



# Dangerous Driving: A Structured Review of Health Effects Caused By Occupational Exposure To Diesel

Mustafa Haiderbhai, Aria Keshoofy, Fady Said



uOttawa

## Abstract:

**Background:** Diesel exhaust is a gas produced from the combustion of diesel fuel in diesel engines. These engines are used mainly in industrial and commercial sectors, with a small amount of consumer use. Diesel exhaust contains chemicals that are known carcinogens, and can negatively impact human health. Many occupations have chronic exposure to diesel exhaust. **Research Question:** The goal of this structured review is to assess whether occupational exposure to diesel exhaust in the working class has any adverse health effects compared to similar reference populations with no exposure to diesel exhaust. **Methodology:** Relevant studies were collected using the keywords “Diesel Exhaust”, “Health Effects”, and “Truck/Bus/Taxi Drivers” from the databases PubMed and SCOPUS. The resulting papers were limited based on criteria such as English language, human clinical studies, and relevance to the research question. The papers were reviewed to assess overall quality, and key components such as authors, study design, sample population, key data, and key finding were extracted. **Results:** 8 relevant papers were found and reviewed. **Discussion:** The results indicate a positive association between diesel exhaust and lung cancer/cardiovascular disease. Truck drivers were most at risk due to longer exposure times when compared to the on-exposure reference populations. Bus drivers and taxi drivers were found not to be at the same risk level. **Conclusion:** These results provide evidence of the negative impact to health caused by chronic exposure to diesel exhaust. The populations at risk should be monitored and measures should be taken to avoid and mitigate the damage caused by this pollutant. Further studies should examine the decrease in adverse effects when diesel engines are substituted with cleaner energy sources.

## Introduction:

Diesel motors are currently the most efficient and cost effective method of moving material goods and services across vast distances (Lloyd & Cackette, 2001). The byproduct of using these diesel motors is the diesel motor exhaust (DME) that is created from the combustion of diesel fuel. DME has been criticized for the mutagenic properties of the organic solvent extracts that it produces (Hesterberg et al., 2012). These criticisms against diesel fuel and its by-products have resulted in major advancements in diesel engine technology. This includes the implementation of “clean diesel technology” and fuel additives such as Diesel Exhaust Fluid. Even with these advancements, exposure to DME has only been increasing, especially with the added application of commercial and consumer level, heavy- and light-duty diesel motors in urban environments. The International Agency for Research on Cancer (IARC) has classified DME as carcinogenic to humans (Ilar et al., 2017). Exposure to DME occurs through many occupational settings through indoor and outdoor air pollution. Approximately 781,000 Canadian workers, or 4.6% of the Canadian labour force is exposed to DME. The largest exposed occupational groups include truck drivers and heavy equipment operators (Kachuri et al., 2016). With the increased abundance of diesel motors, and the long exposure durations that some occupations face, these workers might face an increased risk of various adverse health outcomes.

## Research Question:

Does exposure to diesel motor exhaust in occupational vehicle operators (truck drivers, bus drivers, taxi drivers), aged 19–65, have adverse health effects compared to similar reference populations with no exposure to diesel exhaust?

## Methodology:

**Study Design:** Structured literature review using Pubmed and Scopus databases to find papers, and summarize findings.  
**Search Strategy:** Search for papers relevant to Diesel Exhaust AND Truck/Bus/Taxi Drivers AND Health Effects.  
**Inclusion Criteria:** Clinical studies on human populations, Papers in English, Relevant keyword and topics included.  
**Exclusion Criteria:** Full text not available, Studies with focus on other associations.  
**Review Process:** Each paper was reviewed by 3 readers to ensure its relevancy with the research question, and to ensure the legitimacy of results based on study design and conclusions drawn.  
**Data Extraction:** Data and key findings for the sample population and size, study design, results/data, and key finding were extracted.  
**Summary Process:** The findings of the paper were summarized into a table, highlighting key ideas. The papers were ranked in order of strength based on the study design, population size, and robustness of calculations and findings.

