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Work Patterns, Sleeping Hours And Excess Weight In Commercial Drivers

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Abstract

Background: Work and sleep patterns for commercial motor vehicle (CMV) drivers often include long working hours, shift work and diminished sleep duration and quality, which have been linked to overweight, obesity and other problems. Aims: To explore possible connections between work, sleep and obesity among CMV drivers. Methods: Survey and anthropometric data were collected from male long-haul CMV drivers in central North Carolina, USA, over a period of 6 months. Drivers' body mass index (BMI) was used as a measure of total body obesity and sagittal abdominal diameter (SAD) as a measure of central adiposity. Results: Among the 260 study subjects, mean BMI was 33.1 (64% were obese or morbidly obese) and mean SAD was 32.3cm, classifying 89% of drivers as being at high or very high cardiometabolic risk. About 83% of drivers worked an irregular daily schedule, 64% worked irregular total daily hours, 32% worked irregular days of the week and 46% reported getting <7h of sleep during work nights. Significant predictors of BMI included the number of hours worked daily ($P < 0.05$) and the age ($P < 0.01$) of the driver, while age was also a significant predictor for SAD ($P < 0.05$). Significant predictors of sleep quality included the extent of shift work ($P < 0.05$) and sleep duration ($P < 0.001$). Conclusions: Work and sleep configurations appear to affect the weight status of CMV drivers. Shift work and sleep duration are both associated with the weight status of CMV drivers, and both appear to function as indicators of their sleep quality.

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Work patterns, sleeping hours and excess weight in commercial drivers

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Background Work and sleep patterns for commercial motor vehicle (CMV) drivers often include long working hours, shift work and diminished sleep duration and quality, which have been linked to overweight, obesity and other problems.

Aims To explore possible connections between work, sleep and obesity among CMV drivers.

Methods Survey and anthropometric data were collected from male long-haul CMV drivers in central North Carolina, USA, over a period of 6 months. Drivers' body mass index (BMI) was used as a measure of total body obesity and sagittal abdominal diameter (SAD) as a measure of central adiposity.

Results Among the 260 study subjects, mean BMI was 33.1 (64% were obese or morbidly obese) and mean SAD was 32.3 cm, classifying 89% of drivers as being at high or very high cardiometabolic risk. About 83% of drivers worked an irregular daily schedule, 64% worked irregular total daily hours, 32% worked irregular days of the week and 46% reported getting <7 h of sleep during work nights. Significant predictors of BMI included the number of hours worked daily ($P < 0.05$) and the age ($P < 0.01$) of the driver, while age was also a significant predictor for SAD ($P < 0.05$). Significant predictors of sleep quality included the extent of shift work ($P < 0.05$) and sleep duration ($P < 0.001$).

Conclusions Work and sleep configurations appear to affect the weight status of CMV drivers. Shift work and sleep duration are both associated with the weight status of CMV drivers, and both appear to function as indicators of their sleep quality.

Key words Central obesity; commercial drivers; shift work; total body obesity; work hours.

Introduction

Commercial motor vehicle (CMV) drivers are an occupational group with pronounced health disparities, many of which are directly linked to the unique characteristics of their profession [1,2]. Unhealthy weight has disproportionately affected CMV drivers, as evidenced by the recent US national study on long-haul CMV driver health, which found 69% of drivers to be obese compared with 31% of the adult working population [3]. Overweight and obesity are linked to a number of co-morbidities, including cardiometabolic disease, certain cancers, musculoskeletal and sleep disorders, which in turn can potentially lead to driving accidents [4,5].

Daily work hours for CMV drivers are regulated by the US federal government: drivers may not drive >11 h without taking 10 consecutive hours off-duty, may not drive 14 h after their last 10 consecutive hours off-duty and may not be on-duty for >60 h in any consecutive 7 day period or 70 h in any consecutive 8 day period [6]. However, the current organization of the trucking industry often requires drivers to work beyond these hours [7]. Drivers may also have to undertake shift work, causing their daily working and sleeping times to vary.

Long working hours, shift work and sleep duration and quality have been shown to be associated with overweight and obesity. Long working hours, including working overtime and working over 50 h per week, have been linked to higher total body obesity, measured by body mass index (BMI) [8,9]. There is an inverse relationship between BMI and sleep duration and quality. Short sleep duration is associated with an increased risk of being overweight or obese [8,10–12]. For individuals with daily sleep duration of <8 h, the increase in BMI is proportional to the reduction in sleep duration [13]. Shift work, where individuals work non-standard schedules, has been associated with less healthy sleep, higher rates of short sleep duration and higher BMI [8,14], while night workers have been shown to have higher BMI [10,14]. Finally, strong associations have been found between long working hours, short sleep duration and central obesity, measured by sagittal abdominal diameter (SAD) [15,16]. Similar relationships have been found among CMV drivers as well. An investigation of professional drivers in China found that shift work was associated with lower scores on a health-related quality of life scale [17]. Among CMV drivers in Brazil, short sleep was found to be independently associated with obesity [15].

