

# Report of Research Results

## A. Title:

A Research of Highway Bus Drivers' Stress and Sleep Quality

## B. Primary Researcher:

Ching-Hao Chen, Associate Professor, Department of Risk Management and Insurance  
National Kaohsiung University of Science and Technology, chinghao@nkust.edu.tw

### Co-researcher:

An-Li Sui, Associate Professor, Department of Hospital and Health Care Administration  
Chia Nan University of Pharmacy and Science, anlisui@mail.cnu.edu.tw

## C. Summary:

Stress and sleep disturbance are the common persecutions that modern people often encounter, not only they associate with physical and psychological health, but also affect interpersonal relationship and social functions. This research took highway bus drivers as the research subjects to analyze their stress and sleep quality, aims to explore the associations and the impact factors. The Pittsburgh sleep quality index (PSQI), the stress scale (PSS), the adapted adolescent sleep hygiene scale (ASHS) and the Epworth sleepiness scale (ESS) are used in the questionnaire, trained survey investigators collected questionnaires at the bus transfer stations in Tainan city and Kaohsiung city from April to May 2021, 71 valid questionnaires were retrieved.

Most of the surveyed drivers are 31-50 years old (78.8%), more than 60% are married and graduated from senior high school or vocational high school. The average body mass index (BMI) is  $26.08 \pm 4.03$ , and more than 60% (66.2%) are overweight and obese. The proportion with physical diseases is 35.2%, the most common ones are hypertension (9.0%) and heart disease (8.5%). The average sleep quality score is  $5.34 \pm 3.27$ , the percentage of poor sleep quality accounts for 45.1%, and 23.9% of drivers sleep less than 6 hours a day.

Correlation analysis result shows that there are significant positive correlations between sleep quality, BMI, stress, sleep hygiene, and sleepiness. Regression analysis shows that the significant main factors affecting sleep quality are BMI and stress, while the "work in shifts" effect and all interactions are not significant. Risk odds is explored by logistic regression analysis, the results show that: for the "BMI obesity" group, the odds of having poor sleep quality is 3.744 times that of the "BMI normal" group, and it is significant (p value 0.044). For the "high stress" group, the odds of having poor sleep quality is 4.573 times that of the "low stress" group, and it is significant (p value 0.006).

Most of the highway bus drivers are obese, have poor sleep quality and poor sleep hygiene, the transport company operators and the competent authorities should pay more attention to their health, provide regular physical examinations and appropriate health education to improve sleep quality, relieve stress and reduce obesity.

#### **D. Aim of Research**

The research objectives of this study are:

- (1) to investigate and analyze demographic variables, health status, sleep quality, stress, sleep hygiene and sleepiness of highway bus drivers.
- (2) to explore the associations among demographic variables, sleep quality, stress, sleep hygiene and sleepiness of highway bus drivers.
- (3) to analyze the effects of demographic variables, stress, sleep hygiene, and sleepiness on sleep quality for highway bus drivers.
- (4) to find the main risk factors that affect highway bus drivers' sleep quality and compute the odds ratio.

#### **E. Method of Research & Progression**

- (1) Questionnaires were collected at the transfer stations in Tainan City and Kaohsiung City the questionnaires were completed by volunteer drivers after got their agreements, the survey period is from April to May 2021, 75 questionnaires were collected, of which 71 were valid.
- (2) The statistical methods of this study include:
  - a. Descriptive statistics: to present the response of the subjects, including basic information, sleep quality, stress, sleep hygiene, and sleepiness.
  - b. Analysis of variance: to test whether there were significant differences in the demographic variables, health status, stress, sleep hygiene, and sleepiness between the “good sleep quality” group and the “poor sleep quality” group.
  - c. Pearson correlation analysis: to analyze the correlations among BMI, sleep quality, stress, sleep hygiene, and sleepiness.
  - d. Regression analysis: to find the main impact factors of sleep quality, and the effect of shift work was added for discussion.
  - e. Logistic regression analysis: to explore the risk factors of sleep quality and the odds ratio were computed.

#### **F. Results of Research**

##### **(1) Regression analysis of sleep quality**

Regression analysis was used to explore the factors that affect sleep quality, the dependent

variable is sleep quality (PSQI), we screened many different variables and tried to constructed models that explained and fitted well, after all, we constructed a final model, the independent variables we selected are: stress (PSS), sleep hygiene (ASHS), sleepiness (ESS), and body mass index (BMI). In addition, in order to explore the effects of needing to work in shifts outside of normal working hours, an indicator variable  $I$  is added, a value of 0 means no shift work is required, and a value of 1 means shift work is required.  $I\_PSS$  represents the interaction between stress and shift,  $I\_ASHS$  represents the interaction between sleep hygiene and shift,  $I\_ESS$  represents the interaction between sleepiness and shift, and  $I\_BMI$  represents the interaction between body mass index and shift. The regression model is as follows:

$$PSQI = \beta_0 + \beta_1 PSS + \beta_2 ASHS + \beta_3 ESS + \beta_4 BMI + \beta_5 I\_PSS + \beta_6 I\_ASHS + \beta_7 I\_ESS + \beta_8 I\_BMI + \beta_9 I + \varepsilon$$

