ORIGINAL ARTICLE

# Modelling the Relationship Between Job Satisfaction, Need for Recovery and Occupational Fatigue Using PLS-SEM Among Malaysian Truck Drivers

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## ABSTRACT

**Introduction:** Fatigue is one of the occupational hazards among truck drivers which can impair drivers' performance and increase fatal accidents. This study aims to investigate the relationship between organizational factors and work-related factors towards occupational fatigue levels among truck drivers in Malaysia. **Materials and methods:** A questionnaire was validated, and one hundred-sixty eight drivers (168) were recruited based on a stratified random sampling method. The job satisfaction survey (JSS) and Need for Recovery (NFR) questionnaire were administered in a Malay-validated form. Structural equation modelling (PLS-SEM) was used to test the hypotheses. **Results:** According to the results, job satisfaction ($p<0.001$) and need for recovery (NFR) ($p<0.05$) were found to be significant factors which influence the occupational fatigue of the truck drivers. **Conclusion:** To summarized, the study identified organizational and work-related factors as the significant contributors factors to occupational fatigue. Therefore, the emphasis on organization and work-related management is essential to reduce fatigue occurrence among truck drivers.
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**Keywords:** Fatigue, Modelling, PLS-SEM, Ttruck drivers, Psychomotor vigilance

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## INTRODUCTION

The logistics industry is developing rapidly at an unprecedented pace and like other industries it needs to confront immense change. The Malaysian logistics sector contributed 3.8% to the country's gross domestic product (GDP) in 2019, and the government initiative aims to increase the GDP contribution of logistics services to 8.9% in 2020. Since then, the global logistics industry has become increasingly complex and has major implications for occupational health and safety issues in the logistics and transport sector (1). There are ranging of workplace hazards in the logistics industry including driving accidents (2), excessive daytime sleepiness (3), musculoskeletal disorder (4), stress (5) as well as fatigue (6).

Fatigue is a state of feeling tired, weary or sleepy resulting from insufficient sleep or prolonged mental or physical work which reduces attention, perceptions, decision-making, and operational capabilities. Driver fatigue is the effect of sleep deprivation, exertion, and the consequences of fatigue due to individual, work-related, and environmental factors (7). Fatigue is a serious problem in the transport sector, including the logistics industry. The job description of truck drivers, who must cover long distances with less sleep and monotonous journeys causes the truck drivers' fatigue. Driver fatigue was significantly associated with sleep deprivation, part-time job, and extended driving hours (8), work pressure (9), older age and poor health status (10). Apart from that, previous researchers highlighted other factors that contribute to driving fatigue such as driving experience (11), time of driving (12) and alertness level (13,14).

The logistics industry that includes road transportation dealing with freight management and product movement within the supply chain imposes some features of driver's fatigue such as working long hours with less sleep and long duration spent on monotonous tasks. Driving fatigue arises from two categories; first is caused by driving itself, especially during long working hours identified as "time-to-task" fatigue, meanwhile, fatigue arises from other sources such as sleep loss, circadian rhythm disruption, and other work performed before driving mostly known as "carry-over" fatigue (15).

Organizational factors can impact truck drivers' fatigue either directly or indirectly including the size of the company, regulations and enforcements, nature of work, safety culture, safety management system (SMS), supervision, remuneration practices as well as knowledge about the fatigue. Organizational components that influence the work environment and help or hinder employees in getting the most out of their jobs are known as organizational job satisfaction factors (16).

In this study, a job satisfaction survey (JSS) was used to assess the organizational factors of truck drivers' attitudes towards parameters such as pay, promotion, supervision, operation procedure, nature of work, and communication. Job satisfaction is defined as a pleasant or positive emotional state resulting from the evaluation of one's work or work experience. Low job satisfaction arises among truck drivers due to monotonous or stressful work, lack of supervision and organizational support and leads to work-related stress including job strain, social support, and effort-reward imbalance. Similarly, fatigue is the mechanism that links other types of stress-related fatigue. Job satisfaction in the transport sector was significantly associated with several crashes and monetary losses (19). Several studies on job satisfaction and fatigue have been carried out both domestically and abroad; however, limited study involving truck drivers has been done in Malaysia. In Malaysia, job satisfaction has been examined among manufacturing employees discovered three factors that contributed to to high job satisfaction factors including compensation and reward ($p<0.001$), training and education ($p<0.05$) and work-life balance ($p<0.001$) (18). Apart from that, low job satisfaction and fatigue subsequently contribute to the burnout syndrome, which occurs in response to work stress. Recent study by Amoei and Zeverdegani revealed that job satisfaction score among drivers significantly associated with rest hours, exercise hours and salary, meanwhile professional drivers in Spain found that the most influential variables between job satisfaction and psychosocial factors were work development, company integration, social relations, esteem and level of psychosocial demands (19).

