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Road accidents caused by sleepy drivers: Update of a Norwegian survey

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ABSTRACT

The current study tests, updates and expands a model of factors associated with sleepy driving, originally based on a 1997 survey of accident-involved Norwegian drivers (Sagberg, F., 1999. Road accidents caused by drivers falling asleep. Accident Analysis & Prevention 31, 639–649). The aim is to establish a robust model to inform measures to tackle sleepy driving. The original questions on (i) tiredness-related accidents and (ii) incidents of sleep behind the wheel in the last 12 months were again posed in 2003 and 2008, in independent surveys of Norwegian drivers involved in accidents reported to a large insurance company. According to those drivers at-fault for the accident, tiredness or sleepiness behind the wheel contributed to between 1.9 and 3.9 per cent of all types of accident reported to the insurance company across these years. Accident-involved drivers not at fault for the accident reported a reduction in the incidence of sleep behind the wheel for the preceding year, decreasing from 8.3 per cent in 1997 to 2.9 per cent in 2008. The reasons for this are not clear. According to logistic regression analysis of survey responses, the following factors were robustly associated with road accidents involving sleepy driving: driving off the road; good road conditions; longer distance driven since the start of the trip; and fewer years with a driving licence. The following factors are consistently associated with reports of sleep behind the wheel, whether or not it leads to an accident: being male; driving further per year; being younger; and having sleep-related health problems. Taken together these findings suggest that young, inexperienced male drivers who drive long distances may be a suitable target for road safety campaigns aimed at tackling sleepy driving.

1. Introduction

Fatigue is detrimental to attention, recall, reaction time, hand-eye coordination and vigilance (Gall, 2006; Caldwell, 2009). The implications for the driver are serious. Reports based on comprehensive accident analysis estimate that fatigue is involved in between 10 and 20 per cent of serious road accidents, with higher prevalence reported for motorway accidents or accidents involving professional drivers (Horne and Reyner, 1995; Philip et al., 2001; Hartley, 2007; Craft, 2009).

Although the terminology used can differ, most research on driver fatigue actually addresses sleepy driving, which since it can result in sleep at the wheel poses the greatest fatigue-related safety problem for drivers (Brown, 1994). One of the most important predictors of sleepy driving is sleep history, which itself comprises time since last sleep (Gander et al., 1997), quantity and quality of previous sleep (Tasca, 2006) and cumulative sleep deficit (Williamson et al., 2010). Individual proneness to fatigue is also a predictor of sleepy driving (Knipling, 2005), and is in turn influenced by health (Knipling et al., 2004; Czeisler et al., 2009), age (Holland and Leutzinger, 2003), and lifestyle (Gertler et al., 2002). In addition to person factors, those inherent to the driving task must also been considered, such as time on task (Feyer and Williamson, 2000), time of task (Hartley, 2007), road environment, and purpose of the journey (Williamson et al., 2010). As modern trends reduce sleep opportunities, and lead us to travel greater distances at all times of the day, the problem of sleepy driving only looks set to grow (Dinges, 2011).

Information on the importance of sleepy driving as a contributor to road accidents is available from accident analyses which aim to characterize and identify sleepy driving accidents using information in national databases (Garbarino et al., 2001). These analyses consistently confirm that the main temporal and environmental risk factors are early hours driving and long, monotonous driving tasks. Accident analyses can also inform about certain driver demographics, for instance that young drivers appear to be more susceptible to early-hours effects (Åkerstedt and Kecklund, 2001). Due to limitations in the way information in databases is collected (e.g. Horne and Reyner, 1999), these analyses have been cross-validated and supplemented using national driver surveys. Importantly, questions can be included on these surveys about all types of incidences of sleepy driving, whether or not an accident resulted. In this way national surveys can supplement database

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analysis with knowledge about the general prevalence of the problem on the roads, and in addition provide detailed information about driving demographics and sleep-related factors. Thus the results better represent the problem of sleepiness as it exists in the national driving population than do those gained from the analysis of a limited number of accidents.

A national driver survey in New Zealand sampled 5534 current drivers, and found that sleep problems were more prevalent among accident-involved drivers (Gander et al., 2005). A UK survey of 4600 respondents found that 29 per cent admitted to have been close to falling asleep at the wheel in the previous twelve month period, and that company car drivers were more likely to have a sleepy driving accident, presumably due to greater exposure to long, monotonous driving (Maycock, 1996). In the US, 29 per cent of drivers reported actually sleeping or nodding off during the preceding 12 months (Gaarder and Alexander, 1995), a figure which remains at least as high according to recent national polls (National Sleep Foundation, 2011). The prevalence of sleepy driving appears to vary substantially between countries, possibly due to geographical differences. A Norwegian survey of 2922 drivers in 1997 found that only eight per cent reported sleeping or nodding off behind the wheel during the preceding 12 months (Sagberg, 1999). One explanation for this is that Norway has fewer motorways and a higher density of mountains and fjords, and thus the roads can be considered less monotonous than they are in many parts of the US. Thus, to inform countermeasures, it may be important to characterize sleepy driving in the country in which those measures will be implemented.

