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Driver sleepiness and risk of motor vehicle crash injuries: A population-based case control study in Fiji (TRIP 12)

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ABSTRACT

Introduction: Published studies investigating the role of driver sleepiness in road crashes in low and middle-income countries have largely focused on heavy vehicles. We investigated the contribution of driver sleepiness to four-wheel motor vehicle crashes in Fiji, a middle-income Pacific Island country.
Method: The population-based case control study included 131 motor vehicles involved in crashes where at least one person died or was hospitalised (cases) and 752 motor vehicles identified in roadside surveys (controls). An interviewer-administered questionnaire completed by drivers or proxies collected information on potential risks for crashes including sleepiness while driving, and factors that may influence the quantity or quality of sleep.
Results: Following adjustment for confounders, there was an almost six-fold increase in the odds of injury-involved crashes for vehicles driven by people who were not fully alert or sleepy (OR 5.7, 95%CI: 2.7, 12.3), or those who reported less than 6 h of sleep during the previous 24 h (OR 5.9, 95%CI: 1.7, 20.9). The population attributable risk for crashes associated with driving while not fully alert or sleepy was 34%, and driving after less than 6 h sleep in the previous 24 h was 9%. Driving by people reporting symptoms suggestive of obstructive sleep apnoea was not significantly associated with crash risk.
Conclusion: Driver sleepiness is an important contributor to injury-involved four-wheel motor vehicle crashes in Fiji, highlighting the need for evidence-based strategies to address this poorly characterised risk factor for car crashes in less resourced settings.

Introduction

Studies largely conducted in high-income countries suggest driver sleepiness is a significant contributor to the burden of road traffic injuries (RTI) [1,2], with a three to six-fold increased risk of road crashes [3–5], and population attributable estimates as high as 22% [6]

Although over 90% of RTI-related deaths occur in low and middle-income countries, the few epidemiological studies examining driver sleepiness as a risk factor for crashes and related injuries in this context have primarily focussed on truck drivers [7–9]. The high prevalence of driving while drowsy among Thai (75%) [9], Argentinean (44%) [7], and Brazilian bus/truck drivers (22%) [8], suggests the contribution of this factor to RTI in less resourced settings may be under-appreciated. A study among Thai commercial bus/truck drivers attributed 23% of crashes to driver sleepiness [9], while another study among Brazilian truck drivers reported significant proportions of crashes or near-miss crashes could be accounted for by excessive daytime sleepiness (18%), snoring (24%), and driver sleepiness (16%) [7]. A case control study from Shenyang, China – the only aetiological study focusing on car drivers that we are aware of found a two-fold increase in crashes among drivers with chronic but not acute sleepiness [10].

Factors associated with sleepiness which may also increase the risk of RTI include working for extended periods involving multiple jobs, night shifts, or unusual work schedules [11–14]. These occupational risks are of increasing concern in low and middle-income countries where drivers are vulnerable to less regulated labour conditions, and socioeconomic pressures to drive for prolonged periods without adequate rest [15–17].

In comparison with research conducted in more populous nations, low and middle-income countries with small populations draw less attention despite the substantial impact of RTI to these

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vulnerable economies. There is a notable paucity of research from Pacific Island countries and territories for over a decade, with most research to date focusing on Papua New Guinea [18]. In 2006, RTI in Fiji (the second largest Pacific Island country) accounted for 17% of all fatal and hospitalised injuries and 27% of all injury-related deaths in the country [19]. Fiji data suggest that three quarters of road crash fatalities in Fiji involve four-wheel motor vehicle occupants (drivers 26%, passengers 49%) [20].

While aetiological studies are rare, postulated risk factors for RTI in Pacific Island countries include travel in open-back utility vehicles, utility vehicle overcrowding, and alcohol [18]. To our knowledge, no studies have examined driver sleepiness as a risk factor for crashes or crash-related injuries. We investigated the contribution of driver sleepiness to the risk of injury-producing crashes involving four-wheel motor vehicles in Fiji, as part of the Traffic Related Injuries in the Pacific (TRIP) research project.

The aim of our study was to quantify the contribution of driver sleepiness to the risk of serious injury-involved four-wheel motor vehicle crashes in Viti Levu, Fiji.

Methods

A population-based case control study of motor vehicles, using a similar design to the Auckland Car Crash Injury Study [21], was conducted on Viti Levu, the main island of Fiji, from July 2005 to December 2006.

Viti Levu has a relatively young population (48% of 650,000 aged less than 24 years) and two main ethnic groups; indigenous Fijian (54%) and Indian (40%) [22]. The two main cities, Suva and Lautoka, are linked by sealed highways running along the coast.