## Results Continued:

**Table 1. Key components extracted from resulting papers. Organized by quality of overall paper.**

Authors / Date	Population and Sample Size	Research Design	Data Gathered	Summarized Findings
(Cynthia F. Robinson, & Carol A. Burnett, 2005)	Truck Drivers (n=93,438)	Retrospective Cohort	•Highest PMR of 23 for white male truck drivers 19-65	•The highest significantly elevated proportionate heart disease and lung cancer mortality was found for White and Black male long haul truck drivers age 15–54
(Garshick, Laden, Hart, Davis, Eisen, & Smith, 2012)	Males in U.S. trucking industry workers (n=31,135)	Retrospective Cohort Study	•Hazard Ratio was 1.07 after a 5-year exposure lag. •Hazard Ratio was 1.09 for a 10 year exposure lag.	•Lung cancer mortality in trucking industry workers increased in association with cumulative exposure to EC after adjusting for negative confounding by employment duration.
(Laden, Hart, Smith, Davis, & Garshick, 2007)	Records male truck drivers from four trucking companies (n= 54,319)	Retrospective Cohort Study	•Standardized mortality ratio for lung cancer deaths among truck drivers found to be SMR = 1.10 (95% CI, 1.02–1.19) •Ischemic heart disease was found to be higher among [drivers, SMR = 1.49 (95% CI, 1.40–1.59)	•Elevated rates of lung and heart disease among the long haul truck drivers •Limitation of the available data on confounders such as diet and smoking •Smoking was found not to be a confounder due to low rated of pulmonary disease, and similar rates of smoking to the general population using a birth-cohort representative study
(Jarvholm & Silverman, 2005)	Swedish male truck drivers (n=6364)	Quantitative Prospective Cohort Study	•Relative risk of 1.3 for lung cancer compared to general population. •Standardized incidence ratio of 1.24 for prostate cancer when compared to general population	•Study found an increased risk of lung and prostate cancer among truck drivers when compared to the general population. •When compared to heavy equipment operators, truck drivers had a higher risk of lung cancer, showing an association between exposure as truck drivers have increased exposure duration. •Study was limited due to an inability to quantify the duration and intensity of diesel exposure
(Paradis, Theriault, & Tremblay, C. 1989)	Bus Drivers (n=2134)	Occupational Cohort Study	•non-significant excess mortality was found for ischaemic heart disease (IHD) (O/E = 313/295, SMR = 106, 95% CI: 95-118) and circulatory system diseases (O/E = 441/405, SMR = 109, 95% CI: 99-119) •no excesses were observed for lung cancer (O/E = 78/84.4, SMR = 92, 95% CI: 73-114) or bladder cancer (O/E = 4/7.4, SMR = 54, 95% CI: 15-138)	•Significantly higher mortality was found for circulatory system disease among drivers with less than 30 years employment. •A slight excess risk of mortality by IHD for bus drivers with less than 30 years experience was observed. •An association between exposure and cancer mortality was unable to be confirmed in Montreal City bus drivers.
(Steenland, Silverman, & Hornun, 1990)	Unionized North American Truck Drivers (n=2081)	Case-control study	•Odds ratio of lung cancer death for long-term long haul truck drivers was 1.55 (95% CI: 0.97, 2.47) when compared to reference no exposure group •Odds ratio of lung cancer death for diesel truck drivers was 1.89 (95% CI: 1.04, 3.42) •Odds ratio for short term of employment was 1.27 (95% CI: .70, 2.27)	•Data shows an excess risk lung cancer among diesel truck drivers •Positive trend of duration of employment and odds ratio for lung cancer •Study was limited due to a lack of data on duration of exposure to diesel exhaust
(Soll-Johanning, Bach, & Jensen, 2003)	Danish Bus Drivers (n=18,174)	Case - Control Study	•Relative risk of 0.97 for lung cancer, for each added year of employment as a bus driver (95% CI= 0.96–0.99)	•The air pollution index based on main bus for the bus drivers showed no positive correlation with risk of bladder or lung cancer •Study showed decreasing risk for lung cancer with increasing years of employment as a bus driver
(Brüske-Hohlfeld et al., 1999)	Truck drivers and other heavy equipment operators (n=7039)	Case-Control Study	•increased risk of lung cancer only in West Germany (OR=1.44, 95%-CI: 1.18–1.76), but not in East Germany (OR=0.83, 95%-CI: 0.60–1.14) in professional drivers (e.g., trucks, buses, and taxis)	•Study showed increased risk of lung cancer for all jobs with exposure to DME •The number of vehicles with diesel engines per km-sq was about five times higher in West Germany. Also professional drivers in West Germany covered more miles, and were probably more heavily exposed to DME than their colleagues in East Germany

## Discussion:

**Findings:**

- The structured review found 8 relevant articles. These articles are all in consensus that exposure to diesel exhaust increases the risk of lung cancers and cardiovascular disease for truck drivers
- It was also found that other occupations, such as bus drivers, do not face the same risk ratios and mortality rates. This is most likely because truck drivers face the highest duration of exposure.
- Confounders such as smoking and dietary habits were not found to be significant to explain the excess risks found, thereby solidifying the association with diesel exhaust.
- Our results are in agreement with the knowledge of the carcinogenic potential of exposure to diesel exhaust. The results were expected as it is common knowledge that diesel pollutants are harmful to human health, and are expected due to the studied toxicity of the pollutants found in diesel exhaust.

