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Statement on Building Dampness, Mold, and Health

September 2011

CDPH has concluded that the presence of *water damage, dampness, visible mold, or mold odor* in schools, workplaces, residences, and other indoor environments is unhealthy. We recommend against measuring indoor microorganisms or using the presence of specific microorganisms to determine the level of health hazard or the need for urgent remediation. Rather, we strongly recommend addressing water damage, dampness, visible mold, and mold odor by (a) identification and correction of the *source of water* that may allow microbial growth or contribute to other problems, (b) the rapid drying or removal of *damp materials*, and (c) the cleaning or removal of *mold and moldy materials*, as rapidly and safely as possible, to protect the health and well-being of building occupants, especially children.

Indoor dampness and mold (fungal growth) are common problems in California and worldwide. To date, no clear state or federal policy has been issued on how to assess the health risks that dampness and mold pose to building occupants. In 2001, the Toxic Mold Protection Act (Senate Bill 732, Ortiz*) mandated that the California Department of Health Services (currently the California Department of Public Health, CDPH) determine the feasibility of setting Permissible Exposure Limits (PELs) for mold in indoor environments. In its 2005 report to the Legislature, CDPH concluded that “sound, science-based PELs for indoor molds cannot be established at this time” and outlined the reasoning by which the department reached that conclusion.

While PELs remain elusive, mounting scientific evidence on dampness and mold, much of it published since 2005, supports an alternate, evidence-based approach to the assessment of health risks from indoor dampness and mold. Human health studies have led to a consensus among scientists and medical experts that the presence in buildings of (a) visible water damage, (b) damp materials, (c) visible mold, or (d) mold odor indicates an increased risk of respiratory disease for occupants. Known health risks include: the development of asthma, allergies, and respiratory infections; the triggering of asthma attacks; and increased wheeze, cough, difficulty breathing, and other symptoms. Available information suggests that children are more sensitive to dampness and mold than adults. In addition, evidence is accumulating, although not yet conclusive, that the more extensive, widespread, or severe the water damage, dampness, visible mold, or mold odor, the greater the health risks.

There also is consensus that the traditional methods used to identify increased mold exposure do not reliably predict increased health risks. Therefore, the current practices for the collection, analysis, and interpretation of environmental samples for mold cannot be used to quantify health risks posed by dampness and mold in buildings or to guide health-based actions.

Finally, current consensus does not justify the differentiation of some molds (such as *Stachybotrys* species) as “toxic molds” that are especially hazardous to healthy individuals. The presence of molds such as *Stachybotrys* that grow only on very wet materials might be interpreted as demonstrating damp conditions that could place occupants at increased risk. However, the only types of evidence that have been related consistently to adverse health effects are the presence of current or past water damage, damp materials, visible mold, and mold odor, *not* the number or type of mold spores nor the presence of other markers of mold in indoor air or dust.

Our goal in issuing this notice is to increase awareness of the hazards from indoor dampness and mold and to reduce exposures to these hazards. The following are recent publications that support our positions on the assessment of health risks and the remediation of dampness and mold:

- (1) Mendell MJ, Mirer AG, Cheung K, Tong M, Douwes J. Respiratory and allergic health effects of dampness, mold, and dampness-related agents: a review of the epidemiologic evidence. *Environmental Health Perspectives*, 2011, doi:10.1289/ehp.1002410; available at <http://ehp03.niehs.nih.gov/article/fetchArticle.action?articleURI=info%3Adoi%2F10.1289%2Fehp.1002410>.
- (2) World Health Organization. *WHO Guidelines for Indoor Air Quality: Dampness and Mould*. Copenhagen: WHO Europe, 2009 (see Chapter 4, Health effects associated with dampness and mould); available at www.euro.who.int/_data/assets/pdf_file/0017/43325/E92645.pdf.
- (3) Institute of Medicine. *Damp Indoor Spaces and Health*. Washington, D.C.: National Academies Press, 2004; available at www.nap.edu/openbook.php?isbn=0309091934.
- (4) Krieger J, Jacobs DE, Ashley PJ, et al. Housing interventions and control of asthma-related indoor biologic agents: A review of the evidence. *Journal of Public Health Management and Practice*, 2010, 16(5):S11–S20; available at www.bu-eh.org/uploads/Main/Sandel_HousingInterventions.pdf.
- (5) U.S. Environmental Protection Agency. *Mold Remediation in Schools and Commercial Buildings*. Washington, D.C.: USEPA; available at www.epa.gov/mold/mold_remediation.html.

