

TITLE

A ventilation intervention study in classrooms to improve indoor air quality: the FRESH study**AUTHOR(S)**

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ABSTRACTBackground:

Children spend a great deal of time at school, and in the U.S. nearly one in 10 school-aged children have asthma. Schools are four times more densely occupied than offices, yet they are not required to meet certain federal standards of maintenance. Indoor air pollution at school has been linked to increased asthma and upper respiratory symptoms, as well as increased absenteeism and decreased school performance. A U.S. Government Accounting Office report stated that at least 60% of U.S. schools need to correct an environmental problem such as poor ventilation or heating. Inadequate ventilation can increase indoor pollutant levels by not bringing in enough outdoor air to dilute emissions from indoor sources and by not carrying indoor air pollutants out of the residence or facility. Indoor air pollution sources include building materials, carpets, and furnishings such as asbestos-containing insulation and cabinetry or furniture made of certain pressed wood products; products for cleaning and maintenance or arts and crafts or hobbies; central heating and cooling systems and humidification devices; and outdoor sources such as radon, pesticides, and outdoor air pollution. Carbon dioxide (CO₂) measurements are commonly used as a proxy for concentrations of an array of other indoor pollutants, and thus as a screening test of indoor air quality and the amount of ventilation in a particular setting. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has developed ventilation guidelines for different types of facilities and rooms and recommends that indoor CO₂ concentrations be maintained at or below 1,000 ppm in schools. States may suggest or set a different threshold. For instance, the Pennsylvania Department of Health states that CO₂ levels above 700 parts per million (ppm) indicate inadequate ventilation with outdoor air. Maintaining healthy classroom environments should be paramount as poor indoor air quality can influence both children's health and performance.

Objective:

As part of the FRESH study (Forced-ventilation Related Environmental School Health) researchers investigated whether an intervention can be used to improve classroom indoor air quality by increasing classroom ventilation and whether this intervention affects children's cognitive performance and/or respiratory health. The purpose of the article highlighted here was to focus on the performance of the ventilation system in terms of achieved classroom CO₂ concentrations. A separate article will publish findings on the students' cognitive performance and respiratory health.

Methods:

A total of 18 (6 control and 12 intervention) 7th grade classrooms from the north and north-eastern regions of The Netherlands were studied during two consecutive heating seasons (October-April) of 2010-2011 and 2011-2012. Measurements of CO₂ were taken over 3 consecutive weeks. The first week served as the baseline sampling period with measurements of normally existing CO₂ levels and ventilation according to the teachers' own preference. In the following two weeks, in the 12 intervention classrooms, the concentrations of CO₂ were maintained at pre-set levels of 800 and 1200 ppm, established with a mechanical ventilation device. During these weeks, the teachers were asked not to ventilate the classroom by opening doors or windows. In the 6 schools that acted as the control group, no intervention on ventilation took place. In these classrooms, CO₂ levels were monitored and teachers were allowed to ventilate as they preferred. Temperature and relative humidity data were collected in addition to levels of CO₂. Statistical models were used to evaluate the effect of the intervention and to assess the differences between the two settings of the intervention (800 ppm and 1200 ppm).

Results:

At baseline, a mean CO₂ concentration for all schools was 1335 ppm (range: 763-2000 ppm). The intervention was significantly able to reduce CO₂ concentrations in the intervention group with mean decrease of 491 ppm. With the target set at 800 ppm, mean CO₂ was 841 ppm (range: 743-925 ppm); with the target set at 1200 ppm, mean CO₂ was 975 ppm (range: 887-1077 ppm).

Conclusion:

This study showed that while the controlled mechanical system was not able to precisely achieve the two predetermined levels of CO₂, it was effective in reducing classroom CO₂ levels.

POLICY IMPLICATIONS

This study showed that targeted mechanical ventilation interventions in classrooms can significantly reduce CO₂ concentrations and improve the IAQ in these settings. All schools need to have effective ventilation systems in place to improve students' health, development, attendance, and performance. Some U.S. states and local school districts have promulgated IAQ regulations or guidelines for schools, but no federal agency has broad authority concerning IAQ in indoor environments. Nonetheless, numerous federal agencies have some authority to control particular indoor pollutants or sources of pollution. For example, while EPA has authority under the Toxic Substances Control Act (TSCA) to study and issue safety guidelines for radon and lead-based paint hazards, the Consumer Product Safety Commission (CPSC) has authority to set emission limits for, and to restrict uses of, certain chemicals in consumer products. Improved coordination of federal efforts to address indoor pollution is necessary, but is complicated by the need to coordinate with local and state governments, as well as the need to address potentially overlapping jurisdictions and resources. States should continue working on establishing comprehensive IAQ guidelines and regulations for schools and child care facilities, and on implementing interventions such as that described in this study where necessary.

Note: While EPA does not regulate indoor air, the agency does offer resources to help schools improve their indoor air quality: [IAQ Tools for Schools Toolkit](#) and the [IAQ Tools for Schools Framework](#).

REFERENCE

[Article](#) available in [Environmental Health](#).

KEY WORD(S)

[Indoor Air Quality \(IAQ\)](#), [Asthma](#)