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Sleep, Dietary, and Exercise Behavioral Clusters among Truck Drivers with Obesity: Implications for Interventions

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Abstract

Objective—Our objectives were to describe a sample of truck drivers, identify clusters of drivers with similar patterns in behaviors affecting energy balance (sleep, diet, and exercise), and test for cluster differences in health and psychosocial factors.

Methods—Participants' (n=452, BMI M=37.2, 86.4% male) self-reported behaviors were dichotomized prior to hierarchical cluster analysis, which identified groups with similar behavior co-variation. Cluster differences were tested with generalized estimating equations.

Results—Five behavioral clusters were identified that differed significantly in age, smoking status, diabetes prevalence, lost work days, stress, and social support, but not in BMI. Cluster 2, characterized by the best sleep quality, had significantly lower lost workdays and stress than other clusters.

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Author contributions: All authors contributed to writing and editing the manuscript, and read and approved the final content. Unique contributions are summarized as follows. RO is the principal investigator and led the team in carrying out the research and preparing the current manuscript. ST is a research associate on the project, and contributed to data collection and validation, preparatory analyses, the manuscript plan, and figures and tables. BW is a staff scientist on the project, and contributions included original project design, supervising field data collection and processing, key aspects of the manuscript introduction, and final editing. GH, a data analyst on the project, conducted the hierarchical cluster analysis and prepared results sections in collaboration with co-investigator NP. Co-investigators DLE, WKA, TB, LH, and NP contributed to the design of the study, interpretation of findings, and overall plan and content of the manuscript. EH was a research staff member on the project who contributed data collection, data validation, early versions of the manuscript plan, and research literature reviews.

Conclusions—Weight management interventions for drivers should explicitly address sleep, and may be maximally effective after establishing socially supportive work environments that reduce stress exposures.

Keywords

Truck Drivers; Obesity; Behavioral Strategies; Diet; Exercise; Sleep

Introduction

Commercial truck drivers are exposed to conditions that promote weight gain and associated health problems. Current US federal regulations permit 11 driving hours per day (up to 14 hours on-duty) and up to 70 total driving hours every 8 days¹. Sedentary work elevates risk for obesity, related chronic diseases, and overall mortality². Obesity is more than twice as prevalent among truck drivers compared to the general population (69% vs. 31%)³. In a safety-sensitive occupation like commercial trucking, excess body weight among drivers also has important safety implications. Obesity is associated with sleep problems such as obstructive sleep apnea that increase crash risk⁴. Large truck crashes, while more rare per vehicle mile traveled than those involving personal vehicles, are 20% to 55% more likely to result in a fatality⁵. Truck drivers' nonfatal injury and illness rate is three times higher than the national average⁶. Obesity and associated health conditions may magnify hazards and exacerbate these injuries. For example, compensated workplace injuries with co-morbid obesity generate 80% greater cost and lost work time⁷. However, despite the severity of the public health problem, evidence-based weight loss and health promotion programs for commercial truck drivers are scarce⁸.

Health Behavior Research with Truck Drivers

Integrated studies of drivers' behaviors that impact metabolism, energy balance, and body composition are needed to guide targeting and tailoring of interventions. In our view, these key behavioral domains include sleep, diet, and exercise.

Shiftwork, variable schedules, and unfavorable sleeping conditions put drivers at-risk for sleep problems. Sleep deficiency is associated with obesity, metabolic syndrome, and diabetes, with potential causal mechanisms including the effects of sleep deprivation on carbohydrate metabolism and appetite regulation⁹. Research indicates that short sleep, sleep disturbances, and chronic fatigue are common among truck drivers^{3, 10}. In a recent study¹¹ average actigraphically measured sleep duration was over two and a half hours shorter in the truck sleeper berth (6.0 to 6.2 hrs) compared to home (8.8 to 8.9 hrs). Although important interactions between driver sleep, dietary, and exercise behaviors are probable, no peer-reviewed driver sleep study has fully examined potential relationships with diet and exercise. Several authors reported collecting data in all three domains but did not report statistics for all domains¹²⁻¹⁵.

Investigations of driver dietary and exercise behaviors are less abundant than sleep studies and should be interpreted conservatively due to common use of single item questions with unknown reliability and validity. However, consumption of fast, fried, and fatty foods

appears common¹⁶, and obese drivers may consume more than 130g of fat (roughly double the daily recommendation)¹⁷ and over 3,000 total calories per day¹⁸. Only 6.5-23.8% of drivers report eating 5 or more daily servings of fruits and vegetables^{16, 19} with daily serving estimates ranging from 1.7 to 2.8^{19, 20}. In two studies 70-90% of drivers reported not regularly engaging in exercise^{15, 21}. In one study 27.1% of drivers reported zero days per week with 30 minutes of moderate exercise;³ in another, the median weekly minutes of physical activity was zero¹⁸.

