Identifying Variables That Predict Falling Asleep at the Wheel Among Long-Haul Truck Drivers

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RESEARCH ABSTRACT

Analysis of data from 843 long-haul truck drivers was conducted to determine the variables that predicted falling asleep at the wheel. Demographics, sleep-specific questions, and the Epworth Sleepiness Scale were used for analysis. More than 25% of the participants ($n = 247$) scored 10 or higher on the Epworth Sleepiness Scale, indicating chronic sleepiness. Eight initial predictor variables were included in the logistic regression analysis. Four of the eight original variables were retained in the final model to predict falling asleep at the wheel within the past 12 months. Four variables were retained in the final model to predict falling asleep at the wheel within the past 30 days. Screening for excessive sleepiness using the Epworth Sleepiness Scale and an extensive history of medication use should be conducted for all long-haul truck drivers.

The purpose of this study was to identify factors that predict the probability of long-haul truck drivers falling asleep at the wheel. Almost 3 million truckers share highways with other vehicle occupants in the United States (Bureau of Labor Statistics [BLS], 2006). Sleep-related motor vehicle crashes involving truck drivers are often fatal to the truck drivers as well as the occupants of other involved vehicles (Federal Motor Carrier Safety Administration [FMCSA], 2002). Cognitive processes critical to driving have been found to fail in sleep-impaired drivers (Dement, 1999; Van Dongen, Maislin, Mullington, & Dinges, 2003). An exploration of factors that contribute to falling asleep at the wheel could assist health care providers to develop healthy sleep-promoting strategies among long-haul truckers and prevent vehicular crashes.

BACKGROUND

Long-Haul Trucking

Long-haul truckers often work irregular and unpredictable schedules (Ouellet, 1994; Renner, 1998). Truck drivers may organize their work to meet the needs of customers, resulting in fragmented and erratic schedules (Ouellet). These schedules place truck drivers at risk for sleep disruption and deprivation; associated decreased alertness and reaction times may lead to catastrophic vehicular crashes (Hanowski, Hickman, Fumero, Olson, & Dingus, 2007).

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Motor Vehicle Crashes and Truck Drivers

Between the years 2001 and 2005, approximately 5,200 trucks were involved in fatal crashes each year. In the 3-year period between 2002 and 2005, the number of truck drivers killed in motor vehicle crashes increased from 664 to 778 (Mattson, Jarossi, & Woodrooffe, 2008). BLS (2006) projects truck driving jobs to increase through 2013 because of economic growth and continuing demand for delivery of goods. As the numbers of truck drivers and miles driven increase (exposure), the rates of motor vehicle accidents involving truck drivers could also be expected to increase.

Previous Research

Working irregular schedules and driving at night were found to contribute to falling asleep at the wheel in studies of Finnish truckers and bus drivers ($N = 560$) (Hakkanen & Summala, 2000) and American truck drivers (Abrams, Schultz, & Wylie, 1997). Hakkanen and

Applying Research to Practice

Long-haul truck drivers are at risk for occupational motor vehicle crashes. This study identified several variables that may predict increased risk for falling asleep at the wheel: excess sleepiness as measured by the Epworth Sleepiness Scale, night driving, sleeping less than 6 hours per night, working 13 hours or more in 24 hours, and taking medications for sleep or to maintain wakefulness. Occupational health nurses can use these findings to screen and educate truck drivers and to advocate for working conditions and policies that will improve the health and safety of these workers.

Summala also found a significant relationship between length of driving time and falling asleep at the wheel. Compared to driving 6 hours, driving 14 to 16 hours and 17 or more hours per day significantly increased the risk of falling asleep at the wheel (odds ratio [OR] = 2.80, p = .05; OR = 3.42, $p < .05$).

Drivers who slept less than 6 hours prior to a trip experienced significantly more episodes of "hazardous events" during the trip, including "nodding off," compared to those drivers who slept longer than 6 hours ($\chi^2 = 8.52$; $df = 2$; $p = .01$). Although drivers who slept less were only 20% of the study sample ($N = 638$), they experienced 40% of the hazardous events reported (Arnold et al., 1997).