It has been agreed that work factors influence the development of fatigue among drivers. The nature of work as a truck drivers that involved driving, shifting activities, monotonous driving and environmental interaction induced work fatigue and primarily experienced after a day work. Sluiter and colleagues, 2001 reported that the need for recovery was one of the indicators of health complaints among workers (20). A previous study showed that truck drivers who work more than five hours have a higher need for recovery as compared to other driving durations in a such way that time on task has a greater influence on the level of fatigue among the drivers (21). Need for recovery (NFR), on the other hand was used to assess work-induced fatigue and the quality of recovery time of workers using the Effort Recovery Model method which explains the effects of overload on workers, which are strongly influenced by individual and work-related factors (22). NFR was efficient in detecting the effect of the increase in working hours and predictor of work fatigue.

Fatigue modelling in the transportation industry has been examined extensively, however, less is known regarding driving fatigue modelling in Malaysia. A comprehensive and strategically searched using PubMed, ScienceDirect and SCOPUS engine managed to find several articles regarding driving fatigue modelling restricted to psychophysical factors (389), and work factors (1763). The current study aims to make up for the lack of empirical research on the effect of job satisfaction levels and the need for recovery (NFR) towards occupational fatigue in the context of the logistics industry in Malaysia. Structural equation modelling partial least square (PLS-SEM) was employed for model development in this study. The following hypotheses were established based on the above discussion to study the relationship among organizational factors, work-related factors, and occupational fatigue. Figure 1 illustrates the hypothesized conceptual model.

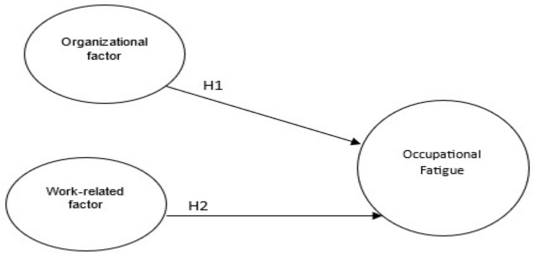


**Figure 1: The Hypothesized Conceptual Model**

Hypothesis 1: There is a significant association between organisational factors and occupational fatigue
Hypothesis 2: There is a significant association between work-related factors and occupational fatigue

## MATERIALS AND METHODS

### Study design

A cross-sectional study was conducted among truck drivers in several logistics companies in Malaysia. The questionnaire was adopted and validated, and the data was collected using a stratified sampling technique. This sampling technique was employed as the total population of truck drivers was sampled into subgroups based on work locations (regions) which are the central region, southern region, and northern region. Before conducting this study, ethics approval was obtained from the Ethical Committee of Universiti Putra Malaysia

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**Study variables**

The questionnaire was translated into Malay and pilot-tested among a small group of logistic truck drivers in Selangor, Malaysia (n=16). Respondents were among full-time truck drivers working under a logistics company. Several validated questionnaires were used in this study, such as Job Satisfaction Survey (JSS) to evaluate the organizational factors of the respondents (18). The Malay version of JSS had been validated with Cronbach's alpha (0.86) for reliability (25). Other than that, the Need for Recovery (NFR) questionnaire was used to evaluate the work-related factors had 0.73 of Cronbach's alpha and the Swedish Occupational Fatigue Inventory (SOFI) obtained 0.93 (26). A value of Cronbach's alpha obtained from these three questionnaires was above the satisfactory value of 0.70, indicating a high degree of internal consistency of the scale (27).

