ORIGINAL ARTICLE

ASSOCIATION OF SLEEP FACTORS AND DRIVING BEHAVIOURS AMONG GENERAL ADULT POPULATION IN MALAYSIA: A CROSS-SECTIONAL STUDY

Dharma Krishnamoorthy[1], Pretti A/P Nadarraju Udayar[1], Vikyath Chengappa Theethira Appachu[1], Ankitha Narasimhamurthy Sirivalam[1], Vaitheshri A/P Rajendran[1], Annikha Vishnu A/P Manivannan[1], Soe Moe[2], Htay Lwin[2] and Mila Nu Nu Htay[2,3*]

[1] Faculty of Medicine, Manipal University College Malaysia, Bukit Baru, 75150 Melaka, Malaysia.
[2] Department of Community Medicine, Faculty of Medicine, Manipal University College Malaysia, Bukit Baru, 75150 Melaka, Malaysia.
[3] Centre for Population Health (CePH), Department of Social and Preventive Medicine, Faculty of Medicine, Universiti Malaya, Kuala Lumpur, Malaysia

Corresponding author: Mila Nu Nu Htay
Email: drmlnnh@gmail.com

ABSTRACT

Dangerous driving behaviours have a significant impact on road safety amongst the general population. This study aims to investigate the prevalence of sleep issues, driving behaviours, and association between driving behaviours and road traffic accidents among the general adult population in Malaysia. This cross-sectional study was conducted in 2024 by recruiting the general adult population in Malaysia. Responses were collected through an online questionnaire which included demographic factors, sleep issues and sleepiness, lifestyle behaviours, driving behaviours and involvement in road traffic accidents. A total of 425 adults responded to the survey. Among them, the prevalence of sleep issues ranged from 1.9% to 21.2%. More than half of the respondents reported engaging in risky driving behaviours, including exceeding the speed limit (72.2%), being distracted while driving (68.9%), and making improper lane changes (60.5%). Excessive daytime sleepiness was found to be significantly associated with risky driving behaviours. Only alcohol drinking was found to be associated with involvement in road traffic accidents (RTAs) (aOR 9.2, 95%CI 1.66, 51.08). Our study has provided valuable insights into the different sleep disorders, daytime sleepiness, and lifestyle factors that influence the prevalence of road traffic accidents in the adult population of Malaysia. A multifaceted approach is essential to reduce the incidence of road traffic accidents caused by sleepiness and lifestyle behaviours, specifically alcohol. Public awareness campaigns in multiple languages should be launched to educate drivers about the dangers of driving under these conditions, with this education also integrated into driving schools and the license renewal process.

Keywords: *Traffic Accidents, Sleepiness, Alcohol Drinking, Driving behaviours, Malaysia*

INTRODUCTION

Dangerous driving behaviours have a significant impact on road safety amongst the general population. Globally, 1.19 million people die every year, especially in the low- and middle-income countries, due to road traffic accidents [1]. Therefore, the World Health Organization (WHO) recommended holistic prevention measures for road traffic accidents (RTA) with multisectoral collaboration in countries [1]. Despite the law enforcement and prevention measures being in place, the number of road traffic accidents is on an increasing trend in Malaysia [2]. Road traffic accidents are still a public issue, and a total of 567,516 road accidents were reported, which led to 6,167 deaths in 2019 [2].

While considering the triad of accident causation, i.e., "human, vehicle, and road condition", human factor plays a major role in the majority of the accident cases [3,4]. Among human factors that contribute to the RTAs, sleep factors were shown to have a significant impact on the driving behaviours among the general population of non-professional drivers [5]. Sleep quality can be defined as the individual's satisfaction with the duration of the sleep, quality of the sleep, and the feeling of awakening rested and restored upon awakening. The various factors of good quality sleep have an impact both in the long and short term. For instance, the loss of good sleep quality can result in mental wellbeing, as well as road or work-related accidents [6,7].

