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RACP Submission to the Australian Parliament's Health, Aged Care and Sport Committee Inquiry into Biotoxin-related Illnesses in Australia

August 2018

Introduction

The Royal Australasian College of Physicians (RACP) welcomes the opportunity to contribute to the Australian Parliament's Health, Aged Care and Sport Committee Inquiry into Biotoxin-related Illnesses in Australia. We also wish to thank the Committee for its invitation to nominate an RACP representative to attend the public hearing roundtables in Canberra on 9 August 2018. Dr Graeme Edwards represented the RACP at this public hearing and we trust the Committee benefited from his contribution to the discussions.

The RACP trains, educates and advocates on behalf of over 15,000 physicians and 7,500 trainee physicians across Australia and New Zealand. The RACP represents physicians from a diverse range of disciplines including occupational and environmental medicine physicians, public health medicine physicians, clinical immunology physicians and respiratory physicians.

We note this inquiry is focused on the following terms of reference:

1. The prevalence and geographic distribution of biotoxin-related illnesses in Australia, particularly related to water-damaged buildings;

2. The prevalence of Chronic Inflammatory Response Syndrome (CIRS) or biotoxin-related illness in Australian patients and the treatment available to them;

3. The current medical process of identifying biotoxin-related illness in patients and the medical evaluation of symptom complexes attributed to biotoxins and CIRS;

4. Any intersection with other chronic diseases;

5. Investment in contemporary Australian research to discover and provide evidence of CIRS as a chronic, multisystem disease;

6. Research into biotoxin-related illness caused from water damaged buildings; and

7. Any related matters.

This submission has been led by the Australasian Faculty of Occupational and Environmental Medicine (AFOEM). AFOEM is a Faculty of the RACP representing specialist occupational and environmental physicians (OEPs) in Australia and New Zealand.

This specialist discipline is primarily focused on the effects of people's health on their ability to work safely, and conversely, the effects of work and the workplace environment on the health and wellbeing of people at work, both individually and collectively, and the effects of exposures on health and wellbeing in the general community beyond the factory gates. They are specifically trained and experienced in:

- investigating the relationships between potential contributing factors: medical, physical, biological, psychological, emotional, environmental and psychosocial factors;

- differentiating, on the balance of the available evidence, the relative contribution of each factor;

- distinguishing between association and causation when assessing the causes of harm; and

- identifying possible interventions and treatments to prevent or minimize harm.

The speciality of Occupational and Environmental Medicine is directly relevant to the questions posed by the Committee.

The College is committed to establishing and maintaining the highest standards of practice in occupational and environmental medicine (OEM) in Australia and New Zealand through training, continuing professional development and advocacy.

The evidence on biotoxin-related illnesses

'Biotoxins' is an umbrella term for substances of biological origin, some of which can produce toxic effects in humans. Although this covers a wide range of organisms, for the purpose of this Inquiry we have focused on those effects linked to water-damaged buildings in general, and mould in particular.

In preparing this submission, we have undertaken a rapid review of the most recent evidence produced by reputable medical professional bodies and studies published in peer-reviewed journals. Key findings from these studies are summarised in the Appendix.

The major concordant message arising from the evidence-based peer-reviewed medical literature is the apparent link between subjective assessments of dampness and/or mould in the indoor environment and the *potential* for environmental harm with *specific* respiratory conditions, in particular childhood asthma. This has significant implications for socio-economically disadvantaged families and their children given their greater likelihood of having to live in water-damaged houses. Consequently, there is reasonable evidence that these subjective assessments of damp and mould can be used as a crude surrogate index of the environment until more robust and objective indices are identified.

Presently, sufficient research has not been conducted nor consensus reached for the terms ‘biotoxin-related illnesses’ or ‘Chronic Inflammatory Response Syndrome (CIRS)’ to be used as valid diagnostic labels. While CIRS is a term promoted by Dr R Shoemaker, our rapid review indicates that he is speculating as to cause and effect. In particular, the fact that inflammatory markers are *not* consistently present in people who are suffering from multiple not-readily-explainable symptoms indicates that the term ‘chronic inflammation’ is inappropriate.

The current body of evidence does not support a direct “cause and effect relationship”, between water damaged properties or mould and some of the clinical manifestations of ill-health, for these terms to be reliably used as “classifiable conditions” per the World Health Organisation’s *International Statistical Classification of Diseases and Related Health Problems* (‘International Classification of Diseases’ or ‘ICD’ for short).

