Giresun Üniversitesi İktisadi ve İdari Bilimler Dergisi, 2022, 8(1): 98-112
Giresun University Journal of Economics and Administrative Sciences, 2022, 8(1): 98-112
Araştırma Makalesi, DOI: 10.46849/guiibd.1126107

# THE EFFECT OF DRIVER SAFETY PRIORITY ON SLEEPY DRIVING BEHAVIOUR: LINEAR AND NON-LINEAR REGRESSION ANALYSIS

**Yetkili Yazar | Correspondent Author: Karahan KARA**

**Sürücü Emniyet Önceliğinin Uykulu Sürüş Davranışı Üzerindeki Etkisi: Doğrusal ve Doğrusal Olmayan Regresyon Analizi**

**Yazar(lar) | Author(s)**
*Karahan Kara* [1]
*Emre İpekçi* [2]

## ARTICLE INFORMATION

Submission Date : 04/06/2022
Accepted Date : 17/06/2022

**Keywords:**
Driver Safety Priority, Sleepy Driving Behavior, Linear Model, Non-Linear Model, Curve Estimation Models

## ABSTRACT

Driver safety priority is among the factors that affect the sleepy driving behavior of truck drivers. The aim of this paper is to determine the effect of truck drivers' driver safety priority on sleepy driving behavior with linear and non-linear models. Two hypotheses have been developed within the scope of the research. The sample area consists of 399 Turkish truck drivers. Surveys were collected face to face and online between January 2022 and April 2022. The sample area has been determined by simple random method. "Driver safety priority" and "Sleepy driving behavior" scales is used, which is tested for reliability and validity. Simple regression analysis has been performed for the linear model. In the selection of non-linear models, curve estimation models have been tested. The "Power" estimation model has been determined as the best model. According to the research findings, driver safety priority has a negative and significant effect on sleepy driving behavior in both linear and non-linear models. In addition, it has been determined that there is no significant difference between the percentages of explanation of linear and non-linear models. It has also been determined that the coefficient of the driver safety priority of the linear model on sleepy driving behavior is higher than the non-linear model. Based on the empirical findings, implications for both managers and drivers have been presented.

## MAKALE BİLGİSİ

Makale Geliş Tarihi : 04/06/2022
Makale Kabul Tarihi : 17/06/2022

## ÖZ

Tır sürücülerinin uykulu sürücü davranışı oluşumuna etki eden faktörler arasında sürücü emniyet önceliği gelmektedir. Bu ampirik araştırmanın amacı Türkiye'de tır sürücülerinin sürücü emniyet önceliğinin uykulu sürücü davranışı üzerindeki etkisinin doğrusal ve doğrusal olmayan modellerle tespit edilmesidir. Araştırma kapsamında iki hipotez geliştirilmiştir. Araştırmanın örneklem alanını 399 adet Türk tır

[1] Asst.Prof., Artvin Coruh University, Hopa Vocational School, Logistics Program, ORCID No: 0000-0002-1359-0244, e-posta: karahan.kara@artvin.edu.tr
[2] Lecturer, Artvin Coruh University, Hopa Vocational School, Logistics Program, ORCID No: 0000-0002-0389-2089, e-posta: emre.ipekci@artvin.edu.tr

**Anahtar Kelimeler:** Sürücü Emniyet Önceliği, Uykulu Sürüş Davranışı, Doğrusal Model, Doğrusal olmayan Model, Eğri Tahmin Modelleri

sürücüsü oluşturmaktadır. Anketler yüz yüze ve çevrimiçi olarak Ocak 2022-Nisan 2022 tarihleri arasında toplanmıştır. Örneklem alan basit rastgele yöntemle belirlenmiştir. Araştırmada güvenilirliği ve geçerliliği test edilmiş "sürücü emniyet önceliği" ve "uykulu sürüş davranışı" ölçekleri kullanılmıştır. Doğrusal model için basit regresyon analizi yapılmıştır. Doğrusal olmayan model seçiminde eğri tahmin modelleri test edilmiştir. "Power" eğri tahmin modeli en iyi model olarak tespit edilmiştir. Araştırma bulgularına göre hem doğrusal hem de doğrusal olmayan modellerde sürücü emniyet önceliği uykulu sürücü davranışı üzerinde negatif yönde anlamlı bir etkiye sahiptir. Ayrıca doğrusal ve doğrusal olmayan modellere ait açıklama yüzdeleri arasında dikkate değer bir fark olmadığı tespit edilmiştir. Bunun yanı sıra doğrusal modele ait sürücü emniyet önceliğinin uykulu sürücü davranışı üzerindeki etki katsayısının doğrusal olmayan modele göre yüksek olduğu tespit edilmiştir. Araştırma bulgularına dayalı hem yöneticilere hem de sürücülere yönelik çıkarımlar sunulmuştur.