**Limitations:**

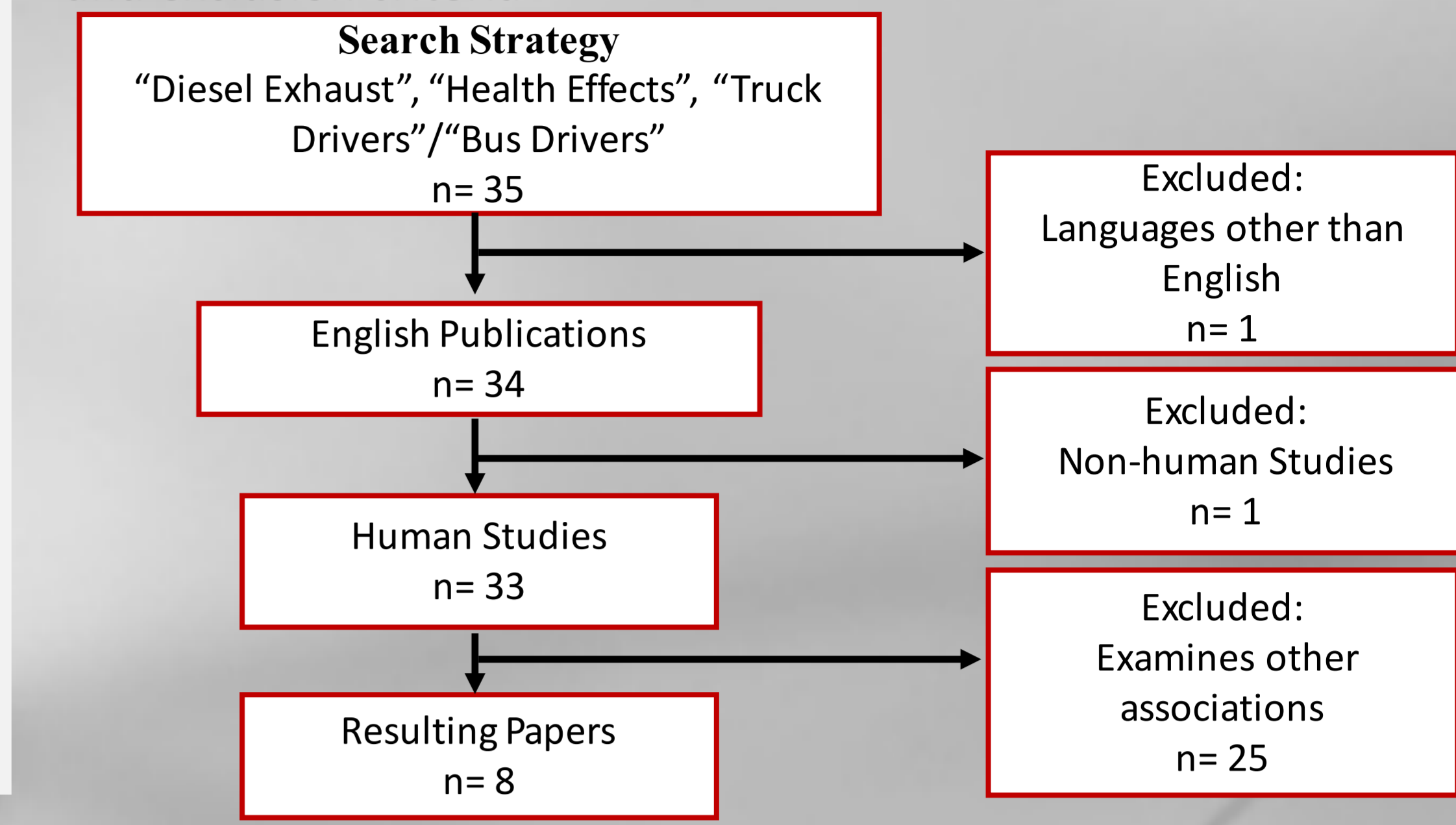
- Limitations of our study include the inability to examine studies in other languages, especially due to the increased use of diesel in European countries.
- We are also limited to the accessibility research papers by needing full free texts.
- Search terms limited results due to constraining by keyword

**Implications for the Future:**

- With the news of electric trucks coming soon, the research on current health problems can be used as a baseline to assess the positive financial and health benefits of moving to electric trucks.
- Addition of additives to diesel fuels, and continued optimization of diesel motors to improve efficiency and reduce emissions can be assessed to see the increase or decrease in adverse health effects

## Results:

**Figure 1. Results from search strategy and filtering with inclusion and exclusion criteria**



## Conclusion:

In conclusion, exposure to diesel exhaust among truck drivers is positively associated with increased cases of lung cancer and cardiovascular disease when compared to a non-exposure reference group of similar ages. This association is especially strong in long-haul truck drivers, but there is no evidence to support the claim that bus and taxi drivers face the same risks as truck drivers.

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