Truckers who drive without a driving partner (solo) may also be at greater risk for falling asleep at the wheel than team drivers. In a study of 30 solo drivers and 13 teams, Dingus et al. (2002) found a significant difference in rates of critical driving incidents (e.g., lane deviation, hard braking, abrupt steering maneuvers, following too closely, drowsiness, and changing lanes with a vehicle in the adjacent lane) between the two groups ($F = 8.49$; $df = 1$; $p < .01$). Four of the 24 critical incidents observed in the study were associated with "extreme" fatigue as evidenced by videotaped driver head-bobbing (Dingus et al.).

The current study used a logistic regression modeling approach to evaluate the predictive value of the independent variables, subjective sleepiness, night driving duration, duration of work hours, sleep duration, solo versus team driving, years of experience, and use of medication for sleeping and waking, for the dependent variable, falling asleep at the wheel.

METHODS

Design

Data analyzed for this study were a subset of the survey data from a study entitled Risks for Workplace Violence in Long-Haul Truckers (Anderson, 2002).

Sample

After informed consent was secured from participants by research team members, survey data were collected from a convenience sample of 843 long-haul truck drivers at trade shows across the United States (Iowa, Kentucky, and Texas) and truck stops in Kentucky during 2003 and 2004.

Measures

Items used in the analysis included demographics and answers to questions related to sleep and work practices. Participants were asked to quantify hours of sleep, work time, and nighttime driving they typically experienced in 24 hours; whether they drove with a driving partner or took medications to stay awake or to sleep; and how often they had fallen asleep at the wheel within the previous 30 days and 12 months. Eight of the survey items included the individual components of the Epworth Sleepiness Scale (ESS), presented in a 4-point Likert scale format. Each of the individual components of the ESS was scored on a scale of 0 to 3 and summed for a total score ranging from 0 to 24. This instrument measures sleep propensity, or the likelihood of falling asleep under various conditions (Johns, 1991). The ESS has been used extensively in clinical and research settings as a proxy measure of excessive sleepiness at scores of 10 or higher (Chervin & Aldrich, 1999; Davies, Rodgers, Walshaw, James, & Gibson, 2003; Fong, Ho, & Wing, 2005; Kingshott et al., 2001; Parker, Kutner, Bliwise, Bailey, & Rye, 2003; Pilcher, Pury, & Muth, 2003; Watanabe, Matsuura, Sano, Matsuda, & Kojima, 2003). In the original study, questions related to sleepiness were included because truck drivers are considered an at-risk population for sleep restriction and the research team wanted to explore the relationship between sleep and workplace violence.

Procedures

The Statistical Package for the Social Sciences (SPSS), version 12.0, was used in the data analysis. Initially, descriptive statistics were run on the demographic data. ESS scores were computed for each truck driver based on the sums of ratings on each of the eight items (Johns, 1991). To calculate ORs, Likert scale data were transformed into bivariate data. ESS scores were transformed into sleepy "yes" or "no" based on individual scores. Because the reference range for the ESS is 0 to 10 (Johns, 1991, 2000; Johns & Hocking, 1997), a cutpoint of 10 was set so that participants scoring greater than 10 on the ESS were designated "sleepy." Self-reported numbers of years of experience as a long-haul trucker were transformed into quintiles for inclusion in the logistic regression analysis. Based on the review of the literature, cutpoints for night driving duration and sleep duration were set at 6 hours.

Duration of night driving exceeding 6 hours was considered an exposure (Abrams et al., 1997; McCartt, Rohrbaugh, Hammer, & Fuller, 2000; Stutts, Wilkins, Scott-Osberg, & Vaughan, 2003). Duration of sleep up to 6 hours was also considered an exposure (Stutts et al.; Van Dongen et al., 2003). Duration of driving of 13 or more hours in 24 hours was coded into bivariate data. The cutpoint of 13 hours reflects a state of wakefulness past the typical 12-hour midpoint of a 24-hour human circadian cycle (Czeisler & Gooley, 2007). Cross-tabulation

Table 1

Distribution of Demographics of the Long-Haul Truck Drivers (*N* = 843)

