Indoor dust microbiota composition and allergic diseases: a scoping review to construct a reusable DAG

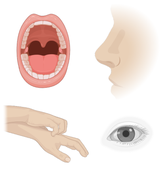
Javier Mancilla Galindo, Inge M. Wouters, Lidwien A.M. Smit, Alex Bossers
One Health Epidemiology Microbial Agents, Population Health Sciences,
Institute for Risk Assessment Sciences, Utrecht University

Background

Allergy is an exaggerated immune response against predominantly environmental or other exogenous antigens.[2]

Prevalence Allergic Diseases[1]
Asthma: 3.42% (95%CI: 2.98 – 3.91)
Atopic dermatitis: 1.69% (95%CI: 1.62– 1.76)

Different microbes can promote or protect from allergies as a result of complex immunologic, genetic, and environmental interactions.[3]



Indoor dust particles are an important source of exposure to microbes since humans spend up to 90% of their time indoors.[4]

1. Ferrari A, et al. *Lancet;* 2024; 403(10440): 2133-2161.
2. Cruz RH, et al. *Allergol Immunopathol;* 2023; 51: 16–21.
3. Kelly MS, et al. *J Allergy Clin Immunol Pract;* 2022; 10: 2206-2217.e1.
4. Shan Y, et al. *Int Microbiol* International Microbiology; 2019; 22: 297–304.

Research Question

What environmental determinants and outcomes have been studied in association with the indoor dust microbiome and what methods for the identification of variables for controlling of confounding have been applied for this purpose?

Objectives

1. Describe the methods and topics studied in association with the indoor dust microbiome in the existing literature
2. Classify studies according to the method for controlling of confounding applied
3. Construct an evidence-synthesis directed acyclic graph (DAG)[5] indoor dust microbiome → allergies

5. Ferguson KD, et al. *Int J Epidemiol.* 2020;49;322-29

Methods

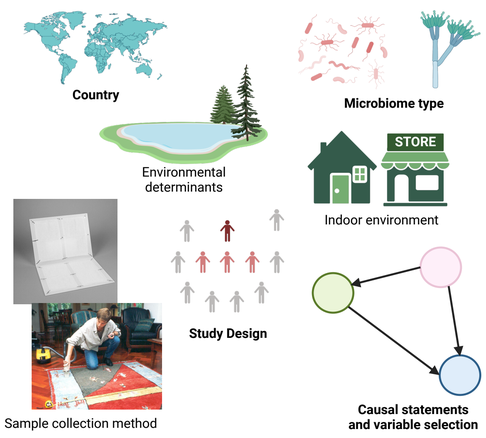
Search Strategy

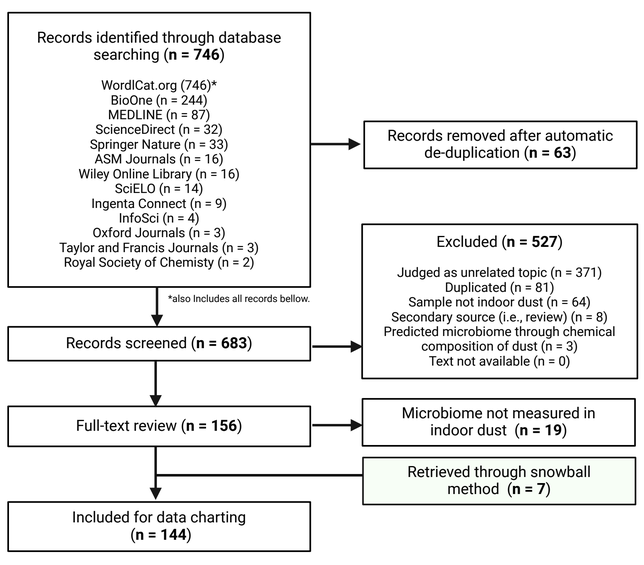
- WorldCat.org and SciELO
- Keywords:

kw:(dust) AND kw:(indoor OR dwelling OR house OR household OR residence OR store OR mall OR hospital OR workplace OR office OR school OR university OR sport OR closed environment) AND kw:(microbiota OR microbiome OR microbial community OR virome)

- initial (08-03-2023), updated: 15-09-2023 and 30-01-2024
- English and Spanish
- 2000-2024

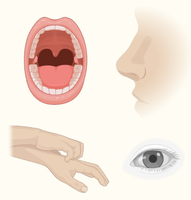
Data extraction





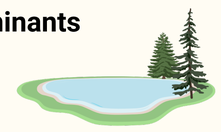
Results

Variables studied in association with the indoor dust microbiome
n=144 studies

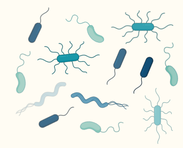


Allergies
28.5% (n = 41)

Environmental Determinants
80.6% (n = 116)

