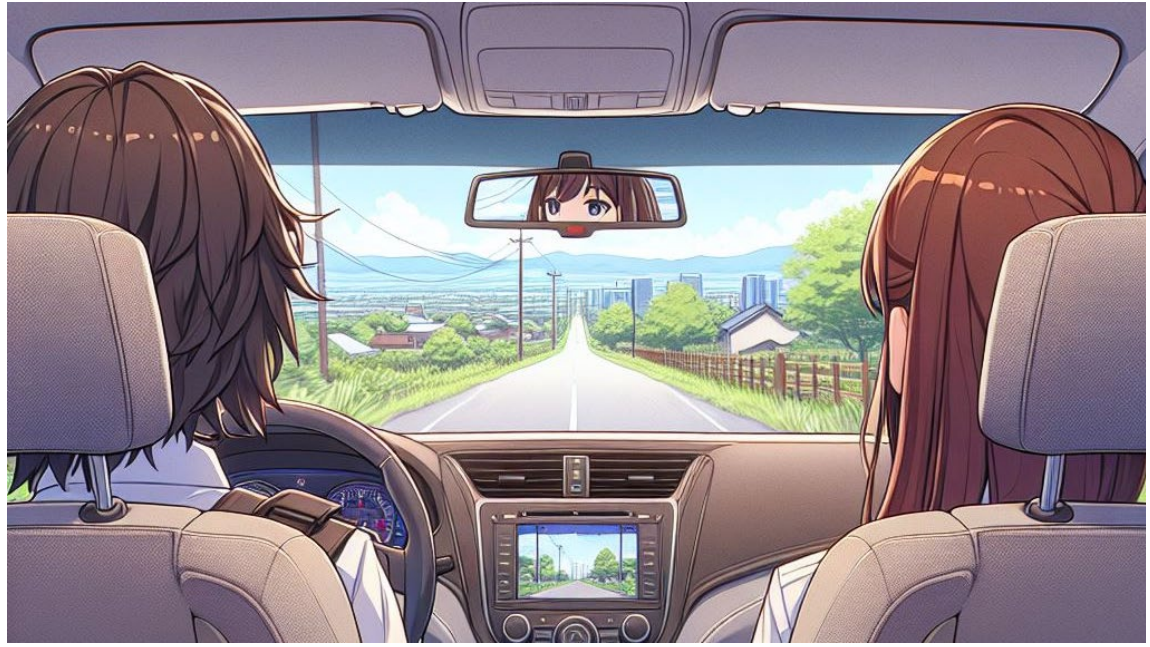
Pre-crash driver behaviors in motor vehicle crashes caused by sudden illness

Emma Nilsson, Mirta Zelenika Zeba, Emma Tivesten

Volvo Cars Safety Centre, Gothenburg, Sweden



Literature: Crashes caused by sudden illness

- At least 9-15% of driver fatalities (Ahlm et al., 2001; Breen et al., 2018; Brodie et al., 2019; Tervo et al., 2008)
  - Underreported since non-fatal conditions leading to fatal crashes are often missed
- 1.3-14.5% of severe crashes (Hanna, 2009; Lindsay & Baldock, 2008; Fitzharris et al., 2020)
- Mostly single vehicle crashes initiated by lane departures (Brodie et al., 2019; Hanna, 2009; Neal et al., 2018)
- Vehicle pre-crash movements “out of control” for ~50% of seizure-related crashes (Neal et al., 2018)
- 7 case studies with crash descriptions and medical conditions, 1 with video (Lindsay & Baldock, 2008; Marinella, 2004; Motozawa et al., 2005; Sakurai et al., 2014)

→ More knowledge needed about how sudden illness manifests and how drivers behave when falling ill.

Study aim: Investigate drivers’ pre-crash vehicle handling and signs off illness in crashes where sudden illness was the main contributing factor

Data and analysis

Crashes with Volvo cars in Sweden, in which sudden illness was identified as the main contributing factor.

Two databases:

- Volvo Cars' Accident Database (VCAD), involving crashes collected based on repair cost level
- Swedish Transport Administration's database of fatal crashes

In total 138 cases (73 fatalities), occurring 2010-2023.

