at the time of driving. This has the potential to affect drug-impaired driving prosecution, particularly in jurisdictions whose laws specify per se impairment thresholds (117).

**Drug Driving in Italy. The Results of the First Roadside Drug Testing Service Utilizing On-Site Confirmatory Analysis Between 2019 And 2022**

The prevalence of drivers testing positive for illicit drugs resulted to be higher compared to the results obtained in the DRUID project and to other surveys previously performed in Italy (118).

**Colorado Drugged Driving Prevalence and Impaired Driving Conviction Rates: Effects of Impaired Driving Definitions and A 5-Nanogram Limit For Delta-9 Tetrahydrocannabinol**

The largest component of drugged driving was polydrug impairment, rather than impairment by a single drug like THC. Conviction rates in 2020 were 91% for alcohol only, 90% for polydrug cases, and 72% for THC only (119).

**All-Cause and Cause-Specific Mortality Among Individuals Imprisoned for Driving Under the Influence Of Alcohol and Drugs In Norway (2000-2016): A Retrospective Cohort Study**

The risk of all-cause mortality was significantly elevated for those convicted of DUI, but only in combination with other types of crimes (120).

**Do Crashed Drivers Need More Drug Testing? A Retrospective Analysis of Blood Samples from Hospitalised Post-Crash Drivers in New Zealand**

A driver having at least one prior drink and drug driving offence is 61% more likely to be positive for a drug of interest when involved in a crash. Similarly, a driver having at least one prior non-traffic drug offence is 4.7 times more likely to be positive for at least a drug of interest when involved in a crash (121).

**Cannabis Adaptation During and After Alcohol Ignition Interlock Device Installation: A Longitudinal Study**

Drivers who decreased their alcohol use while the IID was installed on their car significantly increased their cannabis use while the IID was in place and further increased cannabis use after the device's removal (122).

**Drivers and Passengers in Vehicles Driven Under the Influence of Alcohol or Marijuana: Behaviour Profiles and Risk Factors Among Young Adults in a Longitudinal Study**

Relative to the other classes, alcohol and marijuana risk takers were more likely male, heterosexual, and White, and alcohol and marijuana risk takers reported greater depressive symptoms. Influences of parent/peer alcohol versus marijuana use were specific to the respective DUI risk behaviours. No differences emerged for legal marijuana retail (123).

**Simultaneous Alcohol/Cannabis Use and Driving Under the Influence in the U.S**

Overall, 2 in 5 drivers who used alcohol and cannabis reported driving under the influence of alcohol and/or cannabis. People reporting simultaneous alcohol/cannabis use were more likely to report cannabis-related driving under the influence. Prevention strategies should target individuals reporting simultaneous alcohol/cannabis use to reduce the occurrence of driving under the influence (124).

**The Effects of Cannabis and Alcohol on Driving Performance and Driver Behaviour: A Systematic Review and Meta-Analysis**

This meta-analysis indicates that cannabis, like alcohol, impairs driving, and the combination of the two drugs is more detrimental to driving performance than either in isolation (125).

## 3.4 Other drugs

**Trait Anger as A Predictor of Dangerous Driving Behaviour Amongst People Who Use Methamphetamine**

The trait anger is a strong predictor of risky driving among road users who use methamphetamine. Interactions between stable negative-emotional and situational traffic and driving-related factors may increase risk of harm through greater engagement in risk-taking behaviour (126).

**Enantiomeric Profile of Amphetamines in Seized Drug Samples and in Blood of Impaired Drivers in Iceland: The Rise Of (R)-Methamphetamine?**

The findings of this study show a significantly lower blood concentration in drivers with only S-AMP detected compared with when the R-isomer is also detected (127).

**A Two-Year Review of Cocaine Findings in Impaired Driving Investigations in Ontario, Canada**

Driving observations reported by the arresting officer in cases where cocaine and/or benzoylecgonine were the only drug finding in blood and urine included the driver being involved in a collision, the vehicle leaving the roadway, erratic driving and the driver being asleep at the wheel; observations of drug impairment reported by the drug recognition expert at the time of driver evaluation included abnormal speech patterns, poor balance/incoordination, abnormal body movements and the individual falling asleep (128).

**Driving Under the Influence of Cocaine and MDMA: Relationship Between Blood Concentrations and Results from Clinical Test of Impairment**

There was a statistically significant difference in the median cocaine concentration between drivers assessed as not impaired (0.07 mg/L) and drivers assessed as impaired (0.10 mg/L) ($P = 0.009$). The median MDMA concentration was 0.19 mg/L (range: 0.04-1.36 mg/L), and 38% were clinically impaired (129).

**Sex Differences and Driving Impairment Related to Psychoactive Substances**

Men exhibited a higher prevalence of tobacco, alcohol, and illicit psychoactive substance use. Women were more frequently co-users of alcohol and psychoactive substances and involved in road accidents at the time of DUI. Among the men, being married or having a partner was found to be a protective factor concerning past traffic accidents. For both sexes, a DUI episode with a blood alcohol concentration (BAC) exceeding 1.5 g/L or the co-ingestion of alcohol and drugs was identified as a risk factor for road accident involvement. For men, smoking more than 20 cigarettes per day and, for women, having a DUI episode with a BAC over 1.5 g/L were the main factors indicating unfitness to drive, as determined through high hair EtG levels (> 30 pg/mg). Women with a previous history of road accidents were less likely to have EtG levels of 30 pg/mg or more (130).

**Gabapentin in Drugged Driving Investigations**

A review of approximately 108,000 gabapentin positive DUID cases was conducted. Of those, 858 cases met inclusion criteria and underwent additional evaluation. Blood specimens were

screened via enzyme-linked immunosorbent assay (ELISA) and confirmed by liquid chromatography tandem mass spectrometry (LC-MS/MS) for quantitation of gabapentin. This review found an overall DUID gabapentin positivity of 7.9% between January 2020 and December 2022; 17 states from various geographical regions had at least one positive gabapentin DUID case (131).

**Residual Effects of Medications for Sleep Disorders on Driving Performance: A Systematic Review and Network Meta-Analysis of Randomized Controlled Trials: NMA Driving and Hypnotics**

Most FDA-approved hypnotics overlapped placebo at in-label doses, outperforming zopiclone. Repeated administration for 15 days or less reduced residual effects, warranting further research on the matter (132).

**Ketamine In DUID Cases in the Greater Cologne Area**

Ketamine plasma concentrations in a range of approx. 100-1200 ng/mL (mean: 510 ng/mL, median: 370 ng/mL) were detected. Co-consumption of at least one substance was ascertained in all cases. Besides driving impairments, recorded psychomotor impairments of the drivers comprised e.g. dilated pupils, missing or delayed pupil reactions, a slurred or decelerated speech, delayed reaction, lack of concentration, vertigo or agitation (133).

**Driving Under the Influence of Amphetamine: Analytical Evaluation of Illegal or Prescription Drug Intake Using Chiral UHPLC-MS-MS**

Implementation of a simple and rapid chiral method in the conventional analytical workflow for routine forensic casework proved to be an efficient way to elucidate whether a positive amphetamine result originates from illegal or prescription drug consumption, without increasing turnaround time nor costs to any significant extent, as no additional sample preparation was required (134).

**What Contributes to Drug Driving? An Exploratory Investigation into the Influence of Problematic Substance Use, Roadside Testing and Alternative Transport Options**

The findings of this study suggest that ongoing improvements to drug driving enforcement will need to be complemented by health-based approaches designed to reduce drug abuse

and dependence, and improvements to public transport, in order to achieve a sustainable reduction in drug driving (135).

**Drug-Impaired Driving and Traffic Collisions: Study on a Cross Section of the Italian Population**

The risk of being involved in a road accident if cocaine or cannabis markers were present in the urine specimens was evaluated compared to a control population. The odds ratios calculated, being 8.13 for cannabis and 5.32 for cocaine, suggest a strong association between the presence of these drugs in the urine of drivers and traffic accidents, regardless of their presence in blood samples (136).

**The Prevalence of Alcohol Use and Risky Driving Practises Among Individuals Who Consume Sedatives Nonmedically: Findings from the NESARC-III**

When controlling for demographic, lifestyle, and health factors, they were 1.84 times as likely to drink-drive (95% confidence interval = 1.46-2.33, $p < .001$) compared to those not using sedatives or using them as prescribed (137).

**Disparities in Expected Driving Time to Opioid Treatment and Treatment Completion: Findings from an Exploratory Study**

Specifically, the result showing reduced treatment completion rates for drive times longer than 10 min may inform policies regarding the ideal geographic placement of methadone-based treatment programs and service expansion initiatives (138).

**Driving Impairment Cases Involving Flualprazolam**

The increased prevalence in which laboratories are detecting flualprazolam along with the low concentrations necessary for pharmacological effects illustrates the importance of laboratories to remain vigilant in testing for novel psychoactive substances (139).

**Evaluation of Rapidstat®, Drugwipe® 6S, Drugscreen® 5TK and Drugscreen® 7TR for On-Site Drug Testing in German Police Roadside Traffic Patrol**

Overall, the screening devices performed well for individual drugs; however, none of the test devices assessed in this study fulfilled the ROSITA-1 criteria (sensitivity, specificity ≥ 90% and accuracy ≥ 95%) for all substances (140).

**Do They Need to Be Tested to be Deterred? Exploring the Impact of Exposure to Roadside Drug Testing on Drug Driving**

The results illuminate the extent of the drug driving problem and the need for greater resourcing to increase the real threat of detection. While the effect of exposure to enforcement was small, it was positive, incremental and supportive of increased roadside police enforcement as well as further research to quantify such deterrent processes (141).