	N	%
Gender		
Male	677	80.3
Female	166	19.7
Marital status		
Married	542	64
Single	119	14
Divorced	129	15
Other	38	5
Missing	15	2
Education		
< 12th grade	98	12
High school/general equivalency diploma	355	42
> 12th grade	377	44
Missing	13	2
Annual income		
⩽ $35,000	121	14
$35,001–$55,000	270	32
$55,001–$75,000	194	23
$75,001–$100,000	102	12
> $100,000	135	16
Missing	21	3
Race		
White	749	89
Black	54	6
Other	30	4
Missing	10	1
Employer		
Company	452	54
Independent	386	46

procedures were conducted among bivariate variables to determine ORs and confidence intervals (CIs). Categorical variables were coded as binary dummy variables in analysis. Logistic regression analysis was used to identify a best predictive model for the probability of falling asleep at the wheel within the past 12 months and within the past 30 days. Predictors for falling asleep at the wheel for both time frames were investigated in an attempt to capture both patterns of activity within the previous 12 months and random or sentinel events in the more recent timespan of 30 days.

Eight predictor variables were included in the initial model. Backward elimination was used to determine the final model. This strategy was chosen to achieve a parsimonious model with a small set of variables that would yield an optimum model fit. Post hoc Hosmer-Lemeshow goodness-of-fit testing was conducted to determine how well the final model fit the data set (Bagley, White, & Golomb, 2001; Hosmer, Taber, & Lemeshow, 1991).

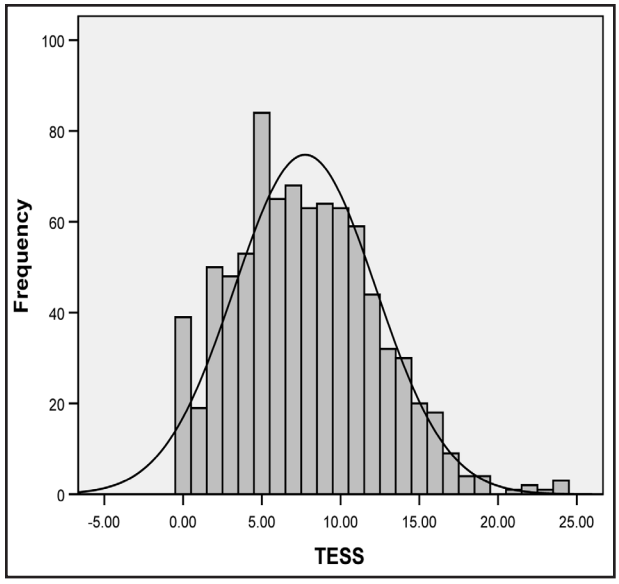

Figure. Distribution of total Epworth Sleepiness Scale scores (TESS) for the long-haul truckers (*M* = 7.7497, *SD* = 4.49811, *N* = 843).

RESULTS

Descriptive Statistics

Sample characteristics are summarized in Table 1. Participants were primarily White, married, and male with at least a high school education.

The sample was fairly evenly divided between truck drivers employed by trucking companies and independent truckers. Participants' truck driving experience ranged from 6 months to 50 years. The Figure shows the distribution of ESS scores across the sample. Although the mean ESS score for the group was 7.75, 29.3% (n = 247) scored 10 or higher, indicating chronic sleepiness. Falling asleep at the wheel within 12 months and 30 days occurred in 8.5% (n = 72) and 5.3% (n = 45) of the sample, respectively.

Bivariate Risk Analysis

Falling Asleep Within the Past 12 Months. In this sample, the truckers with an ESS score of greater than 10 were 2.61 (95% CI = 1.60 to 4.25) times more likely to have fallen asleep at the wheel within the past 12 months compared to the truckers with an ESS score of 10 or lower. Driving more than 6 hours at night increased the probability of having fallen asleep at the wheel within the past 12 months to 3.51 (95% CI = 1.26 to 9.80) times that of truckers who did not drive more than 6 hours at night. Working 13 hours or more in a 24-hour period more than doubled the probability of having fallen asleep

Table 2

Odds Ratios and Confidence Intervals for Having Fallen Asleep at the Wheel Within the Past 12 Months and 30 Days—Bivariate Analysis

	12 Months		*30 Days*	
Variable	***OR***	***95% CI***	***OR***	***95% CI***
Sleepy	2.61	1.60–4.25*	3.05	1.65–5.64*
Night driving	3.51	1.26–9.80*	4.34	1.04–18.13*
Work duration	2.13	1.26–3.62*	2.46	1.30–4.66*
Sleep duration	2.99	1.78–5.00*	2.43	1.30–4.54*
Medications for wake	3.50	1.89–6.50*	4.97	2.47–9.98*
Partner	1.05	0.64–1.71	1.30	0.71–2.37
Medications for sleep	1.91	0.96–3.82	2.30	1.03–5.14*