Sources of information:

- Questionnaires (VCAD only, 64 cases)
- EDR data on speed, pedal use and/or steering (25 cases)
- Medical records/autopsy reports (67 cases)
- Additional witness statements, e.g., in-depth investigations, police reports (61 cases)

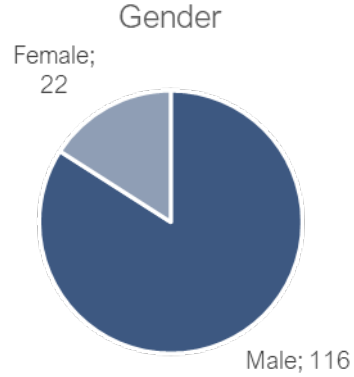
Retrospective analysis, two parts:

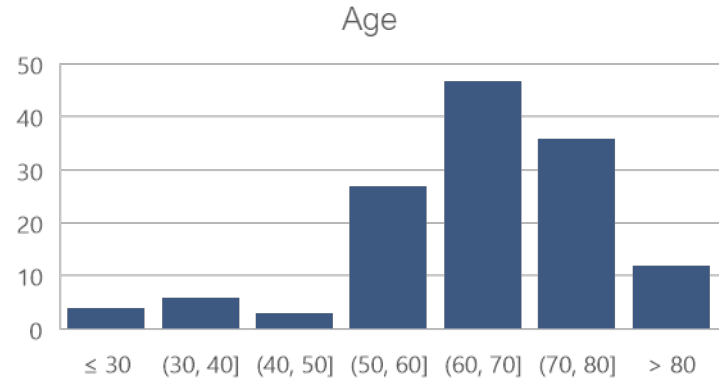
- Descriptive statistics (all cases)
- Explorative analysis to identify driver pre-crash vehicle handling and signs of illness (subset of cases)

Demographics, road environment and trips

Driver info:

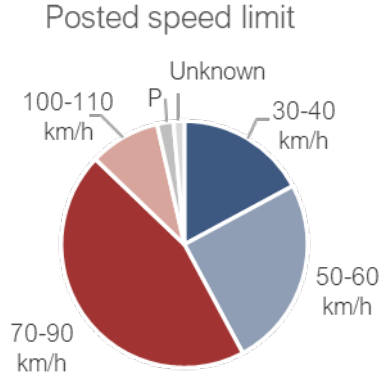
- Dominance towards men and age above 50 years
- Cases seen for ages 21-90 years

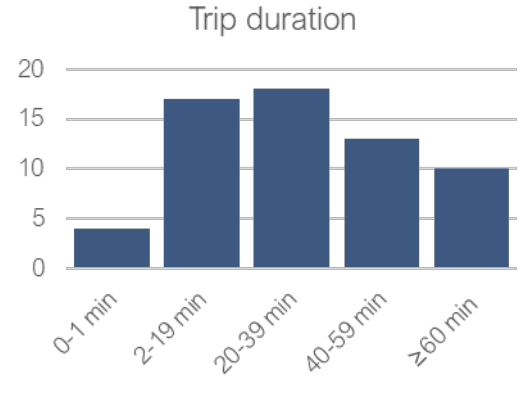


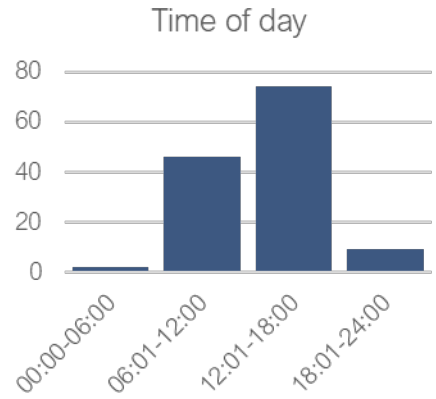


Time and place:

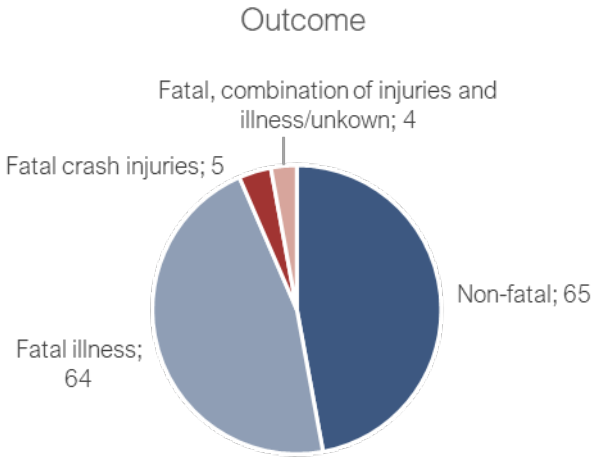
- Cases seen in all environments and times

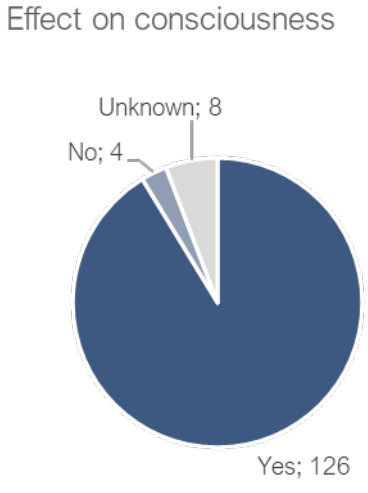






Types of illness

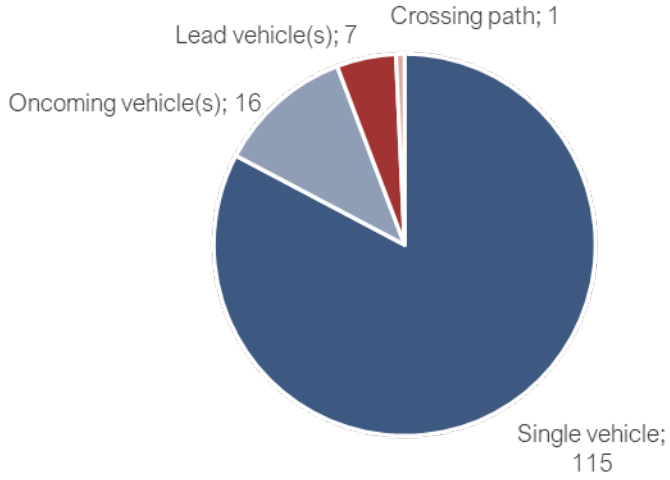




Medical condition	Fatal	Non-fatal
Syncope/Transient loss of consciousness	1	44
Cardiac arrest	44	0
Seizure	0	10
Acute myocardial infarction (heart attack)	7	1
Stroke	3	4
Diabetic event	1	4
Aortic dissection	2	0
Respiratory illness	1	1
Nausea	0	1
Alcohol poisoning	1	0
Unknown	13	0
	73	65

Crash types

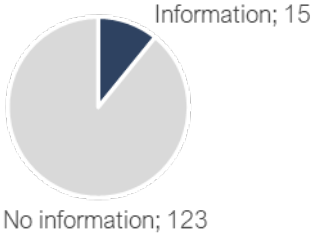
In most cases (96%), the vehicle first leaves its lane/road.
What happens next depends on the environment.