## 1. Introduction

Truck drivers working in irregular and lonely working conditions are the invisible heroes of logistics and transportation activities. However, irregular working conditions prevent truck drivers from fully performing their duties and cause vehicle accidents. In the literature, it is shown that drivers being tired, sleepless, distracted, and exhausted are among the causes of driver-based vehicle accidents (Phillips and Sagberg, 2013; Moradi et al., 2019). Truck vehicle accidents play a major role in accidents resulting in death and injury. The sleepy behavior of truck drivers is among the main reasons for these accidents (Mahajan et al., 2019). There are three basic dimensions that affect the formation of sleepy driver behavior. These are cognitive, psychological, and environmental causes. The cognitive reason is that the truck drivers do not reach the level of consciousness that adopts the importance of regular sleep in increasing the driving success. The psychological reason revolves around the factors that negatively affect the sleep pattern of the truck drivers, whereas the environmental reason is related to the working conditions which are insufficient in terms of safety priority (Wang et al., 2019).

A safety climate should be created by the managers for the truck drivers to adopt the safety priority and transform it into behaviors (Huang et al., 2013). Driver safety priority can only be achieved by establishing a successful safety climate. In environmental conditions where the driving safety priority is not considered, the risk of vehicle accidents increases by not ensuring the sleep patterns of the drivers. In cases where driver safety priority is adopted, it is seen that drivers pay more attention to their sleep patterns and display safe behavior (Shi et al., 2022). At this point, a negative relationship is expected between driver safety priority and sleepy driving behavior. However, it is not clear whether this relationship is linear or non-linear. Therefore, two basic research questions have been developed.

*Research question 1:* Is the relationship between driver safety priority and sleepy driving behavior of truck drivers a negative linear relationship?

*Research question 2:* Is the relationship between driver safety priority and sleepy driving behavior of truck drivers a negative non-linear relationship?

Within the scope of the above research questions, in the second part, the concepts of driver safety priority and sleepy driving behavior are explained, and a literature review is presented. In the third part, the methodology of the research is presented. In the fourth part, the findings of the statistical analyzes are explained (Linear and non-linear). In the last two parts, the conclusions, implications, and limitations are presented.

## 2. Theoretical Background and Literature Review

### 2.1. Driver Safety Priority

Driver safety priority is among the sub-dimensions of the safety climate in the working environment of drivers (Huang et al., 2013). In terms of individual-organization relationship, the safety climate refers to the sum of the feelings and thoughts of the employees (Lee et al., 2019). For employees to work in a safe environment, a successful safety climate must be created by the organization (Cooper and Phillips, 2004). To create a successful driver safety priority, both managers and drivers must exhibit attitudes and behaviors that take driver safety priority into account. Truck drivers' working conditions do not care about the priority of safety due to the pressure of just-in-time delivery. At this point, managers need to make accurate delivery plans.

In the literature, there are studies indicating that managers take the safety priority of truck drivers into consideration at high levels (Chen et al., 2015; Anderson et al., 2017). On the other hand, there are also findings that it is harder to create a safety climate for truck drivers in developing countries, compared to developed countries (Mahajan et al., 2019). These findings explain that perceptions and attitudes towards safety in society have a dominant effect on the determination of safety priorities (Myers et al., 2014). In addition, the differentiation of drivers' attitudes towards tired and sleepy driving is also effective in the driver safety (Meng et al., 2015). In particular, the attitudes of drivers towards risky vehicle use weaken the driver's safety priority and contribute to risky driver behaviors (Watling, 2018). These findings in the literature indicate that driver safety priority play an active role in reducing sleepy driving behavior.

### 2.2. Sleepy Driving Behavior

Since road transportation is used extensively both in domestic and international transportation, trucks are heavily and actively involved in traffic. In this process, driving time restrictions are applied to prevent heavy vehicle drivers from causing traffic accidents due to fatigue and sleeplessness (Bunn et al., 2005, Mahajan et al., 2019). In different studies, it has been determined that truck drivers continue to work despite being sleepy (Spielholz et al., 2008). Road and driving conditions also have a significant effect on sleepiness (Zhang et al., 2016). Truck drivers may continue to drive without rest due to the pressure for on-time delivery, as well as the desire to earn more money or to arrive home early (Crum and Morrow, 2002).

Sleepiness of drivers is among the causes of vehicle accidents and collisions (Schwarz et al., 2019). Radun et al. (2013) argue that the sleepiness goes hand in hand with tiredness and increases the risk of traffic accidents. Driver safety priority is also among the main factors affecting sleepy driving behavior. In this study, it is aimed to determine the effect of driver safety priority on drowsy driving behavior. In addition, the negative effect of driver safety priority on drowsy driving behavior will be determined based on both linear and non-linear relationships.