Social support and stress may impact sleep, diet, exercise, and body weight management. For example, in the Whitehall II study, overweight male employees with elevated stress had significantly increased odds of additional weight gain 5 years after initial measurement²². Truck drivers are isolated from family and peers for significant periods of time. This may reduce access to social support that can buffer against negative effects of stress and improve overall well-being²³. In a study of transportation workers, supportive supervision and lower job strain were associated with more healthful dietary behaviors⁹. Final multivariate models in the same study suggested that sleep adequacy may have mediated these relationships.

Research Gap and Study Goals

Obesity among commercial truck drivers is a socially important public health problem. Behavioral research with truck drivers reveals sleep, dietary, and exercise deficiencies; however, there is a lack of integrated investigations of all three behavioral domains. A better understanding of driver behaviors related to body weight management may help inform the design, tailoring, and targeting of interventions. To address research gaps and inform future programs we conducted a behavioral analysis of commercial truck drivers enrolled in the SHIFT study (Safety & Health Involvement For Truckers). Our first goal was to describe sample demographics and health characteristics. Our second goal was to use hierarchical cluster analysis to investigate patterns in sleep, dietary, and exercise behaviors, and then test whether clusters of drivers with similar behavior patterns differed in demographics, BMI, occupational safety and health incidents, stress, and social support.

Methods and Procedures

The SHIFT Research Program: A Total Worker Health™ Approach

Here we report analyses of baseline data from truck drivers enrolled in the SHIFT study; a cluster-randomized trial to evaluate the effectiveness of a weight loss, health, and safety intervention (NHLBI, R01HL105495; ClinicalTrials.Gov Registry #NCT02105571). Descriptions of the intervention as well as clinically and statistically significant pilot results are available in prior publications^{24, 25}. The SHIFT research program is aligned with a Total Worker Health™ perspective, which promotes an integrated view of the impact of work environments on employee well-being, health, and safety²⁶.

Study Design and Participants

Twenty-two terminals from five US-based trucking carriers participated. Drivers were recruited using printed advertisements, mailings, announcements at safety meetings, and direct satellite messages. A total of 602 drivers expressed interest and were pre-screened for

eligibility; 452 drivers were fully enrolled. Reasons for not participating included not meeting study criteria (n=4) or declining to participate (n=4) during the pre-screen phone call, not reporting during an enrollment period (n=122), and initiating but not completing enrollment (n=20). Eligibility criteria included a body mass index (BMI) ≥ 27.0 kg/m², an interest in managing or losing weight, and the absence of contraindicating health conditions. Surveys and study instructions were mailed to drivers, and driver managers were asked to help route them to meet with researchers at a company terminal. Participants received \$40, study-branded gear (water bottle, towel, cinch bag), and entry into a drawing for supplemental compensation (amounts ranging from \$100-\$500). All study procedures were reviewed and approved by the Oregon Health & Science University institutional review board.

Measures

Demographics and Health History—Demographic variables collected included sex, age, race/ethnicity, family, and work-related measures. Health history measures included lifetime diagnoses and current treatment for high blood pressure, diabetes, and obstructive sleep apnea. Body weight cycling was captured using the difference between participants' highest and lowest weight in the past three years, the number of times in their life they purposefully lost 4.5 or more kilograms, and the number of times in their life they regained 4.5 or more kilograms.

Health Behaviors—Self-reported sleep duration and quality were measured with the Pittsburgh Sleep Quality Index (PSQI) ²⁷. Dietary measures included National Cancer Institute screeners for fruit and vegetable servings and dietary fat ^{28,29}, along with daily sugary snack and drink consumption ⁹. Days per week with moderate/vigorous physical activity and strength training were measured with the Healthy Physical Activity Scale ³⁰.

Directly Measured Biometrics—Body measurements included waist and hip circumference (Gulick II measuring tape, Country Technology Co., Gays Mills, WI); height (SECA 213 stadiometer, SECA, Hamburg, Germany); and body weight and percent body fat (Tanita TBF-310GS, Tanita Corporation, Tokyo, Japan). BMI and waist-to-hip ratio were calculated. Blood pressure was the average of three measurements taken in a seated position following a 3-minute initial rest period (Omron HEM-907XL, Omron, Kyoto, Japan). Lipids and glucose were measured via capillary whole blood samples collected by fingerstick following a minimum 3-hour fasting period (Cholestech PA Analyzer, Alere, Waltham, MA). Metabolic syndrome was determined using current American Heart Association criteria ³¹.

