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# Hospitalization for lifestyle related diseases in long haul drivers compared with other truck drivers and the working population at large

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**Abstract.** Personal lifestyle and working conditions are closely linked for long haul truck drivers. We compare lifestyle related diseases in long haul drivers with other drivers of goods and the working population at large. Standardized hospital treatment ratios (SHR) for lifestyle related diseases were compared for long haul truck drivers and other truck drivers to the working population at large. The follow up group comprised of 2,175 long haul drivers and 15,060 other truck drivers. An increased risk was found for lifestyle related diseases among truck drivers except for alcohol related diseases. We identified a strong association between hospital treatment for obesity and working as a driver and an association between diabetes and working as a driver. No major differences in lifestyle related diseases were found in long haul drivers compared to other truck drivers with the exception of a significant lower risk for alcohol-related diseases and a possibly higher risk for lung cancer in long haul drivers. It is concluded that diseases related to excess caloric intake or lack of exercise may be a problem for truck drivers. This risk is preventable and of importance both in occupational medicine as in public health.

**Keywords:** Lifestyle related diseases, long haul truck driver, diabetes, obesity, chronic ischaemic heart disease, alcohol related diseases, lung cancer

## 1. Introduction

The health of long haul truck drivers in industrialized countries has mainly attracted public interest in relation to traffic accidents but the drivers health con-

ditions deserves attention in their own rights. Drivers are exposed to diesel exhaust, whole-body vibration, heavy lifting and stress arising from demands to keep their work schedule despite traffic jams, irregular meals and sleeping patterns [13,21]. Long haul truck drivers' work in particular is characterized by long working hours, work at different times of day, and other conditions that impact not only their working conditions but also their out of work living conditions. They live and work away from home for days or sometimes weeks,

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and their spare time on the route is spent in conditions that are restricted by their responsibility for their cargo and vehicle. Their opportunities to participate in common social and leisure time activities are limited while being away from home and their access to healthy food and leisure time physical activities is often sparse.

Earlier studies indicated health differences among different groups of drivers [3,5,16,17,24,31,32]. Data drawn from large nationally representative US data sets on occupation and workers' compensation in the mid eighties showed that heavy truck driving was the occupation that most frequently ranked at the top of most disease lists and indicated that the risk in truck drivers for myocardial infarctions was increased by a factor 4 and the risk for mental disorders by a factor 3. Heavy truck driving was also among the occupations on top of the list for stroke, diseases in respiratory system, and poisoning. Other groups of drivers had different disease patterns. Bus drivers came out with high frequency of inflammation of joints, tendons, or muscles and mental disorders. Taxicab drivers and other chauffeurs had often heart attacks but less often than heavy truck drivers and did not rank the lists for several other diseases as heavy truck drivers did [24].

Proportional mortality ratios for long and short haul truck drivers were compared in the US for lung cancer, stroke and other circulatory system disease. For long haul truck drivers who were under age 55 at death significant excess proportionate mortality were found for lung cancer, ischemic heart disease and acute myocardial infarction [32].

In London, Great Brittan, lorry drivers had excess deaths rates from stomach cancer, lung cancer, bronchitis, emphysema, and asthma, a pattern not seen for taxi drivers [3]. In Reykjavik, Iceland, truck drivers also had an excess of lung cancer deaths, but fewer deaths than expected from respiratory diseases while the standardised mortality rates did not deviate substantially from unity for taxi drivers [31]. In Stockholm, Sweden, the risk for myocardial infarction was studied in different groups of drivers (bus, taxi and lorry drivers). Among truck drivers, lifestyle factors (smoking habits) seemed to explain most of the elevated risk, but overall bus and taxi drivers had the highest risk, which was partly explained by unfavourable life-style factors, social factors, and work environment factors [5]. During 1985–96 the relative risk remained high compared to other manual workers among taxi and lorry drivers, but not among bus drivers [4].

