Transportation Research Part F 21 (2013) 242–252

Contents lists available at ScienceDirect

Transportation Research Part F

journal homepage: www.elsevier.com/locate/trf

Efficacy of proxy definitions for identification of fatigue/sleep-related crashes: An Australian evaluation ☆

Kerry Armstrong *, Ashleigh J. Filtness, Christopher N. Watling, Peter Barraclough, Narelle Haworth

Centre for Accident Research and Road Safety – Queensland, School of Psychology and Counselling, Faculty of Health, Queensland University of Technology, Kelvin Grove, Queensland 4059, Australia

ARTICLE INFO

Article history:
Received 15 January 2013
Received in revised form 4 July 2013
Accepted 3 October 2013

Keywords:
Driver behaviour
Sleep related crash
Near miss crash
Road traffic incident

ABSTRACT

Fatigue/sleepiness is recognised as an important contributory factor in fatal and serious injury road traffic incidents (RTIs), however, identifying fatigue/sleepiness as a causal factor remains an uncertain science. Within Australia attending police officers at a RTI report the causal factors; one option is fatigue/sleepiness. In some Australian jurisdictions police incident databases are subject to post hoc analysis using a proxy definition for fatigue/sleepiness. This secondary analysis identifies further RTIs caused by fatigue/sleepiness not initially identified by attending officers. The current study investigates the efficacy of such proxy definitions for attributing fatigue/sleepiness as a RTI causal factor. Over 1600 Australian drivers were surveyed regarding their experience and involvement in fatigue/sleep-related RTIs and near-misses during the past five years. Driving while fatigued/sleepy had been experienced by the majority of participants (66.0% of participants). Fatigue/sleep-related near misses were reported by 19.1% of participants, with 2.4% being involved in a fatigue/sleep-related RTI. Examination of the characteristics for the most recent event (either a near miss or crash) found that the largest proportion of incidents (28.0%) occurred when commuting to or from work, followed by social activities (25.1%), holiday travel (19.8%), or for work purposes (10.1%). The fatigue/sleep related RTI and near-miss experience of a representative sample of Australian drivers does not reflect the proxy definitions used for fatigue/sleepiness identification. In particular those RTIs that occur in urban areas and at slow speeds may not be identified. While important to have a strategy for identifying fatigue/sleepiness related RTIs proxy measures appear best suited to identifying specific subsets of such RTIs.

1. Introduction

Fatigue/sleepiness road traffic incidents (RTIs) are one of the most preventable types of RTI in the developed world. However the extent of this problem is often understated. The importance of fatigue/sleep-related driving as a contributory factor in fatal and serious injury RTIs is well established within Australia (ATSB, 2006; Dobbie, 2002) and internationally (Connor et al., 2002; Dinges, 1995; Horne & Reyner, 1995; Åkerstedt, 2000). Fatigue/sleepiness accounts for up to 20.0% of population attributable risk (Connor et al., 2002) and is on par with the contribution of alcohol related factors to RTI (Australian Transport Council, 2011).

☆ This research grant was made possible as the result of a funding grant by the NRMA-ACT Road Safety Trust and the Roads and Traffic Authority, New South Wales. This work has been prepared exclusively by the authors and is not endorsed or guaranteed by the Trust.

* Corresponding author. Tel.: +61 7 3138 8418.
E-mail address: ka.armstrong@qut.edu.au (K. Armstrong).

1369-8478/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.trf.2013.10.002

The percentages of RTIs attributed to fatigue/sleepiness have varied across different studies. For example, in the United States driver fatigue/sleepiness has been identified as a causative factor in one to three percent of all RTIs (Lyznicki, Doege, Davis, Williams, & Fabrizio, 1998). In the United Kingdom, Horne and Reyner (1995) reported that 16.0% of all RTIs were sleep related and 20.0% of motorway RTIs were due to fatigue/sleepiness. In more recent times there has been a consensus within the literature that the proportion of all RTIs related to fatigue/sleepiness is in the order of 20.0% (Connor et al., 2002; Garbarino, Nobili, Beelke, De Carli, & Ferrillo, 2001). Moreover, the study by Connor et al. (2002) provides sound evidence of the role of fatigue/sleepiness in RTIs. This stringent case controlled study found the population attributable risk for fatigued/sleepy driving to be 19.0%; that is, a cessation of all fatigue/sleep-related crashes would result in a 19.0% decrease in the total number of RTIs.