Workplace Safety and Health Incidents—Self-reported frequencies of occupational safety and health incidents and lost workdays were reported for the prior six months. From multiple questions three summarized counts were computed: (1) number of driving violations and collisions, (2) number of work injuries, and (3) number of workdays missed due to illness or injury.

Social Support and Stress—Social support measures included general supervisor support³² and support for physical activity and dietary behaviors from family and others (reduced items)³³. We measured life stress with the Perceived Stress Scale (reduced items)³⁴ and work stress with the Stress in General “Pressure” subscale (anchoring modified)³⁵.

Statistical Analyses

Common participant clusters were identified based on dichotomized driver scores for eight health behaviors using hierarchical cluster analysis. Ward's method with squared Euclidean distance measures on binary responses was applied³⁶. Behaviors were dichotomized using healthy criteria from authoritative sources as available. These included 7 or more hours of sleep per night over the past month³⁷; a sleep quality index of 5 or less on the PSQI²⁷; less than 35% energy from fat; 5 or more daily fruit and vegetable servings¹⁷; infrequent consumption of sugary drinks and snacks (.21 servings per day or fewer [1-2 times per week]); 5 or more days per week with 30+ minutes of moderate/vigorous physical activity; and strength training 2 or more times per week³⁸.

The agglomeration schedule, dendrogram, and interpretability of solutions were used to determine the number of clusters. Next, we used K-means cluster analysis to finalize the classification of individuals into clusters and discriminant analysis to further validate classification. We conducted generalized estimating equations (GEE) to examine differences between the clusters in demographics, BMI, safety and health incidents, stress, and social support. GEE was selected to account for potential intra-class correlations among drivers nested within driver managers. Normal distribution models, logistic models, or Poisson models were used depending on the variable distribution of interest. The correlation matrix was specified as exchangeable.

Results

Sample Characteristics

The sample (n=452) was predominantly male (86.4%), Caucasian (78.6%), with a mean age of 47.8 years. Drivers averaged 59.6 weekly driving hours and most spent 5 or more nights away from home per dispatch or trip assignment (55.7%). Body weight cycling was common with 41.5% of drivers reporting three or more instances of regaining 4.5 or more kilograms. Lifetime prevalence of medical conditions was 34.2% for hypertension, 12.4% for diabetes, and 18.0% for obstructive sleep apnea. Among drivers with sufficient data (n=372), 73.7% met diagnostic criteria for metabolic syndrome (casual vs. fasting glucose was the common reason for missing data; see Table 1 for demographics and self-reported health conditions). Obesity prevalence was 85.6% and BMI averaged 37.2 kg/m² (SD=8.1) (see Table 2 for biometric statistics and sample proportions in risk categories).

Health Behaviors and Behavioral Clusters

The first two left hand columns in Table 3 provide descriptive statistics for the overall sample for sleep, dietary, and exercise measures, including both mean (SD) and proportions of drivers meeting health criteria. Mean daily fruit and vegetable consumption was low

($M=2.6$ servings, $SD=2.3$), and only .09 proportion of drivers met the “5-A-Day” recommendation. Days per week with 30 minutes of moderate to vigorous exercise averaged 2.7 ($SD=2.9$) and strength training averaged 0.7 ($SD=1.4$) days per week. Only .24 and .20 proportions of the sample met recommendations for physical activity and strength training, respectively. Only .39 had a sleep quality index ≤ 5 (lower is better).

A five-cluster solution was selected using procedures described above. Using discriminant analysis to predict cluster membership from the 8 health behaviors, 95.8% of individuals were classified correctly. Clusters were named based on defining features. Table 3 provides cluster names and proportions of participants in each cluster meeting healthy behavioral criteria. Figure 1 is a radar plot of cluster profiles where the outside boundary represents 1.0 proportion meeting the specified criteria.