### 2.3. The Relationship Between Driver Safety Priority and Sleepy Driving Behavior

There are many studies in the literature dealing with the effect of safety climate and driver safety priority on sleepy driving behavior of truck drivers. Anderson et al. (2017) argue that low attention to safety priority increase occupational accidents, especially truck drivers taking an active role in vehicle accidents. Contrary to this finding, there are also findings supporting that truck drivers with high sleep quality attach more importance to driving safety (Lemke et al., 2016). Also, Zohar et al. (2014) found that driver safety climate plays an important role in ensuring safe driving.

Drowsy driving behavior is basically an unsafe driver behavior. Chen et al. (2015) pointed that such an unsafe driving behavior causes vehicle accidents. Low driver safety priority causes sleepy driving behavior as well as sleepy driving causes deterioration of driver safety climate (Gharibi et al., 2020). At this point, it can be mentioned that there is a reciprocal relationship between driver safety priority and sleepy driver behavior. However, no research has been found in the literature on whether the relationship between these two variables is linear or non-linear. In this paper, it is aimed to determine whether the relationship between driver safety priority and sleepy driving behavior is linear or non-linear. Therefore, two hypotheses have been developed. These hypotheses are as follows:

*H1: Driver safety priority has a negative linear impact on sleepy driving behavior.*

*H2: Driver safety priority has a negative non-linear impact on sleepy driving behavior.*

## 3. Methodology

### 3.1. Questionnaire design

"Driver Safety Priority" is among the factors affecting the sleepy driver behavior of truck drivers. Driver safety priority is fundamentally among the building blocks of the safety climate. To make the safety climate measurable, Huang et al. (2013) developed the Safety climate scale. The focus of this research is to determine the effect of driver safety priority on sleepy driving behavior. For this reason, the sub-dimension of the safety climate scale "driver safety priority" has been used in this research. The Driver safety priority scale consists of 4 statements in total. Huang et al. (2013) determined that the reliability level of the scale was high (Cronbach alpha=0.92). In addition, the fit values of the measurement model of the scale are at an acceptable level ($X^2$= 4500.90, df=167, CFI=0.99, TLI=0.99, RMSEA=0.59). Misa et al. (2011) developed the "Sleepy Driving Behavior" scale. The scale consists of 3 statements in total. According to the exploratory factor analysis findings of the scale, factor loads were 0.92, 0.90 and 0.81, respectively. Scale items were prepared in a 5-point Likert format. ("1" never, "5" very often" for Sleepy Driving Behavior; "1" strongly disagree, "5" strongly agree for Driver Safety Priority").

### 3.2. Sampling

This research was carried out in a sample area that is a Turkish citizen and a truck driver in Turkey. Due to the large number of truck drivers, simple random sampling method was used. Truck drivers voluntarily participated in the survey. The questionnaires were applied face to face and online between January 2022 and April 2022. In addition, the ethics committee approval form was obtained from Artvin Coruh University to carry out the data collection process within ethical principles. Among the collected questionnaires, a total of 399 questionnaires were found to be at a successful level. The reasons for not including the questionnaires that were not included in the analysis were: incomplete filling, marking all the answers the same, subjective behavior and some questionnaires being between extreme values.

About 75% of the truck drivers participating in the survey are married, 25% are single, about 18% are truck owners and 82% are only truck drivers. Looking at the age groups, it is seen that the greatest majority is between the ages of 35-55 with approximately 70%. In terms of tenure, it is seen that approximately half of the sample area has less than 10 years of experience and the other half has more than 10 years of experience. The frequency values of the sample area are shown in the Table 1.

**Table 1.** Frequency of the sample

| Truck Ownership | Number | % | Marital Status | Number | % |
|---|---|---|---|---|---|
| Truck Owner | 72 | 18.0 | Married | 303 | 75.9 |
| Truck Driver | 327 | 82.0 | Single | 106 | 24.1 |
| Total | 399 | 100 | Total | 399 | 100 |
| **Tenure** | **Number** | **%** | **Age** | **Number** | **%** |
| 0-5 | 107 | 26.8 | 18-25 | 26 | 6.5 |
| 6-10 | 70 | 17.6 | 26-35 | 79 | 19.7 |
| 11-15 | 84 | 21.1 | 36-45 | 144 | 36.2 |
| 16-20 | 63 | 15.7 | 46-55 | 116 | 29.1 |
| 21+ | 75 | 18.8 | 56+ | 34 | 8.5 |
| Total | 399 | 100 | Total | 399 | 100 |

## 4. Findings

### 4.1. Reliability and validity of the scales

In social science research, it is necessary to determine the normal distribution of the data set collected from the sample area in statistical analyzes based on scales. Kolmogorov-Smirnov normality test is performed to determine whether the sample area has a normal distribution. In addition, the normal distribution interpretation is made according to the kurtosis and skewness values of the variables in the literature. Kolmogorov-Smirnov normality test findings, kurtosis and skewness values of Driver Safety Priority and Sleepy Driving Behavior are presented in the Table 2. Kline (2011:63) explained that for the data set to have a normal distribution, the skewness value should be less than 3 and the kurtosis value should be less than 10. The kurtosis and skewness values of the variables indicate a normal distribution. In addition, the Q-Q plot graphs of the variables are shown in the Figure 1.