Background note: *Building dampness degrades indoor environmental quality in many ways. Mold growth is perhaps the most common and noticeable result of excessive or chronic indoor dampness. Molds are fungi (as are mushrooms and yeasts). To grow and reproduce, molds need only moisture and nutrients. As nutrients are almost always available from organic material (e.g., leaves, wood, paper, and dirt), the presence or lack of moisture generally is what allows or limits mold growth. In addition to mold, indoor dampness can support bacterial growth and contribute to infestations of house dust mites, cockroaches, and rodents, which also pose health risks for building occupants. Moisture also may alter the chemistry of damp materials. Hence, while excessive or chronic dampness is not by itself a cause of ill health, it may indicate or increase other exposures that do have adverse health effects.*

*Information on SB 732, the 2005 CDPH report to the legislature, and the 2008 update to the report are available at www.cdph.ca.gov/programs/IAQ/Pages/IndoorMold.aspx.

Recent Reviews on Dampness, Mold, and Health

(1) Damp Indoor Spaces and Health

(Institute of Medicine 2004)

Available at http://www.nap.edu/catalog.php?record_id=11011

(2) WHO Guidelines for Indoor Air Quality: Dampness and Mould

(WHO 2009)

Available at <http://www.euro.who.int/document/E92645.pdf>)

(3) Respiratory and Allergic Health Effects of Dampness, Mold, and Dampness-Related Agents: A Review of the Epidemiologic Evidence

(Mendell, Mirer, Cheung, Tong, and Douwes, 2010 in press).

Available at

<http://ehp03.niehs.nih.gov/article/fetchArticle.action?articleURI=info%3Adoi%2F10.1289%2Fehp.1002410>

Respiratory and Allergic Health Effects of Dampness, Mold, and Dampness-Related Agents: A Review of the Epidemiologic Evidence

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OBJECTIVES: Many studies have shown consistent associations between evident indoor dampness or mold and respiratory or allergic health effects, but causal links remain unclear. Findings on measured microbiologic factors have received little review. We conducted an updated, comprehensive review on these topics.

DATA SOURCES: We reviewed eligible peer-reviewed epidemiologic studies or quantitative meta-analyses, up to late 2009, on dampness, mold, or other microbiologic agents and respiratory or allergic effects.

DATA EXTRACTION: We evaluated evidence for causation or association between qualitative/subjective assessments of dampness or mold (considered together) and specific health outcomes. We separately considered evidence for associations between specific quantitative measurements of microbiologic factors and each health outcome.

DATA SYNTHESIS: Evidence from epidemiologic studies and meta-analyses showed indoor dampness or mold to be associated consistently with increased asthma development and exacerbation, current and ever diagnosis of asthma, dyspnea, wheeze, cough, respiratory infections, bronchitis, allergic rhinitis, eczema, and upper respiratory tract symptoms. Associations were found in allergic and nonallergic individuals. Evidence strongly suggested causation of asthma exacerbation in children. Suggestive evidence was available for only a few specific measured microbiologic factors and was in part equivocal, suggesting both adverse and protective associations with health.

CONCLUSIONS: Evident dampness or mold had consistent positive associations with multiple allergic and respiratory effects. Measured microbiologic agents in dust had limited suggestive associations, including both positive and negative associations for some agents. Thus, prevention and remediation of indoor dampness and mold are likely to reduce health risks, but current evidence does not support measuring specific indoor microbiologic factors to guide health-protective actions.