All clusters had low proportions meeting the fruit and vegetable consumption standard (.00-.22). Cluster 1 (Healthier Diet/Active) had the healthiest overall diet, and was the only active cluster with high proportions meeting physical activity and strength training standards (.84 and .87, respectively). Cluster 2 (Low Sugar Drinkers/Best Quality Sleepers) had high proportions meeting energy from fat (.78), sugary drink avoidance (1.00), and sleep quality (1.00) criteria. Cluster 3 (Sugar Drinkers/Worst Sleepers) had the poorest health profile with low proportions of members meeting standards for fruit and vegetable intake (.05), sugary drink avoidance (.00) sleep duration (.00), and sleep quality (.11). Cluster 4 (Highest Sugar/Long Sleepers) was characterized by all members reporting sleep duration of 7 or more hours per night, and by the lowest overall proportion meeting standards for sugar avoidance (.33 for sugary snacks; .00 for sugary drinks). Cluster 5 was named Low Sugar Drinkers/Poor Sleepers with .25 meeting sleep duration, and .00 meeting sleep quality standards. Like Cluster 2, all members of Cluster 5 met sugary drink avoidance standards (1.00).

Cluster Differences

Clusters differed significantly across several demographic variables, including age, smoking status, and lifetime diabetes diagnoses (see Table 4 for demographic differences). Participants in Clusters 2 (Low Sugar Drinkers/Best Quality Sleepers) and 5 (Low Sugar Drinkers/Poor Sleepers) were significantly older, less likely to smoke, and more likely to have diabetes than Clusters 1, 3, and 4.

Significant differences were also observed across clusters for missed workdays, stress (life and work), and social support (supervisor, family, and others), but not BMI (see Table 5). Participants in Cluster 2 (Low Sugar Drinkers/Best Quality Sleepers) reported significantly fewer missed workdays on average than participants in Cluster 5 (Low Sugar Drinkers/Poor Sleepers). Clusters 3 and 5 reported significantly more life stress than all other clusters. Cluster 5 also reported significantly more work stress and lower social support from all sources (supervisors, family, and other) compared to all other clusters. Cluster 1 (Healthier Diet/Active) reported more social support from others than all other clusters, and higher social support from family than Clusters 4 (Highest Sugar/Long Sleepers) and 5 (Low Sugar Drinkers/Poor Sleepers).

Discussion

Descriptive results confirm the need for health interventions for truck drivers. The sample was predominantly male, older, with a mean BMI in the class II obese range. Nearly 75% of a subsample of assessed drivers had metabolic syndrome. Fruit and vegetable consumption and exercise were deficient, and 61% of drivers had sleep quality indices predictive of clinical sleep problems. Roughly half of the sample met selected healthy criteria for dietary fat, sugary snack and drink avoidance, and sleep duration.

Obesity has been categorized based on its level and related morbid conditions; however, there has been little work to categorize behavioral patterns that might allow tailoring of interventions. This is especially true of studies with commercial truck drivers, which have lacked an integrated focus on three key behavioral domains related to metabolism, energy balance, and weight gain. In this regard, our cluster analyses provide a novel integrated investigation of behavior patterns among drivers interested in managing or losing weight.

Distinctive clusters were associated with differences in age, smoking status, lifetime diabetes diagnosis, lost workdays, stress, and social support. We did not observe significant differences in BMI, although range was restricted (no BMIs < 27). Smoking was significantly elevated in clusters of younger age (Clusters 1, 3, and 4) and diabetes was significantly elevated in clusters of older age (Clusters 2 and 5). Clusters with the poorest sleep profiles (Clusters 3 and 5) had elevated stress and/or low social support. Cluster 3 (Sugar Drinkers/Worst Sleepers) was characterized by the worst sleep profile and a diet higher in fat and sugar, and had significantly elevated life stress. Cluster 5 (Low Sugar Drinkers/Poor Sleepers) had elevated life and job stress, the lowest levels of all three sources of social support, and significantly elevated lost workdays. In contrast, Cluster 2 (Low Sugar Drinkers/Best Quality Sleepers) had the best sleep quality, and this cluster had lower stress, higher support, and the fewest lost workdays. Further contrast of Clusters 2 and 5 is warranted given their similarity in most factors except for sleep. Both clusters were older, had elevated diabetes prevalence, similar smoking rates, and avoided sugary drinks. Why would two such highly similar clusters have opposite sleep quality profiles? This may be explained in part by a higher, yet non-significant, prevalence of sleep apnea in Cluster 5. However, given cluster similarities, significant differences in stress and social support are salient potential explanations for sleep differences.

Intervention Implications

Sleep, stress, and social support findings have important implications for interventions. First, we provide further evidence that weight loss and health programs for truck drivers should explicitly address sleep. Many drivers (61%) had sleep quality indices predictive of clinical sleep symptoms. The metabolic and appetitive effects of insufficient sleep would predict less successful weight loss outcomes for these participants without concurrent sleep intervention. Second, our data are consistent with theory and prior research on the health protective and stress-buffering effects of social support²³. Thus, interventions may be maximally effective in supportive workplace environments that control or reduce driver exposures to stress.