As awareness grows about the risks of driving while sleepy, authorities are increasingly attempting to manage the problem. For professional drivers attempts are made to limit sleepy driving by hours of work legislation or, increasingly, organizational-based fatigue management programs (Phillips and Sagberg, 2010a). To address the problem in the general driving population authorities often resort to awareness campaigns.

Compared to drink-drive, speeding and seatbelt campaigns, sleepy driving campaigns have been limited in number, and those that have been executed are poorly evaluated, such that it is difficult to conclude much about their effect to date (Fletcher et al., 2005; Phillips et al., 2011). However, there are several reasons to believe that their effects will be limited. Firstly, the lack of an objective measure of sleepiness limits the extent to which these campaigns can be enforced by the police (Ulleberg, 2004; Wilschut and Caljouw, 2009). Secondly, campaigns often attempt to improve knowledge and awareness about sleepy driving when evidence indicates that drivers already have this information, already know about effective countermeasures, and continue driving knowing that they are sleepy (Nordbakke and Sagberg, 2007). The reason for the latter could be because the drivers do not believe that they themselves are prone to risks of driving while sleepy, which leads us to a third problem, namely that sleepy driving campaigns rarely target driver subgroups, and therefore fail to personalize the risk (Fletcher et al., 2005; Delhomme et al., 2009).

To help tackle these problems, culturally specific, robust information is needed about which driver populations are most likely to be involved in a sleepy driving accident, and the environmental and temporal conditions under which such accidents are likely to occur. There is also a need for knowledge on robust predictors of sleepy driving incidents to inform the targeting of groups for sleepy driving campaigns. It is, after all, the behavior leading to sleepy driving that safety campaigns wish to change.

With this in mind, the present study updates and expands a Norwegian driver survey reported by Sagberg (1999), which found that the following factors made significant and independent contributions to increasing the odds of sleep involvement in an accident: dry road, high speed limit, driving one's own car, not driving the car daily, higher education and fewer years of driving experience. Subsequent to the original survey, conducted in 1997, two similar surveys were conducted, one in 2003 and one in 2008. Like the original survey, the 2003 and 2008 surveys asked Norwegian drivers reporting to their insurance company an accident for which the company judged them to be at fault, whether sleepiness contributed to the event, and about personal background and environmental factors related to the accident. Self-reports of accident-involved drivers judged not to be at-fault were used to learn about incidences of sleep behind the wheel, since not-at-fault drivers are thought to be a better proxy for the normal driving population than are at-fault drivers. Reports of sleep behind the wheel are not considered salient enough in the driver's memory to be able to gather situational variables describing the conditions in which the driver slept behind the wheel. However, it is possible to use driver demographics to try and predict what sort of drivers are most at risk for sleeping behind the wheel. Some of the data from the 2003 survey have been reported previously (Sagberg, 2008, 2010), but they have not yet been used as part of an independent test of the robustness of the model of factors associated with sleep-related accidents reported by Sagberg (1999).

The aim of this paper is to report the results of an independent test of Sagberg's (1999) original model by analyzing data from the same survey questions posed six and eleven years afterwards. It extends the previous study, as well as the existing literature, in the following ways. Firstly, an attempt is made to establish a set of predictors that is highly robust in the sense that each predictor is both stable across time and linked to both incidents of sleep behind the wheel and accidents caused by sleepiness. Secondly, we attempt to assess any changes in the prevalence of sleepy driving accidents or sleep behind the wheel over the last 15 years – have contemporary pressures on sleep resulted in an increase in sleepy driving outcomes? Finally, we further address the need for culturally specific self-reports of sleepy driving to consolidate data from analysis of accident databases.

2. Methods

2.1. Sample and survey procedure

Procedures related to the original 1997 survey are reported by Sagberg (1999). Invitations to participate in two later surveys were sent by post to drivers who had been involved in a road accident in the previous 12 months for which resultant injury to person or vehicle had been registered by a major Norwegian insurance company. The surveys were sent in June 2003 ($n = 15{,}000$) and May 2008 ($n = 33{,}691$). Invitations were restricted to drivers of private light vehicles. Each invitation specified that only the driver of the accident-involved vehicle should fill out the survey.

In 2003, a paper survey was enclosed along with the invitation letter and a pre-paid self-addressed envelope for returning the survey. In 2008 the invitation letter gave a link and password to an internet survey, but participants were informed that a corresponding paper survey was available if they preferred. Only one per cent responded using paper surveys so these responses were grouped with the internet responses for analysis. Pilot work showed that both the paper and internet survey took between ten and 25 min to complete.

2.2. Survey items

In both years the survey comprised items that addressed in addition to tiredness and sleepiness behind the wheel, respondent demographics; details about last reported accident; illness, medicine use and health complaints; mobile telephone use; and other distractions. Results on mobile use and distractions are