The Study Model of Workload, Sleep Quality with Work Fatigue on Workers in Oil and Gas and Palm Plantations Industry

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Abstract. Fatigue is one of the risk factors that contributes greatly to the occurrence of work accidents that can cause death. Workers who experience fatigue will give a negative contribution to the safety performance of workers, a decrease in the level of worker productivity, low quality of work, and an increase in the risk of work accidents. This study aims to examine the risk factors, either directly or indirectly, causing fatigue in workers in the oil and gas and oil palm industries using the Structural Equation Modelling (SEM) approach. This research is a quantitative study with a cross sectional design. This research was conducted from March-November 2021 with a total sample of 222 people who are workers in the oil and gas industry and oil palm plantations in Jambi Province. This study uses an international standardized questionnaire from the Industrial Fatigue Research Committee (IFRC), NASA TLX AND PSQI. The results of this research are that the value of cr (Critical correlation) is -0.334 which has met the requirements for data normality. Furthermore, the model suitability test was carried out through a study with the goodness of fit criteria, with indicators X2 Chi Square, CMIN/DF, RMSEA and CFI. The test results show that the model used is acceptable. From this study, it can be concluded that there is a significant effect of sleep quality on work fatigue.

Keywords: Workload · Sleep quality · fatigue

1 Introduction

BPJS Ketenagakerjaan has released data of work accidents that occurred in Indonesia which shows an increasing trend with a significant increase. Every year on average BPJSTK serves 130 thousand cases of work accidents ranging from mild cases to fatal cases impact in death. Total of approximately 123,000 cases of work accidents have been reported throughout 2017. In 2018 the nominal amount of compensation has reached IDR 1.2 trillion with the number of cases reaching 173,105 [1].

One of the risk factors that cause work accidents is fatigue. Fatigue is considered a major factor in the occurrence of morbidity and mortality in the workplace and on roads [2]. Long working duration is an important characteristic of work organization systems

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that can increase fatigue in workers both directly and indirectly by reducing the quality and efficiency of work and sleep quality for recovery [3].

Fatigue is one of the risk factors that contributes greatly to work accidents in various industrial sectors. In the scientific perspective of Occupational Health and Safety fatigue has become a serious concern for companies or workers to minimize the negative impact it causes. Workers who have fatigue (fatigue) will make a negative contribution to the safety performance of workers [4]. Fatigue is also one of the factors that can cause a decrease in worker productivity, low quality of work, and an increase in the risk of accidents in the industrial sector construction industry [5].

Fatigue is a complex phenomenon that can be caused by various factors (multifactorial). Therefore, it is difficult to find a comprehensive definition with uniform agreement. In addition, there are other terms such as feelings sleepy and drowsiness which are often used interchangeably in the literature regarding fatigue. One of them is the aspect of fatigue, then it is easier to define it compared to fatigue. The first step in dealing with complaints of fatigue (fatigue) is to distinguish between drowsiness and fatigue. Differentiate between the two is quite difficult, but some multiple sleep latency testing would be helpful [6].

Lack of sleep in workers will cause drowsiness and fatigue that can occur together. Drowsiness reflects a neurobiological need for sleep that causes a person's sleep drive to fall asleep. Workers will have a higher level of sleepiness after working at night or sleepless nights. We will experience fatigue after vigorous physical exercise during the day, but we cannot sleep easily. Fatigue will usually refer to a decrease in work performance. In addition, fatigue has a psychological aspect which means not having enough energy to do work and experiencing reluctance to continue with work [7].

There are various factors that cause fatigue both at work and outside the workplace that can affect the level of fatigue. The most important cause of fatigue is a lack of restorative sleep. In addition, fatigue can be caused by a combination of interrelated factors. Workload refers to the amount of work that employees are assigned to do. It causes fatigue in the workplace and can be assessed in three categories including physical burden, environmental burden, and mental burden. The following diagram provides a comprehensive view of the causes of work-related fatigue [2].

In this era, information regarding the incidence of fatigue that occurs in workers in the oil and gas industry and oil palm plantations, especially in Jambi Province, has not been studied. In addition, the impact on health or work safety due to work fatigue is very large.

2 Method

This research is a quantitative observational study with a cross sectional design. This research was implemented in companies engaged in the oil and gas industry and oil palm plantations. Sampling in the two companies by taking into account the inclusion and exclusion criteria that have been set. The research time is April 2021 to November 2021. Sample size using the Slovin formula, the number of samples is 200 people. To anticipate the sampling error, the number of samples was increased by 10% (20 people) so that it became as many as 220 people. But in this study, the sample obtained was 222 people.

