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Globalization of markets, technological advances, deregulation of industries, and declines in union membership have all contributed to changes in working conditions beginning in the early 1980s. As a result, American workers are working longer hours to meet the demands of their employers, schedules requiring increased night and rotating shifts, and higher levels of stress from the workplace. These workplace factors serve as physiological, psychological, and behavioral mechanisms for poor health outcomes, increased safety risks, and ultimately shorter life expectancy. Discrepancies in work organization features are considered a major contributor to occupational health disparities for populations such as long-haul truck drivers.

Long-haul truck drivers' work organization is characterized by long work hours, irregular and rotating work schedules, and high job stress. Their work organization is substantially influenced by public policy from the U.S. Department of Transportation concerning Hours of Service (HOS), which legally allows up to 14 hours of work per day (11 of driving time), corporate operations and policies focused on profit and increasing productivity, and the competitive nature of the industry. As a result, drivers experience time pressures due to tight-running delivery schedules imposed by dispatchers who function as their immediate supervisor and have little control over the conditions influencing their work. Meanwhile, epidemiological research has revealed that the work environment is responsible for many of the poor health outcomes experienced by this

occupational population. Not surprisingly, it is a population classified as one of the highest-risk occupations, having higher morbidity rates, and a decreased life expectancy when compared to the general population.

A recent survey supported by the National Institute of Occupational Safety and Health (NIOSH) found that nearly 70 percent of U.S. long haul truck drivers are obese. This is more than double the rate of American workers according to the 2010 National Health Interview Survey, which presents further risks for cardio-metabolic conditions (hypertension, diabetes, cardiovascular disease). In the aforementioned survey of U.S. truck drivers, heart disease prevalence was actually less than the general population according to 2010 NHIS data (4.4 % vs. 6.7 %), but drivers had a higher prevalence of hypertension (26.3 % vs. 24.1%) and more than double the prevalence rate of diabetes (14.4 % to 6.8%).

The causes of obesity are complex and multilevel and linked to numerous safety and health risks, while individual level behavior strategies have had little impact on long-haul truck drivers at the population level. Recent research has suggested that work conditions experienced by long-haul truck drivers deserve further attention in terms of their contribution to the high obesity prevalence among long-haul truck drivers. Therefore, it is critical to further understand how the work environment experienced by long-haul truck drivers serves as a mechanism for exacerbating the already ‘obesogenic’ environment in terms of individual level behavior mechanisms. As such, the aims of this study are to examine the relationships between the features of work organization such as work hours, irregular scheduling practices, and job stress and general obesity, abdominal obesity, and cardio-metabolic disease risk among a sample of 260 U.S. long-haul truck drivers. Specific understanding of these interactions may help to inform both prevention programming in long-haul trucking companies and public policy enacted at the federal level in relation to the industry.

From this sample, the mean BMI was 33.40, 63.7 percent were obese, and 18.3 were characterized as extreme obese (a BMI of 40 or greater). The mean waist circumference was 114.77 cm and 76.0 percent were abdominally obese, or had a waist circumference of 102 cm or greater. When combining BMI and waist circumference measures, 80.0 percent of the sample was at high, very high, or extremely high risk of cardio-metabolic disease risk according to NIH's classification system.

Findings from this study suggest that working long hours may be the most critical work organization feature to long-haul truckers for general obesity. Specifically, working more than 11 and up to 14 hours daily was associated with increased odds for being overweight, obese, and most concerning extreme obese. These associations persisted after adjustments for other job stressors, driver age, and years of experience. A low level of supervisor support was associated with higher odds for abdominal obesity. With a BMI of 40 or greater being a significant problem among this sample, the longer working hours were associated with increased odds of an extremely high risk for cardio-metabolic disease. Daily working hours and supervisor support were both statistically significant predictors of cardio-metabolic disease risk. As such, the findings from this study support recent calls at the national level for integrated approaches to address long-haul truck driver health, including the monitoring of federal policy concerning the Hours of Service (HOS) regulations as well as organizational and scheduling practices incorporated by trucking companies.

THE RELATIONSHIP BETWEEN THE WORK ORGANIZATION OF LONG-HAUL TRUCK DRIVERS AND BODY MASS INDEX (BMI), WAIST CIRCUMFERENCE, AND CARDIO-METABOLIC DISEASE RISK

by

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~ To my family: Mom, Dad, Susan "my best friend," Andrew, Amanda, Jeremy, and all other extended family members: I thank you from the bottom of my heart for all of your love, support, and encouragement during my doctoral studies. Above all, to my beautiful wife Jennifer and precious daughter Ellie; when my days were long and stressful and I needed a "break," you were always there to put a smile on my face! I love you all!

APPROVAL PAGE

This dissertation, written by Barry Adam Hege, has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I

INTRODUCTION

Neoliberal ideology rooted in globalization, technological advances, and market competition, has been the predominant economic framework for industrialized nations, including the United States, for the past 40 years resulting in a 24/7 economy (Gordon & Schnall, 2009; Heymann & Earle, 2010; Navarro, 2007a, 2007b; Schnall et al., 2009). This economic theory maintains that the most profitable economic returns come when labor and financial markets are deregulated, government welfare spending is reduced and public services are privatized, trade policies are liberalized, and collective bargaining rights and union memberships are reduced in what is commonly referred to as the “trickle down approach” advocated by U.S. President Ronald Reagan’s administration during the early 1980s (Bezruchka, 2012; Crowley & Hodson, 2014; Gordon & Schnall, 2009; Navarro, 2007a, 2007b; Navarro, 2009; Schnall et al., 2009). Proponents of neoliberalism argue that the approach leads to increased wealth, innovation, improvements in health and well-being, and promotes democracy globally (Moutsatsos, 2008). Its’ critics have argued that the approach, while supported by a U.S. culture emphasizing individualism and a devout faith in the market to improve the quality of life and well-being for its citizens, have led to rises in income inequality due to stagnating or declining wages, hazardous work conditions and environments, and growing social and health inequalities (Bezruchka, 2012; Navarro, 2007a, 2007b; Gordon & Schnall, 2009).

Specific to the work setting, research has highlighted the significance of the manner in which work is organized as being a critical determinant of health disparities among occupations (Landsbergis, Grzywacz, & LaMontagne, 2014). Globalization of markets, technological advances, deregulation of industries, and declines in union membership have all contributed to changes in working conditions beginning in the early 1980s (Sauter et al., 2002; Gordon & Schnall, 2009; Landsbergis et al., 2014). Due to neoliberalism, many occupations have been defined by new forms of work organization, including temporary and precarious employment, decreased job security, altered scheduling practices, and production-based compensation systems (Sauter et al., 2002; Gordon & Schnall, 2009; Landsbergis et al., 2014). In return, American workers are working longer hours to meet the demands of their employers, schedules requiring increased night and rotating shifts, and higher levels of stress or job strain from the workplace (Schnall et al., 2009). These workplace factors serve as physiological, psychological, and behavioral mechanisms for poor health outcomes, increased safety risks, and ultimately shorter life expectancy (Landsbergis et al., 2014).

During the rise in neoliberal ideology, obesity rates in the U.S. have more than doubled over the past 40 years (Fryar, Carroll, & Ogden, 2012). Data from 2011–2012 revealed that nearly 35 percent (78.6 million) of American adults can be classified as obese, a body mass index (BMI) of 30 or greater (Ogden, Carroll, Kit, & Flegal, 2014). Forecasts performed by Wang, McPherson, Marsh, Gortmaker, and Brown (2011) predicted that within the next two decades an additional 65 million adults will be classified as obese. Of particular concern is abdominal or centralized obesity (excess belly fat), measured by waist circumference, as it further increases the risk of cardio-metabolic disease. A recent report showed that while general obesity rates have not significantly increased in the United States over the last decade, the prevalence of abdominal obesity is still on the rise (Ford et al., 2014). Globally, projections are for 1.12 billion people to become obese by 2030 (Kelly et al., 2008). Specific to the U.S., Finkelstein and colleagues (2012) predict that 51 percent of citizens will be considered obese by 2030.

Obesity is a critical public health epidemic affecting the United States due to its association with chronic disease, increased healthcare costs, decreased workforce productivity, and human capital losses (CDC Overweight and Obesity, 2012; Hammond & Levine, 2010; Wang et al., 2011). Frequent health problems associated with obesity include increased risk for the development of type 2 diabetes, cardiovascular diseases, and certain forms of cancer as well as sleep apnea and other respiratory problems and musculoskeletal disorders (CDC, 2012; Wang et al., 2011). Obesity has been linked with up to 300,000 annual preventable deaths in the U.S., trailing only smoking in terms of preventable forms of death (Tomer, 2011), although some argue it is the highest based on the most recent estimates (Hennekens, et al., 2013). A seminal 2008 report (Finkelstein, Trogdon, Cohen, & Dietz, 2009) estimated that annual medical spending related to obesity in the U.S. could be as high as $147 billion, while healthcare costs could increase by between $48 to $66 billion per year by 2030 (Wang et al., 2011). Speculation exists that obesity and its related disease processes will hamper the American workforce in terms of productivity through increased rates of absenteeism, presenteeism, disability, premature mortality, and rising health insurance costs for both employers and employees (Hammond & Levine, 2010).

Research demonstrates that obesity has complex and interacting sets of causal mechanisms including genetics, behavior, and the surrounding physical and social environment (CDC Overweight and Obesity, 2012). There have been conflicting findings in terms of the extent of the effect, but recurrent evidence has shown that genetics, metabolic disturbances, and misalignments of circadian rhythms at the physiological level have influences on weight gain and obesity (Ahima, 2011; Froy, 2010; Ramachandrappa & Farooqi, 2011). Research suggests that inadequate sleep may negatively influence physiological homeostasis and increase the risk for obesity (Ford et al., 2014; Nielsen, Danielsen, & Sørensen, 2011; Jean-Louis et al., 2014). Health behaviors chiefly identified as predictors of obesity risk include physical inactivity, poor dietary intake, and sedentariness, particularly in the occupational setting (Choi et al., 2010; Maher et al., 2013; Smith et al., 2011). Social and environmental factors influencing obesity include socioeconomic status, living conditions, built environment, food policy, work conditions, and public policy and can serve both as a link through chronic stress on the physiology of the body or as a negative influence on health behaviors (Giskes, Van Lenthe, Avendano-Pabon, & Brug, 2011; Sinha & Jastreboff, 2013; Swinburn et al., 2011).

Long-Haul Truck Drivers and Obesity

One occupational segment encountering increased occupational hazards is long-haul truck drivers who function in a work organization characterized by long work hours, irregular and rotating work schedules, and a highly stressful work environment (Apostolopoulos, Sönmez, Shattell, Gonzales, & Fehrenbacher, 2013; Apostolopoulos, Lemke, & Sönmez, 2014). As a result of the 1980 deregulation of the industry and other neoliberal policies of the late 1970s, corporate policies and operations have caused drivers to work longer hours, have more intense delivery pressures and schedules, involve productivity-based forms of compensation (chiefly by miles driven), and have diminished relations with employers, all resulting in increased job stress or job strain (Apostolopoulos, Sönmez, & Shattell, 2010; Apostolopoulos et al., 2014; Belzer, 2000). Since 2000, the transportation industry has been regulated by the Federal Motor Carrier Safety Administration (FMCSA, 2014), a subdivision of the Department of Transportation (DOT) (FMCSA, 2014; Freund, 2007; Saltzman & Belzer, 2007). The FMCSA sets regulations pertaining to medical requirements for drivers, drug and alcohol testing, transportation of hazardous materials, and Hours of Service (HOS) (FMCSA, 2014). The primary aim of the HOS are to protect drivers from excess fatigue and accident risks by allowing drivers to only drive up to 11 hours per day and perform their range of other duties within a consecutive 14 hour time period. Meanwhile, drivers' worksites are diverse and include their truck cabs, terminals, and warehouses; drivers spend most of their "down time" at truck stops or highway rest areas and many continuous nights away from home (Apostolopoulos et al., 2014). The long hours behind the wheel results in chronic sedentariness, terminals and warehouses lead to potential exposures to harmful chemicals or substances or other injury risks, while truck stops offer little in the form healthy food selections or opportunities for physical activity.

Research suggests that many of the health problems associated with long haul truck drivers can be attributed to their work environment (Apostolopoulos et al., 2010; Apostolopoulos, Sönmez, Shattell, & Belzer 2012a; Apostolopoulos, Shattell, et al., 2012, 2014). Due to social isolation, job stressors, and erratic scheduling practices, this population has been associated with increased risks for depression and other mental illnesses as well as sleep disorders (Apostolopoulos, Sönmez, et al., 2011; Shattell et al., 2012; Ulhoa et al., 2011; van der Beek, 2012). Sleep problems and fatigue puts drivers and the general public on the highway in danger as a result of increased risk for accidents (Johnson et al., 2014; Sharwood et al., 2011). Being seated for long periods of time, frequently in detrimental ergonomic positions and experiencing constant vibration from trucks, drivers suffer from musculoskeletal disorders such as neck and lower back pains (Apostolopoulos et al., 2010, 2014; Robb & Mansfield, 2007). Work conditions and environments can also influence behaviors as certain segments of truckers have been associated with substance abuse, sexual risk-taking, poor eating habits, and low levels of physical activity (Apostolopoulos et al., 2013, 2014; Girotto et al., 2013; Ng,Yousuf, Bigelow, & Van Eerd, 2014; Sieber et al., 2014). Additionally, drivers face exposures to harmful toxins including diesel exhaust as well as various chemicals at their worksites (Apostolopoulos et al., 2014; Garshick et al., 2012; Garshick et al., 2008). At more than double the rate of American workers according to the 2010 National Health Interview Survey, long-haul truck drivers have a disproportionately higher prevalence of obesity, which presents further risks for cardio-metabolic conditions (hypertension, diabetes, cardiovascular disease; Sieber et al., 2014). The end result is the classification as one of the highest-risk occupations, including both elevated morbidity rates and decreased life expectancy when compared to the general population (Apostolopoulos et al., 2010, 2014; Saltzman & Belzer, 2007).

Interventions targeting long-haul truck drivers have been sparse. A recent review by Ng and colleagues (2014) of interventions targeting the reduction of chronic disease among drivers stressed the limited comprehensive worksite health promotion efforts and subsequent lack of organizational practices. Much of the weakness stems from the majority of interventions focusing on changing individual health behavior with limited attention to addressing the work organization (Ng et al., 2014). While there have been occupational safety and health efforts, most have been directed at reducing traffic accident rates and other occupational injuries with limited attention toward work organization's influence on obesity or other chronic disease risks (Apostolopoulos et al., 2014; Saltzman & Belzer, 2007).

Purpose and Need of Study

The Centers for Disease Control (CDC) and the National Institute for Occupational Safety and Health (NIOSH) currently emphasize work organization characteristics and organizational policies, such as benefits and compensation structures, work/life balance, and working hours and schedules as well as job stress as focal research areas (Sorenson et al., 2011; NIOSH – Total Worker Health). Similarly, Healthy People 2020 has identified social determinants of health and the reduction of health disparities as two of its significant areas of concern (US DHHS, 2012). The occupational setting is an influential social determinant of health, serving as the chief source of income and benefits (health insurance, paid leave, schedule flexibility, wellness programs). One's workplace also affects psychosocial aspects of life (job demands, social support) and ultimately serves as the pathway to living conditions and quality of life (Braveman, Egerter, & Williams, 2011). Recent literature has highlighted the links for occupational health disparities regarding health outcomes, with obesity being increasingly implicated (Baron et al., 2014; Landsbergis et al., 2014; Luckhaupt, Cohen, Li, & Calvert, 2014; Pandalai et al., 2013; Siqueira et al., 2014). Specifically, Luckhaupt and colleagues (2014) reported that the highest prevalence of obesity found among U.S. workers was among those subjected to long work hours, shift work, and adverse or stressful work environments.

Therefore, the purpose of this study is to examine the relationship between work organization factors (work hours, work schedules, perceived job stress) and the health outcomes of general and abdominal obesity and the risk of cardio-metabolic disease among long haul truck drivers. To meet these aims, primary data collected from a sample of long haul truck drivers were analyzed to provide insights into variables specific to obesity and work organization characteristics. Specific understanding of these interactions may help to inform both prevention programming in long-haul trucking companies and public policy enacted at the federal level in relation to the industry.

Research Aims

The research aims are to examine the relationships between the work organization features of work hours, work schedules, and job stress and general obesity, abdominal obesity, and cardio-metabolic disease risk among U.S. long-haul truck drivers. To meet these aims, the following research questions were answered.

Research Questions

Research Question #1: Do work hours predict BMI, waist circumference, and risk for cardio-metabolic disease?

Research Question #2: Does consistency of work schedules predict BMI, waist circumference, and risk for cardio-metabolic disease?

Research Question #3: Does perceived psychosocial job stress predict BMI, waist circumference, and risk for cardio-metabolic disease?

Definition of Terms

Long-haul truck driver—often referred to as over-the road drivers; "truck drivers who transport goods (freight, refrigerated foods, etc.) from one location to another; these drivers' routes may extend to several states and they are away from home for extended periods of time (days or weeks)" (U.S. Bureau of Labor Statistics).

Obesity—"BMI of 30 or higher" (Centers for Disease Control and Prevention).

Body Mass Index (BMI)—"a number calculated from a person's weight and height, which provides a reliable indicator of body fatness for most people" (Centers for Disease Control and Prevention) - Formula: weight (lb) / [height (in)]^2 x 703.

Waist Circumference—"waist size can help to determine if someone is at a higher risk for developing obesity-related conditions (diabetes, high cholesterol, high blood pressure, coronary heart disease; a man with a waist circumference of greater than 102 cm (40 inches) is at highest risk" (Centers for Disease Control and Prevention).

Work organization—"the work process and the organizational practices that influence how jobs are and human resource policies are structured" (Centers for Disease

Control and Prevention); characteristics include organizational context (management structures, supervisory practices, production methods, and human resource policies) and work context (job and task characteristics—physical/psychological demands, social-relational aspects of work, hours/schedules, employee development/job security).

Job stress—"the harmful physical and emotional responses that occur when the requirements of the job do not match the capabilities, resources, or needs of the worker" (National Institute of Occupational Safety and Health).

Job strain—"a mismatch in the psychological demands placed upon a worker and the range of decision-making freedom available to the worker facing those demands" (Kasarek, 1979); "characterized by continued work under stressful conditions that exceed the coping ability of the worker" (Apostolopoulos, Peachey, & Sönmez, 2011).

Federal Motor Carrier Safety Administration (FMCSA)—"agency was established with the Department of Transportation, pursuant to the Motor Carrier Safety Improvement Act of 1999; the primary mission is to prevent commercial motor vehicle-related fatalities and injuries by enforcing safety regulations" (www.fmcsa.dot.gov/mission/about-us)

CHAPTER II

LITERATURE REVIEW

The purpose of the literature review is to provide an overview of the concept of work organization and its effects on health and how it significantly impacts long-haul truck drivers. The review summarizes the concept of work organization and the changes that have taken place both in the U.S. and globally and presents a historical perspective on U.S. truck driving and how changes in work organization have played a pivotal role for the occupational segment. The review also investigates the U.S. epidemic of obesity and details disparities among occupational sectors, with a specific emphasis on long-haul truck drivers. Previous intervention strategies targeting reduced obesity rates among long-haul truck drivers and lastly, the significance of U.S. long-haul truck drivers' work organization and its impact on health outcomes including obesity and other illnesses and injuries are also presented.

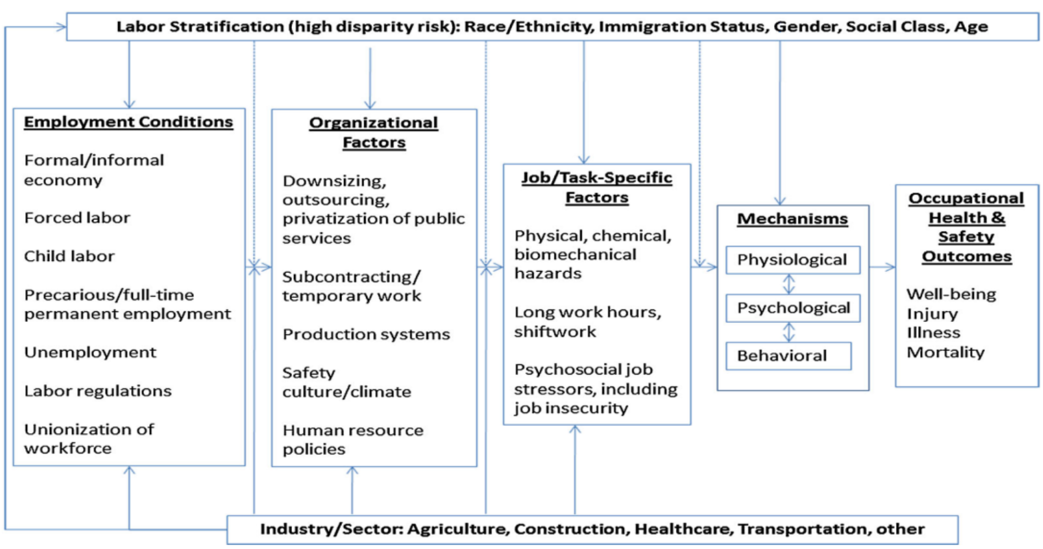
Work Organization and Occupational Health Disparities

Work is a well-established critical determinant of one's health and well-being (Clougherty et al., 2010; Gordon & Schnall, 2009). One's job serves not only as a direct link to injuries and illnesses, but more broadly serves as the foundation to one's socioeconomic status and other aspects of life, offering numerous pathways for health complications outside of the workplace (Braveman et al., 2011; Clougherty et al., 2010; Krieger, 2010). As such, it is widely accepted that those working in higher status jobs (higher incomes, better benefits, and supportive work conditions and environment) generally experience better health outcomes than those in less skilled positions (Clougherty et al., 2010; Krieger, 2010; McLeod, Hall, Siddiqi, & Hertzman, 2012).