Lung cancer frequency was elevated in bus, lorry, taxi, and unspecified male drivers when compared with

other employees in Denmark, after adjustment for socioeconomic differences. But the excess risk was 31% in bus and lorry driver compared with 64% in taxi drivers and 39% in "Unspecified drivers" [17]. Also in Denmark drivers of goods vehicles and drivers of passenger transport were compared for a number of diseases. Standardised hospital admission ratios were higher among professional drivers than in the male working population at large for diseases in practically all systems and organs of the body. It was concluded that drivers of passenger transport and drivers of goods vehicles differed in their disease patterns [15].

Apart from the study by Robinson et al. [32] the former studies did not differentiate between long haul drivers and other group of drivers. As long haul truck drivers' living condition and lifestyle differ from the work and lifestyle of other drivers of goods, we wanted to compare lifestyle related diseases in long haul drivers with other drivers of goods and with the working population as a whole to establish baseline values for future evaluation of preventive efforts. The aim of the present study was to elucidate the disease pattern among [male] professional long haul truck drivers in Denmark. This occupational group with its unique workings condition have never before been studied thoroughly using the comprehensive Danish person- and health-registry systems, probably because long haul truck drivers are not registered as a separate occupation but are mixed up with drivers of all kind such as bus drivers, local drivers without overnight routes, or drivers employed only on a "dedicated run" (same route continuously) etc. Thus, in this study great effort were made to define a cohort of long haul truck drivers.

## 2. Method

A ten-year follow-up study, starting on January 1, 1994 was established to examine standardized hospital treatment ratios (SHR) of lifestyle related diseases in a cohort of long haul truck drivers in Denmark compared with SHRs among other truck drivers and the working population at large. SHRs were obtained by linkage of data from the Occupational Hospitalization Register (OHR) to data extracted from the Danish Labour Market Supplementary Pension Fund (ATP) registry and Statistics Denmark.

### 2.1. Data sources for hospitalization and profession

The Occupational Hospitalization Register (OHR) consists of individual-level information obtained throu-

gh a record-linkage between three Danish national registers – the National Civil Register, the National Hospital Patient Register, and the Employment Classification Module [34].

The National Civil Register (CPR) has since 1968 registered all persons with a permanent address in Denmark, and provided each person with a unique 10-digit personal identification number (PIN). The number includes information on date of birth, gender, and the register also hold information on death and migrations for every person who is or has been an inhabitant of Denmark sometime between 1968 and the present time. The PIN contains a mathematical structure that makes most coding errors detectable. This number is used by all authorities, employers, pension funds, hospitals, and others to identify a person. The PIN was used to link the data sources.

The National Hospital Patient Register has existed since 1977 and contains data from all hospitals in Denmark. More than 99% of all admissions to Danish hospitals are registered and it is updated every year. In the time period 1977–94, the register only included inpatients but since 1995 it also covers outpatients and emergency ward visits. The diagnoses have, since 1994, been coded according to the International Classification of Diseases, 10th revision (ICD-10).

A person's occupation, industry and employment status are registered annually in the Employment Classification Module (ECM) – a database maintained by Statistics Denmark. The industries in the ECM are coded in accordance with the Danish Industrial Classification of All Economic Activities 1993 [35], which is a national version of the European Industrial Classification of All Economic Activities. The occupations are coded in accordance with Statistics Denmark's Standard Classification of Occupations (DISCO-88) [36], which is a national version of the International Standard Classification of Occupations (ISCO-88). It is extended so that it also includes self employed people. Through the ECM we were able to identify truck and bus drivers, but we could not differentiate between long haul and short haul truck drivers.

## 2.2. Identification of long haul drivers

In Denmark long haul truck drivers are for geographical reasons almost exclusively truck drivers, who carry goods across the border (also known as export drivers). Statistics Denmark does not record long haul drivers as such in any register. Instead long haul drivers are lumped together with other groups of truck drivers

transporting the same sort of goods. We had to use a combination of data sources to identify long haul drivers.

