La Medicina del Lavoro

Original article

Med. Lav. 2025; 116 (5): 17014
DOI: 10.23749/mdl.v116i5.17014

Occupational-Related Exposure to Diesel Exhaust and Kidney Cancer: Systematic Review and Meta-Analysis of Cohort Studies

SUPPLEMENTARY MATERIAL

Table S1. Characteristics of common occupational diesel exposure.

Occupational activities	Exposure scenarios	Particle characteristics	Composition
Maintenance shops for railroads and trucks	Briefly move vehicles in/out of shop; emissions into confined space; slow removal by ventilation	High agglomeration; considerably reduced nuclei and surface area; most in accumulation mode	Lower EC and very high OC from lubricating oils
Railroad operations and exposures of crews	Emissions into the environment by leading locomotive(s); exposure intensity defined by downwind proximity to source	Low agglomeration Idling: high nuclei level and PM Steady speed: low/no nuclei, reduced surface.	Higher EC and very high OC Moderate EC and lower OC from lubricating oils
Underground mining	Exposure intensity defined by proximity to vehicles – haulage trucks, loaders; and fixed engines – generators, large equipment; moderate to fast removal by ventilation	High agglomeration; no nuclei and lower surface area	Higher EC and lower OC from lubricating oils
Above-ground mining	Brief exposure to occasional exhaust from preceding trucks or nearby heavy equipment	Idle: high nuclei level and PM Steady speed: up-hill, low nuclei and low hydrocarbons Down-hill, high, nuclei and high hydrocarbons	High EC and OC High EC and low OC High EC and OC
City driving	Exposure from preceding vehicles depends on traffic density and proximity	Moderate agglomeration; Idle and high acceleration: high nuclei level and PM Steady speed: low nuclei and accumulation mode (depends on proximity).	High EC and OC Moderate EC and low OC
Highway driving	Exposure from preceding vehicles depends on traffic density and proximity	Low agglomeration; low nuclei and accumulation mode (depends on proximity)	High EC and low OC

Ref [1] IARC 2012, Table 1.13

Table S2. PRISMA checklist.

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	2
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	2
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	3
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	3
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	3
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	3
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	3
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	3
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	3
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	3,4
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	3
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	3
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	NA
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	3
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	3,4
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	3,4

Section and Topic	Item #	Checklist item	Location where item is reported
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	NA
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	NA
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	NA
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	11
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	11
Study characteristics	17	Cite each included study and present its characteristics.	6-10
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	NA
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	12
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	NA
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	11, 12
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	4
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	NA
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	NA
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	NA
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	12-14
	23b	Discuss any limitations of the evidence included in the review.	14,15
	23c	Discuss any limitations of the review processes used.	14,15
	23d	Discuss implications of the results for practice, policy, and future research.	15
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	2
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	2
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	NA
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	16
Competing interests	26	Declare any competing interests of review authors.	16
Availability of	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included	16

Section and Topic	Item #	Checklist item	Location where item is reported
data, code and other materials		studies; data used for all analyses; analytic code; any other materials used in the review.	

Table S3. Modified version of the Critical Appraisal Skills Program (CASP) checklist for cohort studies adopted for quality assessment.

Items	Possible scores
Section A: Are the results of the study valid?	
1. Did the study address a clearly focused issue?	- 1.5 - 1.0 - 0.0
2. Was the cohort recruited in an acceptable way?	- 1.5 - 1.0 - 0.0
3. Was the exposure accurately measured to minimize bias?	- 1.0 - 0.5 - 0.0
4. Was the outcome accurately measured to minimize bias?	- 1.0 - 0.5 - 0.0
5.(a) Have the authors identified all important confounding factors?	- 1.0 - 0.5 - 0.0
5.(b) Have they take account of the confounding factors in the design and/or analysis?	- 1.0 - 0.5 - 0.0
6.(a) Was the follow up of subjects complete enough?	- 1.0 - 0.5 - 0.0
6. (b) Was the follow up of subjects long enough?	- 1.0 - 0.5 - 0.0
Section B: What are the results?	
7. What are the results of this study?	Excluded
8. How precise are the results?	- 1.0 - 0.5 - 0.0
9. Do you believe the results?	- 1.0 - 0.5 - 0.0
Section C: Will the results help locally?	
10. Can the results be applied to the local population?	- 1.0 - 0.5 - 0.0
11. Do the results of this study fit with other available evidence?	- 1.0 - 0.5 - 0.0
12. What are the implications of this study for practice?	- 1.0 - 0.5 - 0.0

For each item, scores were assigned according to researchers' consideration of the quality of the content (higher score means higher quality).

Table S4. Quality assessment of the included studies according to the Critical Appraisal Skills Programme (CASP) score.