The questionnaire contained several parts including demographic information (Part A), organizational data (Part B), work-related data (Part C), and occupational fatigue data (Part D). For demographic information, respondents are required to fill up personal information such as age, gender, education level, smoking status, work experience and working duration. Part B which is organizational data, job satisfaction survey (JSS) questionnaire which contained 36 items was employed, ranging from 1 (strongly disagree) to 6 (strongly agree). The JSS questionnaire was divided into nine subfactors such as pay, promotion, supervisor, fringe benefit, contingent rewards, operational condition, co-workers, nature of work, and communication. The work-related data (Part C) which employed the Need for Recovery (NFR) questionnaire contains 11 dichotomous items and Part D (occupational fatigue) which employed the Swedish Occupational Fatigue Inventory (SOFI) questionnaire that comprised of 20-items used to measure drivers' fatigue and the scale was ranging from 0 (not at all) to 6 (to a very high degree). SOFI questionnaire consists of five subfactors which were lack of energy, physical exertion, physical discomfort, lack of motivation, and sleepiness.

**Participants**

A set of completed questionnaires were distributed to the respondents of the population truck drivers (n=200) in several logistic companies in Malaysia. Fulltime truck drivers who worked for at least 6 months were eligible and truck drivers diagnosed with health problems including sleep disorder were excluded from this study. The questionnaires were distributed manually to the respondents, and they were asked to complete the questionnaire within 20 minutes during their break time with the assistance of the research team. All truck drivers with incomplete questionnaires and missing values on the key study variables were excluded, which reduced the number of respondents to 168. Of these, 168 valid questionnaires were collected, and the response rate was 84% which is acceptable for survey research which was 80% and above (≥80%) (28).

**Questionnaire**

The study utilized a Likert scale containing 67 items in the questionnaire. Table I display the distribution of the study instrument.

**Table I: Distribution of the study instrument**

| Construct | Dimensions | No of items |
|---|---|---|
| Job satisfaction (JS) | Pay (P) | 4 |
| | Promotion (PR) | 4 |
| | Supervisor (SV) | 4 |
| | Fringe benefit (FB) | 4 |
| | Contingent rewards (CF) | 4 |
| | Operational condition (OC) | 4 |
| | Co-workers (CW) | 4 |
| | Nature of work (NoW) | 4 |
| | Communication (C) | 3 |
| Need for recovery (NFR) | - | 4 |
| Occupational fatigue (OF) | Lack of energy (LE) | 4 |
| | Physical exertion (PE) | 4 |
| | Physical discomfort (PD) | 4 |
| | Lack of motivation (LM) | 4 |
| | Sleepiness (SL) | 4 |

Structural Equation Modelling (SEM) is a multivariate method that used to analyze the accuracy of hypotheses and collecting samples concerning a concept and theory. PLS-SEM was choose over covariance-based structural equation modelling (CB-SEM) because its represent a causal-predicitive approach to SEM and the ultimate goal is predicting target construct and estimating models. In addition, PLS-SEM is more flexible when structural model includes many constructs and indicators as well as to better understand of research objectives by given any sample size (29).

PLS-SEM comprised two models which were the structural model (inner model) and measurement model (outer model). Measurement models measure the relationship between variables (subfactors) and latent variables (factors). In the measurement model, there are two important criteria to need to be measured: convergent validity and discriminant validity. Convergent validity is defined as how many correlated items of a latent structure, meanwhile discriminate validity explains how many uncorrelated items of one latent construct to the items of another latent construct.

**Statistical Analysis**

The data was analyzed using SPSS Version 25.0 for demographic data interpretation and SmartPLS Version 3.2.9. The descriptive analysis that comprises Part A (demographic information) was analyzed using SPSS through frequency, percentage, mean score, and standard deviations. To test the research hypothesis 1 and 2, Structural Equation Model Partial Least

Square (PLS-SEM) was employed using the method of SmartPLS software. Smart-PLS was used to confirm the measure of the measurement model and structural models. Two factors included in the present study were organizational factors (job satisfaction) and work factors (Need for Recovery). To assess the multicollinearity, the variance inflation factor (VIF) was applied to test the multicollinearity issue.