Inappropriate labels can mislead efforts to improve the health and wellbeing of people with symptoms. We prefer such patients being referred to as people with ’multiple not-readily-explained symptoms’ until there is consensus as to how their illnesses can best be characterised and there is greater clarity on aetiological factors.

There is considerable overlap between these phrases, and those used or several other not-readily-explainable conditions such as (but not limited to) Chronic Fatigue Syndrome, Fibromyalgia, and Electromagnetic Hypersensitivity Syndrome. While there is an increasing body of evidence to suggest a common neuroplastic change underpinning the clinical manifestations (see for example Woofe 2011[1]), the threshold of concordant evidence has not yet been reached to support their widespread acceptance in the medical community.

Other terms have been used in the literature including ‘multiple system multiple symptom multi-factorial conditions’ which are then sub-categorised by the dominant feature of their clinical presentation and/or a proposed relevant exposure. This is best exemplified by the body of work undertaken by the US Departments of Veteran Affairs and Defence in addressing what they termed ‘Chronic Multisymptom Illness’ (CMI). There are many overlapping features of CMI with those described by others as CIRS.

Patients presenting with multiple not-readily explained symptoms

As the clinical presentation of these patients is multifactorial, a direct cause and effect relationship based on sound evidence-based medical research does not exist. This means it is not possible to point to one specific factor which may be addressed to relieve the symptoms being suffered by such patients.

Rather, as physicians we know that complex biopsychosocial factors involving the neuro-emotive limbic and neuro-endocrine systems, and our developing understanding of neuroplasticity (the ability of a person’s brain

[1] Woolf, C. (2011). Central sensitization: Implications for the diagnosis and treatment of pain. *Pain, 152*(3, Supplement), S2-S15.

to change throughout life), are likely to be involved. Hence, in order to maximise health outcomes for people who are suffering from multiple symptoms, interventions must address the *multiple* factors that reflect the clinical context of each affected *individual*.

Hence, within the milieu of the existing scientific and medical knowledge for dealing with multi-factorial multi-system multi-symptom conditions, it is not easy to attribute one particular cause to address and obtain evidence supported treatment. Unsubstantiated theories abound that can be easily used to take advantage of highly vulnerable people.

This situation is directly relevant to the group of people of main concern to this Inquiry. There are a multitude of factors that can create damp environments and mould, which can then be collectively but only loosely connected to ill-health. Furthermore, this situation is compounded by the simple fact that doctors, in both general and specialist practice, do not have any agreed, Commonwealth Department of Health supported, guideline or clinical pathway for managing patients with multiple not-readily-explained symptoms. Such a clinical pathway should take a holistic approach focusing on the multifactorial nature of this condition, rather than just one specific environmental factor.

Key Recommendation

To improve the care of all patients presenting with multiple not-readily explained symptoms, the RACP supports the development of a clinical pathway or a clinical guideline, based on the best available evidence, for doctors in both general and specialist practice that addresses the following key issues:

1. The formulation of clear working diagnostic criteria and an agreed minimum dataset to enable better case-definition, case management and cohort identification for research purposes.

2. Development of standardised indices of exposure of damp or mould-contaminated environments on which research and clinical judgement and management can be reliably founded.

3. The development of well-designed longitudinal studies to understand the relative contribution of genetics, epigenetics and the range of biopsychosocial factors impacting on those suffering from multiple not-readily explained symptoms.

4. Research into the role of various biomarkers which have been championed by some authors in the broader and general literature.

5. Research to improve ways of preventing, reducing and removing damp and mould in homes in order to prevent / reduce childhood asthma, especially among children in socio-economically disadvantaged families and communities.

6. The development of clinical guidelines based on the evolving evidence derived from the management and treatment of people who suffer from multiple not-readily explainable symptoms; and

7. Access to co-ordinated biopsychosocial supports for those people who meet agreed criteria.

Process Guidance

The joint United States Department of Veterans Affairs and US Department of Defense' *Clinical Practice Guideline for the Management of Chronic Multisymptom Illness* (2014) and the accompanying Clinician Pocket Guide could be used as a model to develop the proposed clinical pathway or guideline.

This could be complemented by Australian experience such as the 2015 Medical Journal of Australia article *Managing medically unexplained illness in general practice (L Stone 2015)*.

The RACP would be willing to facilitate access our members' expertise and contribute to the development of such a clinical pathway or guideline. We would also be willing to disseminate the outcomes to our members.