**A Two-Year Evaluation of Flualprazolam Concentrations in Orange County Drivers: Effects on Driving and Field Sobriety Test (FST) Performance**

The field sobriety test (FST) results were evaluated and showed a higher frequency of impaired performance in cases of flualprazolam in combination with other drugs. No conclusion could be made regarding the effect of flualprazolam alone on FST performance (142).

**A Systematic Review of Factors Associated with Illegal Drug Driving**

The key social factor found to be associated with drug driving was peer acceptance/disapproval of the behaviour. At the legal level, the review suggested that the effectiveness of current enforcement approaches to drug driving vary among jurisdictions around the world due to differences in the level of perceived certainty of apprehension and the chances of punishment avoidance (143).

**The Incidence of Psychoactive Substances and Alcohol Among Impaired Drivers in Denmark in 2015-2019**

Ethanol (89.2%) was the overall most frequent single substance, followed by THC (68.2%). CNS stimulants (46.8%) were the second most prevalent group of non-alcoholic drugs. Cocaine (23.8%) and amphetamine (22.9%) were the most frequent CNS stimulants. The

proportion of CNS-stimulant positive drivers more than doubled in ten years. Benzodiazepines/z-hypnotics (12.7%) were the third most prevalent drug group detected, with clonazepam (8%) as the most frequent drug. Opioids were above the legal limit in 9.8% of the cases. NPS was above the legal limit in 128 cases (0.6%). Poly-drug use occurred in 40% of the DUID cases in the requested groups: other drug or other drug/THC. Young males dominated the DUID cases (median age 26). Drink-drivers (median age 39) were also mainly men, but the age distribution was equally spread over the age groups. Re-arrest occurred more often in DUID drivers (18-29%) than in drinking drivers (6-12%). DUID was evenly spread over the week, while drink-driving was most frequent on weekends (144).

**A Unique Case of Driving While Under the Influence of Isopropanol**

This case report provides a unique comprehensive evaluation of a driver under the influence of isopropanol (145).

**Prevalence and Concentrations of Sedative-Hypnotic Drugs in Blood of Drivers Involved in Road Traffic Crashes in the Padova Region of Italy - Not So Easy to Interpret**

Sedative-hypnotic drugs are medicinal substances frequently identified in drivers involved in RTA, commonly in concentrations associated with driving impairment. Besides the concentrations of drugs in blood, several factors have to be considered to conclude that a driver was impaired. The frequent association with alcohol, cocaine and other BZDs, confirms the abuse potential of these medications (146).

**Driving While Under the Influence of Hallucinogens: Prevalence, Correlates, and Risk Profiles**

Nearly one in ten individuals who report using hallucinogens also report driving under the influence of hallucinogens-drugs that affect perception and risk-taking, with alarming implications for driving safety (147).

**Simulated and Self-Reported Driving Among Young Adults with and Without Prenatal Cocaine Exposure (PCE)**

This exploratory study suggests that young adults with PCE have similar neurocognitive performance and driving behaviours as their non-drug exposed (NDE) peers (148).

**A Randomized, Multicentre Trial Assessing the Effects of Rapastinel Compared to Ketamine, Alprazolam, and Placebo on Simulated Driving Performance**

This first study of rapastinel effects on simulated driving found that rapastinel 900 and 1800 mg did not impair driving performance, but ketamine 0.5 mg/kg resulted in significantly impaired driving performance. Ketamine's effects on driving were maintained for at least 105 min, indicating that clinicians should be vigilant to prevent or postpone driving in patients after ketamine treatment (149).

**Alcohol, Marijuana, and Nicotine Use as Predictors of Impaired Driving and Riding with an Impaired Driver Among College Students Who Engage in Polysubstance Use**

Students reporting use of all 3 substances had higher overall risk of DUI and RWID indicating prevention efforts for DUI and RWID should include all substances. Implications for prevention and intervention strategies at the individual and environmental level are discussed (150).

**Evaluating the Computerized Assessment and Referral System (CARS) Screener: Sensitivity and Specificity as a Screening Tool for Mental Health Disorders among DUI Offenders**

The authors found that the CARS Screener offers a sensitive and specific method to screen for many psychiatric disorders. Specifically, the CARS Screener has a high sensitivity and specificity for bipolar disorder, intermittent explosive disorder, depressive disorders, generalized anxiety disorder, alcohol and drug use disorders, gambling disorder, post-traumatic stress disorder, panic attacks, and social phobia. Conclusion: The CARS Screener appears to be an effective tool that will help DUI programs better understand and address the mental health issues facing their clients (151).

**11-Year Study of Fentanyl in Driving Under the Influence of Drugs Casework**

Fentanyl percentage positivity increased from 0.60% in 2010 to 12% in 2020. Of 5,976 confirmed fentanyl-positive cases in 2018-2020, blood concentrations >4.0 ng/mL were observed in 44% (2018), 55% (2019) and 59% (2020) of cases. Polypharmacy was common with 87% of blood samples confirmed positive for fentanyl and at least one other compound. Stimulant was the most commonly identified drug class in cases where at least one additional

drug class was present. This study illustrates the importance of including fentanyl in a routine blood DUID panel (152).

## 4. Dementia and other cognitive disorders

**Young Onset Dementia and Driving Cessation: A Scoping Review of Lived Experiences**

Scoping review shows little research on driving and young-onset dementia (153).

**Impact of Cognitive Impairment on Driving Behaviour and Route Choices of Older Drivers: A Real-World Driving Study**

The sample included 230 cognitively normal older adults (CN; Clinical Dementia Rating [CDR] = 0) and 16 older adults with incident cognitive impairment (ICI; CDR = 0.5). The incident cognitive impairment group used fewer distinct routes to their most common destination. These differences can be leveraged to develop driving as a digital biomarker for the early detection and continuous monitoring of cognitive impairment (154).

**Somatic Factors Predict On-Road Driving Skills in Older Drivers and Drivers with Mild Cognitive Impairment**

Results revealed that the combination of somatic factors significantly predicted on-road driving skills in Older Drivers and Drivers with Mild Cognitive Impairment (155).

**Fit2Drive: Screening Older Drivers with Cognitive Concerns**

The Fit2Drive algorithm demonstrated a strong 91.5% predictive accuracy. Usefulness in office-based patient consultations is promising but remains to be rigorously tested (156).

**Predicting Driving Cessation in Alzheimer Disease: Performance Beats Biomarkers, comment on**

Female sex, CDR progression, and neuropsychological measures of cognitive functioning obtained in the clinic were strongly associated with future driving cessation (157), (158).

**Alterations in Driving Ability and their Relationship with Morphometric Magnetic Resonance Imaging Indicators in Patients with Amnestic Mild Cognitive Impairment and Alzheimer's Disease**

An increase in the operational errors for attention allocation in the complex task test could be a potential indicator of progression from aMCI to AD. Atrophy of the medial temporal

structures could be a potential predictor of impaired judgement in driving performance in aMCI and AD (159).

**State Department of Motor Vehicles Reporting Mandates of Dementia Diagnoses and Dementia Underdiagnosis**

Results of this cross-sectional study of primary care clinicians suggest that mandatory DMV policies for clinicians to report patients with dementia may be associated with a higher risk of missed or delayed dementia diagnoses (160).

**Australian Medical Practitioners' Perspectives About Current Practice Relating to Fitness to Drive Assessment for Older People with Dementia and Mild Cognitive Impairment: A Qualitative Study**

Perceptions of discomfort relating to fitness to drive assessment of older people with dementia and MCI exist amongst medical practitioners from health-care settings across Australia. In the absence of a well-validated in-office assessment tool, practitioners may benefit from an evidence-based clinical pathway to guide driving recommendations (161).

**Driving Automation for Older Adults with Preclinical Alzheimer's Disease**

Older drivers with preclinical AD may safely operate AV technology, without increased response times or cognitive workload (162).

**Driving Practice Effects for Older Drivers with Mild Cognitive Impairment: A Preliminary Study**

No significant inter-group difference in the pass/fail rate and number of mistakes (163).

**Driving Following a Diagnosis of Dementia: Exploring the Views and Experiences of People with Dementia-A UK Survey**

The difficulties reported by people with dementia suggest a need to provide more structured post diagnostic support to aid decision making of driving continuation or cessation; with the view to reducing associated distress and enabling people with dementia to continue to live a meaningful life (164).

**Predicting Fitness to Drive for Medically At-Risk Drivers Using Touchscreen Drivesafe Driveaware**

Specificity of the touchscreen DSDA was 86%, and sensitivity was 91%; positive predictive value was 83%, negative predictive value was 92%, and overall accuracy of classification was 88% (165).

**Refining a Driving Retirement Program for Persons with Dementia and their Care Partners: A Mixed Methods Evaluation of Carfreeme™-Dementia**

This study established initial support for CarFreeMe™-Dementia in the United States. Participants indicated the program facilitated dialogue around driving retirement and provided guidance on community engagement without driving. Respondents appreciated the program's emphasis on overall well-being, promoted through lifestyle planning and stress management. They also reported the program offered practical preparation for transitioning to driving retirement (166).

**Driving Errors Predicting Pass/Fail On-Road Assessment Outcomes Among Cognitively Impaired Older Drivers**

Adjustment to stimuli, lane maintenance, and speed regulation errors may be critical indicators of failing an on-road assessment in older drivers with CI. Prioritizing these errors may help identify at-risk drivers (167).

**Can Automated Vehicles be Useful to Persons Living with Dementia? The Perspectives of Care Partners of People Living with Dementia**

The results demonstrated that care partners identified possible benefits of AV use by people with dementia such as their anticipated higher social participation. However, care partners also voiced major concerns around AV use by people with dementia and reported significantly lower levels of trust in and perceived safety of AVs if used by the person with dementia in their care compared to themselves. Care partners' concerns about AV use by people with dementia included concerns around the driving of people with dementia that AVs are not designed to address; concerns that are specific to AVs but are not relevant to the nonautomated driving of people with dementia; and concerns that arise from existing

challenges around the nonautomated driving of people with dementia but may be exacerbated by AV use (168).