Rooted in neoliberalism, U.S. and international workers have experienced vast changes to their work environments due to the combined forces of politics, economics, and cultural influences (Gordon & Schnall, 2009). Beginning in the 1970s and growing substantially in the early 1980s, developed countries, in trying to compete in a global market, witnessed drastic labor market changes (Sauter et al., 2002). While focusing on the expansion of profit opportunities, businesses shifted to new types of production systems and the markets created jobs emphasizing service over the traditional blue-collar and manufacturing occupations (Landsbergis, Cahill, & Schnall, 1999; Kompier, 2006). Public services became largely privatized, markets experienced less regulation or deregulation, workers lost previously held rights, union memberships declined, technological advances included the increased use of computer and information technology, and as a result workers began to experience profound changes in the way their work was organized (Gordon & Schnall, 2009). Yet another consequence of the globalization of markets and neoliberal policies emphasizing decreased regulation of industries has been an increased segmentation or stratification of workers and occupations (Siegrist, 2014). This segmentation has been frequently associated with the ever-growing income inequality, in addition to increased exposures to hazards and low safety in the workplace among those considered less skilled (Siegrist, 2014).

The National Institute of Occupational Safety and Health (NIOSH), a sub agency of the Centers for Disease Control and Prevention (CDC), identifies work organization as a significant priority area for occupational health research (Sauter et al., 2002). Work organization includes how jobs are designed and performed as well as organizational and human resource policies developed and implemented by employers (Sauter et al., 2002). From a work context, tasks performed on the job and the resulting demands, the social support and relationships within the workplace, the roles and duties assigned, the scheduling and hours of work, job security, and the opportunity for development are all features (Sauter et al., 2002). Correspondingly, the organizational context describes restructuring of employees, measures for increased productivity (faster pace of work), employment arrangements, work-life balance programs, and compensation systems and benefits such as health insurance (Sauter et al., 2002). Within that context and due to a variety of factors including globalization, technological advances, and public policy, the U.S. has encountered numerous changes to the ways in which work is organized and specific tasks that are performed (Landsbergis, 2003; Landsbergis et al., 2014). The work context further includes the culture and social-relational aspects, such as relationships with coworkers and supervisors, and opportunities for professional growth and development (Sauter et al., 2002).

The organization of work can play a profound role on one’s health and safety not only in the workplace but also in their quality of life outside of work in the form of chronic health conditions and life expectancy. The discrepancies in work organization among occupations have been recognized as playing a critical role in occupational health disparities (Landsbergis et al., 2014). Figure 1 displays Landsbergis et al.'s conceptual model supporting this rationale. Moreover, the National Occupational Research Agenda (NORA), as a part of NIOSH, has identified work organization as a key research area for certain occupations such as long-haul truck drivers (Alterman, Luckhaupt, Dahlhamer, Ward, & Calvert, 2013). Specific to obesity, Luckhaupt and colleagues (2014) reported that the prevalence of obesity among U.S. workers was greatest among those working more than 40 hours a week, those working night or rotating shifts, those encountering a hostile work environment with high job strain, and those with a work-family imbalance. The following sections examine the job/task-specific factors of work organization in relation to their influence on health behaviors and outcomes with an emphasis on work schedules, namely long hours and shift work, and psychosocial job stress that result from the job tasks assigned.



Source: Landsbergis et al. (2014)

Figure 1. Conceptual Overview of the Role of Work Organization in the Creation of Occupational Health Disparities.

Long Work Hours

Among all industrialized nations, the U.S. has the longest working hours on an annual basis and the proportion of workers working long hours has increased substantially over the past three decades (Caruso et al., 2006; Johnson and Lipscomb, 2006). The longer hours of work allow employees less time to recover for their next shift and the lack of proper recovery time has been associated with added risks of work injuries and health complications (Geiger-Brown, Lee, & Trinkoff, 2012). Specifically, of those employed persons between the ages of 25 and 54, the average works nearly 9 hours (8.7 hours) daily (Bureau of Labor Statistics, 2014). Using data from the 2010 National Health Interview Survey, Alterman and colleagues (2013) found that 18.7 percent (24.5 percent of men) of American workers work 48 or more hours per week; the highest prevalence rates were found in the mining (50.4 percent), agriculture, forestry or fishing (37.3 percent), and transportation and manufacturing sectors (28.4 percent). Meanwhile, 7.2 percent (9.5 percent of men) Americans reported working 60 or more hours per week, with transportation and material moving occupations having the highest prevalence rate (10.9 percent) (Alterman et al., 2013). Sieber's (2014) survey findings revealed that long-haul truck drivers averaged 60.4 hours per week.

Long work hours have been associated with numerous factors contributing to obesity and recent evidence has indicated those working more hours are at greatest risk (Courtemanche et al., 2009; Escoto et al., 2010; Gu et al., 2012). Luckhaupt and colleagues (2014) found a 1.09 prevalence ratio for those American workers working more than 40 hours a week, when compared to those working between 35 and 40 hours.

Most notably, past reviews have detailed extended working hours association with sleep problems or deprivation (Caruso, 2014). Poor sleep quality can affect the body physiologically and alter the circadian rhythm; furthermore, long work hours can create abnormal stress responses (Johnson & Lipscomb, 2006). Prolonged sleep deprivation and sleep disorders can potentially lead to detrimental effects on the body's endocrine system and metabolic rate (Caruso, 2006; Caruso, 2014). In fact, several studies have indicated that the link between longer work hours and obesity is mediated by short sleep duration (Di'Milia & Mummery, 2009; Ko et al., 2006; Magee, Caputi, & Iverson, 2011). Concerning long work hours and psychological responses, studies have suggested that there is greater risk for depression and anxiety (Virtanen et al., 2011; Virtanen et al., 2012) as well as mood disorders and decreased cognitive functioning, attention span, and concentration level (Caruso, 2006, 2014; Virtnanen et al., 2009). The combination of sleep deprivation and misaligned circadian rhythm in conjunction with stress and depressive disorders can significantly impact health behaviors (Bushnell et al., 2010; Geiger-Brown et al., 2012). Specifically, the longer hours of work allows for less time to exercise and obtain physical activity, particularly in sedentary jobs, and less time to prepare and consume healthier food options (Caruso, 2006). In a review of psychosocial factors and long hours of work, researchers indicated that the evidence shows a suggestive association between obesity and long work hours, particularly among men (Solovieva et al., 2013).

Shift Work

Shift work refers to any work shift during hours outside the 7 a.m. to 6 p.m. period (Caruso, 2014). Within the realm of shift work, many also refer to rotating shifts and those that work night shifts (Geiger-Brown et al., 2012). Rotating shifts refers to working inconsistent schedules on either a daily or weekly basis (Wang et al., 2011). Findings from the 2010 National Health Interview Survey revealed that 28.7 percent of American workers reported alternative or rotating shifts (Alterman et al., 2013), up from the 17.7 percent found from data compiled in 2004 by the Bureau of Labor Statistics. Transportation and material moving occupations were again among the highest, with 38.6 percent working alternative shifts (Alterman et al., 2013). Among those American workers working either predominantly night shifts or rotating shifts, their prevalence ratio for obesity was 1.05 when compared to those working only day shifts, signifying a slightly higher rate.

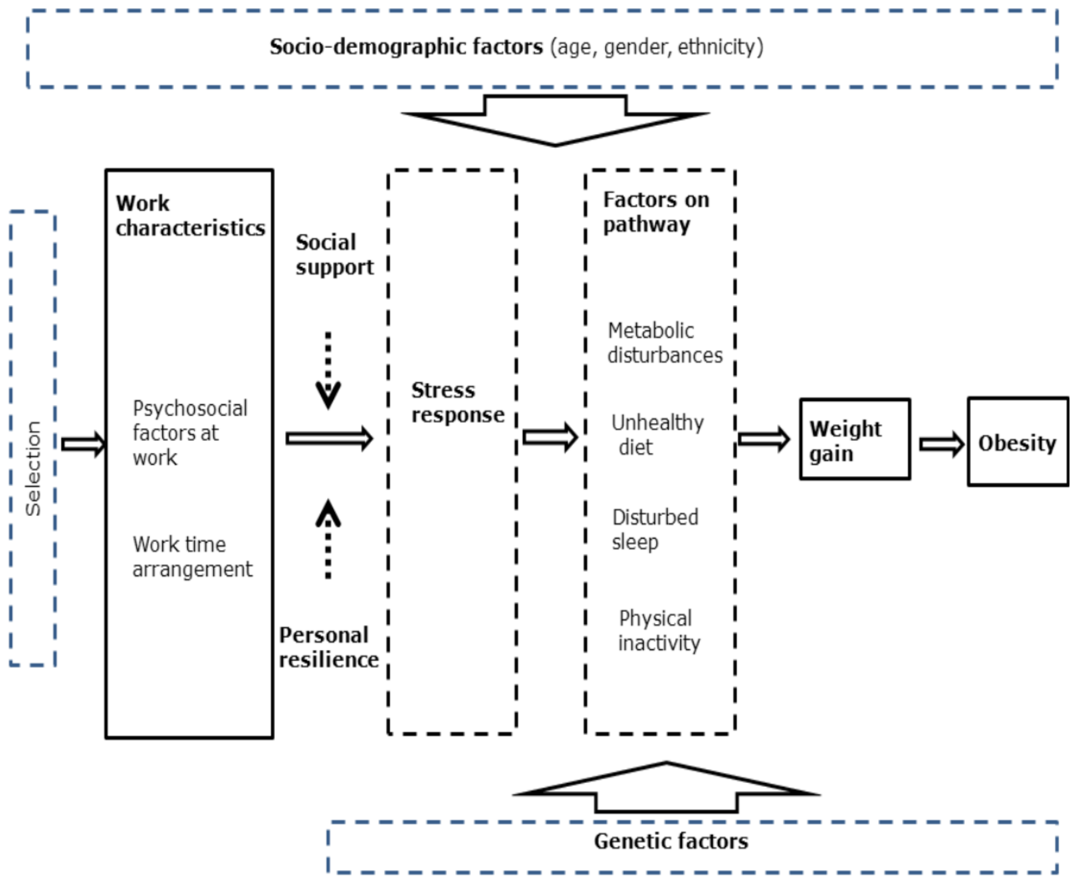
Much like long hours of work, shift work has been found to be associated with numerous contributing factors to obesity. Antunes and colleagues' review (2010) described the various mechanisms in which shift work impacts the biological rhythms of the body and contributes to a misaligned circadian rhythm. Their review highlighted studies in which occupations featuring prevalent shift work, such as nursing or manufacturing, consistently had higher BMIs and waist circumferences when compared to workers working regular hours. Alternative work hours were also associated with environmental and social discrepancies, which impacted sleep patterns, including the sleep-wake cycle, and meal patterns in which unhealthy food options are prevalent when working during the night hours. As well, the review documented shift workers' struggles with psychosocial disorders and anxiety and how shift work had been associated with metabolic disorders like glucose intolerance or insulin resistance. Most critically, however, are the effects shift work has been shown to have on the secretion levels of leptin and ghrelin. Also, the misalignment of the body's exposure to light and darkness in combination with stress in the workplace may potentially lead to increased fat composition in the mid-section of the body such as found in centralized obesity (Antunes et al., 2010). Likewise, findings from another review concerning shift work and body weight change pointed to a causal link between prolonged exposure to shift work and the development of excess body weight (van Drongelen et al., 2011). However, van Drongelen and colleagues (2011) were quick to highlight potential confounders such as physical activity could reduce this association as shift workers have been associated with lower physical activity levels. Lower levels of physical activity in combination with the physiological effects and poor nutritional intake could lead to the increased odds of obesity. Furthermore, physical activity has been associated with improved sleep quality and increased sleep duration as well as improved metabolic functioning in previous literature (van Drongelen et al., 2011). Another factor that could be considered would be age as it could be that those who are older and have experienced more shift work could be able to better tolerate the effects of shift work. Marqueze and colleagues (2012) focused solely on the influence of irregular work schedules on metabolic disorders among truck drivers. Much like the other reviews, they emphasized the impact the circadian misalignment has on metabolism, particularly on the hormones leptin and ghrelin, which when combined with sleep disorders, presents the 'perfect storm' for obesity. Specific to truck drivers, the lifestyle factors, physical activity and diet, are intricately linked with irregular work shifts. The inconsistency has been shown to contribute to unhealthy food selections, as well as lessening the opportunities for engaging in physical activity. In turn, poor lifestyle choices such as a high frequency of processed and sugar-laden snacks and short sleep duration can impede the circadian rhythm (Marqueze et al., 2012).

Psychosocial Job Stress (Job Strain)

Psychosocial job stress, often referred to in the literature as job strain, refers to stress resulting from the interaction between the worker and the job's environment, is a theoretical framework closely related to the organization of work and a major concern of occupational health professionals (CDC – Work Organization and Stress-Related Disorders). Four models have been utilized to describe job strain: the Person-Environment Fit Model, the Effort-Reward Imbalance Model, the Demand-Control Model, and the Iso-Strain Model (Kuper & Marmot, 2003). The Person-Environment Fit model maintains that an individual worker may not fit with his/her environment or conditions surrounding the job (Kristof-Brown & Guay, 2011). The Effort-Reward Imbalance Model suggests that workers not sensing worth in their job or that they are rewarded accordingly experience strain (Siegrist, 2002). The Demand-Control Model emphasizes that workers experience excessive physical and psychological demands that exceed the ability to cope with or to control situations affecting their work (Häusser et al., 2010). Key psychological demands from this model include working at a very fast pace, not having enough time to get the job done, the job not allowing learning new things or making use of one's skills, job involving frequent repetitive work, and the job not allowing decisional latitude or how it affects their life outside of work, including home and family responsibilities (Belkic, Landsbergis, Schnall, & Baker, 2004). Last, the Iso-Strain Model extends beyond the demand-control model to suggest that if it is accompanied with social isolation (lacking support from supervisors and coworkers) the risks for health complications increase (Johnson et al., 1989). On the other hand, social support from supervisors and coworkers can decrease health implications associated with high psychosocial stress stemming from the work environment.

Recently, Luckhaupt and colleagues (2014) reported that those American workers encountering a hostile work environment, indicative of high job stress, had a prevalence ratio of 1.13 for obesity when compared to those who did not have a hostile work environment. Similar to long hours and shift work, psychosocial job stressors related to work conditions have been associated with numerous contributing factors to obesity (Brunner, Chandola, & Marmot, 2007; Ostry, Radi, Louie, & LaMontagne, 2006; Schulte et al., 2008). Using data from the Whitehall II Study in Britain, the Helsinki Health Study from Finland, and the Japanese Civil Servants Study, researchers found discrepancies in the number of hours worked in each study as well as job strain levels among participants from each study (Lallukka et al., 2008). Concurrently, there were differences in the health behaviors and outcomes (unhealthy eating, physical inactivity, and obesity) of the groups, however, the associations were weak and rare (Lallukka et al., 2008). Similar findings were reported in another examination of the Helsinki Health Study (Roos et al., 2013). Solovieva and colleagues (2013 also reported weak and inconsistent associations between psychosocial job stressors and weight gain or obesity. This contradicted findings from a previous examination of the Whitehall II study performed by Brunner and colleauges (2007) in which they found that job strain, particularly when there is a lack of social support at work, was indeed a strong predictor of both general and central obesity. In another study, researchers examined data from 13 employee cohorts from European countries and reported that there were associations, but the associations provided limited evidence to support job strain as a direct causal factor for obesity (Nyberg et al., 2012). The researchers postulated that an increased waist circumference could be the role in which job strain affects the body physically. Interestingly, in another study depicting the inconsistent relationship between job strain and obesity, conclusions were that there may be a bidirectional effect between job strain and obesity, in that job strain increases weight upon those who already have a higher BMI, whereas, it reduces weight on those who are already lean (Kivimäki et al., 2006). In a study of Swedish workers, job control (e.g., pace of work) and stressors (e.g., poor relationships with supervisors and coworkers) were significantly important predictors of subsequently a higher BMI (Berset et al., 2011). The researchers speculated that the stress incurred from the work environment potentially had adverse effects on metabolic conditions and physiological changes within the body, which also provided a negative influence on eating and physical activity behaviors, and sleep (Berset et al., 2011). Siervo and colleagues (2012) further supported this hypothesis when they argued that the increased risk of hypertension due to poor work conditions could serve as the pathway to obesity through chronic stress and alteration to homeostasis of the physical body. An

Australian study found that job strain in conjunction with longer work hours and adverse work schedules were indicative of weight gain and obesity (Magee, Caputi, Stefanic, & Iverson, 2010). Figure 2 depicts Solovieva and colleagues' (2013) model for the associations between psychosocial factors at work, work hours, and obesity. The section that follows details the historical context of the trucking industry up to the present work organization.



Source: Solovieva et al. (2013)

Figure 2. Hypothetical Model of the Associations between Psychosocial Factors at Work, Long Work Hours, and Obesity.

The Obesity Epidemic

The rates of obesity in the U.S. and globally have drastically increased over the last half century, more than doubling since 1970 (Hammond & Levine, 2010). In fact, currently more than two-thirds of Americans (34.9 percent) are classified as obese (Ogden et al., 2014) compared to just a 15 percent prevalence rate between the years of 1976-1980 and a 13.4 percent rate from 1960-1962 (Ford et al., 2011). Specifically, a recent study found that the average BMI of an American male in 2009-2010 was 28.6, compared to 26.6 from 1988 to 1994 (Ladabaum et al., 2014). Forecasts performed by Wang and colleagues (2011) predicted that within the next two decades an additional 65 million adults will be classified as obese. Globally, projections are for 1.12 billion people to obese by 2030 (Kelly et al., 2008). Specific to the U.S., Finkelstein and colleagues (2012) predict that 51 percent of citizens will be considered obese by 2030.

Of particular concern is abdominal or centralized obesity (excess belly fat), measured by waist circumference. A recent report showed that while general obesity rates have not significantly increased in the U.S. over the last decade, the prevalence of abdominal obesity is still on the rise (Ford et al., 2014). The increased waist circumferences of Americans, particularly among men, resulting in abdominal obesity and centered in the mid-section of the body contributes to even greater health risks (Ford et al., 2011; Ladabaum et al., 2014). Findings from the Ladabaum et al. (2014) study further indicated that the mean waist circumference of American males in 2009-2010 was 100.4 centimeters, up from 95.6 in 1988-1994; the percentage of males considered abdominally obese was 42.0, as compared to 29.1 in 1988-1994.

Determinants of Obesity

Obesity is caused by a complex set of intertwined and multilevel reinforcing factors (Huang, Drewnowski, Kumanyika, & Glass, 2009). At the most elementary level, obesity occurs due to an individual's imbalance between energy intake (dietary consumption) and energy expenditure (physical activity). Underlying effects on the individual's risk for weight gain and ultimately the development of obesity include genetic predispositions and physiological and metabolic disturbances at the biological level. At the individual level, other health behaviors and outcomes such as a lack of sleep, misaligned circadian rhythm (the body's 24 hour physiological clock), and excessive stress can both impact the physiology of the body and influence decision making in terms of physical activity and dietary intake. In terms of population-level obesity, and likewise at the individual level, environmental determinants at the social, organizational, and community levels as well as physical and food environments serve as influences. At the macro-level, public policies instituted by all levels of government position as sources of influence on behavior and obesity outcomes.

Genetics/Physiology/Metabolism/Circadian Rhythm. At the genetic, physiological, and metabolic levels, much of the literature points to the influence of the hormone leptin, in its effect on weight gain and obesity. Leptin is responsible for the body's signals, particularly when there is a drop in leptin levels, for food or energy intake as well as energy expenditure (Ahima, 2011; Ramachandrappa & Farooqi, 2011). Neuroendocrine functioning, basal metabolic rates, and insulin production, have also been associated with leptin (Ahima, 2011; Ramachandrappa & Farooqi, 2011). Much of the body's production and utilization of leptin, as well as insulin resistance, β cell expansion, and hyperinsulinemia, have been shown to have a strong association with the circadian clock, specifically misalignments of the body's physiological 24-hour clock (Ahima, 2011; Froy 2010, 2011). Froy (2010, 2011) detailed how the circadian clock regulates both the body's physiology and subsequent behaviors such as food intake, the sleep/wake cycle, the endocrine system, metabolism within the body including the hormones insulin, leptin, and ghrelin as well as cardiovascular activity. As such, leptin serves as a bridge between energy homeostasis or physiological balance and the control of the circadian clock.

