In Danger? An Exploration of Canadian Truck Drivers' Health through the Canadian Community Health Survey

by
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AUTHORS DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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ABSTRACT

Background: There exists substantive evidence showing that the health status of truck drivers from the United States (US) is much poorer than the general US population. Comparatively there is much less research on Canadian truck drivers, however the macroergonomics of the motor carrier industry in both countries makes it challenging for drivers to maintain a healthy lifestyle. Thus Canadian truck drivers may also be at risk for poor health outcomes. The objectives of this thesis are threefold; to: (1) estimate the prevalence of chronic diseases in Canadian truck drivers and determine if the prevalence rates are higher than in the Canadian population, (2) identify and quantify the risk factors for chronic diseases in Canadian truck drivers, and (3) elucidate the variables that significantly correlate to BMI in Canadian truck drivers.

Methods: A sample of 991 male truck drivers was compared to 29,958 male respondents of a similar demographic profile in the Canadian Community Health Survey (CCHS) from 2009-2010 (Cycle 5.1). The samples were comprised of those who were aged 18-65, worked 10-130 hours a week, had an income of at least $20,000, and had a Body Mass Index less than 60. The sample was restricted to males since female truck drivers make up less than 5% of the truck driver population, and there would be an insufficient sample size of female truck drivers to generate statistically sound confidence intervals. Furthermore female truck drivers have similar morbidities when compared to males. Cycle 5.1 of the 2009-2010 CCHS was used as this was the last year that occupation was measured in the CCHS. The reporting of occupation made this analysis on truck drivers possible. The CCHS is a cross sectional design survey which had a multi-stage stratified clustering sample design which obtained samples from all health regions of Canada. Chi-squared and regression analyses were performed, following bootstrapping and application of sample weights.

Results: When compared to other working males in the CCHS, male truck drivers had an adjusted Prevalence Ratio (PR) of 1.45 (p<0.05) for heart disease, thus male truck drivers were 1.45 times as likely to report having heart disease as compared to other male workers. Prevalence ratios reported were adjusted for age, hours worked per week, household income, marital status, and education, as these were significantly different between populations in the Chi Square analysis. Truck drivers also had other adjusted PRs with p<0.05; higher BMI (PR of 1.69 for being obese, and 1.45 for being overweight, versus having a BMI in the normal range) higher amphetamine usage (PR of 2.04 for reporting usage "More than once" versus no usage), lower seat belt usage (PR of 5.99 for reporting using a seatbelt "Rarely" or "Never" versus "Always" or "Most of the Time"), higher rates of smoking (PR of 1.49 for being a daily smoker versus never smoking), high rates of fatigue (PR of 2.74 for the reported frequency of driving while tired being "Often" versus "Never"), lower levels of physical activity (PR of 0.52 for being active [versus inactive]) and lower fruit/vegetable intake (PR of 0.76 for reporting consuming 5-10 fruits/vegetables per day vs less than 5 fruits/vegetables per day). Although these prevalence ratios were expected based upon the literature review, some findings were unexpected: truck drivers lower prevalence ratios for frequency of having 5 or more drinks, prevalence of mood disorders, and self-perceived work stress and self-perceived life stress. Linear regression analysis on BMI was performed, elucidating that smoking status and daily physical activity over 15 minutes long significantly explained the variation in BMI; the more one smoked and the more active one was, the lower their predicted BMI was.

Conclusion: This sample of truck drivers was markedly different from other employed Canadian workers with respect to chronic disease prevalence and overweight status. Findings, such as the relationship between smoking, physical activity and BMI, will be useful in designing intervention studies to improve the health of truck drivers.

Keywords: truck driver, health status, cardiovascular disease, musculoskeletal disorders, motor-vehicle collisions, Canadian Community Health Survey, Body Mass Index.

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DEDICATION

For Mom & Dad.

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LIST OF ACRONYMS

BMI: Body Mass Index
CCHS: Canadian Community Health Survey
COPD: Chronic Obstructive Pulmonary Disease
HR: Health Region
HWE: Healthy Worker Effect
MSD: Musculoskeletal Disorder
MVC: Motor Vehicle Collision
OSA: Obstructive Sleep Apnea
OTDS: Ontario Truck Driver Survey
PR: Prevalence Ratio
RDC: Research Data Centre
UI: Uncertainty Interval

CHAPTER 1: INTRODUCTION

Life expectancy for the average male unionized truck driver from the United States (US) is 63 years old (Saltzman & Belzer, 2007). Members of the Owner-Operator Independent (Truck) Drivers Association have an even lower life expectancy of 56 years old (Saltzman & Belzer, 2007). Instead of being in-line with the US general male national average of 75.9, these figures are similar to the life expectancy found in such developing countries as Haiti, Kenya, and Ethiopia (59, 57, and 53, respectively; Central Intelligence Agency, 2011). Truck driving is reported as one of the highest risk occupations in the US, based on having the most injuries and illnesses with missed work days (Bureau of Labor Statistics, 2007). Since there are over 2.8 million truck drivers in the US alone (Steenland, Deddens, & Stayner, 1998), and over 270,000 truck drivers in Canada (Dubé & Pilon, 2006), these poor life expectancies as well the associated high rates of chronic disease morbidity are impacting many lives in North America.

Despite these facts "neither the epidemiology of trucking nor the surveillance of multilevel effects on truck drivers' morbidity and mortality in North America have received substantive research attention" (Apostopoulos, Sönmez, Shattell, & Belzer, 2010, p. 285). There is even less research on Canadian truck drivers in particular. There are three relevant pieces of research which examine Canadian truck drivers. However none of them report on modern data on truck drivers from across the country. This thesis filled in the gaps of these three aforementioned studies.

1.1 - Overview

Firstly, this thesis examined the literature on truck drivers' health and well-being. Broadly, this covered various biopsychosocial aspects of their health; this included issues of cardiovascular disease, diesel exhaust exposure and cancer, musculoskeletal disorders, nutrition, physical activity, psychological health, and other health concerns and issues unique to truck drivers. Cycle 5.1 of the 2009/2010 Canadian Community Health Survey Master File was then utilized for several different analyses; Chi-square analyses were used to illustrate the differences in prevalence rates of the above listed conditions and risk factors; multivariable logistic regressions were used to develop adjusted Prevalence Ratios (PRs) which represented the risk one has as a truck driver (compared to being another worker) for reporting to have a given chronic disease or chronic disease risk factor, after controlling for confounding variables such as age; linear regressions on Body Mass Index (BMI) were performed to examine the associations between body mass and chronic disease risk factors.

CHAPTER 2: Literature Review

2.1 – Overview

Three relevant Canadian studies have examined truck driver health. One was an epidemiological study of 457,224 male workers employed between 1965 and 1971. This study examined data from labour surveys from Employment Canada, and linked it to data from the Canadian mortality database on the same employees' deaths between 1965 and 1991. This study showed that truck drivers are at a significantly higher risk for death from motor vehicle collision (MVC), colon cancer, laryngeal cancer, lung cancer, diabetes, ischemic heart disease, and non-alcohol cirrhosis (Aronson, Howe, Carpenter, & Fair, 1999). However, this is a dated piece of literature, since it only reports on truck drivers who worked between 1965 and 1971. Additionally, the study examined nearly 750,000 males and females to produce over 26,000 Relative Risk values specific to occupation, cause, sex and age group (Aronson et al, 1999). Therefore many of these RR values of $p<0.05$ may simply be due to chance because of the high number of comparisons made. Thus further study investigating these potential elevated risk factors in truck drivers is warranted. The Canadian Community Health Survey (CCHS) of 2009-2010 will allow further examination of the health outcomes Aronson et al. (1999) saw. The other two Canadian studies were conducted by Bigelow et al. (2012) and Angeles et al. (2013). They both examined truck drivers from Southern Ontario, and both found high levels of smoking, obesity, high blood pressure, high cholesterol, diabetes, and physical inactivity. These three pieces of literature represent an overview of the health issues truck drivers have.

2.2 – Importance

Renner (1998) cogently sums up why truck driver health is an important public health issue: “[b]ecause all persons in the United States share a single highway system, drivers’ issues should be important to everyone.” (p. 167). In the US alone, between 1975 and 1999 there have been 114,343 occupant deaths in crashes involving large trucks. Passenger vehicle-occupants comprise most (83%) of these deaths (Lyman & Braver, 2003), which is to be expected given that trucks may weigh up to 80,000lb in the US (or 138,000lb in Canada) and passenger vehicles typically weigh closer to 2,000-6,000lb (Schulman, 2003). Thus the health of truck drivers and their resultant driving ability is an important public health issue that affects many people both in the US and in Canada.

In the US, the overall number of miles annually driven by truck drivers between 1975 and 1999 has increased from 81 billion to 203 billion (a 149% increase; Lyman & Braver, 2003). However, there has been only a 45% increase in large truck registrations (Lyman & Braver, 2003). Thus, truck drivers are spending a longer time on the road.

Since truck drivers may be driving for up to 13 hours per day (Government of Canada, 2009; Jensen & Dahl, 2009), it is possible that they may experience an incident associated with a chronic disease during driving (e.g., stroke, adverse response to medication, symptoms of diabetes). Obesity as a risk factor alone can put one at a 55% greater risk for a Motor Vehicle Collision (Anderson et al., 2012). Hitosugi, Gomei, Okubo, and Tokudome (2012) found that 70% of such aforementioned incidents were due to cardiovascular disease. Over 80% of these incidents caused traffic accidents. Therefore, risk factors for cardiovascular disease are relevant in this review and should thus be examined.

2.3 – Cardiovascular Disease

Cardiovascular disease is the leading cause of death in North America (Ordunez et al., 2015). This disease involves a complex interaction of many risk factors including, but not limited to hypertension, hypercholesterolemia, obesity, long work hours, physical stressors, shift work, sleep irregularity, deprivation, debt, substance misuse, stress, and sedentary behaviour (Byrne & Espnes, 2008; Yarnell et al., 2005). Unfortunately, truck drivers tend to possess many of these factors (Apostolopoulos et al., 2010), making them a high-risk population for cardiovascular disease.

Hypertension, a major risk factor for cardiovascular disease, is a unique problem in truck driver populations. While there are US federal guidelines stating that commercial drivers' blood pressure shall not exceed 140/90 mmHg (Blumenthal et al., 2002), out of a sample of 3,000 truck drivers attending a trade show, 33% recorded blood pressures greater than this, and 11% recorded blood pressures greater than 160/95 mmHg (Korelitz et al., 1993). In contrast, only 26.3% of males in the US general population have blood pressures greater than 140/90 mmHg (American Heart Association, 2007).

2.3.1 Overweight/Obesity

2.3.1.1 Body Mass Index (BMI)

Another major risk factor for cardiovascular disease is overweight/obesity (Byrne & Espnes, 2008; Yarnell et al., 2005). Body Mass Index (BMI) is often used to quantify overweight/obesity rates. It is derived by dividing the individuals body weight in kilograms by their height in metres squared. BMI values and their corresponding relations to body composition are given below in Table 1.

Table 1. Body Mass Index Values and Corresponding Body Compositions.

BMI (kg/m^2)	Body Composition
<18.5	Underweight
18.5-25	Normal Weight
25-30	Overweight
>30	Obese

(Sieber, 2014)

BMI is not an optimal measure of one's adiposity (Shields et al., 2008) since it does not take into account lean mass. However it is still accepted as a validated measure of adiposity (Bouchard, 2007); for example in 1288 North Americans it had a mean correlation of 0.94 to fat mass (Bouchard, 2007). Furthermore, this finding was consistent across race and sex (ranging from 0.90 to 0.96). Other methods (e.g., Dual-Energy X-ray Absorptiometry [DEXA], skinfold measurements) are more accurate (Gupta & Kapoor, 2014), but cost-prohibitive in large-scale studies like the CCHS.

Many truck drivers have BMIs indicative of overweight/obesity. Turner & Reed (2011), in a convenience sample of 300 long-haul US truck drivers, found that 93.3% were overweight/obese. Martin, Church, Bonnell, Ben-Joseph, & Borgstadt (2009) had findings with higher external validity however, since their sample was a random sample from 10 truck stops across the US. . They found a high obesity rate (55% of 2849 US truck drivers). Obesity was found to be consistently higher, independent of factors such as racial status. Sieber et al. (2014) had an even more representative sample, as they reported on data from 2010 examining 1,670 US long-haul truck drivers from 32 different truck stops across 48 different States in the US. Truck stops were picked to be representative, as they were along high-flow and low-flow routes, in addition to having restaurants and overnight parking spots. They found 69% of the truck drivers to be obese (versus 31% in the general population). Turner & Reed (2009) and Sieber et al. (2014) have notable samples since participants were measured for their height and weight (as opposed to self-report height and weight, which introduced a 7% under-report bias in Shields et al. [2008]). These prevalence rates of obesity are important to note since they are the highest rates among all occupational groups (Caban et al., 2005).

Thus, many truck drivers are overweight/obese. Both epidemiological and biomedical research has shown that being overweight and/or obese is linked to a wide range of morbidities (Järvholm & Silverman, 2003); it is well known that being overweight and/or obese puts one at higher risk for cardiovascular disease, stroke, hypertension, and diabetes (Ostbye, Dement, &

Krause, 2007). In addition, obesity puts one at increased risk for a Motor-Vehicle Collision (MVC); Anderson et al. (2012) noted in their sample that there was a relative risk of 1.55 for an MVC for heavy truck drivers who were obese (BMI≥30) versus non-obese heavy truck drivers. Their sample was composed of 744 participants who were all new truck drivers, who were followed for two years (Anderson et al., 2012). Since the truck driver population tends to be experienced (Apostolopoulos et al., 2013; Bigelow et al., 2012, Angeles et al., 2013), this finding applies to the new truck drivers in the population. Certain truck driver populations have fast turnover rates. For example the trucking industry has an overall turnover rate of 35%, with a 130% turnover rate in some large trucking fleets (Bigelow et al., 2012). Therefore the finding of increased MVCs in unexperienced (obese) drivers is still relevant, especially to large trucking companies.

Truck drivers with sleep disorders have a two-fold increased risk of MVC per mile than otherwise comparable drivers (Stoohs, Guilleminault, Itoi, & Dement, 1994). Obese truck drivers in particular were found to have twice the accident-involvement rate of normal weight truck drivers (Roberts & York, 2000). Strongly correlated with obesity is Obstructive Sleep Apnea (OSA; Baskin, Ard, Franklin, & Allison, 2005). Individuals with OSA were shown to perform as poorly as those over the legal blood-alcohol limit (Pack et al., 2006). The cost of overweight/obesity in truck drivers may be large; in terms of obesity, for every BMI point above 25, health-care costs per employee increase by $202.30 annually (Wang et al., 2006). In terms of safety, the average large truck crash costs upwards of $90,000, and upwards of $4,000,000 if a fatality occurs (Federal Motor Carrier Safety Administration, 2001). The total annual cost of truck crashes to the US economy is $31.1 billion dollars, in 2007 (Federal Motor Carrier Safety Administration, 2001). Thus it appears overweight/obesity in the truck driving population is placing a large financial cost upon the system.

2.3.1.2 – Fatigue

Driving for long periods of time can be a difficult task, as one must maintain vigilance despite drowsiness from the monotonous nature of the job. This can lead to physical and mental fatigue and stress (Renner, 1998). McCartt, Rohrbaugh, Hammer, & Fuller (2009) found that in a sample of 593 randomly selected truck drivers from New York state, 47.1% reported having fallen asleep at the wheel at one point. Having fallen asleep while driving in the past puts one at a significantly higher risk for a MVC (Hanowski et al., 2000; Wiegand, Hanowski, & McDonald, 2009).

Obesity significantly correlates to fatigue: Vgontzas (1998) found in 73 people who were obese that (when compared to 45 controls) they had more trouble falling asleep at night, and staying asleep, than did the age-matched normal weight controls. These participants also fell asleep during the day more easily, and slept more deeply during the day. Obesity and fatigue were also examined in Wiegand et al. (2009). They found in 103 US truck drivers that obese truck drivers were between 1.22 (CI=1.03-1.45) and 1.69 (CI=1.32-2.18) times more likely than non-obese truck drivers to be rated as fatigued based on their two measures of fatigue. They also found that obese truck drivers were 1.37 (CI=1.19-1.59) times more likely to be involved in a safety-critical event. Finally, they found that obese truck drivers were 1.99 (CI=1.02-3.88) times more likely to be fatigued while involved in an at-fault safety-critical accident (Wiegand et al., 2009). Given the large amount of time truck drivers are on the road, this link between adiposity and fatigue poses an important safety issue worthy of further investigation.

These links are especially important because of the high proportion of truck drivers that tend to be obese (as is aforementioned in section 5.2). Significantly correlated with obesity is obstructive sleep apnea (Baskin, Ard, Franklin, & Allison, 2005).

2.3.1.3 – Obstructive Sleep Apnea (OSA)

OSA is a condition that disrupts one's sleep, and thus increases fatigue in general. In a truck driver, this may make him/her more susceptible to falling asleep while driving for long periods of time (Wiegand et al., 2009). In-fact, a sample of individuals with OSA were shown to perform as poorly as those over the legal blood-alcohol limit (Pack et al., 2006); similar poor scores were obtained in both groups for both measures of driving skill used: the Psychomotor Vigilance Task (a standardized task measuring reaction time to assess behavioural alertness) and the Divided Attention Driving Task (a task measuring one's ability to track something closely to assess driving performance; Pack et al., 2006).

Type 2 Diabetes is a condition commonly elevated in truck driver populations (Aronson et al., 1998; Bigelow et al., 2012, Angeles et al,. 2013). It is a condition that is classified by insulin resistance. Vgontzas et al. (2008) reported that insulin resistance and the resulting visceral adiposity leads to inflammatory signalling and mechanisms. They hypothesized these factors contribute to the pathogenesis of obstructive sleep apnea and daytime sleepiness, as well as dysfunctional circadian biology. Truck drivers' dysfunctional circadian biology is attributed to these inflammatory signals and mechanisms, as well as to truck drivers erratic schedules and long hours driving at night (Vgontzas et al., 2008; Apostolopoulos et al., 2012).

OSA is costly; Sassani et al. (2004) examined the OSA literature from 1980-2003, finding that 800,000 drivers were in OSA-related collisions in the US, costing $15.9 billion dollars and 1,400 lives (Sassani et al., 2004). Treating all drivers suffering from MVCs would cost $3.18 billion, saving $11.1 billion in collision costs, and saving 980 lives annually. Thus fatigue and OSA are collectively an important issue.

In aims to reduce fatigue behind the wheel, there are Hours of Service Regulations (HoSR). In the United States HoSR have existed since the 1930's, but remained largely unchanged from 1962 to 2005. In 2005, both the US and Canadian HoSR were thoroughly revised. Similar regulations exist (and were modified around the same time) in Australia and the European Union. Canadian regulations allow for a maximum of "On-Duty" time of 14 hours per day, and a "Daily Driving" time of 13 hours per 24-hour period (Government of Canada, 2009; Jensen & Dahl, 2009). American regulations are 14, and 11 hours per day, respectively (Jensen & Dahl, 2009). Canadian drivers may drive up to 70 hours per 7 days, and then must take 36 hours off afterwards (Government of Canada, 2009). American drivers may drive up to 60/70 hours in 7/8 consecutive days, and must take 34 hours off (as a "reset") afterwards (Federal Motor Carrier Safety Administration, 2014). Between July 1, 2013 and December 16, 2014, it was mandated that these 34 hours off had to include 8 hours between 1-5am, and only one "reset" may be done per week/168 hours. However since December 16, 2014, these two stipulations have been suspended, pending further research (Federal Motor Carrier Safety Administration, 2014).