**Mild Cognitive Impairment and Fitness to Drive: An Audit of Practice in a Driving Specialist Clinic in Australia**

Driving outcomes for people with MCI with questionable driving capabilities are variable, with both cognitive and non-cognitive factors important in guiding medical fitness to drive recommendations. There is a need for more driving clinics to provide in-depth assessment for people with MCI who demonstrate uncertain driving capabilities and improved support for decision-making in other non-driving specialist settings (169).

**Evaluating the Fitness-to-Drive Using Evoked Visual Responses in Alzheimer's Disease**

The results show that random forest models predict patients' fitness-to-drive with AUC=0.83 and provide accurate measures of other driving performance metrics. Therefore, machine learning and event-related potential offer a valuable approach to assess driving safety for patients with early AD symptoms in the laboratory setting (170).

**Lifespace Metrics of Older Adults with Mild Cognitive Impairment and Dementia Recorded Via Geolocation Data**

Results indicated a large range of lifespace areas (0.1 - 97.88 km (2) ; median 6.77 km(2) ) with similar patterns across lifespace metrics. Significant relationships were found between lifespace metrics and concurrent driving status and anteceding scores on the sit-to-stand test (at baseline and follow-up) (171).

**Effect of Apolipoprotein E4 on the Driving Behaviour of Patients with Amnestic Mild Cognitive Impairment or Mild Alzheimer's Disease Dementia**

The lower speed variability of APOE4 carriers in the absence of neuropsychological test differences indicates reduced speed adaptations, possibly as a compensatory strategy (172).

**Driving and Alzheimer's Dementia or Mild Cognitive Impairment: A Systematic Review of the Existing Guidelines Emphasizing on the Neurologist's Role**

Although extensive multi-disciplinary research has provided useful information for driving behaviour of cognitively impaired individuals, we are still far from a widely accepted approach of driving ability evaluation in this increasing population (173).

# 5. Psychiatry

## 5.1 General

**Schizophrenia, Antipsychotic Treatment Adherence and Driver Responsibility for Motor Vehicle Crash: A Population-Based Retrospective Study in British Columbia, Canada**

Crash-involved drivers with schizophrenia are more likely to be responsible for their crash, but the magnitude of risk is similar to socially acceptable risk factors such as older age or possession of a learner license. Contemporary driving restrictions for individuals with schizophrenia appear to adequately mitigate road risks, suggesting more stringent driving restrictions are not warranted (174).

**A Letter to The Editor: The Impact of Comorbid Depression and Substance Use Disorder on Drivers with a Psychotic Disorder Killed in Motor Vehicle Accidents** (175)

**Guideline For Evaluating the Effects of Psychotropic Drugs on Motor Vehicle Driving Performance in Japan: A Tiered Approach for the Assessment of Clinically Meaningful Driving Impairment**

The MHLW guideline, developed by the authors, emphasizes the need to assess the temporal profile of adverse events affecting driving in all clinical trials. Additionally, the guideline states that when conducting driving studies, the timing of multiple dosing should consider not only the pharmacokinetics of the investigational drug but also its tolerance (176).

**Driving Performance Under Treatment of Most Frequently Prescribed Drugs for Mental Disorders: A Systematic Review of Patient Studies**

The available evidence suggests that psychopharmacologic medicines improve or at least stabilize driving performance of patients under long-term treatment when given on clinical considerations. To enhance treatment compliance, existing classification systems of medicinal drugs concerning impact on driving performance should also incorporate information about effects of long-term-treatment (177).

**Mental Health and Behavioural Factors Involved in Road Traffic Crashes by Young Adults: Analysis of The Raine Study**

Measures of mental health scores at age 17 were not predictive of subsequent RTC, after adjusting for measures of driving-risk activities. We need to better understand the determinants of externalising and risky driving behaviours if we are to address the increased risk of RTC (178).

## 5.2 Neurodevelopmental

**Reducing Driving Risk Factors in Adolescents with Attention Deficit Hyperactivity Disorder (ADHD): Insights from EEG and Eye-Tracking Analysis**

The findings underscore that holistic strategies with personalized, comprehensive approaches for adolescents with ADHD are particularly effective in improving driving performance (179).

**Trial of Training to Reduce Driver Inattention in Teens with ADHD**

In teens with ADHD, a specially designed computerized simulated-driving program with feedback to reduce long glances away from the roadway reduced the frequency of long glances and lessened variation in lane position as compared with a control program. During real-world driving in the year after training, the rate of collisions and near-collisions was lower in the intervention group (180)**.**

**Driving Risks of Young Drivers with Symptoms of Attention Deficit Hyperactivity Disorder: Association with the Dopamine Transporter Gene VNTR Polymorphism**

Drivers with more self-reported ADHD symptoms also reported more risk-taking in traffic and had more of recorded traffic accidents and violations. DAT1 9 R carriers had a higher probability of high traffic risk behaviour only if they also had ADHD symptoms (181).

**A Systematic Review of the Risks of Motor Vehicle Crashes Associated with Psychiatric Disorders**

The available evidence is mixed, not of high quality, and does not support a blanket restriction on drivers with psychiatric disorder (182).

**ADHD and Dangerous Driving in Emerging Adults: The Moderating Role of Family Climate for Road Safety**

Results indicated that higher levels of parental feedback weakened the relation between ADHD symptoms and aggressive driving; higher levels of parental monitoring strengthened this relationship. Higher levels of parental monitoring strengthened the association between ADHD symptoms and negative emotion while driving. When participants perceived their parents as having high levels of noncommitment to road safety, the association between ADHD symptoms and self-reported risky driving increased. Higher levels of open communication about unsafe driving attenuated the relation between ADHD and risky driving. Overall, some but not all components of family climate for road safety appear to affect the relation between ADHD symptoms and dangerous driving in the expected direction (183).

**Driving Performance of Experienced Young Adult Drivers with and without Autism Spectrum Disorder While Listening to Music on Two Scenarios: Hazards versus Wayfinding**

Paired sample t-tests demonstrated no effect of music for any condition (184).

**Mental Health Conditions and Unsafe Driving Behaviours: A Naturalistic Driving Study on ADHD and Depression**

Controlling for other covariates, people with self-reported ADHD were more likely to have performed improper braking or stopping (OR = 4.89, 95% CI 1.82-13.17) prior to an at-fault crash or near-crash, while those with self-reported depression did not have a significant association with any unsafe driving behaviour (185).

**Use of Psychotropic Medication and Risk of Road Traffic Crashes: A Registry-Based Case-Control Study in Denmark, 1996-2018**

For antipsychotics, we found odds ratios of 0.86 and 1.29 for traffic crashes and single crashes, respectively; for benzodiazepines and z-hypnotics, 1.29 and 2.49, respectively; for antidepressants, 1.30 and 2.25, respectively; and for stimulants of ADHD treatment, 1.62 and 1.95, respectively. All p values were below 0.001 (186).

**Real-World Crash Circumstances Among Newly Licensed Adolescent Drivers with and Without Attention-Deficit/Hyperactivity Disorder**

Within 48 months post licensure, drivers with ADHD were more likely to be at fault for their crash (prevalence ratio: 1.09 (1.05-1.14)) and noted as inattentive (1.15 (1.07-1.23)). With the exception that drivers with ADHD were less likely to crash while making a left/U-turn, we did not find substantial differences in crash types by diagnosis. Analyses also suggest females with ADHD may have a higher risk of colliding with a nonmotor vehicle and crashing due to unsafe speed than females without ADHD (187).

**Associations Between Post-Traumatic Stress Disorder Symptoms and Automobile Driving Behaviours: A Review of the Literature**

PTSD was most frequently associated with increased rates of hostile driving behaviours (e.g., cutting off others), unintentional driving errors (e.g., lapses in attention) and negative thoughts and emotions experienced behind the wheel. Findings regarding risk of motor vehicle accident and driving-related legal issues were variable (188).

**Time-to-Collision (TTC) Estimations in Young Drivers with Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD)**

Results indicated drivers with ASD were less precise in time reproduction across all time intervals and over-reproduced time at shorter intervals. Drivers with ASD produced larger TTC estimates when driving at a faster speed compared to typically developing drivers. Drivers with ASD, but not ADHD, appear to present difficulties in time estimation abilities (189).

## 5. Vision

**Impact of Vision Disorders and Vision Impairment on Motor Vehicle Crash Risk and On-Road Driving Performance: A Systematic Review**

Due to the small number of studies and often conflicting findings, it was not possible to draw firm conclusions for most vision disorders. However, evidence from several 'good' and 'fair' quality studies suggested increased MVC risk with binocular visual field impairment. There was mixed evidence regarding the impact of cataract, glaucoma, age-related macular degeneration and homonymous field loss on MVC risk and no evidence of increased MVC risk with mild VA impairment (190).

**The Impact of Vision Loss on Attitudes Toward Autonomous Vehicles: A Vision-Centric Analysis**

The blind ($p<0.001$), VI ($p<0.001$), and nondrivers ($p<0.001$) showed a greater intention to use AVs compared with those with normal vision and drivers (191).

**Does Using a Bioptic Telescope Improve Visual Recognition of the On-Road Environment?**

Road signs were recognized at significantly longer distances when using a bioptic telescope, confirming their positive impact on timely visual recognition of objects within the driving scene (192).

**Hazard Perception in Visually Impaired Drivers Who Use Bioptic Telescopes**

Drivers with central vision loss had improved hazard response times with the use of bioptic telescopic spectacles, although their responses were still slower than normally sighted control drivers (193).