Strengths and Limitations

Our study provides rare and unique investigation of the health status and behavior patterns of truck drivers who were interested in managing or losing weight. Over-the-road commercial truck drivers are notoriously difficult to reach, but we successfully enrolled a sample who predominantly (55.7%) spent 5 or more nights away from home per trip. Our sample should also be reasonably representative of US truck drivers. Participants were recruited from 5 companies that varied in size, ranging from several hundred to over 2000 drivers. The 22 participating terminals also varied in size (range approximately 40 to 800 drivers). Terminals were predominantly located in Western states, but did include Midwestern and Southeastern US locations. Measurement quality was strong. Driver biometrics were directly measured, and our survey emphasized validated, reliable, and standardized measures in three behavioral domains associated with excessive weight gain.

The use of hierarchical cluster analysis to examine behavior co-variation and its relationships with driver health and safety provides novel integrated guidance for intervention design, tailoring, and targeting. Health behaviors are multidimensional, but as with prior studies of truckers, the behaviors and their assessments often differ across studies or omit one or more behavioral domains. Typically correlations are reported to assess associations among continuous health variables. However, public health recommendations are often dichotomous, such as achieving a certain level of daily physical activity. Thus, we dichotomized health behaviors based on established criteria as available. Adherence to such criteria may be evidence of motivation to achieve health goals (health-directed behavior), and assessing for patterns in adherence may be a preferred categorical parallel to factor analysis³⁹. Prior cluster analysis research suggests that using identified clusters to tailor interventions may also allow programs that are more client-centered with enhanced efficacy^{40, 41}.

Study limitations suggest areas for future research. While dietary screeners used are proven instruments, they are less accurate than food frequency questionnaires or dietary recalls. Physical activity and sleep measures, while also established scales, were self-reported and subject to error and bias relevant to all survey instruments. Future actigraphic studies of measured driver physical activity and sleep are encouraged. Dichotomizing variables facilitated a parsimonious approach for cluster analyses, but this also means our cluster solution and differences detected were driven by the selected criteria, including some criteria without established standards (e.g., avoiding sugary snacks and drinks). And while our original cluster solution was internally validated with a subsequent K means cluster analysis, the utility of the solution may best be determined in future longitudinal analyses (e.g., whether cluster membership relates to future intervention efficacy) or through testing the generality of the solution in other samples. Further, relationships observed at a single time point cannot be viewed as directional or causal. Future experimental and longitudinal research may elucidate relationships suggested by our observations. Finally, while the sample was robust, it was a non-random sample of drivers with BMIs greater than 27 kg/m² and an expressed interest in managing or losing weight, which limits the generalizability of our findings to similar drivers. Restriction in BMI range may have also reduced our ability to

detect cluster differences on this factor. Therefore, future integrated behavioral studies with random and/or representative samples of truck drivers are encouraged.

Conclusion

Commercial truck driving is obesogenic. Effective body weight interventions are scarce, and research on driver health behaviors associated with energy balance and weight gain is needed to inform interventions. The SHIFT research program adopts a Total Worker Health™ perspective by considering interactions between sleep, dietary, and exercise behaviors, and their impacts on both occupational safety and health outcomes. Our investigation reveals heterogeneity of health behavior patterns among overweight and obese truck drivers, and highlights potential sleep and health protective benefits of higher social support and lower stress. Identified clusters, or behavioral profiles of individual drivers, may be used to tailor interventions for enhanced effectiveness. In addition, to maximize results, weight loss interventions for drivers should overtly address sleep in addition to traditional diet and exercise focused approaches. We also recommend strong cross-level interventions in the future that combine driver-level programs with simultaneous work environment-level changes that increase social support and remove or reduce workplace stressors.

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Figure 1.

Proportion of participants within clusters meeting health behavior criteria for truck drivers from five US-based carriers, 2012-2013. The outer boundary of the figure represents 1.0 proportion adhering to the standard.

Table 1

Demographics and health conditions for truck drivers from five US-based carriers (n=452).