Among the previous literature, there have been studies linking the various lifestyle habits of individuals, such as increased work hours, consumption of alcohol, and other stressors have mediated the feeling of sleepiness and drowsiness among the general population [5]. Prolonged working hours with minimal rest breaks amongst drivers were found to be a major contributing factor in the prevalence of road traffic accidents due to sleep factors. The lack of sleep duration and sleep quality impairs the performance of cognitive and psychomotor tasks such as driving [8].

Amongst road traffic accidents, near misses, and breaches of road traffic rules are also consequences seen in drivers with poor sleep quality. A cross-sectional study was conducted among 517 long-distance bus drivers to determine the significant factors for near-miss incidents among long-distance bus drivers in Malaysia. The prevalence of near-miss incidents among long-distance bus drivers was 37.5% [9].

Chronic insufficient sleep has been linked to not just risky driving behaviours but also to poorer health. The recommended time duration for adult individuals aged 18 - 64 years old is seven to nine hours of sleep per day [10]. In terms of intensity, risky and unsafe driving behaviours due to sleep-related factors are more severe than other road traffic-related accidents [11,12].

In Malaysia, insufficient sleep is gaining more public recognition as a health concern with more links to detriments to the health of the general population and chronic insufficient sleep. A study conducted among working adults revealed that more than half (54.7%) of them had insufficient sleep, i.e., having < 7 hours of sleep daily [10]. However, there have been no nationally representative studies based on sleep and driving behaviours in Malaysia.

Another study was done in 2022 discussing the various factors associated with non-fatal injuries from road traffic accidents among Malaysian adults. The study involved 15,321 respondents with 863 respondents reporting the involvement in a nonfatal injury (NFI) due to a road traffic accident. The results of the study showed how various factors were associated with the reports of NFI, the majority being the adult population having multiple jobs, leading to longer periods of work without adequate rest which could result in sleep deprivation [13].

The association of a healthy lifestyle and the prevalence of safe driving behaviours has been investigated in a previous study [14]. Although a scientific report was released by the national health and morbidity survey about the lifestyle behaviours amongst Malaysians [15], it did not stress the factors of sleep behaviour in such great detail, as it was brought up as an important lifestyle habit amongst Malaysians.

There has been extensive research linking sleep factors to driving behaviours; there is a limited literature in Malaysian studies, particularly those that encompass a broad range of occupational groups. Most existing research in Malaysia focuses on specific populations such as undergraduates or health workers. This leaves a significant gap in understanding how sleep quality, sleep disorders, and sleep durations affect driving behaviours among the general population across diverse professions. This study aims to investigate the prevalence of sleep issues, driving behaviours, and association between driving behaviours and road traffic accidents among the general adult population in Malaysia.

METHODS

Study design and study population

This cross-sectional analytical study was conducted between June to August 2024, targeting the general population in Malaysia. Participants were Malaysian adults aged 18 and above across different ethnicities.

Sample size and sampling

The sample size was calculated by using the Open EPI online sample size calculator. The expected proportion of sleepy driving was 42% [16], 5% precision, and 95% confidence interval. Taking into consideration of 10% non-response rate, the estimated sample of 416 respondents was required for this study.

The respondents were recruited by a non-probability convenience sampling method. To gather the responses, a link to the survey was shared on social media platforms such as WhatsApp, Instagram, Facebook, Telegram, and Email.

The inclusion requirements were the general adult population aged 18 and above, people of all ethnicities and nationalities who are currently living in Malaysia, who were willing to participate, and who provided informed consent. Exclusion criteria include especially disabled persons, persons driving with an instructor, non-drivers and non- licensed individuals.

Data collection

An online questionnaire form was created via Google Form and distributed via social media such as WhatsApp, Instagram, Facebook, etc. The background of the study was provided, and participants' consent was obtained. The data collection questionnaire included four sections as follows.

Section 1: Demographic information

The demographic section included age, gender, ethnicity, occupation, and the participants' monthly family income.

Section 2: Sleep Factors

In this section, sleep quantity, sleep disorders, and questions were included. In sleep quantity, questions on the average sleep duration, frequency of sleep duration less than 7 hours, getting sufficient sleep daily, maintaining a consistent sleep schedule, and the respondent's perception of getting enough sleep to feel rested and alert during the day were included.

