อุบัติเหตุจราจร อาการง่วงนอน และโรคหยุดหายใจขณะนอนหลับจากการอุดกั้น : การศึกษาภาคตัดขวางในผู้ขับขี่รถสาธารณะในจังหวัดชลบุรี

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บทคัดย่อ

อุบัติเหตุจากการจราจรทางบกเป็นสาเหตุการเสียชีวิต 3 อันดับแรกของประเทศไทยมาตลอด 10 ปีที่ผ่านมา อาการง่วงนอนขณะขับขี่เป็นปัจจัยที่เพิ่มความเสี่ยงต่อการเกิดอุบัติเหตุมากขึ้น ซึ่งโรคหยุดหายใจขณะนอนหลับจากการอุดกั้น (OSA) เป็นสาเหตุหนึ่งที่ทำให้เกิดอาการง่วงนอนได้บ่อย ผู้ขับขี่รถสาธารณะมีความเสี่ยงทั้งอาการง่วงนอนและโรค OSA สูงกว่าประชากรทั่วไป ดังนั้น การศึกษานี้ วัตถุประสงค์เพื่อศึกษาสาเหตุของการเกิดอุบัติเหตุจราจรทางบก ปัจจัยที่สัมพันธ์กับอุบัติเหตุการจราจรทางบกและอาการง่วงนอน และความชุกของโรค OSA ในผู้ขับขี่รถสาธารณะในจังหวัดชลบุรี ประเทศไทย การศึกษานี้เป็นการศึกษาเชิงวิเคราะห์แบบตัดขวาง โดยใช้แบบสอบถามแบบเผชิญหน้าร่วมกับการตรวจร่างกายในกลุ่มตัวอย่างผู้ขับขี่รถโดยสารสาธารณะ จำนวน 218 คน พบประวัติการเกิดอุบัติเหตุร้อยละ 43.1 โดยมีสาเหตุจากอาการง่วงนอน/หลับในมากที่สุดคือร้อยละ 20.3 ปัจจัยที่มีผลต่อการเกิดอุบัติเหตุคือ การดื่มคาเฟอีน (adjusted OR=2.7, 95% CI=1.3-5.8) ค่า Epworth Sleepiness Score >10 (adjusted OR=2.0, 95% CI=1.1-3.8) ค่า Pittsburgh Sleep Quality Index >5 (adjusted OR=3.2, 95% CI=1.7-5.9) พบผู้ที่มีอาการง่วงนอนตอนกลางวันมากกว่าปกติจำนวนร้อยละ 33 คุณภาพการนอนโดยรวมที่ไม่ดีจำนวนร้อยละ 43.1 โดยปัจจัยที่มีผลต่ออาการง่วงนอนกลางวันมากกว่าปกติคือ ดัชนีมวลกาย >25 กก./ม.^{2} (adjusted OR=1.7, 95% CI=2.2-11.8) ค่า Pittsburgh Sleep Quality Index >5 (adjusted OR=3.6, 95% CI=1.18-4.75) และคะแนน STOP BANG >3 (adjusted OR=2.3, 95% CI=1.30-4.12) และพบความชุกของความเสี่ยงการเกิดโรค OSA ร้อยละ 41.7 อาการง่วงนอนตอนกลางวันและคุณภาพการนอนที่ไม่ดี เป็นปัจจัยเสี่ยงต่อการเกิดอุบัติเหตุทางจราจรในผู้ขับขี่รถสาธารณะ การทำใบขับขี่รถสาธารณะในอนาคตจึงควรมีการคัดกรองความเสี่ยงของการเกิดอาการง่วงนอน และรณรงค์เพิ่มคุณภาพการนอนในผู้ขับขี่รถสาธารณะ

คำสำคัญ: ผู้ขับขี่รถสาธารณะ อุบัติเหตุจราจรทางบก อาการง่วงนอน โรคหยุดหายใจขณะนอนหลับจากการอุดกั้น