KEY WORDS: allergy, asthma, dampness, fungi, indoor air, moisture, mold. *Environ Health Perspect* 119:748–756 (2011). doi:10.1289/ehp.1002410 [Online 26 January 2011]

Dampness and mold exposures in buildings are common, with estimates ranging from 18% to 50% of buildings (Gunnbjornsdottir et al. 2006; Mudarri and Fisk 2007). A large number of studies in many geographical regions have found consistent associations between evident indoor dampness or mold and respiratory or allergic health effects in infants, children, and adults [Institute of Medicine (IOM) 2004; World Health Organization (WHO) Europe 2009]. A review by the IOM (2004) reported documented associations, but not documented causal relationships, between indoor dampness and upper respiratory tract symptoms, cough, wheeze, and asthma symptoms in sensitized persons, but not for asthma development. A more recent review by WHO up to 2007 expanded the observed associations to include asthma development, current asthma, dyspnea, and respiratory infections (WHO Europe 2009). Associations were found in both atopic and nonatopic individuals. Other published reviews or opinion pieces on this topic are available (e.g., Bornehag et al. 2004; Douwes 2005; Mudarri and Fisk 2007).

The consistent associations between evident dampness or mold and health may represent

underlying causal relationships between fungal exposures and health. However, conventional quantitative measurements of fungi or other microbiologic exposures, such as counts of culturable airborne fungi, have shown less consistent associations with health effects than have qualitative assessments of visible dampness or water damage, visible mold, or mold odor. Thus, although a causal role for microbiologic exposures is plausible and likely, the evidence for this is still weak (Douwes and Pearce 2003). This is likely attributable in part to the lack of valid exposure assessment methods for the still unknown causal agents, microbial and possibly nonmicrobial, that increase with dampness and directly cause adverse respiratory and allergic effects.

Much additional epidemiologic research on qualitative and quantitative assessments of dampness and dampness-related agents has become available in the last few years. The present review combines findings of the IOM review of findings up to 2003 (IOM 2004) and a new assessment of later published studies. In this review we provide *a)* an updated, comprehensive review of available epidemiologic evidence on qualitative assessments

of dampness or mold factors, and *b)* a new synthesis of evidence on quantitative measurements of microbiologic factors. Earlier work on this review (summarizing literature through 2007) was originally done to support the WHO Guidelines for Indoor Air Quality related to dampness and mold (2009).

Methods

The online database PubMed (National Library of Medicine 2010) was searched using three groups of keywords such as dampness, damp, “water damage,” moisture, humidity, fungi, fungus, mold, mould, bacteria, or microorganisms, crossed with health, asthma, allergy, eczema, wheeze, cough, respiratory, “respiratory infection,” lung, skin, nasal, nose, “hypersensitivity pneumonitis,” alveolitis, bronchial, hypersensitivity, or inflammation and with building, house, home, residence, dwelling, office, school, or “day-care center.” A similar search was run in the ISI/Web of Knowledge database (Thomson Reuters 2010). We identified additional publications from reference lists and personal databases. Some indoor exposures/conditions were not included, for example, humidity, mattress moisture, and dust mites.

Inclusion of a primary study required the following characteristics:

- Publication in a peer-reviewed journal by November 2009
- Reporting of original data from one of the following study designs: intervention (quasi-experimental intervention), prospective (prospective cohort), retrospective (retrospective cohort or nested case-control), or

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Supplemental Material is available online (doi:10.1289/ehp.1002410 via <http://dx.doi.org/>).

An earlier version of this review, Chapter 4.1 in World Health Organization (WHO) Guidelines for Indoor Air Quality: Dampness and Mould (available: http://www.euro.who.int/__data/assets/pdf_file/0017/43325/E92645.pdf), was supported in part by the WHO Regional Office for Europe. We acknowledge all coauthors and reviewers (and M. Krzyzanowski, project leader) of that review, which this article updates and expands.

The authors declare they have no actual or potential competing financial interests.

Received 7 May 2010; accepted 26 January 2011.