## RESULTS

### Individual and Working Information of the Drivers

Table II displays the demographic information of the drivers. This study shows that 98.8% of all drivers in the logistics sector are male as reported by Layne and colleagues stated that transportation and logistics drivers dominated the industry with females making up less than 2% (30). The mean age was 36.37 with more than half (64.9%) aged between 20 and and 39 years old. Most of them completed secondary education (73.2%) and 62.5% were smokers (62.5%). About 73.2% had worked between one and four years, meanwhile, for average working duration per day, 77.3% of the respondents worked between four and eleven hours and the remaining worked 12 hours and above (22.6%).

**Table II: Demographic Information of the Respondents**

| Characteristics | Frequency, n (%) | Mean (SD) |
|---|---|---|
| Gender | | |
| Male | 166 (98.8) | |
| Female | 2 (1.2) | |
| Age | | |
| 20 – 29 | 50 (29.8) | 36.37 (9.53) |
| 30 – 39 | 59 (35.1) | |
| 40 – 49 | 39 (22.9) | |
| ≥50 | 20 (11.9) | |
| Educational level | | |
| Primary | 6 (3.6) | |
| Secondary | 123 (73.2) | |
| Tertiary | 39 (23.2) | |
| Current smoking | | |
| Yes | 105 (62.5) | |
| No | 63 (37.1) | |
| Working experience (years) | | |
| 1 – 4 | 123 (73.2) | |
| ≥ 5 | 45 (26.8) | |
| Average Working duration (hours) | | |
| 4 – 11 | 130 (77.3) | |
| ≥ 12 | 38 (22.6) | |

### Multicollinearity Test

According to Hair and colleagues, researchers should test the multicollinearity before model testing which was very recommended. Multicollinearity was performed to detect if the two or more independent constructs were very much correlated (31). If common indicators exist among the constructs, there will be an issue with multicollinearity. Variance inflation factors (VIF) were used to detect the multicollinearity. To assume there were no multicollinearity issues among the constructs, the value of VIF should be less than five (<5). In the present study, there were no multicollinearity issues as the VIF values were less than five (NFR= 1.016, JS=1.016).

### Assessment of Measurement Model

Cronbach's alpha and composite reliability were used to assess construct reliability, while convergent and discriminant validity were evaluated.

#### *Construct Reliability*

The outer loadings (absolute correction) must be more than 50% (32) meanwhile Henseler, Ringle and Sinkovics highlighted the value must be 0.7 and above (33). Construct-level reliability measured how well all assigned items represented its construct and it was assessed using composite reliability (CR) and Cronbach's alpha (CA) (34). The values of CR and CA must be higher than 0.7 (35). Based on the current study, the latent construct showed that all the outer loading was above the acceptable values as well as CR and CA (Table III).

**Table III: Reliability and Convergence Validity Results**

| Construct | Item | Loading | CA | CR | AVE |
|---|---|---|---|---|---|
| P | P1 | 0.928 | 0.972 | 0.980 | 0.923 |
| | P2 | 0.963 | | | |
| | P3 | 0.991 | | | |
| | P4 | 0.961 | | | |
| PR | PR1 | 0.928 | 0.959 | 0.970 | 0.890 |
| | PR2 | 0.961 | | | |
| | PR3 | 0.929 | | | |
| | PR4 | 0.956 | | | |
| SV | SV1 | 0.919 | 0.844 | 0.903 | 0.711 |
| | SV2 | 0.946 | | | |
| | SV3 | 0.942 | | | |
| | SV4 | 0.568 | | | |
| FB | FB1 | 0.928 | 0.923 | 0.945 | 0.812 |
| | FB2 | 0.885 | | | |
| | FB3 | 0.880 | | | |
| | FB4 | 0.913 | | | |
| CR | CR1 | 0.856 | 0.830 | 0.888 | 0.665 |
| | CR2 | 0.764 | | | |
| | CR3 | 0.883 | | | |
| | CR4 | 0.750 | | | |
| OC | OC1 | 0.960 | 0.966 | 0.975 | 0.907 |
| | OC2 | 0.946 | | | |
| | OC3 | 0.945 | | | |
| | OC4 | 0.957 | | | |
| CW | CW1 | 0.932 | 0.967 | 0.976 | 0.911 |
| | CW2 | 0.958 | | | |
| | CW3 | 0.956 | | | |
| | CW4 | 0.971 | | | |

