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Evaluation of Fatigue Risk, Subjective Fatigue, and Work Motivation Level of Intercity Bus Driver

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Abstract

In Indonesia, the bus is one of the affordable transportation for intercity/province routes. However, there are accident risks faced by bus drivers related to fatigue caused by inadequate rest and sleep. The objective of this study is to assess the bus driver fatigue risks level, accompanied by work motivation and subjective fatigue. Using the convenience sampling method, 300 intercity bus drivers from 12 bus companies (male, age between 25-68 years old (44.06 ± 9.83)) agree to involve in the study. Fatigue risk level was estimated by fatigue likelihood score (FLS) which indicated by driving tasks hours and the rest time opportunity. Work motivation and subjective fatigue were measured using 20 questions. The FLS result has a range between 13-39 (scale 0-40) or the risks are categorized into medium to very high. The major finding in this study, while a fatigue risks were relatively high, the subjective fatigue level were low to medium, and work motivations were medium to somewhat high. Statistical test showed that work motivation has a significant correlation with fatigue risks ($p < 0.05$; $r = -0.139$), but not with a subjective fatigue level.

Keywords: Fatigue likelihood score (FLS), Intercity bus driver, Subjective fatigue, Work motivation

1. INTRODUCTION

The number of traffic accidents in Indonesia keeps increasing every year (Central Bureau of Statistics, 2020; Suraji, Harnen, Wicaksono, & Djakfar, 2017), and the accidents that involve inter-city bus mostly has fatal consequences with a large number of victims. Between 2009 to 2015, there were significant number of deaths and serious injuries based on summarized data of 25 worst traffic accidents involving buses. About 279 people died, 380 had serious injuries, and 175 experienced minor injuries in those accidents (Santosa, Mahyuddin, & Sunoto, 2017). Based on fatality trends data, its predict that in the future the victim will reach 40,000 people per year (Jusuf, Nurprasetio, & Prihutama, 2017).

Human error and drivers' fatigue mention as factors that contribute to the road accidents, and it is believed to be one of the main factors in traffic accidents (Hirshkowitz, 2013). Fatigue is defined as a physiological state of reduced mental or physical performance capability (Phillips, 2016). Human fatigue is resulting

from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity) (Rupp, 2013). Fatigue is also a condition which formed from excessive work, physical and/ or mental exertion, or prolonged waking times (Dawson, Reynolds, Van Dongen, & Thomas, 2018).

Fatigue signs and symptoms can be recognized in three different conditions, physical, cognitive, and emotional signs (Phillips, 2019). The important thing is excessive fatigue can impair a person's alertness and ability to perform safety-related operational duties such as driving in transportation sectors (Kim, Jang, Kim, & Lee, 2018; Miller et al., 2020; Davidović, Pešić , Lipovac, & Antić, 2020).

A fatigue risk management system emphasized policies, risk assessment, hazard controls or action plans, training and education, and ongoing review and improvement in reducing the impact of work fatigue. The risk assessment measures sleep opportunity based on the work schedule showed by fatigue likelihood score (Transport Canada, 2020). The score can give an understanding about the driver's initial state before driving.

In many bus companies, it is very common for drivers to have long hour driving scheduled (Kim, Jang, Kim, & Lee, 2018; Miller, Filtness, Anund, Maynard, & Pilkington-Cheney, 2020). For example, in Korea, the drivers were scheduled to drive at least 14.6 hours a day with 3-5 consecutive days work or at least 16.5 days per month. While drivers in London, it reported the drivers have less than 11 hours rest between shifts, working 6 or more days without a rest day. About 20% of drivers experienced fighting sleepiness at least 2–3 times a week. Similar suffering from sleepiness also experience by bus drivers in Sweden and Indonesia (Davidović, Pešić, Lipovac, & Antić, 2020; Zuraida, 2015). Those conditions contribute to risk index higher than 1.6 as a threshold refers to Health and Safety Executive (HSE) tools to asses fatigue. This is a serious situation, since a severe sleepiness correlated with driver's fatigue and it increase the risks, such as near crashes (Davidović, Pešić, Lipovac, & Antić, 2020; Transport Canada, 2020; Zuraida, 2015; Anund, Ihlström, Fors, Kecklund, & Filtness, 2016).