It is difficult to monitor adherence to said guidelines, especially in the face of pressure from management. There is even evidence showing that truck drivers are driving more now than they did before the HoSR were put in place (McCartt, Hellinga, & Solomon, 2008). Thus driver fatigue is an important issue.

2.3.2 – Food

2.3.2.1 – Access

Another major risk factor for cardiovascular disease is a poor diet (Byrne & Espnes, 2008; Yarnell et al., 2005). Apostolopoulos et al. (2011) indicated that much of truck drivers' food came from truck stops (e.g., from vending machines; food and drink are brought into the truck drivers' cab to eat until a hot meal is available), rather than from home. Furthermore, due to parking restrictions, these truck drivers are often unable to visit food establishments that have healthier options, such as grocery stores. Instead, the available establishments are often food "mini-marts" or corner stores that commonly are characterized by a lack of healthful foods; Flegal et al. (2010) found that "more than 85% of the items carried in the mini-marts were deemed extremely unhealthful options (i.e., sodas, hot dogs, nachos/cheese, candies and donuts)" (p. 134). Thus, the places truck drivers often eat at have been aptly named "healthy food desert[s]" (Apostolopoulos et al., 2011, p. 137).

2.3.2.2– Fruit & Vegetable Consumption

Since the incidence of death from cancer, heart disease and stroke all decrease with increased fruit and vegetable consumption (Whitfield Jacobson et al., 2007), such food choices may be important for truck drivers. In-fact, stroke-risk decreased by 11% for each fruit serving, and 3% for each vegetable serving consumed in Whitfield Jacobson et al.'s (2007) study of 97 truck drivers from the Mid-Western United States. Unfortunately, this was too small of a sample to establish strong external validity. Much larger sampled studies (not on truck drivers) have been carried out on fruit and vegetable intake and cardiovascular disease risk factors however, showing favourable impacts on cardiovascular disease (Liu et al., 2001; He, Nowson, Lucas & MacGregor, 2007; Ascherio et al., 1996). These findings are elaborated upon in section 6.1.1.

From what research is present, it appears truck drivers have limited access to fruits and vegetables, since the small amount of data available on this issue shows low intakes. For instance, "few" of the 91 US truck drivers surveyed by Whitfield, Jacobson et al. (2007) had 3 or more servings of fruits and vegetables per day, and 11 had zero servings of fruits and vegetables per day. Additionally, Apostopoulos, Sonmez, Shattell, & Belzer (2012) reported on Holmes et al.'s (1996) sample of truck drivers where only 15% were getting 5 or more servings of fruits and vegetables per day.

The sample of truck drivers from Whitfield Jacobson et al. (2007) indicated that healthful choices were important to them, and that they would choose them if they were available. However "neither restaurant owners nor truck drivers have accurate perceptions about which food choices are healthful." (Whitfield Jacobson et al., 2007, p. 2128). Thus the issue here is not only one of a lack of access, but also of a lack of knowledge.

2.3.3 – Physical activity

Another risk factor for cardiovascular disease is low levels of physical activity (Byrne & Espnes, 2008; Yarnell et al., 2005). Truck drivers face very little opportunity for physical activity (Wood, Hegmann, Murtaugh, & Thiese, 2007). Truck drivers in Canada are allowed to spend up to 13 hours driving per 24-hour period, and then they must not drive for 8 hours (Government of Canada, 2009). Some of these drivers pair with a partner, so that they may spend their off-time duty in their truck, maximizing overall driving time between the pair. This highly sedentary behaviour leaves little to no time for exercise. The notion that truck drivers are sedentary gains support from Korelitz et al. (1993), who showed that 92% of 2945 male truck drivers are inactive (compared to 27.89% of the general US male population [Pate et al., 1995]). This was a convenience sample of truck drivers at a truck driving expo in the US however; a more robust sample was taken by Apostolopoulos et al., 2013 who randomly sampled 316 long-haul truck drivers from truck stops in North Carolina. They found that 69% of the sample did not perform regular exercise. A more robust sample still was taken by Sieber et al. (2014) from 32 different truck stops across the US, finding that 76% were not physically active.

Since exercise has been shown to improve health among the overweight/obese, and since many truck drivers are obese, physical activity may be of great importance in this population (Shaw, Gennat, O'Rourke, & Del Mar, 2006; Turner & Reed, 2011).

2.3.4 – Sedentary Behaviour

Another issue is the sedentary behaviour inherent in truck driving. Even in populations that get the recommended amount of physical activity per day, there is a marked difference in the health of those who spent their non-exercising time sitting versus being more ambulatory. Dunstan, Howard, Healy, & Owen (2012) showed this to be the case particularly for cardiovascular disease risk biomarkers and premature mortality. Katzmarzyk, Church, Craig, & Bouchard (2009) in particular examined 17,013 Canadians over 12 years, finding a dose-response relationship between sitting hours and cardiovascular disease and all-cause mortality. Sitting "almost all the time" had a Hazard Ratio of 1.54 ($p<0.0001$) for both cardiovascular disease and all-cause mortality (Katzmarzyk et al., 2009).

Lynch (2010) examined 18 studies pertaining to cancer and sedentary behaviour and found 10 of them had significant associations to cancer (which specifically included colorectal, endometrial, ovarian and prostate cancer). Metabolic dysfunction and adiposity are hypothesized to be the mechanisms by which this behaviour contributes to cancer risk (Lynch, 2010).

Sedentary behaviour was associated with cardiometabolic risk factor variables (e.g., BMI, Waist Circumference, Triglycerides, High-Density Lipoprotein Cholesterol, Insulin) across low- and middle-socioeconomic status groups and race groups (Staiano, Harrington, Barreira, & Katzmarzyk, 2014). These aforementioned trends remained after controlling for physical activity.

Veerman et al. (2012) examined 11,247 Australians (aged 25 and over) and the time they spent watching TV, finding the amount watched in 2008 reduced life expectancy at birth by 1.8 years (95% Uncertainty Interval [UI]: 8.4 days – 3.7 years) in males, and 1.5 years (95% UI: 6.8 days to 3.1 years) in females. Overall, those who spent 6 hours a day watching TV could be expected to live 4.8 years (95% UI: 11 days – 10.4 years) less than those who didn't watch TV (Veerman et al., 2012). Though these UIs are very wide two other studies have reported similar findings; Stamatakis et al. (2011), examined data from Scotland, finding a 7% increase in all-cause mortality (HR= 1.07; 95% CI: 1.03-1.11) per daily hour of TV time, and Wijndaele et al examined data from England, finding a 4% increase in all-cause mortality (HR=1.04; 95% CI: 1.01-1.09) per daily hour of TV time. The magnitude of findings in Stamatakis et al. (2011) are approximately equal to those found in Veerman et al. (2012), however the findings from Wijndaele et al. (2011) were approximately half as large in magnitude. Wijndaele et al. (2011) used less strict definitions for time spent watching TV, which could have contributed to the magnitude of their findings being less. Veerman et al. (2012) used a reliable and valid measure to assess hours watching TV or videos in the past week when it was the main activity that they were doing at the time.

Veerman et al. (2012) has contributed to the slogan "sitting is the new smoking" as they calculated that half an hour of TV viewing above age 25 may shorten life to a similar degree that smoking a single cigarette would. This calculation should be interpreted with caution, as their 95% Uncertainty Interval was wide; one hour of TV reduced life expectancy in this sample by

21.8 minutes, however the 95% Uncertainty Interval ranged from 0.3 to 44.7 minutes. Thus these results are worthy of further investigation.

Warren et al. (2010) examined the sedentary behaviour from riding in a car in particular, which may have more applicability to truck drivers than TV watching sedentary behaviour. Warren et al. (2010) found a significant association between mortality risk and time spent sitting in cars in 7744 males. In particular >10 hours per week (versus < 4 hours) riding in a car was associated with a 82% greater risk of dying from CVD. These figures did not significantly change after adjusting for: age, being physically active, smoking status, alcohol intake, BMI, hypertension, diabetes, hypercholesterolemia, and family history of CVD (Warren et al., 2010).

All of these findings taken together suggest that the act of sitting for long periods of time itself may be deleterious. Therefore ameliorating this problem for truck drivers may not be just as simple as increasing physical activity at truck stops.

2.4 – Musculoskeletal Disorders (MSDs)

Prolonged sitting-workdays, total-body vibration and postural fatigue are three risk factors for MSDs that truck drivers experience. Magnusson, Pope, Wilder, and Areskoug (1996) found that in a large sample of drivers, the primary risk factors for back and neck MSDs were long-term vibration exposure, heavy lifting, and frequent lifting. Drivers with long-term vibration exposure and frequent lifting together had the highest risk of low back pain. Finally, lost workdays most often resulted from low back pain when perceived job stress was present.

These aforementioned risk factors are all risk factors that are present in many truck drivers' day-to-day work (Spielholz et al., 2008) so back pain and injury are an important concern. These work-related MSDs account for more than one third of injuries and illnesses on the job that involved lost work time (US Department of Labor, n.d.). MSDs are such a problem for truck drivers that they are a major reason why truck drivers quit their jobs (Jensen & Dahl, 2009).

MSDs seem to have a high prevalence in truck drivers; ChevronTexaco examined their truck driver workforce in 2002, indicating that approximately 50% of the sample (n=109) were at risk for a back injury (defined as having risk factors such as: history of back pain, regular lifting or long periods of sitting or standing; Kashima, 2003). Furthermore, 82% of a sample of 192 truck drivers from the UK reported musculoskeletal pain (Robb & Mansfield, 2007). 60% specifically reported back pain, a prevalence similar to other pieces of primary literature (Magnusson et al., 1996).

The high prevalence of overweight/obesity in truck drivers may contribute to MSDs, as overweight/obesity is linked to MSDs; increased adipose tissue (an endocrine tissue responsible for secreting various cytokines) may promote low-grade systemic inflammation through dysregulated TNF-α and IL-6 levels, and is associated with degeneration of both loaded joints (i.e., knees) and non-loaded joints (i.e., hands and wrists; Thijssen, van Caam, & van der Kraan, 2015). Increased systemic and local inflammation, and also dyslipidemia, is theorized to contribute to the joint pathology seen in obese individuals (Thijssen, van Caam, & van der Kraan, 2015). Thus examining BMI and MSDs in truck drivers may be valuable.

2.5 – Respiratory Health and Cancer

"A critical assessment of the currently available laboratory and epidemiological data has not provided a convincing argument for a causal relationship between exposure to TDE [traditional diesel exhaust] and an increased incidence of lung cancer" (Hesterberg et al., 2006, p. 760). It is extremely difficult to provide "a convincing argument for a causal relationship" between any two factors, however Hesterberg et al. examined both epidemiologic studies, and extensive investigations in laboratory animals, and found that both confounding factors, and the lack of dose-response suggests the relationship between diesel exhaust and lung cancer is weak. However they point out the fact that truck drivers reliably show a higher relative risk for lung cancer of 1.0-1.5. Steenland, Deddens and Stayner (1998) showed that truck drivers have a significantly higher risk of lung cancer than the general population (1-2% higher than the general population risk of 5%), after adjusting for age, smoking, and potential asbestos exposure. In a truck driver population of 2.8 million (in the US; Steenland et al., 1998), a 2% higher rate of lung cancer translates into 56,000 more people having lung cancer

Besides lung cancer, diesel exposure is associated with chronic respiratory problems such as wheezing, asthma, reduction in pulmonary function, and allergic inflammation (Steenland et al., 1998; Steenland, Silverman & Zaebst, 1992). The diesel exhaust exposure is also associated with prostate cancer in male drivers (Jarvholm & Silverman, 2003). A meta-analysis of 35 studies found that increased bladder cancer may be due to diesel exhaust exposure (Boffetta & Silverman, 2001). Findings from these studies warrant the exploration of trends between truck drivers (who have high amounts of exposure to diesel exhaust) and health outcomes in the CCHS.

2.6 – Psychological health

The unique nature of the trucking occupation presents many distinct challenges since truck drivers can be removed from family and most of their social support for several days at a time. Even when truck drivers are on leisure time, they often remain disconnected until they are able to get back home briefly each month (Apostolopoulos et al., 2011). This lack of social support from family and friends is potentially dangerous since truck drivers have higher levels of stress and risk for various psychiatric disorders (Hilton et al., 2009). Among other occupations, truck drivers from across the US (N=317) were found to be in the 91st percentile on the Global Stress Index, the "best single scale of psychological distress" (Orris et al., 1997, p. 208). There are many unique aspects of the occupation that place truck drivers at this heightened stress: "traffic congestion, loneliness and social isolation, fear of assault and robbery while out on the road, lack of job satisfaction and control, crash fatality risks, financial pressures, disrespectful treatment by shipping and receiving personnel, insufficient sleep and chronic fatigue, tight schedules, and continually rotating shift patterns" (Apostolopoulos et al., 2010; p. 288). In addition, demanding delivery schedules can produce very erratic work and rest schedules, leading to a wide variety of health risks from family strife to drug abuse (Renner, 1998).

There is limited research on prevalence rates of depression in truck drivers, and much of the research that is present examines international drivers (thus this research may not be extensible to North American truck drivers). For example, Wong, Tam & Leung (2007) reported high levels of depression and anxiety (14.5% and 25.9%, respectively) among a sample of 193 male long-haul truck drivers from Hong Kong. These truck drivers had poorer health than Canadian truck drivers however, and approximately half of them smoked, engaged in risky sexual activity, drank regularly, and a quarter had sexual dysfunction.

da Silva-Júnior, de Pinho, de Mello, de Bruin, & de Bruin (2009) showed that Brazilian truck drivers had a depression prevalence of 13.6%, versus 1.9-5.9% (the rate in the Brazilian population varied by region in the country). The questionnaire used here was reported, and had excellent psychometrics; the questionnaire had a high specificity (88%) and sensitivity (96%; da Silva et al., 2009) for identifying true positive and true negative cases. However, like the aforementioned Chinese drivers, these Brazilian drivers' health is likely not comparable to Canadians, making the findings not very generalizable to North Americans. For example, 48.3% of drivers reported drinking alcoholic beverages during working hours, and 88.6% reported being aware of similar behaviour among their colleagues. Similar figures were found for amphetamine usage (35% and 90.6%, respectively). In addition, 53.4% had less than a high school education. The Brazilian truck drivers' potential use of stimulants, low education level, and wage earning (as opposed to self-employment) all placed them at high risk for depression (da Silva-Júnior et al., 2009). Since truck drivers have a lot of work stress (especially long-haul truck drivers; work overload, high mileage exposure, irregular work/rest schedule, little control of pace of work, extended isolation, exposure to a lot of stressors such as heavy traffic), and work stress is an independent predictor of depression, this is an especially vulnerable population (da Silva-Júnior et al., 2009).

Depression is an important issue since it can lead to many other problems, including significant loss of productivity and disability (da Silva-Júnior et al., 2009). In fact, stress results in a large financial cost, as seen in an International Labor Organization report, indicating that stress costs over $200 billion USD annually (Apostolopoulos et al., 2010). Beyond the financial cost, the stress truck drivers experience can result in many deleterious outcomes, from relationship and family problems, to increased cholesterol levels linked to dietary patterns and overweight/obesity, to high rates of suicide (Steptoe & Brydon, 2005). Hilton, Staddon, Sheridan and Whiteford (2009) found that severe (1.5% of drivers) and very severe (1.8% of drivers) depression, in their sample of Australian drivers, was associated with increased Odds Ratio (OR=4.5 and 5.0, respectively) for being involved in an accident or near miss in the past month. The questionnaire given in this survey utilized the *Depression, Anxiety and Stress Scale (DASS),* which for depression had a Cronbach's alpha of 0.94, indicating excellent internal consistency and reliability. The survey had a low response rate (36%), and it is possible that non-responders may be more stressed, anxious or depressed. This may be why the truck drivers didn't answer the survey, however this hypothesis may not be true; Sanderson et al. (2007) and Wang et al. (2004) showed no difference in the prevalence of anxiety or depression between responders and non-responders to mental health surveys.

The increased OR (5.0) for being involved in an accident for those reporting very severe depression (Hilton et al., 2009) is similar to the increased OR from driving at a Blood Alcohol

Content of 0.08% (Fabbri et al., 2005) the criminal limit in Canada. Assuming that the prevalence rates of severe and very severe depression in Australian truck drivers are similar to Canadian truck drivers, over 8,000 Canadian truck drivers would have a significantly increased risk of an accident or near miss. Rates of depression are similar in Australia and Canada (6.2% and 5.7%, respectively; Mental Health Council of Australia, 2007; Public Health Agency of Canada, 2012), making this a good comparison population. Thus the depression-related findings in these Australians are likely generalizable to Canadians. However, there is no research to confirm this hypothesis in regards to truck drivers. Further research on depression in North American truck drivers is needed.

2.7 – Healthcare Usage

Truck drivers often have difficulty using healthcare to treat or prevent the aforementioned conditions. Long-haul truck drivers have even greater difficulty: Solomon et al. (2004) sampled 521 long-distance truck drivers from 16 truck stops in 14 US states about their healthcare usage; 47% lacked a regular healthcare provider, 20% frequented emergency rooms, 32% were unable to received needed healthcare within the last year, and 56% had difficulty accessing healthcare at home. This lack of access creates problems for managing chronic conditions, helping treat acute conditions when they happen, and any sort of routine prevention efforts in general.

This issue of poor healthcare usage may be a problem for this thesis research since it may lead to some under-reporting bias; it is likely that truck driver's chronic disease prevalence will be under-reported since truck drivers may not access their healthcare provider often enough to be diagnosed with chronic disease in the first place. Since the CCHS asked respondents to report diagnosed chronic disease, this will likely lead to some under-reporting bias.

2.8 – Summary

Truck drivers face an adverse set of conditions while on the job. Due to the nature of their job being sedentary, remote or removed from much of society, monotonous, and demanding, truck drivers have many health problems. Perhaps the greatest of these problems are increased overweight/obesity, cardiovascular disease, cancers, musculoskeletal disorders, and psychological stress and fatigue. These circumstances are made more understandable because of their poor access to healthful food, limited physical activity, sedentary behaviour, and reduced use of the healthcare system.

CHAPTER 3: THESIS RATIONALE

This thesis fills in several of the existing research gaps on current Canadian truck driver health. As is mentioned earlier, there are few pieces of modern literature on Canadian truck drivers. The largest study looked at truck drivers between 1965 and 1971 (Aronson et al., 1999). This study revealed that truck drivers had increased death from Motor Vehicle Collisions (MVCs), colon cancer, laryngeal cancer, lung cancer, diabetes, ischemic heart disease, and non-alcohol cirrhosis, when compared to the general population (Aronson et al., 1999). The CCHS was chosen to examine truck drivers because this survey contains many relevant health indicators such as presence of diagnosed cancer, diabetes, heart disease and fatigue. Furthermore, it examined food intake, physical activity measures, and BMI, which are key indicators to assess health risk. Finally, the CCHS delves into more detailed questions about each of these chronic diseases (or chronic disease risk factors). This thesis follows up on the work of Aronson et al. (1999) and addresses issues not addressed by Aronson et al. (1999). The present thesis also provides a picture of truck driver health from across Canada; the other two recent studies (Angeles et al., 2013; Bigelow et al., 2012) sampled truck drivers from Southern Ontario only.

