Estimating and Valuing Asthma Impacts of Formaldehyde Exposure to Improve Decision-Making

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The Navigation Guide: Systematic & transparent method to evaluate environmental health evidence to support evidence-based health and policy recommendations

Study Question & PECO Statement

Is exposure to formaldehyde associated with diagnosis, signs, symptoms, exacerbation, or other measures of asthma in humans?

Outcome
Confounding
Incomplete
COI Other

Population: Humans
Exposure: Indoor/outdoor inhalation exposure to formaldehyde prior or concurrent to evaluation of asthma
Comparator: Humans exposed to lower levels of formaldehyde than more highly exposed humans
Outcome: Diagnosis of asthma, asthma signs or symptoms, asthma exacerbation (requiring systemic treatment), or indirect measures of asthma

4,482 unique records searching databases & grey literature
904 full-text articles screened
149 studies included
4 studies identified from snowball searching and consulting experts
153 total studies included

4.828 unique records searching databases & grey literature
904 full-text articles screened
149 studies included
4 studies identified from snowball searching and consulting experts
153 total studies included

Systematic Search & Study Selection

Results

- Identified 150 studies relevant to asthma and asthma-related outcomes (wheezing, breathlessness, pulmonary functions, etc.) [Fig 1]
- Included studies overall had low risk of bias concerns [Fig 2]. Potential biases were related to knowledge of group assignments (i.e., blinding) or source population representation (i.e., selection bias)
- 11 studies of asthma diagnosis in children were combinable in a meta-analysis, most with overall low risk of bias [Fig 3]
- We estimated an 8% increase in asthma per 10-fold increase in indoor formaldehyde exposure for children [Table 1]
- Data not amenable to meta-analysis were visually displayed in scatterplots, such as for childhood asthma symptoms [Fig 4]

Background

- Formaldehyde is widely prevalent in household building materials
- Formaldehyde is classified as a carcinogen and acute exposure can cause eye, nose, throat and skin irritation

Significance

- Recent EPA regulations (2016) fail to account for asthma outcomes in benefit-cost evaluations, weakening justification for more stringent exposure limits

Next Steps

- Complete quantitative evaluation of data deemed not combinable in a meta-analysis to incorporate data into final rating decisions
- Finalize overall quality/strength ratings for the body of evidence by outcome, separately for children, adults and occupational exposures

Conclusions

- 8% increase in children’s asthma diagnosis per 10-fold increase in indoor exposure
- A policy reducing indoor formaldehyde exposure by 10 μg/m³ could be worth up to $717,000/year per 100,000 children, from reduced diagnoses of asthma
- Use of more robust search methods identified a larger group of studies compared to previous reviews
- Reporting standards and consistent reporting of results would increase the utility of study results in systematic reviews
- Systematic review methods are a powerful tool to support prevention-oriented decisions to efficiently summarize the scientific knowledge and create simple, bottom-line messages regarding the toxicity of environmental chemicals

Figure 1. Prisma diagram for screening relevant studies

Figure 2. Risk of bias results for meta-analysis studies

Table 1. Meta-analysis results for children and asthma diagnosis

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<tr>
<th>Outcome</th>
<th>Number of studies</th>
<th>OR (95% CI) per 10 μg/m³ increase</th>
<th>p (%)</th>
<th>HR (95% CI)</th>
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<td>Asthma</td>
<td>11</td>
<td>1.17 (1.01, 1.35)</td>
<td>0.02</td>
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<td>Indoor</td>
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<td>0.004</td>
<td>1.04 (0.81, 1.33)</td>
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<tr>
<td>Ambient</td>
<td>3</td>
<td>2.27 (1.26, 4.09)</td>
<td>0.01</td>
<td>1.03 (0.42, 2.56)</td>
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Figure 3. Risk of bias results across all studies

Figure 4. Scatterplot of childhood asthma symptoms

*An economic analysis used to quantify the benefit of a reduction in chemical exposure, based on the maximum dollar amount taken from an individual in exchange for reducing their exposure level

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