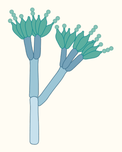


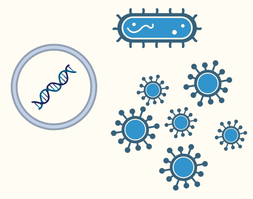
Microbiome Type



Bacterial
88.9% (n = 128)

Fungal
57.6% (n = 83)





Other
6.9% (n = 10)

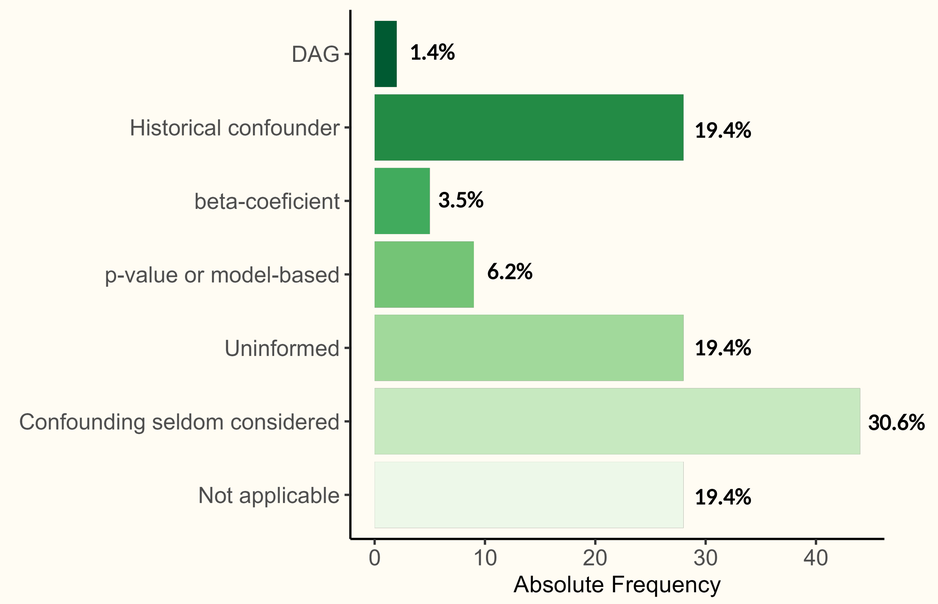


Figure 1. Classification of variable selection in studies included in the review (n= 144). Not applicable refers to those studies using randomization or not making causal statements.

Mapping

23 studies selected
- Exposure: indoor dust microbiome
- Outcome: any allergy

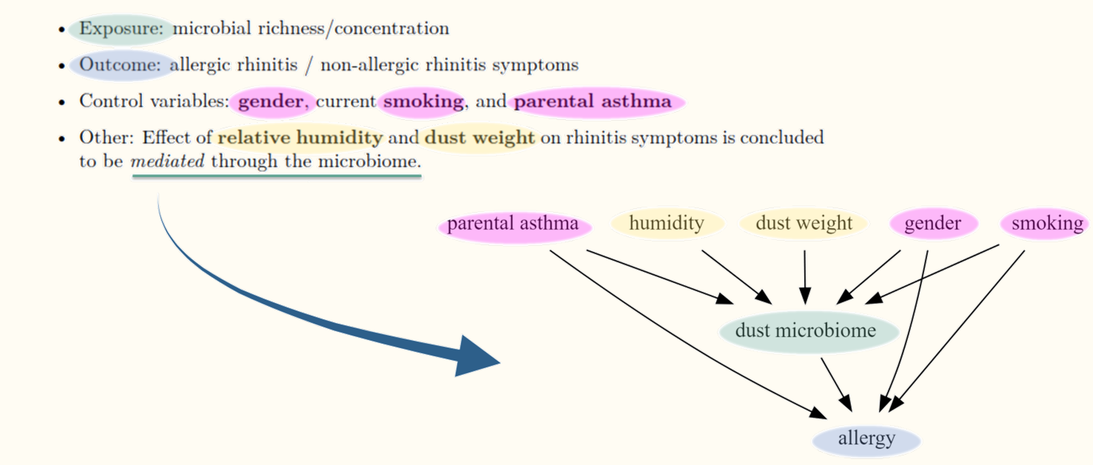


Figure 2. Example of mapping procedure of a single study into an implied graph. A total of 23 implied graphs will be constructed in order to synthesize them into a reusable directed acyclic graph.

Conclusions and Outlook

- Directed acyclic graphs (DAG), which are the preferred method for identification of variables to control for in observational studies, have been underused in studies of the indoor dust microbiome making causal statements.
- The construction of well-documented, reusable, and adaptable DAG may increase the use of this method in studies of the indoor dust microbiome, for which mediation analysis may be of particular interest.

More resources about DAGs:
https://dagitty.net https://cbdrh.shinyapps.io/daggle/