**Knowing Me, Knowing You-A Study on Top-Down Requirements for Compensatory Scanning in Drivers with Homonymous Visual Field Loss**

Participants with an overestimation of their visual field size tended to prioritize their seeing side over their blind side both in subjective and objective measures. The mental model of the driving scene showed close relations to the subjective and actual attention allocation. While participants with homonymous visual field loss were less anticipatory in their usage of the

visual precursors and showed poorer performances compared to participants with normal vision, the results indicate a stronger reliance on top-down mechanism for drivers with visual impairments. A subjective focus on the seeing side or on near peripheries more frequently led to bad performances in terms of collisions with crossing cyclists (35).

**A Comparison of Night Hazard Detection between Younger and Older Drivers under Driving Simulation and Real-World Conditions**

Older adults detected hazards similarly to younger adults, especially during on-road performance. Night hazard detection was similar across driving conditions except for time to first fixation, which was faster on-road for both age groups (194).

**Visual Function Correlates of Self-Reported Vision-Related Nighttime Driving Difficulties**

Changes in mesopic visual acuity, photopic and mesopic contrast sensitivity, as well as disability glare index are associated with and explain night driving-related visual difficulties (195).

**Mandatory Vision Test for Driver License Renewal in Association with Traffic Fatality and Injury Among Older Road Users in Utah**

The authors did not find evidence that implementing an accelerated vision test for older adults in Utah was associated with a reduction in injury or fatality rates among older (65+) drivers and non-drivers relative to those aged 45-64 (196).

**The Effects of Visual Field Loss from Stroke on Performance in a Driving Simulator**

Sixty-five percent of the stroke participants passed the simulator test (95% confidence interval, 57 to 72%). Younger patients were more successful than older. However, classification by neither type of homonymous visual field loss nor side of visual field loss was predictive of driver safety. Participants with hemianopia had their lateral lane position dislocated to the nonaffected side of the visual field. None of the participants with a regained license were involved in motor vehicle accidents 3 to 6 years after the test (38).

**Understanding the Relationship Between Eye Disease and Driving in Very Old Australian Women: A Longitudinal Thematic Evaluation**

Key findings highlighted driving cessation, or reduction, is often attributed to deterioration in vision. The consequence is dependence on others for transport, typically children and friends. Access to successful treatment for eye disease allowed older women to continue driving (197).

**Driving And Exceptional Cases: Supporting Relicensing Evaluation in Patients Whose Visual Fields Fail to Meet Standards**

Conventional visual field tests are not necessarily predictive of real-world driving performance, with drivers' adaptive strategies not being accommodated. In the UK, individuals with visual field loss failing to meet the standard may be eligible for relicensing as exceptional cases if specific criteria can be met (198).

**Self-Reported Driving Difficulty, Avoidance, and Negative Emotion with On-Road Driving Performance in Older Adults with Glaucoma**

Compared to controls, glaucoma participants reported greater driving difficulty with as early as mild glaucoma (P = .0391) and negative emotion about driving starting with moderate glaucoma (P = .0042). Glaucoma participants reporting at least 1 driving difficulty and negative emotion had a 3.3-fold (adjusted odds ratio (OR) = 3.3; 95% CI = 1.24-8.52; P = .0163) and 4.2-fold (adjusted OR = 4.2; 95% CI = 1.5-12.2; P = .0078) greater odds, respectively, of an at-risk score on the on-road test. Self-reported driving difficulty in "difficult" conditions (P = .0019), rain (P = .0096), interstates (P = .0378), and high traffic (P = .0076), driving avoidance on sunny (P = .0065) and cloudy (P = .0043) days, and driving fewer days per week (P = .0329) were also associated with at-risk driving (199).

**Vision Screening for Motor Vehicle Collision Involvement among Older Drivers**

The negative impact of involuntary driving cessation on mobility and the associated mental health implications likely outweigh the safety benefit of vision screening (200).

**Beyond Gaze Fixation: Modelling Peripheral Vision in Relation to Speed, Tesla Autopilot, Cognitive Load, and Age in Highway Driving**

Drivers can reliably detect objects through near-peripheral vision, but their peripheral detection degrades gradually due to further eccentricity, foveal demand during low-speed vehicle following, cognitive load, and age (201).

**Driving and Glaucoma in the UK: A National Survey of Clinicians' Advice and Guidance to Patients**

The study found that most clinicians are familiar with DVLA driving standards. However, busy clinical environments limit detailed discussion about this, leading to only one in four clinicians being very confident to broach the subject with patients in clinic (202).

**Visual Functions Associated with On-Road Performance by Older Drivers Evaluated by a Certified Driving Rehabilitation Specialist (CDRS)**

The CDRS composite score of on-road driving performance by older adults was associated with slowed visual processing and impaired motion perception, suggesting that older driver performance, as rated by a CDRS, relies on visual skills. The CDRS global rating was also associated with impaired visual processing speed (203).

**Use and Perceptions of Advanced Driver Assistance Systems (ADAS) by Older Drivers with and Without Age-Related Macular Degeneration**

Any drivers with AMD utilize common ADAS, which subjectively improve their road safety and may help to reduce self-imposed restrictions for difficult situations and mileage (204).

**National Application of The European Visual Field Standards for Driving: A Survey Study**

The directive fails to establish a uniform approach to the visual field requirements, as evident by moderate pass/fail agreement between the national experts. Because the visual standards for driving are enforced differently, identical visual field loss can result in either revocation or approval of a driving license (205).

**Predictive Value of the Esterman Visual Field Test on the Outcome of the On-Road Driving Test**

These findings confirm the relation between visual field damage and impaired driving performance. However, the Esterman visual field results were not conclusive for predicting the driving performance of the individual driver with visual field defects (206).

**Driving Behaviour and Visual Compensation in Glaucoma Patients: Evaluation on a Driving Simulator**

Glaucoma patients showed poor driving performance with longer reaction time to hazardous situations than control subjects: pedestrians crossing the road from the left ($p < 0.022$) or from the right ($p = 0.013$), and vehicles coming from the left ($p = 0.002$). Their mean duration of lateral excursion was longer ($p = 0.045$), and they showed more lane excursions in a wide left curve ($p = 0.045$). Glaucoma patients also showed a higher standard deviation of time-headway ($p = 0.048$) with preceding vehicles. Analyses of driving behavioural compensations on curved roads showed that glaucoma patients stayed closer to the centre line in large ($p = 0.006$) and small ($p = 0.025$) left curves and on small right curves ($p = 0.041$). Additionally, on straight roads, as compared to control subjects, glaucoma patients showed longer mean time-headway ($p = 0.032$) and lower mean speed ($p = 0.04$). Finally, the glaucoma group exhibited a larger standard deviation of horizontal gaze ($p = 0.034$), (207).

**Clinical Report: Experiences of a Driver with Vision Impairment when Using a Tesla Car**

This clinical report demonstrates how assisted and semiautonomous driving systems in a Tesla car were used to support daily driving by a driver with vision impairment. Codriving with these systems allows him to confidently drive more often and to avoid less situations than he used to (208).

**Licensure and Driving Status among Visually Impaired Persons**

Many drivers do not possess adequate vision for licensure based on their home state's current standards. Changes to licensure qualification and renewal procedures may be advisable (170).

**Vision, Driving Exposure, and Collisions in Bioptic Drivers**

Visual acuity, visual field, and contrast sensitivity were associated with driving exposure in bioptic drivers (with drivers with poorer vision reporting lower annual mileage), and poorer visual acuity and visual field were associated with more collisions. The per-mile collision rate for bioptic drivers was within the range of that previously reported for fully sighted drivers, although higher than would be expected for fully sighted drivers of similar age distribution (209).

**Self-Reported Driving Difficulty in Patients with Bilateral Cataract**

The mean age of the participants was 65.04±7.22 years old. Results showed that the mean composite driving difficulty score was 83.18±11.74 and most of the participants were having difficulty for driving in the rain (73.7%) and at night (85.9%). Furthermore, the study found that there was a significant correlation between driving difficulty score and contrast sensitivity (CS) ($rs = 0.40$, $p = 0.03$). However, there was no significant correlation between driving difficulty score and VA ($rs = -0.14$, $p = 0.17$). A linear regression was calculated to predict driving difficulty score based on binocular CS and a significant regression equation was found ($F(1,28) = 8.115$, $p = 0.008$) with $R^2$ of 0.225. Drivers with bilateral cataract will most likely experience some forms of difficulty, especially when driving under low contrast conditions (210).

**Night Vision and Carotenoids (NVC): A Randomized Placebo Controlled Clinical Trial on Effects of Carotenoid Supplementation on Night Vision in Older Adults**

The NVC demonstrates that augmenting MPOD in individuals with difficulty in night vision showed measurable benefits in numerous visual functions that are important for night vision driving in this small sample RCT. Additionally, we observed an improvement in UFOV divided attention test scores and decreased composite risk scores (211).

**Changes in Driving Performance After First and Second Eye Cataract Surgery: A Driving Simulator Study**

The rate of crashes/near crashes decreased significantly by 36% (incidence rate ratio (IRR) 0.64, 95% CI 0.47-0.88, $p = 0.01$) after first eye surgery and 47% (IRR 0.53, 95% CI 0.35-0.78,

$p < 0.001$) after second eye surgery, compared to before first eye cataract surgery, after accounting for confounders. The rate of crashes/near crashes also decreased with better contrast sensitivity (IRR 0.69, 95% CI 0.48-0.90, $p = 0.041$). A separate model found that time spent speeding 10 kilometres per hour or more over the limit after second eye surgery was significantly less (0.14 min, $p = 0.002$), compared to before first eye surgery, after accounting for confounders. As contrast sensitivity improved, the duration of speeding also decreased significantly by 0.46 min ($p = 0.038$). There were no statistically significant changes in lane excursions or speed variation (212).