CONTINUE

**Table III: Reliability and Convergence Validity Results. (CONT.)**

| Construct | Item | Loading | CA | CR | AVE |
|---|---|---|---|---|---|
| NoW | NoW1 | 0.947 | 0.961 | 0.972 | 0.896 |
| | NoW2 | 0.959 | | | |
| | NoW3 | 0.955 | | | |
| | NoW4 | 0.924 | | | |
| C | C1 | 0.968 | 0.925 | 0.953 | 0.870 |
| | C3 | 0.898 | | | |
| | C4 | 0.932 | | | |
| NFR | NFR1 | 0.817 | 0.747 | 0.815 | 0.531 |
| | NFR2 | 0.814 | | | |
| | NFR3 | 0.731 | | | |
| | NFR11 | 0.508 | | | |
| Lack of Energy | LE1 | 0.880 | 0.914 | 0.940 | 0.796 |
| | LE2 | 0.922 | | | |
| | LE3 | 0.928 | | | |
| | LE4 | 0.836 | | | |
| Physical Exertion | PE1 | 0.877 | 0.928 | 0.949 | 0.822 |
| | PE2 | 0.775 | | | |
| | PE3 | 0.929 | | | |
| | PE4 | 0.914 | | | |
| Physical Discomfort | PD1 | 0.900 | 0.897 | 0.929 | 0.767 |
| | PD2 | 0.908 | | | |
| | PD3 | 0.936 | | | |
| | PD4 | 0.881 | | | |
| Lack of Motivation | LM1 | 0.864 | 0.880 | 0.918 | 0.736 |
| | LM2 | 0.890 | | | |
| | LM3 | 0.840 | | | |
| | LM4 | 0.837 | | | |
| Sleepiness | SOFI17 | 0.898 | 0.926 | 0.947 | 0.818 |
| | SOFI18 | 0.912 | | | |
| | SOFI19 | 0.895 | | | |
| | SOFI20 | 0.913 | | | |

### *Convergent Validity*

Convergent validity is a set of observing items that demonstrate the correlation between responses obtained through various measures that represent the same construct. The Average Variance Extracted (AVE) technique was used to indicate the convergent validity (36). Table III showed that AVE for every latent variable was greater than the recommended values of 0.5% which explained that every construct could explain more than half of the variance to its measuring items on average (37).

### *Discriminant Validity*

Discriminant validity was measured to reflect the actual distinctiveness of one construct to another construct. For example, Fornell-Larcker, HTMT and Cross Loadings were among the common approaches to determine the discriminant validity. Fornell-Larcker was the first criterion to determine the discriminant validity where the value of the square root of AVE of one construct must be higher than the value of inter-correlations between the constructs. Table IV showed that the square roots of the AVE of all constructs were bigger than their corresponding inter-correlations.

## Assessment of Structural Model

To validate the structural model, several statistical tests were used including path coefficient (β), predictive relevance ($Q^2$), effect size ($f^2$) and coefficient of determination ($R^2$). After that, causal paths between independent (exogenous) and dependent (endogenous) variables were performed to establish covariance linear relationships.