For sleep disorders, a total of 9 questions were included. The presence of sleep disorders was asked, and the responses were collected as "yes" or "no".

Regarding sleepiness, the Epworth Sleepiness Scale (ESS) [17] was used to assess the sleepiness among the respondents in this study. ESS is categorized as normal daytime sleepiness (Score 0 -10), and excessive daytime sleepiness (Score 11-24) [18].

Section 3: Driving behaviours
Respondents' driving patterns and the frequency of sleepy driving/ accidents/ near-miss accidents in the last six months were enumerated. The respondents needed to rate the related events they experienced as "never" or "having experience" of that particular driving behaviour.

Section 4: Lifestyle behaviours
In the lifestyle behaviours section, the questions asked about the respondents' consumption of caffeine, alcohol, obedience to the road traffic rules, whether they have experienced any levels of stress, or have had any difficulty sleeping due to stress. The total number of questions in this section was 7, requiring 'yes or no' responses.

Validated Epworth Sleepiness Scale (ESS) [17] was applied to assess sleepiness level. While the other questions in sleep factors, driving, and lifestyle behaviours were content validated with the experts.

Data analysis
Data was analyzed by using IBM Statistical Package for the Social Sciences (SPSS version 28), Armonk, NY: IBM Corp. Descriptive statistical analysis was done for the demographic variables, sleep issues, driving behaviours, and occurrence of accidents. Descriptive analysis was reported with frequency, percentage, mean, median, standard deviation, and interquartile range. Multivariable logistic regression analysis was conducted to identify the association between sleepiness and each of the individual risky driving behaviours. Furthermore, factors associated with having had road traffic accidents were assessed by using multivariable logistic regression analysis. The regression model is adjusted for age, gender, ethnicity, occupation, and income of the respondents.

Ethical consideration
Respondents were provided with clear and understandable information about the purpose of the study, potential risk, benefits, and their rights to withdraw at any stage without consequences. Participation was voluntary, and informed consent was obtained. This proposal was granted approval from the Research Ethics Committee, Manipal University College Malaysia (MUCM/ Research Ethics Committee – 005A/01/2024).

RESULTS
Demographic characteristics of the respondents are presented in Table 1a and 1b. Approximately half of the respondents were male (48.8%), with a mean age of 41 years, and approximately half of them were currently working (54.6%).

Table 1a: Demographic characteristics of the respondents (n=425)

Variables	n (%)
Gender	
Male	206 (48.8)
Female	216 (51.2)
Age	
Mean (SD)	41.33 (16.60)
Minimum-Maximum	18 - 79
≤ 25 years	125 (30.3)
26 -59 years	219 (53.0)
60 years and above	69 (16.7)
Ethnicity	
Malay	29 (6.8)
Chinese	32 (7.5)
Indian	349 (82.1)
Others*	15 (3.5)
Occupation status	
Students	117 (27.5)
Working	232 (54.6)
Retired	63 (14.8)
Unemployed	13 (3.1)

Table 1b: Demographic characteristics of the respondents (n=425)

Variables	n (%)
Income	
Bottom 40	172 (40.5)
Middle 40	149 (35.1)
Top 20	104 (24.5)

Among the respondents, the majority (81.4%) had less than 7 hours of sleep per day. However, 50% of the respondents perceived that their sleep duration is sufficient. Approximately one-third of the respondents (33.18%) reported that they did not feel rested and alert during the day (Table 2).

Table 2. Sleep quality, sleep duration, and perception of sleep among the respondents (n=425)

Variables	n (%)
Getting inadequate sleep of less than 7 hours per night (per week)	
1 to 3 times	102 (24.0)
4 times and above	323 (76.0)
Sleep duration per night during the last week	
Less than 7 hours	346 (81.4)
7 hours and above	79 (18.6)
Perception of the respondents that their sleep duration is sufficient	
Yes	214 (50.4)
No	211 (49.6)
Maintaining consistent sleep schedule	
Yes	197 (46.4)
No	228 (53.6)
Having enough sleep to feel rested and alert during the day	
Agree	168 (39.53)
Neutral	116 (27.29)
Disagree	141 (33.18)

Among the self-reported sleep disorders, restless leg syndrome was the most common (21.2%), followed by narcolepsy (16.7%) and having episodes of disorientation or confusion during sleep (12.7%) (Table 3).