Recently, more research has implicated the impact that sleep and psychosocial disorders and particularly chronic stress, have on the physiology of the body. For instance, there has been an association with both a disruption of the circadian clock and hormonal imbalances as a result of these disorders (Froy, 2010, 2011). Chronic stress, in addition to its influence on physiology, also serves as an adverse effect on behaviors such as dietary intake and physical activity (Dallman, 2010; Scott et al., 2012; Siervo et al., 2009). Specific to the effect of stress on metabolism, studies have suggested that cortisol may be a causal factor for obesity, particularly centralized obesity (Brunner et al., 2007; Chandola et al., 2008). Conversely, Abraham, Rubino, Sinaii, Ramsey, and Nieman (2013) conducted a literature review and utilized data from 369 overweight and obese participants as well as 60 healthy participants and reported no strong relationship between cortisol or stress and obesity. In addition, short sleep durations have been shown to be an independent risk factor for obesity (Nielsen et al., 2011). More specifically, Buxton and

Marcelli (2010) used data from the 2004-2005 National Health Interview Survey (NHIS) and found that those reporting an average sleep duration of less than seven hours daily were significantly associated with a probability of obesity; interestingly, they also reported that those sleeping more than eight hours were also associated with a probability of obesity. Findings from the NHIS for the years 2005-2010 further support short sleep duration as a greater risk as researchers observed that shorter sleepers were more likely to be obese or abdominally obese (Ford et al., 2011). There is even further concern with the ongoing increase in prevalence of Americans reporting six or less hours sleep daily (29.9 percent of civilian workers between 2004 and 2007); there are also distinct disparities in sleep duration existing between certain industries and occupations (Luckhaupt, Tak, & Calvert, 2010). However, there is reason to believe that many of the other underlying factors, such as environmental, social, and public policy, may serve as primary culprits leading to decreased sleep durations among Americans (Nielsen et al., 2011).

Health behaviors—Physical inactivity and dietary intake. Most widely accepted and considered key components of weight gain and obesity are physical activity and diet. The behaviors are influenced by many factors as pointed out in subsequent sections of this review, but it is evident that physical activity levels and nutritional intake have vastly changed in the last 30 to 40 years (Ford & Dietz, 2013; Maher et al., 2013). Using data from the National Health and Nutrition Examination Survey (NHANES) from the years 2003-2006, Maher and colleagues (2013) found that those participating in lower levels of physical activity, even when controlling for total sedentary time and dietary factors, were at a higher risk for developing obesity. The authors' conclusions actually contradicted much of the previous research that had highlighted the effects of prolonged sedentariness as being the more significant contributor to general and centralized obesity (Healy et al., 2011). In another study using data from the Nurses' Health Study, with three separate cohorts and evaluated at 4-year intervals, researchers reported that those participants who increased their physical activity levels the greatest during each 4-year interval gained nearly two fewer pounds, regardless of other controlled factors such as dietary intake or sleep duration (Mozaffarian, Hao, Rimm, Willett, & Hu, 2011). One plausible explanation that has been documented for the nation's decreased physical activity levels and increased sedentariness is the ongoing evolution in jobs from physically demanding labor to service sector jobs requiring little physical activity (Choi et al., 2010). The changing diet of Americans, meanwhile, has been a highly debated topic in the literature as well. According to findings from Ford and Dietz (2013), using self-reported data from the NHANES, the caloric (energy) intake of Americans increased yearly from 1970 to 2004, when it peaked; however, there has been a gradual decline in the years since. The authors pointed out that their research did not consider such factors as the frequency of eating out, particularly at fast food venues which has increased substantially, the larger portion sizes at restaurants, and the intake of energy-dense processed foods that are frequently consumed by Americans. This was the argument that Lucan and DiNicolantonio (2014) made in their commentary regarding the influence of food intake on rising obesity rates. Further, research has shown that the majority of Americans does not comprehend appropriate portion sizes and as a result many times consume a higher caloric intake than is estimated (Cohen & Story, 2014). This was the premise of *Fast Food Nation*, in which Schlosser (2001) detailed the changes in food consumption in the U.S. and how the fast food industry has profoundly affected the American diet and how eating is approached. Popkin (2009) further describes the change in eating patterns in relation to the obesity epidemic, and pointed to the rise in consumption of sugar-rich and processed foods along with the larger serving sizes at restaurants.

Social, cultural, organizational, community, physical/food environments. Extensive literature points to many social, cultural, organizational, community level factors including the built environment and food environment, which influence stress levels and physical activity and dietary behaviors. For instance, increased social support and social relationships, which come in large part from family members, friends, and coworkers, have been associated with healthier behaviors (Kiernan et al., 2012; Tamers, 2011), whereas a lack of social connectivity or support or negative social interactions can have the reverse affect and create additional stressors on the body (Berkman, Glass, Brissette, & Seeman, 2000; Heaney & Israel, 2008). In their longitudinal study, Wang, Pbert, and Lemon (2014) further supported this finding indicating that friend and coworker support for healthy eating and family support systems for physical activity all predicted improved weight management. In contrast, if family members did not model good eating habits or were not supportive of healthy eating, the familial social undermining was predictive of weight gain (Wang et al., 2014). Culturally, the western lifestyle in the U.S. is predicated on social connections with food and inactive lifestyles along with hurried lifestyles (Froy, 2010). At the organizational level, work and school settings are vastly regarded as influential on rising obesity rates and this is the primary reason for interventions targeting these environments. Workplaces are where adults spend the majority of their waking time and form social networks. The physical environments of worksites and psychosocial working conditions have each been associated with obesity (Cairns et al., 2014). In addition, work is widely considered the key component to social status and a social determinant of health, therefore, workplaces can influence obesity socially and behaviorally (Cairns et al., 2014). Likewise, school settings are where children spend large amounts of time and thus dietary intake is largely shaped by the food choices offered and physical activity afforded through structured physical education (Bleich et al., 2014). At the community level, much of the literature has focused on the built environment's role in physical activity participation and the local food environment's role in eating habits (Ding & Gebel, 2012; Giskes et al., 2011; Sallis et al., 2012). The built environment's role in physical activity exists in multiple levels including recreational facilities and community design features such as sidewalks and greenways, transportation patterns and walkability, worksites for adults and schools for students, and in home settings (Sallis et al., 2012). Giskes et al. (2011) further suggested that when environmental surroundings fail to provide access to physical activity opportunities or healthy food options, the settings can be considered 'obesogenic.'

Public policy—Economics, social determinants, and health disparities. Public policy, forged through the political process at the macro-level, shapes societies including the living conditions and working conditions experienced by citizens, their access to health resources and insurance, their quality of life, and in large part their health behaviors and outcomes (Navarro, 2009). As such, researchers have made the connection over the last decade between policy transformations, based in neoliberalism, around the world in the late 1970s and the early 1980s and worsening health outcomes including rises in obesity rates (Navarro, 2009; Swinburn et al., 2011). During this time period, neoliberalism led to a reduction in government regulations regarding economic and social activity; labor and financial markets were deregulated and globalized markets and numerous technological advances have transpired (Navarro, 2009). Neoliberalism has thus been frequently associated with driving income inequalities among individuals and populations and wealth inequalities among nations, having huge implications for health disparities (Coburn, 2004). These changes have led to a more focused examination of the social determinants of health in public health research, including such factors as educational attainment, employment/working conditions, access to healthcare, and income as pivotal to population level health indicators (Raphael, 2006).

Much literature has shown the effects of public policy on rising obesity and how policy serves as a mechanism for creating health disparities in relation to obesity, particularly among race, income, educational attainment, housing, and medical and health access (Braveman, 2009). In turn, each of these social factors is intricately connected and simultaneously influences each other (Braveman, 2009). Most notably, these factors can cause psychological distress and chronic stress, which impact the body both at the physiological level and behavioral level. In addition, for example, educational attainment directly affects one’s income potential and thus their housing and living conditions and where they live as well as their access to health and medical resources; these factors ultimately play a large role in determining access to physical activity and exercise patterns and to healthy food options (Braveman, 2009).

Central to the obesity epidemic, the literature has suggested that changes in food policy and lifestyle as a result of neoliberal policies, globalization of markets, and technological advances serves as a mechanism. The food policy changes have emphasized the types of food produced and why (corn and soybeans) through subsidies provided by government for farmers to produce them rather than healthier fruits and vegetables. It is closely associated with our increased dependence on sugar-sweetened and processed foods (Gearhardt et al., 2012; Huang et al., 2009). Other areas include the marketing of unhealthy foods (particularly to vulnerable populations), how food companies manipulate certain ingredients spurring food addictions, unhealthy school food practices and the reduction physical activity opportunities, and food menu and labeling policies (Gearhardt et al., 2012). Regarding physical activity, urbanization and built environments, modifications to work environments, people working more hours and spending more time sedentary, and the promotion of other forms of entertainment or recreation are frequently mentioned as contributors (Swinburn et al., 2011; Choi et al., 2010).

Long-Haul Truck Driver Work Organization and Obesity

The U.S. trucking industry initially grew out of the teaming industry, beginning with the use of carts and horses, of pre-colonial America (Belzer, 2000). As the U.S. economy progressed and further demanded the movement of commerce from region to region, teamsters had to adapt, which brought about using ports, canals, and rail lines

(Belzer, 2000). In 1896, the motorized truck was invented, signifying a demand for better roads and new ways to transport goods and materials (Belzer, 2000).

Unionization, specifically the Teamsters, had a profound impact on the industry in the early 20th century as the trucking industry expanded after World War I, and even more so with the development of the Interstate Highway System in the 1950s (Belzer, 2000). As a result, the first three quarters of the 20th century were marked by government regulation, initially operating at the state level (Belzer, 2000; Freund, 2007). Regulations kept businesses and their practices in check, controlled prices within the economy, and improved social and environmental conditions for working class populations (Belzer, 2000). Specific to the trucking industry, the U.S. Motor Carrier Safety Act of 1935, enacted as a portion of the Interstate Commerce Act (Freund, 2007), regulated interstate competition and thereby also secondarily addressed safety concerns on state and federal highways (Belzer, 2000). With strong union and collective bargaining support, drivers experienced steady rises in wages while work conditions remained stable (Belzer, 2000). The industry remained under federal regulation under the authority of the Interstate Commerce Commission until the mid-1970s (Belzer, 2000).

Beginning in the mid-1970s and reaching a tipping point in 1980, numerous industries (airlines, construction, banking, etc.) including trucking, experienced historic adjustments in the way businesses operated (Belzer, 2000). With an American culture emphasizing individualism and liberty along with fears of inflation and economic recession, this time period brought about intensified calls for deregulation of industries and a shift in control from the government to the private sector (Schnall et al., 2009).

The years of the Reagan presidency, notorious for the enactments of neoliberal policy initiatives across the U.S., have been described as a causal pathway for a reduced quality of life and social inequalities experienced by the working class that still exists today (Navarro, 2007b). These changes led to a rapid decline in unionization among long-haul truck drivers and they relinquished much of the power previously held in terms of shaping their work conditions (Saltzman & Belzer, 2007). The U.S. Congress passed the Motor Carrier Act of 1980, dismantling much of the regulatory control of the trucking industry, and therefore, drivers experienced significant alterations to their pay structures (piece-rate—paid by the mile) leading to wage declines, excessive competition among companies, loss of previously provided benefits, and hazardous working conditions (Belzer, 2000). Now more than 30 years later, the work organization mirrors that of the conceptual model portrayed by Landsbergis and colleagues (2014) featuring long hours, irregular schedules and rotating shifts, and numerous psychosocial job stressors. The next couple of sections describe the government/public policy and corporate policy and operations driving the work organization of the trucking industry.

Federal Motor Carrier Safety Administration (FMCSA)

The FMCSA, a sub-agency of the Department of Transportation, was established on January 1, 2000 in response to the Motor Carrier Safety Act of 1999 and is the government regulating body for the trucking industry. The FMCSA is responsible for such areas as medical requirements for drivers, drug and alcohol testing of drivers, regulations surrounding the delivery of hazardous materials, monitoring compliance with noise and environmental standards, and their rules are applicable to employees, employers, commercial motor vehicles such as tractor trailer trucks for interstate commerce. This dissertation focuses on the key component of the hours of service (HOS) for drivers, which emphasizes driver and public safety on highways.

The HOS regulations are primarily centered on the prevention of excess fatigue among drivers and restrict the legal number of hours drivers are allowed to incur daily and weekly, or in some cases 8-day periods (FMCSA, 2014; Jensen & Dahl, 2009). The HOS have been in place since the 1930s, specifically 1937 as a result of the Motor Carrier Act of 1935 (Robin-Vergeer, 2007), and excluding slight modifications have remained in the same form until significant changes took place in 2005 and received even further updates in 2013 (FMCSA, 2014; Freund, 2007; Saltzman & Belzer, 2007). Presently, drivers are allowed to drive up to 11 hours daily and have an overall 14-hour work day limit, which includes all job duties (FMCSA, 2014). The newest provisions limit drivers to accumulate a maximum 8-day period of 70 work hours, or 60 hours per 7 days, which is down from the previous maximum of 82 hours (FMCSA, 2014). A caveat is that drivers are allowed to resume driving if they have reached the 70 hour limit but they have had a 34-hour continuous rest period (FMCSA, 2014). Drivers must have at least two nights of sleeping time between 1:00 and 5:00 a.m. and take a 30-minute break during the first eight hours of their work shift. Recognizing the complications stemming from rotating work schedules, the two nights of sleeping time between the hours of 1:00 and 5:00 a.m., when the body is most apt to sleep and rest, were put into place in to try to alleviate the repercussions of a circadian misalignment due to the abnormal sleep and wake schedules. In addition, those drivers with sleeper berths in their truck cab must have 8 consecutive hours within their sleeper berth and at least two hours of a separate time either in the berth or off duty in some other location such as a truck stop or rest area. The latest rules further require trucks to feature electronic onboard monitors to ensure that HOS are followed (Kemp et al., 2013).

Corporate Policies and Operations

In response to deregulation of the industry, operations and policies implemented by trucking companies center on profit, productivity, and competition. This includes such strategies as just-in-time delivery schedules, irregular work hours, and compensation structures based on productivity (paid by the mile, percentage of revenue), which incentivize drivers to work more hours and at a faster pace (Apostolopoulos et al., 2014). Further, to meet the demands of delivery schedules, drivers must work and be alert at all hours of the day and are away from their homes for extended periods of time, spending only a few days home a month. The intensified work environment has fueled imbalances between the drivers and their employers and contributed to an overall hostile work climate (Belzer, 2000; Saltzman & Belzer, 2007). Meanwhile, the operations extend to worksite settings including truck stops and terminals in which they deliver goods to warehouses, rest areas, and the truck cab (Apostolopoulos, Peachey, et al., 2012; Apostolopoulos, Sönmez, et al., 2012). The truck stops are where drivers spend their down time and eat their meals and engage in conversation with other drivers and relax in entertainment and leisure venues. It is also where drivers get maintenance performed on their trucks and shower and do their laundry (Apostolopoulos, Peachey, et al., 2012; Apostolopoulos, Sönmez, et al., 2012). At truck stops, truckers find unhealthy food options in the form of fast food and other processed options (Apostolopoulos, Sönmez, et al., 2011). In addition, due to adverse and unpredictable work schedules, they may only have one large meal at the end of the work day while relying on unhealthy snacks throughout their driving time. Meanwhile, the resources and facilities for physical activity and the surrounding built environment at truckers' worksites are limited as well (Apostolopoulos, Shattell, et al., 2012).

Long-Haul Truck Driver Health Effects and Comorbidities

Long-haul truck driving has been repeatedly classified as one of the highest-risk occupations in the U.S., due to the wide array of physical and psychological disease resulting in high morbidity rates and a reduced life expectancy when compared to the general population. Apostolopoulos and colleagues (2010) reported on six predominant health problems of truck drivers including psychological and psychiatric disorders such as depression and chronic stress, disrupted circadian rhythms and sleep disorders, musculoskeletal disorders, cancers and respiratory diseases, cardiovascular disease, and risk-laden substance use and sexual practices. Specific to the physical and psychological workload of the profession, truckers experience long hours of sitting while driving, which also involves much vibration and jarring, resulting in lower back pain, neck pain, and general discomfort (Apostolopoulos et al., 2014). The long hours in combination with disrupted sleep schedules, time and delivery pressures, lack of support from coworkers and supervisors, and social isolation contributes to the gamut of work-related stress and can lead to elevated risks for depression or other psychological disorders (Apostolopoulos et al., 2014). Sleep deprivation and other sleep disorders such as obstructive sleep apnea are prevalent among the truck-driving population and puts drivers and the public at risk of highway traffic accidents (Apostolopoulos et al., 2014). Besides physical inactivity and poor nutritional intake, long-haul truck drivers have been associated with drug use in the form of stimulants to assist in concentrating while driving and staying awake and depressants (e.g., tobacco, alcohol) to help cope with stress involved with the work (Apostolopoulos et al., 2014). Some smaller segments of this population have been associated with unsafe sexual practices taking place at truck stops and involving female sex workers; on some occasions these experiences involve drug transactions as well (Apostolopoulos et al., 2014). Exposures to harmful chemicals including diesel exhaust have been associated with increased cancer risks among truck drivers and the development of heart disease stemming from respiratory conditions (Apostolopoulos et al., 2014). The combination of chronic stress and poor behaviors contribute to the long-haul truck driving population having an increased risk for obesity and cardio-metabolic disease risk in the form of hypertension, diabetes, and cardiovascular disease (Apostolopoulos et al., 2014).

Worksite Interventions Targeting Long-Haul Truck Drivers

Previous studies (Ng et al., 2014; Krueger, 2007; Saltzman & Belzer, 2007) have consistently revealed the lack of worksite health promotion interventions and the many weaknesses of the attempts. Much of the limitation has stemmed from the predominant focus on individual level behavior changes such as increased physical activity and improved diet, with little attention placed on the overall work environment. One particular program developed in collaboration with the FMCSA, the Gettin' in Gear program offered the 4-Rs featuring: refueling, rejuvenating, relating, and relaxing (Krueger, 2007). The program provided recommendations for healthy food selections while on the road, educational information regarding proper nutritional intake and physical activity, descriptions of sample exercises, education on the importance of personal relationships and how to improve and expand social networks, and stress management techniques. While this program provided short-term positive results in the form of healthier behavior, it did not address work conditions influencing drivers' behaviors. More recently, programs such as the Safety and Health Involvement for Trucker (SHIFT) and the Gear Up for Health programs sought to incorporate strategies into the daily work lives of drivers (Olson et al., 2009; Sorenson et al., 2010). The SHIFT program utilized a weight-loss competition with incentives, computer-based health education for exercise and diet changes for drivers while on the road, and a website to monitor their goal attainment. The Gear Up for Health program featured telephone counseling to reach drivers out on the road along with educational materials on how to respond to stressful work situations and improved coping mechanisms. None of these programs, however, appeared to recognize that work organization was a critical factor. Moreover, none of the programs appeared to be comprehensive as it pertains to the five elements considered the key components of worksite health promotion: health education; links to employee services; supportive physical and social environments for health improvement; integration of health promotion into the organization's overall culture; and employee screenings with treatment and follow-up (Goetzel & Ozminkowski et al., 2008). Others have also reported the weaknesses being that companies and the industry are overly concerned with the safety aspects while overlooking the chronic disease risks associated with the profession (Apostolopoulos et al., 2014).

Obesity among American Long-Haul Truck Drivers

A recent survey of U.S. long-haul truckers (*n*=1,265) found that 68.9 percent (*n*=815) of drivers were classified as obese; of the 68.9 percent considered obese, 17.4 percent were morbidly obese (*n*=210) (Sieber et al., 2014). This was not surprising as the literature has depicted the truck driving occupation as having an 'obesogenic' work environment featuring high levels of sedentariness, lack of physical activity opportunities, and primarily fast food and processed food options when stopping at truck stops and other rest areas (Apostolopoulos, Shattell, et al., 2012; Apostolopoulos, Sönmez, et al., 2012; Apostolopoulos, Sönmez, et al., 2011). Meanwhile, those working in the transportation and warehousing sectors were among those U.S. industries experiencing the highest prevalence of a short sleep duration (Luckhaupt et al., 2010) and truck drivers work in a stressful environment and suffer disproportionately from mental illness (Apostolopoulos et al., 2014; Apostolopoulos, Peachey, et al., 2011; Apostolopoulos et al., 2013). In addition, data from 1997 to 2002 showed that motor vehicle operators had the highest prevalence of obesity as an occupational category (Caban et al., 2005), while more recent findings from the National Health Interview Survey (NHIS) from 2004-2011 continued to show that motor vehicle operators had the highest prevalence (Gu et al., 2014).

