SWEDISH AGENCY FOR HEALTH TECHNOLOGY ASSESSMENT AND ASSESSMENT OF SOCIAL SERVICES

English Summary

# Occupational Exposures and Chronic Obstructive Pulmonary Disease (COPD)

## A systematic review

March 2025. The full report in Swedish (www.sbu.se/388)

## Main message

Research shows that there is an association between occupational exposure to airborne substances and increased occurrence of chronic obstructive pulmonary disease (COPD).

## Conclusions

After reviewing the scientific literature, SBU draws the following conclusions:

- There is a positive association between occupational exposure to *inorganic dust*, *organic dust*, *unspecified dust*, and *vapours*, *gases or fumes* and COPD.
- The scientific evidence regarding *pesticides* in working environment is insufficient to determine a link with COPD. Further research is needed.

## Aim

The purpose of this systematic review was to evaluate the scientific support regarding the association between airborne occupational exposures and COPD. We grouped exposures into five exposure categories: inorganic dust (e.g. stone dust); organic dust (e.g. wood dust); unspecified dust; vapours, gases or fumes; and pesticides.

## Background

It is estimated that COPD is the third leading cause of death globally, and that between 7 and 10 percent of the world's population have the disease. COPD is characterized by a respiratory airflow limitation that is not fully reversible, and which often worsens with time. Diagnosis is mainly based on clinical symptoms in combination with airflow obstruction measured by spirometry and an associated history of exposure to tobacco smoke or other noxious particles and gases. Tobacco smoking is the most common cause of COPD, but factors in for example occupational environment have been shown to relate to the development of COPD. However, the understanding of the relationship is incomplete, especially regarding the role of different types of exposure agents.

Occupational exposure can be assessed by objective technical measurements of levels of airborne agents in a specific working environment or using a quantitative job exposure matrix (JEM). A JEM links levels of exposure for each occupation into exposure categories and can be a useful tool to assess exposure in large groups of participants. Levels of exposure can also be collected though self-reports from study participants, or from expert opinion.

## Method

We conducted a systematic review and reported it in accordance with the PRISMA statement. The protocol was registered in Prospero (CRD42023437701). The certainty of evidence was assessed with GRADE.

### Inclusion criteria (PECO)

**Population:** Occupationally exposed women and men.

**Exposures:** To be included, studies needed to have the exposure assessed. Either with an objective measure of levels of airborne agents, using a JEM, or self-reported occupational exposures.

**Comparison:** We included comparisons between relevant occupational exposures and the outcome either as exposed versus unexposed groups, or high- versus low-levels of exposure. Comparisons between different exposures were not included.

**Outcome:** COPD diagnosed by physician or through relevant proxy measures. Outcomes could be from clinical assessment, hospital registries or be self-reported. Relevant proxies for COPD were spirometry-assessed thresholds $FEV_1/FVC<0.7$ or less than the lower limit of normal (LLN).

**Setting:** Studies examining occupational exposures and COPD in middle- and high-income countries.

**Study design:** Controlled studies (with and without randomisation), retrospective and prospective cohort studies (longitudinal designs), case-control studies, cross-sectional studies.

**Language:** English, Swedish, Norwegian, Danish.

**Databases searched:** Cochrane Library, Embase and MEDLINE

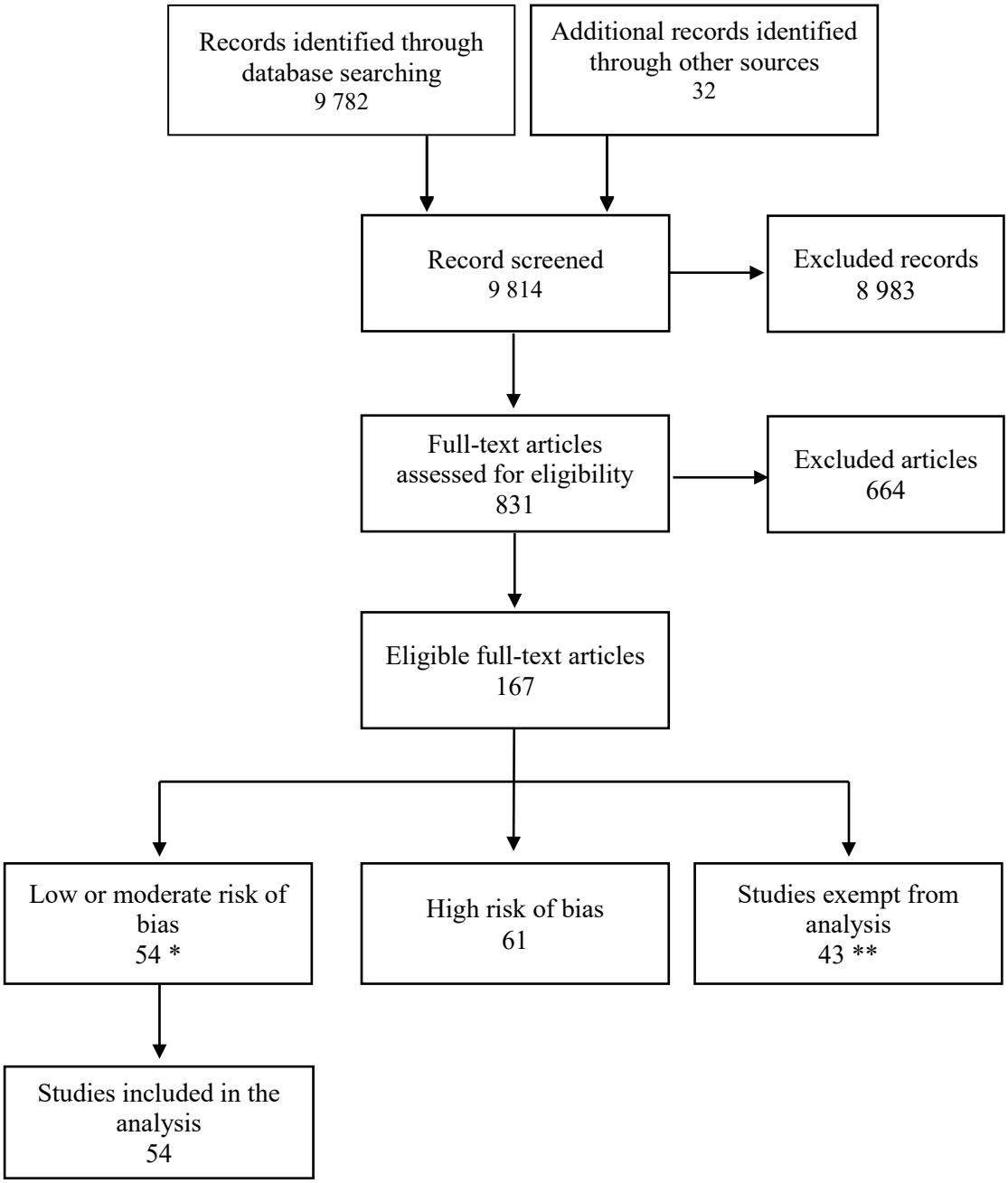
**Other criteria:** Peer-reviewed studies published 2001 or later with at least 100 participants were included. Studies examining indirect exposure to tobacco smoke were not included, nor were studies without data on smoking. Studies not relevant for working conditions in Sweden were not included. Studies had to control for participants' sex, age and tobacco smoking habits. Risk of bias assessed using the Assessment of Studies of exposure tool in Swedish (www.sbu.se/). Only studies with low or moderate risk of bias were included in the analysis.