Improper driving behaviours among the respondents are presented in Figure 1. Exceeding the speed limit while driving was highly reported (72.2%), which was followed by distracted driving (68.9%), drowsiness while driving (61.9%), and improper lane changes (60.5%) (Figure 1).

The association between daytime sleepiness and improper driving behaviours is presented in Table 4. Excessive daytime sleepiness was found to be significantly associated with drowsiness while driving. Those who had excessive daytime sleepiness were 3.42 times likely to have drowsiness during driving time (aOR 3.42, 95% CI: 1.57, 7.42). Those who had excessive daytime sleepiness were 2.9 times likely to exceed the speed limit compared to those with normal daytime sleepiness (aOR 2.9, 95% CI: 1.19, 6.50). Those who had excessive daytime sleepiness were 4.01 times likely to get distracted while driving (aOR 4.01, 95% CI: 1.64, 9.79). Furthermore, improper lane changes are more likely to occur among people with excessive daytime sleepiness (aOR 3.13, 95% CI: 1.50, 6.50) (Table 4).

Among the lifestyle behaviours, only alcohol consumption before driving was found to be significantly associated with the involvement in road traffic accidents (aOR: 9.20, 95% CI:1.66, 51.08). Meanwhile, self-reported sleep disorders were not significantly associated with the involvement in road traffic accidents (Table 5a, 5b).

Table 3. Prevalence of sleep disorders among the respondents (n=425)

Sleep Disorders	n (%)
Diagnosed with a sleep disorder by a healthcare professional	
Yes	23 (5.4)
No	402 (94.6)
Currently taking medication for sleep disorder	
Yes	11 (2.6)
No	414 (97.4)
Having insomnia	
Yes	31 (7.3)
No	394 (92.7)
Having sleep apnoea	
Yes	20 (4.7)
No	405 (95.3)
Having restless legs syndrome	
Yes	90 (21.2)
No	335 (78.8)
Having episodes of disorientation or confusion during sleep	
Yes	54 (12.7)
No	371 (87.3)
Using special machine (CPAP) for sleep apnoea	
Yes	8 (1.9)
No	417 (98.1)
Having narcolepsy	
Yes	71 (16.7)
No	354 (83.3)