Note. *OR = odds ratio; CI = confidence interval. *p < .05.*

at the wheel within the past 12 months (OR = 2.13; 95% CI = 1.26 to 3.62). Truck drivers who reported sleeping 6 hours or less were almost 3 times more likely to have fallen asleep at the wheel within the past 12 months compared to truck drivers who slept 7 hours or more per night (OR = 2.99; 95% CI = 1.78 to 5.00). Use of medication to sleep was not found to increase the probability of having fallen asleep at the wheel within the past 12 months (OR = 1.91; 95% CI = 0.96 to 3.82). In contrast, truck drivers who used medication to stay awake were 3.5 times more likely to have fallen asleep at the wheel within the past 12 months (95% CI = 1.89 to 6.50) compared to truckers who did not use medication to stay awake. Driving with a partner did not affect the probability of having fallen asleep at the wheel within the past 12 months (OR = 1.05; 95% CI = 0.64 to 1.71) (Table 2).

Falling Asleep Within the Past 30 Days. An ESS score of greater than 10 also predicted increased probability for having fallen asleep at the wheel within the previous 30 days. Truckers with an ESS score greater than 10 were 3 times more likely to have fallen asleep at the wheel within the past 30 days compared to truckers with an ESS score of 10 or less (OR = 3.05; 95% CI = 1.65 to 5.64). Nighttime driving duration of greater than 6 hours quadrupled the probability of having fallen asleep at the wheel within the past 30 days compared to truckers who drove less than 6 hours at night (OR = 4.34; 95% CI = 1.04 to 18.13). Truck drivers who reported working more than 13 hours in a 24-hour period had almost 2.5 times the probability of having fallen asleep at the wheel within the past 30 days compared to truck drivers who worked less than 13 hours in a 24-hour period (OR = 2.46; 95% CI = 1.30 to 4.66). The use of medications to either maintain wakefulness or facilitate sleep significantly increased the probability of having fallen asleep at the wheel within the past 30 days. Truckers who used medications to maintain wakefulness were almost 5 times more likely to have fallen asleep at the wheel within the past 30 days than truckers who did not use medications to maintain wakefulness (OR = 4.97; 95% CI = 2.47 to 9.98). The probability of having fallen asleep within the past 30 days was more than doubled in truck drivers who used medications to facilitate sleep, compared to truck drivers who did not use medications to facilitate sleep (OR = 2.30; 95% CI = 1.03 to 5.14) (Table 2).

Logistic Regression Analysis

Eight predictor variables were included in the initial logistic regression model: subjective sleepiness, night driving duration, duration of work hours, sleep duration, solo versus team driving, years of experience, and use of medication for sleep and wakefulness. Backward elimination was used to determine the set of variables that best predicted falling asleep at the wheel for long-haul truckers during the past 12 months and 30 days. Four of the original eight variables were retained in the final predictive models. Table 3 presents the final models in the logistic regression analysis. In the final predictive models, drivers who were chronically sleepy were 2.14 to 2.69 times more likely to have fallen asleep at the wheel within the past 12 months and 30 days (95% CI = 1.29 to 3.60 and 1.42 to 5.10, respectively) compared to drivers with ESS scores of 10 or less. Truck drivers who reported driving more than 6 hours at night were 3 times more likely to have fallen asleep at the wheel within the past 12 months compared to truck drivers who reported driving less than 6 hours at night (95% CI = 1.09 to 8.72). More than double the probability of having fallen asleep at the wheel within the previous 12 months was associated with truckers who slept less than 6 hours per night, compared to truckers who slept more than 6 hours per night. Truck drivers who used medications to stay awake were 2.7 times more likely to have fallen asleep at the wheel within the past 12 months and 30 days, compared to truck drivers who did not use medications to stay awake (95% CI = 1.42 to 5.14 and 2.02 to 8.50, respectively). In Table 3, the variables "work duration" and "sleep duration" were not retained in the final models for falling asleep at the wheel during the previous 12 months and 30 days, respectively. Hosmer-Lemeshow (1989) goodness-