Determinations as to the involvement of fatigue/sleep-related factors can only be arrived at indirectly, and tend to rely on subjective police reports. Within Australia, as with many other jurisdictions, the attending police officer is responsible for identifying causal factors at an RTI and one option available is 'fatigue/sleep-related'. Given that there is no objective method for identifying the involvement of fatigue/sleepiness in RTIs, as there is for other factors such as alcohol use or speeding, researchers and crash investigators therefore often rely upon evidence of erratic driving immediately prior to the crash to indicate the involvement of fatigue/sleepiness. These indicators include crossing the centre line, running off the edge of the road and the frequency of lane excursions, as well as driver behaviour in the days leading up to the crash. Police attribution of fatigue/sleepiness in RTI reports is, in some instances, the only data available. In some Australian jurisdictions (including Queensland, New South Wales and Western Australia), police check a box on the crash report form to indicate that fatigue/sleepiness was considered to be a contributing factor in the crash. The figures derived from such coding are considered to be an underestimate of the true number of fatigue/sleep-related crashes (Attewell, Lock, Dobbie, & Walker, 2001).

In response to concerns of underestimation of the contribution of fatigue/sleepiness to crashes by self-report and subjective police reports, five of the eight Australian jurisdictions and the national Australian Transport Safety Bureau (ATSB) have developed proxy measures of fatigue/sleep-involvement which can be applied post hoc to all RTIs in a police report databases, these definitions are displayed in Table 1.

In general, these proxy measures use characteristics that have been repeatedly found by research studies to be associated with fatigue/sleepiness to identify crashes that are likely to be fatigue/sleep-related. For example, studies have shown that drivers are much more likely to fall asleep at the wheel between midnight and 6 am (or 2 am and 6 am) and fatigue/sleep-related crashes are more likely to involve a single vehicle running off the road (Horne & Reyner, 1995; Pack et al., 2006). While these proxy definitions have been shown to provide sound estimations as to the extent of fatigue/sleep-related crashes (e.g., Dobbie, 2002) other studies have identified proxy definitions to be of limited value. A study by Crummy, Cameron, Swann, Kossmann, and Naughton (2008) employed the ATSB operational definitions used by Dobbie (2002) for identification of a fatigue/sleep related crash. These definitions had been developed following investigations into the characteristics of fatal RTI's in which fatigue/sleepiness was identified as an important contributing factor by police, witnesses or

Table 1
Outline of proxy definition by Australian agency or jurisdiction.

	Time of day	Road speed	Outcome	Features not present	Reporting officer consideration
Australian Transport Safety Bureau (ATSB)	Midnight to 6 am, 2 pm to 4 pm	$\geqslant$80 km/h	Single vehicle	Pedestrian, unlicensed driver, blood alcohol concentration > 0.05%	NA
Queensland (QLD)	2 pm to 4 pm, 10 pm to 6 pm	$\geqslant$100 km/h	Single vehicle	NA	Fatigue to be contributory
New South Wales (NSW)	NA	NA	Travel onto incorrect side of road, Head on collision with oncoming vehicle (not overtaking), Run off road	Excess speed, Another relevant factor which may affect manoeuvre	Driver described as asleep or drowsy
Victoria (VIC)	NA	NA	NA	NA	Involuntary and progressive withdrawal of attention. Witness accounts of fatigue
Western Australia (WA)	NA	NA	Travel onto incorrect side of road, Head on collision with oncoming vehicle (not overtaking), Run off road	Excess speed, Another relevant factor affecting loss of control (alcohol, road condition, tyre blow out, sun glare, side wind, headlights, driver condition, broken screen)	Fatigue stated as likely cause
Tasmania (TAS)	NA	NA	NA	NA	Reports of inattentiveness, drowsiness or falling asleep