



Does Exposure to Bleach Cause or Help Prevent Childhood Infections?

A case study in interpreting population-based health effects research

By the Water Quality & Health Council

A short report in the journal [*Occupational & Environmental Medicine*](#) concludes passive exposure to weekly use of bleach in the home could promote some infections in school-age children. The report is poorly documented, highly speculative and although the researchers recommend exercising caution when interpreting their results, some in the media have erroneously interpreted the findings as definitive, with headlines such as: [“How cleaning with bleach can make children ill: Those living in super clean houses are 20% more likely to catch flu, tonsillitis and pneumonia.”](#)



Chlorine bleach is a time-tested and “go-to” household sanitizer and disinfectant. Does exposure to bleach actually make a child more susceptible to infections? Our reading of this study is that it lacks credibility based on its poor design.

The Study Findings

The researchers analyzed survey data collected from parents of over 9,000 school children in Spain, Finland and the Netherlands. Their objective was to examine any association between weekly bleach use and childhood infections including influenza, tonsillitis, sinusitis, otitis (inflammation of the ear) and bronchitis.

The researchers measured the association between the use of bleach for household cleaning and childhood infections by calculating the statistical parameter known as the “Relative Risk Ratio,” or “RRR” at the 95% confidence interval. An RRR value of “1” represents no additional risk from an exposure, but as risk rises, the RRR value increases. For example, an RRR value of 2 indicates that those exposed to the causative agent are twice as likely to become ill as those not exposed. An RRR value of 1.2 indicates a 20% increase in likelihood of disease in those exposed (in this case an infection in 1,800 of the roughly 9,000 children in the study). For perspective, the RRR for smoking and lung cancer ranges from 8 to more than 100.¹ In the current study, statistically significant associations between childhood infections and bleach use in the home were identified for:

¹ Reference: Pesch, B. et al (2012). Cigarette smoking and lung cancer—relative risk estimates for the major histological types from a pooled analysis of case-control studies. *Int. J. Cancer*, 131 (5): 1210-1219. On-line, available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3296911/pdf/nihms-336924.pdf>

- Influenza “only once,” (“only once” refers to one case of influenza in a child) (RRR=1.20, 95% Confidence Interval: 1.04 to 1.38)
- Recurrent tonsillitis (RRR=1.35, 95% Confidence Interval: 1.07 to 1.71)
- Any infection (RRR=1.18, 95% Confidence Interval: 1.01 to 1.38).

No association was reported for bleach use and the following infections: recurrent influenza, tonsillitis (“only once”), or any form of sinusitis, otitis, bronchitis or pneumonia. The researchers also found no statistical association between the use of bleach and asthma, rhinitis (inflammation of the mucous membrane of the nose) and cough.

Study Design Flaws

Several design flaws in the study prevent drawing conclusions. These include:

Health Effects Data Quality: The study data were taken from questionnaires completed by lay people who were asked to differentiate between specific conditions that may require medical diagnoses. In addition, the study failed to account for many other factors that could influence the occurrence of infection in the children studied.

Exposure Data Quality: In this study, exposure to bleach is based on a “yes or no” answer to the question as to whether someone uses bleach to clean the home at least once per week. A “yes” or “no” response provides no information to help characterize whether there was actual exposure, such as when the bleach is used, how much is used, and where the children are located when bleach is used. Further, the authors report no data collected on the use of other cleaning products or irritant chemicals in homes, a factor that could confound any reported association between bleach exposure and infection.

Bradford Hill Criteria for Confirming Cause and Effect

Criterion #1: Strength of Association: The larger the association, the more likely it is causal.

Criterion #2: Consistency of Association: The more consistent the findings by different researchers in different places with different sample populations, the greater the likelihood of an effect.

Criterion #3: Specificity: Causation is more likely if there are no other likely explanations for the effect.

Criterion #4: Temporality: The effect has to occur after the cause.

Criterion #5: Biological Gradient: Greater exposure should generally lead to greater incidence of the effect.

Criterion #6: Plausibility: A plausible mechanism between cause and effect is helpful in ascertaining cause and effect.

Criterion #7: Coherence: Coherence between epidemiological and laboratory findings increases the likelihood of an effect.

Criterion #8: Experiment: Experimental evidence can help confirm causality.

Criterion #9: Analogy: The effect of similar factors may be considered.

Additionally, the study authors report the Spanish children are from Barcelona, but there is no information on the locations of the Finnish or Dutch children. Confounding factors could include urban versus rural locations and factors dependent upon seasonal variations. No information is provided on how confounding factors such as passive smoking were handled, which applies to 28% of Barcelona households (which also used the most bleach) and 0% in Finland households, and is much more likely to be the cause of the results observed.

Bradford Hill Criteria of Causality

The “Bradford Hill Criteria,” developed by Sir Austin Bradford Hill in 1965, provide a set of nine universally applied criteria under which a cause and effect relationship may be confirmed scientifically (see text box above). Applying the Bradford Hill criteria to the bleach study helps illustrate some of the study flaws.

Criterion #1 (Strength of Association) shows the association is relatively weak based on low RRRs. Examining the study against Criterion #2 (Consistency of Association), we note the authors cite several studies suggesting that using cleaning agents may increase the risk of wheezing and respiratory infection and airway inflammation in children of various ages. However, they admit that “evidence is inconsistent across countries, health effects are rather modest, and the exposure and health assessment and cross-sectional design are a limitation, not only in our study but also in the previous studies.”

This research also fails to meet Bradford Hill Criteria #3 through #9. Regarding Specificity (#3), the authors did not study or eliminate other possible causes of infection beyond bleach use in homes. Temporality (#4) is not met because the data collection method used makes it impossible to determine whether bleach use causes infection or infection prompts the use of more bleach. For criterion #5, it appears there was no information collected to assess whether there was evidence of a dose-response relationship between exposure and illness. No data addressed Criteria #6 through #9.

Don't Discard the Bleach

Given the many flaws in the experimental design, the report offers very tenuous support for an association or a causal relationship between passive bleach exposure and certain childhood infectious illnesses. On the other hand, there is substantial science demonstrating that bleach solutions continue to be effective disinfectants around the house when used in a targeted way on high-touch surfaces and those vulnerable to contamination, such as food preparation and bathroom surfaces. EPA-registered chlorine bleach is proven to destroy a wide range of pathogens on surfaces, including rhinoviruses, influenza A virus, norovirus, *Salmonella*, *E. coli*, *Staph* and *C. difficile*.

All household cleaning products, including those containing bleach should be used with care, especially around children. It is imperative to read and follow manufacturer's directions on safe use and storage of any chemical product.

It is important to continue studying the effects of household chemical exposures on children. However, proper study design and data analysis are equally important. Given the many health benefits of using bleach in a targeted way around the house, we don't think it is time to discard bleach. Just use it smartly.