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Road traffic accidents, sleepiness, and Obstructive sleep apnea: A cross sectional study among public transport drivers in Chonburi province

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Abstract

For a decade, road accidents have been one of the top three causes of death in Thailand. Driving while drowsy is a factor that increases accident risks and Obstructive sleep apnea (OSA), which is often a cause of drowsiness. Public transport drivers have a higher risk of driving when drowsy and are at a higher risk of OSA than other members of the population. The aim of this study was to explore the causes of road accidents, the factors associated with road accidents and sleepiness, and to examine the prevalence of OSA among public transport drivers in the Chonburi province of Thailand. A cross-sectional analytical study was employed in this study, employing a face-to-face questionnaire, together with a physical examination, was used to collect data from 218 public transport drivers. It was found that 43.1% of the samples had been involved in road accidents. The highest percentage of accidents were caused by sleepiness or micro-sleep (20.3%). The factors associated with road accidents included caffeinated drink consumption (adjusted OR=2.7, 95%CI=1.3-5.8), the Epworth sleepiness score >10 (adjusted OR=2.0, 95%CI=1.1-3.8), and the Pittsburgh Sleep Quality Index >5 (adjusted OR=3.2, 95% CI=1.7-5.9). Furthermore, excessive daytime sleepiness was indicated by 33% of the samples. Poor sleep quality was revealed in 43.1% of the samples. The factors associated with excessive daytime sleepiness was body mass index >25 kg/m^2 (adjusted OR=1.7, 95%CI=2.2-11.8), Pittsburgh Sleep Quality Index >5 (adjusted OR=3.6, 95%CI=1.18-4.75), and STOP BANG >3 (adjusted OR=2.3, 95%CI=1.30-4.12). The prevalence of OSA risk was 41.7%. Excessive daytime sleepiness and poor sleep quality were the leading factors for road accident risks among public transport drivers. Drowsiness or micro-sleep driving screening among people applying for commercial driver's licenses is essential. Furthermore, campaigns promoting good sleep quality for public transport drivers should be regularly held.

Keywords: public transport drivers, road accidents, sleepiness, Obstructive sleep apnea

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Introduction

Road accidents have been ranked as the third most prevalent cause of death in Thailand for this decade[1]. According to the World Health Organization, the incident rate of people injured by road accidents was 165 per 100,000 people and the rate of death was 22.89 per 100,000 people. Road accidents have caused direct negative effects on the economy of around 328 million baht annually, excluding the loss in social cost. Although the highest vehicle type involvement in road accidents was motorbikes, the number of road accidents by public transport was the highest when considering the accident rate per 10,000 vehicles. The accidental rates per 10,000 vehicles were 72.8 by public transport[2], 29 by private cars, 24.4 by lorries, 22 by passenger vans, 24.4 by lorries and 17.3 by pickup trucks, 10.8 by private motorbikes.

Daytime drowsy driving reduces performance in vehicle control and responding to unexpected situations, and this increases road accident risk[3]. From The Royal Thai Police records in 2013, the top three causes for road accidents were exceeding the speed limit (12.6%), dangerous lane change (12.2%), and drunk driving (6.9%). Micro-sleep was in 10th rank (1.03%). This finding was inconsistent with other parts of the world. For instance, a study in Brazil showed 28% drowsy driving, and 7.6% of road accidents were associated with drowsiness[4]. A study in Scotland found that the Epworth Sleepiness Score (ESS) of public transport drivers was 20% higher than the normal score. Eighteen percent of the drivers had experienced micro-sleep, and 7% of this group previously had road accidents[5]. Apart from the association of sleepiness with road accidents, it was still found that public transport drivers had a higher tendency to have obstructive sleep apnea (OSA) than the general population[6,7].