**Table 2.** Kolmogorov-Smirnov Normality Test, Skewness, and Kurtosis findings

| Scales | N | Mean | SD | Kolmogorov-Smirnov Z | Asymp. Sig. (2-tailed) | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| Driver Safety Priority (DSP) | 399 | 3.76 | 1.08 | 2.963 | 0.000 | -0.607006 | -0.710608 |
| Sleepy Driving Behavior (SDB) | 399 | 1.29 | 0.44 | 6.104 | 0.000 | 1.898214 | 3.925570 |

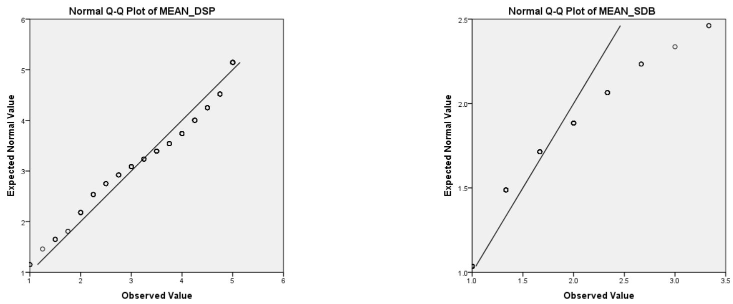


**Figure 1.** Q-Q Plots

Charts

Kaiser Meyer Olkin (KMO) and Bartlett tests should be performed to determine sample adequacy before factor analysis of the scales is performed. As a result of this test, the sample adequacy level should be greater than 0.60 and the significance level of Bartlett's Test of Sphericity should be less than 0.01 (Tabachnick et al., 2007). As seen in the Table 3, both the sample adequacy level ($KMO_{DSP}$=0.734, $KMO_{SDB}$=0.674) and the level of significance ($Sig._{DSP}$=0.000, $Sig._{SDB}$=0.000) are at the desired level. At this point, it is seen that the sample area is sufficient for factor analysis.

**Table 3.** Kaiser Meyer Olkin (KMO) and Bartlett Tests Results of the scales

| | | DSP | SDB |
|---|---|---|---|
| **Kaiser-Meyer-Olkin Measure of Sampling Adequacy.** | | 0.734 | 0.674 |
| **Bartlett's Test of Sphericity** | **Approx. Chi-Square** | 588.387 | 220.889 |
| | **df** | 6 | 3 |
| | **Sig.** | 0.000 | 0.000 |

In scale-based studies, it is common to use scales whose validity and reliability have been tested in the literature. Five basic steps must be carried out for the application of scales in different languages and cultures (Sinaiko and Brislin, 1973). These steps explain how to implement a scale developed in a different language in a different language. In the first step, the English expressions were translated into Turkish. In the second step, the translations were approved by linguists. In the third step, Turkish expressions were translated back into English. In the fourth step, the translations were again approved by linguists. In the fifth step, the semantic integrity was checked by comparing the initial and final sentences of the English expressions. Exploratory factor analysis (EFA) was performed with the SPSS program to determine the basic relationships between the items. The findings obtained are as seen in the Table 4. Factor loads of items are expected to be greater than 0.32 in social science research (Buyukozturk et al., 2016). All expressions have factor loads greater than 0.32. In addition, Average Variance Extracted (AVE) and composite reliability (CR) validity analyzes of the scales were performed. AVE value should be greater than 0.50 and CR value should be greater than 0.60 (Fornell and Larcker, 1981). In addition, the CR value should be higher than the AVE value (Hair et al., 2011). As seen in the Table 4, the AVE and CR values are at the desired level. According to these findings, it was determined that the scales were valid.

**Table 4.** EFA, AVE and CR findings of scales

| Items | Factor Loads | Eigenvalues / Total Variance Percentage | AVE / CR |
|---|---|---|---|
| **DSP2-** "Makes it clear that, regardless of safety, I must pick up/deliver on time." | 0.883 | 2.501 / % 62.532 | 0.625 / 0.866 |
| **DSP3-** "Expects me to sometimes bend safety rules for important customers." | 0.875 | | |
| **DSP4-** "Turns a blind eye when we use hand-held cell phones while driving." | 0.792 | | |
| **DSP1-** "Will overlook log discrepancies if I deliver on time." | 0.574 | | |
| **SDB3-** "I tended keep driving even when I was fighting sleep." | 0.812 | 1.900 / % 63.329 | 0.633 / 0.838 |
| **SDB2-** "How often did you continue driving even when you felt that you may have been too sleepy to drive safely?" | 0.798 | | |
| **SDB1-** "How often did you continue driving when you were experiencing sleepiness instead of taking a break?" | 0.777 | | |

***Note(s):*** Driver Safety Priority (DSP), Sleepy Driving Behavior (SDB). Driver Safety Priority scale items are reverse coded.