First step was to identify possible employers of long haul drivers. From the Association of Danish International Hauliers (ITD) we obtained a member's list from June 2004. To this list we added companies registered in a Danish Internet-based comprehensive address book ([www.krak.dk](http://www.krak.dk)) under "International transport" or "Danish exporters/transport". Only companies, both registered in the Danish registry of enterprises (CVR) under the relevant branch codes (hauliers: code 602410, removal enterprises: code 602420 and forwarders: code 634020) and having a EU authorization for international transportation, were included. The resulting 405 companies can be assumed to be the major part of the Danish export hauliers.

Second step was to establish a list of long haul drivers employed by Danish export hauliers at our baseline (1.1.1994). For all 405 identified companies we extracted the personal 10-digit PIN-number for all employees since 1964 from the Labour Market Supplementary Pension Fund (ATP) registry. ATP is a compulsory pension scheme for all employees in Denmark working 9 hours or more per week. Thus the ATP register holds information about practically all Danish employees. From ATP we also got data on employment periods. We identified 27,649 employees, aged between 20 and 59 years at baseline. Of these, 5,506 men and 629 women were employed in one or more of the listed companies for 3 months or more before 1994 and were employed in the companies in 1993, used as an expression for employment at our baseline. Women were excluded because we had too few to make informative analyses. We also excluded employees not registered by job code as truck driver by Statistics Denmark leaving a cohort of 2,175 male, who could be assumed to be long haul drivers at baseline 1994.

## 2.3. Other truck drivers

For comparison, we defined a group of other (than long haul) truck drivers based on data from Statistics Denmark. Other truck drivers were defined as economically active men in the age interval 20–59 years at baseline, with the occupational code 8324 (truck driver), employed in a company with one of the industrial codes 602410, 602420 or 634020 as their main occupation in the 1993 registration in the ECM and not on our list of long haul drivers.

#### 2.4. Follow-up for diagnoses in the Occupational Hospitalization Register

The follow up comprised 2,175 long haul drivers and 15,060 other truck drivers. Mean ages at baseline were 39.4 years for the long haul truck drivers and 40.5 years for the other truck drivers. Each person was linked to the files of the nationwide OHR by use of the PIN. Observation time began on January 1, 1994. Cases were followed up until the date of diagnosis, date of death, date of emigration, or at the end of study (December 31, 2003) whichever came first. Person-years (PY) at risk were calculated for each individual.

#### 2.5. Statistical analyses

The standardized hospitalization ratio (SHR) was calculated as the ratio between the total number of observed cases with a specific hospital diagnosis (see Table 1) and the total number of expected cases. The latter was calculated by multiplying the PY at risk during the follow-up period in each five-year age group by the corresponding rates of hospital contacts among economically active people in the total Danish population. Their corresponding 95% confidence intervals (CI) were estimated assuming a Poisson distribution for the observed number of cases with a specific diagnosis. For the SHRs, we calculated exact intervals when the observed number of cases was less than 100. Otherwise we used the propagation of error formulas and normal approximation to form a 95% CI around the logarithm of the risk ratio, which we then transformed into a 95% CI around the risk ratio. We used the likelihood ratio to test the null-hypothesis that SHR is independent of driver category (long haul truck driver, other truck driver).

We used the statistical software SAS version 8.2.

### 3. Results

Compared to the working population at large both long haul and other drivers had a statistical significant elevated risk for being hospitalized for obesity (SHR: 254, 95% CI: 127–454) and diabetes mellitus (SHR: 140, 95% CI: 104–185) (Table 1).

An increased, but not statistically significant, risk for malignant neoplasm of bronchus and lung was seen in long haul drivers (SHR: 173, 95% CI: 95–290) at a higher level than among other drivers (SHR: 118, 95% CI: 94–147). Other drivers also had statistically

significant elevated risk for bronchitis and emphysema (SHR: 123, 95% CI: 106–143), acute (SHR: 122, 95% CI: 113–131), and chronic ischaemic heart diseases (SHR: 129, 95% CI: 116–144) but a slightly reduced risk for diseases of the respiratory system on the whole (SHR: 93, 95% CI: 87–99). The risks of these diseases for long haul drivers were at the same level although not statistically significant. Also other drivers had modest but statistical significant elevated risk for endocrine, nutritional and metabolic diseases (SHR: 119, 95% CI: 109–129) as well as diseases of the circulatory system (SHR: 108, 95% CI: 104–113). The SHRs for long haul drivers were at the same level but with broader confidence intervals