This thesis aims to determine if risk factors for chronic disease are elevated in Canadian truck drivers as compared to other occupations, since there is little recent research on the population in question. Three research questions reflect these aims: "*Is the health of Canadian truck drivers significantly poorer than the rest of the Canadian population?*", "*Do Canadian truck drivers have higher prevalence rates of risk factors for chronic disease?*", and "*If so, what is the* *magnitude of these differences?"*. It is hypothesized truck drivers' risk factors for developing chronic diseases will be higher and their health will be poorer than the comparison population of those employed in other occupations. If the findings in this thesis support these hypotheses, this would have important implications for further research; this would give further research evidence to support further research and interventions aimed at improving the risk factors for chronic disease and/or chronic disease itself.

Furthermore, since obesity has strong correlations with many of the aforementioned chronic diseases, such as cardiovascular disease, cancer, etc. (Järvholm & Silverman, 2003), a measure of obesity, Body Mass Index (BMI), will be examined; the final research question in this thesis is "*Which variables significantly correlate to Body Mass Index?*". BMI status in truck drivers will be examined for correlations with fruit and vegetable consumption, physical activity, and other relevant variables in order to produce an extensive model of BMI and what factors explain the variation in BMI in this sample. These variables for fruit and vegetable consumption and physical activity will be examined and included in the final model and were chosen since they are modifiable risk factors; truck drivers may change their level of physical activity and how many fruits and vegetables they consume. This thesis may have considerable value for future studies that examine interventions; if fruit and vegetable consumption or physical activity were found to be correlated with obesity in this thesis, support would be lent to future interventions investigating environmental and behavioural approaches to increasing physical activity and fruit and vegetable consumption in truck drivers (and the resultant impact upon truck driver weight and health).

This thesis also serves the purpose of creating a comparable piece of research to the Ontario Truck Driver Survey (OTDS). This way, the Ontarian and overall Canadian truck driving populations can be compared to examine whether or not there are any significant differences between the two populations; perhaps Ontarian drivers have significantly poorer levels of physical activity than Canadians overall (as one may hypothesize from the results from Bigelow et al., 2012). In this case this would be an important finding since it would point to the fact that Ontarian truck drivers have a higher priority for a physical activity-based intervention, versus Canadian truck drivers on the whole. Thus this thesis may provide evidence of geographic differences or differences in other demographic variables that would be useful in designing interventions as well as future studies on the health of truck drivers.

CHAPTER 4: METHODS

This thesis explored the health of truck drivers through examining the following questions.(1) Do truck drivers have significantly higher prevalence rates of chronic disease? (2) Do truck drivers have elevated risk factors for chronic disease? (3) Is there a relationship between truck driver BMI and physical activity, fruit/vegetable consumption, and other modifiable variables. In order to examine these research questions, the Canadian Community Health Survey (CCHS) was examined by looking at descriptive output, Chi Square analyses, multivariable logistic regressions, and linear regression modelling.

4.1 – The Canadian Community Health Survey

The CCHS is an annual cross-sectional survey which targets 98% of Canadians aged 12 and older. The only Canadians excluded are people living on Aboriginal Reserves or Crown lands, full-time members of the Canadian Forces, people in certain remote regions, and institutional residents (Statistics Canada, 2011a). Cycle 5.1 of the survey (data collected over the period January 2009 to December 2010) was used, since this was the most recent cycle that contains occupational data, which made this analysis on truck drivers possible.

4.1.1 –Sampling and Advantages

The survey samples 121 Health Regions (HR) in the ten provinces and three territories (Statistics Canada, 2011a). "In the first step, a minimum size of 500 respondents per HR was imposed. This is considered the minimum for obtaining a reasonable level of data quality" (Statistics Canada, 2011a). A breakdown of the health regions and targeted sample sizes by province and territory is seen below in Table 2 (adapted from Statistics Canada, 2011a).

It is worth mentioning that the frame for the CCHS covered 90% of the private households in the Yukon, 97% in the Northwest Territories, and 71% in Nunavut (Statistics Canada, 2011). This is one important advantage the 2009/2010 CCHS has over previous years, as previous surveys did not survey northern Canada (Shields et al., 2008).

Table 2. CCHS Health Region Sampling Breakdown by Province/Territory.

Province/Territory	Number of Health Regions	Targeted sample size 2009–2010
Newfoundland and Labrador	4	4,010
Prince Edward Island	3	2,002
Nova Scotia	6	5,041
New Brunswick	7	5,150
Quebec	16	24,289
Ontario	36	44,379
Manitoba	10	7,500
Saskatchewan	11	7,720
Alberta	9	12,200
British Columbia	16	16,095
Yukon	1	1,200
Northwest Territories	1	1,200
Nunavut	1	700
Canada	**121**	**131,486**

A total of 139,841 households/individuals (i.e., one individual per household) were selected to participate in the survey. Of these, 124,870 individuals responded, resulting in a response rate of 89.3% (Statistics Canada, 2011a). This high response rate is attributed to several things. Firstly, interviewers were trained in negotiating refusal conversations. Secondly, letters were mailed to households who initially declined to participate. These letters informed the households of the importance of the CCHS (Statistics Canada, 2011a). Thirdly, interviewers called or visited again after the letter had been received. Thus, refusals to participate were minimized. The other important non-response reason was because of failure to make contact (Statistics Canada, 2011a).

The CCHS used a complex multi-stage stratified clustering sample design to select the eligible households. Fifty percent (49.5%) of the sample of households surveyed came from an area frame, 49.5% of the sample came from a list frame of telephone numbers, and 1% came from random digit dialing telephone numbers (Statistics Canada, 2011a). The sampling procedure was as follows: homogenous strata of geographic (rural/urban status) were made. Then independent clusters of samples were randomly taken from each stratum. Within each cluster, dwellings or households were selected using a systematic sampling method, which was based upon socioeconomic status, ethnicity and age in order to try and get the most representative sample as possible (Statistics Canada, 2011a).

The interviews were conducted equally over the two year period of 2009 and 2010. Roughly half the interviews were conducted in person with computer assistance, and the other half were conducted over the phone with computer assistance (Statistics Canada, 2011a). Use of computers not only solved important logistical issues, but made navigation through the massive survey quicker and easier by eliminating flow errors through programmed skip patterns. It also eliminated non-sampling errors such as entering inappropriate data out of the specified data range and/or type.

In addition to having computer guidance, interviewers were extensively prepared beforehand with self-study training packages, and customised training sessions as needed (Statistics Canada, 2011a). This further reduced non-sampling errors.

The CCHS reached a wide-variety of ethnicities, reflecting the cultural mosaic that is the Canadian population. Each respondent was asked the language that they preferred to have the interview taken in. Since there were over 29 possible languages the respondents could choose from (Statistics Canada, 2011a), it is unlikely respondents faced any language barriers. Thus the accuracy of the results across many cultures was increased.

4.1.2 – Weighting

Since the sampling strategy used in CCHS is non-random, respondent data is weighted accordingly; probability weights are assigned to the data to account for uneven probabilities of selection, and to yield more precise estimates of variance around point estimates (Statistics Canada, 2011a). These weightings also take into account the season of response, and non-responses (Statistics Canada, 2011a). While these weightings effectively reduce sampling error, there is still sampling error present. This is a disadvantage of the non-random sampling in CCHS.

4.1.3 – Variables Used

Below are the variables used from the CCHS. Noted in italics are the variables that were recoded. These variables were collapsed so that they would have fewer (often 4) categories, making the chi square analysis more statistically sound. Decisions to collapse categories were made based on cell sizes, as un-weighted cell sizes could not be vetted if they were less than 5 (Statistics Canada, 2011a).

Table 3. CCHS Variables Used in the Study.

Variables	Response
Demographic Variables	
Age	18-25
	26-35
	36-49
	50-65
Usual Number of Hours Worked Per Week	<20
	21-35
	36-50
	>50
Household Income	$20,000-$49,999
	$50,000-$69,999
	$70,000-$99,999
	$100,000+
Marital Status	Married or Common-Law
	Widowed, Separated or Divorced
	Single
Highest Level of Education	Less than Secondary
	Secondary
	Other post-secondary
	Post-Secondary
Province of Residence	Western Canada

	Northern Canada
	Eastern Canada
	Central Canada (ON+QC)
Cardiovascular Disease	
Body Mass Index	Underweight
	Normal Weight
	Overweight
	Obese - Class 1
	Obese - Class 2
	Obese - Class 3
Ever diagnosed with high blood pressure	Yes
	No
Has diabetes	Yes
	No
Has heart disease	Yes
	No
Respiratory/Cancer	
Has asthma	Yes
	No
Has chronic bronchitis, emphysema, or COPD	Yes
	No
Has cancer	Yes
	No
Ever had cancer	Yes
	No
Musculoskeletal Disorders	
Repetitive Strain Injury	Yes
	No
Has back problems	Yes
	No
Has arthritis	Yes
	No
Number of injuries in past 12 months	1-2
	≥3
Healthcare Access	

Received treatment within 4 hours for most serious injury they've had	Yes
	No
Regularly visit healthcare professional	Yes
	No
Consulted mental health professional	Yes
	No
Has regular family doctor	Yes
	No
Has regular medical doctor	Yes
	No
Number of consultations with MD per year	0
	1-3
	4-10
	>10
Food	
Daily consumption of total fruits/vegetables	<5/day
	5-10/day
	>10/day
Chooses/avoids foods - content reasons	Yes
	No
Chooses/avoids foods - weight concern	Yes
	No
Chooses/avoids foods - heart disease	Yes
	No
Chooses/avoids food - cancer	Yes

	No
Physical Activity	
Physical Activity Index	Active
	Moderately Active
	Inactive
Daily Physical Activity >15min	Yes
	No
Frequency of all physical activity	Regular
	Occasional
	Infrequent
Daily Energy Expenditure Index	0-2
	2-5
	5-8
	>8
Participate in leisure physical activity	Yes
	No
Amount of sedentary activity per week	<15 hours
	15-24 hours
	24-34 hours
	≥35 hours
High Risk Behaviours	
Frequency of drinking alcohol	<2/month
	2-4/month
	2-3/week
	>3/week
Frequency of having 5 or more drinks	Never
	<1/month
	1-3/month
	≥1/week
Type of drinker	Regular
	Occasional
	No drinks last 12 months

Type of smoker	Daily
	Occasional
	Former
	Never
Lifetime speed (amphetamines) use	Just once
	More than once
	Never
Illicit drug use in last 12 months	Yes
	No
Ever diagnosed with STD	Yes
	No
Condom use - last time	Yes
	No
Frequency of seat belt use while driving	Always
	Most of the time
	"Rarely" or "Never"
Frequency of being tired while driving	Often
	Sometimes
	Rarely
	Never
Psychological Health	
Distress Scale	0-13
	13-24
Self-Perceived Mental Health	Poor or Fair
	Good
	Very Good
	Excellent
Self-Perceived Health	Poor or Fair
	Good

	Very Good
	Excellent
Self-Perceived Work Stress	"Not at all" or "Not very" stressful
	A bit stressful
	Quite a bit stressful
	Extremely stressful
Self-Perceived Life Stress	Not at all stressful
	Not very stressful
	A bit stressful
	Quite a bit stressful
	Extremely stressful
Has a mood disorder (depression, bipolar, mania, or dysthymia)	Yes
	No
Miscellaneous	
Has urinary incontinence	Yes
	No
Hearing index	Able to hear well
	Hearing difficulties
Has migraine headaches	Yes
	No
Has bowel disorder	Yes
	No

All the variables from the CCHS that were relevant to the topics investigated in the literature review were used, except those variables that produced small cell sizes and resulted in insufficient sample sizes. Most notably these variables were questions on depression, or detailed questions about each topic (e.g., number of cigarettes smoked per day). The full list of the question topics available in the CCHS is presented in Appendix A.

In the 2009-2010 CCHS, respondent data is broken down into categories called NOC-S codes. The NOC-S code for truck drivers, for example, is H711. There were 1,246 respondents under this category. This category has the following description:

"Truck drivers operate heavy trucks to transport goods and materials over urban, interurban, provincial and international routes. They are employed by transportation companies, manufacturing and distribution companies, moving companies and employment service agencies, or they may be self-employed. This unit group also includes shunters who move trailers to and from loading docks within trucking yards or lots." (Statistics Canada, 2007)

In addition, there are footnotes that this category does not include Delivery/Courier service drivers, nor drivers of specialized equipment like snowplows, road oilers or garbage trucks.

There is no further differentiation in this category; H711 includes both short-haul and long-haul truck drivers. This is an unfortunate but unavoidable limitation in the CCHS.

A further breakdown of the H7 category is seen below (and further still, in Appendix B):

"**H7 Transportation Equipment Operators and Related Workers, Excluding Labourers**
H71 Motor Vehicle and Transit Drivers
H711 Truck Drivers
H712 Bus Drivers, Subway Operators and Other Transit Operators
H713 Taxi and Limousine Drivers and Chauffeurs
H714 Delivery and Courier Service Drivers
H72 Train Crew Operating Occupations
H721 Railway and Yard Locomotive Engineers
H722 Railway Conductors and Brakemen / women
H73 Other Transport Equipment Operators and Related Workers
H731 Railway Yard Workers
H732 Railway Track Maintenance Workers

H733 Deck Crew, Water Transport
H734 Engine Room Crew, Water Transport
H735 Lock and Cable Ferry Operators and Related Occupations
H736 Boat Operators
H737 Air Transport Ramp Attendants" (Statistics Canada, 2007)

4.1.3.1 – Psychometric Research

The CCHS is a multi-million dollar survey, and as a result, a lot of time and effort went into ensuring the questions asked in the survey were of high statistical quality; each set of questions in the CCHS underwent extensive qualitative testing to meet Statistics Canada's high quality standards (A. MacKenzie, personal communication, September 8, 2014). A large portion of the questions presented in the Chi Square and Logistic Regression analyses in this thesis were taken from the Chronic Conditions section of the CCHS. The psychometrics of this section tested extremely well, and there were no concerns of the reliability or validity of these questions (A. MacKenzie, personal communication, September 8, 2014). Specific questions from the CCHS will be examined in detail, as exemplars. Firstly a mental health scale will be examined.

4.1.3.1.1 – Mental Health

The Kessler 6-item Psychological Distress Scale (K6; composed of 6 Likert scale questions) is an excellent screening instrument for current (1-month) depression in Cycle 1.2 of the CCHS (AUC=0.93; Area Under the Curve in this case reflected the chance that a randomly selected case would have a higher score than a randomly selected non-case). It also had a high validity for 12-month depression (AUC=0.86; Cairney et al., 2007). The Distress Scale was developed by Harvard University with support from the US National Center for Health Statistics. Answers to each item in the scale have a numerical value and a score is derived by summing the values for the 6 items, yielding a score between 0 and 24. Scores between 13 and 24 correspond to probable serious mental illness. It was designed to elucidate cases of serious mental illness, and was found overall to have an average AUC of 0.83 (Kessler et al., 2010).

4.1.3.1.2 – Alcohol Abuse

The Alcohol Use Disorders Identification Test (AUDIT) questionnaire is a 10-item questionnaire with a sensitivity of 84-85% and a specificity of 77-84%. The AUDIT-C questionnaire, a shortened version of AUDIT (specifically, a 3 question survey), still has high sensitivity and specificity (74-76% and 80-83% for a cut-off of 4 points; Moyer, 2013). The questions for AUDIT-C are:

Table 4. AUDIT-C Questions and Responses.

How often do you have a drink containing alcohol?	0 points – Never 1 point – Monthly or less 2 points – 2-4 times a month 3 points – 2-3 times a week 4 points – 4 or more times a week
How many drinks of alcohol do you drink on a typical day when you are drinking?	0 points – 1-2 drinks 1 point – 3-4 drinks 2 points – 5-6 drinks 3 points – 7-9 drinks 4 points – 10 or more drinks
How often have you had six or more drinks if female [or eight or more if male] on one occasion?	0 points – Never 1 point – Less than monthly 2 points – Monthly 3 points – Weekly 4 points – Daily or almost daily

(Babor et al., 2001)

There is a version of this survey that is shorter still (1 question) that still has acceptably high sensitivity and specificity (82-87% and 61-79%; Moyer, 2013). The question is: "*On any* *single occasion during the past 3 months, have you had more than 5 drinks containing alcohol*?". An affirmative answer indicates the respondent meets the criteria for alcohol abuse or dependence, as specified in the DSM-IV (Moyer, 2013).

Comparatively, the CCHS asked the following questions:

Table 5. CCHS Alcohol Questions and Responses.

During the past 12 months, how often did you drink alcohol beverages?	Less than 2 times a month 2-4 times a month 2-3 times a week More than 3 times a week
How often in the past 12 months have you had 5 or more drinks on one occasion	Never Less than 1 time a month 1-3 times a month Once or more a month

(Statistics Canada, 2010)

Since the CCHS' questions regarding alcohol are comparable to the questions in the AUDIT-C and 1 item questionnaire, the sensitivity and specificity of the CCHS regarding alcohol is likely comparable to the AUDIT-C and 1 item questionnaire. Thus utilizing these questions in this thesis is relevant for assessing alcohol abuse.

<u>4.1.3.1.3 – Condom Usage</u>

CCHS participants were asked if they had used a condom the last time they had sex. This was found to be a valid measure for capturing long-term condom use (Younge et al., 2008).

4.1.4 – Statistical Analyses

The statistical analysis software "IBM SPSS Statistics for Windows Version 23.0 (IBM; Armonk, New York)" was utilized for these quantitative analyses, in accordance with procedures of the Research Data Centres (RDCs) of Statistics Canada. As previously stated, the version of the CCHS survey used was Cycle 5.1 (2009/2010) Master File, since this is the latest CCHS data-file with occupational data (newer CCHS surveys, and publicly available files do not contain occupation data; Statistics Canada, 2011a). This made it possible to analyze the truck driver occupation separately from the general population. As is aforementioned, the RDC of Statistics Canada provided the appropriate sample weightings for the data analyses steps (Statistics Canada, 2011a).

Firstly, the samples were modified to remove extreme values in order to make the sample populations more comparable; age was restricted to between 18 and 65, income was restricted to greater than $20,000, sex was restricted to males, hours worked per week was restricted to between 10 and 130 hours per week, and BMI was restricted to less than 60.

Restricting the sample to males was done because female truck drivers represent less than 5% of the truck driver population (Bigelow et al., 2012; Angeles et al., 2013; Apostolopoulos et al., 2013; Statistics Canada, 2011c), and they have similar morbidities to male drivers (Layne, Rogers, & Randolph, 2009; Apostolopoulos et al., 2013). Furthermore, in a sample of ~1,200 truck drivers, 5% females would equate to 60 females (before the aforementioned modifications which would reduce this sample size further). Since female truck drivers commonly represent <5% of truck drivers, and there were approximately 270,000 truck drivers in 2006 (Dube & Pilon, 2006), the population size of female truck drivers in Canada may be less than 13,500 (Krejcie & Morgan, 1970; Raosoft, 2004). The sample size needed to generate statistically sound confidence intervals for this population size is approximately 372 (Krejcie & Morgan, 1970; Raosoft, 2004). Therefore the 60 or less females that would be in this sample in the CCHS would be inadequate to calculate statistically sound confidence intervals.

Making the demographic variable restrictions as mentioned above (e.g., BMI<60) reduced merging data cells, since Statistics Canada (2011) requires that no data be released with the un-weighted cell sizes having less than 5 observations.

Truck drivers with values outside of these ranges (e.g., BMI≥60) represented extreme cases. For example a person with a BMI of 65, assuming they are 5'10", would be 452 lbs.

Descriptive analyses were carried out on the truck driver sample and the truck drivers who reported living in Ontario. These were compared to each other, and to the results from the OTDS.