Obesity is a critical problem for long-haul truck drivers for public safety and health reasons as well as healthcare costs and productivity. As such, the relationship between obesity and occupational hazards is frequently interrelated and interactive (Schulte et al., 2007). First, obesity has been associated with a greater risk for the development of obstructive sleep apnea (OSA); statistics have indicated that anywhere from 28 to 80 percent of truck drivers potentially have OSA (Gurubhagavatula, 2012). OSA leads to a higher prevalence of daytime sleepiness, which can serve as a mechanism for drowsy driving and decreased cognitive attention (Gurubhagavatula, 2012). The excessive daytime sleepiness due to OSA has been associated with a greater risk of up to seven times when compared to those without OSA of being involved in a traffic accident (Ward et al., 2013). Research on long-haul truck drivers has consistently shown that those drivers who are obese are at greater risk for motor-vehicle accidents and an increased risk for mortality and severe injury as a result (Anderson et al., 2012; Stoohs et al., 1994; Wiegand, Hanowski, & McDonald, 2009). Next, there are indications of an association between obesity and ergonomic challenges, and subsequently musculoskeletal disorders (Pandalai et al., 2013) and increases in injuries stemming from repetitive vibrations such as found in a truck cab (Schulte et al., 2007). When combined with long periods of sedentariness in uncomfortable truck cabs, as well as stressors from the driving conditions, in conjunction with added body weight, drivers readily encounter lower back pain and other spinal disorders (Apostolopoulos et al., 2014). As a result, of all work-related musculoskeletal disorders in the U.S., long-haul truck drivers account for eight percent (Apostolopoulos et al., 2014). As with the general population, the high rates of obesity among drivers results in obesity-related chronic and cardio-metabolic disease. In the aforementioned survey of U.S. truck drivers, heart disease prevalence was actually less than the general population according to 2010 NHIS data (4.4 % vs. 6.7 %), but drivers had a higher prevalence of hypertension (26.3 % vs. 24.1%) and more than double the prevalence rate of diabetes (14.4 % to 6.8%) (Sieber et al., 2014). The culmination of health and safety risks can have a significant impact on the healthcare costs of drivers. Specifically, obesity was associated with a more than 50 percent increase in healthcare expenditures when compared to those of normal weight in the same sample of U.S. drivers (Martin, Church, Bonnell, Ben-Joseph, & Borgstadt, 2009). With the increased healthcare costs of being obese, a significant concern among the truck driving population is the limited health insurance coverage of drivers (Solomon et al., 2004; Apostolopoulos et al., 2013). Among the recent sample of U.S. long-haul drivers, 38.1 percent were not covered compared to 17.2 percent of the general population (Sieber et al., 2014). As a result, 18.3 percent did not get care in the past year when it was needed compared to 9.7 percent of the general population (Sieber et al., 2014). Last, the obesity of drivers can have an impact on their productivity and absenteeism (Apostolopoulos et al., 2014). Howard and Potter (2012) examined data from the 2000 and 2010 National Health Interview Surveys and reported that obesity was related to higher work absences due to illness, while Finkelstein, daCosta DiBonaventura, Burgess, and Hale (2010) concluded that presenteeism, or lack of focus and attention to detail, and overall productivity were the greatest consequences of obese workers.

With obesity being linked to so many safety and health risks and individual level behavior strategies having little impact on long-haul truck drivers at the population level, recent research has suggested that the work conditions experienced by long-haul truck drivers deserves further attention in terms of its contribution to the obesity crisis among long-haul truck drivers (Apostolopoulos et al., 2014). Therefore, it is critical to further understand how the work environment experienced by long-haul truck drivers serves as a mechanism for exacerbating the already 'obesogenic' environment in terms of individual level behavior mechanisms.

Summary and Implications from the Literature

The literature highlights that obesity is a multifaceted and complex public health issue impacting the U.S, with rates continually rising since the 1970s. This increase in obesity parallels the vast changes in work organization experienced by many occupations since the early 1980s. Meanwhile, the current literature pertaining to long-haul truck drivers suggests a link between their organization of work and high obesity rates. Therefore, additional inquiry into this relationship is warranted and has implications for policy change and intervention strategies.

CHAPTER III

METHODS

Research Questions

Within the work organization of long-haul truck drivers, there are several job specific features that are potential contributors to diminished health outcomes including obesity. To address these features, the following research questions were asked:

1. Do work hours predict BMI, waist circumference, and the risk for cardio-metabolic disease?
2. Does consistency of work schedules predict BMI, waist circumference, and the risk for cardio-metabolic disease?
3. Does perceived psychosocial job stress predict BMI, waist circumference, and the risk index for cardio-metabolic disease?

Research questions are answered by analyzing survey data collected from a sample of long-haul truck drivers regarding work organization factors and anthropometric data.

Hypothesis #1

H_0: Among long-haul truck drivers, work hours will not predict BMI, waist circumference, and risk of cardio-metabolic disease.

H_1: Among long-haul truck drivers, work hours will predict BMI, waist circumference category, and risk of cardio-metabolic disease.

Hypothesis #2

H_0: Among long-haul truck drivers, consistency of work schedules will not predict BMI, waist circumference, and risk of cardio-metabolic disease.

H_1: Among long-haul truck drivers, consistency of work schedules will predict BMI, waist circumference, and risk of cardio-metabolic disease.

Hypothesis #3

H_0: Among long-haul truck drivers, psychosocial job stress will not predict BMI, waist circumference, and risk of cardio-metabolic disease.

H_1: Among long-haul truck drivers, psychosocial job stress will predict BMI, waist circumference, and risk of cardio-metabolic disease.

Data Collection

A non-experimental descriptive, cross sectional design was employed to collect survey and anthropometric data from 260 long-haul truck drivers at a major truck stop located on I-40 in central North Carolina over a period of six months 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 a television lounge, laundry room, and pinball machines, including a large sign regarding the study, a long table, several chairs, and a weight scale. During the data collection period, two teams of field researchers spent three to four 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 the study. To be enrolled, drivers were required to be long-haul truckers who planned to spend the night at the truck stop where data collection took place. The following morning prior to returning to their work duties, drivers who agreed to fasting blood draws were enrolled. From approximately 360 drivers who were approached for potential inclusion, 260 met the criteria and were included, yielding a response rate of over 72 percent. The truckers who did not meet the criteria were either short-haul or regional drivers or were not spending the night at the truck stop. During collection of data, researchers explained the voluntary and confidential nature of participation, the types of data to be collected, and the associated cash incentives. Participants 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 drivers worried may get back to their employers. The study and data collection were approved by the Institutional Review Board (IRB) of the University of North Carolina Greensboro. Table 1 provides a demographic profile of the participants.

Table 1

Trucker Profile

	M	*n*	%
Age	46.43		
35 years and younger		47	18.1
36 to 50 years		106	40.8
51 years and older		107	41.2
Driving Experience	14.97		
10 years or less		113	43.6
11 to 20 years		70	27.0
Greater than 20 years		76	29.3

Table 1

(Cont.)

	M	*n*	%
Race/Ethnicity			
White/Caucasian		149	57.3
Black/African American		84	32.3
Hispanic		22	8.5
Other		5	2.0
Education			
High School or less		144	55.4
Some college		79	30.4
College degree		37	14.3
Income			
$40,000 or less		95	36.6
$40,000 to $60,000		100	38.4
$60,000 or greater		65	25.0
Compensation type			
By the mile		183	70.4
By the load		34	13.1
Percentage of revenue		39	15.0
Other		4	1.5
Health insurance			
No health insurance		87	33.5
Insured		173	66.5
Union membership			
No		251	96.5
Yes		9	3.5

Instrument

The *Trucker Sleep Disorders Survey* (TSLDS) (see Appendix A) utilized in this study was developed from insights from key sleep instruments (i.e., Basic Nordic Sleep Questionnaire, Berlin Questionnaire), sleep literature, and previous research conducted with long-haul truck drivers. Cognitive testing involved a review of the instrument by public health professionals to assure the appropriateness of the language used, that questions conveyed intended meanings and were easily understandable, and to assure optimal question placement and flow. Following necessary revisions, a paper-and-pencil draft of the instrument was tested with six drivers in the Piedmont Triad area of central North Carolina. The truckers were monitored and timed as they completed the survey to detect pauses and problems for further appropriate revisions. This phase was performed to help determine construct validity, identify missing items, clarify scale distributions, help to conduct item correlations, and determine reliability.

The key components of the TSLDS included questions in five focus areas: (1) Trucking work environment including work hours, workplace factors, job strains, workload, and work scheduling; (2) Truck drivers' work and health-related individual factors such as sociodemographics, dietary and physical activity patterns, substance use, health history, sleep patterns, and psychosocial factors; (3) Truckers' (self-reported) sleep disorders and complications such as daytime sleepiness, insomnia, restless leg syndrome, periodic limb movement disorder, sleep fragmentation, sleep deprivation, and sleep apnea; (4) 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 (5) Truckers' (self-reported) comorbidities associated with sleep disorders such as psychiatric disorders, stroke, hypertension, metabolic syndrome, diabetes, and ischemic heart disease. Research questions were answered by making use of the anthropometric measures of Body Mass Index (BMI) and Waist Circumference and survey questions pertaining to work hours, scheduling, workload, and psychosocial job stress.

Dependent Variables

1. **BMI** is the accepted measure for general obesity and was operationalized according to the Centers for Disease Control and Prevention (CDC) as "24.99 or less 'normal'; 25 to 29.99 'overweight'; 30 to 39.99 'obese'; 40 or greater 'extreme obese.'"
2. **Waist circumference** is an accepted measure for abdominal obesity and was operationalized as "102 cm or less as 'lower health risks' and greater than 102 cm as 'increased health risks.'"
3. According to the NIH, the combination of BMI and Waist Circumference measures determines the risk for **cardio-metabolic disease**. Specifically, this variable was operationalized as:
    a. BMI of 25.0-29.99 and Waist Circumference 102 cm or less as **'Increased Risk'**
    b. BMI of 25.0-29.99 and Waist Circumference of greater than 102 cm or BMI of 30.0-34.99 and Waist Circumference of 102 cm or less as **'High Risk'**
    c. BMI of 30.0-34.99 and Waist Circumference of greater than 102 cm or BMI of 35.0 to 39.99 and Waist Circumference of either 102 cm or less or greater than 102 cm as **'Very High Risk'**
    d. BMI of 40.0 or greater and Waist Circumference either 102 cm or less or greater than 102 cm as **'Extremely High Risk'**

Tables 2 and 3 provide descriptive findings from the dependent variables. Figure 3 provides details of the NIH risk table. For further details on the NIH risk table refer to: http://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmi_dis.htm

Table 2

BMI Descriptive Statistics

	M	*n*	(%)
BMI	33.40		
Normal/Healthy		29	11.1
Overweight		66	25.2
Obese		119	45.4
Extreme Obese		48	18.3

Table 3

Waist Circumference and Cardio-metabolic Disease Risk Descriptive Statistics

	M	*n*	(%)
Waist Circumference (cm)	114.77		
102 cm or less		63	24.0
Greater than 102 cm		199	76.0
Disease Risk			
Low Risk		27	10.4
Increased Risk		25	9.6
High Risk		49	18.8
Very High Risk		111	42.7
Extremely High Risk		48	18.5

Disease Risk* Relative to Normal Weight and Waist Circumference				
	BMI (kg/m^2)	Obesity Class	Men 102 cm or less	Men > 102 cm
Underweight	< 18.5		-	-
Normal	18.5-24.99		-	-
Overweight	25.0-29.99		Increased	High
Obesity	30.0-34.99	I	High	Very High
	35.0-39.99	II	Very High	Very High
Extreme Obesity	40.0+	III	Extremely High	Extremely High
* Disease risk for type 2 diabetes, hypertension, and CVD. + Increased waist circumference also can be a marker for increased risk, even in person of normal weight.				
Retrieved from https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmi_dis.htm				

Figure 3. Classification of Overweight and Obesity by BMI, Waist Circumference, and Associated Disease Risks.

Independent Variables

Work Hours

The number of work hours was measured by asking drivers, “how many hours of work do you average on a daily basis including both driving and other duties?” Response selections included: less than six hours, between 6 and 7 hours, between 7 and 8 hours, between 8 and 9 hours, between 9 and 10 hours, 10-11 hours, 11–12 hours, 12–13 hours, 13–14 hours, over 14 hours. Based on the government regulations and the high number of hours that drivers accumulate (i.e., only 3 drivers in our sample worked 8 or less hours per day), the number of hours was further categorized in this manner: “11 hours or less” and “more than 11 and up to 14.” Those who reported working over 14 hours (*N*=39) were removed from analysis because researchers considered it unlikely that truckers were averaging working more than 14 hours due to improved enforcement of HOS regulations through electronic logging by the FMCSA (FMCSA, 2014).

Work Schedules

To measure participants' experiences with rotating work schedules often characterized as shift work, the following two questions were asked: "Is your daily work schedule the same each day?" and "Is your weekly work schedule the same each week?" The response selections for these questions were: 'same' or 'different.' A variable was created incorporating the two in which it was categorized: 'no shift work' or 'at least one form of shift work.' Drivers were then asked about perception of their delivery schedules. Supervisors, in most instances a dispatcher, schedules delivery times and monitors drivers' driving time. Specifically, the following question was asked: "How often do you consider your delivery schedule to be realistic?" The response selections included: never, rarely, sometimes, frequently, and always. For analysis, the variable was categorized as "never, rarely, or sometimes" as "unrealistic" and "frequently or always" as "realistic." Table 4 provides the descriptive statistics for the work hours and work schedule variables.

Table 4

Work Hours and Schedules Descriptive Statistics

	n	%
Work Hours		
11 hours or less	76	34.7
11-14 hours	143	65.3

Table 4

(Cont.)

	n	%
Daily Schedule		
Same every day	45	17.3
Different every day	215	82.7
Weekly Schedule		
Same each week	175	67.6
Different each week	84	32.4
Delivery Schedule		
Unrealistic	90	35.4
Realistic	164	64.6

Psychosocial Job Stress

Six questions were asked regarding stress experienced while on the job. Participants were asked about the frequency of **fast pace of work, time pressures, repetitive work, learning new things, supervisor support,** and **coworker support**. The response selections for each of the questions were: never, rarely, sometimes, frequently, and always. For analysis, the variables were categorized with “never, rarely, or sometimes” as “low” and “frequently or always” as “high”; for work pace it became “slow” or “fast.” A seventh question asked drivers about their perceived stress level. Response selections included: no stress, mild stress, moderate stress, high stress, very high stress, chronic stress. For analysis, “no stress or mild stress” became “low level of stress” and “moderate, high, very high, and chronic” became “high stress.” Table 5 provides descriptive findings for the psychosocial job stress independent variables.

Table 5

Job Stress Descriptive Statistics

	n	%
Work Pace		
Slow	139	53.7
Fast	120	46.3
Time Pressure		
Low	127	48.8
High	133	51.2
Repetitive Work		
Low	47	18.1
High	213	81.9
Learning new things		
Low	155	59.6
High	105	40.4
Supervisor Support		
Low	59	23.8
High	189	76.2
Coworker Support		
Low	97	51.1
High	93	48.9
Perceived Stress		
Low	97	37.5
High	162	62.5

Potential Confounders

Research has shown (Soloveiva et al., 2013) that individual level factors could affect the relationship between work hours and schedules and job stress and the risk for obesity and these were treated as potential confounders. Specific measures included the driver's age and their years of experience in the profession. With increasing age and years of experience, one could expect that the driver would be able to better adapt to the work conditions and manage his health behaviors and stress levels. On the other hand, the chronic stress could affect the body physiologically over time and with years of driving experience. For analysis, drivers' age was categorized as: '35 years old or younger,' '36 to 50 years of age,' '51 and older.' Years of driving experience was categorized as: '10 or less years,' 'between 10 and 20 years,' and '21 or greater.'

Plan of Analysis

To answer the research questions, logistic regression was used to predict multiple dependent variables of general obesity (BMI-categorized), abdominal obesity criteria (waist circumference 102 cm or greater), and cardio-metabolic risk (combination of BMI and waist circumference) from the independent variables. Multiple models were used in the analyses. The **first model** depicted the dependent variables of general, abdominal obesity, and cardio-metabolic risk in relation to work hours and schedules. Findings identified if work hours or work schedules independently predicted the dependent variables, if each is dependent upon each other, or if neither is true. For the **second model**, psychosocial job stress variables were included as predictors of the dependent variables. This highlighted which specific variables are predictive of general, abdominal obesity, and cardio-metabolic risk. A **third model** included all of the work hour, work schedule, and job stress variables as predictors for the dependent variables. The **fourth** model included age categories and driving experience categories along with the work organization variables. All statistical analyses were conducted using SPSS 22.00 (IBMI Corp., 2013).

Limitations

The study has several limitations. As a result of the cross-sectional research design, causal connections cannot be claimed due to any established associations. Furthermore, due to driver selection and retention bias, as well as the extensive use of prescription medications and the use of drivers' self-reported measures in terms of work hours, schedules, and perceived job stressors, the findings may underrepresent the true scale of the plethora of health-related challenges of long-haul truck drivers in association with their work environment. As such, the results from this study cannot be generalized to all long-haul truck drivers. Future studies should seek to incorporate larger and more representative samples, health behavior data (physical activity, diet, sleep, etc.) and the collection of longitudinal data as well as the use of biological data (insulin, cholesterol, lipids, etc.). Randomized control trials would be best, but there is the recognition with occupational health studies of the practical, ethical, and legal constraints.

CHAPTER IV

THE WORK ORGANIZATION OF LONG-HAUL TRUCK DRIVERS AND THE ASSOCIATION WITH BODY MASS INDEX (BMI)

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Introduction

The globalization of markets, technological advances, deregulation of industries, and declines in union membership beginning in the early 1980s have all been deemed responsible for changes in work organization (longer work hours, irregular work schedules, and increased job stress) around the world and are a major contributor to occupational health disparities (Landsbergis et al., 2014). Currently, among all industrialized nations, the U.S. has the longest working hours on a yearly basis and the proportion of workers working long hours has increased substantially over the past three decades (Caruso et al., 2006; Johnson & Lipscomb, 2006). Findings from the 2010 National Health Interview Survey, showed that at the weekly level 18.7 percent (24.5 percent of men) of American workers work 48 or more hours per week and 7.2 percent (9.5 percent of men) Americans reported working 60 or more hours per week (Alterman et al., 2013). Shift work refers to any work shift outside the 7 a.m. to 6 p.m. period or rotating shifts (Caruso, 2014; Geiger-Brown et al., 2012; Wang et al., 2011). The 2010 National Health Interview Survey also revealed that 28.7 percent of American workers reported working alternative or rotating shifts, up from the 17.7 percent found in 2004 by the Bureau of Labor Statistics (Alterman et al., 2013). While long work hours and shift work are prevalent, job stress refers to imbalances between the physical and psychological demands and ability to cope with or control situations affecting their work (Hausser et al., 2010). Key psychological demands include a fast work pace, time pressures, having to learn new things, and repetitive work (Belkic et al., 2004). Previous research has also suggested social isolation on the job or lack of support from coworkers and supervisors may increase psychosocial job stress (Hausser et al., 2010).

The work organization of long-haul truck drivers, characterized by long work hours, irregular work schedules, and high job stress (Apostolopoulos et al., 2013, 2014), is substantially influenced by the Department of Transportation's (DOT) hours of service (HOS) regulations allowing up to 14 hours of work per day (11 of driving time), corporate operations and policies focused on profit and productivity, and the competitive nature of the industry (Apostolopoulos et al., 2014). As a result, drivers experience time pressures due to tight-running delivery schedules imposed by dispatchers (their supervisor) and little control over the conditions influencing their work (Apostolopoulos et al., 2014). Epidemiological evidence suggests that the work environment has an influence on the poor health outcomes of the occupational population (Apostolopoulos et al., 2010). Not surprisingly, the profession is classified as one of the riskiest occupations, having higher morbidity rates and a decreased life expectancy when compared to the general population (Apostolopoulos et al., 2014; Apostolopoulos et al., 2010; Saltzman & Belzer, 2007).

Obesity, a BMI of 30 or greater, is linked to these work organization features, and affects certain occupations more than others (Luckhaupt et al., 2014; Ogden et al., 2014; Soloveiva et al., 2013). Specific to long-haul truck drivers, a recent survey from the National Institute of Occupational Safety and Health (NIOSH) found that nearly 70 percent of U.S. long haul truck drivers were obese, more than double the rate of American workers, and increases the risk for cardio-metabolic conditions (Sieber et al., 2014). In the aforementioned survey of U.S. truck drivers, heart disease prevalence was actually less than the general population according to 2010 NHIS data (4.4 % vs. 6.7 %), but drivers had a higher prevalence of hypertension (26.3 % vs. 24.1%) and more than double the prevalence rate of diabetes (14.4 % to 6.8%) (Sieber et al., 2014).