Table 3

Logistic Regression Analysis—Final Models

	Regression Coefficient		SE		*OR (95% CI)*		p	
Variable	*12 Months*	*30 Days*	*12 Months*	*30 Days*	*12 Months*	*30 Days*	*12 Months*	*30 Days*
Sleepy	0.76	0.99	0.26	0.33	2.14 (1.29–3.60)	2.69 (1.42–5.10)	.003*	.002*
Night driving	1.13	1.25	0.53	0.74	3.08 (1.09–8.72)	3.50 (0.82–14.92)	.034*	.092
Sleep duration	0.86	-	0.27	-	2.36 (1.38–4.03)	-	.002*	-
Work duration	-	0.59	-	0.75	-	1.80 (0.92–3.52)	-	.084
Medications for wakefulness	0.99	1.42	0.33	0.75	2.70 (1.42–5.14)	4.12 (2.02–8.49)	.002*	< .001*

Note. *OR = odds ratio; CI = confidence interval. *p < .05.*

of-fit testing was used to assess the fit of the best predictive models. Results indicated predicting falling asleep at the wheel at 12 months and 30 days were a good fit to the data ($\chi^2 = 4.37$, $df = 6$, $p = .626$ and $\chi^2 = 2.65$, $df = 7$, $p = .916$, respectively).

DISCUSSION

Four of the eight original predictor variables were retained in the final model to predict falling asleep at the wheel within the past 12 months. Four variables were also retained in the final model to predict falling asleep at the wheel within the past 30 days. Chronic sleepiness, as measured by the ESS, contributed to increased risk of falling asleep at the wheel. Earlier studies of truck drivers under simulated and real-time driving conditions have implicated chronic sleepiness as a contributing factor to sleeping at the wheel (Belenky et al., 2003; Macchi, Boulos, Ranney, Simmons, & Campbell, 2002; Mitler, Miller, Lipsitz, Walsh, & Wylie, 1997). Another study identified daytime sleepiness as highly predictive of falling asleep at the wheel among long-haul truckers (McCartt et al., 2000). However, increased risk was not associated with years of experience in the current study as it was in the study by McCartt et al. In contrast to the Dingus et al. (2002) sleeper berth study, an increased risk of falling asleep at the wheel was not found among solo truck drivers compared to those with a driving partner at least half of the time.

A surprising finding from this study was the analysis of the variable work duration. In the bivariate analysis, long-haul truckers who drove more than 12 of 24 hours experienced an increased risk of sleeping at the wheel within 12 months and 30 days compared to truckers who drove less than 12 hours daily (Table 2). However, the variable was not retained in the final multivariate models for predicting falling asleep at the wheel (Table 3). These findings seem to be inconsistent with the findings of Hakkanen and Summala (2000). The Finnish study showed an increased risk of falling asleep at the wheel among truckers who drove more than 14 hours of almost 4 to 5 times that of truckers who drove 6 hours. Although the comparison of studies from two cultures under different regulatory systems may be questionable, the driving tasks involved were essentially the same for both groups. Therefore, the difference in findings is interesting and merits further exploration.

LIMITATIONS

This study almost exclusively includes findings from White male truckers. Although this is currently the predominant demographic group in the industry, studies should be conducted that target the enrollment of women and ethnically diverse truck drivers. This is particularly important because trade agreements between the United States and neighboring countries will bring increased ethnic diversity to long-haul trucking in the United States (FMCSA, 2007).

An additional limitation of this study is that these data comprise a subset of data from a larger study. This study was not designed specifically to analyze sleep and risk of sleeping at the wheel. Therefore, important potential confounders were not considered or measured. Diagnosed sleep-disordered breathing or the presence of indicators such as obesity, hypertension, and neck circumference might have provided insight into the prevalence of sleep-

disordered breathing and its effects on these data (Phillips, 2005). The use of medications to stay awake and to sleep was elicited in the study. However, scores of various drug classes can impact sleep. Thus, a complete medication history would have been most helpful in determining the potential effects of medication on drowsiness and falling asleep at the wheel.

Despite the limitations of this study, it has added to the body of knowledge of trucker sleep by evaluating variables that increase risk and predict falling asleep at the wheel. As the number of truck drivers grows, more may be at risk for work-related sleep deprivation and motor vehicle crashes. Findings from this study may be used by the trucking industry to assess the risk of falling asleep at the wheel and to redesign work practices to decrease the risk of falling asleep at the wheel.