Objectives

1. To explore the causes and factors associated with road accidents of public transport drivers in Chon Buri province, Thailand
2. To explore the factors associated with sleepiness of public transport drivers in Chon Buri province, Thailand
3. To examine the prevalence of OSA risk of public transport drivers in Chon Buri province, Thailand

Material and methods

This study employed a cross-sectional analytic study approved by the Ethics Committee on Human Research of Burapha University (project code no. HS 097/2563). The population were public transport drivers, both male and female, aged ≥ 18 years old, in Chon Buri province, Thailand. Participants included public transport drivers such as public bus drivers, motorbike taxi riders, taxi drivers, passenger pickup drivers, passenger van drivers, and lorry drivers whose driving experience was ≥ 1 year in Chon Buri province, Thailand. The drivers were visited at bus terminals, 10-wheel truck driver stations, and Chonburi's transport office where they were

asked to take part voluntarily in the questionnaire and physical examination. They were also informed of their privacy and information confidentiality and requested to confirm they agreed.

The sample size in this study used the Wayne's equation under the following parameters: p=0.8613, α=0.05 and d=0.05. Therefore, the minimum sample size was 186 samples. This study added 20% for non-responses and the final total sample size was 222 samples.

The researcher selected qualified and consented drivers in this study had their neck circumferences and waist circumferences measured. They were asked to respond to a face-to-face questionnaire comprised five parts: 1) personal data and health problems, 2) working information, road accident experience, and the causation, 3) OSA risk assessment by the Thai STOP-BANG questionnaire, 4) daytime sleepiness assessment by Thai Epworth sleepiness Scale, (ESS). It comprised an 8-item questionnaire that estimates the likelihood of falling asleep in the daytime under a variety of situations (total score range from 0 to 24). An ESS score of over 10 points consider as excessive sleepiness., and 5) sleep quality assessment over the past month by the Thai Pittsburgh Sleep Quality Index (PSQI). It was a standard questionnaire assessing global sleep quality comprising of 7-components, with a total score range of 0 to 21. A PSQI score greater than 5 indicated poor sleep quality.

The quantitative data were presented in mean and standard deviation. While, the qualitative data were presented in frequency and percentage.

Chi-square was used to identify the association of road accident experience with its variables and the association of excessive daytime sleepiness with its variables presented with crude odds ratio and 95% confidence interval. Multiple logistic regression analysis (forward selection approach) was used to analyze the variables with a statistical significance on road accidents and on excessive daytime sleepiness presented with adjusted odds ratio and 95% confidence interval. The statistical significant was set as p-value<0.05.

Results

From all 222 public transport drivers, 218 (98.1%) were interviewed, four participants were excluded due to incomplete data. Of the 218 participants, 97.7% were male and 2.3% were female and the mean age was 42.9 years (SD=9.7). The mean weight was 74.6 kg. (SD=14.4), mean height was 170.2 cm. (SD=7.4), mean BMI was 25.8 kg/m^2 (SD=4.7), mean neck circumference was 39.1 cm. (SD=4.8), and the mean waist circumference was 85.5 cm. (SD=18.4). The marital status survey showed that 37.2% were single, 56.8% were married, and 6% were divorced. The survey on personal behaviors were as follows: consumed caffeinated drinks 77% (n=168) with an average consumption rate of 1.5 glasses/day (SD=0.9),

current smoking 57.3% (n=125) with average smoking exposure rate of 12.5 cigarettes/day (SD=8.6), alcohol consumption 65.6% (n=143) with an average consumption rate of 3.7 glasses/day (SD=3.1). Of all the drinkers, 13 participants (9.1%) consumed alcohol every day. About 32.1% of samples had health problems including hypertension (21.6%), diabetes mellitus (11.5%), hyperlipidemia (1.8%), coronary artery disease (0.9), and stroke (0.5%), respectively.

