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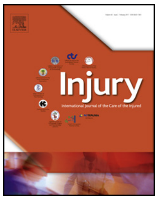

Driver sleepiness and risk of motor vehicle crash injuries: A population-based case control study in Fiji (TRIP 12)

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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

Table 1
Stanford sleepiness scale and it's adaptation for the study used in the TRIP study.

Stanford sleepiness scale	Sleepiness scale used in the TRIP study
1. Felt active, wide awake	Level 1: Felt active, wide awake
2. Was functioning at a high level but not at peak 3. Felt relaxed, awake but not fully alert, responsive	Level 2: Relaxed and awake but not fully alert
4. Felt a little foggy headed 5. Felt foggy headed, had difficulty staying awake, was beginning to lose track	Level 3: Difficulty staying awake, was beginning to lose track
6. Felt sleepy, would have preferred to lie down, woozy 7. Could not stay awake, sleep onset imminent	Level 4: Felt sleepy, would have preferred to lie down.

of these questionnaires. This resulted in the withdrawal of the ESS as a study instrument, and the collapsing of the standard seven-point scale of the SSS to a four-level sleepiness scale adapted specifically for the TRIP study (Table 1). The TRIP sleepiness scale comprised four categories: drivers who felt active and fully alert, those who were less alert, those having difficulty staying awake, and those who reported feeling sleepy.

Alternative sleep measures were sought to establish the amount of driver-reported sleep prior to the survey/crash relating to the quantity of sleep, quality of sleep, and work patterns. Regarding quantity of sleep, we investigated the number of hours slept in the previous 24 h (using 'sleep of 6 h or less', as the measure for acute sleep deprivation) [21,29], and number of nights of adequate sleep in the previous week; defining adequate sleep as sleep mostly between 11 p.m. and 7 a.m. for 7 h or more (using 'No full nights of adequate sleep in the previous week' to measure chronic sleep deprivation) [21]. For quality of sleep, we collected information on participants experiencing symptoms suggestive of obstructive sleep apnoea syndrome (regular loud snoring, breathing pauses, and choking) as reported to them by friends or relatives. We also sought information on the work patterns of drivers in paid work, specifically the number of work hours per week, and those working shifts (starting before 6 a.m. or finishing after midnight, whether permanent, rotating or on call).

Potential confounding variables

The following variables were considered as potential confounders or factors requiring adjustment in models: age, sex, ethnicity, income, use of alcohol, time and day of survey/crash, vehicle type, and speed prior to the survey/crash. We also sought information on the self-reported use of psychotropic and soporific agents such as marijuana, recreation drugs, sleeping tablets, including kava (a drink with sedative and anxiolytic properties consumed in Fiji) [30,31]. No objective measures for vehicle speed, alcohol, psychotropic or soporific agents were collected.

Analysis

Information collected on completed questionnaires was entered on EpiData Entry Version 2.0 software then transferred to STATA 12 statistical software for detailed analysis using survey procedures. To reflect the cluster sampling design and the disproportionate probability of selection due to varying traffic flows at different sites, weighting was assigned to each control recruitment site and the variance adjusted to account for the correlation within sites. Odds ratios with 95% confidence intervals were calculated using unconditional logistic regression. We developed separate models for each of the measures of sleepiness to avoid including correlated measures in a single model. Age, sex and ethnicity were forced into models, while all other factors and potential confounders were considered for inclusion in the models based on a 10% change-in-estimate method described by Greenland [32]. Population attributable risks and the associated 95% confidence interval were calculated for sleep-related factors found to have a significant association with the odds of injury crash [33,34].

This study was approved by the Fiji National Research Ethics Review Committee with approval to undertake the roadside survey granted by the Fiji Police Force and Land Transport Authority. All participants provided informed consent.

Results

The study involved 142 cases and 752 controls. Overall, 30% of eligible cases and 16% of eligible control participants declined to participate or could not be contacted for interviews, most often due to incorrect contact details. Of the drivers of case vehicles, 18 died, 76 were hospitalised, and the remainder were not hospitalised (although someone else involved in the crash was). Of the 19 proxies (all of whom were in the vehicle at the time of the crash, and proxies for all the drivers fatally injured) data on the level of sleepiness was unavailable for 11 cases. Therefore this analysis was limited to 131 cases and 752 controls.

Table 2 shows the distribution of measures of sleepiness and potential confounders among cases and controls. After controlling

Table 2
Distribution of driver sleepiness and potential confounders.