After the EFA analysis, confirmatory factor analysis (CFA) was performed to confirm the factor loadings of the scale items. CFA analysis was performed with the AMOS program. CFA findings are presented in the Table 5. Model fit level is high according to CFA measurement model fits (Byrne, 2011). The findings of the scale reliability analysis are also presented in the Table 5. Cronbach's Alpha (α) values of Driver Safety Priority and Sleepy Driving Behavior are 0.798 and 0.783, respectively. The fact that both values are higher than 0.7 indicates that the scales are reliable (Eymen, 2007).

**Table 5.** CFA and Cronbach's Alpha findings of scales

| Parameter Estimates | Estimate | S.E. | Fit Values | Cronbach's Alpha(α) |
|---|---|---|---|---|
| **Measuring Model** | | | | |
| DSP3 <--- DSP | $0.893^{*}$ | 0.074 | $X^2$ [0.8, N=399] = 1, CMIN/df $(0.765)^{**}$, CFI $(1.000)^{***}$, RFI $(0.992)^{***}$, IFI $(1.000)^{***}$, TLI (1.000), NFI $(0.999)^{***}$, RMSA $(0.001)^{******}$ | 0.798 |
| DSP2 <--- DSP | $0.835^{*}$ | 0.072 | | |
| DSP4 <--- DSP | $0.670^{*}$ | 0.068 | | |
| DSP1 <--- DSP | $0.471^{*}$ | 0.059 | | |
| SDB1 <--- SDB | $0.690^{*}$ | 0.035 | $X^2$ [40.7, N=399] = 12, CMIN/df $(3.392)^{*****}$, CFI $(0.968)^{***}$, RFI $(0.922)^{***}$, IFI $(0.968)^{***}$, TLI (0.944), NFI $(0.955)^{***}$, RMSA $(0.078)^{****}$ | 0.783 |
| SDB3 <--- SDB | $0.688^{*}$ | 0.027 | | |
| SDB2 <--- SDB | $0.629^{*}$ | 0.021 | | |

***Note(s):*** $^{*}$ p<0.01, $^{**}$ CMIN/df < 3 (Good fit), $^{***}$ CFI, NFI, RFI, IFI, TLI > 0.90 (Acceptable fit), $^{****}$ 0.05 <RMSA< 0.08 (Acceptable fit), $^{*****}$ 3<CMIN/df < 5 (Acceptable fit), $^{******}$0.00 <RMSA< 0.05 (Good fit).

### 4.2. Linear Regression Findings

The first hypothesis assumes that there is a negative linear relationship between the driver safety priority and sleepy driving behavior of the truck drivers. Simple regression analysis was performed using SPSS to determine the linear relationship between these two variables. The coefficients values are shown in the Table 6. In addition, as a result of the analysis, $R^2$=0.166 and adjusted $R^2$=0.164 values were determined. The linear model is significant (F=78.950, Sig.= 0.000). The final linear regression model is as follows: “SDB=1.919 - 0.407*DSP”. *This finding supports the first hypothesis*.

**Table 6.** Coefficients

| | Model | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 1.919 | 0.073 | | 26.192 | .000 |
| | Driver Safety Priority (DSP) | - 0.166 | 0.019 | - .407 | - 8.885 | .000 |

*Note:* Dependent Variable: Sleepy Driving Behavior

### 4.3. Curve Estimation Models Findings

The second hypothesis assumes that there is a negative non-linear relationship between the driver safety priority of truck drivers and sleepy driver behavior. At this point, using curve estimation models, the model structure that explains the non-linear relationship at the highest level has been determined. The estimation parameters and $R^2$ values of the curve estimation models are presented in the Table 7. The model with the highest disclosure rate was determined as the “Power” model ($R^2$=0.187, Sig.=0.000). However, when the linear model and Non-linear Power model explanation rates were compared, no big difference is observed. Also, as can be seen in the Figure 2, there is a similarity between the curve estimation models. In the next phase of the research, non-linear regression analysis is performed.