The driver plays an important role in ensuring of having sufficient rest from fatigue. Some researchers suggested to consider a work motivations, drivers' age, driving duration, driving time, how driver and company view the driving safety aspects, in understanding driver's fatigue phenomena (Dawson et al., 2014; Anund, Ihlström, Fors, Kecklund, & Filtness, 2016; Ma, et al., 2018; Safitri, Surjandari, & Sumabrata, 2020). The objective of this study is to evaluate the fatigue risk of intercity bus drivers in Indonesia based on fatigue likelihood scoring accompanied by subjective fatigue and work motivation level.

2. METHODS

The research implementation described in Figure 1 below (Figure 1 Research flow chart):

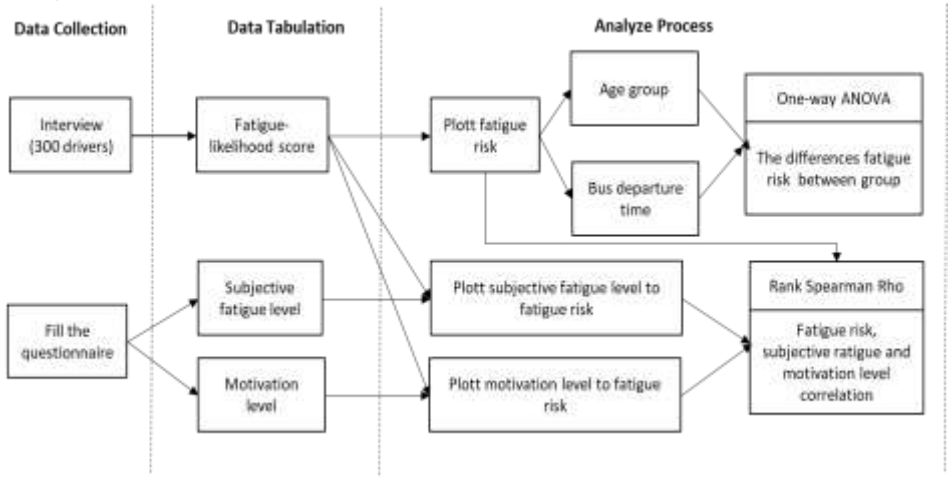


Figure 1 Research flow chart

As can be seen in Figure 1, data were collected by interviewing 300 bus drivers from 12 bus companies follow by filling a questionnaire. This number of samples is sufficiently based on the Slovin formula (Adam, 2020) using 10% of error (> 99.79 sample) with the estimation number of intercity bus drivers in Indonesia (N) is 35.000 drivers (Azka, 2020). The collecting data took 4 months and finish at the end of 2019 before the pandemic Covid-19 started, and the bus companies still operate with their regular schedule.

The interview was run to collect data about the driving schedule and driver's sleep opportunity. The questions during the interview were developed based on the fatigue likelihood scoring matrix (Transport Canada, 2020). The interview covers about total driving hours per 7 days, maximum shift duration (hours), minimum short break duration (hours), maximum night driving per 7 days (hours), and long break frequency (days).

The drivers were also asked to fill a questionnaire about work motivation (10 questions) and a subjective fatigue level (10 questions) in the end of interview. Work motivation questions referred to Herzberg's motivation factors (Alshmemri, Shawan-Akl, & Maude, 2017), and subjective fatigue was assessed using a Fatigue Assessment Scale Questionnaire (FAS questionnaire) (De Vries, Michielsen, & Van Heck, 2003)

3. RESULTS AND DISCUSSION

3.1 Fatigue risk assessment result

The interview was conducted with drivers who operate an intercity route across provinces. All participants are males aged between 25-68-year-old (44.06 ± 9.83). Based on their experience, the participants at least one and max twenty years work as bus drivers (12.28 ± 8.9 years). The bus drivers assigned to the same route and daily same schedule. All interview data work schedules are tabulated into a fatigue likelihood scoring matrix to obtain a fatigue likelihood score (FLS) for each driver. Figure 2 showed the FLS value in percentage.