Variables	Case drivers		Control drivers	
	n	%	*n*	%
Sleepiness scale for TRIP				
1. Felt active, wide awake	77	58.8	629	81.8
2. Not fully alert	37	28.2	114	17.2
3. Difficulty staying awake	5	3.8	4	0.1
4. Sleepy, would have preferred to lie down	12	9.2	5	0.9
Acute sleep deprivation				
Amount of sleep in the previous 24 h[a]				
≥6 h	112	85.5	718	96.4
<6 h	19	14.5	34	3.6
Chronic sleep deprivation				
Number of nights of adequate sleep in the previous week[b]				
At least 1 night of adequate sleep	122	93.1	725	95.8
No nights of adequate sleep	9	6.9	27	4.3
Obstructive sleep apnoea symptoms				
Triad of symptoms[c]				
No	127	97.0	745	99.2
Yes	4	3.1	7	0.9
≥2 symptoms				
No	119	90.8	724	97.2
Yes	12	9.2	28	2.8
Regularly snore loudly				
No	89	67.9	488	64.1
Yes	42	32.1	264	35.9
Work patterns				
Shift work[d]				
No	112	85.5	634	85.0

Table 2 (*Continued*)

Variables	Case drivers		Control drivers	
	n	%	*n*	%
Yes	19	14.5	118	15.0
Hours paid work per week (>60 h)				
No	121	92.4	701	93.7
Yes	10	7.6	51	6.3
Age category				
15–24 years	19	14.5	84	12.9
25–34 years	47	35.9	220	31.8
35–44 years	33	25.2	223	29.3
≥45 years	32	24.4	223	25.9
Missing data	0	0	2	0.3
Sex				
Female	6	4.6	35	6.8
Male	125	95.4	717	93.2
Ethnic group				
Fijian	41	31.3	154	21.9
Indian	88	67.2	551	70.1
Other	2	1.5	47	8.1
Income (Fijian Dollars)				
<10,000	60	45.8	275	25.8
10,000–19,999	35	26.7	239	38.1
≥20,000	29	22.1	231	35.3
Declined to answer/missing data	7	5.3	7	0.9
Alcohol use in the 12 h before the crash/survey				
No	112	85.5	734	96.5
Yes	19	14.5	18	3.5
Psychotropic/soporific agent use in the 12 h before the crash/survey				
No	100	76.3	693	93.8
Yes	30	22.9	59	6.2
Missing data	1	0.8	0	0
Speed: how fast do you think you were travelling?				
≤50 km/h	51	38.9	502	74.4
51–60 km/h	28	21.4	160	21.2
≥61 km/h	46	35.1	90	4.5
Missing data	6	4.6	0	0
Vehicle type				
Cars	82	62.6	468	67.3
Other 4-wheel vehicles[e]	33	25.2	257	29.8
4-Wheel trucks	16	12.2	27	2.9

Note: Column totals may differ due to missing data.

[a] Number of hours slept.

[b] Number of nights of adequate sleep (mostly between 11 p.m. and 7 a.m. for 7 h or more).

[c] Witnessed reports of symptoms of obstructive sleep apnoea (regular loud snoring, breathing pauses, and choking).

[d] Involving paid work starting before 6 a.m. or finishing after midnight whether permanent, rotating or on call.

[e] Other 4-wheel vehicles: light and heavy goods vehicles such as minivan/bus, open back utility vehicles.

for confounders, we found an almost six-fold increase in odds of injury crash (OR 5.7, 95%CI 2.7, 12.3) among drivers who reported being less alert, having difficulty staying awake, or sleepy, compared with those who felt active and fully awake (TRIP sleepiness scale: level 2–4 versus level 1) (Table 3). There was also a significant increase in the odds of crash among drivers reporting less than 6 h of sleep during the previous 24 h (OR 5.9, 95%CI 1.7, 20.9). The population attributable risk (PAR) for crashes associated with driving while not fully alert or sleepy was 34% (95%CI 30.0, 37.4), while the PAR for driving after less than 6 h of sleep in the previous 24 h was 9% (95%CI, 6.3, 11.9).

The multivariable model of primary interest for our analysis did not include the use of psychotropic or soporific agents because the main exposure variable of interest (sleepiness) is in the pathway of the potential effect on the risk of a crash. However, including the use of psychotropic or soporific agents as a covariate shifted the point estimates for driver sleepiness relatively little (OR 5.5, 95%CI 2.4, 13.0). A sensitivity analysis that excluded all proxy data did not significantly change the effect estimates presented in Table 3.