There is a lack of empirical research into the health of CMV drivers that extends to potential links between work duration, sleep patterns and weight status. Although such relationships have been established in various occupational groups, lack of empirical evidence makes it more difficult to draw conclusions regarding such relationships in CMV driver populations. Because of the unique occupational milieu, including the highly regulated nature of sleep and work schedules in US CMV drivers, further investigation is needed to better understand how to best tailor work and sleep schedules to ensure their well-being. The aim of this study was to explore possible connections between work hours, shift work, sleep duration and quality and total body and central obesity in long-haul CMV drivers.

Methods

We undertook a non-experimental descriptive cross-sectional survey to collect data from long-haul truckers at a major truck stop located on I-40 in central North Carolina from October 2012 until March 2013. Permission to collect data was granted by the corporate office of the national truck stop. The facility's manager permitted the placement of a data-collection station in a central location near the television lounge, laundry room and pinball machines, including a large sign regarding the study, a long table, several chairs and a weight scale. The sample was drawn from an occupational population of heavy and tractor-trailer truck drivers that number ~1 585 300 nationally [16]. Two teams of field researchers spent 3–4 days each week at the truck stop from ~6:00 to 10:00 p.m. Using intercept techniques, researchers approached drivers and asked several screening questions to determine whether they would be eligible for inclusion in this study. To be included drivers were required to be long haul, meaning they spend consecutive nights away from home, and they had to be spending the night at the truck stop where data collection took place, so that fasting blood samples could be taken the following morning before they got back on the road. Blood samples were collected from drivers (serological data analysis results are not reported in this paper) where possible. The voluntary and confidential nature of participation, the types of data to be collected and associated cash incentives were explained. Enrolled drivers were then asked to sign an informed consent form and were allowed to use aliases to assure greater confidentiality and in some cases anonymity to protect their identity from being revealed in future reports that may get back to their employer. The study and data collection was approved by the Institutional Review Board of the University of North Carolina Greensboro.

The *Trucker Sleep Disorders Survey (TSLDS)* was developed from key sleep instruments (i.e. Basic Nordic Sleep Questionnaire, Berlin Questionnaire), sleep literature and our previous work with truckers [18–20]. Cognitive testing involved *TSLDS* review by public health professionals to ensure the language used was appropriate, that questions conveyed intended meanings and made sense and optimal placement and flow of questions. Following necessary revisions, a paper-and-pencil draft of the instrument was tested with a sample of six truckers in the Piedmont Triad area of North Carolina. Truckers were monitored and timed as they completed the survey to detect pauses and problems requiring revisions. This phase was intended to help determine validity, identify missing items, clarify scale distributions, help to conduct item correlations and determine reliability.

Key components of the *TSLDS* included questions on: (i) *Trucking work environment* such as working hours, workplace factors, job strains, workload and irregular schedules; (ii) *Truck drivers' work and health-related individual factors* such as socio-demographic characteristics, dietary and physical activity patterns, substance use, health history, sleep patterns and psychosocial factors; (iii) *Truckers' (self-reported) sleep disorders* such as daytime sleepiness, insomnia, restless leg syndrome, periodic limb movement disorder, sleep fragmentation, sleep deprivation and sleep apnoea; (iv) *Truckers' health consequences attributable to sleep disorders* such as concentration lapses, judgment errors, work injuries, accident and crash history and disability and medical claims and (v) *Truckers' (self-reported) co-morbidities associated with chronic sleep disorders* such as psychiatric disorders, stroke, hypertension, metabolic syndrome, diabetes and ischemic heart disease.

The truckers' weight (kg) and height (m) were used to calculate their BMI (kg/m^2). Using criteria from the National Heart, Lung, and Blood Institute [21], they were categorized as: 'healthy/normal' (<25 kg/m^2), 'overweight' (25–29.99 kg/m^2), 'obese' (30–39.99 kg/m^2) and 'morbidly obese' (≥40 kg/m^2). Using established sagittal abdominal obesity criteria for increased cardiovascular and insulin resistance risks [22], truckers were categorized as ‘low risk’ (<25 cm), ‘high risk’ (25–29.99 cm) and ‘very high risk’ (≥30 cm). Drivers were grouped into four age categories: 35 and younger, 36–45, 46–55 and 56 and older. Trucker experience, measured in years of driving, was grouped as: 10 years or less, 11–20 years and 21 years or more (Table 1).