The only statistically significant difference between the two driver groups was that long haul drivers had statistical significant lower risk (SHR: 20, 95% CI: 2–73) than other drivers (SHR: 67, 95% CI: 50–89) for alcoholic related diseases ( $p$  for difference between groups = 0.043). But both occupational groups had low risk levels for alcoholic related diseases when compared to the working population at large.

### 4. Discussion

In the present study we took great care in identifying a cohort of long haul truck drivers since it is the first time this group of drivers were compared to other truck drivers with regard to lifestyle related diseases. We may not have identified all long haul drivers in the country, but we still have a considerable sample size, and our selection of long haul drivers was not related to the risk of being hospitalized. Our aim was to establish a group that exclusively included long haul truck drivers, but we cannot rule out that some export hauliers also employ short haul drivers. If so, our results may not have as strong an exposure contrast as wanted and we may underestimate the differences in the risk of lifestyle related diseases.

We have complete registrations of all hospital admissions and hardly any persons were lost to follow-up. Studies using hospital admissions often suffer from referral bias if patients have to pay for the treatment or if the geographical distance to a hospital is a problem. In Denmark all hospital treatment is free of charge and the geographical distance to hospitals is short for all.

We have no data on hospitalization abroad, and drivers in international transport may seek hospital treatment abroad in case of severe accidents or acute illness. Otherwise, truck drivers are likely to delay

Table 1

Standardized Hospital treatment Ratios (SHR) and 95% confidence intervals (CI) for male long haul drivers and other male drivers for lifestyle related ICD-10 diagnoses in Denmark 1994–2003. For comparison main groups of diseases with relevance for lifestyle related diagnoses are shown too

ICD 10	SHR Long haul drivers (cases) N = 2,175	95% CI	SHR other drivers (cases) N = 15,060	95% CI	Difference in SHR between the 2 occupational groups	$\Pi^2$ P- value ChiSq
<b>Lifestyle related diseases</b>						
Bronchitis and emphysema	128 (22)	80–193	123 (169)	106–143	5	0.869
Malignant neoplasm of bronchus and lung	173 (14)	95–290	118 (82)	94–147	55	0.207
Acute ischaemic heart diseases	116 (87)	93–143	122 (709)	113–131	–6	0.672
Chronic ischaemic heart disease	125 (40)	89–170	129 (331)	116–144	–4	0.829
Alcoholic liver disease, cirrhosis of liver and oesophageal varices	20 (2)	2–73	67 (48)	50–89	–47	0.043
Diabetes mellitus	140 (50)	104–185	137 (361)	124–152	3	0.882
Obesity and other hyperalimantation	254 (11)	127–454	216 (65)	167–275	38	0.627
<b>Main groups of diseases</b>						
All diseases, except mental and behavioural disorders	102 (1646)	97–107	102 (11407)	100–104	0	0.938
Neoplasms	108 (125)	90–128	103 (913)	97–110	5	0.660
Endocrine, nutritional and metabolic diseases	117 (79)	93–146	119 (582)	109–129	–2	0.909
Diseases of the circulatory system	104 (265)	92–117	108 (2079)	104–113	–4	0.481
Diseases of the respiratory system	91 (124)	76–108	93 (911)	87–99	–2	0.787

ICD 10: International Classification of Diseases, 10<sup>th</sup> revision.

elective hospital treatment until they return to their residence according to anecdotal information from truck drivers. Most hospital treatments abroad for serious diseases will probably also be followed by hospital treatment at home.

#### 4.1. Differences between groups

Indications for differences in disease patterns in different groups of drivers were previously found in studies on chronic obstructive lung disease [43] heart diseases [5,18,32], lung cancer [3,16,17,31], and other types of cancers [3]. None of the previous studies specifically dealt with long haul drivers' lifestyle related diseases in general; only one study on heart diseases distinguished between long and short haul drivers [32] (more on heart diseases below).