**Table IV: Discriminant Validity – Fornell and Larcker Criterion**

| Construct | C | CR | CW | FB | LE | LM | NFR | NoW | OC | PD | PE | P | PR | SL | SV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | **0.933** | | | | | | | | | | | | | | |
| CR | 0.740 | **0.815** | | | | | | | | | | | | | |
| CW | 0.534 | 0.499 | **0.954** | | | | | | | | | | | | |
| FB | 0.284 | 0.392 | 0.277 | **0.901** | | | | | | | | | | | |
| LE | -0.153 | -0.387 | -0.216 | -0.130 | **0.892** | | | | | | | | | | |
| LM | -0.119 | -0.245 | -0.218 | -0.235 | 0.588 | **0.858** | | | | | | | | | |
| NFR | -0.205 | -0.137 | -0.065 | 0.026 | 0.260 | 0.151 | **0.729** | | | | | | | | |
| NoW | 0.316 | 0.429 | 0.308 | 0.433 | -0.230 | -0.280 | -0.008 | **0.947** | | | | | | | |
| OC | 0.395 | 0.508 | 0.252 | 0.247 | -0.108 | -0.112 | -0.031 | 0.310 | **0.952** | | | | | | |
| PD | -0.115 | -0.272 | -0.068 | -0.171 | 0.669 | 0.722 | 0.205 | -0.289 | -0.063 | **0.907** | | | | | |
| PE | -0.212 | -0.353 | -0.162 | -0.050 | 0.714 | 0.660 | 0.167 | -0.229 | -0.167 | 0.709 | **0.876** | | | | |
| P | 0.361 | 0.587 | 0.350 | 0.662 | -0.233 | -0.280 | -0.134 | 0.710 | 0.426 | -0.301 | -0.181 | **0.961** | | | |
| PR | 0.343 | 0.479 | 0.392 | 0.665 | -0.189 | -0.255 | -0.169 | 0.472 | 0.302 | -0.196 | -0.132 | 0.773 | **0.944** | | |
| SL | -0.144 | -0.182 | -0.148 | -0.131 | 0.408 | 0.636 | 0.214 | -0.235 | -0.091 | 0.563 | 0.411 | -0.230 | -0.205 | **0.904** | |
| SV | 0.511 | 0.613 | 0.830 | 0.301 | -0.276 | -0.196 | -0.095 | 0.317 | 0.291 | -0.132 | -0.194 | 0.417 | 0.355 | -0.088 | **0.843** |

### *Measuring the Coefficient of Determination Values ($R^2$)*

The $R^2$ measures the model's predictive accuracy because it measures the size of the overall effect and variance described in the structural model's endogenous construct. The result of $R^2$ in this study indicates that the combined two factors of job satisfaction and need for recovery account for 28% of the variance in satisfaction which was considered low. $R^2$ values greater than 25% demonstrate an acceptable prediction level in empirical research and $R^2$ in the present study achieved an acceptable prediction level which is 0.28 (38).

### *Measuring the Effect Size ($f^2$)*

The effect size of the path coefficient between endogenous (dependent) and exogenous (independent) construct was measured using $f^2$. According to Sarstedt and colleagues, values between 0.00 to 0.15 indicate a small effect size, values between 0.15 and 0.35 indicate a medium effect size, and values greater than 0.35 indicate a larger effect size (39). The $f^2$ obtained from this study were 0.057 for NFR and 0.327 for job satisfaction respectively which interprets NFR and JS had a small effect size.

### *Measuring Predictive Relevance ($Q^2$)*

The $Q^2$ is an additional assessment for model fit to observe the predictive capabilities by reproducing the manifest values and estimating parameters. According to the Stone-Geisser indicator, the model must be able to predict the dependent variable items and $Q^2$ also functions as a sample reprocessing method that facilitates the model cross-validation evaluation (40,41). The $Q^2$ criteria suggested that the conceptual model be able to predict the latent structure. A model has a predictive relevance when $Q^2$ is above zero ($Q^2>0$).

Adhering to the blindfolding procedure in PLS, the result showed that the $Q^2$ value for this study is equal to 0.154 for Occupational Fatigue which was greater than zero and confirmed that the predictive relevance of the path model was valid.

### Direct Effect Analysis

The standardized β in the multiple regression analysis is similar to the path coefficient in Smart-PLS. Bootstrapping procedures were performed to estimate the t statistics and confidence intervals since PLS doesn't have any requirements for distribution assumptions. In addition, path analysis or hypothetical relations with each other latent indicator to examine the significant relationship in the inner path model and tested research hypothesis using PLS-SEM.

Table V displays the path coefficients assessment result where there was a significant effect of NFR on occupational fatigue (β=0.202, t=2.801, p=<0.050) and job satisfaction on occupational fatigue (β=-0.302, t=3.959, p=<0.001). Figure 2 illustrates the measurement model test.