Three variables were used to determine extent of shift work: irregular daily schedule (same or different each day?), irregular total hours (same or different each day?) and irregular days of the week (same or different each week?). For multivariate analysis, three variables were used to create a composite variable on the extent of shift work: if truckers reported working the same schedule daily (time of day and total hours) and weekly, they were denoted with a ‘0’; if truckers reported working a different schedule for one of the three days, they were denoted with a ‘1’; those who reported working different schedules for two of the three days were denoted with a ‘2’ and if they reported working different schedules for all three, they were denoted with a ‘3’.

For sleep duration, drivers were categorized according to National Sleep Foundation guidelines [23]: ‘Short’ (<7 h); ‘Optimal’ (7–9 h) and ‘Long’ (>9 h). For sleep quality, participants were asked to indicate how often they got a good night’s sleep using the following responses: never, rarely, almost every night or every night. For multivariate analysis, perceived sleep quality was categorized as ‘poor’ (never or rarely) or ‘good’ (almost every night or every night).

Results

Of ~360 drivers approached by the field researchers, 260 met the inclusion criteria, giving an over 72% response rate. Approximately 100 did not meet the criteria because they were either short-haul drivers or were not planning to spend the night at the truck stop. The mean BMI was 33.1 (SD = 7.8), with 64% obese or morbidly obese. Mean driver age was 47 (SD = 10.5) with drivers’ ages ranging from 23 to 72 (age was not a selection criterion during subject enrolment). There was a significant difference ($P < 0.01$) between the four BMI categories based on age. The mean shift duration was 11 h and 55 min. Most drivers (71%) worked >11 h per day including both driving and other job-related duties, and there was a significant difference ($P < 0.05$) between the four BMI categories based on hours worked.

Mean years of driving experience was 14.9 (SD = 11.5), with 56% having driven for at least

Table 1. Distribution of categorical variables by BMI (mean = 33.15)

Variable	Healthy (11%), *n* (%)	Overweight (25%), *n* (%)	Obese (46%), *n* (%)	Morbid obesity (18%), *n* (%)	Totals, *n* (%)	*P*
Age (mean = 46.6 years)						**
35 and younger	5 (19)	10 (15)	20 (17)	12 (25)	47 (18)	
36–45	4 (15)	10 (15)	31 (26)	17 (35)	62 (24)	
46–55	9 (33)	23 (35)	49 (41)	14 (29)	95 (37)	
56 and older	9 (33)	23 (35)	19 (16)	5 (10)	56 (21)	
Daily working hours (mean 11 h, 55 min)						*
11 h or less	9 (33)	14 (22)	45 (38)	8 (17)	76 (30)	
>11 h	18 (67)	50 (78)	74 (62)	40 (83)	182 (70)	
Driver experience (mean = 14.97 years)						NS
10 years or less	12 (44)	25 (38)	52 (44)	24 (50)	113 (44)	
11–20 years	3 (12)	24 (36)	33 (28)	10 (21)	70 (27)	
21 or more years	12 (44)	17 (26)	33 (28)	14 (29)	76 (29)	
Shift work						
Irregular daily schedule	23 (85)	57 (86)	95 (80)	40 (83)	215 (83)	NS
Irregular total hours	17 (63)	44 (67)	75 (63)	30 (63)	166 (64)	NS
Irregular days of week	10 (37)	26 (39)	34 (29)	14 (29)	84 (32)	NS
Sleep duration (work nights)						NS
Short (<7 h)	12 (44)	30 (46)	55 (46)	23 (48)	120 (46)	
Optimal (7–9 h)	13 (48)	31 (47)	53 (45)	20 (42)	117 (45)	
Long (>9 h)	2 (8)	5 (7)	11 (9)	5 (10)	23 (9)	
Sleep quality (work nights)						NS
Never	1 (3)	5 (8)	12 (10)	4 (8)	22 (9)	
Rarely	9 (35)	22 (34)	32 (27)	13 (28)	76 (29)	
Almost every night	10 (39)	27 (41)	52 (44)	23 (49)	112 (44)	
Every night	6 (23)	11 (17)	23 (19)	7 (15)	47 (18)	

NS, not significant.
*$P < 0.05$; **$P < 0.01$.