In the present study no major differences in lifestyle related diseases were seen when comparing long haul

drivers with other drivers of goods except for alcoholic related diseases. A tendency toward an increased risk for long haul drivers was also found for "Malignant neoplasm of bronchus and lung".

#### 4.2. Obesity

No previous studies have been published that showed an association between hospital treatment for obesity and working as a driver. Obesity is often mentioned as being prevalent among drivers, but this was only recently documented in an extensive representative sample of Teamster drivers working for Motor Freight Carriers Association (MFCA) companies in the USA. Half of the drivers had a body mass index (BMI) in the obese range, which is nearly double the prevalence of obesity in the general population. Only 10% of respondent were normal weight [14]. Although we do not know the frequency of obesity in the present study cohort,

a hospital referral frequency higher than 2.5 times the referral for the same reason in the general public suggests that obesity might be a major health problem on both sides of the Atlantic. This is a public health issue since obese drivers have a higher frequency of obstructive sleep apnoea and tend to be sleepier during the day [11]. Studies have shown that untreated obstructive sleep apnoea increases the risk for sleepiness-related motor vehicle accidents [29]. Also obese drivers tend to be more vulnerable to injuries when accidents in fact occur [44]. Furthermore obesity is in itself a risk factor for several diseases and early death.

A combination of physical inactivity and dietary factors which again are influenced by working condition and lifestyle factors may explain the increased risk for obesity: The organization of working time for long haul drivers in Europe is mainly determined by the EU-rules on driving and rest times. Driving as much as the rules permit – which is the common practice – consequently lead long haul truck drivers to take breaks as short as possible and eat the foods that are offered for sale along the motorways. The driving periods are often uninterrupted in sedentary posture and with the speed or cruise control hooked on; so the driver remains physically inactive for extended time periods. In domestic freight transportation in Denmark where distances are short, the drivers usually return home every night and may participate in common leisure time and sport activities near their home. They often have at least two of their main meals at home and these meals are supposed to be more wholesome than meals bought in fast food restaurant or kiosks along the motorways. Whether the slightly higher SHR for obesity for long haul drivers reflect this difference in working condition remain however speculative.

#### 4.3. Diabetes

The association between diabetes and working as a driver is in accordance with one study that found increased diabetes mortality among lorry drivers [2]. In this study approximately five times more drivers acquired hospital treatment for diabetes than for obesity. This probably does not reflect a higher frequency of diabetes compared to obesity, but in Denmark most diabetics sooner or later have medical examinations in hospitals to prevent diabetic complications. Drivers are only permitted to drive if their diabetes is well treated and hospitalization for diabetes might therefore be influenced by this legislative restriction, leading to a

greater demand for treatment for professional diabetic drivers.

The same combination of physical inactivity and dietary factors influenced by working condition mentioned above for obesity may also explain the increased risk for diabetes – obesity of course being a risk factor in itself.

#### 4.4. Chronic ischemic heart disease

An increased risk of cardiovascular diseases among truck drivers has been shown in a number of studies [5, 18, 20, 25, 26, 32, 33, 37]. In one study the risk for myocardial infarctions in drivers was found to be increased by a factor of 4 [25]. In the only previous study dealing with long and short haul drivers, an increased risk was found for male long haul truck drivers age 15–54, but not for short haul truck drivers, nor for truck drivers who died after age 65. Indirect adjustment suggested that smoking could explain the excess heart mortality [25]. In our study the excess risk was modest in both groups of drivers and only statistically significant for other truck drivers.

Apart from risk factors arising from smoking, nutritional factors and physical inactivity already mentioned, truck drivers also have irregular sleep/wake schedules and a high prevalence of sleep-disorders [22, 23] which may contribute to the elevated risk. Also stress arising from demands to keep time-schedules (exposure factor “tempo/time-limit/urgency in job”) has been shown to be of importance among truck drivers [18]. Compared to other trades, transportation workers in Denmark had the longest work weeks [8]. These factors are supposed to be associated with coronary heart disease, and physiological studies in drivers support this assumption [28, 42, 45]. Also indicators were found of an association between driving time and changes in haematological markers of increased risks for cardiovascular diseases [9].