Reference	CASP score
Bender et al., 1989 [27]	L
Birdsey et al., 2010 [24]	L
Boffetta et al., 2001 [6]	H
Guo et al., 2004 [7]	H
Gustavsson et al., 1990 [21]	L
Howe et al., 1983 [28]	L
Jarvholm & Silverman, 2003 [18]	H
Koutros et al., 2020 (17)	H
Nokso-Koivisto & Pukkala, 1994 [26]	L
Pukkala et al., 2009 [3]	H
Raffnson & Gunnarsdòttir, 1991 [23]	L
Schenker et al., 1984 [25]	L
Soll-Johanning et al., 1998 [22]	L
Van Den Eeden & Friedman, 1993 [20]	H
Wong et al., 1985 [19]	L

Note: Low- and medium-low-quality studies are indicated as "L"; medium-high- and high-quality studies are indicated as "H".

Figure S1. Flow diagram of the study selection process.

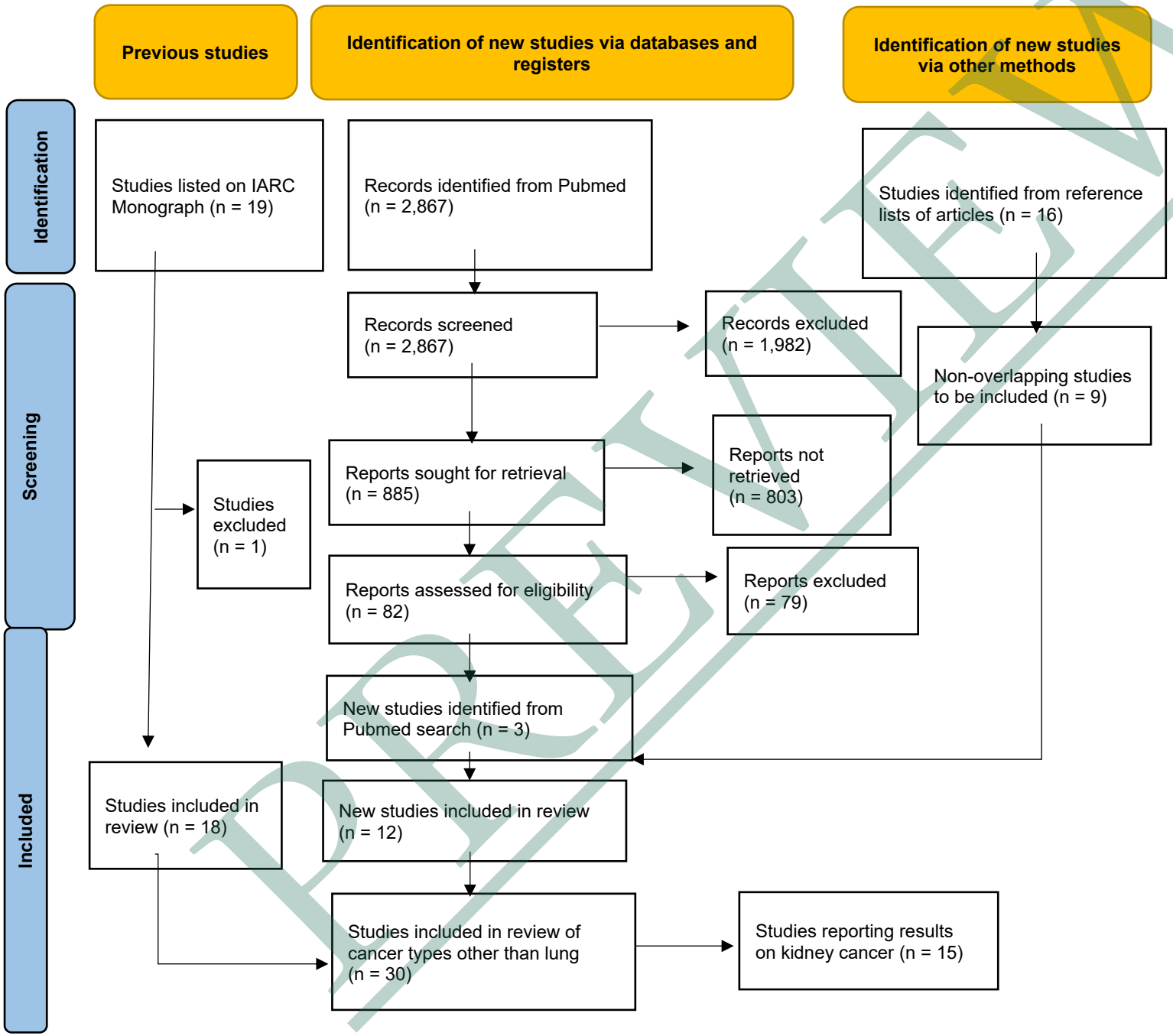

Figure S2. Scatter plot of unweighted correlation coefficients between risk of lung and kidney cancers of the 16 studies reporting them.