**Exploring the Effect of Glaucomatous Visual Field Defects of Current Drivers on a Neuropsychological Test Battery**

Glaucoma severity did not influence results, except for the Benton Visual Retention Test on which the moderate/severe group has better scores (213).

**The Effect of Visually Significant Dermatochalasis and Blepharoptosis on Driving Safety**

In this cohort, visually significant blepharoptosis and dermatochalasis were not associated with rates of motor vehicle crashes or moving violations (214).

**Bilateral Cataract Surgery Improves Neurologic Brake Reaction Time and Stopping Distance in Elderly Drivers**

The findings show a significant effect of CS on neurological BRTs and the corresponding stopping distances. This highlights the importance of presurgical CS evaluation as a critical factor in cataract surgery decisions in elderly drivers (215).

**Driving Vision in Patients with Neovascular AMD in Anti-VEGF Treatment**

Driving vision can be sustained in the majority of the patients if they have driving vision at baseline (216).

## 6. Obstructive sleep apnoea and sleep disorders

**Association of Visual-Based Signals with Electroencephalography Patterns in Enhancing the Drowsiness Detection in Drivers with Obstructive Sleep Apnea**

This work could potentially enhance real-time drowsiness detection reliability and assess fitness to drive in OSA drivers (217).

**A Novel Approach to Quantify Microsleep (MS) in Drivers with Obstructive Sleep Apnea by Concurrent Analysis of EEG Patterns and Driving Attributes**

Combining frontal channels F3 and F4 yielded increased sensitivity in detecting MS, achieving 83.7% combined mean identification rate (CMIR), surpassing individual channel's MIR, highlighting potential for further improvement with additional frontal channels. We quantified MS duration, with 95% of total episodes lasting between 1 to 15 seconds, and pioneered a robust correlation ($r = 0.8913$, $p<0.001$) between maximum drowsiness level and MS density (218).

**Effects Of Solriamfetol on On-The-Road Driving in Participants with Narcolepsy: A Randomised Crossover Trial**

Solriamfetol 300 mg/day improved on-the-road driving performance, at 2 h post-administration in participants with narcolepsy (219).

**Association Between Driving a Car and Retention of Brain Volume in Japanese Older Adults**

Driving was associated with hippocampal brain atrophy attenuation, with active drivers exhibiting decreased brain atrophy in the temporal and cingulate cortices (220).

**Obstructive Sleep Apnea and Road Traffic Accidents: A Danish Nationwide Cohort Study**

Patients with OSA had an increased risk of road traffic accidents when compared with the reference cohort (hazard ratio, 1.15; 95% CI, 1.10-1.20; IRR: 1.19; 95% CI, 1.14-1.29), especially motor vehicle accidents (hazard ratio, 1.29; 95% CI, 1.18-1.39; IRR 1.30; 95% CI, 1.20-1.42). The risk of accidents as pedestrian or bicyclist were not increased. Further, patients with OSA had a tendency to be involved in more severe motor vehicle accidents (221)

**Adverse Driving Behaviours are Associated with Sleep Apnea Severity and Age in Cognitively Normal Older Adults at Risk for Alzheimer's Disease**

These findings suggest that adverse driving behaviors linked to a higher rate of traffic crashes in older adults are associated with sleep apnea severity and AD pathology even in cognitively unimpaired individuals (222).

**Obstructive Sleep Apnea Screening, Diagnosis, and Treatment in the Transportation Industry**

An Advanced Notice of Proposed Rulemaking regarding the diagnosis and treatment of OSA in commercial truck and rail operators was issued by the Federal Motor Carrier Safety Administration and Federal Railroad Administration, but it was later withdrawn. This reversal of the agencies' position has caused confusion among some, who have questioned whether efforts to identify and treat the disorder are warranted. In response, we urge key stakeholders, including employers, operators, legislators, payers, clinicians, and patients, to engage in a collaborative, patient-centred approach to address the disorder. At a minimum, stakeholders should follow the guidelines issued by a medical review board commissioned by the Federal Motor Carrier Safety Administration in 2016 alone, or in combination with the 2006 criteria, "Sleep Apnea and Commercial Motor Vehicle Operators," a Statement from the Joint Task Force of the American College of Chest Physicians, the American College of Occupational and Environmental Medicine, and the National Sleep Foundation developed by a joint task force (223).

**Brain Mitochondrial Dysfunction and Driving Simulator Performance in Untreated Obstructive Sleep Apnea**

Brain mitochondrial bioenergetics in the frontal brain regions are impaired in OSA patients who are vulnerable to driving impairment following sleep loss. These findings provide a potential way to identify at risk OSA phenotype when assessing fitness to drive, but this requires confirmation in larger future studies (224).

**The Relationship between Insomnia and Lifestyle-Related Diseases among Japanese Male Truck Drivers**

Insomnia is significantly associated with increased risks of lifestyle-related diseases among male truck drivers in Japan (225).

**Skin Temperature as a Predictor of On-The-Road Driving Performance in People with Central Disorders of Hypersomnolence (CDH)**

Mixed-effect model analyses showed a strong, quadratic association between proximal skin temperature and SDLP ($p < 0.001$) and a linear association between DPG and SDLP ($p < 0.021$). Proximal skin temperature changes over 3 to 15 min were predictive for SDLP. Moreover, SDLP increased over time (0.34 cm/segment, $p < 0.001$) and was higher in men than in women (3.50 cm, $p = 0.012$). We conclude that proximal skin temperature is a promising predictor for real-time assessment of driving performance in people with CDH (226).

# 7. Cardiology

**Syncope While Driving and the Risk of a Subsequent Motor Vehicle Crash**

In the year following their index emergency visit, 13 of 63 drivers with crash-associated syncope and 852 of 9,160 controls with syncope alone experienced a subsequent crash as a driver (crash risk 21% versus 9%). After accounting for censoring and potential confounders, crash-associated syncope was not associated with a significant increase in the risk of subsequent crash (adjusted hazard ratio (aHR) 1.38, 95% confidence interval ((CI) 0.78 to 2.47). Individuals with crash-associated syncope were 31-fold more likely to have physician driving advice documented during their index visit (prevalence ratio 31.0, 95% CI, 21.3 to 45.1). In the subgroup without documented driving advice, crash-associated syncope was associated with a significant increase in subsequent crash risk (aHR 1.88, 95% CI 1.06 to 3.36). CONCLUSIONS: Crash risk after crash-associated syncope appears similar to crash risk after syncope alone (227).

**Syncope and Traffic Crash: A Population-Based Case-Crossover Analysis**

Among eligible crash-involved drivers, 47 of 3026 pre-crash intervals and 112 of 9078 control intervals had emergency visits for syncope, indicating syncope was not significantly associated with subsequent crash (1.6% vs 1.2%; adjusted odds ratio (OR), 1.27; 95% confidence interval (CI), 0.90-1.79; P = 0.18). There was no significant association between syncope and crash in subgroups at higher risk for adverse outcomes after syncope (eg, age > 65 years, cardiovascular disease, cardiac syncope), (228).

**Overestimation of On-Road Driving Performance is Associated with Reduced Driving Safety in Older Drivers**

The results suggest that older drivers who overestimate their driving skills show poorer performances within a broad range of skills that directly reflect or are closely related to driving safety (229).

**Syncope and Subsequent Traffic Crash: A Responsibility Analysis**

Recent syncope was not significantly associated with driver responsibility for traffic crash. Clinicians and policymakers should consider these results when making fitness-to-drive recommendations after syncope (230).

**Cardiac Disease and Driver Fatality**

Drivers with significant cardiac disease did not, therefore, have increased rates of death in crashes, although a distinct subgroup of drivers consisted of those who had died from cardiac events and not trauma, while driving (231).

**Cough Syncope as a Cause of Motor Vehicle Crash: Fatal Distraction?**

We report six occasions in which motor vehicle drivers have been involved in serious crashes and cough syncope was cited as the cause. On each occasion, an alternative cause leading to the crash could be identified. Cough as a cause of syncope should be a diagnosis of exclusion and used with great caution as a medico-legal defence. A suggested criterion for confirmation of cough syncope is recommended (232).

**Cardiovascular Health Status of Taxi/For-Hire Vehicle Drivers in the United States: A Systematic Review**

The high prevalence of poor nutrition, limited physical activity, diabetes, and blood pressure across studies indicates an urgent need to address low rates of health care access at a policy level and to design targeted workplace interventions (233).

**Coronary Artery Disease Evaluation and Management Considerations for High-Risk Occupations: Commercial Vehicle Drivers and Pilots**

This article discusses coronary heart disease in patients in high-risk occupations and covers current guideline recommendations for screening, treatment, and secondary prevention. The importance of the complimentary perspectives of the regulatory agency, medical examiners, physicians, and pilot or driver are considered in this narrative review, as are considerations for future guideline updates (234).

**Driving Restriction in Patients with Cardiac Implantable Electronic Devices: An Overview of Worldwide Regulations**

Current regulations are mainly based on historical data that do not take into account improvements in ICD/PM technologies and driving environment, which have made driving with an ICD/PM is substantially safe. Newer studies and updated regulatory documents are warranted to set the best driving restrictions and reach homogeneity worldwide (235).

**Driving with Cardiac Devices in Australia. Does a Review of Recent Evidence Prompt a Change in Guidelines?**

Through a systematic literature review, along with discussion of current guidelines, we combine new evidence with well-established risk assessment tools to ask the following questions: (i) Given the heterogeneity of patient risk within the defibrillator population, should guidelines allow for further individualisation of risk and subsequent licensing restrictions?; and (ii) Could some patients with primary prevention automated cardioverter defibrillators be able to hold a commercial driving licence? (236).