**Table 7.** Model Summary and Parameter Estimates

| Equation | Model Summary | | | | | Parameter Estimates | | | |
|---|---|---|---|---|---|---|---|---|---|
| | R Square | F | df1 | df2 | Sig. | Constant | b1 | b2 | b3 |
| Linear | 0.166 | 78.950 | 1 | 397 | .000 | 1.919 | -0.166 | | |
| Logarithmic | 0.173 | 83.205 | 1 | 397 | .000 | 1.961 | -0.525 | | |
| Inverse | 0.170 | 81.112 | 1 | 397 | .000 | 0.893 | 1.331 | | |
| Quadratic | 0.169 | 40.271 | 2 | 396 | .000 | 2.152 | -0.318 | 0.022 | |
| Cubic | 0.174 | 27.722 | 3 | 395 | .000 | 2.789 | -1.020 | 0.255 | -0.024 |
| Compound | 0.185 | 89.821 | 1 | 397 | .000 | 1.892 | 0.893 | | |
| Power | 0.187 | 91.486 | 1 | 397 | .000 | 1.934 | -0.352 | | |
| S | 0.175 | 84.365 | 1 | 397 | .000 | -0.051 | 0.873 | | |
| Growth | 0.185 | 89.821 | 1 | 397 | .000 | 0.638 | -0.113 | | |
| Exponential | 0.185 | 89.821 | 1 | 397 | .000 | 1.892 | -0.113 | | |
| Logistic | 0.185 | 89.821 | 1 | 397 | .000 | .529 | 1.120 | | |

*Note*: The independent variable is Driver Safety Priority. Dependent variable is Sleepy Driving Behavior.


**Figure 2.** Curve Estimation Models Chart

### 4.4. Non-Linear Regression Findings

The model structure with the highest $R^2$ value among the curve estimation model findings is the "Power" model. Therefore, this model was applied for non-linear regression analysis. According to SPSS non-linear analysis findings, a total of 2 models and 3 derivatives resulted in a non-linear model. The final model structure is as follows: "Ln(SDB)=0.637546-0. 113150*DSP". According to the ANOVA test findings of the model, the $R^2$ value was determined as 0.187. The information about the iteration parameters is shown in the Table 8, and the parameter estimates of the non-linear model are shown in the Table 9. According to these findings, *the second hypothesis has been accepted*.

**Table 8.** Iteration History

| Iteration Number | Residual Sum of Squares | Parameter | |
|---|---|---|---|
| | | b0 | b1 |
| 1.0 | 116.008673 | 1.934000 | -0.352000 |
| 1.1 | 26.331256 | 0.637546 | -0.113150 |
| 2.0 | 26.331256 | 0.637546 | -0.113150 |

***Notes:*** Derivatives are calculated numerically. Major iteration number is displayed to the left of the decimal, and minor iteration number is to the right of the decimal. Run stopped after 3 model evaluations and 2 derivative evaluations because the relative reduction between successive parameter estimates is at most PCON = 1.000E-008.

**Table 9.** Parameter Estimates

| Parameter | Estimate | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| b0 | 0.637546 | 0.046735 | 0.545668 | 0.729424 |
| b1 | -0.113150 | 0.011939 | -0.136622 | -0.089679 |

Araştırma Makalesi, DOI: 10.46849/guiibd.1126107

## 5. Conclusion and discussion

In this empirical research, it is aimed to determine the linear and non-linear effects of driver safety priority on sleepy driver behavior. Two main hypotheses were developed in this study. The first hypothesis is to explain the linear relationship whereas the second hypothesis is to explain the non-linear relationship. As a result of the research, both hypotheses are supported. Considering the findings of the first hypothesis, driver safety priority affects sleepy driver behavior in a negative direction linearly. However, it is seen that the percentage of explanation of the established research model is low (adjusted R2=0.164). This finding is in parallel with the results obtained in the literature (Bosak et al., 2013; Chen et al., 2015; Anderson et al., 2017; Lemke et al., 2021).

In testing the second hypothesis, the model structure with the highest percentage of explanation among curve estimation models is determined. The "Power" estimation model has the highest percentage of explanation. The "Power" model was applied as a non-linear model. Driver safety priority affects drowsy driver behavior in a non-linear way in a negatively. As with the linear relationship, the percentage of explanation of the non-linear research model is low (adjusted $R^2$=0.187). Although both hypotheses are accepted, when the effects of the independent variable (driver safety priority) on the dependent variable (sleepy driver behavior) are compared; the effect level of the independent variable in the linear model (Beta: 0.407) is higher than the effect level of the independent variable in the non-linear model (Beta: 0.113150).

Finally, it has been proven with both linear and non-linear relationship models that the driving safety priority perceptions of truck drivers working in Turkey have a negative and significant effect on drowsy driving behaviors.

## 6. Implication and limitation

Driver failures are among the main causes of truck accidents that usually result in death and injury in Turkey. Causes of driver errors include sleepy driver behavior. Drowsy driving behavior cause risky driving. The sleepy driver behavior, on the other hand, is due to the insufficient level of driver safety priority. In this context, the implications for reducing sleepy driver behavior of truck drivers are as follows: (i) Truck drivers should adopt the priority of driver safety and exhibit behaviors and attitudes accordingly. (ii) Managers should not put pressure on truck drivers for just-in-time delivery and should prepare accurate delivery schedules, considering the working conditions of truck drivers lonely. (iii) Employee-organization compliance should be based on a driver safety priority. (iv) Truck drivers should make a regular sleep plan for a safe driving environment and act according to this sleep plan. (v) Considering that driver safety priority affects sleepy driving behavior linearly, it should be adopted by both managers and drivers that increasing driver safety priority will increase sleepy driving behavior. (v) While driver safety priority affects sleepy driving behavior linearly, it should be adopted by both managers and drivers that increasing driver safety priority increase sleepy driving behavior.