Chi Square analyses were performed on all variables. Ratio variables were coded to become categorical in this analysis. Truck drivers were compared against the rest of the sample to determine whether or not they had significantly different values of the variables in question. If demographic variables (such as age, number of hours worked per week, household income, marital status, province of residence and education) were significantly different in the Chi square analyses, multivariable logistic regressions were performed to control for the effects of these variables on the outcomes being estimated (e.g., prevalence ratios for various chronic diseases). Logistic regressions were performed for each outcome separately, to calculate the unadjusted prevalence ratios (PR). Then, multivariable logistic regression models were developed, adding in such variables as age, number of hours worked per week, household income, marital status, province of residence and education. This way, adjusted PRs were obtained for the association between being a truck driver and outcomes as such as reported heart disease, when taking into account the effects of such variables as age.

Finally, linear regression modelling analysis was conducted for BMI. Variables were examined because they significantly relate to overweight/obesity in the literature, and thus there may be relations in truck drivers. All of the following variables were analysed for their contribution to the variance in BMI since trends in regards to BMI were found in the literature: MSD variables (presence of repetitive stress injury, back problems, arthritis; Thijssen, van Caam, & van der Kraan, 2015), fruit and vegetable intake (Whitfield Jacobson et al., 2007), physical activity indexes (Shaw, Gennat, O'Rourke, & Del Mar, 2006; Turner & Reed, 2011), Alcohol consumption variables (frequency of drinking, frequency of having 5 or more drinks; Poppitt, 2015), smoking status (Woodhall-Melnik, 2013), Psychological stress variables (perceived mental health, perceived work stress, perceived life stress, mood disorder; Huang, Webb, Zourdos, & Acevedo, 2013; Hon & Nicol, 2011), number of yearly consults with MD, total yearly consults with any healthcare professional, and demographic variables (income, hours worked per week, age, education, and marital status; Hon & Nicol, 2011; Sieber et al., 2014). A wide range of variables that have biological plausibility or that were significant in previous studies were included in the models in order to capture the key variables responsible for the most variation in BMI. Modifiable variables (e.g., fruit and vegetable intake) were also a focus of modelling since results of this analysis may benefit future studies that examine interventions that focus on these modifiable variables in truck drivers.

Woodhall-Melnik (2013) examined fast food workers in the CCHS to see which variables significantly correlated to BMI. Due to mean age being different between the fast food worker sample (N=921) and the general population sample (N=58,272; mean ages of 30 and 45, respectively), and overweight/obesity varying between different age groups (Woodhall-Melnik, 2013), she conducted analyses stratified by age. She found trends only within certain age demographics in her BMI linear regression. Thus linear regression was stratified by different age samples in this thesis as well, in order to elucidate the variables significantly associated with BMI in both younger and older truck drivers. This would be beneficial in the case that the age distribution of truck drivers significantly differs from the general working population.

As in Barrett (2011), many of the variables had several categories, thus a simple linear regression model was used. These variables were eliminated one by one, based on minimizing p values (variables were eliminated with $p>0.10$), maximizing the r^2 term, and minimizing Mallow's C_p. Mallow's C_p is a measure of the total square errors, and thus an indicator of lack of fit of a model (Yu, 2000). Both Mallow's C_p and the r^2 term are sound measures to use in linear regression variable selection (Yu, 2000). The models that were arrived at are presented in Table 9, Table 11 and Table 12. These models were independently confirmed by running the Forward Selection, Backward Elimination and Stepwise Method procedures. In addition, the appropriate diagnostic plots (see section 4.2.3) were constructed in order to ensure no assumptions of normality have been violated (Matthews, 2011).

A bootstrapping resampling procedure, involving specific bootstrapping weights provided by Statistics Canada, was used to account for the multi-stage sampling design used by the CCHS (as in Bielska, 2009; Munce, 2005; Saqib, 2009) to provide better point estimates in the regression modelling. These were applied to the data before the regression analyses were performed.

4.1.5 – Ethics

The processes of Statistics Canada RDCs ensure privacy since “all data sets have been stripped of personal details-such as names, addresses and phone numbers- that could be used to identify particular individuals” (Statistics Canada, 2009). Also, “all results to be physically removed from secure areas will be carefully screened for confidential data, whether as direct listings or as possible residual disclosures” (Statistics Canada, 2009).

Ethics review from the University of Waterloo’s Office of Research Ethics was not required; “research that relies exclusively on secondary use of anonymous information, or anonymous human biological materials, may not require ethics review so long as there is no process of data linkage and the recording or dissemination of results does not generate identifiable information.” (University of Waterloo, 2015). Since the data carries no linking attributes, nor is there any identifiable information, ethics review was not required.

<u>4.1.6 –Hypotheses</u>

First, it was hypothesized that chronic disease prevalence would not be higher in truck drivers compared to other Canadian male workers. However it was hypothesized that Canadian male truck drivers would have higher risk factors for chronic illness, as compared to Canadian male workers. Second, it was also hypothesized that BMI would correlate negatively with fruit and vegetable consumption and physical activity. Third, it was expected that the Canadian truck driver population would not significantly differ from the overall Ontarian population, in terms of risk factors for cardiovascular disease (high blood pressure, diabetes, fruit/vegetable intake) and heart disease rates.

CHAPTER 5: RESULTS

5.1 – Descriptive Statistics

As is mentioned earlier, the sample size of truck drivers in this survey was 1,246, 97.6% of which were male. The sample size of the general Canadian population in Cycle 5.1 of the CCHS was 124,870. These two samples were reduced based on restricting values for age, income, sex, hours worked per week, and BMI (as explained in Chapter 4); this brought the truck driver sample from 1,246 to 990 and the general population sample from 124,870 to 29,958. The average age of the truck drivers was 43.4 (σ=11.9) and the average age of the general Canadian working population (excluding truck drivers) was 41.3 (σ=12.2). These two samples had significantly different means ($p<0.0001$).

Several prevalence rates were obtained in order to construct comparisons with the Ontario Truck Driver Survey (Bigelow et al., 2012*)*. These prevalence rates are seen below in Table 6.

Table 6. Descriptive Output Comparisons Between Canadian and Ontarian Truckers in the CCHS and in the OTDS.

Variable	CAN Truckers	ON Truckers	OTDS Truckers
Sample Size	1,264	422	107
Proportion Male	97.6%	98.3%	98.1%
Mean age	43.4	43.9	50.5
High blood pressure	4.3%	4.4%	22.0%
Diabetes	5.9%	6.2%	14.0%
Heart disease	3.6%	5.9%	7.0%
≥5 fruits/vegetables per day	30.1%	35.9%	21.0%

In cases in which the selected respondent was not physically or mentally capable of responding, another knowledgeable member of the household ("proxy respondent") was selected to respond for him/her (Statistics Canada, 2011a). The sample used in this thesis had the advantage of not having any proxy respondents, meaning that no additional bias was introduced into the answers to questions of a more sensitive/personal nature.

5.2 – Chi Square Analysis

Many chronic disease and chronic disease risk factor variables were examined with Chi Square analysis to determine whether or not there were statistically significant differences between the sample of male truck drivers ("truck driver sample"; n=990) and the sample of the general population of employed males ("general Canadian population sample"; the rest of the CCHS; n=29,958). The results of the Chi Square analysis are seen in Table 7, below.

Sample size varied with the variable in question, as not all provinces and territories asked all the CCHS questions to the respondents. There are a few instances in which the sample size was greater than the minimum size put forth by Statistics Canada for release, but less than the required sample size for 95% confidence intervals to be valid for a sample of a population of 270,000 (N=384; Krejcie & Morgan, 1970). The following is the equation and variable definitions, verbatim, from Krejcie & Morgan (1970, p. 607):

$$s = X^2NP(1-P) \div d^2(N-1) + X^2P(1-P).$$

s = required sample size.
X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).
N = the population size.
P = the population proportion (assumed to be .50 since this would provide the maximum
sample size).
d = the degree of accuracy expressed as a proportion (.05).

The required sample size of 384 was independently confirmed with Raosoft software sample size calculator (Raosoft, 2004), using the following inputs: population of 270,000, margin of error of 5%, 95% confidence level, and 50% response distribution. The margin of error and response distribution values used were conservative, since they yielded a larger required sample size calculation than other input values.

Samples were less than 384 for the following variables: number of injuries in past 12 months, received treatment within 4 hours for most serious injury they've had, has regular family doctor, chooses/avoids foods for content, weight, heart disease, or cancer reasons, amount of sedentary activity per week, condom use – last time. Results in regards to these variables were not interpreted.

Statistics Canada (2011) states that analysts are not to release and/or publish any un-weighted data where there are less than 5 observations in each cell due to confidentiality issues. Certain variables had sample sizes with distributions that failed to meet this requirement; they were depression scale, distress scale, province of residence, psychological well-being scale, frequency of emotional support, frequency of coping by talking to others, and considered suicide. The fact that these were asked much less often by provinces/territories is made more understandable by the sensitive nature of some of these questions.

Table 7. Prevalence Rate Differences Between Truck Drivers and the General Working Canadian Population, CCHS Cycle 5.1 (N=30,948).

Variables	Population	Sample Size	Response	% of All Respondents	% of Truckers	P Value
Demographic Variables						
Age	Truckers	989	18-25	12.5	8.8	<0.001
	Non-Truckers	29946	26-35	21.9	18.9	
			36-49	36	37.3	
			50-65	29.6	35	
Usual Number of Hours Worked Per Week	Truckers	990	<20	4.4	2.2	<0.001
	Non-Truckers	29946	21-35	11.9	6.3	
			36-50	68	52.8	
			>50	15.7	38.7	
Marital Status		987	Married or	71.3	71.3	

			Common-Law			
		29930	Widowed, Separated or Divorced	6.2	11.9	<0.001
			Single	22.5	16.8	
Highest Level of Education	Truckers	924	Less than Secondary	2.8	9.2	
	Non-Truckers	28739	Secondary	9.1	19.6	
			Other post-secondary	4.6	7.1	<0.001
			Post-Secondary	83.5	64.1	
Household Income	Truckers	989	$20,000-$49,999	17.5	26.9	
	Non-Truckers	29946	$50,000-$69,999	17.8	23.1	
			$70,000-$99,999	23.1	23.9	<0.001
			$100,000+	41.6	26.2	
Chronic Diseases and Risk Factors						
Body Mass Index	Truckers	990	Underweight	0.8	2	<0.001
	Non-Truckers	29958	Normal Weight	37	27	
			Overweight	42.2	44.4	
			Obese - Class 1	15.2	18.9	
			Obese - Class 2	3.4	6.4	
			Obese - Class 3	1.3	1.3	
Ever diagnosed with high blood pressure	Truckers	805	Yes	4.0	4.1	0.457
	Non-Truckers	26237	No	96.0	95.9	
Has diabetes	Truckers	989	Yes	4.2	5.1	0.103
	Non-Truckers	29942	No	95.8	94.9	
Has heart disease	Truckers	988	Yes	2.4	3.6	0.011
	Non-Truckers	29928	No	97.6	96.4	

Has asthma	Truckers	989	Yes	5.9	4.2	0.015
	Non-Truckers	29940	No	94.1	95.8	
Has chronic bronchitis, emphysema, or COPD	Truckers	729	Yes	2	2.5	0.228
	Non-Truckers	20333	No	98	97.5	
Has cancer	Truckers	989	Yes	0.9	0.9	0.524
	Non-Truckers	29928	No	99.1	99.1	
Ever had cancer	Truckers	981	Yes	1.6	1.8	0.367
	Non-Truckers	29665	No	98.4	98.2	
Musculoskeletal Disorders and Injury						
Repetitive Strain Injury	Truckers	990	Yes	16.9	14.1	0.012
	Non-Truckers	29912	No	83.1	85.9	
Has back problems	Truckers	989	Yes	21.1	17.9	0.005
	Non-Truckers	29928	No	78.9	82.1	
Has arthritis	Truckers	989	Yes	8.0	9.6	0.034
	Non-Truckers	29911	No	92.0	90.4	
Number of injuries in past 12 months	Truckers	136	1-2	88.6	91.9	0.144
	Non-Truckers	5205	≥3	11.4	8.1	
Nutrition						
Daily consumption of total fruits/vegetables	Truckers	944	<5/day	62.7	70.7	<0.001
	Non-Truckers	29447	5-10/day	33.5	24.9	
			>10/day	3.8	4.4	
Chooses/avoids foods - content reasons	Truckers	238	Yes	72.1	63.4	0.003

	Non-Truckers	7850	No	27.9	36.6	
Chooses/avoids foods - weight concern	Truckers	238	Yes	52.8	42.0	0.001
	Non-Truckers	7851	No	47.2	58.0	
Chooses/avoids foods - heart disease	Truckers	237	Yes	42.6	37.6	0.071
	Non-Truckers	7847	No	57.4	62.4	
Chooses/avoids food - cancer	Truckers	237	Yes	33.3	35.0	0.312
	Non-Truckers	7842	No	66.7	65.0	
Physical Activity						
Physical Activity Index	Truckers	984	Active	29.5	18.6	<0.001
	Non-Truckers	29936	Moderately Active	25.8	16.1	
			Inactive	44.7	65.3	
Daily Physical Activity >15min	Truckers	985	Yes	36.9	24.7	<0.001
	Non-Truckers	29937	No	63.1	75.3	
Frequency of all physical activity	Truckers	985	Regular	67.4	50.6	<0.001
	Non-Truckers	29937	Occasional	18.0	25.0	
			Infrequent	14.6	24.5	
Daily Energy Expenditure Index	Truckers	984	0-2	56.9	74.4	<0.001
	Non-Truckers	29936	2-5	31.7	17.4	
			5-8	8.2	5.3	
			>8	3.1	2.9	
Participate in leisure physical activity	Truckers	985	Yes	93.8	89.6	<0.001
	Non-Truckers	29937	No	6.2	10.4	
Amount of sedentary activity per week	Truckers	168	<15 hours	25.3	40.5	<0.001

	Non-Truckers	5173	15-24 hours	36.3	17.9	
			24-34 hours	19.9	25.0	
Healthcare Access						
Received treatment within 4 hours for most serious injury they've had	Truckers	136	Yes	51.5	49.3	0.335
	Non-Truckers	5193	No	48.5	50.7	
Regularly visit healthcare professional	Truckers	989	Yes	92.0	89.3	0.001
	Non-Truckers	29914	No	8.0	10.7	
Consulted mental health professional	Truckers	782	Yes	6.7	4.1	0.003
	Non-Truckers	24137	No	93.3	95.9	
Has regular family doctor	Truckers	337	Yes	87.2	87.5	0.462
	Non-Truckers	11396	No	12.4	12.5	
Has regular medical doctor	Truckers	989	Yes	78.0	79.2	0.203
	Non-Truckers	29932	No	22.0	20.8	
Number of consultations with MD per year	Truckers	987	0	27.0	25.5	0.015
	Non-Truckers	29892	1-3	50.6	47.7	
			4-10	19.0	22.9	
			>10	3.4	3.9	
			≥35 hours	18.5	16.7	
High Risk Behaviours						
Frequency of drinking alcohol	Truckers	816	<2/month	18.8	25.6	<0.001
	Non-Truckers	26639	2-4/month	33.3	33.9	
			2-3/week	28.8	30.4	
			>3/week	19.2	10.0	

Frequency of having 5 or more drinks	Truckers	806	Never	33.4	30.8	0.13
	Non-Truckers	26604	<1/month	31.6	35.4	
			1-3/month	21.0	19.9	
			≥1/week	14.0	14.0	
Type of drinker	Truckers	989	Regular	79.8	68.6	<0.001
	Non-Truckers	29911	Occasional	9.3	14.0	
			No drinks last 12 months	10.9	17.5	
Type of smoker	Truckers	988	Daily	18.7	31.9	<0.001
	Non-Truckers	29924	Occasional	6.2	6.0	
			Former	40.8	36.2	
			Never	34.3	25.9	
Lifetime speed (amphetamines) use	Truckers	427	Just once	0.8	0.7	0.02
	Non-Truckers	13026	More than once	2.7	4.9	
			Never	96.6	94.4	
Illicit drug use in last 12 months	Truckers	427	Yes	15.8	13.1	0.075
	Non-Truckers	13025	No	84.2	86.9	
Ever diagnosed with STD	Truckers	586	Yes	6.7	6.5	0.445
	Non-Truckers	19469	No	93.3	93.5	
Condom use - last time	Truckers	170	Yes	56.5	38.8	<0.001
	Non-Truckers	5710	No	43.5	61.2	
Frequency of seat belt use while driving	Truckers	488	Always	91.1	75.9	<0.001
	Non-Truckers	14710	Most of the time	7.0	11.5	
			"Rarely" or "Never	2.0	12.7	
Frequency of being tired while driving	Truckers	490	Often	10.8	20.8	<0.001
	Non-Truckers	14698	Sometimes	29.4	30.4	

			Rarely	39.8	31.8	
			Never	20.0	16.9	
Psychological Health						
Self-Perceived Mental Health	Truckers	989	Poor or Fair	3.1	3.6	0.013
	Non-Truckers	29934	Good	18.3	22.1	
			Very Good	37.6	35.6	
			Excellent	41.0	38.6	
Self-Perceived Health	Truckers	986	Poor or Fair	6.4	6.5	<0.001
	Non-Truckers	29943	Good	27.3	35.2	
			Very Good	40.7	38.2	
			Excellent	25.5	20.1	
Self-Perceived Work Stress	Truckers	981	"Not at all" or "Not very" stressful	25.5	29.3	0.009
	Non-Truckers	29766	A bit stressful	43.9	44.3	
			Quite a bit stressful	25.5	22.7	
			Extremely stressful	5.0	3.7	
Self-Perceived Life Stress	Truckers	984	Not at all stressful	8.5	12.8	<0.001
	Non-Truckers	29923	Not very stressful	20.1	17.3	
			A bit stressful	45.7	45.7	
			Quite a bit stressful	22.3	21.0	
			Extremely stressful	3.4	3.2	
Has a mood disorder	Truckers	987	Yes	3.7	2.6	0.046
	Non-Truckers	29940	No	96.3	97.4	
Miscellaneous						
Has urinary incontinence	Truckers	908	Yes	0.7	1.0	0.181
	Non-Truckers	26786	No	99.3	99.0	

Hearing index	Truckers	974	Able to hear well	98.4	98.7	0.296
	Non-Truckers	29763	Hearing difficulties	1.6	1.3	
Has migraine headaches	Truckers	989	Yes	6.1	5.8	0.341
	Non-Truckers	29940	No	93.9	94.2	
Has bowel disorder	Truckers	988	Yes	2.5	2.5	0.503
	Non-Truckers	29932	No	97.5	97.5	

Truck drivers were significantly different in all demographic variables. Age distribution differed significantly between truck drivers and other employed Canadians as the percentage of those aged 50 to 65 was 35% in truck drivers and 29.6% in the general Canadian population. Similarly, 8% of truck drivers were aged 18-25 versus 12.5% of other employed Canadians. Those truck drivers in the highest quartile of number of hours worked per week were also significantly different from other occupations; 38.7% of truck drivers worked over 50 hours a week, versus 15.7% of the general Canadian population. Like the general Canadian population, 71.3% of truck drivers were married or common-law, however 11.9% of truck drivers (versus 6.2% of other workers; $p<0.001$) were widowed, separated or divorced. Truck drivers had less education ($p<0.001$) as 64.1% of them had post-secondary education, versus 83.5% of the general population, and 9.2% of truck drivers had less than secondary education, versus 2.8% of the general population. Household income was different between the two samples ($p<0.001$), as 41.6% of the general population had a household income over $100,000, versus 26.2% of truck drivers.