	N	Mean (SD) %
Age	445	47.8 (11.4)
Male	385	47.7 (11.6)
Female	60	48.5 (9.6)
Race	444	
American Indian/Alaskan Native	6	1.4
Asian	1	0.2
Native Hawaiian/Pacific Islander	3	0.7
Black/African American	33	7.4
White Caucasian	349	78.6
More than one	27	6.1
Other	25	5.6
Ethnicity	414	
Hispanic/Latino(a)	42	10.1
Not Hispanic/Latino(a)	372	89.9
Sex	450	
Male	389	86.4
Female	61	13.6
Relationship status	451	
Married	247	54.8
Divorced or separated	92	20.4
Widowed	6	1.3
Living with a significant other	44	9.8
Never married	62	13.7
Education	452	
No Degree	20	4.5
HS diploma or GED	219	49.5
Vocational or technical certificate	116	26.2
Associates degree	50	11.3
Bachelor's degree	29	6.6
Graduate degree	8	1.8
Dependent children	448	
0	300	67.0
1-2	107	23.9
3 or more	41	9.1
Smoked in past month	451	
Yes	136	30.2
No	315	69.8
Years as a truck driver	449	
<5 years	158	35.2

	N	Mean (SD) %
5-9 years	68	15.1
10 or more	223	49.7
Tenure at current company	450	
<1 year	161	35.8
1-4.99 years	129	28.7
5 years	160	35.5
Weekly Driving Hours	442	59.6 (11.4)
Handle Freight/Tarp, Move Material	450	
0	208	46.2
1-2	167	37.1
3	75	16.7
Nights Away per Dispatch	449	
<5	199	44.3
5	250	55.7
Number of Times Lost 4.5+ kg	448	
0	113	25.2
1-2	139	31.0
3 or more	196	43.8
Number of Times Regained 4.5+ kg	448	
0	109	24.3
1-2	153	34.2
3 or more	186	41.5
Weight difference (high – low) in previous 3 years (kg)	447	15.9 (12.2)
Hypertension diagnosis	450	
Hypertension Diagnosis	154	34.2
Hypertension medication¹	153	
No	13	8.6
Yes	120	78.4
Diabetes	451	
Diabetes diagnosis	56	12.4
Diabetes medication	53	
None	6	11.3
Oral medication(s)	46	86.8
Oral & insulin	1	1.9
Obstructive Sleep apnea	449	
Sleep apnea diagnosis	81	18.0
Sleep apnea treatment	79	
None	8	10.1
CPAP	66	83.5
Other	5	6.4
Metabolic syndrome risk factors	452	
0	10	2.2

	N	Mean (SD) %
1	54	11.9
2	114	25.2
3	143	31.6
4	112	24.8
5	19	4.2
Metabolic syndrome determination²	372	
Meets metabolic syndrome criteria	274	73.7

Note: **Bold** in N column refers to number of participants with valid responses.

¹ Indented and italicized variables represent data broken out for dependent sub-questions relevant to and answered by only part of the sample.

² Subsample with sufficient data for metabolic syndrome determination (the most frequent missing value was insufficient fasting time for glucose measure).

Table 2

Biometric descriptive statistics and risk levels for truck drivers from five US-based carriers.

Measures	N	Mean (SD)	Risk Level (% of sample)			
			Low	Moderate	High	Very High
Body Mass Index (kg/m ²)	452	37.2 (8.1)	14.4	35.6	21.7	28.3
Body Fat Percentage	450	36.8 (9.0)	1.6	14.9	83.5	--
Systolic Blood Pressure (mm Hg)	452	125.6 (14.0)	36.7	48.9	12.6	1.8
Diastolic Blood Pressure (mm Hg)	452	80.6 (10.0)	50.7	33.6	11.5	4.2
Total Cholesterol (mmol/L)	445	4.8 (1.1)	69.2	21.6	9.2	--
HDL Cholesterol (mmol/L)	440	1.0 (0.3)	37.9	--	62.1	--
LDL Cholesterol (mmol/L)	405	2.8 (0.9)	73.1	18.8	6.9	1.2
Triglycerides (mmol/L)	445	2.1 (1.3)	--	--	--	--
Fasting Triglycerides (mmol/L)	142	1.8 (1.1)	57.7	14.8	26.1	1.4
Casual Triglycerides (mmol/L)	301	2.3 (1.4)	40.2	20.6	35.5	3.7
Glucose (mmol/L)	445	5.7 (1.9)	--	--	--	--
Fasting Glucose (mmol/L)	142	5.7 (1.7)	97.0	--	3.0	--
Casual Glucose (mmol/L)	301	5.7 (2.0)	67.6	24.6	7.7	--
Waist Circumference (cm)	452	117.1 (16.8)	9.6	--	90.4	--
Waist to Hip Ratio	452	0.96 (0.08)	34.9	--	65.1	--