This study used the IFRC questionnaire to measure work fatigue, PSQI to measure sleep quality, and NASA TLX to measure mental workload. Furthermore, univariate analysis was carried out to determine the distribution of frequencies, proportions and averages used to enrich the discussion presented in tabular or graphic format. Then SEM analysis was carried out to test the hypothesis which was measured through two analysis steps, namely the measurement model and the structural model.

3 Result and Discussion

Respondent by Gender

Characteristics of respondents based on gender aspects can be seen in Table 1.

Based on Table 1 shows that more male respondents (68.01%) than female respondents (31.98%) participated in this study.

Respondent by Age

Characteristics of respondents based on age are divided into 2 categories, ages18–35 years old and 36–59 years old, which can then be seen in Table 2.

Based on Table 2 shows that respondents aged 36–59 years more (75.44%) than respondents with younger ages, namely 18–35 (23.66%) participated in this study.

Respondent by Level of Education

Characteristics of respondents according to education level were assessed from the last education obtained at the time of the research which consisted of elementary, junior high, high school, D3 and high school education levels, which can then be seen in Table 3.

Based on Table 3 shows that the most respondents are Bachelor (47.74%), then senior high school (37.38%) and Diploma (10.81%), while respondents whose last education is junior high school there are 2 people (0.9%) and no one respondents whose last education is elementary school.

Table 1. Respondents by Gender

No	Gender	Counts (n)	Percentage (%)
1	Male	151	68,01
2.	Female	71	31,98
	Count	222	100

Table 2. Respondent by Age

No	Age	Counts (n)	Percentage (%)
1	18 sd. 35 years old	53	23,66
2.	36 sd. 59 years old	169	75,44
	Count	222	100

Table 3. Respondent by Level of Education

No	Last Education	Count (n)	Percentage (%)
1	Elementary	0	0
2.	Junior High School	2	0,9
3.	Senior High School	83	37,38
4.	Diploma	24	10,81
5.	Bachelor	106	47,74
6.	Magister	7	3,15
	Count	222	100

Respondent by Marital Status

Characteristics of respondents according to marital status are divided into 2 categories, categorized married and not married, which can then be seen in Table 4.

Based on the table, it shows that married respondents dominate the respondents in this study as much as 86.48%, while respondents who are not married are 13.51%.

Respondent by Workload

Characteristics of respondents according to workload are divided into 3 categories, categorized: low, medium and heavy, which can then be seen in Table 5.

Based on Table 5 shows that the majority of respondents have a moderate workload (71.62%), then 17.56% have a heavy workload and only 10.81% have a light workload.

Table 4. Respondent by Marital Status.

No	Marital Status	Count (n)	Percentage (%)
1	Not married	30	13,51
2.	Married	192	86,48
	Count	222	100

Table 5. Respondent by Workload

No	Workload	Count (n)	Percentage (%)
1	Low	24	10,81
2.	Medium	159	71,62
3.	Heavy	39	17,56
	Count	222	100

Table 6. Respondent by Sleep Quality

No	Sleep Quality	Count (n)	Percentage (%)
1	Good	70	31,5
2.	Bad	152	68,5
		222	100

Respondent by Sleep Quality

The characteristics of respondents according to sleep quality are divided into 2, categorized: good and bad, which can then be seen in Table 6.

Based on Table 6 shows that the majority of respondents have bad sleep quality (68.5%), while 31.5% have good sleep quality.

Data Analysis

Data analysis used in this study is using Structural Equation Modelling (SEM). This analysis was carried out by conducting a Full Model suitability test and statistical tests on the data. The results of data management for this analysis were tested using Chi Square, CIMN/DF, RMSEA and CFI [1, 8].

Data Normality Test

From the results obtained, then the normality test was carried out with the following results:

The normality of the data is determined by the value of CR (Critical Correlation) with the condition that the normality of the data is -2.58 < c.r < 2.58. From Table 7 shows that the value of cr (Critical correlation) is -0.334 which has met the requirements for data normality.

Model Fit Test

Next step the model suitability test was carried out through a study with the goodness of fit criteria, with indicators X2 Chi Square, CMIN/DF, RMSEA and CFI [1, 8].

a. X2 Chi- Square Statistic.

The model that is considered good if the chi-square value is low. The smaller the X2 value, the better the model or accepted based on probability with a cut off value of $p > 0.05$ or $p > 0.1$

Table 7. Normality Test

Variable	Min	Max	Skew	c.r.	kurtosis	c.r.
Workload	1.000	3.000	.072	.440	.505	1.535
Sleep Quality	1.000	2.000	-.795	-4.836	-1.368	-4.161
Work Fatigue	1.000	4.000	.999	6.078	.567	1.724
Multivariate					-.246	-.334

b. CMIN / DF.