Table 3

Association of variables related to sleep with risk of crash in which a road user (driver, passenger, pedestrian) was injured. Adjusted odds ratio and 95% confidence intervals for multivariate model.

Variables	Unadjusted odds[a] (95%CI)	Adjusted odds[b] (95%CI)
Sleepiness scale for TRIP		
1. Felt active, wide awake	1.0	1.0
2–4. Not fully alert, difficulty staying awake, sleepy	3.1 (2.03–4.84)	5.7 (2.67–12.28)
Amount of sleep in the previous 24 h[c]		
≥6 h	1.0	1.0
<6 h	4.6 (1.83–11.46)	5.9 (1.66–20.85)
Number of nights of adequate sleep in the previous week[d]		
≥1 night of adequate sleep	1.0	1.0
No night of adequate sleep	1.7 (0.51–5.43)	1.1 (0.18–7.09)
≥2 obstructive sleep apnoea symptoms[e]		
No	1.0	1.0
Yes	3.5 (1.49–8.16)	2.9 (0.61–13.57)
Shift work[f]		
No	1.0	1.0
Yes	1.0 (0.46–2.04)	0.4 (0.10–1.80)
Hours paid work per week (>60 h)		
No	1.0	1.0
Yes	1.2 (0.54–2.82)	0.4 (0.05–2.82)

[a] Adjusted for sampling design.

[b] Logistic regression analysis included age, sex, ethnicity, income, self-reported alcohol use, vehicle type, vehicle speed prior to survey/crash, day and time of survey/crash.

[c] Number of hours slept.

[d] Number of nights of adequate sleep (mostly between 11 p.m. and 7 a.m. for 7 h or more).

[e] Witnessed reports of symptoms of obstructive sleep apnoea (regular loud snoring, breathing pauses, and choking).

[f] Involving paid work starting before 6 a.m. or finishing after midnight whether permanent, rotating or on call.

Discussion

Our study found a strong and significant association between driving a four-wheel motor vehicle while not fully alert or sleepy, and involvement in injury-producing crashes. The related increase in odds of injury crash was almost six-fold and, if un-confounded, is estimated to contribute to a third of the crash injury burden in the study base. Having less than 6 h sleep in the previous 24 h was also associated with a six-fold increase in the odds of involvement in crash-related injuries, suggesting a reasonably consistent acute effect from driver sleepiness.

There are several limitations to our study, which may have introduced biases. While a population-based study reduced the risk of selection bias, the relatively small number of cases (given the population size of Fiji) compromised the precision of some estimates of interest. The low response rates (cases 70%, controls 84%) and lack of available information on those who declined to participate, were lost to follow up, or not contactable, made it difficult to determine the degree to which potential systemic effects among this group, may have affected effect estimates. Although we used a standardised and structured interviewer-administered questionnaire for all participants to minimise information bias, all data on sleepiness and most confounders (including alcohol use) were collected by self report, increasing the risk for recall bias and misclassification [35]. A standardised structured interview anchored to a specified event (crash in cases, and a roadside stopping in controls) as used in a previous study in Auckland [21] was employed to minimise bias. In order to reduce the likelihood of control driver responses being constrained by the presence of police at roadside stopping sites, all participants were provided the option of being interviewed by phone at another time. If they expressed a preference to be interviewed at the stopping site, the questionnaire was administered some distance from police officials, and the latter did not have access to this information.

Regarding sleep and sleep-related disorders, the absence of validated subjective and objective measures, may have introduced misclassification and recall bias. While there are objective and subjective measures of sleepiness [25,36–41], direct application of some was compromised by resource constraints (e.g. polysomnography) and the lack of validated self-report measures in Pacific populations. We therefore employed a modified version of the Stanford sleepiness scale which was adapted following pre-testing in the study population, alongside several single item measures to examine acute and chronic sleep deprivation, used in our previous research [21]. Selecting the threshold for driver sleepiness as that of drivers who were fully alert versus those who were not fully alert, having difficulty staying awake, or feeling sleepy, was based on the knowledge that drivers are poor at predicting when the level of sleep impairment they are experiencing might overwhelm them [42,43]. Furthermore, in contexts like Fiji, where resource constraints challenge maintenance of high quality roads (sometimes referred to as 'unforgiving' roads) and vehicles do not have all the safety features apparent in high income countries, the risk of any level of reduced driver alertness is likely to be of greater concern than may be the case in more tolerant road environments. While this threshold indicated a 5.7-fold increase in odds of injury-involved crashes, the alternative threshold of driving while having difficulty staying awake or feeling sleepy (compared with driving while fully alert or not fully alert) was associated with a much higher albeit considerably less precise adjusted odds ratio of 12.4 (95%CI 1.5, 105.2).