## 8. Diabetes and endocrine

**Driving-Related Glucose Patterns Among Older Adults with Type 1 Diabetes**

The findings support a glucose "above-5-to-drive" recommendation to avoid CGM-detected hypoglycemia among older drivers, including for prolonged drives, and highlight the importance of active CGM low-glucose alerts to prevent hypoglycemia during driving (237).

**Higher Prevalence of Hypoglycemia and Unsafe Driving Practices in Adults with Type 1 Diabetes**

Nearly 72% of respondents reported having had hypoglycemic episodes while driving, and 4.3% of all respondents reported having a vehicular accident due to hypoglycemia in the previous 2 years (238).

**Metabolic Syndrome among Commercial Truck Drivers: The Relationship Between Condition Prevalence and Crashes**

Specific combinations and higher prevalence of MetS conditions were associated with increased frequency of reported crashes. Moreover, when the co-occurrence of MetS conditions is aggregated, a dose-response relationship with crashes appears. These results suggest that policy changes and interventions addressing MetS may increase driver health and reduce crash risk (239).

**Sugar and Stops in Drivers with Insulin-Dependent Type 1 Diabetes**

Diabetes drivers who were acutely hyperglycemic (≥ 300 mg/dL) had 2.37 increased odds of unsafe stopping (95% CI: 1.26-4.47, p = 0.008) compared to those with normal physiology. Acute hypoglycemia did not associate with unsafe stopping (p = 0.537), however the lower frequency of hypoglycemia (vs. hyperglycemia) warrants a larger sample of drivers to investigate this effect. Critically, presence of diabetes alone did not associate with unsafe stopping, underscoring the need to evaluate driver physiology in licensing guidelines (240).

**Does Gender Affect the Driving Performance of Young Patients with Diabetes?**

The first main result is that young female drivers are more affected by diabetes than young male drivers, regardless of momentary glycemic changes. The second main result is that poor glycemic control substantially deteriorates hazard perception and driving performance of young males with diabetes. Thus, it is argued that an uncontrolled state of a high blood glucose level may be more hazardous for young males with diabetes since it negatively impacts their driving performance (241).

## 9. Temporary surgical and medical problems

**Factors Associated with a Prolonged Time to Return to Safe Driving Following Lower Extremity Injuries**

Almost all the categories examined had longer time to brake (TTB) than the DOT recommended TTB for safe driving, whatever the age, sex, ethnic origin use or not of narcotic analgesia, use or not of walking aids, type of insurance, employment status and number of comorbidities (242).

**Rapid Return to Braking after Anterior and Posterior Approach Total Hip Arthroplasty**

With modern surgical techniques, BRT after right-sided THA returns to baseline levels approximately 2 weeks after surgery. There seems to be a quicker return to preoperative BRT observed in patients with a posterior approach (243).

**Safe Driving Recommendations Following Lower Extremity Orthopedic Surgery: A Systematic Review**

Average RTD recommendations in weeks were: hip surgeries, 4.1 (± 2.7); foot surgeries, 6.67 (± 0.94); Achilles surgeries, 6.67 (± 0.25); ankle surgeries, 4 (± 2); knee surgeries, 5.42 (± 0.77); and multiple lower extremity surgeries, 3.85 (± 0.15) ,(244).

**Motor Vehicle Crash Risk among Adults Undergoing General Surgery: A Retrospective Case-Crossover Study**

Using population-based crash and hospital discharge data, the incidence of motor vehicle crashes over a 28-day period did not change on average before compared to after surgery (245).

**Return to Driving After Critical Illness**

Of 196 consecutive patients seen at the clinic between June 2018 and March 2020, 126 (47 females (37%), 79 males (63%); mean (SD) age, 58 (16) years) reported driving before critical illness. Sixteen of these patients (13%) had resumed driving 1 month after hospital discharge, whereas 110 patients (87%) had not (246).

**Scoping Review of Education for Women About Return to Driving After Abdominal Surgery**

Education provided to women about return to driving after abdominal surgery varies substantially and has a weak evidence base (247).

**When Do Patients Return to Driving After Outpatient Foot and Ankle Surgery?**

Ten patients (59%) recalled having a discussion with the surgeon regarding when to resume driving, of which only 4 (23.5%) returned to driving at the suggested time they remembered. One patient (6%) returned to driving 2 weeks sooner, and 1 patient (6%) returned to driving 4 weeks later than recommended. No patient reported experiencing a driving-related adverse event. This study suggests that despite surgeons' recommendations, patients are returning to driving sooner than traditionally recommended. The surgeon's advice regarding when to return to driving may not be as influential as a patient's own self-assessment of their readiness to operate a vehicle after outpatient foot and ankle surgery (248).

**Return to Driving After Total Hip and Knee Arthroplasty - The Perspective of Employed Patients**

There is inconsistency in driving advice provided after THA and TKA. Consequently, patients make their own decisions about how and when to drive and develop strategies to accelerate the process. Greater clarity is required from healthcare professionals on time frames for driving post-surgery and for advising patients on their responsibilities around informing the DVLA and insurance companies of their surgery (249).

**Factors Associated with Early Return to Driving Following Total Joint Arthroplasty**

A total of 1128 of 2508 eligible patients (45%) completed surveys and returned them by mail. After 121 surveys were discarded for incompletion, inconsistency, or limited preoperative driving volume, 1007 patients were included in the study. Among these patients, 99% returned to driving postoperatively, with 23% returning within 2 weeks, and 88% returning within 6 weeks. Factors associated with the odds of a patient returning to driving within 2 weeks included laterality, gender, postoperative confidence, postoperative comfort, and surgeon advice. Ten patients (1%) have been involved in a car accident postoperatively (250).

## 10. Ear, Nose and Throat

**Medical Record Prompts Improve the Frequency and Documentation of Dizziness and Driving Conversations in the ENT Balance Clinic**

This study highlights the benefits of medical record prompts for documented and accurate shared decision-making conversations surrounding dizziness, vertigo, vestibular conditions and driving (251).

## 11. Rheumatology

**Vehicle Control as a Measure of Real-World Driving Performance in Patients with Rheumatoid Arthritis**

Using novel naturalistic assessments, we linked RA and worsening RA disease severity with aberrant vehicle control. These findings support the need for further research to map these observed patterns in vehicle control to metrics of driver risk and, in turn, to link patterns of real-world driving behaviour to diagnosis and disease activity (252).

## 12. Older People

**Toward Safe and Confident Silver Drivers: Interview Study Investigating Older Adults' Driving Practices**

This study uncovered a noticeable disparity between the perceived driving competence of older adults and the actual challenges they confront while driving (253).

**Mobility, Driving, and Functional Competence in Older People-Selected Results from the Longitudinal Urban Cohort Ageing Study (LUCAS)**

The results show that losses in functional competence were associated with impaired mobility and reduced car driving. Impaired mobility led to restricted radius of action (in German), (254).

**Transferability of Effective Consultation Skills for Decision-Making Support in the Voluntary Surrender of Older Adult Drivers' Licences in Super-Aged Japan**

The research identified eight effective consultation skills to support decision-making in the voluntary surrender of older adult drivers' licences in super-aged Japan (255).

**Relationship between Driving Ability and Physical Fitness Factors in Older Adults: A Multiple Linear Regression Analysis**

The single regression analysis revealed no relationship between driving ability among older drivers and any physical fitness factor. In the multiple regression model analysis, only grip strength was an important explanatory factor; however, the driving ability scores decreased as grip strength scores increased (256).

**"You Just Have to be Careful How You Do It": A Qualitative Study of The Healthwise Decision Aid for Older Drivers**

Attention to individual, interpersonal, institutional, and cultural factors may enhance the use and dissemination of an online decision aid about driving, as well as its effectiveness in decision making (257).

**Association Between Polypharmacy and Hard Braking Events in Older Adult Drivers**

Polypharmacy in older adult drivers is associated with significantly increased incidence of hard-braking events in a dose-response fashion. Effective interventions to reduce polypharmacy use may help improve driving safety in older adults (258).

**Frailty and Poor Physical Functioning as Risk Factors for Driving Cessation**

Frailty and poor physical functioning are major risk factors for driving cessation. Staying physically active may help older adults to extend their driving life expectancy and mobility (259).

**Oldest Old's Travel Mode Choice and New Mobility Technology Acceptance: Case in America and China**

Old-old in China and USA: The results show that both panels of older adults similarly feel some extent of travel limitations. But the responses among the two groups differ: 18 American participants chose "drive myself" as their primary option a decade ago, while 11 chose it now; no Chinese participants selected it either a decade ago or now (260).

**Effects of Repetition of a Car-Driving Pedal Manoeuvre and Neural Output in Older Adults**

There was no significant difference in neural drive variability between older and young adults (261).

**Getting Rides from Others as a Coping Mechanism in the Transition to Non-Driving**

Older adults who got rides from others in 2015 had greater odds of reporting no longer driving at 3-year follow-up compared to those who did not get rides (262).

**Exploring the Associations of Demographics and Scale Measures with Cognitive Driving Behaviour among Older Drivers in China**

Age, as a physiological indicator, is not sufficient to be a strong predictive factor for lateral stability and driving speed (263).

**Australian Medical Practitioners' Perspectives About Current Practice Relating to Fitness to Drive Assessment for Older People with Dementia and Mild Cognitive Impairment: A Qualitative Study**

Perceptions of discomfort relating to fitness to drive assessment of older people with dementia and MCI exist amongst medical practitioners from health-care settings across Australia. In the absence of a well-validated in-office assessment tool, practitioners may benefit from an evidence-based clinical pathway to guide driving recommendations (161).