With obesity being a complex health challenge (Huang et al., 2009) linked to numerous occupational safety and health risks (Schulte et al., 2007) and with individual level behavior change strategies having little impact on long-haul truck drivers at the population level (Ng et al., 2014), recent research has suggested that the work conditions experienced by long-haul truck drivers deserves further attention regarding its contribution to the high obesity prevalence (Apostolopoulos et al., 2014). Therefore, it is critical to further understand how the work organization of long-haul truck drivers serves as a mechanism for exacerbating an already 'obesogenic' environment in terms of individual level behavior mechanisms (physical activity, diet; Apostolopoulos, Shattell, et al., 2012; Apostolopoulos, Sönmez, et al., 2012; Apostolopoulos, Sönmez, et al., 2011). As such, the purpose of this study was to examine the relationships between the work organization features of work hours, work schedules, and job stress with the BMI's of long haul truck drivers. Specific understanding of these interactions may inform both prevention programming in long-haul trucking companies and public policy enacted at the federal level in relation to the industry.

Methods

Study Sample

A non-experimental descriptive, cross sectional design was employed to collect survey and anthropometric data from 260 long-haul truck drivers at a major truck stop 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. Using intercept techniques, researchers approached drivers and asked several screening questions to determine eligibility for inclusion in the study. To be enrolled, drivers were required to be long-haul truckers planning to spend the night at the truck stop where data collection took place. From approximately 360 drivers approached for potential inclusion, 260 met the criteria and were included. Truckers not meeting the criteria were either short-haul or regional drivers or not spending the night at the truck stop. Informed consent was collected from drivers. The study and data collection were approved by the Institutional Review Board (IRB) of the University of North Carolina Greensboro.

Measures

Body Mass Index (BMI). BMI was the main outcome for this study. BMI was categorized: $\leq$ 24.99 ‘Normal’; 25-29.99 ‘Overweight’; 30-39.99 ‘Obese’; $\geq$ 40 ‘Extreme Obese.’

Work hours. Work Hours were measured by asking drivers, "how many hours of work do you average on a daily basis including both driving and other duties?" Response selections included: less than six hours, between six and seven hours, between seven and eight hours, between eight and nine hours, between nine and 10 hours, 10-11 hours, 11-12 hours, 12-13 hours, 13-14 hours, over 14 hours. Based on government regulations and the high number of hours that drivers accumulate (i.e., only three drivers in our sample worked eight or less hours per day), the number of hours was further categorized in this manner: 11 hours or less and between 11 and 14 hours. Those reporting working over 14 hours (N=39) were removed from analysis because researchers considered it improbable truckers were averaging working more than 14 hours due to improved enforcement of HOS regulations through electronic logging by the DOT (Federal Motor Carrier Safety Administration).

Work schedules. To measure participant's experiences with rotating work schedules, the following two questions were asked: "Is your daily work schedule the same each day?" and "Is your weekly work schedule the same each week?" The response selections were: 'same' or 'different.' From these two variables a variable was created incorporating the two in and was categorized: 'no shift work' or 'at least one form of shift work.' Drivers were then asked about perception of delivery schedules. Supervisors schedule delivery times and monitor drivers' driving time. Specifically, the following question was asked: "How often do you consider your delivery schedule to be realistic?" The response selections included: never, rarely, sometimes, frequently, and always. For analysis, the variable was categorized: “never, rarely, or sometimes” as “unrealistic” and “frequently or always” as “realistic.”

Job stress. Six questions were asked regarding stress job stress. Participants were asked about the frequency of fast work pace, time pressures, repetitive work, learning new things, supervisor support, and coworker support. The response selections were: never, rarely, sometimes, frequently, and always. For analysis, the variables were categorized: “never, rarely, or sometimes” as “low” and “frequently or always” as “high.” A seventh question asked drivers about their perceived job stress. Response selections included: no stress, mild stress, moderate stress, high stress, very high stress, chronic stress. For analysis, “no stress or mild stress” became “low stress” and “moderate, high, very high, and chronic” became “high stress.”

Potential confounders. Based on the literature (Soloveiva et al., 2013), there is the recognition that individual level factors could affect the relationship between work hours, schedules, and job stress and BMI and were treated as potential confounders. Specific confounding measures included driver age and years of experience in the profession. With increasing age and years of experience, one could expect the driver would be able to better adapt to the work conditions and manage his health behaviors and stress level. Conversely, chronic stress could affect the body physiologically over time and with years of driving experience. For analysis, driver age was categorized: ‘35 years old or younger,’ ‘36 to 50 years of age,’ ‘51 and older.’ Years of driving experience was categorized: ‘10 or less years,’ ‘between 10 and 20 years,’ and ‘21 or greater.’

Data Analysis

Logistic regression was used to identify significant predictors of BMI category and to analyze odds ratios from the predictor variables. The first regression model included just the work hour and work scheduling variables, while the second model included solely the job stress variables. A third model included each of the work organization characteristics. The fourth and final model included age and driving experience along with the work organization variables. All statistical analyses were conducted using SPSS 22.00 (IBM Corp., 2013).

Results

The mean age was 46.63 years of age and the mean years of driving experience was 14.97 years. The mean BMI was 33.40 with 63.7 percent being obese and 18.3 being characterized as extreme obese. 65.3 percent averaged working more than 11 hours and up to 14 hours daily, 82.7 percent worked irregular daily schedules, 32.4 percent worked irregular weekly schedules, and 35.4 percent considered their delivery schedules to be unrealistic. Regarding job stress: 46.3 percent reported a fast work pace, 51.2 increased time pressures, 81.9 high levels of repetitive work, 40.4 having to frequently learn new things, 23.8 percent had low supervisor support, 51.1 percent had low coworker support, and 62.5 percent considered their job highly stressful. Table 6 provides a profile of the trucker sample.

Table 6

Trucker Profile

	n	(%)		*n*	(%)		*n*	(%)
Age			**Work Hours**			**Learn new things**		
35 and younger	47	18.1	11 or less	76	34.7	Low	155	59.6
36-50	106	40.8	11-14 hrs	143	65.3	High	105	40.4
51 and older	107	41.2						
Driving Experience			**Daily Schedule**			**Supervisor Support**		
10 or less yrs	113	43.6	Same	45	17.3	Low	59	23.8
11-20 yrs	70	27.0	Different	215	82.7	High	189	76.2
21 or more yrs	76	29.3						
Race/Ethnicity			**Weekly Schedule**			**Coworker Support**		
White/Caucasian	149	57.3						
Black/AA	84	32.3	Same	175	67.6	Low	97	51.1
Hispanic	22	8.5	Different	84	32.4	High	93	48.9
Other	5	2.0						
Education			**Delivery Schedule**			**Perceived Stress**		
$\leq$ High School	144	55.4						
Some college	79	30.4	Unrealistic	90	35.4	Low	97	37.5
College degree	37	14.3	Realistic	164	64.6	High	162	62.5
Compensation			**Work Pace**			**BMI**		
By the mile	183	70.4				Healthy	29	11.1
By the load	34	13.1	Slow	139	53.7	Overweight	48	25.2
% of revenue	39	15.0	Fast	120	46.3	Obese	119	45.4
Other	4	1.5				Ext. Obese	66	18.3
Health Insurance			**Time Pressure**					
None	87	33.5	Low	127	51.2			
Insured	173	66.5	High	133	48.8			
Union membership			**Repetitive Work**					
No	251	96.5	Low	47	18.1			
Yes	9	3.5	High	213	81.9			

The first model was significant (X^2 = 17.05, p < 0.05). Both the Pearson (X^2 = 10.08, p = 0.61) and deviance (X^2 = 12.11, p = 0.44) statistics were not significant, indicating a good fit. The two measures of R^2 (Cox & Snell, Nagelkerke) were relatively low (0.08). Work hours were the only significant predictor to the model ($X^2 = 9.96$, $p < 0.05$). The second ($X^2 = 14.71$, $p = 0.84$) and third models ($X^2 = 34.77$, $p = 0.25$) were not significant. While the third model was not statistically significant overall, daily work hours remained a significant predictor to the model ($X^2 = 8.05$, $p < 0.05$). The fourth model was significant ($X^2 = 62.80$, $p < 0.05$). The deviance ($X^2 = 293.72$, $p = 0.99$) was not significant, indicating a good fit, but the Pearson ($X^2 = 557.19$, $p < 0.01$) was, raising concerns for overdispersion. When examining this possibility, the dispersion parameter was 1.49 (557.19/375df), greater than one but not close to two, lowering the concern for overdispersion (Fields, 2013). The two measures of R^2 were modestly high (0.34, 0.37), a good effect size. Significant predictors to the model included work hours ($X^2 = 10.20$, $p < 0.05$), driver age ($X^2 = 17.72$, $p < 0.01$), and driving experience ($X^2 = 12.06$, $p < 0.1$).

The reference category for the regression models was healthy BMI (24.99 or less). Table 7 provides odds ratio estimates for the overweight BMI category (25-29.99). There were no significant odds ratios within the first model. In the second model, having to more frequently learn new things resulted in a 258% greater odds of being overweight when compared to those less frequently having to learn new things. In both the third and fourth models, a less realistic delivery schedule resulted in significantly greater odds of being overweight (582%, and 665%). Statistically significant to models 1, 3, and 4, working more than 11 and up to 14 hours continually resulted in greater odds of being overweight (107%, 135%, and 150%).

Table 7

Logistic Regression Results (BMI: 25–29.99)

	Model 1			Model 2			Model 3			Model 4		
	Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI	
Work Hours	2.07	0.71	6.09	-	-	-	2.35	0.61	9.16	2.50	0.59	10.52
Shift Work	0.97	0.17	5.49	-	-	-	0.71	0.11	4.65	0.47	0.07	3.38
Delivery Schedule	1.67	0.48	5.89	-	-	-	6.82*	0.71	66.29	7.65*	0.78	75.18
Work Pace	-	-	-	2.34	0.63	8.65	2.89	0.52	15.99	2.56	0.42	15.67
Time Pressure	-	-	-	0.68	0.19	2.47	0.71	0.16	3.18	0.65	0.13	3.22
Learn New Things	-	-	-	3.58**	1.02	12.58	2.82	0.61	13.00	3.79	0.72	20.06
Repetitive Work	-	-	-	1.55	0.38	6.27	2.64	0.50	13.80	2.55	0.44	14.72
Supervisor Support	-	-	-	1.46	0.33	6.54	0.52	0.09	3.03	0.55	0.09	3.50
Coworker Support	-	-	-	1.87	0.58	6.08	1.36	0.31	5.87	1.15	0.26	5.18
Perceived Job Stress	-	-	-	1.27	0.36	4.52	1.90	0.41	8.70	2.17	0.43	11.05
Driver Age												
≤ 35	-	-	-	-	-	-	-	-	-	0.80	0.07	8.73
36–50	-	-	-	-	-	-	-	-	-	0.92	0.16	5.10
Driver Experience												
≤ 10 yrs	-	-	-	-	-	-	-	-	-	0.69	0.11	4.55
11–20 yrs	-	-	-	-	-	-	-	-	-	4.26	0.63	28.80

Note. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 8 provides the odds ratio estimates for the obese BMI category (30-39.99). There were no significant individual odds ratios. Again, statistically significant to models 1, 3, and 4, a continual rise in odds occurred when working longer hours (10%, 41%, and 69%).

Table 9 provides the odds ratio estimates for the extreme obese BMI category (BMI of 40 or greater). Across all models, working longer hours resulted in statistically significant increased odds of extreme obesity (275%, 405%, and 655%). While not statistically significant predictors to the models, an unrealistic delivery schedule presented significantly higher odds in the third and fourth models (687% and 623). In the full model, being 35 and younger and between 36 and 50 years of age significantly increased the odds of being extreme obese when compared to those 51 and older.

Discussion

Findings from this study suggest that working long hours may be the most critical work organization feature to long-haul truckers. Specifically, working more than 11 and up to 14 hours daily was associated with increased odds for being overweight, obese, and most concerning extreme obese. These associations persisted after adjustments for other job stressors, driver age, and years of experience. Consistent with the literature, the findings insinuate that long work hours could influence drivers' body physiologically and their health behavior (physical inactivity and poor nutritional intake; Landsbergis et al., 2014).

Table 8

Logistic Regression Results (BMI: 30–39.99)

	Model 1			Model 2			Model 3			Model 4		
	Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI	
Work Hours	1.10	0.42	2.90	-	-	-	1.41	0.42	4.66	1.69	0.48	5.97
Shift Work	0.42	0.09	1.98	-	-	-	0.48	0.09	2.61	0.53	0.09	3.04
Delivery Schedule	1.84	0.57	5.95	-	-	-	5.02	0.56	44.92	4.63	0.52	41.22
Work Pace	-	-	-	1.95	0.58	6.53	2.78	0.58	13.33	2.92	0.57	15.08
Time Pressure	-	-	-	0.52	0.16	1.70	0.70	0.18	2.65	0.79	0.19	3.23
Learn New Things	-	-	-	2.35	0.72	7.61	2.12	0.53	8.47	2.34	0.53	10.29
Repetitive Work	-	-	-	2.19	0.60	7.96	2.51	0.60	10.40	2.14	0.49	9.30
Supervisor Support	-	-	-	1.44	0.35	5.83	0.77	0.16	3.74	0.99	0.19	5.21
Coworker Support	-	-	-	1.99	0.68	5.89	1.36	0.36	5.08	1.28	0.34	4.85
Perceived Job Stress	-	-	-	0.83	0.26	2.60	1.21	0.31	4.64	1.22	0.29	5.10
Driver Age												
≤ 35	-	-	-	-	-	-	-	-	-	2.29	0.27	19.14
36–50	-	-	-	-	-	-	-	-	-	3.57	0.77	16.47
Driver Experience												
≤ 10 yrs	-	-	-	-	-	-	-	-	-	0.57	0.11	2.92
11–20 yrs	-	-	-	-	-	-	-	-	-	1.21	0.20	7.16

Note. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 9

Logistic Regression Results (BMI: 40 or Greater)

	Model 1			Model 2			Model 3			Model 4		
	Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI	
Work Hours	3.75*	112	12.53	-	-	-	5.05**	1.19	21.43	7.55***	1.61	35.38
Shift Work	0.93	015	5.69	-	-	-	1.08	0.15	7.60	1.35	0.18	10.33
Delivery Schedule	2.57	072	9.22	-	-	-	7.87*	0.80	77.97	7.23*	0.71	71.92
Work Pace	-	-	-	1.90	0.51	7.18	2.67	0.47	15.29	3.21	0.51	20.13
Time Pressure	-	-	-	0.74	0.20	2.71	1.37	0.30	6.23	1.85	0.37	9.26
Learn New Things	-	-	-	2.27	0.63	8.10	3.91*	0.84	18.19	3.37	0.64	17.83
Repetitive Work	-	-	-	2.37	0.56	10.08	5.09*	0.91	28.34	3.48	0.57	21.23
Supervisor Support	-	-	-	1.93	0.43	8.73	0.71	0.12	4.15	0.95	0.14	6.29
Coworker Support	-	-	-	1.20	0.36	3.98	0.69	0.16	3.07	0.71	0.16	3.23
Perceived Job Stress	-	-	-	0.52	0.15	1.81	0.40	0.12	2.37	0.45	0.09	2.30
Driver Age												
≤ 35	-	-	-	-	-	-	-	-	-	11.13*	1.01	122.55
36–50	-	-	-	-	-	-	-	-	-	9.96*	1.67	59.41
Driver Experience												
≤ 10 yrs	-	-	-	-	-	-	-	-	-	0.37	0.06	2.35
11–20 yrs	-	-	-	-	-	-	-	-	-	0.40	0.05	3.33

Note. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

The findings also concur with Soloveiva and colleagues (2013) review which concluded that longer work hours were the most critical aspect of work organization to weight gain and obesity among men. Critically, longer hours of work could allow for less time to exercise and obtain physical activity, particularly in sedentary jobs such as truck driving, and less time to prepare and consume healthier food options (Caruso et al., 2006; Turner & Reed, 2011).

Chronic stress from repeated long hour days has been shown to alter health behaviors through hormone imbalances, namely leptin (Ahima, 2011; Ramachandrappa & Farooqi, 2011). Long work hours have also been associated with sleep deprivation, which can impact the body physiologically, specifically cortisol levels, and create abnormal stress responses (Johnson & Lipscomb, 2006). Prolonged sleep deprivation and sleep disorders can potentially lead to detrimental effects on the body's endocrine system and metabolic rate (Caruso et al., 2006; Geiger-Brown et al., 2012). In fact, several studies have indicated that the linkage between longer work hours and obesity is mediated by shorter sleep duration (Di Milia & Mummery, 2009; Ko et al., 2006; Magee et al., 2011).

With 70 percent of the sample working more than 11 hours daily and up to 14 hours (approximately 55 to 70 hours per week) and 63.7 percent obese, the findings are comparable to the approximately 60 hours a week of work and nearly 69% of obese participants Sieber and colleagues (2014) found in the national survey of long-haul truck drivers. Another recent study of 85,000 long haul truck drivers found a slightly lower but still high prevalence of obesity (53.3%) and extreme obesity (12.1%; Thiese et al., 2015).

Correspondingly, Luckhaupt and colleagues (2014) also reported that working more than 40 hours per week was significantly associated with obesity, particularly among men, and that transportation and material moving occupations, such as truck driving, were among the occupations with the highest prevalence ratios.

The findings from this study also support calls from occupational health scholars for workplace interventions to focus on work organization factors, such as long work hours and scheduling practices, in conjunction with individual level behavior approaches for addressing obesity among employees (Luckhaupt et al., 2014). Mirroring calls for integrated approaches in worksite health promotion and occupational safety and health at the national level with the *Total Worker Health* initiative (CDC – Total Worker Health), many long-haul truck driver researchers have expressed the need for integrated and comprehensive approaches within the trucking industry (Apostolopoulos et al., 2014; Ng et al., 2014; Sieber et al., 2014). Within the workplace, integrated approaches acknowledge that workplace safety factors and health behaviors are intricately linked and that workplaces can and should simultaneously promote and protect health. The policies and programs incorporated should seek to reduce or eliminate job hazards, such as long work hours, shift work, and job stress, while concurrently promoting healthy individual lifestyles. Meanwhile, workplaces should actively engage their employees and seek to provide a work context that is health supportive, both physically and organizationally (Sorenson et al., 2013).

For truck drivers, this includes the work hours, the way that truckers are compensated (paid by the mile) which incentivizes longer hours, and scheduling practices

(Apostolopoulos et al., 2014). Interventions should involve changes to organizational practices within individual trucking companies but just as importantly HOS regulations and other public policies need to be continually monitored. Last, it is recognized that this type of approach to trucker health is dependent upon a systems perspective involving multidisciplinary collaboration from multiple stakeholders which should include representation from government regulatory bodies, trucking companies, unions, truck drivers, occupational health researchers, and other policy makers (Apostolopoulos et al., 2014). Working together and gathering perspectives from each of these individuals and groups can enhance understanding of the long-haul truck driver work organization and identify leverage points for intervening, while also valuing the competitive nature of the industry (Apostolopoulos et al., 2014).

Limitations

The study has several limitations. As a result of the cross-sectional research design, causal connections cannot be claimed due to any established associations. Furthermore, due to driver selection and retention bias, as well as the extensive use of prescription medications and the use of drivers' self-reported measures in terms of work hours, schedules, and perceived job stressors, the findings may underrepresent the true scale of the plethora of health-related challenges of long-haul truck drivers in association with their work environment. As such, the results from this study cannot be generalized to all long-haul truck drivers. Future studies should seek to incorporate larger and more representative samples, health behavior data (physical activity, diet, sleep, etc.) and the collection of longitudinal data as well as the use of biological data (insulin, cholesterol, lipids, etc.). Randomized control trials would be best, but there is the recognition with occupational health studies of the practical, ethical, and legal constraints.

Conclusions

The profession of long-haul truck driving is among the riskiest occupations in the U.S. and as a result has some of the worst health outcomes. Most interventions have focused on individual-behavior changes (Ng et al., 2014), but the findings from this study suggest that longer work hours, specifically, have a major influence on the odds for obesity among this population. As such, the results align with the recent calls at the national level for integrated approaches to worker health and more advanced approaches to understanding and intervening to improve the health of long-haul truck drivers.