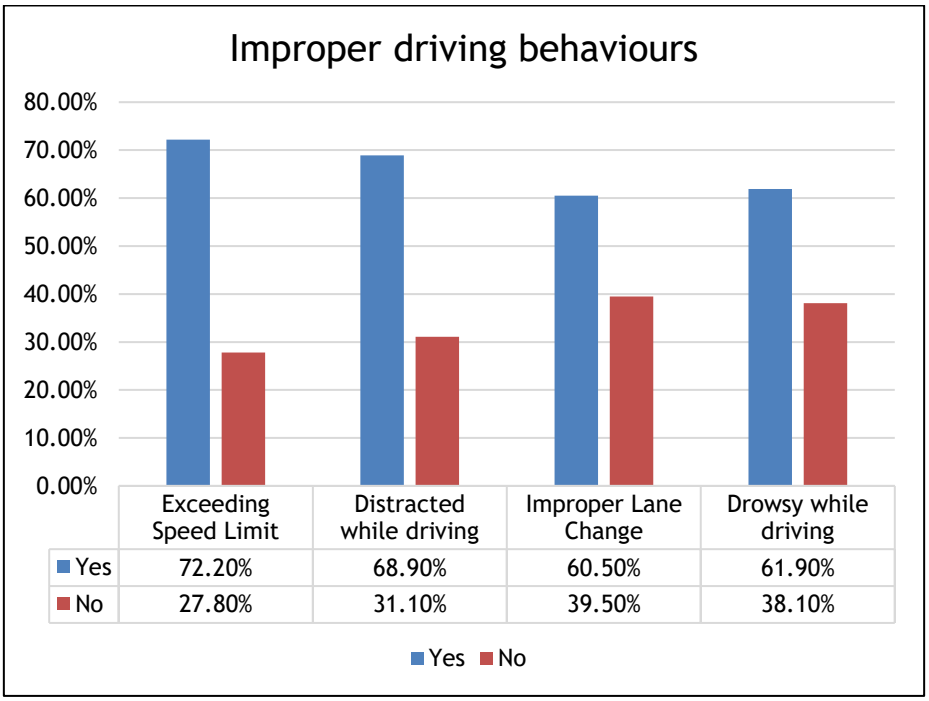

Figure 1. Prevalence of self-reported improper driving behaviours among the respondents (n=425)

Table 4. Association between daytime sleepiness and driving behaviours among the general adult population in Malaysia (n=425)

Daytime Sleepiness		Driving behaviours		aOR* (95%CI)	P
		Yes n (%)	No n (%)		
		Drowsy while driving			
Normal daytime sleepiness		190 (58.6)	134 (41.4)	Reference	
Excessive daytime sleepiness		45 (81.8)	10 (18.2)	3.42 (1.57, 7.42)	0.002
		Exceeding speed limit			
Normal daytime sleepiness		224 (69.1)	100 (30.9)	Reference	
Excessive daytime sleepiness		46 (83.6)	9 (16.4)	2.9 (1.19, 6.50)	0.018
		Distracted while driving			
Normal daytime sleepiness		214 (66.0)	110 (34.0)	Reference	
Excessive daytime sleepiness		47 (85.5)	8 (14.5)	4.01 (1.64, 9.79)	0.002
		Improper lane change			
Normal daytime sleepiness		187 (57.7)	137 (42.3)	Reference	
Excessive daytime sleepiness		43 (78.2)	12 (21.8)	3.13 (1.50, 6.50)	0.002
		Involved in any road traffic accident			
Normal daytime sleepiness		95 (29.3)	229 (70.7)	Reference	
Excessive daytime sleepiness		19 (34.5)	36 (65.5)	1.57 (0.82, 3.01)	0.171

*The regression model is adjusted for age, gender, ethnicity, occupation, and income of the respondents

Table 5a. Lifestyle behaviours and sleep disorders associated with the involvement in road traffic accidents (n=425)

Variables	aOR (95% CI)	P
Lifestyle behaviours		
Consumption of caffeine before driving		
No	Reference	
Yes	1.23 (0.76, 1.99)	0.393
Consumption of alcohol before driving		
No	Reference	
Yes	9.20 (1.66, 51.08)	0.011
Engagement in physical activity regularly		
No	Reference	
Yes	0.85 (0.52, 1.39)	0.526
Strictly adhering to road traffic rules and regulations		
No	Reference	
Yes	0.51 (0.24, 1.10)	0.084
Having difficulty sleeping because of stress		
No	Reference	
Yes	1.30 (0.78, 2.15)	0.315

*The regression model is adjusted for age, gender, ethnicity, occupation, and income of the respondents

Table 5b. Lifestyle behaviours and sleep disorders associated with the involvement in road traffic accidents (n=425)

Variables	aOR (95% CI)	P
Lifestyle behaviours		
Having hard to drive because of stress		
No	Reference	
Yes	0.56 (0.27, 1.15)	0.115
Adequate sleep is important to ensure a safe driving experience		
No	Reference	
Yes	0.64 (0.16, 2.52)	0.523
Diagnosed with a sleep disorder by a healthcare professional		
No	Reference	
Yes	1.55 (0.46, 5.28)	0.481
Currently taking medication for sleep disorder		
No	Reference	
Yes	0.33 (0.05, 2.45)	0.278
Having insomnia		
No	Reference	
Yes	1.04 (0.34, 3.21)	0.940
Having sleep apnoea		
No	Reference	
Yes	0.61 (0.17, 2.19)	0.449
Having restless legs syndrome		
No	Reference	
Yes	0.83 (0.45, 1.53)	0.547
Having episodes of disorientation or confusion during sleep		
No	Reference	
Yes	1.40 (0.66, 2.95)	0.380
Using special machine (CPAP) for sleep apnoea		
No	Reference	
Yes	9.27 (0.81, 105.95)	0.073
Having narcolepsy		
No	Reference	
Yes	0.92(0.46, 1.84)	0.820