11 years. There was no significant difference between truckers' BMI category based on years of driving experience. Eighty-three per cent of participants worked an irregular daily schedule based on time of day, 64% worked irregular total daily hours and 32% worked irregular days of the week. No significant difference in BMI category was found between the three shift work variables. Nearly half (46%) of the drivers reported getting <7 h of sleep on average during work nights but no significant relationship was found between sleep duration and BMI category. Nine per cent of drivers stated they never got a good night's sleep, while another 30% indicated rarely doing so; however, no significant relationship was found among these groups in relation to BMI.

Multinomial logistic regression was used to examine the association between total body obesity (BMI), central obesity (SAD) (mean = 32.3 cm) and a series of explanatory variables. The final model fitting information was significant ($P < 0.05$) indicating the model fit the data appropriately. Significant predictors of total body obesity included the age ($P < 0.01$) of the driver and the number of hours worked daily ($P < 0.05$). Longer working hours had the highest odds ratio (7.67; CI 1.43–7.93) (Table 2). The effect size was 0.42 (partial eta squared). Age was also a significant predictor of central obesity ($P < 0.05$) (Table 3). The effect size was 0.43 (partial eta squared).

Multinomial logistic regression was used to examine the association between perceived sleep quality and predictor variables. The model fitting ($P < 0.001$) indicated the model was appropriate for analysis. Significant predictors of sleep quality included sleep duration ($P < 0.001$) and extent of shift work ($P < 0.05$). The odds ratios suggested that the highest odds for poor sleep quality was for drivers reporting short sleep duration (7.74; CI 1.63–16.67). Additionally, the odds ratios increased as the extent of shift work increased (Table 4). The effect size was 0.63 (partial eta squared).

Discussion

In this study, we found CMV drivers' total body obesity (64%) to be very high as was central obesity (89%), a more valid measure of abdominal adiposity [24]. Most truck drivers (71%) worked >11 h per day, worked an irregular schedule (83%) and had irregular total daily hours (64%). With regard to sleep quality, many drivers reported that they never (9%) or rarely (30%) got a good night's sleep. Among the three shift work variables, there was no significant difference in BMI category; however, driver age and the number of hours worked daily were found to be significant predictors of obesity, with younger drivers and drivers working over 11 h per day most likely to be obese. Shift work and sleep duration were found to be significant predictors of sleep quality and as the extent of shift work increased so did the odds ratios of sleep quality.

Several findings from these analyses stand out. Firstly, the multinomial logistic regression failed to find sleep duration and shift work as being significantly associated with either of the two measures of obesity. This is contrary to other studies of diverse populations, including non-CMV driver occupational populations and non-US populations, which find these factors to be significantly related to unhealthy weight status [8,10–12]. This relationship has also been found between other CMV drivers, with short sleep duration being independently associated with obesity in Brazilian truck drivers [15] and shift work

Table 2. Associations of age, work and sleep with BMI of 30 or greater

Variable	Category	L-R chi square	Point estimate	95% Wald confidence limits	
Age	35 and younger	11.75**	2.51	0.11	1.27
	36–45		2.20	0.13	1.33
	46–55		0.52	0.27	2.80
	56 and older (reference)				
Hours worked	11 or less	10.75*	0.02	0.56	1.66
	>11		7.67	1.43	7.93
Sleep duration	Short	0.02	0.04	0.34	3.78
	Medium		0.04	0.34	3.84
	Long				
Shift work	None	1.44	0.87	0.46	8.87
	One of three		0.43	0.27	1.92
	Two of three		0.01	0.38	2.43
	All three (reference)				
Sleep quality	Poor	0.55	0.11	0.53	2.40
	Good (reference)				

$^{*}P < 0.05$; $^{**}P < 0.01$.

being associated with poorer scores on a health-related quality of life scale among Chinese professional drivers [17]. However, in accord with our findings, other studies have also failed to find an association between objective sleep duration and BMI among North American CMV drivers [24]. Thus, it appears that the relationship between sleep duration, shift work and obesity may be unique to CMV driver populations. One possible explanation is that drivers over-reported their sleep duration, since they may have felt pressure to report longer sleep duration because of federal regulations stipulating driver work and rest hours, so that these self-reported measures may differ from reality. This is supported by our findings regarding sleep quality, with both shift work and sleep duration being significant predictors. Shift work has also been identified in other studies as contributing to metabolic syndrome and as having adverse cardiometabolic implications [25]. Therefore, shift work and sleep duration are both likely to be important in the weight status and co-morbidities associated with weight status for CMV drivers, and both shift work and sleep duration appear to be indicators of sleep quality. We further hypothesized that the sampled truckers may not have been entirely