CHAPTER V

THE WORK ORGANIZATION OF LONG-HAUL TRUCK DRIVERS AND THE ASSOCIATION WITH WAIST CIRCUMFERENCE AND CARDIO-METABOLIC DISEASE RISK

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Introduction

The globalization of markets, technological advances, deregulation of industries, and declines in union membership beginning in the early 1980s have all been deemed responsible for changes in work organization (longer work hours, irregular work schedules, and increased job stress) around the world and are a major contributor to occupational health disparities (Landsbergis et al., 2014). Currently, among all industrialized nations, the U.S. has the longest working hours on a yearly basis and the proportion of workers working long hours has increased substantially over the past three decades (Caruso et al., 2006; Johnson & Lipscomb, 2006). Findings from the 2010 National Health Interview Survey, showed that at the weekly level 18.7 percent (24.5 percent of men) of American workers work 48 or more hours per week and 7.2 percent (9.5 percent of men) Americans reported working 60 or more hours per week (Alterman et al., 2013). Shift work refers to any work shift outside the 7 a.m. to 6 p.m. period or rotating shifts (Geiger-Brown et al., 2012; Caruso, 2014; Wang et al., 2011). The 2010 National Health Interview Survey also revealed that 28.7 percent of American workers reported working alternative or rotating shifts, up from the 17.7 percent found in 2004 by the Bureau of Labor Statistics (Alterman et al., 2013). While long work hours and shift work are prevalent, job stress refers to imbalances between the physical and psychological demands and ability to cope with or control situations affecting their work (Hausser et al., 2010). Key psychological demands include a fast work pace, time pressures, having to learn new things, and repetitive work (Belkic et al., 2004). Previous research has also suggested social isolation on the job or lack of support from coworkers and supervisors may increase psychosocial job stress (Hausser et al., 2010).

The work organization of long-haul truck drivers, characterized by long work hours, irregular work schedules, and high job stress (Apostolopoulos et al., 2013, 2014), is substantially influenced by the Department of Transportation's (DOT) hours of service (HOS) regulations allowing up to 14 hours of work per day (11 of driving time), corporate operations and policies focused on profit and productivity, and the competitive nature of the industry (Apostolopoulos et al., 2014). As a result, drivers experience time pressures due to tight-running delivery schedules imposed by dispatchers (their supervisor) and little control over the conditions influencing their work (Apostolopoulos et al., 2014). Epidemiological evidence suggests that the work environment has an influence on the poor health outcomes of the occupational population (Apostolopoulos et al., 2010). Not surprisingly, the profession is classified as one of the riskiest occupations, having higher morbidity rates and a decreased life expectancy when compared to the general population (Apostolopoulos et al., 2014; Apostolopoulos et al., 2010; Saltzman & Belzer, 2007).

General obesity, or a Body Mass Index (BMI) of greater than 30, has been linked to each of these work organization features (Soloveiva et al., 2013; Luckhaupt et al., 2014; Ogden et al., 2014). Specific to long-haul truck drivers, a recent survey supported by the National Institute of Occupational Safety and Health (NIOSH) found that nearly 70 percent of U.S. long haul truck drivers are obese (Sieber et al., 2014). This is more than double the rate of American workers according to the 2010 National Health Interview Survey, which presents further risks for cardio-metabolic conditions (hypertension, diabetes, cardiovascular disease) (Sieber et al., 2014). In the aforementioned survey of U.S. truck drivers, heart disease prevalence was actually less than the general population according to 2010 NHIS data (4.4 % vs. 6.7 %), but drivers had a higher prevalence of hypertension (26.3 % vs. 24.1%) and more than double the prevalence rate of diabetes (14.4 % to 6.8%) (Sieber et al., 2014).

While general obesity is a significant problem for this occupational segment, it also has broad implications for all American and international workers (Kelly et al., 2008). In fact, the rates of obesity in the United States and globally have drastically increased over the last half century, more than doubling since 1970 (Hammond & Levine, 2010). Currently more than two-thirds of Americans (34.9%) are classified as obese (Ogden et al., 2014), compared to just a 15% prevalence rate between the years of 1976-1980 and a 13.4% rate from 1960-1962 (Ford et al., 2011). Specifically, a recent study found that the average BMI of an American male in 2009-2010 was 28.6, compared to 26.6 from 1988 to 1994 (Ladabaum et al., 2014).

Of increasing concern is abdominal or centralized obesity (excess belly fat), or a waist circumference of greater than 102 centimeters, which is considered to increase the health risks among men (National Heart, Lung, and Blood Institute). A recent report showed that while general obesity rates have not significantly increased in the United States over the last decade, the prevalence of abdominal obesity is still on the rise (Ford et al., 2014). The increased waist circumferences of Americans, particularly among men, resulting in abdominal obesity contributes to even greater health risks, particular cardio-metabolic disease in the form of hypertension, diabetes, and cardiovascular disease (Ford et al., 2011; Ladabaum et al., 2014). Findings from the Ladabaum et al., (2014) study further indicated that the mean waist circumference of American males in 2009-2010 was 100.4 centimeters, up from 95.6 in 1988-1994; the percentage of males considered abdominally obese was 42.0, as compared to 29.1 in 1988-1994.

With the causes of obesity being so complex (Huang et al., 2009), linked to so many safety and health risks (Schulte et al., 2007), and individual level behavior strategies having little impact on long-haul truck drivers at the population level (Ng et al., 2014), recent research has suggested that the work conditions experienced by long-haul truck drivers deserves further attention in terms of its contribution to the high obesity prevalence among long-haul truck drivers (Apostolopoulos et al., 2014). Therefore, it is critical to further understand how the work environment experienced by long-haul truck drivers serves as a mechanism for exacerbating the already ‘obesogenic’ environment in terms of individual level behavior mechanisms (Apostolopoulos, Peachey, et al., 2011; Apostolopoulos, Shattell, et al., 2012; Apostolopoulos, Sönmez, et al., 2012). Beyond general obesity measures such as BMI, it is critical to explore how the work environment potentially influences abdominal obesity through waist circumference measures. Meanwhile, the combination of increased BMI and waist circumferences intensifies the risk for cardio-metabolic disease in the form of hypertension, diabetes, metabolic syndrome, and cardiovascular disease (National Heart, Lung, and Blood Institute). As such, the purpose of this study is to examine the relationships between the work organization factors of work hours, work schedules, and job stress and abdominal obesity and cardio-metabolic disease risk for long haul truck drivers. Specific understanding of these interactions may help to inform both prevention programming in long-haul trucking companies and public policy enacted at the federal level in relation to the industry.

Methods

Study Design and Participants

A non-experimental descriptive, cross sectional design was employed to collect survey and anthropometric data from 260 long-haul truck drivers at a major truck stop 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. Using intercept techniques, researchers approached drivers and asked several screening questions to determine eligibility for inclusion in the study. To be enrolled, drivers were required to be long-haul truckers planning to spend the night at the truck stop where data collection took place. From approximately 360 drivers approached for potential inclusion, 260 met the criteria and were included. Truckers not meeting the criteria were either short-haul or regional drivers or not spending the night at the truck stop. Informed consent was collected from drivers. The study and data collection were approved by the Institutional Review Board (IRB) of the University of North Carolina Greensboro.

Study Outcome

Waist circumference measures were collected and categorized: ≤ 102 cm as ‘lower health risks’ and > 102 cm as ‘increased health risks.’ BMI measures were also collected. With these two variables a composite variable was created to assess cardio-metabolic disease risk. According to the National Institutes of Health (NIH), the combination is grouped into ‘increased risk,’ ‘high risk,’ ‘very high risk,’ and ‘extremely high risk’ categories. Figure 4 depicts the NIH’s classification system.

Disease Risk* Relative to Normal Weight and Waist Circumference

	BMI (kg/m^2)	Obesity Class	Men 102 cm or less	Men > 102 cm
Underweight	< 18.5	I	-	-
Normal	18.5-24.99	II	-	-
Overweight	25.0-29.99	III	Increased	High
Obesity	30.0-34.99		High	Very High
	35.0-39.99		Very High	Very High
Extreme Obesity	40.0 +		Extremely High	Extremely High

* Disease risk for type 2 diabetes, hypertension, and CVD.

\+ Increased waist circumference also can be a marker for increased risk, even in persons of normal weight.

Retrieved from: https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmi_dis.htm

Figure 4. Classification of Overweight and Obesity by BMI, Waist Circumference, and Associated Disease Risks.

Work Hours

Work Hours were measured by asking drivers, “how many hours of work do you average on a daily basis including both driving and other duties?” Response selections included: less than six hours, between six and seven hours, between seven and eight hours, between eight and nine hours, between nine and 10 hours, 10-11 hours, 11-12 hours, 12-13 hours, 13-14 hours, over 14 hours. Based on government regulations and the high number of hours that drivers accumulate (i.e., only three drivers in our sample worked eight or less hours per day), the number of hours was further categorized in this manner: 11 hours or less and between 11 and 14 hours. Those reporting working over 14 hours (N=39) were removed from analysis because researchers considered it improbable truckers were averaging working more than 14 hours due to improved enforcement of HOS regulations through electronic logging by the DOT (Federal Motor Carrier Safety Administration).

Work Schedules

To measure participant’s experiences with rotating work schedules, the following two questions were asked: “Is your daily work schedule the same each day?” and “Is your weekly work schedule the same each week?” The response selections were: ‘same’ or ‘different.’ From these two variables a variable was created incorporating the two in and was categorized: ‘no shift work’ or ‘at least one form of shift work.’ Drivers were then asked about perception of delivery schedules. Supervisors schedule delivery times and monitor drivers’ driving time. Specifically, the following question was asked: “How often do you consider your delivery schedule to be realistic?” The response selections included: never, rarely, sometimes, frequently, and always. For analysis, the variable was categorized: “never, rarely, or sometimes” as “unrealistic” and “frequently or always” as “realistic.”

Psychosocial Job Stress

Six questions were asked regarding stress job stress. Participants were asked about the frequency of fast work pace, time pressures, repetitive work, learning new things, supervisor support, and coworker support. The response selections were: never, rarely, sometimes, frequently, and always. For analysis, the variables were categorized: “never, rarely, or sometimes” as “low” and “frequently or always” as “high.” A seventh question asked drivers about their perceived job stress. Response selections included: no stress, mild stress, moderate stress, high stress, very high stress, chronic stress. For analysis, “no stress or mild stress” became “low stress” and “moderate, high, very high, and chronic” became “high stress.”

Potential Confounders

Based on the literature (Soloveiva et al., 2013), there is the recognition that individual level factors could affect the relationship between work hours, schedules, and job stress and BMI and were treated as potential confounders. Specific confounding measures included driver age and years of experience in the profession. With increasing age and years of experience, one could expect the driver would be able to better adapt to the work conditions and manage his health behaviors and stress level. Conversely, chronic stress could affect the body physiologically over time and with years of driving experience. For analysis, driver age was categorized: ‘35 years old or younger,’ ‘36 to 50 years of age,' '51 and older.' Years of driving experience was categorized: '10 or less years,' 'between 10 and 20 years,' and '21 or greater.'

Statistical Analysis

Logistic regression was used to identify significant predictors of a waist circumference of greater than 102 cm and to analyze the odds ratios. The first regression model included just the job stress variables, while the second model included just the work schedule variables. A third model included both the job stress and work schedule variables. The final model included age categories and driving experience categories as well as the job stress and work schedule variables. Logistic regression was also used to identify significant predictors or cardio-metabolic disease risk based on NIH's standards and to analyze the odds ratios. Like with waist circumference, the first regression model included just the job stress variables, while the second model included just the work schedule variables. A third model included both the job stress and work schedule variables. The final model included age categories and driving experience categories as well as the job stress and work schedule variables. All statistical analyses were conducted using SPSS 22.0 (IBM Corp, 2013).

Results

The mean age was 46.63 years of age and the mean years of driving experience was 14.97 years. The mean waist circumference was 114.77 cm and 76.0 percent were abdominally obese. The mean BMI was 33.40, with 63.7 percent obese. When combining waist circumference measures with BMI measures, 80.0 percent of the drivers were at high, very high, or extremely high risk of cardio-metabolic disease. 65.3 percent averaged working more than 11 hours and up to 14 hours daily, 82.7 percent worked irregular daily schedules, 32.4 percent worked irregular weekly schedules, and 35.4 percent considered their delivery schedules to be unrealistic. Regarding job stress: 46.3 percent reported a fast work pace, 51.2 increased time pressures, 81.9 high levels of repetitive work, 40.4 having to frequently learn new things, 23.8 percent had low supervisor support, 51.1 percent had low coworker support, and 62.5 percent considered their job highly stressful. Table 10 provides a profile of the trucker sample.

Table 10

Trucker Profile

	n (%)		*n* (%)		*n* (%)
Age (*M* = 46.63)		**Work Hours**		**Learn New**	
35 and younger	47 (18.1)	11 or less		**Things**	
36-50	106 (40.8)	11-14 hrs	76 (34.7)	Low	155 (59.6)
51 and older	107 (41.2)		143 (65.3)	High	105 (40.4)
Driving Experience		**Daily**		**Supervisor**	
(*M* = 14.97 yrs)		**Schedule**		**Support**	
10 or less yrs	113 (43.6)	Same	45 (17.3)	Low	59 (23.8)
11-20 yrs	70 (27.0)	Different	215 (82.7)	High	189 (76.2)
21 or more yrs	76 (29.3)				
Race/Ethnicity		**Weekly**		**Coworker**	
White/Caucasian	149 (57.3)	**Schedule**		**Support**	97 (51.1)
Black/AA	84 (32.3)	Same	175 (67.6)	Low	93 (48.9)
Hispanic	22 (8.5)	Different	84 (32.4)	High	
Other	5 (2.0)				
Education		**Delivery**		**Perceived**	
$\leq$ High School	144 (55.4)	**Schedule**		**Stress**	
Some college	79 (30.4)	Unrealistic	90 (35.4)	Low	97 (37.5)
College degree	37 (14.3)	Realistic	164 (64.6)	High	162 (62.5)
Compensation		**Work**		**Waist**	
By the mile	183 (70.4)	**Pace**		**Circumference**	
By the load	34 (13.1)	Slow	139 (53.7)	Healthy	29 (11.1)
% of revenue	39 (15.0)	Fast	120 (46.3)	Overweight	48 (25.2)
Other	4 (1.5)			Obese	119 (45.4)
				Ext. Obese	66 (18.3)

Table 10

(Cont.)

	n (%)		*n* (%)		*n* (%)
Health Insurance		**Time Pressure**		**Cardio-Metabolic**	
None		Low		**Disease Risk**	
Insured	87 (33.5)	High	127(51.2)	Low Risk	27 (10.4)
	173 (66.5)		133 (48.8)	Increased Risk	25 (9.6)
Union Membership		**Repetitive**		High Risk	49 (18.8)
No	251 (96.5)	**Work**		Very High Risk	111 (42.7)
Yes	9 (3.5)	Low	47 (18.1)	Extremely High Risk	48 (18.5)
		High	213 (81.9)		

For a waist circumference greater than 102 cm, the first model was significant (X^2 = 14.73, p < 0.05), indicating that it explains a significant amount of the original variability. The Pearson (X^2 = 56.40, p = 0.50) and deviance statistic (X^2 = 56.24, p = 0.50) were not significant, indicating the model was a good fit. The two measures of R^2 (Cox & Snell, Nagelkerke) were relatively low (0.08, 0.12). The only significant predictor to the model was supervisor support (X^2 = 7.20, p < 0.01). The second (X^2 = 1.91, p = 0.59) and third (X^2 = 13.33, p = 0.21) models were not statistically significant. While the third model was not statistically significant, supervisor support (X^2 = 4.79, p < 0.05) and learning new things (X^2 = 4.21, p < 0.05) were significant predictors to the model. The fourth model was significant (X^2 = 31.61, p < 0.01). The Pearson (X^2 = 138.59, p = 0.19) and deviance (X^2 = 113.84, p = 0.75) statistics were not significant, indicating the model was a good fit. The two measures of R^2 were modestly high (0.19, 0.30). Significant predictors to the model again included supervisor support (X^2 = 5.74, p < 0.05) and learning new things (X^2 = 10.21, p < 0.01); driver age

(X^2 = 9.98, $p < 0.01$) and driving experience (X^2 = 6.38, $p < 0.05$) were also significant predictors

Table 11 provides the odds ratio estimates. A lower level of supervisor support and a higher level of having to learn new things on the job were found to be statistically significant predictors for a waist circumference greater than 102 cm. Specifically, the first model indicated a 307% increase in odds, the third model a 290% increase, and the fourth model a 396% increase in odds with a lower level of job support.

The third model indicated a 172% increase in odds and the fourth model indicated a 522% increase in odds with a higher level of learning new things. When compared to those 51 and older, being between the ages of 36 and 50 held an increase in odds of 316%. When compared to those having 21 or more years of driving experience, 10 or less years of experience held a decrease in odds of 81%.

For cardio-metabolic disease risk, the first (X^2 = 23.08, p = 0.73), the second (X^2 = 16.90, p = 0.15), and third (X^2 = 50.30, p = 0.13) models were not significant, indicating that none of them explained a significant amount of the original variability. While the second and third models were not statistically significant, daily work hours were a significant predictor to the second model (X^2 = 8.46, $p < 0.1$) and supervisor support (X^2 = 8.68, $p < 0.1$) and daily work hours were significant predictors to the third model (X^2 = 8.46, p = 0.1). The fourth model was significant (X^2 = 86.23, $p < 0.01$). The deviance statistic (X^2 = 324.00, p = 1.00) was not significant, indicating the model was a good fit, while the Pearson statistic was significant (X^2 = 612.41, $p < 0.01$). This raised concerns for overdispersion.

Table 11

Logistic Regression Results (Waist Circumference > 102 cm)

	Model 1			Model 2			Model 3			Model 4		
	Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI	
Work Pace	1.18	0.50	2.76	-	-	-	1.48	0.55	4.01	1.52	0.53	4.40
Time Pressure	0.57	0.24	1.33	-	-	-	0.62	0.24	1.62	0.71	0.25	2.06
Learn New Things	1.75	0.79	3.90	-	-	-	2.72^{**}	1.00	7.39	6.22^{***}	1.81	21.37
Repetitive Work	1.76	065	475	-	-	-	1.33	0.41	4.31	1.31	0.37	4.73
Supervisor Support	4.07^{**}	1.30	12.78	-	-	-	3.90^{**}	1.01	15.01	4.96^{**}	1.15	21.34
Coworker Support	0.83	0.39	1.79	-	-	-	0.96	0.39	2.35	0.98	0.36	2.62
Perceived Job Stress	0.53	0.22	1.26	-	-	-	0.46	0.17	1.26	0.49	0.16	1.51
Work Hours	-	-	-	1.18	0.60	2.30	1.39	0.60	3.23	1.38	0.55	3.44
Shift Work	-	-	-	0.58	0.21	1.61	0.72	0.23	2.22	0.70	0.19	2.54
Delivery Schedule	-	-	-	1.32	0.64	2.70	1.18	0.44	3.14	1.09	0.38	3.16
Driver Age												
≤ 35	-	-	-	-	-	-	-	-	-	0.69	0.17	2.69
36–50	-	-	-	-	-	-	-	-	-	4.16^{**}	1.28	13.54
Driver Experience												
≤ 10 yrs	-	-	-	-	-	-	-	-	-	0.19^{**}	0.05	0.76
11–20 yrs	-	-	-	-	-	-	-	-	-	0.54	0.14	2.09

Note. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

When looking into this possibility, the dispersion parameter was found to be 1.22 (612.41/500df), which is greater than one but not close to two, indicating little concern for overdispersion (Fields, 2013). The two measures of R^2 were relatively high (0.43, 0.46), indicative of a high effect size. Significant predictors to the model included supervisor support (X^2 = 7.78, p = 0.1), daily work hours (X^2 = 11.33, $p < 0.05$), driver age (X^2 = 21.27, $p < 0.01$), and driving experience (X^2 = 16.38, $p < 0.05$).

The reference category for the regression models was Low Risk. Table 12 provides the odds ratio estimates for the High Risk category. An increased level of learning new things on the job was statistically significant increase in odds in the first and fourth models (228%, 395%). As statistically significant predictors to the models, working more than 11 and up to 14 hours resulted in increased odds (44%, 427%, and 425%) in models 2, 3 and 4, supervisor support increased odds (6%) in the fourth model, being between the age of 36 and 50 increased odds (110%) in the fourth model when compared to those 51 and older, while 10 or less years of experience decreased the odds (40%) when compared to those with 21 or more years of experience.

Table 12

Logistic Regression Results for Cardio-Metabolic Disease Risk (High Risk)

	Model 1			Model 2			Model 3			Model 4		
	Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI	
Work Pace	1.59	0.41	6.20	-	-	-	2.16	0.38	12.39	2.15	0.34	13.50
Time Pressure	0.91	0.24	3.49	-	-	-	1.09	0.24	4.93	1.19	0.24	5.87
Learn New Things	3.28*	0.89	12.08	-	-	-	3.37	0.72	15.75	4.95*	0.92	26.54
Repetitive Work	1.65	0.38	7.22	-	-	-	2.27	0.43	11.91	2.30	0.41	13.05
Supervisor Support	2.17	0.47	9.98	-	-	-	0.91	0.16	5.21	1.06	0.17	6.62
Coworker Support	1.54	0.45	5.32	-	-	-	1.24	0.28	5.54	1.09	0.24	4.99
Perceived Job Stress	1.03	0.28	3.83	-	-	-	1.26	0.27	5.84	1.37	0.27	6.84
Work Hours	-	-	-	1.44	0.48	4.33	1.45	0.37	5.69	1.49	0.35	6.33
Shift Work	-	-	-	1.29	0.20	8.47	1.11	0.15	8.34	1.07	0.13	8.56
Delivery Schedule	-	-	-	1.54	0.42	5.66	5.27	0.53	52.39	5.25	0.53	52.48
Driver Age												
≤ 35	-	-	-	-	-	-	-	-	-	0.94	0.08	11.59
36–50	-	-	-	-	-	-	-	-	-	2.10	0.38	11.73
Driver Experience												
≤ 10 yrs	-	-	-	-	-	-	-	-	-	0.60	0.09	3.99
11–20 yrs	-	-	-	-	-	-	-	-	-	2.77	0.40	19.05

Note. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 13 provides the odds ratio estimates for a Very High Risk for cardio-metabolic disease. There were no statistically significant findings within the models. As statistically significant predictors to the models, working more than 11 and up to 14 hours resulted in increased odds (19%, 52%, and 412%) in models 2, 3 and 4, being 35 and younger or between the age of 36 and 50 increased odds (90% and 238%) in the fourth model when compared to those 51 and older, while 10 or less years of experience decreased the odds (50%) when compared to those with 21 or more years of experience.