The type of vehicle driven for work were as follow: 18-wheel lorry drivers (n=71, 32.6%), taxi drivers (n=41, 18.8%), motorbike taxi riders (n=31, 14.2%), bus drivers (n=29, 13.3%), passenger van drivers (n=12, 5.5%), passenger pickup drivers (n=8, 3.6%), and others type (n=26, 11.9%). The mean driving period was 9.1 hours/day (SD=3.0) and 5.7 days/week (SD=1.0). The mean of working experience was 9.3 years (SD=8.4). Of all the participants, 74.3% had to work nighttime. About 27.9% experienced micro-sleep, 29.4% experienced almost falling off the curbside while driving at nighttime, and 43.11% had a history of accidents while driving. The causes of their accidents are shown in Table 1.

Table 1 Causes of accidents while driving in public transportation drivers in Chonburi province

Causations	Frequency (%)
Sleepiness or micro-sleep	32 (20.3)
Exceeding speed limit	14 (8.9)
Drunk driving	11 (7)
Improper road surface	19 (12.1)
Traffic sign errors or inappropriate lighting	10 (6.3)
Unsuitable vehicle condition	16 (10.2)
Sudden lane change	26 (16.6)
Others (being hit by others and etcetera)	26 (16.6)

Using the ESS score to represent daytime sleepiness, the results showed the mean score = 8.9 (SD=4.26), where 33% had excessive sleepiness (ESS >10). Of all the participants, 27.5% (n=60) responded “yes” to the question “How likely are you to doze or fall asleep in a car, while stopped for a few minutes in the traffic?” However, most of them responded “little possibility”.

The result of global sleep quality during the past month by using the Thai PSQI questionnaire showed a mean score = 5.5 (SD=2.7). There were 43.1% who had poor sleep quality (PSQI >5). However, there were only three drivers (0.1%) who responded “fairy bad to very bad” to the question “During the past month, how would you rate your sleep quality overall?”. The rest (215 drivers or 99.9%) answered “very good or fairy good.”

Based on the Thai STOP BANG questionnaire, it was found that the mean score was 3.4 (SD=1.5). There were 91 drivers (41.7%) who had an OSA risk. There were 62.8% who responded "yes" to the question "Do you snore loudly?, and there were 54.1% who responded "yes" to the question "Do you feel tired? or Do you sleep during the day?".

Regard to universal analysis, the factors associated with road accident experience were age >50 years, caffeinated drink consumption, exceed driving 8 hours per day, experience of micro-sleep while driving, ESS score >10, and PSQI >5 while the factors associated with ESS >10 were BMI >25 kg/m^2, PSQI >5, and the STOP BANG >3 (Table 2).

Table 2 The associations between road accident experience, ESS >10, and the possible risks by universal analysis

Possible risks	Road accident experience		ESS >10	
	Crude OR (95%CI)	*p*-value	Crude OR (95%CI)	*p*-value
Age >50 years old	0.5 (0.3-0.9)	0.019	0.9 (0.5-1.7)	0.72
Neck circumference >39 cm.	1.4 (0.8-2.4)	0.22	1.0 (0.6-1.7)	0.93
Waist circumference >90 cm.	0.9 (0.6-1.6)	0.85	1.3 (0.7-2.3)	0.39
BMI >25 kg/m^2	1.0 (0.6-1.7)	0.97	1.8 (1.0-3.2)	0.04
Having health problems	1.1 (0.6-1.9)	0.81	1.4 (0.8-2.6)	0.23
Smoking	1.5 (0.9-2.6)	0.16	0.9 (0.5-1.6)	0.71
Alcohol drinking	1.6 (0.9-2.8)	0.12	1.1 (0.6-2.0)	0.82
Caffeinated drink consumption	2.3 (1.2-4.6)	0.013	1.1 (0.5-2.1)	0.86
Driving period >8 hours/day	2.2 (1.0-4.7)	0.037	1.5 (0.7-3.4)	0.28
Sleepiness/micro-sleep experience	2.0 (1.1-3.7)	0.019	1.5 (0.8-2.7)	0.22
Nighttime driving	0.7 (0.4-1.3)	0.22	0.7 (0.4-1.3)	0.25
ESS >10	2.1 (1.2-3.8)	0.009	-	-
PSQI >5	3.6 (2.1-6.4)	<0.001	3.6 (2.0-6.5)	<0.001
STOP BANG >3	1.6 (0.9-2.7)	0.11	2.3 (1.3-4.1)	0.003

From the multiple logistic regression analysis, the factors associated with road accident risk were caffeinated drink consumption, ESS >10, and PSQI >5. While the factors associated with excessive daytime sleepiness (ESS >10) were experience of almost falling off the curbside, drowsy driving, BMI >25 kg/m^2, neck circumference >39 cm, and PSQI >5 (Table 3).