Regression model of sleep quality

Variable	Parameter estimate	t value	p value
Intercept	-7.675	-1.828	.072
Stress (PSS)	.212	2.250	.028***
Sleep hygiene (ASHS)	-.265	-1.354	.181
Sleepiness (ESS)	.053	0.267	.791
BMI	.406	2.424	.018***
$I\_PSS$	.007	.070	.945
$I\_ASHS$	.281	1.314	.194
$I\_ESS$	-.027	-.126	.901
$I\_BMI$	-.299	-1.526	.132
Shift ( $I$ )	4.815	1.002	.320
R-square = 0.612		F = 10.683	0.00***

\*\*\* significant explanatory at the 0.01 significance level.

The shift effect and all of the interactions are not significant. The main significant factors affecting sleep quality are BMI and stress, sleep quality is significantly worse when body is more obese, and is significantly worse when stress is increased. In some previous researches, sleep quality was also found to be significantly correlated with BMI (Patel et al., 2006, Jennings et al., 2007), which is consistent with the results of this research.

## (2) Logistic regression

Regression analysis result showed that the main risk factors affecting sleep quality are BMI and stress, further, we used logistic regression to explore the impact of these risk factors on sleep quality. Take sleep quality groups (two categories: poor, good) as the dependent variable, BMI groups (three categories: normal, overweight, obesity) and stress groups (two categories: low, high) as independent variables, the logistic regression model is as follows:

$$\ln(p/1-p) = \beta_0 + \beta_1 I\_PSS + \beta_2 II\_BMI + \beta_3 I2\_BMI + \varepsilon$$

$p$  is the probability of poor sleep quality,  $1-p$  is the probability of good sleep quality,  $I\_PSS$  is an indicator, a value of 0 represents "low stress" group, and a value of 1 represents "high stress" group.  $II\_BMI$  and  $I2\_BMI$  are also indicators, when  $II\_BMI$  is 0 and  $I2\_BMI$  is 0, it represents "BMI normal" group, when  $II\_BMI$  is 1 and  $I2\_BMI$  is 0, it represents "BMI overweight" group, when  $II\_BMI$  is 0 and  $I2\_BMI$  is 1, it represents "BMI obesity" group. The logistic regression model is estimated by:

$$\ln(p/1-p) = -1.728 + 1.52 I\_PSS + 0.875 II\_BMI + 1.320 I2\_BMI$$

The Cox & Snell  $R^2$  is 0.212, the Nagelkerke  $R^2$  is 0.282, Chi-square value is 2.875 and  $p$  value is 0.579 in Hosmer-Lemeshow test, which shows the model is well fitted, and the overall accurate classification rate is 67.6%. The result showed that for the "BMI overweight" group, the odds of having poor sleep quality is 2.399 times that of the "BMI normal" group, but it is not significant ( $p$  value 0.218). For the "BMI obesity" group, the odds of having poor sleep quality is 3.744 times that of the "BMI normal" group, and it is significant ( $p$  value 0.044). For the "high stress" group, the odds of having poor sleep quality is 4.573 times that of the "low stress" group, and it is significant ( $p$  value 0.006).

Logistic regression for good and poor sleep quality groups

Variable	Parameter estimate	Wald	OR	95% CI of OR	p value
Stress $I\_PSS$	1.520	7.518	4.573	(1.543 , 13.558)	0.006***
BMI normal		4.083			0.130
overweight $II\_BMI$	0.875	1.515	2.399	(0.595 , 9.666)	0.218
obesity $I2\_BMI$	1.320	4.055	3.744	(1.036 , 13.530)	0.044**
Constant	-1.728	9.260	0.178		0.002***

\*\*significant different at the 0.05 significance level, \*\*\* significant different at the 0.01 significance level.

### G. Future Areas to Take Note of, and Going Forward

At present, there is still no comprehensive objective standard to define level of driving fatigue and driving qualifications in country or abroad, there are no clear and consistent guidelines on formulation of relevant policies, there is still a lot of controversy in this issue. In addition, many studies have confirmed that sleep disorders and symptoms such as drowsiness, sleep apnea, and shift work affects driving safety and increases risk of car accidents, which also form a major loophole in the prevention and control work of traffic safety. Therefore, more research and investigations are needed to support the formulation and practical implementation of relevant theories and policy guidelines.

### H. Means of Official Announcement of Research Results

Submit the research results and publish in conference or journal.