Table 14 provides the odds ratio estimates for an Extremely High Risk of cardio-metabolic disease risk. In both models 3 and 4, an unrealistic delivery schedule held statistically significant increased odds (691%, 625%). In the third model, statistically significant odds also included learning new things (285% increase) and repetitive work (405% increase).

As statistically significant predictors to the models, working more than 11 and up to 14 hours resulted in increased odds (275%, 396%, and 645%) in models 2, 3 and 4, while being 35 and younger and between the age of 36 and 50 increased odds (1107% and 949%) in the fourth model when compared to those 51 and older, while 10 or less years or 11 to 20 years of experience decreased the odds (65% and 60%) when compared to those with 21 or more years of experience.

Table 13

Logistic Regression Results for Cardio-Metabolic Disease Risk (Very High Risk)

	Model 1			Model 2			Model 3			Model 4		
	Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI	
Work Pace	2.18	0.64	7.41	-	-	-	3.07	0.64	14.83	3.26	0.62	16.99
Time Pressure	0.45	0.14	1.48	-	-	-	0.58	0.15	2.26	0.65	0.15	2.76
Learn New Things	2.37	0.72	7.76	-	-	-	2.04	0.50	8.25	2.38	0.53	10.62
Repetitive Work	2.30	0.63	8.50	-	-	-	2.59	0.61	10.90	2.23	0.51	9.81
Supervisor Support	1.50	0.36	6.14	-	-	-	0.76	0.16	3.75	0.97	0.18	5.20
Coworker Support	1.95	0.65	5.82	-	-	-	1.34	0.36	5.08	1.24	0.32	4.76
Perceived Job Stress	0.81	0.26	2.58	-	-	-	1.22	0.31	4.74	1.26	0.30	5.25
Work Hours	-	-	-	1.19	0.45	3.15	1.52	0.45	5.12	1.75	0.49	6.24
Shift Work	-	-	-	0.41	0.09	1.90	0.45	0.08	2.44	0.52	0.09	2.99
Delivery Schedule	-	-	-	1.88	0.58	6.14	5.15	0.57	46.49	4.79	0.83	43.08
Driver Age												
≤ 35	-	-	-	-	-	-	-	-	-	1.90	0.21	16.98
36–50	-	-	-	-	-	-	-	-	-	3.38	0.71	16.07
Driver Experience												
≤ 10 yrs	-	-	-	-	-	-	-	-	-	0.50	0.10	2.65
11–20 yrs	-	-	-	-	-	-	-	-	-	1.23	0.21	7.19

Note. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 14

Logistic Regression Results for Cardio-Metabolic Disease Risk (Extremely High Risk)

	Model 1			Model 2			Model 3			Model 4		
	Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI		Odds Ratio	95% CI	
Work Pace	1.90	0.50	7.16	-	-	-	266	047	1521	3.24	0.51	20.44
Time Pressure	0.74	0.20	2.71	-	-	-	136	030	624	1.79	0.35	9.09
Learn New Things	2.26	0.63	8.11	-	-	-	385*	083	1791	3.33	0.62	17.66
Repetitive Work	2.38	0.56	10.16	-	-	-	505*	091	2802	3.37	0.56	20.41
Supervisor Support	1.93	0.43	8.79	-	-	-	068	011	402	0.91	0.14	6.07
Coworker Support	1.20	0.36	3.98	-	-	-	070	016	312	0.73	0.16	3.32
Perceived Job Stress	0.52	0.15	1.80	-	-	-	053	012	239	0.46	0.09	2.31
Work Hours	-	-	-	3.75**	1.12	12.55	4.96**	1.17	21.02	7.45***	1.59	35.00
Shift Work	-	-	-	0.92	0.15	5.60	1.06	0.15	7.49	1.37	0.18	10.47
Delivery Schedule	-	-	-	2.57	0.72	9.23	7.91*	0.80	78.40	7.25*	0.72	73.39
Driver Age												
≤ 35	-	-	-	-	-	-	-	-	-	12.07**	1.07	135.86
36–50	-	-	-	-	-	-	-	-	-	10.49***	1.73	63.57
Driver Experience												
≤ 10 yrs	-	-	-	-	-	-	-	-	-	0.35	0.05	2.26
11–20 yrs	-	-	-	-	-	-	-	-	-	0.40	0.05	3.26

Note. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Discussion

This sample of drivers had an average waist circumference of nearly 115 cm and 76 percent were considered abdominally obese, far greater than the general population. The findings from this study further suggest that job stress is associated with increased odds for abdominal obesity among long-haul truck drivers. Specifically, a lower level of supervisor support and having to learn new things led to higher odds of a waist circumference of greater than 102 cm and persisted after adjustments for other job stressors, including work hours and scheduling, and driver age and years of experience. Supervisors for this population are dispatchers who set the driving schedules and delivery schedules, leaving little decisional authority for individual drivers, and ultimately have significant influence on time pressures and overall job stress of drivers. It is also likely that for truck drivers having to learn new things, whether it be rules, policies, or driving techniques, could serve as a stressor or added demands. The literature supports the perception that low supervisor support and higher demands would be significant influences on abdominal obesity. For men in particular, Block and colleagues (2009) found that higher job demands in conjunction with a lack of authority were associated higher risks for weight gain for U.S. adults. Specific to abdominal obesity, a study of Japanese factory workers found similar results as lower supervisor support was a risk factor in a six year longitudinal study (Ishizaki et al., 2008). These findings also align with a review that determined while there is no significant evidence for a stronger relationship between job stress and abdominal obesity when compared to general obesity, there is most likely a stronger effect in men due to physiological effects in terms of cortisol levels and neuroendocrine functioning (Wardle, Chida, Gibson, Whitaker, & Steptoe, 2011). Likewise, findings from the Whitehall II study showed that chronic work stress, featuring high demands and lower support from supervisors predicted both general and abdominal obesity (Brunner et al., 2007).

When combining the measure of BMI with waist circumference, this study found that 80 percent of the sample either had a high, very high, or extremely high risk of developing cardio-metabolic disease. This is not surprising considering that most people who are generally obese will also be abdominally obese, which suggests that BMI may still be an effective measure for cardio-metabolic disease risk (Abbasi et al., 2013). Freedman and Ford (2015) further reported that the rise in waist circumference among men has not been independent of the rise BMI among Americans over the last 25 years. For cardio-metabolic disease risk, especially for an extremely high risk, longer were hours statistically significant in terms of raising the odds ratios across the models. This leads one to believe that across this sample longer work hours had a larger influence on general obesity and that BMI may have been a better indicator for cardio-metabolic disease risk. Most concerning, an extremely high risk of cardio-metabolic disease means that the drivers had a BMI of 40 or greater. Consistent with the literature, the findings insinuate that long work hours could influence drivers' body physiologically and health behavior in the form of physical inactivity and poor nutritional intake (Landsbergis et al., 2014). The findings also concur with Soloveiva and colleagues (2013) review which concluded that longer work hours were the most critical aspect of work organization to weight gain and obesity among men. Specifically, longer hours of work could allow for less time to exercise and obtain physical activity, particularly in sedentary jobs such as truck driving, and less time to prepare and consume healthier food options (Turner & Reed, 2011). Chronic stress from repeated long hour days can alter health behaviors through hormone imbalances, namely leptin (Ahima, 2011; Ramachandrappa & Farooqi, 2011). Long work hours have also been associated with sleep deprivation, which can impact the body physiologically, specifically cortisol levels, and create abnormal stress responses (Johnson & Lipscomb, 2006). Prolonged sleep deprivation and sleep disorders can potentially lead to detrimental effects on the body's endocrine system and metabolic rate (Caruso, 2014). In fact, several studies have indicated that the linkage between longer work hours and obesity is mediated by shorter sleep duration (Di Milia & Mummery, 2009; Ko et al., 2006; Magee et al., 2011). Last, the odds were also significantly higher for those in the younger age groups. The literature has also indicated that younger men are more likely to gain weight with increased work hours than are older workers (Soloveiva et al., 2013).

The findings from this study also concur with calls from occupational health scholars for workplace interventions to focus on work organization factors, such as long work hour and scheduling practices, in conjunction with individual level behavior approaches in addressing obesity among employees (Luckhaupt et al., 2014). Mirroring the calls for integrated approaches in worksite health promotion and occupational safety and health at the national level through the *Total Worker Health* initiative (CDC – Total Worker Health), many long-haul truck driver researchers have expressed the need for integrated and comprehensive approaches within the trucking industry (Apostolopoulos et al., 2014; Ng et al., 2014; Sieber et al., 2014). Within the workplace, integrated approaches acknowledge that workplace safety factors and health behaviors are intricately linked and within this context, workplaces can and should simultaneously promote and protect health. The policies and programs incorporated should seek to reduce or eliminate job hazards, such as long work hours, shift work, and job stress, and concurrently promote healthy individual lifestyles. Meanwhile, workplaces should actively engage their employees and seek to provide a work context that is health supportive, both physically and organizationally (Sorenson et al., 2013).

For truck drivers, this could include addressing the work hours and schedules, the way that truckers are compensated (paid by the mile), and scheduling and delivery pressures (Apostolopoulos et al., 2014). Interventions should involve changes to organizational practices and public policies relating to the HOS regulations. It is recognized that this type of approach to trucker health is dependent upon a systems perspective involving multidisciplinary collaboration from multiple stakeholders including representation from regulatory bodies, trucking companies, unions, truck drivers, researchers, and other policy makers (Apostolopoulos et al., 2014). Working together and gathering perspectives from each of these individuals and groups can enhance understanding of the long-haul truck driver work organization and identify leverage points for intervening, while also valuing the competitive nature of the industry (Apostolopoulos et al., 2014).

The study has several limitations. As a result of the cross-sectional research design, causal connections cannot be claimed due to any established associations.

Furthermore, due to driver selection and retention bias, as well as the extensive use of prescription medications and the use of drivers' self-reported measures in terms of work hours, schedules, and perceived job stressors, the findings may underrepresent the true scale of the plethora of health-related challenges of long-haul truck drivers in association with their work environment. As such, the results from this study cannot be generalized to all long-haul truck drivers. Future studies should seek to incorporate larger and more representative samples, health behavior data (physical activity, diet, sleep, etc.) and the collection of longitudinal data as well as the use of biological data (insulin, cholesterol, lipids, etc.). Randomized control trials would be best, but there is the recognition with occupational health studies of the practical, ethical, and legal constraints.

Conclusion

The profession of long-haul truck driving is among the riskiest occupations in the U.S. and as a result has some of the worst health outcomes. Most interventions have focused on individual-behavior changes (Ng et al., 2014), but the findings from this study suggest that longer work hours and lack of supervisor support have a major influence on the odds for general and abdominal obesity, resulting with increased risks for cardio-metabolic disease. As such, the results align with the recent calls at the national level for integrated approaches to worker health and more advanced approaches to understanding and intervening to improve the health of long-haul truck drivers.

CHAPTER VI

EPILOGUE

Long-haul truck drivers work in one of the riskiest occupations, have among the worst health outcomes, and as a result have a life expectancy far shorter than the general population. One of the most significant health problems experienced by this occupational segment is obesity, particularly abdominal obesity among males, and the resulting increased risk for cardio-metabolic disease. Most interventions for this population, however, have focused little attention directed on the work environment and as a result have had limited success.

The majority of occupational safety and health approaches have focused on reducing the accident risks associated with fatigue, sleep deprivation, and dangerous driving. Strategies have included fatigue management, drug and alcohol testing, and HOS regulations to limit the number of hours drivers are allowed to work. From a worksite health promotion standpoint, interventions have tended to solely emphasize changing health behaviors with little attention placed on how the work environment influences both health behaviors and outcomes. Strategies have included improving nutritional intake, increasing physical activity, stress and fatigue management, and reducing drug and alcohol use.

While all of these approaches have proven success in various settings, the weaknesses involved with applying them to long-haul truck drivers is that most of the work conditions are out of the individual driver's control. The delivery schedules of drivers are set up by dispatchers, who function as their supervisor, and tend to utilize every hour they can get out of a driver. The schedules can include long work hours (legally up to 14) and rotating daily and nightly driving times. Likewise, the scheduling practices force drivers to often times work at a fast pace and be time pressed to meet frequently unrealistic delivery demands. At the same time, the profession is repetitive with long hours behind the wheel (sedentary) and drivers must keep up to date (learn new things) on the newest government regulations for their industry and the practices implemented by their individual employer. This population tends to be socially isolated and lacks the support from coworkers that many other occupations enjoy. With adverse work schedules, many drivers also consider their supervisors to be unsupportive. As evidenced from the literature, these features can significantly influence drivers physiologically (metabolism, hormones, circadian rhythm), psychologically, and their health behaviors.

While general and abdominal obesity along with the associated cardio-metabolic disease risks are evident among long-haul truck drivers, many of the numerous poor health outcomes are similarly linked with and influenced by the work organization. For example, longer work hours, shift work, and job stress have all been independently associated with sleep deprivation and quality, mental illnesses, and physical inactivity, poor nutritional intake, and drug and alcohol use. Likewise, obesity has also been associated with sleep disorders including sleep apnea (common among long-haul truck drivers), increased accident risks, and mental illness. These connections point toward the longer working hours, irregular work schedules, and job stress as potentially the underlying causes of poor health among the long-haul truck driving population.

Several occupational health scholars have further suggested that work organization is responsible for the increased obesity prevalence among long-haul truckers. In conjunction with the literature, the results of this study suggest that features of the work organization, chiefly the longer work hours and poor supervisor support, increase the odds of general obesity, abdominal obesity, and cardio-metabolic disease. As such, the results also support the recent calls at the national level for integrated approaches to worker health and more advanced approaches to understanding and intervening to improve the health of long-haul truck drivers.

Future Work

While work organization’s relationships with health behaviors and outcomes have been studied internationally for several decades, the number of studies in the U.S. has only begun to pick up over the last decade. Specifically, long-haul truck drivers have been an understudied population. The hope is that this study will help lead to further examinations of the causes of obesity and other poor health outcomes among long-haul truck drivers.

Future studies of long-haul truck drivers should seek to utilize quantitative data as presented in this dissertation while being supplemented with increased use of qualitative data. The use of larger and more representative sample sizes, longitudinal data, and use of health behavior data can further elicit enhanced understanding of the causes of obesity and where to most effectively intervene. Hopefully with the increased studies of this sort, momentum can be built to further support changes in public policy, organizational practices, and subsequently the work organization for not only long-haul truck drivers but all American workers. Collectively, these studies can help to support and continue to provide evidence of the distinguished work that numerous occupational and worksite scholars have previously conducted.

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APPENDIX A

TRUCKER SLEEP DISORDERS SURVEY (TSLDS)

LONG-HAUL TRUCKER DRIVERS SLEEP SURVEY CODE BOOK

PART	VARIABLE	CODE	
PID	Participant ID number	001 through 262	
INT	Research team interviewer	AH SS KH	
DATE	Date of interview	Ex: 10/10/12	
TIME	Time of interview	Ex: 08:30pm	
NAME	**CALCULATE**	**VARIABLE**	**CODE**
Pulse	Mean of two pulse rate readings	Pulse	Ex: 75
Systolic PB	Mean of two PB readings for systolic	Systolic	Ex: 120
Diastolic PB	Mean of two PB readings for diastolic	Diastolic	Ex: 100
Height	Calculate height into inches (5’5” = 65)	Height	Ex: 170
Weight	Report weight as written	Weight	Ex: 360
BMI	Weight/Height in inches x Height in inches x 703	BMI	Ex: 30
Sagittal	Mean of 3 measures of sagittal diameter (convert to inches)	Sagital	Ex: 120
CircW	Mean of 3 measures of waist circumference	CirW	Ex: 100

	(convert to inches)		
Waist-Hip Ratio	Ratio of Waist:Hip	WHpRatio	Ex:
Waist-Height Ratio	Ratio of Waist:Height	WHtRatio	Ex:
CircH	Mean of 3 measures of hip circumference (convert to inches)	CirH	Ex:100
CircUA	Mean of 3 measures of upper arm circumference (convert to inches)	CirUA	Ex: 40
LipidCh-HDL			
LipidCh-LDL			
Glucose			
Insulin			

PART	QUESTN	VARIABLE	VARIABLE NAME	CODE	VALUE
Part 1	1	P1Q1	Driver type	01 02 03 04	Company driver For-hire OO-Own authority OO-Lease
				05	String variable (write out)
Part 1	2	P1Q2	Load type	01 02 03 04 05	Full TL LTL Refrigerated Specialized-bulk Specialized-other
Part 1	3	P1Q3	Years of driving	Years	Write years reported
Part 1	4	P1Q4	Miles per week (if reported in year, convert to week	Years	Write miles reported
Part 1	5	P1Q5	Days on road	01	Less than 5

				02 03 04 05 06 07 08	6-10 days 11-15 days 16-20 days 21-25 days 26-30 days Over 1 month More than 2 months
Part 1	6	P1Q6	Hours work in a day	01 02 03 04 05 06 07 08 09 10	Less than 6 6-7 hours 7-8 hours 8-9 hours 9-10 hours 10-11 hours 11-12 hours 12-13 hours 13-14 hours Over 14 hours
Part 1	7	P1Q7	Schedule	00 01	Different every day Same every day
Part 1	8	P1Q8	Daily hours	00 01	Different every day Same every day
Part 1	9	P1Q9	Days of week	00 01	Different each week Same each week
Part 1	10	P1Q10	Work start	01 02 97	Actual time A.M. *(round off to nearest full hour)* Actual time P.M. Varies
Part 1	11	P1Q11	Work finish	01 02 98	Actual time A.M. Actual time P.M. Varies
Part 1	12	P1Q12	Hour awake: work days	01 02 03 97 99	Actual time A.M. Actual time P.M. Range *(round off to nearest full hour)* Varies Don’t know/remember
Part 1	13	P1Q13	Hour awake: non-work days	01 02	Actual time A.M. Actual time P.M.