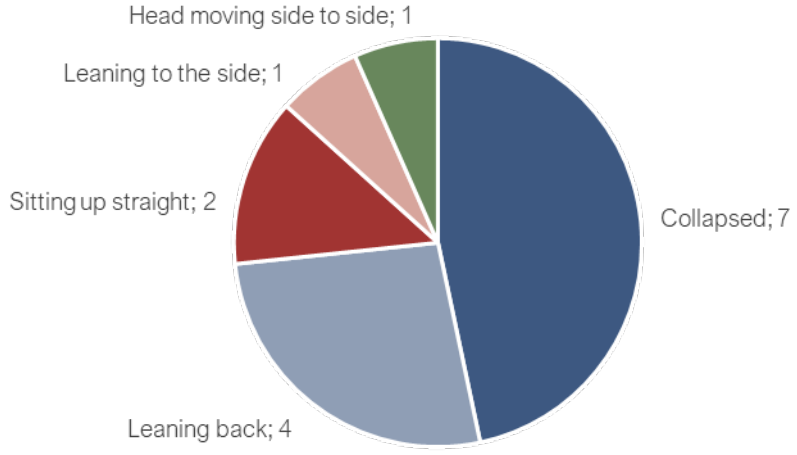


Pre-crash vehicle handling and signs of illness

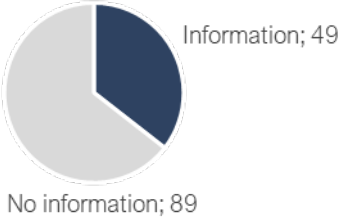
- Posture
- Other signs of illness
- Pedal usage
- Speed and acceleration
- Intention to stop
- Passenger interventions

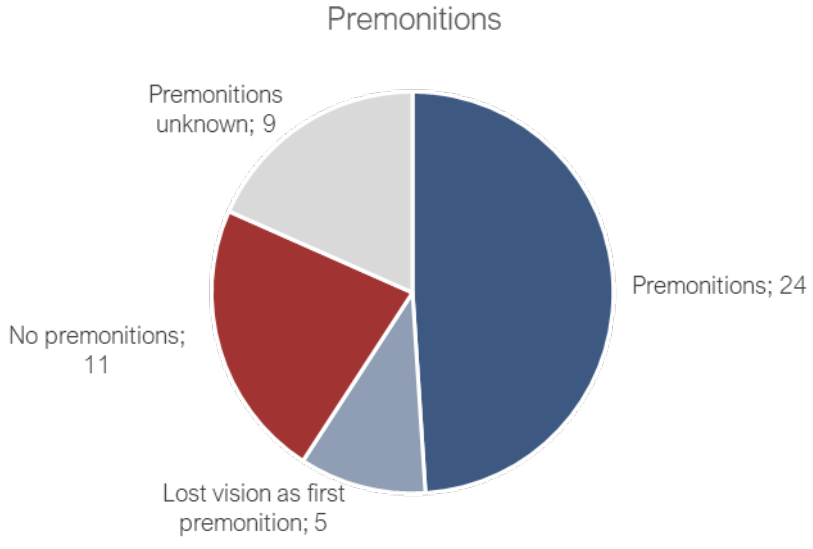
Driver posture (testimonies)





Other signs of illness (testimonies)





Externally observable:

Wheezy/snoring breathing

Gurgling sounds

Sweating

Coughing/sneezing

Convulsions

Mouth smacking

Chills/shaking

Drooling

Paleness

Sensations:

Loss of vision

Pain

Feeling ill/nauseous

Feeling tired/fatigued

Feeling about to faint

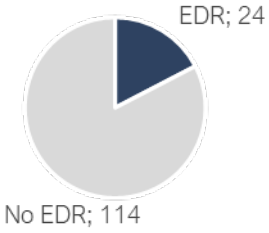
Uneasiness

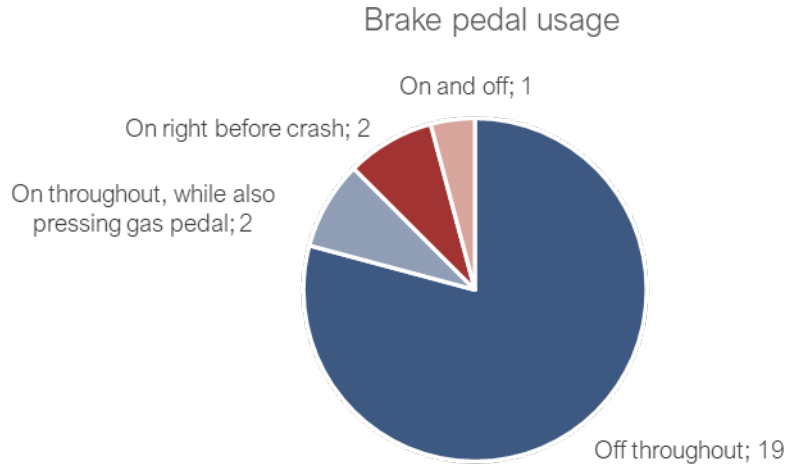
Headache

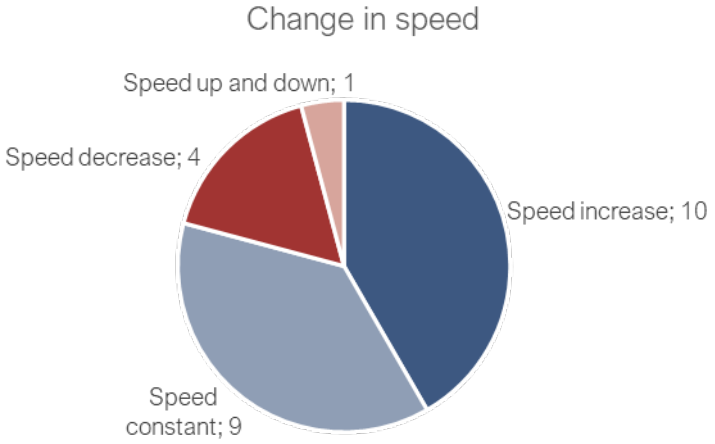
Racing heart

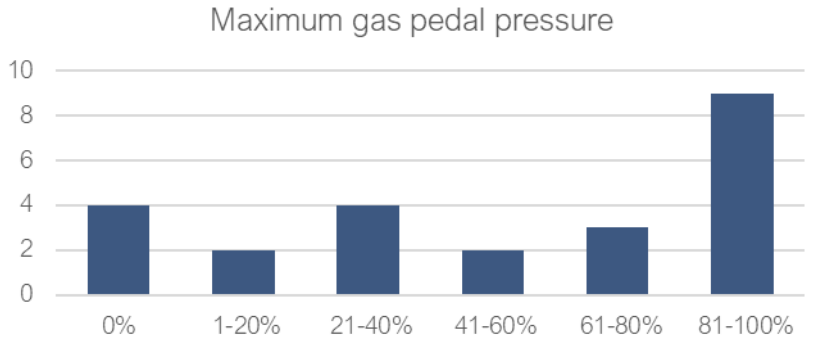
Dizziness

Pedal usage (EDR, last 5 s)

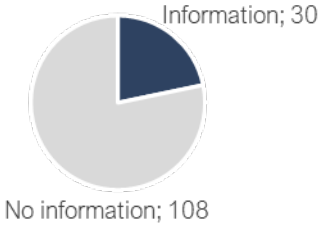


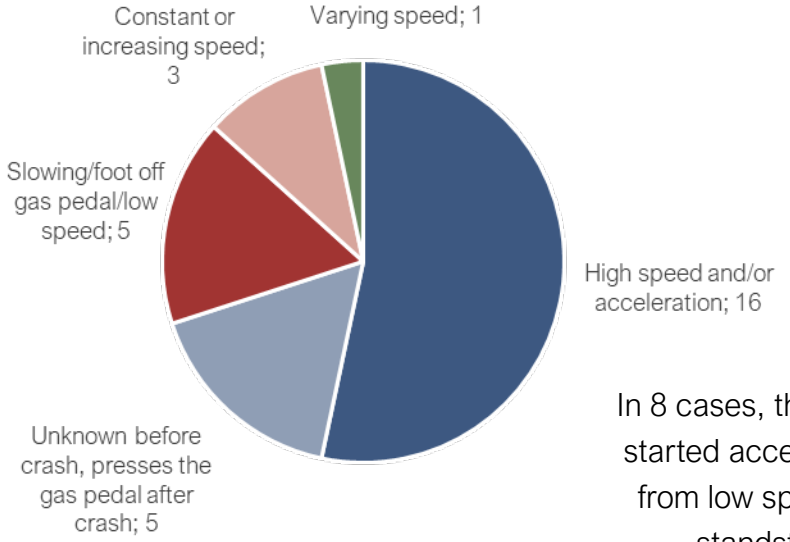






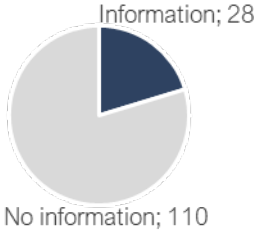
Speed and acceleration (testimonies)