**Impact of Driving Cessation on Health-Related Quality of Life Trajectories**

Ability to participate in social roles and activities after DC improved overall. For those who volunteered, social roles and activities declined not supporting the hypothesis. For those who accessed alternative transportation, fatigue had an initial large increase immediately following DC thus not supporting the hypothesis. Urban residents had worse function and more symptoms after DC compared to rural residents (not supporting the hypothesis) except for social roles and activities that declined steeply (supporting the hypothesis) (264).

**The Impact of Spatial Orientation Changes on Driving Behaviour in Healthy Aging**

The research indicate that worse spatial orientation performance predicted increased driving difficulty and avoidance of challenging situations within an older adult cohort. Deficits in spatial orientation emerge as a robust indicator of driving performance in older age, which should be considered in future aging driving assessments (265).

**Crash Risk Predictors in Older Drivers: A Cross-Sectional Study Based on a Driving Simulator and Machine Learning Algorithms**

Advanced age and the functional reach test were the factors representing the highest risk of road crash (266).

**Impact of Driver's Age and Gender, Built Environment, and Road Conditions on Crash Severity: A Logit Modelling Approach**

The results show that age affects crash severity following a polynomial curve. While the overall pattern is one of a downward trend with age, this trend is weak until the senior years. (267).

**The Association between Psychological Resilience and Driving Behaviour among Older Drivers in Australia**

Strong and consistent associations were found between resilience and driving comfort, abilities, and frequency for the Australian sample. Across samples, resilience remained a significant variable in seven of 10 regression models, more than any other independent variable (268).

**Predictors of Driving Cessation in Older Adults: A 12-year Population-based Study**

Age, sex, cognitive impairments, physical health, and depressive symptoms were associated with driving cessation in this cohort. By identifying potential driving cessation predictors, health care providers and families may better recognize these risk factors and begin the driving cessation discussion early (269).

**Neighbourhood Transportation, Elapsed Years, and Well-Being after Surrendering the Driver's Licence in Older Japanese Adults: The JAGES Longitudinal Study**

The authors found that, while surrendering licence within three years was associated with increased probability of poor self-rated health in more PTS group, the confidence interval was large. Although surrendering licence within three years was associated with decreased social interactions, this association weakened if licence was surrendered more than three years ago. These associations were not markedly affected by neighbourhood public transport systems (PTS). These findings suggested that, regardless of neighbourhood PTS, support and care to promote social interactions at or shortly after surrendering licence may be beneficial to the well-being of older adults who lost their driving licence (270).

**Olfactory Discrimination and Identification as Prognostic Markers of Fitness-To-Drive in Older Drivers**

The findings revealed that discrimination is important for the first year of the examination and as the decline progresses, identification becomes the better olfactory marker. The latter is also evident in the literature. Hence, the results showed that less indicators are required compared to the initial battery. The olfactory markers were dominant over the

neuropsychological tests, apart from alertness, for predicting the older driver's fitness to drive regardless of the presence of cognitive impairment and other chronic conditions (271).

**Parietal And Occipital Leukoaraiosis Due to Cerebral Ischaemic Lesions Decrease The Driving Safety Performance Of Healthy Older Adults**

Parietal and occipital (but not frontal or temporal) leukoaraiosis volumes were significantly correlated with decreased driving safety performance scores regardless of age, especially when turning right at intersections, which needs more attention than turning left because left-side driving is legally enforced in Japan (272).

**Examining Coroners' Recommendations for Health and Safety Management of Ageing Heavy Vehicle Drivers: A STAMP Analysis**

The study found that "unidentified hazards" were the most common type of safety failure in the analysis of cases of ageing drivers, concentrated at the regulatory level, which indicates that additional risk identification methods by upper levels of control are needed (273).

**Changing Vehicles to Reduce Older Driver Fatalities: An Effective Approach?**

Older drivers in crashes were more likely to be in vehicles that were lighter, older, and without standard electronic stability control, standard head-protecting side airbags, and ratings of good in two IIHS crash tests than middle-aged drivers. In adjusted models, the fatality risk for older drivers in all crashes was significantly higher when electronic stability control was not standard (odds ratio (OR), 1.37; 95% confidence interval (CI), 1.12-1.68) or when driving small passenger cars relative to large SUVs (OR, 2.02; 95% CI, 1.25-3.26); in driver-side crashes, the fatality risk doubled when vehicles did not have standard head-protecting side airbags (OR, 2.03; 95% CI, 1.58-2.62). If older drivers drove vehicles similar to middle-aged drivers, we estimated 3.3% and 4.7% fewer deaths in all and side-impact crashes, respectively (274).

**Evidence of Risky Driving in Korean Older Adults: A Longitudinal Cohort**

According to four identified factors-crash history, safety concern, reduced mileage, and aggressive driving-significant associations were found between risky driving over the past 2 years and crash history and for aggressive driving in the normal cognition group. In the

cognitive impairment group, only crash history was significantly associated, although safety concerns showed a trend toward significance (275).

**Handgrip Strength in Older Adults and Driving Aptitude**

Reduced handgrip strength was not shown to predict for loss of driving skills in older adults (276).

**Non-Cognitive Factors Associated with Driving Cessation Among Older Adults: An Integrative Review**

The results revealed six main categories (physical health, psychological health, interpersonal influence, transportation support, policies, and sociodemographic characteristics) and 24 subcategories for driving cessation. Given the potentially serious consequences of driving cessation in the older adult population, exploring the predictors of driving cessation can be used to design interventions for optimizing drivers' health, rehabilitating the functional limitations that affect driving ability, creating a safer driving environment, and optimizing vehicles to meet the needs of older drivers (277).

**Understanding the Relationship Between Eye Disease and Driving in Very Old Australian Women: A Longitudinal Thematic Evaluation**

Key findings highlighted driving cessation, or reduction, is often attributed to deterioration in vision. The consequence is dependence on others for transport, typically children and friends. Access to successful treatment for eye disease allowed older women to continue driving (197).

**Modelling of Older Adults' Driving Exposure and Avoidance Using Objective Driving Data in A Naturalistic Driving Study**

Results indicate that poorer health is associated with less driving exposure; deteriorating cognitive and physical capabilities are associated with more self-reported driving avoidance and less actual driving in challenging situations; visual function is associated with self-reported avoidance; living alone is associated with higher driving exposure in general as well as in challenging situations; self-reported driving avoidance of challenging situations has a negative association with actual driving in those same situations (278).

**A Two-Part Approach Distinguishing the Occurrence and Frequency of Self-reported Attentional Failures During Driving to Predict Crash Risks Among Older Drivers**

Unlike middle-aged drivers, frequency rather than occurrence of attentional failures was a significant predictor of prior traffic violations and crashes among older drivers (279).

**Are the Physical and Cognitive Functions of Older Adults Affected by Having a Driver's License? -A Pilot Study of Suburban Dwellers**

However, in this study, loneliness and executive function were strongly influenced by age and sex, and no direct relationship to a driver's license was suggested. Rather, non-driver license holders may be relieved because there is no risk of accidents due to driving, and there is no possibility of a suddenly decline in physical or cognitive function due to revocation of a driver's license (280).

**Naturalistic Driving Measures of Route Selection Associate with Resting State Networks in Older Adults**

Functional networks associated with the ability to interpret and respond to external sensory stimuli and the ability to multi-task were associated with measures of route selection. Maintenance of these networks may be important for continued preservation of driving abilities (281).

**Examining Patterns of Driving Avoidance Behaviours Among Older People Using Latent Class Analysis**

Avoidance of selected driving behaviours may be one component of a multi-step process supporting the transition to non-driving. Drivers displaying avoidance behaviours may be receptive to resources to prepare for this transition and minimize negative health and quality of life outcomes that accompany driving cessation (282).

**Medical Certificate for Older Drivers - An Analysis of the Norwegian Parliamentary Debate**

The parties that represent the majority decision framed cognitive testing in a way that suggests the decision is a reaction to these tests rather than to the medical certificate

requirement as such. There was little discussion on how the decision will affect GPs' ability to identify impaired fitness to drive among the older population (283).

**Associations of Self-Care Health Behaviours with Driving Cessation among Older Drivers**

Ability to participate in social roles and activities was associated with an 8% reduction in the risk of driving cessation (adjusted hazard ratio (HR): 0.92; 95% CI: 0.89, 0.94). Increased participation in social activities and relationships is associated with driving longevity in older adults and should be targeted for interventions to maintain driving mobility (284).

**How Does Driving Anxiety Relate to the Health and Quality of Life of Older Drivers?**

After adjusting for socio-demographic variables, higher driving anxiety was associated with lower quality of life and lower odds of 'very good' self-reported health, but no difference in odds of multi-comorbidity (285).

**Older Women: How Do They Feel While Driving and What About the Effects of Age-and-Gender Stereotype Threat?**

This study provides knowledge about the driving feelings of this population who appears, globally, as comfortable at the wheel and "immune" to stereotyping (286).

**Why Do Older Drivers Self-Regulate: Psychological Factors Influencing Self-Regulation in a Chinese Sample**

Bivariate correlation analysis showed that self-regulation was negatively correlated with the amount of driving experience (days per week and mileages per month) in a significant way. And so was the number of family-owned motor vehicles. Exploratory factor analysis indicated that the extended TPB questionnaire was reliable and effective for measuring self-regulation. The proposed Structural Equation Model (SEM) explained 73.673% of the variance in self-regulation intention. Attitude (0.50) had the strongest influence among all variables on intention. Subjective norms (0.28), perceived behaviour control (0.27), and alternative traffic quality (0.20) significantly influenced intention. Intention (0.34) and physical condition (0.22) imposed significant effect on self-regulation behaviour (287).