				03 97 98 99	Range *(round off to nearest full hour)* Varies Does not apply Don't know/remember
Part 1	14	P1Q14	Hour asleep: work days	01 02 03 97 99	Actual time A.M. Actual time P.M. Range *(round off to nearest full hour)* Varies Don't know/remember
Part 1	15	P1Q15	Hour asleep: nonwork days	01 02 03 97 98 99	Actual time A.M. Actual time P.M. Range *(round off to nearest full hour)* Varies Does not apply Don't know/remember
Part 1	16	P1Q16	Fast pace of work	00 01 02 03 04	Never Rarely Sometimes Oftentimes Always
Part 1	17	P1Q17	Work under time pressure	00 01 02 03 04	Never Rarely Sometimes Oftentimes Always
Part 1	18	P1Q18	Repetitive work	00 01 02 03 04	Never Rarely Sometimes Oftentimes Always
Part 1	19	P1Q19	Opportunities to learn new things	00 01 02 03 04	Never Rarely Sometimes Oftentimes Always
Part 1	20	P1Q20	Support of co-workers	00 01 02	Never Rarely Sometimes

				03 04	Oftentimes Always
Part 1	21	P1Q21	Support of supervisor	00 01 02 03 04	Never Rarely Sometimes Oftentimes Always
Part 2	22	P2Q22	Overall health	01 02 03 04 05 06	Very Poor Poor Fair Good Very Good Excellent
Part 2	23	P2Q23	Stress level	00 01 02 03 04 05	No stress Mild stress Moderate stress High stress Extreme stress Acute/chronic stress
Part 2	24	P2Q24	Alcohol consumption: workday	00 01 02 03 04 99	None 1 drink 2-3 drinks 4-5 drinks 6+ drinks Don’t know/remember
Part 2	25	P2Q25	Alcohol consumption: nonwork day	00 01 02 03 04 98 99	None 1 drink 2-3 drinks 4-5 drinks 6+ drinks Does not apply Don’t know/remember
Part 2	26	P2Q26a	Diagnosis: arthritis/rheumatism	01 02 99	Yes No Don’t know/remember
Part 2	26	P2Q26b	Diagnosis: chronic back/neck pain	01 02 99	Yes No Don’t know/remember

Part 2	26	P2Q26c	Diagnosis: high blood pressure/hypertensio n	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26d	Diagnosis: cardiovascular problems	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26e	Diagnosis: high cholesterol	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26f	Diagnosis: diabetes	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26g	Diagnosis: ulcer in stomach or intestine	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26h	Diagnosis: irritable bowel syndrome	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26i	Diagnosis: chronic heartburt	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26j	Diagnosis: asthma	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26k	Diagnosis: bronchitis or emphysema	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26l	Diagnosis: obstructive pulmonary disease	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26m	Diagnosis: lung cancer	01 02 99	Yes No Don't

					know/remember
Part 2	26	P2Q26n	Diagnosis: urinary or bladder problems	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26o	Diagnosis: bladder cancer	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26p	Diagnosis: chronic fatigue or low energy	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26q	Diagnosis: anxiety disorder	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26r	Diagnosis: depression	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26s	Diagnosis: frequent/severe headaches	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26t	Diagnosis: other (WRITE IN)	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26u	Diagnosis: other (WRITE IN)	01 02 99	Yes No Don't know/remember
Part 2	26	P2Q26v	Diagnosis: other (WRITE IN)	01 02 99	Yes No Don't know/remember
Part 2	27	P2Q27	Medications prescribed	01 02 03 04 05 06	Arthritis (WRITE IN MED) Back pain (WRITE IN MED) BP (WRITE IN MED) CV problems (WRITE IN MED)

				07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22	Cholesterol (WRITE IN MED) Diabetes (WRITE IN MED) Ulcer (WRITE IN MED) IBS (WRITE IN MED) Heartburn (WRITE IN MED) Asthma (WRITE IN MED) Bronchitis (WRITE IN MED) Pulmonary (WRITE IN MED) Lung cancer (WRITE IN MED) Urinary (WRITE IN MED) Bldr cancer (WRITE IN MED) Fatigue (WRITE IN MED) Anxiety (WRITE IN MED) Depression (WRITE IN MED) Headaches (WRITE IN MED) Other 1 (WRITE IN MED) Other 2 (WRITE IN MED) Other 3 (WRITE IN MED)
Part 3	28	P3Q28	Work night hours of sleep	Hours 99	Write hours reported Don't know/remember
Part 3	29	P3Q29	Nonwork night hours of sleep	Hours 98 99	Write hours reported Not applicable Don't know/remember
Part 3	30	P3Q30	Workday naps	Number Numbe	Actual number of naps Actual times

				r 99	dozed off Don't know/remember
Part 3	31	P3Q31	Workday nap length	Minutes Hours 99	Number of minutes Number of hours Don't know/remember
Part 3	32	P3Q32	Naps while working/not on road	Number 99	Number of times Don't know/remember
Part 3	33	P3Q33	Nonwork day naps	Number 98 99	Actual number of naps Does not apply Don't know/remember
Part 3	34	P3Q34	Nonwork day nap length	Minutes Hours 98 99	Number of minutes Number of hours Does not apply Don't know/remember
Part 3	35	P3Q35	Falling asleep while working	00 01 99	No Yes Don't know/remember
Part 3	36	P3Q36	Told dispatcher too tired to drive	00 01 99	Never told Never told for fear of firing Don't remember
				02	String variable (write out)
Part 3	37	P3Q37	Work nights: good night's sleep	00 01 02 03 99	Never Rarely Almost every night Every night Don't know/remember
Part 3	38	P3Q38	Nonwork nights: good night's sleep	00 01 02 03	Never Rarely Almost every night

				99	Every night Don't know/remember
Part 3	39	P3Q39	Caffeine consumption	Number 99	Calculate total number of ounces Don't' know/remember
Part 3	40	P3Q40	Tobacco consumption	Number 98 99	Number of packs/day Does not apply Don't know/remember
Part 3	41	P3Q41	Other substances	Number 98 99	Number of times/week Does not apply Don't know/remember
				97	Participant wanted to skip question
Part 3	42	P3Q42a	Doze off: sitting/reading	00 01 02 03 04 99	Never Less than once/week 1-2 times/week 3-4 times/week 5+ times/week Don't know/remember
Part 3	42	P3Q42b	Doze off: watching tv	00 01 02 03 04 99	Never Less than once/week 1-2 times/week 3-4 times/week 5+ times/week Don't know/remember
Part 3	42	P3Q42c	Doze off: sitting in public space	00 01 02 03 04 99	Never Less than once/week 1-2 times/week 3-4 times/week 5+ times/week Don't know/remember

Part 3	42	P3Q42d	Doze off: sitting/talking	00 01 02 03 04 99	Never Less than once/week 1-2 times/week 3-4 times/week 5+ times/week Don’t know/remember
Part 3	42	P3Q42e	Doze off: after lunch	00 01 02 03 04 99	Never Less than once/week 1-2 times/week 3-4 times/week 5+ times/week Don’t know/remember

Part 3	42	P3Q42f	Doze off: lying down to rest	00 01 02 03 04 99	Never Less than once/week 1-2 times/week 3-4 times/week 5+ times/week Don’t know/remember	2
Part 3	42	P3Q42g	Doze off:	00 01 02 03 04 99	Never Less than once/week 1-2 times/week 3-4 times/week 5+ times/week Don’t know/remember	2
Part 3	42	P3Q42h	Doze off:	00 01 02 03 04 99	Never Less than once/week 1-2 times/week 3-4 times/week 5+ times/week Don’t know/remember	2
Part 3	42	P3Q42i	Doze off:	00 01 02 03 04 99	Never Less than once/week 1-2 times/week 3-4 times/week 5+ times/week Don’t know/remember	2
Part 3	43	P3Q43	Hours of sleep for highest function	Hours 97	Actual hours noted Depends/varies	2
Part 3	44	P3Q44a	Daily time spent watching TV	00 01 02 03 99	No time Few minutes/less than 1 hr 1-3 hours 3+ hours Don’t know/remember	2
Part 3	44	P3Q44b	Daily time spent computer/Internet	00 01 02 03 99	No time Few minutes/less than 1 hr 1-3 hours 3+ hours Don’t know/remember	2
Part 3	44	P3Q44c	Daily time spent reading	00 01 02 03 99	No time Few minutes/less than 1 hr 1-3 hours 3+ hours	2

					Don’t know/remember	
Part 3	44	P3Q44d	Daily time spent exercising	00 01 02 03 99	No time Few minutes/less than 1 hr 1-3 hours 3+ hours Don’t know/remember	2
Part 3	44	P3Q44e	Daily time spent phone	00 01 02 03 99	No time Few minutes/less than 1 hr 1-3 hours 3+ hours Don’t know/remember	2
Part 3	44	P3Q44f	Daily time spent socializing	00 01 02 03 99	No time Few minutes/less than 1 hr 1-3 hours 3+ hours Don’t know/remember	2
Part 3	44	P3Q44g	Daily time spent cooking/eating	00 01 02 03 99	No time Few minutes/less than 1 hr 1-3 hours 3+ hours Don’t know/remember	2
Part 3	44	P3Q44h	Daily time spent w/ friends/family	00 01 02 03 99	No time Few minutes/less than 1 hr 1-3 hours 3+ hours Don’t know/remember	2
Part 3	44	P3Q44i	Daily time spent: (WRITE IN)	00 01 02 03 99	No time Few minutes/less than 1 hr 1-3 hours 3+ hours Don’t know/remember	2
Part 3	44	P3Q44j	Daily time spent: (WRITE IN)	00 01 02 03 99	No time Few minutes/less than 1 hr 1-3 hours 3+ hours Don’t know/remember	2

Part 3	45	P3Q45	Enough time off between shifts	00 01 99	No Yes Not sure	2
Part 3	46	P3Q46	If work shift was shorter-would get more sleep	00 01 99	No Yes Not sure	2
Part 3	47	P3Q47	Time needed to wind down	00 Minutes Hours 97 99	No time Actual minutes noted Actual hours noted Depends/varies Not sure	2
Part 3	48	P3Q48	Work days: time it takes to fall asleep	Minutes Hours 97 99	Actual minutes noted Actual hours noted Depends/varies Don’t know/don’t remember	2
Part 3	49	P3Q49	Non-work days: time it takes to fall asleep	Minutes Hours 97 98 99	Actual minutes noted Actual hours noted Depends/varies Does not apply Don’t know/don’t remember	2
Part 3	50	P3Q50a	Over past 2 weeks, experienced: difficulty falling asleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
Part 3	50	P3Q50b	Over past 2 weeks, experienced: waking up during sleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
Part 3	50	P3Q50c	Over past 2 weeks, experienced: waking up too early/ being unable to fall back asleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
Part 3	50	P3Q50d	Over past 2 weeks, experienced: waking up feeling	00 01 02	Never Rarely Sometimes	2

			tired	03 04 99	Frequently Always Don't know/remember	
Part 3	50	P3Q50e	Over past 2 weeks, experienced: sleeping soundly	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don't know/remember	2
Part 3	50	P3Q50f	Over past 2 weeks, experienced: sleeping through alarm	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don't know/remember	2
Part 3	50	P3Q50g	Over past 2 weeks, experienced: hitting snooze button	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don't know/remember	2
Part 3	50	P3Q50h	Over past 2 weeks, experienced: waking up from bad dreams	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don't know/remember	2
Part 3	51	P3Q51	How long stays awake after waking in middle of night	Minutes Hours 98	Actual number of minutes Actual number of hours Does not apply	2
Part 3	52	P3Q52	Awakened during statutory rest period	00 01 02 03 04	Never Rarely Sometimes Frequently Always	2
Part 3	53	P3Q53	How long it takes to return to sleep	Minutes Hours 98 99	Actual number of minutes Actual number of hours Does not apply Don't know/remember	2

PART IV – SLEEP PROBLEMS						
Part 4	54	P4Q54	Rest breaks	Minutes Hours 98 99	Actual number of minutes Actual number of hours Doesn't apply/no breaks Don't know/remember	2
Part 4	55	P4Q55	Time allowed to deliver load	00 01 02 03 04 98 99	Never realistic Rarely realistic Sometimes realistic Frequently realistic Always realistic Doesn't apply/no dispatcher Don't know/haven't thought about it	2
Part 4	56	P4Q56	Work over 14 hours/day	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don't know/remember	2
Part 4	57	P4Q57	Work over weekly hour limit	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don't know/remember	2
Part 4	58	P4Q58	Take fewer than 10 hours rest	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don't know/remember	2
Part 4	59	P4Q59	Underreport work hours in logbook	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don't know/remember	2
Part 4	60	P4Q60	Heard of drivers having more than 1 logbook	00 01 99	No Yes Don't know/remember	2

Part 4	61	P4Q61	How often drove sleepy a vehicle other than truck in last month	00 Number 98 99	Never Actual number of times Does not apply Don't know/remember	2
Part 4	62	P4Q62	Drove truck while sleepy in last month	00 Number 99	Never Actual number of times Don't know/remember	2
Part 4	63	P4Q63	Sleepiness impacted job performance	00 01 02 03 04 05 99	Never Less than once/week 2-3 times/week 3-4 times/week 4-5 times/week 5+ times/week Don't know/remember	2
Part 4	64	P4Q64	Work days missed in last month due to sleepiness	00 Number 99	None Actual number of times Don't know/remember	2
Part 4	65	P4Q65	Sleepiness impacted concentration	00 01 02 03 04 05 99	Never Less than once/week 2-3 times/week 3-4 times/week 4-5 times/week 5+ times/week Don't know/remember	2
Part 4	66	P4Q66a	Due to sleepiness: made serious error	01 02 99	Yes No Don't know/remember	2
Part 4	66	P4Q66b	Due to sleepiness: caused an accident	01 02 99	Yes No Don't know/remember	2
Part 4	66	P4Q66c	Due to sleepiness: in accident caused by another	01 02 99	Yes No Don't know/remember	2
Part 4	66	P4Q66d	Due to sleepiness: had near miss	01 02 99	Yes No Don't know/remember	2
Part 4	66	P4Q66e	Due to sleepiness: had crash	01 02 99	Yes No Don't know/remember	2
Part 4	66	P4Q66f	Due to sleepiness: got injured	01 02 99	Yes No Don't know/remember	2
Part	66	P4Q66g	Due to sleepiness:	01	Yes	2

4			injured others	02 99	No Don't know/remember	
Part 4	66	P4Q66h	Due to sleepiness: had injury requiring medical attention	01 02 99	Yes No Don't know/remember	2
Part 4	67	P4Q67a	Impact of insufficient sleep on work	00 01 02 98 99	No impact (WATCH ORDER OF ANSWERS) Some impact Major impact Not applicable Don't know/remember	2
Part 4	67	P4Q67b	Impact of insufficient sleep on social life/leisure activities	00 01 02 98 99	No impact (WATCH ORDER OF ANSWERS) Some impact Major impact Not applicable Don't know/remember	2
Part 4	67	P4Q67c	Impact of insufficient sleep on family life/home responsibilities	00 01 02 98 99	No impact (WATCH ORDER OF ANSWERS) Some impact Major impact Not applicable Don't know/remember	2
Part 4	67	P4Q67d	Impact of insufficient sleep on mood	00 01 02 98 99	No impact (WATCH ORDER OF ANSWERS) Some impact Major impact Not applicable Don't know/remember	2
Part 4	67	P4Q67e	Impact of insufficient sleep on intimate/sexual relations	00 01 02 98 99	No impact (WATCH ORDER OF ANSWERS) Some impact Major impact Not applicable Don't know/remember	2
Part 4	67	P4Q67f	Impact of insufficient sleep on physical health	00 01 02 98 99	No impact (WATCH ORDER OF ANSWERS) Some impact Major impact Not applicable Don't know/remember	2
Part 4	67	P4Q67g	Impact of insufficient sleep on mental health	00 01 02 98	No impact (WATCH ORDER OF ANSWERS) Some impact Major impact Not applicable	2

				99	Don’t know/remember	
Part 4	68	P4Q68a	Walk in sleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
Part 4	68	P4Q68b	Talk in sleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
Part 4	68	P4Q68c	Kick legs in sleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
Part 4	68	P4Q68d	Grind teeth/clench jaw in sleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
Part 4	68	P4Q68e	Gasp, choke, snort in sleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
Part 4	68	P4Q68f	Stop breathing in sleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
Part 4	68	P4Q68g	Have frightening dreams in sleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2

Part 4	68	P4Q68h	Have leg cramps in sleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
Part 4	68	P4Q68i	Snore loudly in sleep	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
Part 4	68	P4Q68j	Other	00 01 02 03 04 99	Never Rarely Sometimes Frequently Always Don’t know/remember	2
				05	String variable (write out)	10
Part 4	69	P4Q69a	Diagnosed with sleep apnea	00 01 99	No (WATCH ORDER OF ANSWERS) Yes Don’t know/remember	2
Part 4	69	P4Q69b	Diagnosed with shiftwork sleep disorder	00 01 99	No (WATCH ORDER OF ANSWERS) Yes Don’t know/remember	2
Part 4	69	P4Q69c	Diagnosed with insomnia	00 01 99	No (WATCH ORDER OF ANSWERS) Yes Don’t know/remember	2
Part 4	69	P4Q69d	Diagnosed with sleep hypopnea	00 01 99	No (WATCH ORDER OF ANSWERS) Yes Don’t know/remember	2
Part 4	69	P4Q69e	Diagnosed with restless leg syndrome	00 01 99	No (WATCH ORDER OF ANSWERS) Yes Don’t know/remember	2
Part 4	69	P4Q69f	Other	00 01 99	No (WATCH ORDER OF ANSWERS) Yes Don’t know/remember	2
				03	String variable (write out)	10
Part 4	70	P4Q70	Prescribed medication for sleep disorder	00 01 99	No Yes Don’t know/remember	2

Part 4	71	P4Q71a	Adavan (or Ativan) *(Lorazepam)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71b	Ambien *(Zolpidem Tartrate)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71c	Anafranil *(Chlomipramine)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71d	Celexa *(Citalopram)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71e	Desyrel *(Desipramine)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71f	Effexor *(Venlafaxine)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71g	Lexapro *(Escitalopram)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71h	Lunesta *(Eszopiclone)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71i	Luvox *(Fluvoxamine)*	00 01 02	Never used Have used in the past Currently use	2

				03 99	Prescribed/never use Don't know/remember	
Part 4	71	P4Q71j	Melatonin	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71k	Mirapex *(Pramipexole)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71l	Neurontin *(Gabapentin)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71m	Paxil *(Paroxetine)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71n	Provigil *(Modafinil)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71o	Prozac *(Fluoxetine)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71p	Remeron *(Mirtazapine)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71q	Requip *(Ropinirole)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part	71	P4Q71r	Restoril	00	Never used	2

4			*(Temazepam)*	01 02 03 99	Have used in the past Currently use Prescribed/never use Don’t know/remember	
Part 4	71	P4Q71s	Ritalin *(Methylphenidate)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don’t know/remember	2
Part 4	71	P4Q71t	Rozerem *(Ramelteon)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don’t know/remember	2
Part 4	71	P4Q71u	Serzone *(Nefazodone)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don’t know/remember	2
Part 4	71	P4Q71v	Silenor *(Doxepin)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don’t know/remember	2
Part 4	71	P4Q71w	Sinemet *(Carbidopa Levotopa)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don’t know/remember	2
Part 4	71	P4Q71x	Sonata *(Zaleplon)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don’t know/remember	2
Part 4	71	P4Q71y	Strattera *(Atomoxetine)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don’t know/remember	2
Part 4	71	P4Q71z	Tofranil *(Imipramine)*	00 01 02 03	Never used Have used in the past Currently use Prescribed/never use	2

				99	Don't know/remember	
Part 4	71	P4Q71aa	Xanax *(Alprazolam)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	71	P4Q71ab	Zoloft *(Sertraline)*	00 01 02 03 99	Never used Have used in the past Currently use Prescribed/never use Don't know/remember	2
Part 4	72	P4Q72	CPAP therapy use	00 01 98 99	No Yes Doesn't apply/no sleep apnea Don't know/not sure	2
Part 4	73	P4Q73	Other substances used to sleep in past year	00 01 02 03 04 05 06 07 99	Never used Once 2-6 times/past year 7-12 times/past year 1-4 times/month 5-8 times/month 3-5 times/week Daily Don't know/remember	2
				97	Participant wanted to skip question	2
PART V - BACKGROUND						
Part 5	74	P5Q74	Age	Number	Write actual age in years	2
Part 5	75	P5Q75	Race/ethnicity	01 02 03 04 05 06 07 08	White/Caucasian Black/African American Latino/Hispanic White Hispanic Asian Native American/Am Indian Multiracial/multiethnic Other	2
				09	String variable (write out)	10

Part 5	76	P5Q76	Education	01 02 03 04 05 06 07 08	Some high school High school diploma/GED Some trade school Trade school Some college College degree Some grad/professnl school Grad/professional degree	2
Part 5	77	P5Q77	Last year's personal income (after taxes)	01 02 03 04 05 06 07 08	$10,000-$20,000 $20,000-$30,000 $30,000-$40,000 $40,000-$50,000 $50,000-$60,000 $60,000-$70,000 $70,000-$80,000 $80,000 or more	2
Part 5	78	P5Q78	Compensation type	01 02 03 04	By the mile By the load Percentage of revenue Other	2
				05	String variable (write out)	10
Part 5	79	P5Q79	Healthcare coverage	00 01 02 03	No insurance Private insurance Government insurance Other	2
				04	String variable (write out)	10
Part 5	80	P5Q80	Who pays for healthcare insurance	01 02 03 04 05 99	Driver alone pays/out-of-pocket Driver and employer Spouse's employer Government Other Don't know/remember/unsure	2
				06	String variable (write out)	10
Part 5	81	P5Q81	Driver pays for others/his employees	01 02 03	Health insurance Workman's compensation	2

				99	Other Does not apply	
				04	String variable (write out)	10
Part 5	82	P5Q82	Union membership	00 01	No Yes	2
				03	String variable (write out union or association name)	10
PART VI – FUELING PREFERENCES (FOR TA)						
Part 6	83	P6Q83	Fleet dictates which truck stop to fuel at	00 01 02 03 04 98	Never Rarely Sometimes Frequently Always Does not apply	2
Part 6	84	P6Q84	Truck stops told to fuel at	01 02 03 98	Pumper-only truck stops Full-service truck stops Other independent truck stop Does not apply	2
Part 6	85	P6Q85	Driver preference of truck stops	01 02 03	Pumper-only stops Full-service truck stops Other independent truck stop	2
Part 6	86	P6Q86	Preference of last 5 fueling stops at brands other than the TA	00 01 02 03 04 98	Never Rarely Sometimes Frequently Always Does not apply	2
Part 6	87	P6Q87	Likelihood of changing fleets for more truck stop fueling choices	01 02 03 04 05 98	Not at all likely Slightly likely Moderately likely Very likely Completely likely Does not apply	2