Table 3 The adjusted odds ratio of possible risk of road accident exposure and ESS >10

Possible risks	Model 1		Model 2	
	Road accident experience		ESS >10	
	adjusted OR (95%CI)	*p*-value	adjusted OR (95%CI)	*p*-value
Caffeinated drink consumption	2.7 (1.3 - 5.8)	0.01	-	-
ESS >10	2.0 (1.0 - 3.8)	0.03	-	-
PSQI >5	3.2 (1.7 - 6.0)	<0.001	2.37 (1.1 - 4.8)	0.02
Almost falling off the curbside	-	-	3.64 (1.8 - 7.6)	0.01
Drowsy driving	-	-	5.5 (2.4 - 12.4)	<0.001
BMI > 25 kg/m^2	-	-	5.1 (2.2 - 11.8)	<0.001
Neck circumference >39 cm.	-	-	0.4 (0.2 - 0.9)	0.03

Remark: Model 1. Constant (b) = -2.049, Model test: χ^2 = 33.960, df = 3, *p*-value < 0.001; Cox & Snell R^2 = 0.144, Nagelkerker R^2 = 0.194

Remark: Model 2. Constant (b) = -2.049, Model test: χ^2 = 59.545, df = 5, *p*-value < 0.001; Cox & Snell R^2 = 0.239, Nagelkerker R^2 = 0.333

Discussion

The findings of this study showed that the main cause of road accidents was sleepiness or micro-sleep (20.3%) was much higher than that reported by Royal Thai Police (1.03%). This might be because the information of Royal Thai Police was gained from general population, not from the public transport drivers. A previous study done in Thailand[7] had reported force majeure (85%) and road condition (15%) as the causes of road accidents. A study done in Jordan[8] reported mini-bus following too closely (21%), lacking of attention (16%), and disobeyed pedestrian priorities (8%) as the causes of road accidents. Neither of them mentioned about sleepiness or micro-sleep and poor sleep quality as the causes of accident. From the review of literature, very few previous studies stated the causes of accidents by public transport drivers.

In Thailand, the studies about the associations of public transport drivers with road accidents, with OSA, and with sleepiness, were rare. In the studies from different parts of the world, the prevalence range of ESS >10 was wide different from 6%[9] to 83%[10], but in this study, the prevalence rate was 33%. This may be because of the differences of race, culture, and types of vehicle. In some previous studies done in Thailand, it was found that public transport drivers with ESS >10 showed the prevalence of 45[11] and 83[10] which were higher than in this study.

However, although ESS is a popular questionnaire used worldwide for assessing daytime sleepiness, a flaw was mentioned by systematic review in 2017[12]. Some argued although experience of drowsy driving was significantly associated with road accidents, there was no evidence to show a significant

association between ESS >10 and road accidents. This is because ESS is the assessment of doze in inactive situations; for instance, when a person sitting quietly after lunch, without an alcohol drinking, or lying down to rest in the afternoon when circumstances permit, but driving is an active activity under brain arousal. However, our study found that ESS >10 and experience of drowsy driving/ micro-sleep were both risk factors equally increasing two times of road accident feasibility. From this information, a screening OSA risk in driver's license applicants should include ESS and the question "Have you experienced sleepiness or doze while driving?".