IMPLICATIONS FOR OCCUPATIONAL HEALTH NURSES

Occupational health nurses can use these findings to screen truckers for some of the predictor variables described in this study. The ESS is a simple tool that should be used by occupational health nurses to determine the presence of excessive sleepiness and increased likelihood of falling asleep at the wheel among truckers. In addition to the ESS, an extensive medication history should be elicited. The medication history may indicate or further support the assessment of increased risk of falling asleep at the wheel in this occupational group.

Along with screening individual truckers, occupational health nurses can work with employers, using findings from this study and others, to prevent conditions that lead to chronic sleep deprivation in truckers. An example of this effort would involve collaborating with employers to use sleep management techniques and work redesign to decrease sleep fragmentation among truckers. This should result in decreased risk for falling asleep at the wheel in the target truckers.

Finally, occupational health nurses could use findings from this and other studies of truck driver sleep to advocate for truck drivers. Discussions among regulatory bodies, trucking industry leaders, and advocacy groups are ongoing and concern such policy issues as hours of service regulation and the use of electronic on-board recorders (black boxes) in trucks (FMCSA, 2007). Occupational health nurses armed with data such as those found in the current study can provide important information to policymakers as they advocate for improved working conditions and the resulting health of long-haul truckers.

REFERENCES

Abrams, C., Schultz, T., & Wylie, C. D. (1997). *Commercial motor vehicle driver fatigue, alertness, and countermeasures survey* (NTIS No. PB2000-102891). Washington, DC: U.S. Department of Transportation.

Anderson, D. (2002). *Risks for workplace violence in long-haul truckers* (1R01OH07931). Washington, DC: Department of Health and Human Services.

Arnold, P. L., Hartley, L., Corry, A., Hochstadt, D., Penna, F., & Feyer, A. (1997). Hours of work and perceptions of fatigue among truck drivers. *Accident Analysis and Prevention, 29*(4), 471-477.

Bagley, S., White, H., & Golomb, B. (2001). Logistic regression in the medical literature: Standards for use and reporting, with particular attention to one medical domain. *Journal of Clinical Epidemiology*, *54*(10), 979-985.

Belenky, G., Wesensten, N., Thorne, D., Thomas, M., Sing, H., Redmond, D., et al. (2003). Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: A sleep-dose response study. *Journal of Sleep Research, 12*(1), 1-12.

Bureau of Labor Statistics. (2006). *Occupational outlook handbook: Truck drivers and driver/sales workers.* Retrieved April 1, 2007, from www.bls.gov/oco/ocos246.htm

Chervin, R., & Aldrich, M. (1999). *The Epworth Sleepiness Scale may not reflect objective measures of sleepiness or sleep apnea*. Retrieved February 5, 2005, from www.neurology.org/cgi/content/full/52/125

Czeisler, C., & Gooley, J. (2007). Sleep and circadian rhythms in humans. *Cold Spring Harbor Symposia on Quantitative Biology, 72*, 579-597.

Davies, D. P., Rodgers, H., Walshaw, D., James, O. F. W., & Gibson, G. J. (2003). Snoring, daytime sleepiness, and stroke: A case-control study of first-ever stroke. *Journal of Sleep Research, 12*(4), 313-318.

Dement, W. (1999). *The promise of sleep*. New York: Dell.

Dingus, T., Neale, V., Garness, S., Hankowski, R., Keisler, A., Lee, S., et al. (2002). *Impact of sleeper berth usage on driver fatigue* (No. FMCSA-RT-02-050). Washington, DC: Federal Motor Carrier Safety Administration.

Federal Motor Carrier Safety Administration. (2002). *Safety regulations pocketbook*. Neenah, WI: J. J. Keller.

Federal Motor Carrier Safety Administration. (2007). *2005 Large truck crash overview*. Retrieved April 1, 2007, from www.fmcsa.dot.gov/facts-research/research-technology/report/2005LargeTruckCrash.htm

Fong, S. Y. Y., Ho, C. K. W., & Wing, Y. K. (2005). Comparing MSLT and ESS in the measurement of excessive daytime sleepiness in obstructive sleep apnea syndrome. *Journal of Psychosomatic Research, 58*(1), 55-60.