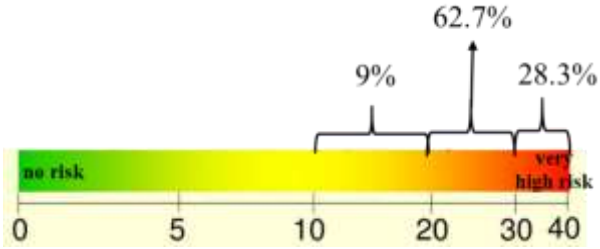
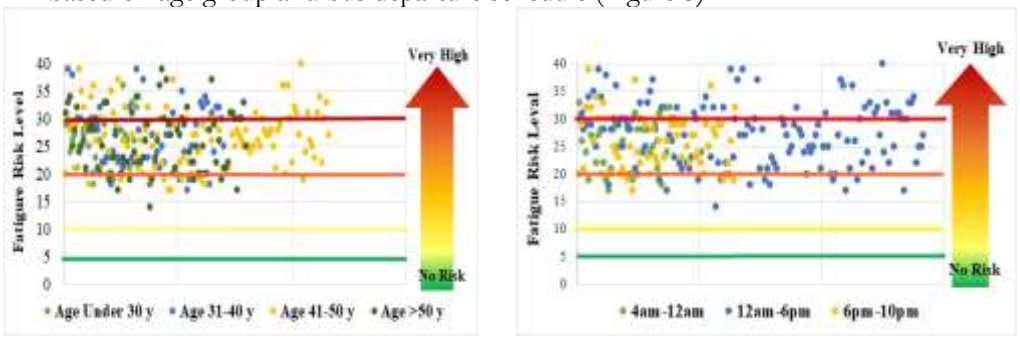


Figure 2 Percentage of drivers based on FLS value

As seen in Figure 2, most drivers have FLS between 20-30 (orange zone) which means they have a high potential fatigue risk (62.7%). About 28.3% of them are in the red zone or have a very high potential fatigue risk. The FLS data is plotted based on age group and bus departure schedule (Figure 3):



(a) (b)

Figure 3 Fatigue risk level (a) age-group (b) bus departure schedule

From both graphs (Figure 3a -b), the risks level lie between medium to high risk (yellow zone to red zone). Table 1 presents the average fatigue likelihood score (FLS) for each group and its standard deviation

Table 1 Average value and standard deviation of fatigue likelihood scoring (FLS)

Age group	Mean	N	Std. Deviation
<30	26.38	34	4.278
31-40	26.41	71	5.481
41-50	26.83	115	5.519
>50	26.08	80	5.787
Total	26.48	300	5.441

Bus departure schedule	Mean	N	Std. Deviation
4am-12am	26.10	60	4.331
12am-6pm	27.26	165	5.904
6pm-10pm	25.92	75	5.421
Total	26.48	300	5.568

Percentage risk data for each age group and bus departure schedule presents in pie chat (Figure 4) as follows:

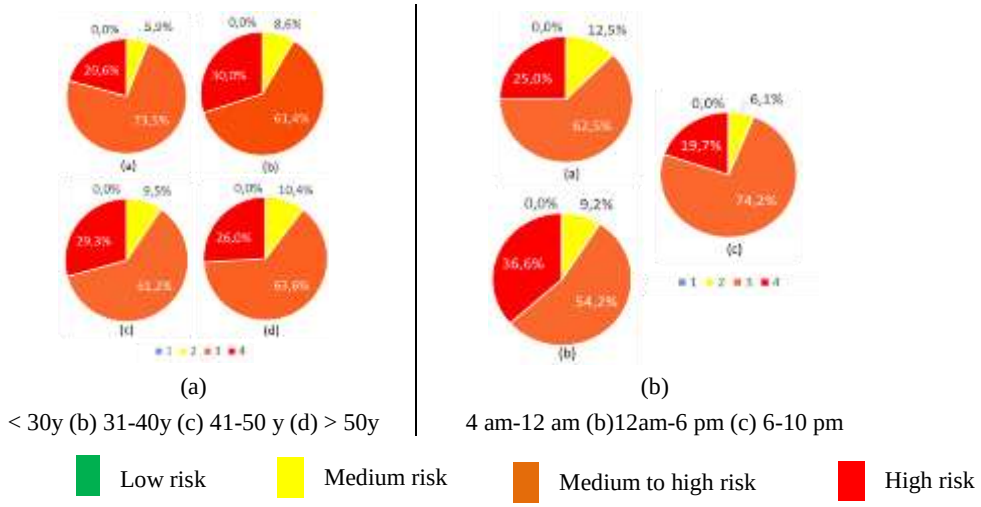


Figure 4 Fatigue risk level for each group: (a) age group (b) bus departure schedule

In Figure 4, about 5.9% to 12.5% of the drivers have a medium fatigue risk level, about 54.2%-74.2% have medium to high risk, and about 19.7% to 30% have very high fatigue risks. There are insignificant differences of fatigue risk level between age groups as determined by One-way ANOVA ($F(3; 296) = 0.316$, $p = 0.814$) and between bus departure schedule ($F(2; 297) = 1.591$, $p = 0.206$). It means, the null hypothesis is accepted for both test which is the fatigue risks is similar between age group driver, and between drivers with different bus departure schedule time.

By accepting the null hypothesis, it implies that insufficient opportunity to rest or recover from fatigue are similar between the drivers.

3.2 Subjective Fatigue (FAS) and Motivation Level

A questionnaire of subjective fatigue and motivation level has Cronbach alpha 0.501 for all 20 questions (r (0.05;20)=0.444). The questionnaire result was tabulated to obtain the average value for each variable (1 is low fatigue- 5 is high fatigue) (see Figure 5-6). The subjective fatigue level of 300 drivers is low-to-medium, medium, and somewhat high, even though their fatigue risks are categorized into medium to high (Figure 5). The motivation level of participants showed in Figure 6 (1 is low motivation – 5 is high motivation).

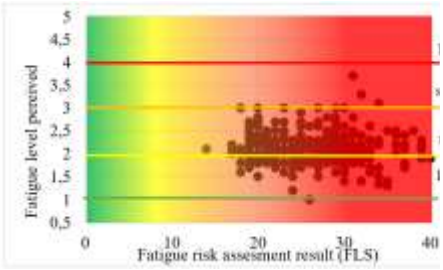


Figure 2 Perceived fatigue level on fatigue likelihood score

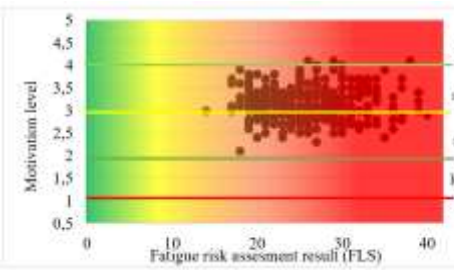


Figure 3 Motivation level on fatigue likelihood score

Correlation analysis was conducted between subjective fatigue variable (FAS) with motivation variable, FAS with FLS, and between motivation variable with FLS. Rank Spearman correlation result (r) are -0.031, 0.044, and -0.139 respectively with significant p-value are 0.594; 0.446; and 0.016. It concludes the correlation between variables is insignificant, except for motivation and FLS (p-value < 0.05)

4. CONCLUSION

There are at least three important findings in this study. First, the risk fatigue level is medium-high for all drivers from 12 different companies, and this can be caused that the companies has a similar policy about driving work schedule. Second, there are no differences in fatigue risk levels between the age group and between bus departure schedules. This means the fatigue risks are similar and each group has a similar workload based on total driving hours per 7 days, maximum shift duration (hours), minimum short break duration (hours), maximum night driving per 7 days (hours), and long break frequency (days). Third, the drivers and the company failed to realize the dangers of this condition, it reflects on how drivers perceived their subjective fatigue and work motivation.

5. ACKNOWLEDGMENT

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