Truck drivers had significantly different rates of chronic disease and chronic disease risk factors. Firstly, Body Mass Index was significantly different in truck drivers compared to other workers; 26.6% of truck drivers were obese (versus 19.9% in other Canadians) and 27% had a normal BMI (versus 37% in others). Prevalence of overweight was the similar in truck drivers and other workers (44.4% and 42.2%, respectively). Rates of high blood pressure and diabetes did not significantly differ between these two samples, however heart disease did; truck drivers had a rate that was 50% higher (3.6% versus 2.4%; p=0.011). Truck drivers had lower rates of asthma (4.2% versus 5.9%; p=0.015). Variables such as presence of "chronic bronchitis, emphysema or COPD," cancer, and "ever had cancer" were not significantly different between truck drivers and other employed Canadians. Servings of fruit/vegetables were grouped into less than five per day, between five and ten per day, and over ten per day. Truck drivers were split into the following groups, respectively: 70.7%, 24.9%, and 4.4%. This is in contrast to other Canadian workers: 62.7%, 33.5%, and 3.8%, respectively; overall truck drivers consumed less fruits/vegetables (p<0.001). Physical activity levels were significantly lower in truck drivers across six of seven variables measured (physical activity index, daily physical activity over 15 minutes, frequency of all physical activity, daily energy expenditure, and participate in leisure physical activity). Truck drivers were found to be less sedentary (p<0.001) in the variable amount of sedentary activity per week; 16.7% of truck drivers were sedentary for 35 hours or more, versus 18.5% of the general population; 40.5% of truck drivers were sedentary for less than 15 hours a week, versus 25.3% of other workers.

Musculoskeletal disorders and injuries were lower in truck drivers; 14.1% of truck drivers had a repetitive strain injury (versus 16.9% of the general population; p=0.012), and 17.9% had back problems (versus 21.1% in others; p=0.005). Arthritis however was higher in truck drivers (9.6% versus 8.0% in other workers; p=0.034). Number of injuries in the past 12 months was not significantly different (p=0.144).

Truck drivers appeared to use healthcare less, as they regularly visited healthcare professionals less (89.3% versus 92%; p=0.001) and consulted mental healthcare professionals less (4.1% versus 6.7%; p=0.003). Several variables had no significant difference between the populations: received treatment within 4 hours for the most serious injury they've had (p=0.335), has regular family doctor (p=0.462), and has regular medical doctor (p=0.203). Truck drivers did have more appointments with medical doctors per year however (p=0.015); 3.9% of truck drivers had over 10 visits with their MD per year, versus 3.4% of the general Canadian population; 25.5% of truck drivers had 0 appointments within the last year, versus 27.0% of other employed Canadians.

Truck drivers engaged in high-risk behaviours more than the general Canadian population. Specifically, 31.9% of truck drivers were daily smokers, in contrast with 18.7% of the general population (p=0.001). Truck drivers had significantly higher amphetamine usage (p=0.02); theyo used amphetamines "more than once" more (4.9% versus 2.7%), though both truck drivers and other workers had similar rates of one time amphetamine usage (0.7% and 0.8%, respectively). Truck drivers also had similar rates of illicit drug usage in the last 12 months, compared to the general working population (the rates were 13.1% and 15.8%, respectively; p=0.075). While last time condom usage was lower in truck drivers (38.8% versus 56.5% in other workers; p<0.001), lifetime prevalence of sexually transmitted diseases was not significantly different (6.5% versus 6.7% in the general Canadian population; p=0.445). Seatbelt usage was significantly different (p<0.001), as 75.9% of truck drivers always used a seatbelt, versus 91.1% of other workers. Driving while tired was also significantly different (p<0.001), as 20.8% were often tired while they drove, versus 10.8% of other Canadians. Frequency of having 5 or more drinks was not significantly different in truck drivers (p=0.13), and frequency of drinking alcohol was lower in truck drivers versus other workers (10.0% versus 19.2% in the highest quartile, and 25.6% versus 18.8% in the lowest quartile, respectively; p<0.001).

Certain measures of general and mental health indicated poorer health in truck drivers, and certain variables indicated better health. Self-perceived overall health and self-perceived mental health were both poorer in truck drivers (p<0.001 and p=0.013, respectively; for overall health, 58.3% of truck drivers reported their status as very good or excellent, versus 66.2% of the general population, and for mental health 74.2% of truck drivers reported their status as very good or excellent, versus 78.6% of other workers), however work stress and life stress were lower in truck drivers (p=0.009 and p<0.001; for work stress, 26.4% of truck drivers felt quite a bit or extremely stressed, versus 30.5% of the general population; for life stress, 24.2% of truck drivers felt quite a bit or extremely stressed, versus 25.7% of other workers), and less truck drivers had mood disorders (3.2% versus 3.4%; p=0.046).

Other measures of health were not significantly different in truck drivers, compared to the general population: urinary incontinence, hearing index, migraine headaches, and bowel disorder (p=0.181, p=0.296, p=0.341, and p=0.503, respectively).

5.3 – Multivariable Logistic Regressions

Since numerous demographic variables were significantly different in truck drivers compared to the general Canadian population, these variables could have been acting as confounders. Thus they were controlled for in the multivariable logistic regressions below, by calculating adjusted Prevalence Ratios (PRs). Unadjusted and adjusted PRs are presented below in Table 8. The adjusted PRs took into account the following key variables: Age, Number of Hours Worked Per Week, Household Income, Education Level and Marital Status.

Table 8. Prevalence Ratios and 95% Confidence Intervals for the Relationship Between Truck Driving and Health Risk Factors, Adjusted for Covariates, CCHS Cycle 5.1 (N=30,948).

	Unadjusted PR			**Adjusted PR***		
		95% CI			95% CI	
Variable		*Lower Bound*	*Upper Bound*		*Lower Bound*	*Upper Bound*
Chronic Diseases and Risk Factors						
BMI						
Normal	1.00			1.00		
Overweight	1.44	1.24	1.68	1.45	1.23	1.71
Obese	1.83	1.54	2.17	1.69	1.40	2.04
High Blood Pressure						
No	1.00			1.00		
Yes	1.04	0.73	1.49	1.06	0.74	1.53
Diabetes						
No	1.00			1.00		
Yes	1.23	0.92	1.64	1.16	0.86	1.56
Heart Disease						
No	1.00			1.00		
Yes	1.52	1.08	2.14	1.45	1.02	2.07

Asthma						
No	1.00			1.00		
Yes	0.71	0.52	0.97	0.76	0.55	1.04
COPD						
No	1.00			1.00		
Yes	1.26	0.78	2.02	0.96	0.58	1.58
Has Cancer						
No	1.00			1.00		
Yes	0.99	0.50	1.94	1.11	0.55	2.21
Ever Had Cancer						
No	1.00			1.00		
Yes	1.09	0.68	1.77	1.03	0.60	1.76
Musculoskeletal Disorders and Injury						
Repetitive Strain Injury						
No	1.00			1.00		
Yes	0.81	0.67	0.97	0.86	0.71	1.03
Back Problems						
No	1.00			1.00		
Yes	1.23	1.06	1.44	1.14	0.96	1.34
Arthritis						
No	1.00			1.00		
Yes	1.22	0.99	1.52	1.07	0.85	1.35
Number of Injuries in Past 12 Months**						
1-2	1.00			1.00		
≥3	0.69	0.37	1.28	0.71	0.37	1.38
Nutrition						
Daily Consumption of Fruits and Vegetables						
<5	1.00			1.00		
5-10	0.66	0.57	0.77	0.76	0.65	0.90
>10	1.06	0.77	1.46	1.32	0.94	1.85
Chooses foods - content reasons**						
No	1.00			1.00		
Yes	0.67	0.51	0.88	0.81	0.61	1.08
Chooses foods - weight concern**						
No	1.00			1.00		
Yes/Sometimes	0.64	0.50	0.84	0.79	0.60	1.04
Chooses foods - heart disease**						
No	1.00			1.00		
Yes/Sometimes	0.81	0.62	1.06	0.88	0.662	1.16
Chooses foods – cancer**						
No	1.00			1.00		
Yes/Sometimes	1.08	0.83	1.42	1.26	0.95	1.68

Physical Activity						
Physical Activity Index						
Inactive	1.00			1.00		
Moderately Active	0.43	0.36	0.51	0.54	0.45	0.64
Active	0.43	0.37	0.51	0.52	0.44	0.63
Participates in Daily Physical Activity >15 minutes						
No	1.00			1.00		
Yes	0.56	0.48	0.65	0.61	0.52	0.71
Frequency of All Physical Activity						
Infrequent	1.00			1.00		
Occasional	0.83	0.69	1.00	0.93	0.77	1.12
Regular	0.45	0.38	0.53	0.59	0.50	0.70
Daily Energy Expenditure Index						
0-2	1.00			1.00		
2-5	0.42	0.36	0.50	0.53	0.44	0.63
5-8	0.49	0.37	0.65	0.41	0.29	0.59
8+	0.72	0.49	1.05	0.98	0.65	1.48
Participant in Leisure Physical Activity						
No	1.00			1.00		
Yes	0.57	0.46	0.71	0.82	0.65	1.02
Amount of Sedentary Activity Per Week**						
<15	1.00			1.00		
15-24	0.31	0.20	0.48	0.30	0.18	0.48
24-34	0.78	0.53	1.16	0.84	0.55	1.27
≥35	0.57	0.36	0.89	0.70	0.43	1.13
Healthcare Access						
Received Treatment Within 48 Hours for Most Serious Injury**						
No	1.00			1.00		
Yes	0.92	0.65	1.29	1.09	0.75	1.58
Regular Consultations with Health Professionals						
No	1.00			1.00		
Yes	0.72	0.59	0.89	0.95	0.76	1.19
Consulted with Mental Health Professional						
No	1.00			1.00		
Yes	0.59	0.42	0.85	0.61	0.42	0.89
Has a Regular Family Doctor**						
No	1.00			1.00		
Yes	1.03	0.74	1.43	1.63	1.11	2.38
Has a Regular Medical Doctor						
No	1.00			1.00		
Yes	1.07	0.92	1.26	1.15	0.97	1.37

Number of Consultations Per Year with MD						
0	1.00			1.00		
1-3	1.00	0.85	1.17	1.06	0.90	1.25
4-10	1.27	1.06	1.52	1.35	1.11	1.64
>10	1.19	0.84	1.69	1.40	0.98	2.00
Higher Risk Behaviours						
Frequency of Drinking						
<2 times per month	1.00			1.00		
2-4 times per month	0.75	0.62	0.90	0.79	0.65	0.96
2-3 times per week	0.77	0.64	0.93	0.89	0.73	1.09
>3 times per week	0.38	0.30	0.50	0.39	0.30	0.51
Frequency of Having 5 or more Drinks						
Never	1.00			1.00		
<1 per month	1.22	1.02	1.45	1.34	1.12	1.62
1-3 times per month	1.03	0.84	1.25	1.15	0.93	1.43
≥1 per week	1.09	0.87	1.36	1.06	0.84	1.35
Type of Drinker						
No Drinks last 12 months	1.00			1.00		
Occasional Drinker	0.94	0.75	1.18	1.08	0.84	1.37
Regular Drinker	0.54	0.45	0.64	0.66	0.55	0.80
Type of Smoker						
Never	1.00			1.00		
Former	1.18	1.00	1.38	1.06	0.89	1.26
Occasional	1.27	0.96	1.70	1.41	1.05	1.89
Daily	2.26	1.91	2.67	1.49	1.24	1.79
Lifetime Use Of Speed (Amphetamines)						
No	1.00			1.00		
Once	1.10	0.38	3.21	1.05	0.33	3.34
More than Once	1.88	1.20	2.96	2.04	1.28	3.24
Illicit Drug Use Within Last 12 Months						
No	1.00			1.00		
Yes	0.81	0.61	1.08	0.83	0.61	1.13
Ever Diagnosed with STD						
No	1.00			1.00		
Yes	0.95	0.68	1.33	1.00	0.71	1.42
Condom Use - Last Time**						
Yes	1.00			1.00		
No	2.06	1.51	2.82	1.96	1.40	2.75
Frequency of Seat Belt Use						
Always or Most of the Time	1.00			1.00		
Rarely or Never	7.25	5.41	9.71	5.99	4.31	8.40
Frequency of Driving While Tired						
Never	1.00			1.00		

Rarely	0.94	0.72	1.23	1.19	0.89	1.60
Sometimes	1.22	0.93	1.60	1.37	1.01	1.85
Often	2.27	1.69	3.06	2.74	1.97	3.80
Psychological Health						
Self-Perceived Mental Health						
Poor or Fair	1.00			1.00		
Good	1.03	0.72	1.48	1.00	0.69	1.46
Very Good	0.81	0.57	1.15	0.93	0.65	1.34
Excellent	0.81	0.57	1.14	0.93	0.65	1.34
Self-Perceived Overall Health						
Poor or Fair	1.00			1.00		
Good	1.27	0.97	1.66	1.41	1.07	1.87
Very Good	0.92	0.71	1.21	1.15	0.87	1.52
Excellent	0.77	0.58	1.03	1.00	0.74	1.35
Self-Perceived Work Stress						
Not at all Stressful	1.00			1.00		
Not very Stressful	0.84	0.66	1.08	0.86	0.66	1.12
A Bit Stressful	0.78	0.63	0.98	0.80	0.63	1.01
Quite A Bit Stressful	0.69	0.54	0.88	0.64	0.50	0.83
Extremely Stressful	0.57	0.38	0.83	1.01	0.83	1.22
Self-Perceived Life Stress						
Not at all Stressful	1.00			1.00		
Not very Stressful	0.57	0.45	0.72	0.81	0.62	1.04
A Bit Stressful	0.66	0.54	0.81	0.81	0.64	1.01
Quite A Bit Stressful	0.62	0.50	0.78	0.72	0.56	0.92
Extremely Stressful	0.62	0.41	0.92	0.50	0.32	0.76
Mood Disorder						
No	1.00			1.00		
Yes	0.70	0.47	1.04	0.65	0.43	0.97
Miscellaneous						
Urinary Incontinence						
No	1.00			1.00		
Yes	1.45	0.74	2.84	1.17	0.59	2.34
Hearing Quality						
Able to Hear Well	1.00			1.00		
Hearing Difficulties	0.82	0.47	1.43	0.73	0.41	1.28
Migraine Headaches						
No	1.00			1.00		
Yes	0.94	0.72	1.23	0.78	0.58	1.06
Bowel Disorder						
No	1.00			1.00		
Yes	1.04	0.70	1.55	0.93	0.61	1.42

*Adjusted for Age, Household Income, Education, Marital Status, Hours Worked Per

Week.
**N<384; interpret with caution

Table 8 presents the odds of reporting having a certain health risk factor or condition based on being a truck driver (versus being another worker) in this sample. The unadjusted PRs for the association between being a truck driver and Body Mass Index (BMI) are a) Normal weight: 1.00 (reference); b) Overweight: 1.44 (95% CI: 1.24-1.68); c) Obese: 1.83 (95% CI: 1.54-2.17). After the PRs for BMI (being a truck driver) had been adjusted for Age, Household Income, Education, Marital Status, and Hours Worked Per Week, they are as follows: a) Normal weight: 1.00 (reference); b) Overweight: 1.45 (95% CI: 1.23-1.71); c) Obese: 1.69 (95% CI: 1.40-2.04). Thus if an individual is a truck driver in this sample, compared to a Canadian worker in this sample, they had a 69% increased chance of being classified as obese based on the height and weight they reported.

Risk for other conditions and risk factors was also elevated. For example, truck drivers in this sample had a 45% increased risk of reporting to have heart disease (95% CI: 1.02-2.07). Truck drivers also had a significantly lower reported rate of consuming 5-10 servings of fruits and vegetables; the adjusted PR was 0.76 (95% CI: 0.65-0.90), thus they had a 24% lower likelihood of reporting eating 5-10 servings of fruits/vegetables per day, compared to eating less than 5 servings of fruits/vegetables per day. In other words, truck drivers were significantly more likely to report that they ate less fruits and vegetables than the general population.

Truck drivers were at higher odds of reporting lower levels of physical activity, as measured across the following variables: Physical Activity Index, Participates Daily in Physical

Activity >15 minutes, Frequency of All Physical Activity, and Daily Energy Expenditure Index. For example truck drivers had adjusted PRs of 0.54 (95% CI: 0.45-0.64) and 0.52 (95% CI: 0.44-0.63) for being Moderately Active or Active, respectively (compared to Inactive; categories of the Physical Activity Index variable). This meant truck drivers had a 46% lower likelihood of being classified as moderately active, compared to being inactive, and a 48% lower likelihood of being classified as being active, compared to being inactive. In other words, truck drivers were significantly more likely to be classified as inactive. Truck drivers were significantly less likely to report being sedentary for between 15 and 24 hours a week (versus less than 15 hours a week; PR=0.30; 95% CI: 0.18-0.48). However, there was no significant trend when comparing spending between 24 and 34 hours, and over 35 hours a week to less than 15 hours a week.

None of the adjusted PRs for musculoskeletal disorders (repetitive strain injury, back problems, arthritis, number of injuries in past 12 months) were significant; truck drivers had the same risk as otherwise comparable Canadian workers for reporting the aforementioned conditions/circumstances.

Compared to not seeing their medical doctor at all in the past year, truck drivers were more likely to have reported seeing them four to ten times (PR=1.35; 95% CI: 1.11-1.64). They were 39% less likely to have reported seeing a mental health professional in the last year (PR=0.61; 95% CI: 0.42-0.89).

Truck drivers had significantly lower odds of reporting increased frequency of drinking, and of reporting being a regular drinker. Conversely, they had a significantly increased risk of reporting drinking more than 5 drinks less than once per month (compared to reporting never drinking more than 5 drinks).

Truck drivers also smoked more than the general Canadian population, as they had a 49% (95% CI: 1.24-1.79) increased risk of reporting that they were a Daily smoker. They were more than twice as likely to have reported using amphetamines “More than Once” (PR=2.04; 95% CI: 1.28-3.24), nearly six times as likely to report using a seat belt “Rarely” or “Never” compared to “Always” or “Most of the Time” (PR= 5.99; 95% CI: 4.31-8.40), and almost three times as likely to report “Often” driving while tired, compared to “Never” driving while tired (PR=2.74; 95% CI: 1.97-3.80).

Several of the mental health variables were significantly different in truck drivers. Truck drivers had a 41% increased chance of reporting their self-perceived overall health as “Good” versus “Poor” or “Fair” (PR=1.41; 95% CI: 1.07-1.87). They also had a 36% less chance of rating work stress as “Quite a Bit Stressful” versus rating it “Not at All Stressful,” (PR=0.64; 95% CI: 0.50-0.83) a 28% less chance of rating life stress as “Quite a Bit Stressful,” versus rating their life stress as “Not at all Stressful,” (PR=0.72; 95% CI: 0.56-0.92) and a 50% less chance of rating life stress as “Extremely Stressful,” versus rating their life stress as “Not at all Stressful” (PR=0.50; 95% CI: 0.32-0.76).

Urinary incontinence, hearing index, migraine headaches, and bowel disorder variables were all non-significant in multivariable logistic regression, as they were in Table 7 in the Chi Square analysis.

5.4 – Linear Regression Modelling

Linear regression was carried out on BMI in order to elucidate which variables significantly explained variation in BMI in truck drivers. BMI significantly differed between the truck driver and general worker populations ($p<0.001$). Seen below in Table 9 is the model constructed explaining the variation in BMI. Daily Participation in Physical Activity over 15 minutes, number of Hours Worked Per Week, and Age significantly explained the variance in BMI ($p<0.05$).

Table 9. BMI Linear Regression Modelling in All Truck Drivers in the CCHS, Cycle 5.1 (N=990).