**Patient involvement:** No.

## Results

We included 54 relevant studies conducted in high- and middle-income countries and published in scientific journals from 2001 onwards (Figure 1). Our analyses show positive and significant associations between COPD and exposure in occupational environment (for the exposure categories inorganic, organic, and unspecified dusts, as well as vapours, gases, or fumes). The evidence was not sufficient to determine whether exposure to pesticides is associated with COPD. For a summary of results and GRADE assessments, see Table 1. For detailed analyses, including moderator and sensitivity analyses as well as analyses of publication bias, see Appendix 8.

**Figure 1** Flowchart.




*Results from the 54 studies included in the analysis were reported in 63 articles.
**Studies only reporting composite measures more broadly defined than the categories used for analysis, such as the composite measure VGDF (exposure to vapours, gases, dust or fumes) were not included in the analysis. Studies investigating the association between exposure to diacetyl and bronchiolitis obliterans were also not included in the analysis. The risk of bias was not assessed for these studies.

**Table 1** Summary of findings (main results) for the association between occupational exposures and COPD.

| Exposure category | # of studies<br># of participants | GRADE | Interpretation |
|---|---|---|---|
| Inorganic dust | 35 studies<br>n=206 951 | ⊕⊕⊕◯[1] | There is a positive association between exposure and COPD |
| Organic dust | 26 studies<br>n=197 978 | ⊕⊕⊕◯[1] | There is a positive association between exposure and COPD |
| Unspecified dust | 15 studies<br>n=279 274 | ⊕⊕⊕◯[1] | There is a positive association between exposure and COPD |
| Vapours, gases or fumes | 32 studies<br>n=294 185 | ⊕⊕⊕◯[1] | There is a positive association between exposure and COPD |
| Pesticides | 7 studies<br>n=104 294 | ⊕◯◯◯[2] | Not possible to ascertain |

**Notes:**
⊕⊕⊕◯ = Moderately strong scientific evidence
⊕◯◯◯ = Insufficient scientific evidence
[1] Downgraded –1 Risk of bias.
[2] Downgraded –1 Risk of bias, –1 precision, –1 heterogeneity.

## Discussion

This systematic review demonstrates that occupational exposure to inorganic, organic and unspecified dust, as well as vapours, gases, or fumes is associated with increased occurrence of COPD after adjusting for tobacco smoking. These updated findings are in line with previous reviews.

We included studies that examined physician-diagnosed COPD as well as those that reported spirometrically assessed airway obstruction as a proxy for COPD. The analyses are more robust due to the added data, but the results are arguably somewhat less clinically relevant, as not all individuals with airway obstruction have a clinically relevant disease.

The knowledge provided by this systematic review highlights the need to investigate occupational exposures as a potential cause for COPD in patients, as well as the importance of reducing exposure to airborne agents in the workplace.

Due to our use of five broad categories of occupational exposure, it was possible to conduct meta-analyses of the overall association of work exposure and COPD. Furthermore, by including studies conducted in many countries and different work settings (e.g. mining, metallurgy, farming, transport), our results have considerable generalisability. Future systematic reviews should make more refined analyses of specific exposure agents and investigate the effect of different levels of exposure.

## Conflict of Interest

In accordance with SBU's requirements, the experts and scientific reviewers participating in this project have submitted statements about conflicts of interest. These documents are available at SBU's secretariat. SBU has determined that the conditions described in the submissions are compatible with SBU's requirements for objectivity and impartiality.

## Appendices

- Appendix 1 Search strategies (pdf)
- Appendix 2 Excluded studies (excel)
- Appendix 3 References exempt from analysis (pdf)
- Appendix 4 Studies with critical or high risk of bias (pdf)
- Appendix 5 Risk of bias (excel)
- Appendix 6 Characteristics of included studies (excel)
- Appendix 7 Categorisation of exposures (excel)
- Appendix 8 Analyses (pdf)