Risk Level Criteria	Low	Moderate	High	Very High
Body Mass Index (kg/m ²)	25.0-29.9	30.0-34.9	35.0-39.9	40.0
Body Fat Percentage	--	--	--	--
Women, 40-59 years	23.0-33.9	34.0-39.9	40.0	--
Men, 40-59 years	11.0-21.9	22.0-27.9	28.0	--
Systolic Blood Pressure (mm Hg)	120	120-139	140-159	160
Diastolic Blood Pressure (mm Hg)	80	80-89	90-99	100
Total Cholesterol (mmol/L)	<5.2	5.2-6.2	6.2	--
HDL Cholesterol (mmol/L)	--	--	--	--
Women	1.3	--	<1.3	--
Men	1.0	--	<1.0	--
LDL Cholesterol (mmol/L)	<3.4	3.4-4.1	4.1-4.9	4.9
Triglycerides (mmol/L)	--	--	--	--
Fasting Triglycerides (mmol/L)	<1.7	1.7-2.3	2.3-5.6	5.6
Casual Triglycerides (mmol/L)	<1.7	1.7-2.3	2.3-5.6	5.6
Glucose (mmol/L)	--	--	--	--
Fasting Glucose (mmol/L)	<5.6	5.6-6.9	7.0	--
Casual Glucose (mmol/L)	11.1	--	>11.1	--
Waist Circumference (cm)	--	--	--	--
Women	<88.9	--	88.9	--
Men	<101.6	--	101.6	--
Waist to Hip Ratio	--	--	--	--

Risk Level Criteria	Low	Moderate	High	Very High
Women	<.80	--	.80	--
Men	<.95	--	.95	--

Note: -- refers to non applicable values

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Table 3

Behavior means and proportions of participants meeting health behavior criteria.

Behavior Criterion	Total Mean (SD)	Total n=433 BMI= 37.2	Cluster 1 n=63 BMI= 35.62	Cluster 2 n=73 BMI= 36.09	Cluster 3 n=104 BMI= 37.21	Cluster 4 n=96 BMI= 37.47	Cluster 5 n=97 BMI= 37.75
			Healthier Diet/Active	Low Sugar Drinkers/Best Quality Sleepers	Sugar Drinkers/Worst Sleepers	Highest Sugar/Long Sleepers	Low Sugar Drinkers/Poor Sleepers
Energy from fat <35%	34.2 (4.7)	.66	.78	.78	.56	.60	.67
Fruits/veggies 5 servings/day	2.6 (2.3)	.09	.22	.10	.05	.07	.08
Sugary snacks .21/d (1-2×/wk)	0.8 (0.9)	.57	.87	.71	.49	.33	.60
Sugary drinks .21/d (1-2×/wk)	1.3 (1.5)	.48	.60	1.00	.00	.00	1.00
Exercise 150 min/week	2.7 (2.9)	.24	.84	.15	.12	.16	.11
Strength train 2 days/week	0.7 (1.4)	.20	.87	.12	.10	.02	.09
Sleep duration 7 hours/day	6.7 (1.2)	.51	.65	.84	.00	1.00	.25
Sleep quality PSQI 5	6.7 (3.4)	.39	.41	1.00	.11	.61	.00

Table 4

Cluster demographic differences for truck drivers from five US-based carriers.

	Cluster 1 n=63	Cluster 2 n=73	Cluster 3 n=104	Cluster 4 n=96	Cluster 5 n=97	
	Healthier Diet/Active	Low Sugar Drinkers/Best Quality Sleepers	Sugar Drinkers/Worst Sleepers	Highest Sugar/Long Sleepers	Low Sugar Drinkers/Poor Sleepers	p-value
Mean Age (SD)	45.38 ^{a,b} (12.23)	51.99 ^{a,c,d} (9.39)	45.93 ^{c,e} (11.13)	43.40 ^{d,f} (11.92)	52.27 ^{b,e,f} (9.69)	<.001
Smoking in past month	34.9% ^{a,b}	17.8% ^{a,c,d}	37.5% ^{c,e}	41.7% ^{d,f}	17.5% ^{b,e,f}	<.001
Married or living with partner	57.1%	67.1%	67.3%	65.6%	65.0%	.719
1+ dependent child	31.8%	26.0%	40.4%	39.0%	25.3%	.084
5 nights/dispatch	55.6%	52.1%	52.9%	59.0%	59.8%	.777
Metabolic Syndrome	70.9%	77.1%	78.1%	68.4%	72.6%	.649
High Blood Pressure	34.9%	38.4%	32.7%	28.1%	41.7%	.679
Diabetes	6.3% ^{a,b}	23.3% ^{a,c,d}	4.8% ^{c,e}	3.1% ^{d,f}	24.7% ^{b,e,f}	<.001
Sleep Apnea	25.8%	12.3%	18.4%	13.5%	20.6%	.215

Note: Values in the same row with the same superscript are significantly different from each other.