Estimated Regression Coefficients				
Parameter	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	19.4179	1.42781	13.6	<.0001
Participates Daily in Physical Activity >15min	1.28942	0.56068	2.3	0.0219
Frequency of Drinking	-0.206	0.12395	-1.66	0.0972
Smoking Status	0.61265	0.32806	1.87	0.0624
Hours Worked per Week	0.05907	0.01719	3.44	0.0006
Age	0.05613	0.01696	3.31	0.001

The variables in the final regression were coded as seen below in Table 10.

Table 10. Linear Regression Variable Coding.

Variable	Value	Description
Participates Daily in Physical Activity >15min	1	Participates in Physical Activity >15 minutes Daily

	2	Does Not Participate in Physical Activity >15 minutes Daily
Frequency of Drinking	1	<1/month
	2	1/month
	3	2-3/month
	4	1/week
	5	2-3/week
	6	4-6/week
	7	1/day
Smoking Status	1	Daily
	2	Occasional
	3	Former
	4	Never
Hours worked per week	(Ratio variable)	
Age	(Ratio variable)	

As seen in Table 9, it is important to note that *Participates Daily in Physical Activity >15min* and *Smoking Status* were coded inversely; a score of "1" on *Participates Daily in Physical Activity* indicated the respondent participated in physical activity over 15 minutes daily, whereas a score of "2" indicated they did not. Thus this positive association between *Participates Daily in Physical Activity* and BMI is actually translated into (the expected) negative correlation between physical activity and BMI. For example, if the person does not engage in daily physical activity over 15 minutes, the predicted BMI increase is 1.29. In a person who is 5'10" tall, this equates to a predicted weight increase of approximately 9 lbs.

While *Smoking status* and *Frequency of drinking* had a significance level greater than 0.05 they substantially reduced the r^2 term upon removal, so they were left in the model since they helped to explain the variation in BMI.

Thus the final linear regression model is as follows:

BMI= 19.42+1.29(*Participates Daily in Physical Activity*)-0.21(*Frequency of drinking*)+0.61(*Smoking status*)+0.06(*Hours worked per week*)+0.06(*Age*).

Thus if we have a truck driver in this sample who does not engage in daily physical activity over 15 minutes, drinks less than once a month, has never smoked, works 60 hours a week and is 55 years old, his predicted BMI would be as follows:

BMI=19.42+1.29(2)-.21(1)+0.61(4)+0.06(60)+0.06(55)

BMI=31.13

This value (31.13) corresponds to being in the "Obese" category, as one would expect from such a hypothetical truck driver.

Since the mean age in the truck driver sample and the general Canadian working population sample was significantly different ($p<0.0001$), two additional models were produced. The first model analyzed truck drivers aged 18-39, and the second analyzed truck drivers aged 40-65. The models are shown below.

Table 11. BMI Linear Regression Modelling Truckers Aged 18-39.

Estimated Regression Coefficients

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	18.478	1.548	10.862	<0.001
Smoking Status	0.457	0.230	2.012	0.045
Hours Worked Per Week	0.43	0.016	2.647	0.009
Age	0.191	0.049	3.912	<0.001

Table 12. BMI Linear Regression Modelling Truckers Aged 40-65.

Estimated Regression Coefficients				
Parameter	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	24.486	1.197	19.536	0.002
Participates Daily in Physical Activity >15min	2.012	0.470	3.826	0.008
Frequency of Drinking	-0.383	0.124	-3.196	0.004
Smoking Status	1.020	-0.514	5.169	0.002

Several variables changed significance; in Table 11, Daily Physical Activity Over 15 Minutes and Frequency of Drinking were not significant. In contrast to Table 9, Smoking Status, Hours Worked Per Week and Age were not significant in Table 12.

Also, the r^2 values changed slightly between Tables 9, 11, and 12; the r^2 terms were 0.114, 0.104, and 0.099, respectively.

Several methods of checking for statistical soundness in the BMI modelling were evaluated. First checks were performed to insure lack of collinearity between variables. Variance Inflation Factor is a widely used measure to assess for multicollinearity, with values higher than 2.50 being potentially problematic (Allison, 2012). Fortunately, as seen in Table 13, values for the three models were all below 2.50.

Table 13. Variance Inflation Factors for Linear Regression Variables in All Three Models.

Variable	Variance Inflation Factors (VIF)		
	All Truckers	Truckers 18-39	Truckers 40-65
Participates Daily in Physical Activity >15min	1.027	-	1.012
Frequency of Drinking	1.039	-	1.007
Smoking Status	1.029	1.009	1.006
Hours worked per week	1.044	1.043	-
Age	1.035	1.052	-

The data was plotted to examine for any (e.g., exponential) trends. None were found. Then the Cook's D and leverage were plotted against the data points, to see if any specific data points were having atypical influence on the models. None were found to do so; the Cook's D was below 0.10, indicating no such atypical influence.

To check for linearity and equality of variances, residual scatter plots of e_i vs $\hat{y}_i$ and each x_i in the models were constructed, all showing a random scatter, indicating the mean was equal to 0, and the standard deviation was constant. This indicated the assumption of equality of variances was not false.

Additionally, normal probability plots were constructed, with ordered e_i's (standardized residuals) plotted against ordered normal quantiles. This was linear, indicating the assumption for normal distribution was not false.

Unfortunately graphs with residuals could not be released, since individual data points are plotted and thus breaches in confidentiality could potentially occur. Those interested in seeing these graphs may contact Melissa Moyser, the Research Data Centre Analyst at York University, at 416-650-8498 x58498.

CHAPTER 6: DISCUSSION

6.1 – Prevalence of Diseases and Disease Risk Factors

As it was mentioned previously, there are three relevant Canadian truck driver studies. The first was Aronson et al. (1999), who found truck drivers, within their sample of 457,224 workers, were are at a significantly higher risk for death from motor vehicle collisions (MVCs), colon cancer, laryngeal cancer, lung cancer, diabetes, ischemic heart disease, and non-alcohol cirrhosis. Unfortunately, MVCs could not be measured in the CCHS. However, BMI was measured, and since it has a strong correlation to MVC risk (MVC risk increased by 55% in those who were obese [BMI>30; Anderson et al., 2012]), it is worthwhile to examine the obesity differences between truck drivers and the general population: 19.9% of the general population in the CCHS sample were obese, versus 26.6% of truck drivers. Also, specific types of cancer (i.e., lung) could not be measured, nor non-alcohol cirrhosis. Heart disease was found to be higher in the CCHS, but diabetes was not. The other two relevant Canadian studies were conducted by Bigelow et al. (the OTDS; 2012) and Angeles et al. (2013). They both examined truck drivers from Southern Ontario, and both found high levels of smoking, obesity, high blood pressure, high cholesterol, diabetes, and physical inactivity.

The present thesis supports these findings, except for diabetes, which was not statistically significant (95%CI = 0.86-1.56), and high cholesterol, which the CCHS did not measure. The third hypothesis of this thesis, that Ontarian truck drivers would not significantly differ from Canadian truck drivers in terms of cardiovascular disease and cardiovascular disease risk factors, was found to be false and true, respectively; the Ontarian truck driver average for heart disease was 5.9%, versus the Canadian truck driver average of 3.6%. Higher rates (than 3.6%) are reported in other research examining Ontarian truck drivers; Bigelow et al. (2012) and Angeles et al. (2013) found heart disease rates of 7% and 4.1%, respectively. High blood pressure, diabetes, and intake of five or more fruits/vegetables per day prevalence rates were 4.3%, 5.9%, and 30.1%, respectively, in Canadian truck drivers, versus 4.4%, 6.2%, and 35.9%, respectively, in Ontarian truck drivers. High blood pressure and fruit/vegetable intake was not measured in Angeles, but diabetes was; the prevalence was 7%. Thus, these risk factors were not different, except fruit/vegetable consumption, which was slightly higher. The same risk factor prevalence rates, were 22%, 14%, and 21%, respectively, in the OTDS. It is possible the risk factors were at worse levels in the OTDS because the mean age of the OTDS sample was 50.5, versus 43.9 in Ontarian truck drivers, and 43.4 in Canadian truck drivers.

Truck drivers in the CCHS, when compared to other working males, were older, worked more hours per week, were more often widowed/separated/divorced, had less education, and had lower household income. These are common findings in the literature, as the following primary pieces of research have had similar findings with age (Bigelow et al., 2012; Angeles et al., 2013; Apostolopoulos et al., 2013; Sieber et al., 2014). A higher prevalence rate of being divorced/widowed/separated (27.5%) was found in Apostolopoulos et al. (2013). Working a high number of hours per week is a common finding in truck driver literature, as truck drivers worked an average of 60 hours per week in both Sieber et al. (2014) and Apostolopoulos et al. (2013). Sieber et al. (2014) also reported low levels of education in their sample, and Apostolopoulos et al. (2013) also reported low levels of household income.

These independent variables being worse in truck drivers have likely affected levels of chronic disease in truck drivers, therefore these factors were controlled for in the calculation of adjusted prevalence ratios (seen in Table 8). Even after controlling for these factors, the following chronic diseases or chronic disease risk factors were still at worse levels in truck drivers, compared to the general population: overweight/obesity, heart disease, fruit/vegetable consumption, physical activity, drinking habits, smoking habits, amphetamine usage, and driving while fatigued. Contrary to the findings in the literature review, truck drivers reported better self-perceived overall health, work stress, and life stress. These findings are discussed below in the following sections.

<u>6.1.1 – Cardiovascular Disease</u>

Heart disease rates had a Prevalence Ratio (PR) of 1.45 (95% CI: 1.02-2.07), compared to non-truck drivers. The prevalence in truck drivers (3.6%) was similar to the rate Angeles et al. (2013) reported (4.1%) in their sample of 406 truck drivers employed in Southern Ontario. As aforementioned, it was hypothesized that chronic disease risk factors would be worse in truck drivers, but not chronic disease itself.

Elevated overweight/obesity, lower fruit/vegetable intake, poorer levels of physical activity (found in 6 different variables measuring physical activity), elevated smoking risk (a PR of 1.49 for being a daily smoker [95% CI: 1.24-1.79]), and sedentary behaviour help to explain the finding of a PR of 1.45 (95% CI: 1.02-2.07) for reporting heart disease.

The elevated heart disease prevalence ratio may be explained by the level of overweight/obesity present, since overweight/obesity has strong correlations to heart disease (Byrne & Espnes, 2008; Yarnell et al., 2005). Prevalence of being overweight/obese was 71%. This was in contrast to 62.1% in the general Canadian population. Even after controlling for age, hours worked per week, education, and household income, overweight risk was 45% higher in truck drivers, and obesity risk was 69% higher.

Angeles et al. (2013) examined 406 Canadian truck drivers from Southern-Ontario and found an overweight/obesity rate of 53.2%. Apostolopoulos et al. (2013) examined truck drivers from North Carolina, finding an overweight/obesity rate of 83.4%. Sieber et al. (2014) examined truck drivers from across the US and found an overweight/obesity rate 91.7%, in contrast to the US average of 65.4% in 2010 (adjusted to include working males of similar age).

Obesity rates in truck drivers were 26.6%, versus 19.9% in the general Canadian population sample in the CCHS. Obesity rate was not given in Angeles et al. (2013). Obesity prevalence was 53.4% in Apostolopoulos et al. (2013) and 68.9% in Sieber et al. (2014). Therefore overweight/obesity rates were similar to Canadian rates but lower than US rates, and obesity rates in were much lower in truck drivers in the CCHS versus truck drivers in the US. This is to be expected as Canadian rates of obesity are lower than American rates (Siddiqi et al., 2015), and truck drivers have one of the highest rates of obesity compared to other occupations; motor vehicle operators had the highest rate of obesity (24.1% in 1995) among 41 occupations surveyed in the 1986-1995 and 1997-2002 National Health Interview surveys (n>600,000; Caban et al., 2002).

Lower fruit/vegetable intake may help to explain the elevated heart disease prevalence since higher fruit/vegetable intake has been shown to be associated with significantly lower risk for heart disease (Liu et al., 2001). The health benefits of these foods are attributed to the following constituents in fruits and vegetables: antioxidants, potassium, fibre, folate, flavonoids, lycopene, other carotenoids, and other unknown phytochemicals (Liu et al., 2001). An example of this inverse correlation is in Liu et al. (2001), who examined 22,071 male physicians, and controlled for cigarette smoking, alcohol intake, physical activity, BMI, history of diabetes mellitus, history of high cholesterol, history of hypertension, and use of multivitamins. After controlling for these factors, they found a risk reduction of 23% in heart disease in those in the highest quintile of vegetable consumption (2.5+ servings/day compared to those with less than 1 serving/day). The highest quintile was a low quantity (2.5+ servings/day of fruits/vegetables). There would have likely been a greater risk reduction at levels say, higher than 5 servings (Liu et al., 2001). However Liu et al.'s data is difficult to compare to the data in this thesis as truck drivers' intakes is grouped into <5 servings, 5-10 servings, and >10 servings. He, Nowson, Lucas, & MacGregor (2007) compared 278,459 individuals (over 11 years) and their consumption of 3-5 servings per day vs >5 servings per day of fruits/vegetables, finding a statistically significant reduction of heart disease with >5 servings (17%), and no benefit with 3-5 servings (compared to <3 servings). Therefore, low fruit/vegetable intake may be contributing to truck drivers elevated heart disease, since 71% of truck drivers eat <5 servings of fruits/vegetables, and truck drivers in this sample were 24% less likely to eat 5-10 servings of fruits/vegetables per day, versus < 5 servings.

It is interesting to note that the Ontarian truck drivers have heightened cardiovascular disease risk factors, when compared to the Canadian truck drivers, despite having a higher proportion of the population eating a slightly higher fruit/vegetable intake. This higher fruit/vegetable intake is consistent with the lower than expected prevalence of high blood pressure, since higher fruit/vegetable intake is inversely associated with systolic and diastolic blood pressure (Ascherio et al., 1996).

Six different variables measuring physical activity levels all indicated that truck drivers were less active than other Canadian workers. For instance 65.3% of truck drivers were "Inactive," 16.1% were "Moderately Active," and 18.6% were "Active," as measured by the Physical Activity Index. Furthermore, 50.6% of truck drivers carried out physical activity "Regularly" (versus "Occasionally" or "Infrequently"), and 24.7% of truck drivers exercised for more than 15 minutes each day. Questions on sedentary activity (the one physical activity measure that was not higher in truck drivers) in the CCHS inquired about time spent using a computer, watching television or reading, therefore this did not encompass time driving. Thus it is not surprising to see sedentary activity lower in truck drivers; truck drivers spend 60 hours on average (Sieber et al., 2014; Apostolopoulos et al. 2013) driving (i.e., sedentary) therefore they may not want to spend more time sedentary when they do not drive, and they would have less time to spend per week doing these activities (e.g., reading). Importantly, there were only 168 truck drivers in the sample for this variable, versus the other physical activity variables (n=985), thus these results must be interpreted with caution. Other physical activity variables suggested truck drivers may be more sedentary; truck drivers were less likely to have higher scores in the

Daily Energy Expenditure Index versus other workers, and truck drivers were less likely to participate in any kind of physical activity regularly (including leisure physical activity) versus the general working population. This sedentary behaviour may help to explain the heart disease PR of 1.45 (95% CI: 1.02-2.07), however it is difficult to tease apart from physical activity with the limited information available.

The aforementioned physical activity trends in the CCHS remained after controlling for confounding variables. Similar types of findings are echoed in other pieces of literature; responses to Bigelow et al.'s (2012) survey were interpreted such that 94.9% of truck drivers were inactive, according to the same Physical Activity Index as used in the CCHS; Angeles found 31.1% of truck drivers to be inactive, based on the IPAQ guidelines for Data Processing and Analysis Manual; 27.1% of truck drivers had not exercised in a moderate or vigorous way within the last 7 days in Sieber et al. (2014); Angeles et al. (2013) found 70% of truck drivers answered "No" when questioned if they exercised regularly.

Lack of standardization in regards to questions on physical activity make comparing these results difficult, however the data point toward truck drivers being significantly more inactive than other workers. This is understandable since the truck driver work environment is setup poorly to facilitate physical activity.

Apostolopoulos et al. (2012) examined 25 trucking work settings (truck stops, loading/unloading warehouses) in the US and found them to be very unsupportive of physical activity: "Out of 23 sampled trucking worksites with over 750 staff that serve several thousand truck drivers each month, not one had even a mixed-used room that included some form of exercise or physical activity (eg, treadmills or stationary bikes in a TV room, a ping-pong table in a lounge)" (p. 265). Physical activity may be able to significantly reduce heart disease risk, as shown by Sesso, Paffenbarger & Lee (2000). These researchers followed 12,516 males (mean age 57.7) from 1977 through 1993, and found that those males who burned over 4,200 Calories per week had a Relative Risk of heart disease of 0.81, while those who burned 2,100-4,200 Calories per week had a relative risk of 0.90. Note that 4,200 Calories per week, or 600 Calories per day is equivalent to walking less than 2.5km per day (Sesso et al., 2000). Vigorous activity had the strongest reductions in risk versus light activity such as walking, which may have been less precisely measured.

These findings (in regards to physical activity, fruit and vegetable consumption) have the following implications for interventions: interventions should be targeted at reducing cardiovascular disease at least in Ontarian truck drivers specifically, and they should study the effects of placing emphasis on increasing fruit/vegetable intake, physical activity support, two factors known to be strongly associated to heart disease (Njolstad, Arnesen, & Lund-Larsen, 1996; Sesso et al., 2000). Heart disease risk can be reduced with physical activity, regardless of the participant's BMI (Physical Activity Guidelines Advisory Committee, 2008). Beyond heart disease, physical activity correlates with reduced fatigue, and reduced risk of motor vehicle crashes (Taylor & Dorn, 2006).

Canadian truck drivers may drive up to 14 hours per day (Government of Canada, 2009). Since over 38% of truck drivers are working over 50 hours per week (versus 15.7% of the general population), many truck drivers may be driving long days. This finding is common in the primary literature on truck drivers (Apostolopoulos et al., 2013). Working longer than 11 hour shifts was associated with a 67% increased risk of heart disease in 7095 adults (2109 females and 4986 males) who were followed up on 11 years later (Kivimaki et al., 2011). Since the heart disease PR reported was adjusted for hours worked per week however, the effect of Canadian truck drivers working long days was minimized.

<u>6.1.2 – Musculoskeletal Disorders</u>

The findings in the CCHS do not support the idea that truck drivers have more MSDs than the general population, at least when specifically discussing arthritis, repetitive strain injuries, and back problems. These variables were not significantly different from the comparison population after adjusting for confounding variables. The variable number of injuries in the past 12 months had a sample size smaller than 384, therefore statistically sound conclusions could not be drawn about this variable.

The Healthy Worker Effect (HWE) may be having an effect on study findings. The HWE is a phenomenon where occupational groups are found to have lower rates of disease or disease risk factors than the general population since those who are too disabled (from illness) to work are excluded from working (Shah, 2009). The magnitude of the HWE was reduced since this sample of truck driver workers is compared to other workers (since those who work less than 10 hours per week were excluded from the analysis). However it may be possible that the HWE effect is still present, since the demands of truck driving may be higher than the demands of other occupations. For example individuals with musculoskeletal pain issues such as low back pain may be filtered out of the truck driving occupation since the high musculoskeletal demands of the truck driving occupation (many hours of sedentary activity each day, vibration exposure, having to secure heavy loads) may exacerbate their condition. Thus the population of workers in the truck driving industry may be selected such that the prevalence of certain conditions (e.g., musculoskeletal disorders such as low back pain) is lower, compared to other occupations. This could contribute to the lower prevalence of MSDs in truck drivers in the CCHS than expected.