Table 3. Associations of age, work and sleep with abdominal obesity (SAD of 25 cm or greater) (mean = 32.30 cm; 88.8% over 25 cm)

Variable	Category	L-R chi square	Point estimate	95% Wald confidence limits	
Age	35 and younger	6.64*	3.62	0.96	15.81
	36–45		0.07	0.27	5.66
	46–55		0.14	0.32	5.30
	56 and older (reference)				
Hours worked	11 or less	0.97	0.90	0.73	2.53
	>11				
Sleep duration	Short	0.28	0.19	0.39	4.42
	Medium		0.92	0.55	5.85
	Long				
Shift work	None	0.09	0.26	0.46	3.81
	One of three		0.13	0.37	1.96
	Two of three		0.35	0.38	1.69
	All three (reference)				
Sleep quality	Poor	2.20	2.20	0.86	2.99
	Good (reference)				

*$P < 0.05$.

Table 4. Associations of age, work, sleep, BMI and SAD with poor perceived sleep quality

Variable	Category	L-R chi square	Point estimate	95% Wald confidence limits	
Sleep duration	Short	24.08***	7.74	1.63	16.67
	Medium		0.31	0.43	4.56
	Long (reference)				
Shift work	None	3.07*	2.39	0.14	1.26
	One of three		2.77	0.24	1.12
	Two of three		3.86	0.25	1.00
	All three (reference)				
Age	35 and younger	1.03	0.07	0.47	2.73
	36–45		1.84	0.77	4.09
	46–55		0.40	0.37	1.67
	56 and older (reference)				
Hours worked	11 or less	0.54	0.54	0.44	1.46
	>11 (reference)				
BMI	Healthy	0.00	0.05	0.22	3.33
	Overweight		0.05	0.42	2.93
	Obese		0.04	0.50	2.34
	Morbidly obese (reference)				
Central obesity	Low	0.79	0.18	0.41	4.03
	Moderate		1.94	0.82	3.36
	High (reference)				

*$P < 0.05$; ***$P < 0.001$.

truthful about the amount of hours of sleep they got because of reluctance to speak candidly for fear of losing their jobs should the information be revealed to their employers. Consequently, we consider that truckers' perception of sleep quality may be a better indicator.

Our findings suggest that younger drivers are most at risk of health complications. This may result from work and sleep configurations affecting health behaviours of CMV drivers. Other studies have found that working long hours may interfere with exercise and eating habits and impede efforts to lead a healthy lifestyle [8,9,26]. Similar effects have been observed with short sleep duration [27–29] and shift work [14]. It may be that younger drivers are more susceptible to the negative effects of sleep and work configurations in the long-haul trucking industry on individual lifestyle choices. It may also be a statistical artefact: because of the increasingly rigorous physical requirements to receive medical certification to operate a CMV, older drivers who are not resilient to these effects of work and sleep configurations are no longer part of the workforce [30]. Future interventions and policy decisions aimed at reducing obesity and obesity-related illnesses among CMV drivers should consider these factors as critical leverage points.

This study has several weaknesses. Firstly, as a result of the cross-sectional design, we cannot claim causal connections for any of the associations found, as overweight and obesity could have been adversely affected by other factors of multiple and interacting origins. Secondly, the diversity of the commercial driver population, along with several key occupational (e.g. employer characteristics), psychosocial and biological features, is difficult to capture fully in a representative way. Although this sample appears to be fairly representative of these characteristics, it is difficult to determine whether all relevant characteristics were adequately captured by our sample. In addition, because data collection only took place at one site, our data may fail to capture regional differences between commercial drivers and may only apply to North American CMV drivers and thus may not be applicable to drivers in other countries. Also morbidities in drivers in this study were self-reported, which may have introduced bias. Key challenges still remaining in transport worker sleep research include the lack of prospective studies, a lack of studies with pre-driving weight and sleep estimates and the absence of adequate control groups. It should also be noted that randomized control trials in occupational health are often not feasible due to practical, ethical, legal or other constraints. Furthermore, due to driver selection and retention biases, as well as extensive use of relevant medication and drivers' self-reported estimates of their sleep, these findings may under-represent the true scale of the health-related challenges of long-haul truckers.

Key points

- Work and sleep configurations appeared to impact on the weight status of commercial motor vehicle drivers.
- Younger commercial drivers were most at risk of health complications associated with work and sleep configurations.
- Both shift work and sleep duration are likely to impact on weight status as well as co-morbidities associated with weight status for these drivers, and both shift work and sleep duration appear to function as indicators of sleep quality.

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Conflicts of interest

None declared.

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