The limitations of this empirical research are as follows: (i) Research method is based on survey and subjective evaluations. (ii) Sampling site selection was determined by simple random sampling method. (iii) Only data of Turkish drivers were used in the study. In addition, the attitudes of truck drivers in Turkey towards driver safety priority and sleepy driving behavior is determined and has been introduced to the literature. The most important contribution of the research to the literature is that the relationship between driver safety priority and sleepy driving behavior can be explained with both linear and non-linear relationship models. Researchers can examine the relationship between driver safety priority and sleepy driving behavior in other countries. By comparing the results to be obtained, the effects in different cultures and languages can be brought to the literature.

**References**

Anderson, N. J., Smith, C. K. & Byrd, J. L. (2017). "Work-related injury factors and safety climate perception in truck drivers". *American Journal of Industrial Medicine*, 60 (8), 711-723. https://doi.org/10.1002/ajim.22737.

Bosak, J., Coetsee, W. J. & Cullinane, S. J. (2013). "Safety climate dimensions as predictors for risk behavior". *Accident Analysis & Prevention,* 55, 256-264. https://doi.org/10.1016/j.aap.2013.02.022.

Bunn, T. L., Slavova, S., Struttmann, T. W. & Browning, S. R. (2005). "Sleepiness/fatigue and distraction/inattention as factors for fatal versus nonfatal commercial motor vehicle driver injuries". *Accident Analysis & Prevention*, *37*(5), 862-869.

Buyukozturk, S. Cakmak, E. K., Akgun, O. E, Karadeniz, S. & Demirel, F. (2016). *Bilimsel arastirma yontemleri*. Ankara, Turkey: Pegem Akademi.

Byrne, B. M. (2011). *Structural equation modeling with Mplus: Basic concepts, applications, and programming*. Routledge. https://doi.org/10.4324/9780203807644.

Chen, G. X., Sieber, W. K., Lincoln, J. E., Birdsey, J., Hitchcock, E. M., Nakata, A. & Sweeney, M. H., (2015). "NIOSH national survey of long-haul truck drivers: injury and safety". *Accident Analysis & Prevention*, 85, 66-72. https://doi.org/10.1016/j.aap.2015.09.001.

Cooper, M. D. & Phillips, R. A. (2004). "Exploratory analysis of the safety climate and safety behavior relationship". *Journal of safety research*, 35 (5), 497-512. https://doi.org/10.1016/j.jsr.2004.08.004.

Crum, M. R. & Morrow, P. C. (2002). "The influence of carrier scheduling practices on truck driver fatigue". *Transportation Journal*, *42*(1), 20.

Eymen, E. (2007). *SPSS Veri Analizi Yöntemleri (1st ed.),* İstatistik Merkezi, Ankara.

Fornell, C. & Larcker, D. F. (1981). "Evaluating structural equation models with unobservable variables and measurement error". *Journal of Marketing Research*, *18*(1), 39-50.

Gharibi, V., Mokarami, H., Cousins, R., Jahangiri, M. & Eskandari, D. (2020). "Excessive daytime sleepiness and safety performance: comparing proactive and reactive approaches". *The International Journal of Occupational and Environmental Medicine*, 11 (2), 95. https://doi.org/10.34172/ijoem.2020.1872.

Hair, J. F., Ringle, C. M. & Sarstedt, M. (2011). "PLS-SEM: Indeed a silver bullet". *Journal of Marketing Theory and Practice*, 19 (2), 139-152. https://doi.org/10.2753/MTP1069-6679190202.

Huang, Y. H., Zohar, D., Robertson, M. M., Garabet, A., Lee, J. & Murphy, L. A. (2013). "Development and validation of safety climate scales for lone workers using truck drivers as exemplar". *Transportation Research Part F: Traffic Psychology And Behaviour*, 17, 5-19. http://dx.doi.org/10.1016/j.trf.2012.08.011.

Kline, R. B. (2011). *Principles and practice of structural equation modelling (3rd ed.).* New York, Guilford press.

Lee, J., Huang, Y. H., Sinclair, R. R. & Cheung, J. H. (2019). "Outcomes of safety climate in trucking: A longitudinal framework". *Journal of Business and Psychology*, 34 (6), 865-878. https://doi.org/10.1007/s10869-018-9610-5.