*The regression model is adjusted for age, gender, ethnicity, occupation, and income of the respondents

DISCUSSION

This study investigated the prevalence of sleep issues, driving behaviours, and the association between sleepiness and driving behaviours. Among the respondents, approximately 5% reported having sleep disorders diagnosed by professionals, and 7% having insomnia. The prevalence of sleep disorders is much lower in our study compared to the previously conducted study, which reported as 60% of insomnia among primary healthcare patients in Malaysia [19]. The different prevalence between the studies might be due to the difference in study population as the previous study was conducted among primary healthcare patients [19]. Therefore, they may have more health-related symptoms compared to the general population.

However, our results suggested that the sleep disorders were not significantly associated with the likelihood of being involved in an RTA. This finding is consistent regardless of whether the sleep disorder was diagnosed by a healthcare professional. These findings align with some earlier studies that found no direct correlation between sleep disorder symptoms or risks and increased RTA risk [20]. However, this finding contrasts with previous research suggesting that sleep disorders, particularly those undiagnosed, may lead to a higher likelihood of accidents due to impaired alertness and reaction times [21-23]. The lack of statistical significance in this study might be attributed to variations in the sample population, differences in how sleep disorders were diagnosed and categorized, or the influence of other confounding factors such as medication use or the presence of other health conditions. Thus, while our findings provide important

insights, they also underscore the complexity of the relationship between sleep disorders and road safety, necessitating further investigation.

Our study revealed that self-reported improper driving behaviours were high among the respondents (> 60%), while exceeding the speed limit was reported among 72% of the respondents. This finding is higher compared to the previous study in Malaysia, in which 45.3% of the respondents self-reported violation of the speed limit [24]. Various internal and external factors contributed to exceeding the speed limit, such as to arrive at the destination quickly, seeing other drivers start speeding, speeding is normal driving behaviour, etc [24]. High prevalence of self-reported speeding is a warning behaviour because speeding behaviours have contributed to 60% of road traffic accidents and deaths in Malaysia [24,25]. Therefore, there is a need for intervention, such as providing feedback and cognitive intervention to reduce the speeding behaviours among the drivers [26].

The interesting findings in our study are that excessive daytime sleepiness is significantly associated with improper driving behaviours such as exceeding the speed limit, being distracted while driving, improper lane changes, etc. Our finding is supported by the previous studies in which sleepiness could significantly increase the risk of behavioral errors and violations among drivers in Turkey [27]. Sleep factor and its association with driving issues and accidents should be made aware to the population in Malaysia. Future prevention programs should emphasize sleep quality, sleep hygiene, and focus on driving behaviours among drivers in Malaysia.

Our study also explored the relationships between various lifestyle factors and RTAs, focusing on the significant findings as well as the lack of significant associations in some variables. For caffeine consumption, our study indicated that there was no significant association between this variable and the occurrence of RTAs. Illustrating that caffeine consumption did not have a clear impact on the likelihood of being involved in an RTA as consumption of caffeinated drinks is for reducing sleepiness among drivers[13]. The lack of significance might be due to the varying effects of caffeine on individuals or possible confounding factors that were present.

Alcohol consumers had a significantly higher occurrence rate of road traffic accidents compared to non- alcohol consumers, indicating a highly significant association. Alcohol consumption has been a known significant risk factor for RTAs among adults in Malaysia, with more than half of road traffic accidents occurring due to driving under the influence [28]. Significant role of alcohol drinking among RTA participants was reported in a study conducted in Central Serbia [29]. Furthermore, alcohol drinking was reported to be a contributing factor to road traffic accidents in previous studies [30-32].