CMIN/DF is The Minimum Sample Disperancy Function which is divided by Degree of Freedom. CMIN/DF is statistic chi square, X2 shared with DF called X2 relative.

c. RMSEA (The Root Mean Square Error of Approximation).

RMSEA is an index used to compensate for chi-square statistics in a large sample (Baugmgartner and Homburg, 1996 in Ferdinand, 2006). The RMSEA value indicates the goodness of fit value that can be expected if the model is estimated in the population. RMSEA value that is small or equal to 0.008 is an index for the acceptance of the model which shows a close fit of the model based on the degree of freedom.

d. CFI (Comparative Fit Index).

The magnitude of this index is in the range of values of 0 to 1, where if the CFI is getting closer to 1, it identifies the highest level of conformity - a very good fit. The recommended value is CFI $> = 0.95$.

The results of the model fit test are shown in the following Table 8:

The test results show that the model used is acceptable. After the initial model is processed, the chi square value is 0.000, the CMIN/DF value 0.000 is good, the CFI value is 1, it is good, only the RMSEA is not good. Therefore, it can be concluded from the 4 categories of assessors of the Fit model, then the model tends to show Fit. So it can be said that the model is Fit.

Hypothesis Test

After all assumptions are met, the next step is to test the hypothesis. Testing the 3 hypotheses of this study was carried out based on the Critical Ratio (CR) value of a causal relationship from the results of SEM processing as shown in Table 9.

Table 8. SEM Feasibility Test Results

Goodness of Fit Indices	Model Result Test	Cut – Off Value	Information
X2 Chi Square	0.000	Low	Good
CMIN/DF	0,000	$\leq$ 2,00	Good
RMSEA	0,124	$\leq$ 0,08	Not Good
CFI	1	$\geq$ 0,95	Good

Table 9. Regression Weight Structural Equational Model

			Estimate	S.E.	C.R.	P	Label
Sleep Quality	< ---	Workload	-.020	.059	-.347	.729	par_2
Work Fatigue	< ---	Workload	.003	.083	.038	.970	par_1
Work Fatigue	< ---	Sleep Quality	.344	.094	3.661	***	par_3

Based on the output of Regression Weights, it can be seen directly the effect of workload on sleep quality, workload on work fatigue and sleep quality on work fatigue, with each coefficient value (-0.020), (0.003) and (0.344).

Hypothesis Test 1

The hypothesis between workload and sleep quality is:

H0: There is no significant effect between workload on sleep quality.

H1: There is a significant effect between workload on sleep quality.

Test statistic if P value < alpha (0.05) then H0 is rejected and if P value > alpha (0.05) then H0 is accepted. From the analysis results obtained P value (0.729) > alpha (0.05) so accept H0, it can be concluded that there is no significant effect between workload on sleep quality.

Hypothesis Test 2

H0: There is no significant effect between workload and work fatigue.

H1: There is a significant effect between workload on work fatigue.

Test statistic If P value < alpha (0.05) then H0 is rejected. If P value > alpha (0.05) then H0 is accepted. From the results obtained P value (0.970) > alpha (0.05) so accept H0, it can be concluded that there is no significant effect between workload on work fatigue.

Hypothesis Test 3

H0: There is no significant effect of sleep quality on Work Fatigue.

H1: there is a significant effect of sleep quality on work fatigue.

Test statistic If P value < alpha (0.05) then H0 is rejected. If P value > alpha (0.05) then H0 is accepted. From the results obtained P value (0.000) < alpha (0.05) so reject H0, it can be concluded that there is a significant influence between sleep quality on work fatigue.

From the results of the research, it was found that the majority of respondents were male, which is adjusted to jobs that require greater physical strength. In terms of age, the majority of respondents are over 36 years old. In theory, it is stated that age can have an influence on a person in physical work and muscle strength [9]. A person's physical ability is highest at the age of 25–39 years, while those who are more than 45 years of age are more prone to experience fatigue because muscle strength has decreased, so it can lead to fatigue. Also causes accumulation of lactic acid in the muscles so that it is easier for fatigue to occur [10]. Another characteristic of the respondents found that the majority of respondents were Bachelors according to the required expertise and also the majority of respondents were married [11].

From the three conclusions, the hypothesis shows that the research problem has been answered. Excessive workload will disrupt sleep quality which in turn will result in work fatigue. This study is in line with research conducted by Safira et al. (2020) and Juliana et al. (2018) that sleep quality can affect fatigue because sleep is a form of body recovery, if the body recovers well then workers will be better prepared to do their jobs. Work fatigue can be said as the body's response to the activities carried out so that it has an impact during work such as frequent yawning, thirst, drowsiness, and difficulty concentrating on work [12].