REVIEW

Open Access

Association of residential dampness and mold with respiratory tract infections and bronchitis: a meta-analysis

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Abstract

Background: Dampness and mold have been shown in qualitative reviews to be associated with a variety of adverse respiratory health effects, including respiratory tract infections. Several published meta-analyses have provided quantitative summaries for some of these associations, but not for respiratory infections. Demonstrating a causal relationship between dampness-related agents, which are preventable exposures, and respiratory tract infections would suggest important new public health strategies. We report the results of quantitative meta-analyses of published studies that examined the association of dampness or mold in homes with respiratory infections and bronchitis.

Methods: For primary studies meeting eligibility criteria, we transformed reported odds ratios (ORs) and confidence intervals (CIs) to the log scale. Both fixed and random effects models were applied to the log ORs and their variances. Most studies contained multiple estimated ORs. Models accounted for the correlation between multiple results within the studies analyzed. One set of analyses was performed with all eligible studies, and another set restricted to studies that controlled for age, gender, smoking, and socioeconomic status. Subgroups of studies were assessed to explore heterogeneity. Funnel plots were used to assess publication bias.

Results: The resulting summary estimates of ORs from random effects models based on all studies ranged from 1.38 to 1.50, with 95% CIs excluding the null in all cases. Use of different analysis models and restricting analyses based on control of multiple confounding variables changed findings only slightly. ORs (95% CIs) from random effects models using studies adjusting for major confounding variables were, for bronchitis, 1.45 (1.32-1.59); for respiratory infections, 1.44 (1.31-1.59); for respiratory infections excluding nonspecific upper respiratory infections, 1.50 (1.32-1.70), and for respiratory infections in children or infants, 1.48 (1.33-1.65). Little effect of publication bias was evident. Estimated attributable risk proportions ranged from 8% to 20%.

Conclusions: Residential dampness and mold are associated with substantial and statistically significant increases in both respiratory infections and bronchitis. If these associations were confirmed as causal, effective control of dampness and mold in buildings would prevent a substantial proportion of respiratory infections.

Background

Dampness and mold in buildings have been associated in many studies with adverse respiratory health effects. A number of qualitative summaries of this literature are available [1-3]. In their review, the Institute of Medicine (IOM) of the National Academy of Sciences found

sufficient evidence to document an association between qualitatively assessed indoor dampness or mold and upper respiratory tract symptoms, cough, wheeze, and asthma symptoms in sensitized persons [2]. A later review by the World Health Organization (WHO), including additional studies, expanded the documented associations to include asthma development, current asthma, dyspnea, and respiratory infections. While both reviews concluded that excessive indoor dampness was an important public health problem meriting prevention and remediation, neither review produced quantitative

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Meta-analyses of the associations of respiratory health effects with dampness and mold in homes

Abstract The Institute of Medicine (IOM) of the National Academy of Sciences recently completed a critical review of the scientific literature pertaining to the association of indoor dampness and mold contamination with adverse health effects. In this paper, we report the results of quantitative meta-analyses of the studies reviewed in the IOM report plus other related studies. We developed point estimates and confidence intervals (CIs) of odds ratios (ORs) that summarize the association of several respiratory and asthma-related health outcomes with the presence of dampness and mold in homes. The ORs and CIs from the original studies were transformed to the log scale and random effect models were applied to the log ORs and their variance. Models accounted for the correlation between multiple results *within* the studies analyzed. Central estimates of ORs for the health outcomes ranged from 1.34 to 1.75. CIs (95%) excluded unity in nine of 10 instances, and in most cases the lower bound of the CI exceeded 1.2. Based on the results of the meta-analyses, building dampness and mold are associated with approximately 30–50% increases in a variety of respiratory and asthma-related health outcomes.

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Key words: Asthma; Dampness; Health; Meta-analysis; Mold.

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Received for review 25 October 2006. Accepted for publication 7 February 2007.
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Practical Implications

The results of these meta-analyses reinforce the IOM's recommendation that actions be taken to prevent and reduce building dampness problems, and also allow estimation of the magnitude of adverse public health impacts associated with failure to do so.