Adherence to road rules was found to have no significant association. Therefore, indicating that adherence to road rules was not a statistically significant factor in this study. This is in line with studies done by Al-Hussein et al., (2021) where it was concluded that the overall adherence to road rules was equal amongst the younger and middle-aged population in Malaysia [3]. While external stressors, such as drivers wanting to arrive at work on time, were a cause of an increased driving speed, it was still not a significant occurrence.

Individuals with stress-related sleep difficulties had no significant association with the prevalence of road traffic accidents. However, other literature and studies have concluded that lack of sleep due to stress would result in impaired normal functioning that would increase the risk of road traffic accidents for people who commute to work [33]. Contrary to this, another study was done, which showed that stress in the form of anxiety-nervousness was independently associated with accident risk, while occupational stress was not associated with accidents. Emotional states such as anger or anxiety led to negative and dangerous driving patterns, which may lead to sudden brakes, near misses, or even road traffic accidents. In the same study, it's mentioned that the experience of occupational stress on the previous day appeared as a protective factor. A study found a protective effect of a moderate level of psychological distress against crashes in young drivers. These results indicate that moderate levels of distress or occupational stress may be associated with more cautious driving behaviours and resulting in fewer driving accidents [34].

Some of the limitations of our study were that sleep disorders, driving behaviours, and involvement in road traffic accidents were self-reported data. Since the respondents were recruited by a convenience sampling method, the generalization of the findings in Malaysia might be limited. Furthermore, the cross-sectional study nature of data collection is not able to estimate the trends of behavior changes and involvement in RTA over time. The sample size in our study might be limited to cover the whole country. Therefore, increasing the sample size to comprehensively cover all regions in Malaysia would strengthen the generalizability of the findings.

CONCLUSION AND RECOMMENDATIONS

In conclusion, our study has provided valuable insights into the different sleep disorders, daytime sleepiness, and lifestyle factors that influence the prevalence of road traffic accidents in the adult population of Malaysia. Our results illustrated that excessive daytime sleepiness

influenced on the respondents' risky driving behaviours. Other variables, such as alcohol drinking habits, demonstrated a significant impact on the occurrence of road traffic accidents in Malaysia. These findings have demonstrated the need for health strategies and interventions that address these issues in every adult in Malaysia who drives to effectively reduce the prevalence of road traffic accidents and overall make every person's driving experience safer in Malaysia.

To reduce the incidence of road traffic accidents caused by sleepiness and lifestyle behaviour, specifically alcohol, a multifaceted approach is essential. Public awareness campaigns in multiple languages should be launched to educate drivers about the dangers of driving under these conditions, with this education also integrated into driving schools and the license renewal process. Improving work-life balance through government and corporate policies, such as flexible working hours and mental health support, is crucial to ensure that employees are well-rested before commuting. Strengthening the enforcement of risky driving behaviour is essential. Enhancing road safety infrastructure by increasing the number of rest areas and nap stations on highways, as well as establishing urban rest zones, will provide drivers with opportunities to take necessary rest and breaks. Stricter regulations and monitoring for commercial drivers should be implemented to ensure they are not driving while fatigued. Lastly, future studies should be conducted with a larger sample size and broader coverage across different states in the country to enhance the generalizability of the findings. Stratification of the sample by region or division will be beneficial as nationwide representation, with clear allocation of sample targets for each division.

ACKNOWLEDGEMENT

We would like to express our gratitude to the Vice Chancellor and Dean of the Faculty of Medicine (MUCM), Professor Dr. Jayakumar Gurusamy, Pro Vice Chancellor Professor Dr. Adinegara Lutfi Abas, and the Higher Management for their support in conducting the study. We would like to thank the Research Ethics Committee (MUCM) for their kind approval to conduct the study. We would also like to further extend our gratitude towards the respondents in this study.

Conflict of interest

The authors declare no potential conflict of interest.

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