**Table V: Path Coefficient Result**

| Path Relationship | Hypothesis | Path Coefficient *(β)* | *t* statistics | *P* Values | Decision |
|---|---|---|---|---|---|
| Need for Recovery → Occupational fatigue | H1 | 0.202 | 3.130 | <0.001 | Supported |
| Job satisfaction→ Occupational fatigue | H2 | -0.483 | 9.068 | 0.002 | Supported |

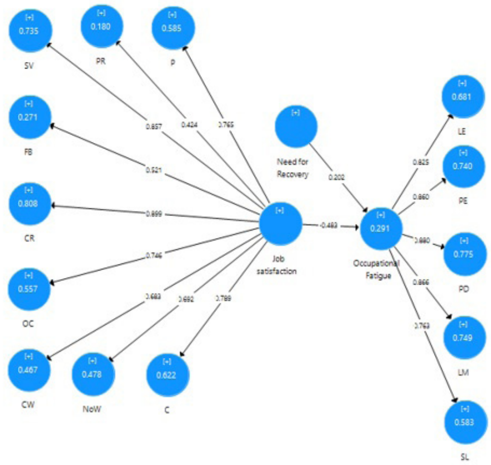


**Figure 2: Measurement model test**

## DISCUSSION

### Hypothesis testing results and discussion

According to the model, there was a significant relationship between organizational factors and occupational fatigue and between work-related factors and occupational fatigue. Frone and Tidwell expressed that employees showed a high level of fatigue in the workplace presenting lower job satisfaction, psychological and physical health and organizational commitment (42). This statement supports the result of the present study that revealed organizational factors significantly associated with occupational fatigue. In addition, extreme fatigue or prolonged mental or physical work reduces employee commitment.

In addition, a previous study has shown that satisfaction with company policy and strategy, satisfaction with supervision, level of remuneration, clarity of tasks and career development significantly reduce the intention to leave (43). Wages and rewards satisfaction has increased the drivers' job performance as well as the greater motivation to do the work. Similar result obtained from previous researchers stated that postivite anticipation effects in job satisfaction when the employee's wage changes exceed the average wage for their reference group (44). Nature of work also plays an important role in determining the job satisfaction level including interior and exterior environments, specific job duties, job facilities and value of work. Due to the nature of work, truck drivers must drive and be alert to their surroundings including traffic signals, prohibited areas, distance between vehicle and sharp steering. The level of fatigue significantly affected the drivers' vigilant, focus and reaction time (24).

Need for recovery (NFR) which quantifies workers' difficulty in recovering from work-related exertions was a parameter measured under work-related factors. Workers who show high levels of NFR have been found an outcome unfavorable working conditions such as long working hours, high job demands, low job control, and increased risk of occupational diseases including cardiovascular disease (45) and musculoskeletal disorder (46) as well as showing a psychological distress (47). Similarly, workers reported having high NFR levels correspond with the upper quartile for those that had the most fatigue.

The NFR assessment of fatigue is based on the Effort-Recovery Model which elucidates the effect of overload on workers through individual and work characteristics. The model further explains that the degree of work control has a major influence on the need for recovery because the level of control determines the workers' chance of recovery (48). Similarly reported by Cristiane and colleagues reported that NFR has shown high scores on the scale associated with accidents in the workplace as well as absenteeism (49). Increasing NFR level controls task behaviors, resulting from preceding mental and/or physical efforts which have become burdensome to such an extent that the workers are no longer able to perform the demands that the job requires on his or her mental functioning. In addition, incomplete recovery also affects the stress response and response of the construction workers (50).

Several limitations can be highlighted in the present study. Firstly, the study was cross-sectional and hence limits the ability to discern the direction of observed associations. Second, a small number of participants does not represent the whole population of truck drivers in Malaysia, a study of a larger and more representative sample is required. Moreover, to improve and enhance the occupational fatigue model, further variables including individual factors as well as psychophysical components must be incorporated.

## CONCLUSION

In summary, fatigue has been found associated with job satisfaction and need for recovery (NFR) among truck drivers. The truck drivers reported high level of fatigue due to the work induced changes in need for recovery, for instance increase in working hours. Higher NFR after working hours increased the risk of sickness absence with the additional stressful working conditions, meanwhile sufficient NFR allow truck drivers to perform their duty effectively by substitute compensation strategies including taking a task breaks or slowing the pace of work. In similar circumstances, increasing job satisfaction level, can prevent the fatigue related work conditions including job strain and low social support. Future studies should consider relevant mediators and moderators to further understand the association between fatigue and contributing factors. Future research also may consider the demographic factors incorporated in the model development for a comprehensive understanding of occupational fatigue and its contributors.

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