From previous studies in Thailand, only one study was conducted in public transport drivers and the prevalence of PSQI >5 was 66%[11]. In this study, the prevalence of PSQI >5 was 43.1%. which was less than the result from previous study. This maybe the difference in study population. The previous study was undertaken by using inter-city bus drivers whose work included nighttime driving and tended to had poor sleep quality. For a subgroup analysis of the 18-wheel lorry drivers whose work included nighttime driving in this study, the result showed that the prevalence of PSQI >5 increased to 63.3%. It was also found that PSQI >5 had 3.2 times higher road accident risk than that of PSQI <5, it was the highest risk for road accidents in this study. As a result, campaigns for good sleep quality in public transport drivers should be promoted.

Since 2014 in EU the policies for issuing private and commercial passenger car driver's licenses have been amended[13]. OSA has been considered a high-risk disease for road accidents. This is under the regulation stipulated by the American Thoracic Society Clinical Practice Guideline[14] that since 2013 henceforth OSA and sleepiness screenings shall be performed for all license holders before renewing their driver's licenses. From previous studies, it was found that the chance of road accidents due to excessive sleepiness increased 2.5 times[12] also, drivers with untreated OSA had a 2-3 times greater chance of road accidents than general people[14]. Public transport drivers had OSA risk 28-78%[15] higher than general people. This study also found that the prevalence of OSA risk was 41.7%. This OSA risk was higher than general Thai men, which was 15.4%[16]. The cause was that most of the public transport drivers were male, aged >40 years, whose work was sedentary and who lacked regular exercise. However, in this study the OSA risk was not associated with the experience of road accidents or excessive daytime sleepiness this may be because OSA risk in the drivers had been screened using only by STOP BANG questionaries but not being confirmed by polysomnogram.

Thai Land Transport Act specifies that "the working hours of individuals working in road transport shall not exceed 8 hours/day or 48 hours/week, and they shall be given rights to take a rest after continuously driving for 4 hours". A study conducted in Thailand[11]

showed that 61% of public transport drivers drove longer than 12 hours per day, while this study found the average of driving period was 9.1 hours per day and 51.87 hours per week. Of the samples, 82.1% drove longer than 8 hours per day which exceeded the limit of Thai law. These drivers had 2.2 times higher risk of road accidents than those with fewer driving hours. Although the working hour limit is specified by Thai law, it is not really enforced; therefore, working the hour limit should be taken seriously or a co-driver should be included for a long-distance transport.

This study comprised a physical examination which differed from other studies and face-to-face responses to a questionnaire. With this approach, the data had a high rate of completion, only 1.9% were incomplete. Previous studies using mail or e-mail questionnaires might experience 24-70% incomplete data[11,17,18]. In addition, face-to-face response reduced the chance of misinterpretation or confusion about the questionnaire, especially the PSQI. Although they were all translated into Thai, they were quite difficult to understand.

There are limitations in this study. First, face-to-face response might lead to information concealment because the participants may not want to take the risk of losing their job if they give true answers. The participants might avoid telling the truth even though they had been informed that the information would be kept confidential. As in this study, most participants responded as a good sleeper, but the PSQI showed almost half of them were poor sleeper. This agreed with the result of a previous study that drivers with severe OSA (AHI 168 times/hour) reported normal sleepiness and ESS score[19]. Second, the assessment of the OSA risk was accomplished through physical examination and STOP BANG questionnaires. For more reliable results, a polysomnogram maybe requisite for diagnosing the OSA, and in the future, some objective test such as a driving simulation test, home sleep test, or polysomnogram should be done for high risk OSA individuals. Maintenance of wakefulness test should be held after OSA treatment, which eventually will lead to a decrease in road accidents.

Conclusion

Currently, although there is no best questionnaire used to screen the OSA risk and excessive sleepiness, the findings of this research encourage OSA risk screening in people applying for driver's license either for commercial passenger cars or public transport. The screening of risks that lead to road accident among public transport drivers should include personal information such as health problems, ESS and STOP BANG questionnaire. The question "Have you experienced sleepiness or micro-sleep while driving?" should be asked. Campaigns promoting good sleep quality for public transport drivers should be regularly held.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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