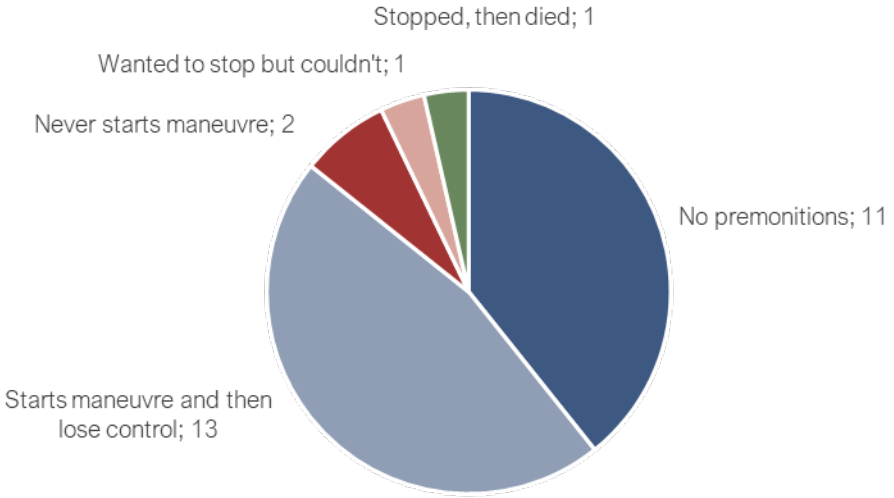




In 8 cases, the driver started accelerating from low speed or standstill.

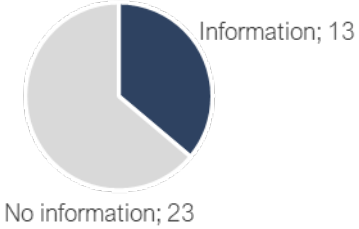
Intention to stop (testimonies)



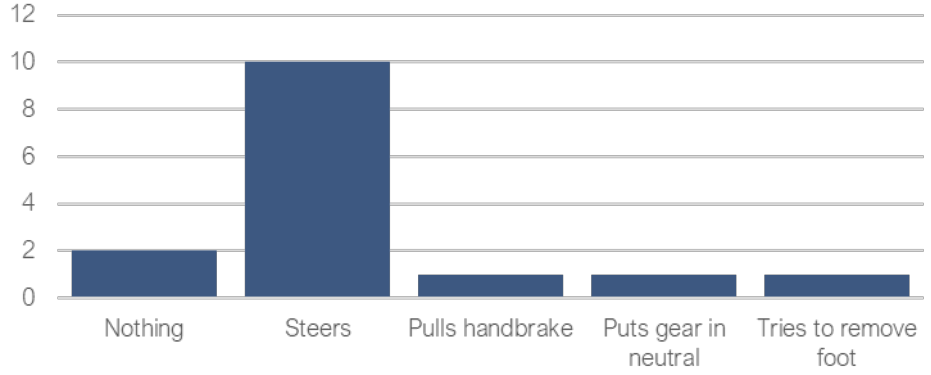


In 6 cases, the driver started accelerating again after losing consciousness.

Passenger interventions (testimonies)



In 5 cases, the driver accelerates while the passenger keeps the car on the road.



Conclusions

- Sudden illness can, and do, occur anywhere and anytime → Outcome depends a lot on the environment
- Many drivers reported no, or very late, premonitions → Little time to act
- Posture and other signs of illness varied → Multiple ways to detect illness are needed
- Drivers many times accelerate the vehicle → Fast interventions are needed
- Pressing the gas pedal may be misinterpreted as an intentional act → How to know if a driver acts intentionally?
- Passengers struggle to deal with the situation → Passenger support needed

Acknowledgement

Joakim Elfving, Traffic accident investigator

Swedish Transport Administration (Trafikverket)

Johan Zelano, Professor of Neurology

Institute of Neuroscience and Physiology, Wallenberg Centre for Molecular and Translational Medicine, University of Gothenburg