Introduction

The association of adverse health effects with dampness and mold in buildings has been the subject of much research. Most studies on this topic have found an increased risk of one or more adverse health effects in buildings with signs of dampness or visible mold. The Institute of Medicine (IOM) of the National Academy of Sciences recently completed a critical review (IOM, 2004) of this scientific literature. The IOM concluded that *excessive indoor dampness is a public health problem*, noted that dampness problems are common, and recommended corrective measures. While the IOM report summarized the main features and results of the reviewed studies, which included a broad range of health outcomes, it provided no quantitative summaries of the findings of these studies.

In this paper, we report the results of quantitative meta-analyses of the studies reviewed in the IOM report and other similar studies that met specified study inclusion criteria. A meta-analysis uses statistical methods to combine data from different but comparable research studies, in order to provide a quantitative summary estimate on the size and variability of an association. Studies are generally selected for relevance, quality, and similarity. The contribution of larger, more precise studies to the summary estimate is generally more heavily weighted. Results of meta-analyses presented here are central point estimates and confidence intervals (CIs) of odds ratios (ORs) that summarize the magnitude of increased risk of several health outcomes in buildings with dampness and mold. The central estimates and CIs of ORs, if assumed to reflect causal relationships, can be used to communicate

Appendix 3. Existing California State Code and Law-related Language

Occupational –

(California Code of Regulations, Title 8, (Article 9) Section 3362.

“When exterior water intrusion, leakage from interior water sources, or other uncontrolled accumulation of water occurs, the intrusion, leakage or accumulation shall be corrected because of the potential for these conditions to cause the growth of mold.”

Residential

California Housing Law and Regulations – Healthy Homes Provisions

§ 17910. Statute Title This part is known as the "State Housing Law."

CALIFORNIA STATE HOUSING LAW – CALIFORNIA HEALTH AND SAFETY CODE,
DIVISION 13, PART 1.5. REGULATION OF BUILDINGS USED FOR HUMAN
HABITATION, CHAPTER 1. GENERAL PROVISIONS, Section 17920.3. Substandard
Building

CHAPTER 1. GENERAL PROVISIONS

§ 17920.3. Substandard Building

Any building or portion thereof including any dwelling unit, guestroom or suite of rooms, or the premises on which the same is located, in which there exists any of the following listed conditions to an extent that endangers the life, limb, health, property, safety, or welfare of the public or the occupants thereof shall be deemed and hereby is declared to be a substandard building:

- (a) Inadequate sanitation shall include, but not be limited to, the following:
 - (1) Dampness of habitable rooms.
 - (g) Faulty weather protection, which shall include, but not be limited to, the following:
 - (2) Deteriorated or ineffective waterproofing of exterior walls, roof, foundations, or floors, including broken windows or doors.
 - (3) Defective or lack of weather protection for exterior wall coverings, including lack of paint, or weathering due to lack of paint or other approved protective covering.
 - (4) Broken, rotted, split, or buckled exterior wall coverings or roof coverings.

source: http://www.healthyhomestraining.org/Codes/HH_Codes_CA_9-9-07.pdf
Complete, official version at www.hcd.ca.gov/codes/shl/SHLStatutes.htm.

Appendix 4. San Francisco Housing Code, Healthy Homes Provisions

CHAPTER 4 – DEFINITIONS *(portions omitted)*.

. . . . Mildew. Any visible or otherwise demonstrable growth of microscopic organisms or fungi (mold or mildew) that feeds on damp conditions in the interior of a residential building, sufficiently chronic or severe to cause a health hazard or damage a residential structure or part thereof, excluding the presence of mold or mildew which is minor in nature caused by inappropriate housekeeping practices or the improper use of natural or mechanical ventilation.

Nuisance. The following shall be defined as nuisances:

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- (3) Whatever is dangerous to human life or is detrimental to health;
- (12) Mold and mildew as defined by this chapter.