Lemke, M. K., Apostolopoulos, Y., Hege, A., Sönmez, S. & Wideman, L. (2016). "Understanding the role of sleep quality and sleep duration in commercial driving safety". *Accident Analysis & Prevention*, 97, 79-86. https://doi.org/10.1016/j.aap.2016.08.024.

Lemke, M. K., Hege, A., Apostolopoulos, Y. & Sönmez, S. (2021). "Hours-of-service compliance and safety outcomes among long-haul truck drivers". *Transportation Research Part F: Traffic Psychology And Behaviour*, 76, 297-308. https://doi.org/10.1016/j.trf.2020.11.017.

Mahajan, K., Velaga, N. R., Kumar, A. & Choudhary, P. (2019). “Effects of driver sleepiness and fatigue on violations among truck drivers in India”. *International Journal of İnjury Control and Safety Promotion*, 26 (4), 412-422. https://doi.org/10.1080/17457300.2019.1660375.

Meng, F., Li, S., Cao, L., Li, M., Peng, Q., Wang, C. & Zhang, W. (2015). “Driving fatigue in professional drivers: a survey of truck and taxi drivers”. *Traffic Injury Prevention*, 16(5), 474-483. https://doi.org/10.1080/15389588.2014.973945.

Misa, R., Conduit, R. & Coleman, G. (2011). “Sleepy driving in truck drivers: Insights from a self-report survey”. *In Proceedings of the 47th Annual Conference Human Factors and Ergonomics Society of Australia* (HFESA 2011) (pp. 1-8). RMIT University.

Moradi, A., Nazari, S. S. H. & Rahmani, K. (2019). “Sleepiness and the risk of road traffic accidents: A systematic review and meta-analysis of previous studies”. *Transportation Research Part F: Traffic Psychology And Behaviour*, 65, 620-629. https://doi.org/10.1016/j.trf.2018.09.013.

Myers, D. J., Nyce, J. M. & Dekker, S. W. (2014). “Setting culture apart: Distinguishing culture from behavior and social structure in safety and injury research”. *Accident Analysis & Prevention*, 68, 25-29. https://doi.org/10.1016/j.aap.2013.12.010.

Phillips, R. O. & Sagberg, F. (2013). “Road accidents caused by sleepy drivers: Update of a Norwegian survey”. *Accident Analysis & Prevention,* 50, 138-146. http://dx.doi.org/10.1016/j.aap.2012.04.003.

Radun, I., Ohisalo, J., Radun, J., Wahde, M. & Kecklund, G. (2013). “Driver fatigue and the law from the perspective of police officers and prosecutors”. *Transportation Research Part F: Traffic Psychology And Behaviour*, 18, 159-167. https://doi.org/10.1016/j.trf.2013.01.001.

Schwarz, C., Gaspar, J., Miller, T. & Yousefian, R. (2019). “The detection of drowsiness using a driver monitoring system”. *Traffic Injury Prevention*, 20(sup1), S157-S161. https://doi.org/10.1080/15389588.2019.1622005.

Shi, B., He, Y., Lee, J., Huang, Y. H. & Li, Y. (2022). “Safety climate profiles in remote workers: Association with key predictors and outcomes at the team level”. *Safety Science*, 145, 105477. https://doi.org/10.1016/j.ssci.2021.105477.

Sinaiko, H. W. & Brislin, R. W. (1973). “Evaluating language translations: Experiments on three assessment methods”. *Journal of Applied Psychology*, *57*(3), 328.

Spielholz, P., Cullen, J., Smith, C., Howard, N., Silverstein, B. & Bonauto, D. (2008). "Assessment of perceived injury risks and priorities among truck drivers and trucking companies in Washington State". *Journal of Safety Research*, *39*(6), 569-576.

Tabachnick, B. G., Fidell, L. S. & Ullman, J. B. (2007). *Using multivariate statistics* (Vol. 5, pp. 481-498). Boston, MA: Pearson.

Wang, Y., Li, L. & Prato, C. G., (2019). "The relation between working conditions, aberrant driving behaviour and crash propensity among taxi drivers in China". *Accident Analysis & Prevention*, 126, 17-24. https://doi.org/10.1016/j.aap.2018.03.028.

Watling, C. N. (2018). "Drivers' perceived legitimacy of enforcement practices for sleep-related crashes: What are the associated factors?". *Journal of Forensic and Legal Medicine*, 54, 34-38. https://doi.org/10.1016/j.jflm.2017.12.005.

Zhang, G., Yau, K. K., Zhang, X. & Li, Y. (2016). "Traffic accidents involving fatigue driving and their extent of casualties". *Accident Analysis & Prevention*, *87*, 34-42.

Zohar, D., Huang, Y. H., Lee, J. & Robertson, M. (2014). A mediation model linking dispatcher leadership and work ownership with safety climate as predictors of truck driver safety performance. *Accident Analysis & Prevention*, *62*, 17-25. https://doi.org/10.1016/j.aap.2013.09.005.