Furthermore, the HWE increases with duration of employment (Shah, 2009), and since Canadian truck drivers may remain employed for a long time (the mean number of years as a commercial driver was 18.4 in Bigelow et al. [2012]; 78% of truck drivers were employed for over 10 years in Angeles et al. [2013]); the HWE may be stronger as a result.

There was likely under-report bias due to the fact respondents were only asked to report conditions for which they have been diagnosed by a healthcare professional. This, as well as the HWE, may have attributed to these musculoskeletal disorder variables not being significantly different.

Another consideration is the fact that the sample of truck drivers in this thesis grouped long-haul and short-haul truck drivers together; it is possible that long-haul truck drivers would have significantly more low back pain and back problems (for example) than short-haul truck drivers. However, Apostolopoulos et al. (2013) examined 316 long-haul truck drivers, recruited in North Carolina, and found similar findings to the present thesis; "[our] sample of truck drivers' rates of work-related accidents or injuries were found to be quite low, in fact, almost half of those of Australian truckers' rates… and thus require further attention."

(Apostolopoulos et al., 2013, p. 121). Since the CCHS did not assess MSDs in truck drivers in optimal detail, and there is disagreement in the most recent literature on MSDs in truck drivers, further research should be done on truck drivers and MSDs.

6.1.3 –Respiratory Health and Cancer

Cancer is a slowly developing chronic disease, often taking decades to progress to showing clinical symptoms, so it is not surprising for truck drivers in this sample (who had an average age of 43.4) to have similar cancer rates to the general population (1.6% in the general population vs 1.8% of truck drivers have "ever had cancer"); especially when the relation between diesel exhaust and lung cancer was found to be weak (Hesterberg et al., 2006; Steenland, Deddens and Stayner, 1998). If chronic disease risk factors worsen over the decades for truck drivers however, it would not be surprising for cancer rates in truck drivers to become significantly higher with age.

After adjusting for confounding factors, truck drivers in this sample had similar risk of asthma, chronic bronchitis, emphysema, COPD, current or lifetime cancer compared to the general Canadian population. This may be attributed to improvements in automotive technology (exhaust systems, particulate filtration systems, etc.; McClellan, Hesterberg and Wall, 2012) that is lessening the potency of diesel exhaust's deleteriousness.

Given the association between smoking and cancer, two findings are surprising: smoking was elevated in truck drivers (18.7% of the general population were "Daily" smokers vs 31.9% of truck drivers were "Daily" smokers; even after controlling for age and other independent variables, being a truck driver carried an increased risk of 49% for reporting being a daily smoker) and yet the "ever had cancer" prevalence was not statistically different (1.6% vs 1.8% in truck drivers). The difference in prevalence of smoking is a firmly established finding in truck drivers (e.g., Sieber et al. [2014] found 51% of truck drivers to be current smokers vs 19% of the general population they examined). So the finding in this thesis that more truck drivers in the sample were smokers is supported by previous research studies. The finding regarding the low prevalence of cancer in this sample may result from lung cancer having not yet developed or being diagnosed, given that the average age of truck drivers in this sample was 43.4, and the average age of diagnosis of lung cancer is 70. Furthermore, less than 2% of lung cancer cases are found in those younger than 45 (American Cancer Society, 2014). Thus what seems most likely in this case (since smoking is so extremely well correlated to lung cancer [Manser et al., 2013]) is that cancer has not yet developed and/or been diagnosed in this population (since the CCHS only reports diagnosed disease).

Furthermore, the truck drivers who are diagnosed with lung cancer may quit their job since this cancer is a difficult disease to treat and the 1-year, 5-year and 10-year survival rates for lung cancer overall are 32%, 10%, and 5%, respectively (Cancer Research UK, 2014). Therefore we are likely seeing the Healthy Worker Effect (HWE) here as well since truck drivers who have lung cancer are not likely to be still working in trucking. This selects for only the healthy truck drivers in the sample in terms of lung cancer which suggests that lung cancer prevalence reported here may be biased to be lower (again, the HWE effect was reduced since the sample taken was only of those who are employed). However it is reasonable to expect that the HWE effect may be stronger in truck drivers given the high physical demands of truck driving. Also, being away on the road for long periods, far from family or any other support, would make it harder for an ill worker to continue working than is the case in other occupations, such as standard 9am-5pm desk jobs, or telecommuting, for instance.

6.1.4 – Healthcare Usage

The following two variables had truck driver sample sizes less than 384, and thus were not interpreted (as is explained in section 5.2): received treatment within 4 hours for most serious injury they've had, and has regular family doctor. Truck drivers were not significantly different in Table 7 for the variable "has regular medical doctor", however they regularly visited healthcare professionals less, and mental health professionals less, and had more consultations with their medical doctor per year. After controlling for confounding variables, truck drivers still saw mental health professionals less (discussed more in the Psychological Health section below), however the trend for regularly seeing healthcare professionals less was no longer present. The trend for not seeing their medical doctor more than other workers was still present after adjusting as well. For the variable number of consultations per year with MD, the only response that was significant was four to ten times (PR=1.35; 95% CI: 1.11-1.64), meaning that after adjusting for confounding variables, truck drivers were 35% more likely to report seeing their medical doctor four to ten times per year (versus not seeing them at all) more than other workers, however they were just as likely to see their medical doctor one to three times, or over ten times (versus not seeing them at all). This would suggest that there is a weak trend that truck drivers use healthcare services more than others. However there is considerable evidence to the contrary.

Truck drivers may be waiting a long time to get into their doctors for chronic concerns; Angeles et al. (2013) surveyed 406 drivers and found that 89% of truck drivers had a regular family physician, but would wait to see them until they got home; since these truck drivers were spending up to 70 hours a week on the road, they could be waiting a long time. Long-haul truck drivers in particular may have especially long wait times, as Sieber et al.'s (2014) sample of 1,670 long-haul truck drivers showed that 45% of the sample spent 1-6 days sleeping at home in the past 30 days, and 18% had not slept at home in the past 30 days at all, making regular healthcare practitioner checkups difficult. The fact that truck drivers spent so much time away from home may contribute to the fact that in the CCHS, 25.5% of truck drivers (versus 27.0% of other workers) did not see their MD at all during the past year. Most telling is that in their study of 406 drivers from Southwestern Ontario, Angeles et al. (2013) found that 54.1% of drivers reported waiting until they could see their family doctor if they felt ill on the road, and 16.2% ignored the illness altogether.

A common finding in the literature is that a high proportion of truck drivers report being in good health (Angeles et al., 2013; Shattell, Apostolopoulos, Sonmez & Griffin, 2010; Apostolopoulos et al., 2013) despite having many health risk factors. It is possible that truck drivers are not accurately assessing their own health, which if true may be contributing to them not seeking out healthcare as much as they should.

It appears that preventative medicine is lacking in truck drivers, as found in a study (Birdsey et al., 2015) of 1265 long-haul truck drivers. They showed that significantly more truck drivers had never had a blood cholesterol test (Birdsey et al., 2015). Monitoring of blood cholesterol is foundational to preventative medical treatment for heart disease. The practicing of preventative medicine is important for truck drivers, a high-risk population, if they are to prevent development and treat serious chronic disease early in its progression since early intervention provides the most long-term benefit (Birdsey et al., 2015).

Healthcare access and usage in American truck drivers is also worse compared to other workers; 38% of American truck (N=1,670) were not covered by a health care plan or health insurance compared to 17% of all working adults in the sample (Sieber et al., 2014). Furthermore, 18% had delayed or had not received needed healthcare in the last 12 months, double the rate of otherwise comparable US workers (Sieber et al., 2014). This is in comparison to 25.5% of Canadian truck drivers who had not seen their MD at all during the past year. Furthermore, 80% of truck drivers from the US had not received the flu shot, versus 67% of other workers (Sieber et al., 2014). Thus the healthcare access situation is also poor for the 2.8 million truck drivers in the US.

A better question in the CCHS to confirm if truck driver have healthcare access issues would be if occupational factors had placed limitations on truck drivers' ability to receive healthcare, and if so by how much these occupational factors had delayed truck drivers receiving healthcare. If this did cause a delay, the question would then be if this delay was substantial enough to cause significantly poorer health outcomes in truck drivers. Such questions were not available in the CCHS. This is an example of the limitations in the CCHS; since so many respondents were queried for this survey nation-wide, questions had to be chosen carefully, and detailed questions (such as the question suggested above) were not included. Such questions may be useful in further research exploring this issue.

6.1.5 – High Risk Behaviours

Just as in the OTDS, truck drivers in the CCHS were found to drink alcohol more infrequently; truck drivers were 21% less likely to report drinking 2-4 times per month (versus less than twice per month; PR=0.79, 95% CI: 0.65-0.96) and they were 61% less likely to report drinking more than 3 times per week (the highest quartile) than other workers (PR=0.39, 95% CI: 0.30-0.51). Also like the OTDS, truck drivers were found to binge-drink more often (Bigelow et al., 2012); there was a small but significant trend since truck drivers were more likely to report having 5 or more drinks at one time (binge drinking), once a month, versus reporting 0 times per month (PR=1.34, 95% CI: 1.12-1.62). However the PRs were non-significant for reporting drinking 1-3 times per month, and once or more per week (PR=1.15, 95%CI: 0.93-1.43; PR=1.06, 95%CI: 0.84-1.35).

The recent work of Birdsey et al. (2015) showed that truck drivers tended to drink less often, but binge-drink more often when they did have alcohol. These findings may be explained by the hypothesis that truck drivers may be away from home for long periods of time on the road, and may have no desire or opportunity to drink as often. However when truck drivers are back at home, it is possible they may feel a stronger desire to drink more. Abstinence from drinking due to being away from home may also contribute to abstinence from drinking completely, as 17.5% of truck drivers had not had a drink in the last 12 months (versus 10.9% of the general Canadian population). This result remained after controlling for confounding factors, as truck drivers were 34% less likely (PR=0.66; 95%CI = 0.55-0.80) to report being a regular drinker, versus reporting not having had any drinks in the past 12 months. Sieber et al. (2014) had similar findings, as 38.9% of truck drivers did not drink alcohol at all, versus 10.9% in the general US population.

A large opportunity for smoking cessation exists in truck drivers, as 31.9% of truck drivers were “Daily” smokers, versus 18.7% in the general population. Furthermore, truck drivers had a PR of 1.49 (95% CI: 1.24-1.79) of reporting being a daily smoker versus the general population. After adjusting for confounding variables, there are more reported occasional smokers as well; the PR for this was 1.41 (95% CI: 1.05-1.89).

Truck drivers in this sample had a higher prevalence of smoking than other occupations. For example the food service industry, an industry with higher risk of smoking than other sectors and occupations (Woodhall-Melnik, 2013), was found to have a smoking prevalence of 27.9% in the US (Pizam, 2012). This is in contrast to the US and Canadian smoking prevalence rates of 18.1% (Agaku, King, & Dube, 2014) and 18.7%, respectively. The high rate of smoking in truck drivers in the CCHS (31.9%) is comparable to other pieces of research like Angeles et al. (2013), who found a rate of 31.5%, and is lower compared to Bigelow et al. (2012) and Sieber et al. (2014), who found rates of 65.7% and 51%.

Truck drivers may have elevated rates of smoking because of several factors. Firstly, compared to other workers, truck drivers do not have smoking bans in their workplace (the truck cabin). Thus it is easier for them to smoke more. Secondly, truck drivers may feel smoking helps them combat fatigue, as a sample of Australian long-haul truck drivers reported this (Williamson, Sadural, Feyer, & Friswell; 2001). Smoking could also be a coping strategy to help deal with the strenuous work inherent in truck driving (Apostolopoulos et al., 2013; Pizam, 2012).

Since smoking is such a major risk factor for heart disease (Njolstad, Arnesen, & Lund-Larsen, 1996), smoking cessation in truck drivers is an issue that should be examined in intervention studies. The high prevalence of smoking in truck drivers has likely contributed to the poor life expectancy of truck drivers mentioned in the Introduction section, as smokers on average die approximately 14 years sooner than non-smokers on average (Centers for Disease Control and Prevention, 2002).

Other issues exist in truck driver health; reported amphetamine usage "more than once" had a PR of 2.04 (95% CI: 1.28-3.24) relative to the general population. Since the side effects of amphetamines include heart failure, very high fever, hallucinations, risky and violent behaviours, seizures, coma, and death due to burst blood vessels in the brain (Centre for Addiction and Mental Health, 2012), this is an important issue. Amphetamines are likely being used to help combat the fatigue that is present at nearly double the prevalence of the general population in such measures as "Frequency of being tired while driving," where truck drivers had a PR of 2.74 (95% CI: 1.97-3.80) for answering "Often" versus the general population. The work of Williamson (2007) specifically ties fatigue and stimulant use together, as she found that truck drivers with the most problems with managing fatigue were twice as likely to use stimulant drugs versus truck drivers with the least problems with managing fatigue. Other strong predictors of stimulant use are if the truck driver is paid based off the amount of work completed, and if they are less experienced (Williamson, 2007).

4.9% of truck drivers in the CCHS had used amphetamines “more than once”. This finding is in line with Birdsey et al. (2015), who found 2.4% of their sample of truck drivers used amphetamines to stay awake while driving within the last 2-days. These figures from Birdsey et al. (2015) are not strongly comparable to this thesis however, since Birdsey et al. (2015) sampled long-haul truck drivers only.

Another higher risk behaviour truck drivers engage in more is the lack of seat belt usage: 75.9% of truck drivers used a seat belt “Always” (versus 91.1% of other workers), 11.5% of truck drivers used a seat belt “Most of the time” (versus 7.0% of other workers) and 12.7% used a seat belt “Rarely” or “Never” (versus 2.0% of other workers). Also, truck drivers had a high PR of 5.99 (95% CI: 4.31-8.40) for reporting using a seat belt “Rarely” or “Never”. Lower levels of seatbelt usage in truck drivers is a common finding in the literature; in a study of 1,265 long-haul truck drivers from the US, 86.1% used seat belts “Often,” 7.8% used them “Sometimes,” and 6.0% used seat belts “Never” (Chen et al., 2015). Seat belt usage may be higher than in the CCHS because the CCHS includes both long-haul and short-haul truck drivers. Short-haul truck drivers may have less seat belt usage, due to stopping more frequently (Kim & Yamashita, 2007).

Truck drivers have reported that seat belts are too rigid and hard, and they rub and vibrate too much against the neck or shoulder (Bergoffen et al., 2005). Other issues are that the belts are reported to lock too easily, be too tight, and restrict range of motion (Bergoffen et al., 2005). Lower levels of seat belt usage in truck drivers may also be attributed to the fact that "large-bellied" truck drivers report seat belts to be especially uncomfortable, saying that they cut into the belly and do not "hang properly" over the shoulder and chest (Transportation Research Board of the National Academies, 2007, p. 65). Since obesity prevalence is high in truck drivers (26.6% in the CCHS), it is feasible that this may be contributing to reduced seat belt usage. Since safety belts are important in protecting truck drivers in collisions, especially in roll-over collisions (Knipling, 2009), this seat belt usage problem is an excellent problem to address in intervention studies.

The aforementioned behaviours are likely to be worse than was reported due to social desirability bias; when questioned about activities that are socially frowned upon (e.g., illicit drug usage or lack of seat belt usage) survey respondents are more likely to under-report in their answers so that they do not feel ashamed of their socially frowned upon behaviour. This same bias likely applied to other questions, for example about physical activity. Therefore the prevalence rates of these variables (physical activity, seat belt usage, etc.) are likely conservative. Furthermore, variables that lost significance after controlling for confounding effects (i.e., last time condom usage rate) could be significantly different if this bias was reduced.

6.1.6 – Psychological Health

Making the analysis of truck driver mental health more difficult was the fact that sample sizes were too small to allow release of the data that looked at depression index scores. Thus other measures must be solely examined.

Truck drivers had lower risk for reporting the presence of a mood disorder (PR=0.65; 95% CI: 0.43-0.97), lower risks to rate work stress highly, lower risks to rate life stress highly, and were more likely to rate their overall health as “Good,” versus “Poor” or “Fair” (PR=1.41; 95% CI: 1.07-1.87). Furthermore, being a truck driver carried a significantly lower likelihood (PR=0.61; 95% CI: 0.42-0.89) of reporting seeing a mental health professional, versus than the general population. It is possible this may be due to a macho/masculine worldview present in the male dominated truck driving workplace of being very tough and not complaining; this may carry over into truck drivers not rating work or life stress poorly. This worldview could also contribute to truck drivers being stigmatized if they saw mental health professionals.

Another possible explanation is that the HWE is responsible for the lower-than-expected levels of stress and mood disorders; those with depression or other mood disorders, or those who are very stressed, may not be able to cope with the social isolation present in the truck driving workplace. Thus these workers would not be employed as truck drivers for long, and the workers who would be employed may be better able to deal with this social isolation. Such workers may have higher stress resilience overall, and thus may report lower stress levels.

These hypotheses are currently difficult to support as there is little literature examining prevalence of depression in truck drivers (Apostopoulos, Peachey, & Sonmez, 2011), let alone literature on truck drivers attitudes about mental health and depression. Hilton et al. (2009) examined 1,324 truck drivers for measures of mental health and found lower prevalence rates for depression, anxiety and stress however. These findings lend support to the findings in this thesis that truck drivers rate their stress as lower than the general population, and have lower rates of mood disorder (e.g., depression). However there is evidence to the contrary provided in the literature review (Apostolopoulos et al., 2011; Orris et al., 1997; Apostolopoulos et al., 2010; Renner, 1998; Wong, Tam, & Leung, 2007; da Silva-Júnior et al., 2009; Steptoe & Brydon, 2005; Hilton et al., 2009). This evidence is best reflected by a truck driver stakeholder describing how isolating trucking can be; in a study with a qualitative component, truck driver stakeholders were vocal about what makes (long-haul) trucking stressful during focus groups: "it's being away from home and the crazy hours, unfamiliar routes, long distances… every time you ask somebody to spend a night away from home it impacts their ability to eat well, exercise, communicate with family…" (Bigelow, Crizzle, Myers & McCrory, 2015, p18).

Truck drivers being widowed/separated/divorced more often (11.9% in truck drivers versus 6.2% in other workers, and 27.5% in Apostolopoulos et al. [2013]) could be attributed to the fact that these workers are on the road for such long periods of time, creating issues with spouses and/or other family members at home.

Other studies have reported discrepancies similar to this thesis in regards to mental health (Sieber et al., 2014; Shattell et al., 2010); Shattell et al. (2010) examined 60 long-haul truck drivers from the Southeastern US, and found that they reported good overall health and mental health– only 3.4% and 1.7% reported their overall health and mental health (respectively) to be "Poor" or "Very poor". However, the qualitative component of this research reported that most of these same truck drivers expressed some form of stress or anxiety (Shattell et al., 2010). For example, one truck driver spoke of the isolation he feels "I'm always alone, man. I'm always alone…I'm sacrificing pretty much my sanity. My ability to talk to people. It is total isolation. You're isolated" (Shattell et al., 2010, p. 563). Another truck driver expressed similar feelings of isolation: "Sometimes I get depressed because, you know, I don't feel like driving. It just hits, that's all I do…you're self-contained in your own world. But the loneliness is the thing that bothers me" (Shattell et al., 2010, p.563). The sample (N=60) was long-haul truck drivers from 2 inner-city truck stops in the Southeastern US, so the sample may be of lower SES and not carry strong external validity to North American truck drivers however. The sample of Australian drivers from Hilton et al. (2009), a sample with good comparability to North Americans (as noted in section 2.6), also had a higher prevalence of mental health problems. This may be due to the social isolation these truck drivers face, as they are "lone workers" who do often not interact with anyone (even other workers) during their work day (Hilton et al., 2009).

