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Zaatari M, Novoselac A, Siegel JA. 2016. Impact of ventilation and filtration strategies on energy consumption and exposures in retail stores. *Building and Environment*, **100**, 186-196.
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Abstract

Particle filtration systems are widely used indoors to Different ventilation strategies can have an enormous impact on both exposures to contaminants of concern (COCs) and energy use in retail buildings. We applied a multi-contaminant model of an area-normalized retail store, and developed estimates for distributions of model inputs. We then used these distributions in a Monte Carlo simulation for six cities to compare the impacts of the ASHRAE 62.1–2013 ventilation rate procedure (VRP), demand controlled ventilation (DCV), and indoor air quality procedure (IAQP), with or without using a high particulate efficiency filter. Results showed that for cities where outdoor $PM_{2.5}$ concentration is low, adopting the IAQP with low efficiency $PM_{2.5}$ filter in grocery stores and the VRP with high $PM_{2.5}$ efficiency in non-grocery stores yielded the greatest exposure benefits. For cities with high outdoor $PM_{2.5}$ concentration, adopting the VRP with high $PM_{2.5}$ efficiency for all store types yielded the greatest exposure benefits. However, these exposure benefits also caused an increase in energy consumption, and the magnitude depends on the city's climate, outdoor $PM_{2.5}$ concentration and the retail store type. We propose a new pollutant exposure control ventilation (PECV) strategy, where ventilation rates are weighed against exposure to different COCs, and the ventilation rate that is most climatically advantageous is chosen.

Highlights

- Impact of ventilation and filtration on **energy** and **air quality** in stores was modeled.
- Exposure benefits depended on **ventilation strategy**, **city**, and **retail type**.
- Exposure benefits translated into an **increase of energy consumption**.
- A **superior ventilation strategy** that is retail type and climate specific was proposed.

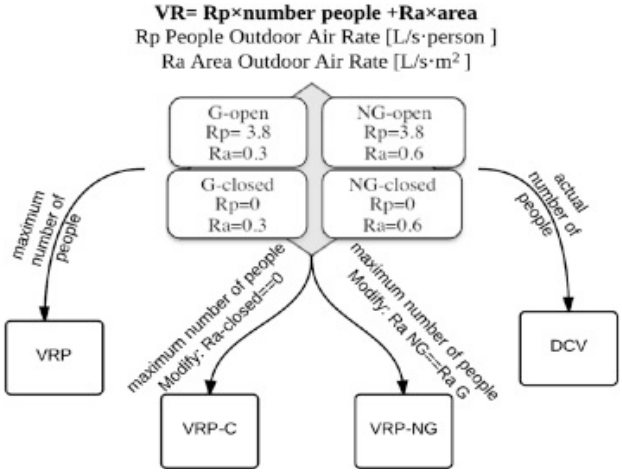

Figure 1. Summary of ventilation scenarios for grocery stores (designated as G), and non-grocery stores (designated as NG). VRP: ventilation rate procedure, DCV: demand control ventilation. VRP-C differs from the VRP by setting the ventilation rate zero at night.

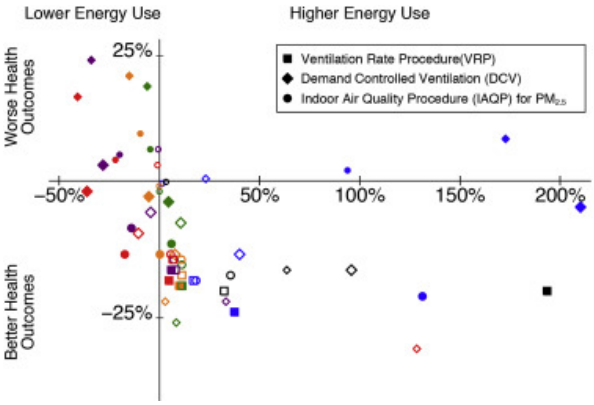

Figure 8. Changes in energy use (x-axis) vs. changes in disability-adjusted life years lost (y-axis) for simulated stores. In the figure, color indicates city (red = Austin, blue = Los Angeles, green = Minneapolis, orange = Philadelphia, purple = Phoenix, black = Seattle), hollow symbols are grocery stores, filled symbols are non-grocery stores, and symbol size indicates filter efficiency (small = MERV 8, large = MERV 13). MERV = minimum efficiency reporting value.

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