Cognisant of the available statistical power, this study was not designed to investigate an exhaustive range of mechanisms that could influence sleepiness. Importantly, we did not explore the relationship of crashes to the circadian cycle (which would suggest crashes associated with drowsy driving are more common in the early hours of the morning, as demonstrated in a previous study undertaken in Auckland [21]). In our study, fewer than 10% of otherwise potentially eligible crashes occurred during the 2–5 a.m. period excluded from the study base. Given the greater likelihood of sleepy driving during this period, it is likely that our study has underestimated the effect of sleepiness on crashes.

While we made efforts to ascertain data on a wide range of potentially important confounding factors, information on exposure to and experience in driving were not systematically collected. As all information was self-reported, we did not obtain objective measures of factors such as alcohol or substance involvement, nor corroborate if information obtained regarding speeding involved driving at speeds greater than posted speed restrictions, including prevailing road and environmental conditions. The extent to which these factors modify the effect of sleepiness on crash risk requires further epidemiological investigation.

Notwithstanding these limitations, this study adds to the very limited evidence base regarding the relationship between driving four-wheel vehicles while acutely sleepy and injury-involved crashes in a less-resourced setting. In this regard, our findings contrast with the findings of the study from Shenyang, China [10] which found an increased risk for chronic driver sleepiness but not acute sleepiness among car drivers. The few studies of heavy motor vehicles in other low- and middle-income countries, have reported a two- to three-fold odds of chronic driver sleepiness-related crashes, often using the ESS. While our study was unable to use the ESS, we used supplementary measures for chronic sleep, such as chronic sleep deprivation, obstructive sleep apnoea, and prolonged work or shift work patterns. Our findings are consistent with the much larger body of evidence from high-income countries indicating acute driver sleepiness is an important contributor to road crashes [6,12,21,44].

Although the findings are inconsistent, some studies have identified groups at increased risk of sleep deprivation and drowsy driving such as shift workers working at night or working long irregular hours; and people with untreated sleep apnoea syndrome or narcolepsy [5,45,46]. The present study did not reveal statistically significant associations between the odds of crashes and factors indicative of chronic sleep deprivation, night shifts, prolonged work hours or symptoms suggestive of obstructive sleep apnoea. This may be partly explained by the limited statistical power of this study resulting in relatively imprecise estimates.

Sleep research has evolved, with experts reviewing the conceptual framework for sleepiness and wakefulness, its definition, aetiology, and measurement tools [36,47–49]. However, identifying the gold standard for measuring sleepiness remains elusive [36,50–52], reflecting the multiple factors influencing the sleep wake circadian cycle. A recent review suggests the need to examine afferent sensory mechanisms, for example, assessing what people are doing at a particular time [36]. Such a personal protective device, based on eye blinking was recently introduced to prevent driver fatigue-related heavy motor vehicle crashes in the Ok Tedi mine in Papua New Guinea [53]. Future research in less resourced settings should explore these factors and incorporate more precise instruments (e.g. objective and validated measures) to elucidate the pathways by which driver sleepiness contributes to RTI [12,54,55].

Based on the limited information available at the time, the World Report on Road Traffic Injury Prevention argued for better working conditions for drivers at risk of sleepiness related crashes [2]. These included using mechanisms such as limiting work and driving hours at night and requiring rest periods for long haul drivers. A strategy proposed in Malaysia includes banning the operation of express buses during early morning hours [56]. Our findings from Fiji highlight the need to design, implement, and evaluate context specific road safety strategies targeting driver sleepiness more generally (including car drivers) and the environmental and transport system characteristics that potentiate the risks involved in less-resourced settings [57]. The low margins for driving error accommodated by relatively unforgiving roads make the need to attend to this factor in rapidly motorising countries a matter of urgency.

Conflict of interest

The authors wish to certify that no actual or potential conflict of interest and financial conflicts in relation to this manuscript article exists.

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