Hakkanen, H., & Summala, H. (2000). Driver sleepiness-related problems, health status and prolonged driving among professional heavy-vehicle drivers. *Transportation Human Factors, 2*(1), 151-172.

Hanowski, R., Hickman, J., Fumero, M., Olson, R., & Dingus, T. (2007). The sleep of commercial vehicle drivers under the 2003 hours-of-service regulations. *Accident Analysis & Prevention, 39*(6), 1140-1145.

Hosmer, D., & Lemeshow, S. (1989). *Applied logistic regression*. New York: Wiley and Sons.

Hosmer, D., Taber, S., & Lemeshow, S. (1991). The importance of assessing the fit of logistic regression models: A case study. *American Journal of Public Health, 81*(12), 1630-1635.

Johns, M. (2000). Sensitivity and specificity of the Multiple Sleep Latency Test (MSLT), the Maintenance of Wakefulness Test and the Epworth Sleepiness Scale: Failure of the MSLT as a gold standard. *Journal of Sleep Research, 9*, 5-11.

Johns, M. W. (1991). A new method for measuring daytime sleepiness: The Epworth Sleepiness Scale. *Sleep, 14*(6), 540-545.

Johns, M., & Hocking, B. (1997). Daytime sleepiness and sleep habits of Australian workers. *Sleep, 20*(10), 844-849.

Kingshott, R., Vennelle, M., Coleman, E., Engleman, H., Mackay, T., & Douglas, N. (2001). Randomized, double-blind, placebo-controlled crossover trial of Modafinil in the treatment of residual excessive sleepiness in the sleep apnea/hypopnea syndrome. *American Journal of Respiratory and Critical Care Medicine, 163*(4), 918-923.

Macchi, M., Boulos, Z., Ranney, T., Simmons, L., & Campbell, S. (2002). Effects of an afternoon nap on nighttime alertness and performance in long-haul drivers. *Accident Analysis and Prevention, 34*(6), 825-834.

Mattson, A., Jarossi, L., & Woodrooffe, J. (2008). *Trucks involved in fatal accidents factbook 2005.* Retrieved August 1, 2008, from www.umtri.umich.edu/content/TIFAfactbook05_final.pdf

McCartt, A., Rohrbaugh, J., Hammer, M., & Fuller, S. (2000). Factors

associated with falling asleep at the wheel among long-distance truck drivers. *Accident Analysis and Prevention, 32*(4), 493-504.
Mitler, M., Miller, J., Lipsitz, J., Walsh, J., & Wylie, D. (1997). The sleep of long-haul truck drivers. *New England Journal of Medicine, 337*(11), 755-762.
Ouellet, L. (1994). *Pedal to the metal: The work lives of truckers*. Philadelphia: Temple University Press.
Parker, K., Kutner, N., Bliwise, D., Bailey, J., & Rye, D. (2003). *Nocturnal sleep, daytime sleepiness and quality of life in stable patients on hemodialysis*. Retrieved February 5, 2005, from www.hqlo.com/content/1/1/68
Phillips, B. (2005). Sleepiness. In P. Carney, R. Berry, & J. Geyer, (Eds.), *Clinical sleep disorders*. Philadelphia: Lippincott, Williams & Wilkins.
Pilcher, J., Pury, S., & Muth, E. (2003). Assessing subjective daytime sleepiness: An internal state versus behavior approach. *Behavioral Medicine, 29*(2), 60-67.
Renner, D. (1998). Cross-country truck drivers: A vulnerable population. *Nursing Outlook, 46*(4), 164-168.
Stutts, J. C., Wilkins, J. W., Scott-Osberg, M., & Vaughan, B. V. (2003). Driver risk factors for sleep-related crashes. *Accident Analysis & Prevention, 35*(3), 321-331.
Van Dongen, H. P., Maislin, G., Mullington, J. M., & Dinges, D. F. (2003). The cumulative cost of additional wakefulness: Dose response effects on neuro-behavioral function and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep, 15*(2), 117-126.
Watanabe, M., Matsuura, M., Sano, T., Matsuda, R., & Kojima, T. (2003). Daytime sleepiness in hypersomniac patients, epileptic patients, and in healthy subjects. *Sleep and Biological Rhythms, 1*(2), 137-138.