Tarwaka (2010) writes that overload work activities cause a workload as a result of the activities they do [13]. One of the causes of the workload is excessive working time so that there is a lack of rest time for workers and causes a person to experience sleep disorders. It is known that 68.5% of workers in the oil and gas industry and oil palm plantations in Jambi Province have poor sleep quality.

In terms of workload, it was found that the workload was dominated by respondents with moderate workloads. As is known, if a person's workload is heavy it will affect fatigue that will occur [14]. This is because working hours are also high so that it can trigger a sense of saturation due to monotonous work so that it also affects fatigue. Fatigue that appears is a form of protection of the body from damage that may occur so that the body tries to recover [15]. Fatigue also includes physical and mental fatigue. The form of recovery that the body does is sleep with sufficient time. If there is a disturbance in sleeping hours, the recovery system that has been planned by the body is also disturbed so that the feeling of tiredness does not disappear but instead stays [16].

4 Conclusion

Conclusion for this study is the normality of the data is determined by the value of CR (Critical Correlation) with the condition that the normality of the data is -2.58 < c.r < 2.58. From Table 5.1, it can be seen that the value of cr (Critical correlation) is -0.334 which has met the requirements for data normality. Test the suitability of the model through a study with the goodness of fit criteria, with indicators X2 Chi Square, CMIN/DF, RMSEA and CFI showing that the model is fit. The results of hypothesis testing can be concluded that there is a significant effect of sleep quality on work fatigue. We provide advice that efforts or programs need to be made to improve sleep quality so that work accidents due to work fatigue caused by poor sleep quality can be avoided such as socializing health information about sleep quality and the factors that influence it. Employees are expected to be able to do relaxation or complementary therapy to improve sleep quality and rearrange their sleep time, sleep duration, and sleep environment so that they can improve their sleep quality.

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References

1. KEMNAKER. Kasus Kecelakaan Kerja di Indonesia. https://satudata.kemnaker.go.id/data-pengawasan-ketenagakerjaan-dan-k3. 2019.
2. Noy IY, Horrey WJ, Popkin SM, Folkard S. Future Directions in Fatigue amd Safety Research. Accid Anal Prev. 2011; 43 (2).
3. Williamson A, Lombardi D, Folkward S, Stutts J, Courtny T, Connor J. The Link Between Fatigue and Safety. Accid Prev. 2011; 43(2): 498–515.
4. Fang D, Jiang Z, Zhang M, Wang H. An Experimental Method to Study the effect of fatigue on construction workers safety performance. Saf Sci. 2015; 73: 80–91.

5. Aryal A, Ghahramani A, Gerber BB. Monitoring Fatigue in Construction workers using Physicological Measurments. Autom Constr. 2017; 82: 154–65.
6. Gander P, Purnell H, Alexander G, Woodward A. Work Patterns and Fatigue-related Risk among Junior Doctors. Occup Environ Med. 2007; 64(11): 733–8.
7. Ferrara M, De Gennaro L. How much sleep do we need? Sleep Med. 2001; 5(2): 155–80.
8. Santoso S. Konsep dasar dan Aplikasi SEM dengan AMOS 24. Jakarta Pusat: Elex Media Komputindo; 2018.
9. Grandjean E. Fitting The Task To The Man. 4th ed. London: Taylor & Francis Inc; 1998.
10. Syavina M. Faktor –Faktor Yang Berhubungan Dengan Kelelahan Kerja Pada Petugas Cleaning Service Di RSUD Kota Semarang Tahun 2013. Universitas Dian Nuswantoro; 2013.
11. Safira ED, Pulungan RM, Arbitera C. Kelelahan Kerja pada Pekerja di PT . Indonesia Power Unit Pembangkitan dan Jasa Pembangkitan (UPJP) Priok. J Kesehat. 2020; 11(2): 265–71.
12. Juliana M, Camelia A, Rahmiwati A. Analisis Faktor Risiko Kelelahan Kerja Pada Karyawan Bagian Produksi PT. Arwana Anugrah Keramik, Tbk. J Ilmu Kesehat Masy. 2018; 9(1): 53–63.
13. Tarwaka. Dasar-Dasar Pengetahuan Ergonomic dan Aplikasi di Tempat Kerja. Solo: Harapan Press; 2010.
14. Saleh L. Man Behind The Scene Aviation Safety. Yogyakarta: CV. Budi Utama; 2018.
15. Suma'mur P. Higene Perusahaan dan Kesehatan Kerja. Jakarta: PT. Toko Gunung Agung; 1996.
16. Setyawati. Selintas Tentang Kelelahan Kerja. Yogyakarta: Asmara Books; 2010.