Due to conflicting pieces of evidence, psychological health should be explored in detail in future studies examining truck drivers. In particular, it would be important to directly assess mood disorders, since mood disorders may be under-reported in truck drivers since, as reported above, they seem to have more trouble getting into see their doctors for chronic care to have mood disorders diagnosed in the first place.

A reason for the discrepancy between self-reported health being good, and health risk factors being poor may be that much of chronic disease has not manifested yet since the average age of the truck driver cohort was 43.4. Following these truck drivers longitudinally would likely result in seeing chronic disease manifest, and self-perceived health ratings to become more in-line with objective health status.

6.1.7 – Aging Workforce

It appears the Canadian truck driver population is an aging workforce: truck drivers examined in this thesis had an average age of 43.4, 35% being 50-65 years old (versus 29.6% in the general population), 27.4% are aged 35 or less, and 72.6% are aged 36-65. Furthermore, the Canadian truck driving population had a significantly higher mean age than otherwise comparable Canadian workers (43.4 versus 41.3; $p<0.0001$).

Other published research lends support to this notion that the truck driver population is aging. For instance, 48.5% of the 1,022 respondents surveyed by Angeles et al. (2013) were over 50 years of age, and Bigelow et al. (2012) found the mean age of the 107 drivers they sampled to be 50.5. Dube & Pilon (2006) examined several labour force surveys (e.g., Survey of Labour and Income Dynamics, Quarterly Motor Carriers of Freight Survey) and reported that 5% of truck drivers were under aged 25, versus 15% in the labour force as a whole. Furthermore, just over 25% of truck drivers were between 15 and 34, whereas 37% were in this age range in the general workforce. Finally, the ratio of truck drivers under 30 to the ratio of truck drivers over 55 has steadily declined from 1987 to 2003 (from ~3.5 to ~1.0; Dube & Pilon, 2006).Truck drivers may be older than other workers due to a shortage of young workers joining the workforce (Gill &

Macdonald, 2013).This, in combination with the fact that demand for truck drivers is forecasted to increase (based on industry growth), may cause a shortage of truck drivers (Gill & Macdonald, 2013). The Canadian Trucking Alliance believes “Canada is facing a long-term, chronic shortage of qualified drivers” (Canadian Trucking Alliance, 2012, p. 1). They launched The Blue Ribbon Task Force to try to begin to address this issue, and they have found that:

> “a number of systemic issues underpin the shortage – demographics of the driver population, public perceptions of the industry and the truck driving job, the fact that the truck driver job is not considered a skilled occupation outside the industry, a traditional ‘piece work’ pay system that it can be argued places the burden of inefficiencies of the freight system created by others onto the backs of drivers, an unpopular lifestyle for many, increasing regulatory barriers and constraints, etc.” (Canadian Trucking Alliance, 2012, p.1)

Therefore there are many factors contributing to this problem.

This problem may have far-reaching consequences, as the transport truck transportation is Canada’s most preferred form of freight transportation (Canadian Trucking Alliance, 2012). Furthermore, the truck driving industry in Canada is responsible for $17 billion in annual Gross Domestic Product and employs 300,000 workers (Gill & Macdonald, 2013). Therefore economic activity could be affected if the truck driver shortage affects supply chains enough (Canadian Trucking Alliance, 2012).

6.2 – BMI Modelling

Age and number of hours worked per week significantly explained the variation in BMI. Interestingly, income and marital status did not significantly explain this variation. These are common findings in BMI modelling in the CCHS when examining lower socioeconomic status occupations (Woodhall-Melnik, 2013). While the hypothesis that fruit and vegetable intake would significantly correlate to BMI was not supported by the findings in our study, physical activity was significant in the final model (p=0.0219). Smoking status (p=0.0624) and (p=0.0972) alcohol drinking status also contributed explained variance in BMI. As aforementioned, smoking status and alcohol drinking frequency reduced the R-squared term significantly upon removal, so these variables were left in the regression even though they were p>0.05. These variables became significant (p<0.05) in the regression of truck drivers aged 40-65.

Increased alcohol drinking frequency predicted lower BMI. As the highest value of the alcohol drinking frequency variable represented "Daily" drinking, this is understandable, since there exists a beneficial relation between heart disease and having 1-2 drinks every day (McCarty, 2000). It would seem this regular drinking represented a health benefit in terms of BMI status (a variable strongly correlated to heart disease). This trend is found elsewhere in the literature (McCarty, 2000), with the specific hypothesized mechanism for this being that alcohol has insulin-sensitizing effects on skeletal muscle, which would decrease the amounts of insulin secreted, which would reduce fat storage (and contribute to lower BMI; McCarty, 2000).

In Woodhall-Melnik's (2013) analysis of fast food workers (based on the CCHS), she found that smoking status was the only health behaviour variable that significantly correlated with BMI. Similar to Woodhall-Melnik's (2013) findings, it was found in the CCHS that increasing smoking correlates to decreasing BMI. A negative trend between BMI and smoking has been found in previous studies (Wright & Aronne, 2012; Audrain & Benowitz, 2011; Luo et al., 2012; Rutten-Jacobs, van Dijk, & Frank-Erik de Leeuw, 2009). This may be because of behavioural patterns, increased metabolic rate, and the chemical properties of nicotine (Audrain

& Benowitz, 2011). This may also be because smoking can reduce the senses of taste and smell, leading to a decreased food consumption and BMI (Wright and Aronne, 2012).

Smoking status had a more powerful effect on BMI in adults aged 40-65 (versus those aged 18-39), however. A similar but weaker trend was found in Woodhall-Melnik (2013).The following hypothesis could help to explain this: older adults may have been smoking for longer, which has cumulatively lead to more reductions in gustatory and olfactory sense, which has led to further decrease in food consumption, leading to their BMI being lowered more by smoking than that of a younger person.

It is worthwhile to note that while increased smoking predicts decrease BMI in this sample, and decreased BMI is usually protective against heart disease, truck drivers are more likely to report having heart disease (PR=1.45; 95% CI: 1.02-2.07) versus the general population.

Considering the impact sedentary behaviour may have on cardiovascular disease, it is interesting to note the linear regression findings in regards to the physical activity variables. "Amount of sedentary behaviour per week" was not significant, however as aforementioned the sample size of this variable was 168. "Daily physical activity over 15 minutes" (n=985) was significant however in the model for all truck drivers, and in the model for truck drivers aged 40-65. Furthermore, "Hours worked per week" was significant in truck drivers aged 18-65, and in truck drivers aged 18-39. It is likely the majority of these hours are spent sedentary, thus this is a measure of sedentary activity. These findings together give encouragement for further research examining the effect of increasing daily physical activity, and decreasing sedentary behaviour, in truckers aged 18-65. A potential intervention could be trucks with autonomous driving technology to relieve the driver for a fraction of the time the truck is operating. This could allow the driver to reduce his sitting time, and potentially increase his physical activity time.

The linear regression findings lend support to intervention programs focused on truck drivers to improve risk factors; especially frequency of physical activity of over 15 minutes, as this had a large impact upon the variation in BMI in the regression model. Incorporating 15 or 20 minutes of exercise a day in truck drivers may improve truck drivers' BMI and thus a whole host of disease risk factors (Ng, Yousuf, Bigelow & Eerd, 2014; Barr-Anderson et al., 2011). The truck driver workplace is a difficult one to improve health-wise (Ng et al., 2014; Apostolopoulos, Shattell, Sönmez, Strack, Haldeman, & Jones, 2012). To improve truck driver health a "multistakeholder, multilevel approach that incorporates WHP [Worksite Health Promotion] and occupational health and safety, and goes beyond individual truck driver lifestyles" (Apostolopoulos et al., 2012, p. 268) is needed.

Intervention programs will need to use much more than educational material. Ng et al. (2014) found that common components of successful truck driver interventions had not only educational material, but also one-on-one counselling, health assessment and feedback, and individually tailored interventions. Promoting competition between groups of truck drivers with incentives for the "winners" has also been found to be effective in promoting participation and completion of programs in truck drivers (Ng et al., 2014). Studies examined that significantly impacted obesity in truck drivers in particular also had group education/counselling, and they incorporated use of the stages of change theory (Ng et al., 2014). Obesity is a difficult risk factor to affect however, since the etiology is "highly complex and includes genetic, physiologic, environmental, psychological, social, economic, and even political factors that interact in varying degrees" (Wright & Aronne, 2012, p. 730). Increases in cheap, processed, unhealthy foods, decreases in physical activity and non-exercise activity thermogenesis, increases in long-term sleep debt, and weight gain as a side effect of prescription drugs are all examples of the above mentioned determinants of obesity that contribute to the modern high rates of obesity (Wright & Aronne, 2012).

The literature would suggest that intensive multicomponent programs are important to significantly impact obesity and disease risk factors in truck drivers. These programs should target dietary changes, physical activity changes, frequent monitoring (Schroer, Haupt & Pieper, 2014), unhealthy hours of service and payment system (payment per kilometre/mile which promotes unhealthy lifestyle and stress [Apostolopoulos et al., 2014]), truck cab redesign, and action on the level of not only truck drivers, but trucking companies, shippers and retailers, truck-stop companies, and trucking regulating bodies (Apostolopoulos et al., 2011).

6.3 – Strengths

This thesis derives many of its strengths from the high quality of methodology used in the CCHS. The sampling, response rate and data overall was of excellent quality, as described in detail in Chapter 4; a multi-stage stratified clustering sample design was used to obtain a representative sample from all health regions of Canada.

6.4 – Limitations

The source of this thesis's strengths is also the source of some of its limitations. The CCHS did not suit this thesis' aims in several instances.

First, some of the questions were not detailed enough. For example, while the 2009-2010 version of the CCHS queried about occupation, it did not get the details of occupation; there was an NOC-S code for truck drivers (H711), but there was no further differentiation between long-haul drivers and short-haul drivers. This would have been a valuable distinction to make, however it exists as an unavoidable limitation of the CCHS.

Second, not all the sections of the questionnaire were administered in every province and territory (Statistics Canada, 2010). As a result, a limitation was that several questions (mainly regarding social support and depression) were not available, due to insufficient sample size. Additionally, several questions had sample sizes too small to make statistically sound decisions about. For instance, province of respondent had the former issue, since those in the Northern territories numbered less than 5, thus the data could not be released. Fortunately, Canadian truck drivers have the same distribution amongst the provinces and territories as does the labour force as a whole however (Dube & Pilon, 2006). Therefore, this variable did not likely have a confounding effect on the data.

Third, there is also under-report bias and recall bias – the CCHS measures "diagnosed" disease, thus survey respondents (truck drivers) must go to a healthcare provider in the first place to have their maladies diagnosed before they can report that they have the said maladies when asked in the CCHS.

Fourth, since the primary data examined here was a cross-sectional survey, causality may not be determined. Thus the only comments on the aforementioned relationships between various risk factors and diseases may be that of reporting on associations. Many further (i.e., longitudinal) studies would be needed to add confidence toward beginning to establish causal relationships.

Fifth, the Healthy Worker Effect (HWE) may have influenced the data for several different variables in the CCHS that were examined in this thesis. As noted in the discussion section, these may have at least been musculoskeletal disorders, lung cancer, and mental health. HWE was reduced however, since the sample selected for only those who work currently. Finally, there is likely self-report bias present, as participants were interviewed, rather than the variables being objectively "measured" by interviewers. For instance Shields et al. (2008) found a 7% difference between self-reported BMI and interviewer-measured BMI (22.6% vs 15.2%) in the 2005 CCHS. Furthermore, these differences increased as BMI increased. Thus the self-report bias in this data may significantly under-report the risk factors and/or chronic disease levels found to be present in this sample. This has ramifications for the conclusions regarding variables such as BMI in this thesis, making the conclusions conservative.

6.5 – Implications

The implications of this thesis are two-fold: firstly, it lends support to prior research that suggested truck drivers have issues with amphetamine use, seat belt use, smoking, fruit/vegetable intake, fatigue while driving, physical activity and heart disease, and thus research exploring interventions targeting such issues is called for by this thesis.

Secondly, this thesis calls for further studies delving into the issues that were not found to be statistically different in this thesis but for which there is extensive evidence in other studies, such as diesel exhaust and cancer, asthma, hypertension, musculoskeletal disorders, alcohol abuse, hearing loss, migraine headaches, bowel disorders, and healthcare usage. Unfortunately, little data was available specifically on depression or other mood disorders due to insufficient sample sizes. This is one gap in the literature that was not well addressed by this thesis. There was some data on mental health, which was utilized, however no major conclusions can be made in this thesis on Canadian truck driver mental health. An excellent opportunity exists for future research examining this topic.

Further research into the above truck driver health is recommended to have a qualitative component. As was seen in the Psychological Health section, truck drivers may have inaccurate quantitative assessments of their health, as they often rated their (e.g.) mental health very well. However when questioned in qualitative interviews about their mental health and the stresses of truck driving, they can provide rich information on the adverse circumstances they face and how it affects them.

This notion gains support from Woodhall-Melnik (2013), who reported on fast-food workers in the CCHS and also did interviewing herself. In her analysis the qualitative portion of the study was much more telling, since many hypotheses were found to be null in the quantitative section, and the underlying reasons were often uncovered in the qualitative section. Thus further research is recommended to have a qualitative component to illuminate truck driver health more fully.

This thesis also lends support to Ontarian-specific truck driver-based interventions, as prevalence of heart disease was nearly 50% higher in Ontarian versus Canadian truck drivers.

The results from this thesis could also serve as guidelines for the design of informational and educational material. Truck driver associations could use the findings from this thesis to educate drivers in training on the health problems truck drivers typically face. This way, new truck drivers could go into the occupation with better knowledge about health. Also, truck driver associations could use this information and push for environmental and regulation-level changes to help support a healthier work environment.

Excellent places to begin research for interventions were examined in the BMI modelling analysis, showing that modifiable variables such as physical activity status (p=0.0219; especially), smoking status (p=.0624), and frequency of drinking alcohol (p=.0972; showing that daily drinking relates to lower BMI) had significant and near-significant impacts upon the variation in BMI, a factor majorly predisposing one to heart disease. Furthermore, additional linear regressions on BMI showed that in truck drivers aged 18-39, smoking status, hours worked per week, and age were significant variables, and in truck drivers aged 40-65, daily physical activity over 15 minutes, frequency of drinking, and smoking status were significantly correlated to BMI. Thus further examining the relation between physical activity and body mass in older truck drivers may be a good future avenue for research. Therefore some light is shed upon how to begin to tackle the difficult problem of ameliorating truck driver health.

CHAPTER 7: CONCLUSION

In sum, truck driver health was found to be significantly worse than the health of the general population in many ways. This was quantified through prevalence rates of chronic disease, and especially through prevalence rates of risk factors for chronic disease. Contrary to expectations, Ontarian truck driver cardiovascular disease levels were worse than Canadian truck driver cardiovascular disease levels, despite better fruit/vegetable intake in Ontarian truck drivers, and similar levels of high blood pressure and diabetes.

There are several broad implications of this thesis. Firstly that cardiovascular disease is significantly higher in Canadian truck drivers (and higher still in Ontarians). This finding is echoed in other research studies, both American and Canadian. Thus this dissertation has strengthened the growing body of evidence that truck driver health is significantly worse than the health of the general population. It has especially contributed in this way to the small body of literature on Canadian truck drivers.

Several important findings were made which may impact road safety: many truck drivers are obese, which carries a high risk of obstructive sleep apnea, which has been shown to have similar effects on driving performance as having a blood alcohol concentration of 0.08, the legal limit in Canada. Furthermore, the prevalence of truck drivers who often drive while tired was almost twice that of otherwise comparable workers. Their seatbelt usage and use of amphetamines was also significantly different.

Since truck drivers account for such an integral component of the economy, and are important in terms of road safety, this is an important problem that merits further attention. This thesis has also highlighted the importance of interventions to improve truck driver health, and has given some possible risk factors these interventions may specifically target.

Truck drivers had high smoking rates, low physical activity rates, and high rates of overweight/obesity. BMI was explored in detail and it was found that smoking status had a significant inverse correlation to BMI in all truck driver age demographics. In truck drivers aged 40-65, participation in daily physical activity over 15 minutes in duration, and drinking alcohol more frequently (in addition to smoking status) significantly correlated to decreased BMI.

Future research is needed in the areas of truck driver respiratory, musculoskeletal, and psychological health, as the healthy worker effect, under-report bias, and insufficient sample sizes hindered the ability to assess these areas of truck driver health accurately. In regards to psychological health in particular, much further research is recommended. Further qualitative research is recommended since these pieces of research typically presented very different data than did the quantitative research in this area.

Future interventions will need to be multifaceted and target all areas of a truck driver's environment; not only do "diet and exercise" need to be considered, but the physical environment, and the labour environment on the level of trucking companies and trucking regulating bodies needs to be addressed to begin to ameliorate the difficult problems truck drivers face.

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APPENDIX A

The following is taken verbatim from Statistics Canada (2011b). It is the index of the CCHS Questionnaire, providing a list of the questions that the CCHS delves into.

Table of Contents - by Questionnaire Order

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APPENDIX B

The following is taken verbatim from Statistics Canada (2007):

The CCHS uses the National Occupational Classification for Statistics (NOC-S) codes, developed by the Human Resources and Social Development Canada (HRSDC; Statistics Canada, 2007). They are designed for use in the statistical analysis of surveys.

The classification of the NOC-S is based centrally upon the kind of work performed. Furthermore, the "tasks, duties, and responsibilities of the occupation [are examined]. Factors such as the materials processed or used, the industrial processes used, the equipment used, the degree of responsibility and complexity of work, the products made and services provided, have been taken as indicators of the work performed when combining jobs into occupations and occupations into groups." (Statistics Canada, 2007).

There are many, many categories developed to encompass the occupations in Canada. The category of interest in this dissertation is the "Truck Drivers" category, given the code H711. This category has the following description:

"*Truck drivers operate heavy trucks to transport goods and materials over urban, interurban, provincial and international routes. They are employed by transportation companies, manufacturing and distribution companies, moving companies and employment service agencies, or they may be self-employed. This unit group also includes shunters who move trailers to and from loading docks within trucking yards or lots."* (Statistics Canada, 2007).

In addition, there are footnotes that this category does not include:

- "*Delivery drivers (H714 - Delivery and Courier Service Drivers)*
- *Drivers of specialized equipment such as snowplows, road oilers and garbage trucks (H612 - Public Works Maintenance Equipment Operators)*" (Statistics Canada, 2007)

There is no further differentiation in this category; H711 includes both short-haul and long-haul truck drivers. This is an unfortunate but unavoidable limitation in the CCHS.

A further breakdown of the H7 category is seen below:

"H7 Transportation Equipment Operators and Related Workers, Excluding Labourers
H71 Motor Vehicle and Transit Drivers
H711 Truck Drivers
H712 Bus Drivers, Subway Operators and Other Transit Operators
H713 Taxi and Limousine Drivers and Chauffeurs
H714 Delivery and Courier Service Drivers
H72 Train Crew Operating Occupations
H721 Railway and Yard Locomotive Engineers
H722 Railway Conductors and Brakemen / women

H73 Other Transport Equipment Operators and Related Workers
H731 Railway YardWorkers
H732 Railway Track Maintenance Workers
H733 Deck Crew, Water Transport
H734 Engine Room Crew, Water Transport
H735 Lock and Cable Ferry Operators and Related Occupations
H736 Boat Operators
H737 Air Transport Ramp Attendants" (Statistics Canada, 2007)