Finding Ways to Assess “Dampness, Moisture, and Flooding” Caused by Climate Change in Built Environment

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科学的に明確に建築物内のダニ等を除去することは健康被害の防止に不可欠なガイドラインを策定することを最終目的とします。その一歩として住宅内の湿度に関する既存の情報等を踏まえた上で検討することとした。Pubmedで文献検索をし、2020年までに発表される住宅の湿度に影響を及ぼすことが示唆されたダニ等を対象にした研究が数多く行われています。これらの研究成果から、ダニ等による健康被害の防止を図るために、適切な湿度管理が重要であることが示唆されています。

Indoor air quality is a field that discusses about peoples exposure to pollutants, health effect caused by those pollutants and measures to reduce exposures to those pollutants in built environment. The IAQ project is not an exempt of being affected by climate change. However, it’s not always clear how climate change will impact indoor air quality. To give some examples of the impact of climate change to indoor air quality, the Institute of Medicine of the United States formed a committee on the “Effect of Climate Change on Indoor Air Quality and Public Health” and they concluded the 4 areas to be the most important issues: 1) Dampness, moisture, and flooding 2) Infectious agents and pests 3) Thermal stress 4) Building ventilation, weatherization, and energy use

Among the 4 topics dampness has been and still is and would continue to be the most questions we receive from the public not just in California but nation wide in the United States. Unfortunately epidemiology proves the conventional way of testing dampness and mold in built environment i.e. culturing airborne microbial has no relationship with negative health effect (IOM, WHO, Mendell, 2021). The only mold related indication that had a correlation with health was, observed mold growth or dampness and existence of mold odor. Based on these facts the Indoor Air Quality Program (IAQP) of California Department of Public Health (CDPH) issued a “Statement on Building Dampness, Mold, and Health” summarizing 1).

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 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.

However these 3 indicators are all subjective and an acceptable level cannot yet be specified. Hereby we still do not have a quantitative method to evaluate the indoor environment of having dampness and mold that could cause negative health effect. The IAQP of CDPH is developing strategies for creating evidence-based, health-protective guidelines for indoor dampness/mold. Ideally, such guidelines for building dampness

Figure 1. Combining findings from two UK studies, both using the Protimeter Surveymastermoisture meter, on moisture meter readings and severity or exacerbation of asthma (REVISe)
would be based on quantitative, dose-response relationships between measured, identified, dampness-related causal agents (presumably but not necessarily microbial) and specific health outcomes. Although consistent associations have been demonstrated between subjectively identified dampness or mold and many health effects, we have very limited evidence on dose-response, and also no consistently demonstrated relationships between measured microbial factors and specific health effects.

Research is ongoing both to better quantify relationships of health with subjectively assessed dampness and mold, and to identify specific dampness-related causal agents and quantify their relationships with health effects. Meanwhile, an additional avenue of research has received little attention: promising initial findings on the relationship between quantified building moisture and health are available but have not been synthesized and interpreted for use. This report describes work aimed at developing evidence to support health-protective guidelines for measured building moisture. This was motivated by two prior studies reporting associations between measured “moisture content” (MC) of home walls and respiratory health effects.

We considered together selected findings of the two studies on measured home wall moisture and respiratory outcomes in asthmatic children. Williamson et al. on severity of asthma, and Venn et al. on frequent night-time exacerbations. The studies agree in finding increased risk of asthma exacerbation or severity associated with higher levels of measured wall moisture, and both studies find dose-related increases. Venn et al., however, found risks at lower moisture levels, and compared to the much lower baseline levels used in that study, much higher increased risks at the highest moisture levels than did Williamson et al. The Williamson et al. findings considered the baseline risk level meter reading to be up to 17, and assessed increasing risk above 17, and above 20, using only dichotomized comparisons. The Venn study, in contrast, considered the baseline risk level to be up to 10, and assessed increasing risk for multiple categories: above 10, above 16, and above 21. The “low” and even part of the medium categories in Venn et al. both associated with increased health risks, were within the “none” category in Williamson et al.; the entire low and medium categories in Venn et al. were within the non-severe category in Williamson et al. Thus, even though the Venn et al. study showed increased risk above readings of 10, compared to the Williamson et al. showing of increased risk associated with moisture readings above 17, the two studies did not disagree about the lower levels of moisture that might indicate increased risk. The Venn et al. study simply was able to assess risks at lower moisture levels than the Williamson et al. study.

The two studies reviewed here each suggest increasing, dose-related increases in respiratory morbidity among persons with asthma in association with increasing measured moisture in home walls. No other published studies have assessed these relationships, although others have reported dose-related increases in various respiratory health effects with more subjective assessments of dampness and mold e.g. Park et al. This suggests that such measurements may be useful in defining indoor environments with increased dampness-related health risks. However, because moisture in buildings may vary substantially by location and over time, and may occur in locations in building envelopes or ventilation systems inaccessible to moisture measurements, even the fullest development of this method is unlikely to provide a complete answer to the problem of identifying all building dampness that requires remediation. Still, if even a subset of problematic building-related moisture could be quantified and systematically related to health risks, it would be an advance over currently available assessment strategies.

References
1) Institute of Medicine, Climate Change, the Indoor Environment, and Health. National Academies Press (2011).
2) Institute of Medicine, Damp Indoor Space and Health, National Academies Press (2004).