The study base comprised motor vehicle 'driving-time' (equivalent to person-time) on public roads in Viti Levu. Eligible vehicles included motorised four-wheel vehicles such as; private cars, taxis, commercial minibus, van or minibus, pick up (open 'ute' with tray), trucks, and rental or government vehicles. We excluded buses, two-wheel vehicles (motorcycles), vehicles of the diplomatic corps, and emergency response vehicles. These vehicles represent less than 5% of the total vehicle fleet in Fiji.

Selection of controls

Controls were selected using a prospective two-stage cluster sample roadside survey of motor vehicles, designed to recruit a random population-based sample representative of motor vehicle driving-time on public roads in Viti Levu. This sample was previously used to study the prevalence of sleepiness in the driving population [23]. The sampling method aimed to recruit controls in proportion to the amount of driving undertaken given that exposure to risk of a crash only occurs when driving. Alternative sampling approaches (e.g. from databases of licensed vehicles or drivers) were considered less appropriate from this perspective.

In order to identify a sampling frame of eligible roads, a list of all public roads in Vii Levu was generated using police, public works and city council data. Roads classified as main, secondary, country, residential, or within-city bus routes; and roads longer than 400 m with daily traffic counts equal to or more than 200, were eligible for selection. Three strata for sampling were used: two for roads within city boundaries (Suva and Lautoka), and the third for roads outside these cities. Fifty roadside survey sites (including 10 for each of the two cities) were randomly selected in proportion to the cumulative road lengths (100 m intervals) of each of the three strata [24]. To identify the sampling period for each of the 50 roadside sites, randomisation to time of day (24-h clock), day of week (seven days), and travel direction (using the Suva Post office as the reference point) was undertaken. In order to optimise road user and research team safety, Fiji Police determined the final site for the roadside survey. The duration of each roadside survey was 2 h, and was undertaken weekly over the study period. To improve the resource-efficiency of data collection, road survey sampling was not undertaken between 2 a.m. and 5 a.m. as Fiji transport data suggested road travel and related crashes were uncommon during this period.

Consistent with established protocols in the country, traffic police used fluorescent road signs and cones to alert oncoming drivers about the road survey in progress, and slow down traffic. Motor vehicles were selected as research team members became available to process them. All potential participants received an information brochure providing an overview of the study and an invitation to participate. During each survey, we collected traffic counts for all vehicles travelling in the same direction as motor vehicles selected for the study. This enabled a weighting to be assigned to controls from each site that was the inverse of the proportion of all vehicles selected as controls.

Selection of cases

The identification of eligible motor vehicles (cases) involved a two-step process. Using a study-specific database established at all hospitals and mortuaries throughout Viti Levu, we prospectively identified all eligible motor vehicles; defined as a four-wheel motor vehicle involved in a crash where a road user (e.g. driver, passenger, pedestrian) had died or been hospitalised (for 12 h or more) due to an injury. Following this process, the drivers of all eligible vehicles identified above, were approached and invited to participate in the study. Eligible 'motor vehicle case drivers' therefore included injured drivers (fatal or hospitalised) as well as drivers who were not injured (but a passenger in their car, or another road user e.g. pedestrian involved in the crash was fatally injured or hospitalised). Consistent with the control selection protocol, crashes between 2 a.m. and 5 a.m. were excluded from this analysis.

Members of the research team collaborated with Fiji police and hospital personnel to ensure all eligible cases were identified, and case records accurate and complete. If the driver had died or was unable to participate due to severe injuries, a passenger in the same car was identified.

Data collection

Interviews for cases were conducted in the hospital or at home taking into consideration sensitivities surrounding those who had sustained severe injuries or in mourning. Interviews of controls were conducted either on-site during the roadside survey or deferred to a more suitable time and location.

Structured questionnaires were administered by trained interviewers, either face-to-face or by telephone. Information sought included motor vehicle details, circumstances prior to the crash/survey, personal factors, driving experience/habits, and demographic characteristics. Questions relating to sleepiness examining a range of potential risk and protective factors were embedded within the questionnaire.

Measures of sleepiness

The Stanford sleepiness scale (SSS) and Epworth sleepiness scale (ESS) are validated self-rating tools for measuring acute (state of drowsiness) and chronic or average daytime sleepiness (sleep propensity) respectively [14,25]. Although the ESS is validated in some low and middle-income populations [26–28], neither the ESS nor SSS have been validated in Pacific populations. During the pilot phase of the study, several study participants found it difficult to understand the terminology used in the English-language versions