A hitherto unheeded risk factor is vibration, as recent studies indicated an association with this exposure and increased risk for acute myocardial infarction [6].

#### 4.5. Alcohol related diseases

The drivers in this study had a reduced risk for alcohol related diseases and this tendency was stronger for long haul drivers than for other drivers. This is remarkable compared to earlier studies from other parts of the world that indicated that truckers often used alcohol or psychoactive drugs. In one study as much as

23% of surveyed truck drivers were tested positive on one measure of alcoholism [23] and in another study 33% of drivers had detectable blood concentrations of psychoactive drugs or alcohol [10].

#### 4.6. Lung cancer

Several studies have shown an increased risk for lung cancer among truck drivers even after controlling for smoking [19,22,27,31,38–40]. Motor exhaust, in particular diesel exhaust, may be an etiologic factor. Factors specific to long haul driving may play a role since long haul drivers have an increased risk. Smoking habits may be more frequent among long haul drivers due to extended periods of inactivity and high psychological job demands combined with low work control may also affect smoking habits [12].

The prevalence of smokers in Denmark has decreased considerably from the beginning of the 1970's to 1997. In this time period the prevalence of smokers in the working population went from 68% to 38%, but only from 73% to 64% among drivers. Other unskilled workers reduced smoking from 75% to 45% in the same period of time [15].

#### 4.7. Combined factors and effects

Personal and work related risk factors for lifestyle related diseases might interact. Personal risk factors arising from caloric intake and lack of physical activity may contribute both to obesity, diabetes and ischemic heart diseases. But these "personal" risk factors are also influenced by work and working conditions. For instance irregular sleep/wake schedules and a high prevalence of sleep-disorders may contribute to increased nutritional intake or tobacco consumption. In a study of body mass index and smoking (both classical risk factors for ischemic heart diseases) among professional drivers in Sweden, it was concluded that both of these factors were related to work [12]. Occupational stress was one of the strongest predictors for intensity of smoking whereas long work hours behind the wheel were a predictor for high BMI. High psychological job demands combined with low work control have also been shown to affect smoking habits [12]. In European drivers one third increased their cigarette smoking during their professional duties [20] and in Australia smoking was used by 44% of drivers as a strategy to deal with fatigue, only exceeded by drinking caffeine beverages as a stimulant which was used by 62% of drivers [1]. In the USA eating (food, snacks, chocolate,

ice or candy), together with smoking (among smokers), and drinking coffee were among the most often used strategies to lessen fatigue while on duty, and far more frequent used than stopping to sleep. The smoking frequency among American drivers was more than 1/5 higher compared to the general population at the same time. The figures also suggested that smoking did not decline among truckers at the same rate as in the general population [14].

Thus personal lifestyle and working conditions may be tightly interwoven in long haul truck driving. Personal habits probably also interacts with the selection into this trade so that persons prone to physical inactivity may prefer this kind of work. This study does not in itself contribute to explain this complex interaction, but point to the need for further research in this field to reduce truck drivers' lifestyle related diseases.

## 5. Conclusion

Personal lifestyle and working conditions are supposed to be tightly interwoven in long haul truck driving, but when compared to other truck drivers this does not reflect major differences in lifestyle related diseases, with the exception of a significantly lower risk for alcohol-related diseases and a possibly higher risk for lung cancer. All truck drivers had an increased risk of hospital treatment for diseases related to excess caloric intake and lack of exercise. New is the finding of an increased risk for hospitalization due to obesity and diabetes in truck drivers. The study indicates that drivers should be offered targeted health promotion programs that address both lifestyle factors and occupational working conditions, focusing on opportunities for physical exercise and better access to quality food for these drivers, alongside with research in health effects of rules on driving and rest times.

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