Table 5

Mean (SD) scores and cluster differences in BMI, safety, health, stress, and social support.

	Cluster 1 n=63	Cluster 2 n=73	Cluster 3 n=104	Cluster 4 n=96	Cluster 5 n=97	
	Healthier Diet/Active	Low Sugar Drinkers/Best Quality Sleepers	Sugar Drinkers/Worst Sleepers	Highest Sugar/Long Sleepers	Low Sugar Drinkers/Poor Sleepers	p-value
Body Mass Index kg/m ²	35.62 (6.40)	36.09 (6.18)	37.21 (8.46)	37.47 (9.85)	37.75 (7.39)	.257
Driving Violations and Collisions¹ 6 month anchor Count (0 to 15+)	.71 (1.08)	.55 (1.20)	.82 (1.20)	.75 (1.26)	.90 (1.29)	.522
Work Injuries² 6 month anchor Count (0 to 10+)	.44 (.93)	.22 (.73)	.48 (1.10)	.35 (.81)	.52 (1.05)	.308
Missed Work Days³ 6 month anchor Count (0 to 10+)	.73 (1.75)	.42 ^a (1.24)	.88 (1.69)	.77 (1.74)	1.32 ^a (2.18)	.025
Life Stress⁴ 3 month anchor Sum of ratings 0-4 (0 to 28)	7.57 ^{a,b} (4.60)	6.08 ^{c,d,e} (4.33)	9.19 ^{a,c,f} (5.11)	7.73 ^{d,f,g} (4.85)	9.16 ^{b,e,g} (5.18)	<.001
Job Stress⁵ 3 month anchor Mean rating (1 to 5)	3.00 ^a (.73)	2.95 ^b (.69)	3.01 ^c (.67)	3.03 ^d (.63)	3.22 ^{a,b,c,d} (.57)	.025
Supervisor Social Support 3 month anchor Sum of ratings 1-5 (0 to 15)	12.34 ^a (2.28)	12.55 ^b (2.48)	12.02 (2.56)	12.59 ^c (2.31)	11.43 ^{a,b,c} (2.88)	.019
Family Social Support⁶ 3 month anchor Sum of ratings NA, 0-4 (0 to 64)	35.13 ^{a,b} (14.63)	33.10 ^c (11.69)	31.90 ^d (11.68)	30.06 ^b (11.10)	27.24 ^{a,c,d} (9.37)	<.001
Others Social Support⁶ 3 month anchor Sum of ratings NA, 0-4 (0 to 64)	27.18 ^{a,b,c,d} (10.85)	23.30 ^{a,e} (7.70)	22.72 ^b (8.43)	22.23 ^c (7.45)	20.93 ^{d,e} (5.08)	<.001

Note: Values in the same row with the same superscript are significantly different from each other.

¹ This count was the sum of 3 items (options 0-5+): citations for moving violations, curb or object strikes with no property damage, and collisions resulting in property damage.² Sum of 2 count items (options 0-5+): minor work injuries (no treatment or first aid only) and major work injuries (resulting in lost work time).³ Sum of 2 count items (options 0-5+): missed work days due to illness and missed work days due to injury.

⁴The four item Perceived Stress Scale (PSS-4) was used plus three more questions (items 6 and 8 from PSS-10, and a reverse phrased version of item 6 from PSS-10).

⁵Stress in General original anchoring was altered to 1 to 5 scale (ranging from “not at all,” to “very much”).

⁶The original Sallis support for diet and exercise scale (23 items) was tailored to the study and reduced to minimize participant burden. Our reduced scale (16 items) emphasized questions with higher factor loadings in original scale development, and omitted questions less relevant to truck drivers. Our 10 dietary items included Sallis questions 1-4, 6, and 10, plus two questions related to portion size (modeled on Sallis 1 and 6) and two questions focused on fruit and vegetable consumption (modeled on Sallis 3 and 10). “High salt” references in original scales were replaced with “high sugar.” Our 6 exercise items include Sallis questions 11, 13, 14, and 16-18.