Neurosjukvården, Sahlgrenska University Hospital

Peter Lundgren, MD, PhD, Associate professor

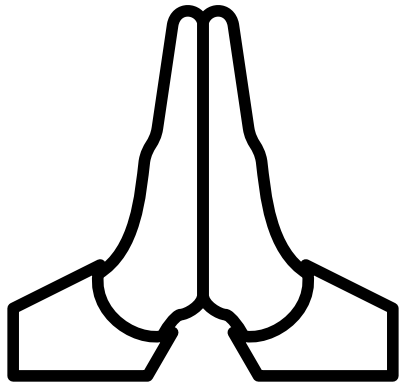
Consultant in Cardiology

Consultant in Internal Medicine

Institute of Medicine. University of Gothenburg

Prehospen - Centre for Prehospital Research, University of Borås

Department of Cardiology, Sahlgrenska University Hospital



References

Ahlm, K., Eriksson, A., Lekander T. and Björnstig, U. (2001). Alla dödsfall i trafiken är inte ”dödsolyckor” – en analys av officiell statistik över dödsfall i svensk vägtrafik år 1999. *Läkartidningen, 17*(98), 2016-2022.

Breen, J. M., Naess, P. A., Gjerde, H., Gaarder, C. and Stray-Pedersen, A. (2018). The significance of preexisting medical conditions, alcohol/drug use and suicidal behaviors for drivers in fatal motor vehicle crashes: a retrospective autopsy study. *Forensic Science, Medicine and Pathology*, *14*, 4-17. doi.org/10.1007/s12024-017-9934-x.

Brodie, L. R., Odell, M., Ranson, D., Young, C., Kitching, F. and Ibrahim, J. E. (2019). Sudden natural death behind the wheel: Review of driver deaths and fitness to drive assessment history in Victoria, Australia 2012–2013. *Journal of Forensic and Legal Medicine*, *63*, 31-33. doi.org/10.1016/j.jflm.2019.02.011.

Fitzharris, M. P., Corben, B., Lenné, M. G., Pok Arundell, T., Peiris, S., Liu, S., Stephens, A., Fitzgerald, M., Judson, R., Bowman, D. M., Gabler, H. C., Morris, A. and Tingvall, C. (2020). *Overview and analysis of serious injury crashes – crash types, injury outcomes and contributing factors, ECIS Report 1*. Monash University Accident Research Centre.

Hanna, R. (2009). *The Contribution of Medical Conditions to Passenger Vehicle Crashes*. U.S. Department of Transportation, National Highway Traffic Safety Administration2.

Lindsay, V. L. A. and Baldock, M. R. J. (2008). Medical conditions as a contributing factor in crash causation. *Proceedings of the 2008 Australasian Road Safety Research, Policing and Education Conference,* 610-628

Marinella, M. A. (2004). A car crash complicating influenza. *Mayo Clinic Proceedings, 79*(8), 1087-1088.

Motozawa, Y., Yokoyama, T., Hitosugi, M. and Tokudome, S. (2005). Analysis of sudden natural deaths while driving with forensic autopsy findings. *19th International Technical Conference on the Enhanced Safety of Vehicles (ESV)*.

Neal, A., Carne, R., Odell, M., Ballek, D., D’Souza, W. J. and Cook, M. J. (2018). Characteristics of motor vehicle crashes associated with seizure: Car crash semiology. *Neurology, 91*(12), e1102-e1111. doi:10.1212/WNL.0000000000006208.

Sakurai, K., Yamamoto, J., Kurita, T., Takeda, Y. and Kusumi, I. (2014). Video event data recording of a taxi driver used for diagnosis of epilepsy. *Epilepsy and Behavior Case Reports, 2*, 24-25. dx.doi.org/10.1016/j.ebcr.2013.12.007.

Tervo, T. M. T., Neira, W., Kivioja, A., Sulander, P., Parkkari, K. And Holopainen, J. M. (2008). Observational Failures/Distraction and Disease Attack/Incapacity as Cause(s) of Fatal Road Crashes in Finland, *Traffic Injury Prevention, 9*(3), 211-216. doi.org/10.1080/15389580802040303.

VOLVO

Thank you! Questions?

DDI 2024, 22-24 October, Emma Nilsson, emma.j.nilsson@volvocars.com