National Collaborating Centre for Environmental Health

Centre de collaboration nationale en santé environnementale

JANUARY 2015

Summary: Review of Indoor Air Interventions

Background

Canadians typically spend about 90% of their time indoors. Poor indoor air quality (IAQ) resulting from biological and chemical exposures is associated with the development of acute and chronic cardio-respiratory disease. Biological agents commonly found in indoor environments include mould, house dust mites (HDM), pests, and pet dander. Chemical agents can include environmental tobacco smoke (ETS), asbestos, lead, pesticides, inhalable particulate matter (PM), and gases such as nitrogen dioxide and formaldehyde. Building conditions, including heating and ventilation and outdoor sources also influence IAQ.

Purpose

This document summarizes a student evidence review of literature concerning indoor air interventions in residences and public buildings that were shown to be effective in improving IAQ and health. The topics of mould and radon remediation were excluded as they were covered in recent NCCEH reviews.

Findings

Policy-based interventions

Population-level interventions include policies, public sector regulations and mass media campaigns. Smoke-free policies, such as bans on smoking in indoor public spaces, have resulted in improvement in IAQ, along with improvement in respiratory and cardiovascular health.

Community-level interventions

Such interventions address issues common to a group of individuals (community) that share similar characteristics or reside in a common geographic area.

Control of House Dust Mites

Reductions in HDM exposure and associated improvement in respiratory symptoms have been demonstrated with a combination of measures to reduce HDM, such as using allergen-impermeable pillow and mattress covers, washing bedding in hot water, removing carpets, and applying acaricides. Applying only one type of intervention, such as using impermeable bed covers, was not found to be effective.

Integrated Pest Management

A combination of strategies aims to prevent, manage, and treat pest infestations as well as eliminate the use of toxic pesticides. For example, an intervention in homes of asthmatic children sensitized to mouse allergen consisted of filling holes and cracks to remove rodent access points; placing traps throughout the home; educating the family about kitchen cleaning and food storage; and use of high efficiency particulate air (HEPA) vacuum cleaner and HEPA air filter in the child's bedroom. This intervention resulted in a reduction of mouse allergens and was associated with fewer missed school days, less sleep disruption, and reduced caretaker burden but was not associated with any reduction in children's asthma symptoms or medical utilization.

Air Filtration

High efficiency particulate air (HEPA) filters improve IAQ by reducing exposure to particulate matter. Interventions using portable room air cleaners targeting ETS have been consistently shown to reduce PM, improve lung function, extend symptom-free days, and reduce unscheduled asthma-related medical visits. Interventions of HEPA-filtered air in an individual's sleep breathing zone reduced levels of allergen-sized particles and improved symptoms and quality of life scores in asthmatic and allergic patients.

Replacing Heaters

Replacement of inefficient heating units in homes and schools, although costly, can reduce asthma morbidity. For example, after replacing unflued gas heaters with flued gas or electric heaters in schools, NO_2 levels were reduced and the children exhibited fewer symptoms, but no improvements in lung function were shown.

Multi-faceted Interventions

Multiple pollutants or triggers are targeted through a variety of strategies. The most commonly targeted indoor pollutants are house dust mites, cockroaches, mould, and mouse, cat, and dog allergens. A summation of 20 studies of multi-faceted interventions involving children and adolescents found average reductions in symptom days by 0.8 days per two weeks and missed school days by 12.3 days per year. Outcomes for the adult population were inconclusive. In addition to the costs involved, implementing multi-faceted environmental interventions may not be acceptable to subjects, contributing to poor compliance.

Gaps In Research, Policy, and Knowledge

There is the need for further study to address the following limitations regarding effectiveness of specific indoor air interventions, or combined intervention approaches, in improving health.

- Limited evidence related to study design: Improvements in study design such as randomization of subjects, double-blinding, and use of placebos, would help to minimize bias and confounding. With short follow-up time, typically of a few weeks to a year, it is unknown if compliance is sustained and whether exposure and associated health effects are reduced over the long term as determined by a longitudinal study. Many IAQ interventions are small in sample size and target allergic and asthmatic populations, who are more likely to show improvements in health. At issue is the generalizability of findings to the general population.

- Exposure misclassification: Errors in exposure ascertainment may result from non-comprehensive sampling strategies that consider only one place of exposure, usually the home. More evidence is needed concerning the contribution to IAQ of non-home settings, such as schools and public buildings.

- Exposure to infectious agents: No studies to date have assessed ventilation and air filtration interventions for control of infectious biological agents in non-hospital settings.

- Cost-benefit: Only a few intervention studies provide cost-benefit or cost-effectiveness analyses; this limits translation of evidence into policy and program development.

Conclusion

Canadians spend a majority of their time indoors exposed to chemical and biological air contaminants that can pose health risks. Interventions ranging from population-level policies to remediation measures in the home can be implemented to improve IAQ and health. HEPA filtration is particularly effective in reducing particulate matter. Multi-faceted interventions can have the greatest cost-benefit impact, with improved asthma morbidity, but are often impractical due to cost considerations and compliance issues for the general population.

This summary is based on a student evidence review written by University of British Columbia Bridge Program Fellow, Ther Aung, entitled “Review of Indoor Air Interventions.” This document was produced by the National Collaborating Centre for Environmental Health at the British Columbia Centre for Disease Control, January 2015.

Production of this document has been made possible through a financial contribution from the Public Health Agency of Canada through the National Collaborating Centre for Environmental Health.

ISBN: 978-1-926933-78-8

200 – 601 West Broadway
Vancouver, BC V5Z 4C2

Tel.: 604-829-2551
contact@ncceh.ca

National Collaborating Centre for Environmental Health

Centre de collaboration nationale en santé environnementale

To provide feedback on this document, please visit http://www.ncceh.ca/forms/feedback-form