**Inability of the Mini-Mental State Exam (MMSE) and High-Contrast Visual Acuity to Identify Unsafe Drivers**

The MMSE and high-contrast visual acuity tests do not reliably identify at-risk older drivers. They have extremely low sensitivity for detecting unsafe drivers, even when used together, and poor prognostic properties relative to validated screening instruments that measure cognitive, vision and sensorimotor functions relevant to driving (288).

**“Getting There": Transportation as a Barrier to Research Participation Among Older Adults**

Driving and living closer to the research site, with better access to public transportation, were associated with significantly greater willingness to come to the medical centre for research even after adjustment for age, difficulty getting in and out of a vehicle, and number of days leaving one's home each week. A qualitative inquiry drawing on a long-term care registry (n = 23) showed a similar role for transportation challenges. Findings suggest transportation challenges among older people are a major source of unwillingness to participate in research even among highly motivated people participating in research registries (289).

**Sex Differences in Cognitive-Motor Components of Braking in Older Adults**

The authors found sex differences in the cognitive-motor components of braking performance with advancing age. Specifically, the cognitive processing speed is 27.41% slower in women, while the motor execution speed is 24.31% slower in men during the braking task (290).

**Road Safety of Older Drivers and the Nursing Profession: A Scoping Review**

This scoping review highlighted the paucity of research addressing the role of the nurse in road safety (291).

**Pre-Frailty Associated with Traffic Crashes in Japanese Community-Dwelling Older Drivers**

Binary logistic regression analyses showed that after adjusting for age, sex, education, driving frequency, and driving distance, pre-frailty (OR = 1.52, 95% CI: 1.10-2.10) was more significantly associated with traffic crashes as compared to robustness. Those who had impairment in the oral domain (OR = 1.57, 95% CI: 1.09-2.27) and memory domain (OR = 1.38, 95% CI: 1.01-1.90) were also more likely to be involved in traffic crashes (292).

**Association Between On-Road Driving Performance Test and Usual Walking Speed (UWS) or Sustainable Attention in the Elderly; Preliminary Survey**

The results of the study suggested that the UWS and sustainable attention might be potential factors influencing on-road driving performance (293).

**Use of Potentially Driver-Impairing (PDI) Drugs Among Older Drivers**

The rate of aged drivers in the S.AGES cohort taking PDI drugs is concerning and highlights the need to carefully assess and reassess PDI-drug prescriptions in this population, particularly hypnotics, anxiolytics and opioids (294).

**Meaningful Activities and Psychosomatic Functions in Japanese Older Adults after Driving Cessation**

In the after driving cessation group, grip strength, and Japan Science and Technology Agency Index of Competence scores were significantly lower. Furthermore, the proportion of apathy and physical and social frailty was significantly higher in the after driving cessation group. Regarding meaningful activity, domestic life scores in the after driving cessation group were significantly higher than those of the active driving group. Decreased driving frequency in the active driving group was associated with weak muscle strength, lack of interest, and low activity. This study demonstrated that meaningful activity differed based on the driving status. Hence, we should support the activities of older adults who are considering driving cessation (295).

**Crash Proneness? Predictors of Repeat Crashes in Older Drivers**

Nearly half (46%) of the repeat crashers were culpable for both of their crashes. Their average age was significantly older than those who were culpable for none or one of their crashes. For older male drivers, riding a motorcycle or driving a heavy vehicle were significant risk factors for having a subsequent crash. The risk for female at-fault drivers being involved in a subsequent crash was 4.53 times greater than those not at-fault. Older female drivers involved in crashes caused by slowing or stopping also presented a higher risk of being involved in subsequent crashes (296).

**Attitude of Swiss General Practitioners to Mandatory Training in Assessing Fitness to Drive of Older Drivers**

In Switzerland, the currently existing regulation for acquiring level 1 competence is widely accepted by GPs. Almost all respondents considered that they have sufficient knowledge to assess MFTD (297).

**Prevention of Road Crashes in Older Adults: Perspectives on Facilitators, Barriers, and the Role of the Family Doctor**

Although family doctors do not usually ask their older patients about road driving, they are highly valued by these patients. Thus, family doctors have a great potential to act, along with the family members, for the benefit of older patients' traffic safety, in ways that can prevent their involvement in road crashes and reduce the negative consequences of having to stop driving if necessary (298).

**Medical Impairment and Road Traffic Crashes Among Older Drivers in Sweden - A National, Population-Based, Case-Control Study**

In Sweden, in the current generation of older drivers, acknowledged driving-impairing medical conditions at the national and European levels remain a concern. After adjustment for one another, all but 2 of the conditions are associated with RTCs albeit to varying degrees and more pronounced in the age group 65-79 compared to 80 or older (299).

**Health and Quality of Life Outcomes of Driving Cessation for Older People are More Complex Than We Thought**

Older past drivers experienced a range of outcomes regarding health and quality of life following driving cessation that clustered into five subgroups, ranging from people with robust outcomes to those with vulnerable health and quality of life. The subgroups were distinguished by economic position, social support, and volunteering (300).

**Survey of Occupational Therapy Driver Assessors' Rehabilitation Interventions with Older Drivers**

The four most common rehabilitation methods were (a) graded driving (18%, n = 118), (b) practicing specific manoeuvres (17.7%, n = 116), (c) using a modified vehicle (16.9%, n = 111),

and (d) graded driving in local areas only (15.1%, n = 99). The most common barrier limiting driver rehabilitation was cost (M = 2.92, SD = 1.24). The most frequently used driver rehabilitation method was on-road training (301).

**Comparison of Older and Middle-Aged Drivers' Driving Performance in a Naturalistic Setting**

Both groups made few driving errors that were mostly low risk. Driving performance of older adults differed from middle-aged drivers; they drove on simpler routes (fewer intersections and lane changes) and made fewer errors. Findings are likely indicative of older drivers' use of adaptive strategies to maintain safe driving (302).

**Assessment of Cognitive Screening Tests as Predictors of Driving Cessation: A Prospective Cohort Study of a Median 4-Year Follow-Up**

The Clock Drawing Test and the Trail Making Test may predict driving cessation in a statistically significant way, with a better performance than the UFOV and MoCA tests during a median 4-year follow-up. Combining tests may increase the predictability of driving cessation. Although the results are consistent with current evidence, they should be interpreted with precaution; more than 95% of the participants above the set threshold were able to continue driving for 4 years without any serious incident! (303).

**Association Between Decision-Making Under Risk Conditions and On-Road Driving Safety Among Older Drivers**

The number of risky choices made, but not the number of strategy changes, across trials of the Game of Dice Task independently predicted on-road safety ratings after controlling for visual acuity, cognitive test performance, and off-road driver screening measures, B = -.146, 95% CI (-.276 to -.016), (304).

**Driving Specialist's Ratings of On-Road Performance and Naturalistic Driving Crashes and Near-Crashes**

Rate ratios examining the association between older drivers with worse CDRS composite scores and rates of at-fault crashes, at-fault near-crashes, and combined at-fault crashes and near-crashes were significantly higher compared to drivers with better scores. Results were similar for the CDRS global score (305).

**Determinants of Driving Among Oldest-Old Australian Women**

The result of the multivariable logistic regression showed providing care, living alone, volunteering, living in rural/outer regional Australia, having higher educational attainment, and social interactions were associated with driving (306).

**Canadian Older Adults' Perceptions of Transitioning from Driver to Non-Driver**

The authors identified five themes: planning for mobility change, mobility supports and neighbourhoods, financial security, fearing loss of control and independence, and coping and acceptance as a part of aging. Findings highlight diverse attitudes toward driving cessation, ranging from avoidance to acceptance, and emphasize the importance of tailored resources for drivers at various stages of behaviour change (307).

**Characteristics of Driving Self-Assessments and Factors Related to Inaccurate Self-Assessment in Japanese Older Adults**

The results showed that older drivers' self-assessments were significantly higher than the experts' assessments of their driving performance. This tendency applied to all driving competencies, including overall rating, speed, and scanning. In addition, there were greater discrepancies between self-assessments and expert assessments for drivers who were rated poorly by experts compared with those who were highly rated (308).

**Continued Trends in Older Driver Crash Involvement Rates in The United States: Data Through 2017-2018**

Since the mid-1990s, fatal crashes per licensed driver trended downward, with greater declines for drivers ages 70 and older than for middle-aged drivers (43% vs. 21%). Fatal crash rates per 100,000 licensed drivers and police-reported crash rates per mile travelled for drivers ages 70-79 are now less than those for drivers ages 35-54 (309).

**Psychological Resources and Driving Status: A Study of Current and Former Drivers 55 Years of Age and Older**

Former drivers were older, reported being in poorer health, and reported more depression symptoms. After controlling for age and health, current drivers reported higher levels of life

control and life purpose and a more internal locus of control. Results highlight the importance of considering psychological resources when examining driving cessation (310).

**How Do Older Drivers Perceive Visual Information Under Increasing Cognitive Load? Significance of Personality On-Road Safety**

With the increase of cognitive load in drivers with high levels of neuroticism and extraversion, the time of saccades and fixation significantly increased. The decrease in the effectiveness of visual attention shifting in older drivers intensified as the difficulty of performing tasks increased and manifested itself in longer saccade and fixation times. A higher level of neuroticism and the resulting stress and emotional tension can translate into a greater tendency to make mistakes in older drivers (311).

**Association of Hospitalization with Driving Reduction and Cessation in Older Adults**

Of hospitalisations in adults aged 65 years and older, 22% were associated with a decrease in driving patterns within 2 years. The relative risk of a reduction or cessation in driving was 1.62 (95% CI: 1.54, 1.70, $p < 0.001$) when there was a hospitalization compared with when a hospitalization did not occur. Baseline functional, cognitive, and visual impairment, fair or poor self-rated health, and diabetes were identified as independent risk factors for decreased driving patterns after hospitalization (312).

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