Appendix

Institute of Medicine (IOM) (US) Committee on Damp Indoor Spaces and Health. Damp Indoor Spaces and Health. Washington (DC): National Academies Press (US); 2004.
Available from: https://www.ncbi.nlm.nih.gov/books/NBK215643/ doi: 10.17226/11011

This review, which is a little old now, concluded there is no single cause of excessive indoor dampness, and the primary risk factors for it differ across climates, geographic area, and building types. Although the prevalence of dampness problems appears to increase as buildings age and deteriorate, the experience of building professionals suggests that some modern construction techniques and materials and the presence of air-conditioning also increase the risk of dampness problems. The prevalence and nature of dampness problems suggest that what is known about their causes and prevention is not consistently applied in building design, construction, maintenance, and use.

Given the present state of the literature, the US Committee identified several kinds of research needs. *Standard definitions of dampness, metrics, and associated dampness-assessment protocols need to be developed to characterize the nature, severity, and spatial extent of dampness.* Precise, agreed definitions will allow important information to be gathered about the determinants of dampness in buildings and the mechanisms by which dampness and dampness-related effects and exposures affect occupant health.

The lack of knowledge regarding the role of microorganisms in the development and exacerbation of diseases found in occupants of damp indoor environments is due largely to the lack of valid quantitative exposure-assessment methods and knowledge of which specific microbial agents may, as an index marker account for the perceived health effects. For the most part, studies have relied on occupants' observations of the presence of "mold" or "moldy odor".

Based on their review of the literature, the US Committee recommended that existing exposure assessment methods for fungal and other microbial agents be subjected to rigorous validation and that they be further refined to make them more suitable for large-scale epidemiologic studies.

Conclusions regarding exposure to agents associated with damp indoor environments are limited by the means used to assess exposure in the epidemiologic studies reviewed by the US Committee.

Evidence Conclusions:

The US Committee specifically considered whether any of the explored health outcomes met their criteria "sufficient evidence of a causal relationship" or "limited or suggestive evidence of no association". Neither criteria were met.

The US Committee found sufficient evidence of an association between exposure to damp indoor environments and *some* respiratory health outcomes: upper respiratory tract symptoms, cough, wheeze, and asthma symptoms *in sensitized* asthmatic persons.

Epidemiologic studies also indicated there was sufficient evidence to conclude that the presence of indoor mold (otherwise unspecified) as an unqualified index of a degraded environment, was associated with upper and lower respiratory symptoms: cough, wheeze, asthma symptoms in sensitized asthmatic persons, and hypersensitivity pneumonitis (a relatively rare immune-mediated condition) in susceptible persons.

Limited or suggestive evidence was found for an association between exposure to damp indoor environments and dyspnoea, lower respiratory illness in otherwise-healthy children, and the development of asthma in susceptible persons.

Two key research issues identified were

1) *Lack of standardized, quantitative methods of measuring exposure to mold.*

2) *Difficulty in determining which of several disease-causing agents in damp indoor environments may be responsible for the adverse health effects.*

The Medical effects of mold exposure. Bush. 2006(7). Journal of Allergy and Clinical Immunology. Position paper of the American Academy of Allergy, Asthma and Immunology.

This position paper is also a little old, but it reviewed the state of the science of mold-related diseases and provides an interpretation as to 'what was' and 'what was not' supported by scientific evidence.

Many conclusions were proffered, and with particular relevance to this Inquiry:

- Available studies do not conclusively prove that exposure to outdoor airborne molds plays a role in allergic rhinitis, and studies on the contribution of indoor molds to upper airway disease are even less convincing. Patients with suspected mold allergy should be evaluated by means of an accepted method of skin or blood testing for IgE antibodies to appropriate mold antigens as part of the clinical evaluation of potential allergies.

- Allergic bronchopulmonary aspergillosis (ABPA) and allergic fungal sinusitis are manifestations of significant hypersensitivity to fungi, particularly A*spergillus* species.

- Hypersensitivity pneumonitis (HP) is an uncommon but important disease that can occur as a result of mold exposure, particularly in occupational settings with high levels of exposure.

- The occurrence of mold-related toxicity (mycotoxicosis) from exposure to inhaled mycotoxins in non-occupational settings is not supported by the then available data, and its occurrence was considered "improbable".

- Exposure to molds and their products does not induce a state of immune dysregulation. The practice of performing large numbers of nonspecific immune-based tests following a suggestion of mold exposure or mold-related illness is not evidence based and is to be discouraged.

- Measurement of antibodies to specific molds has scientific merit in the assessment of IgE-mediated allergic disease, HP, and allergic bronchopulmonary mycosis.

- *Measurement of antibodies to molds cannot be used as an immunologic marker to define dose, timing, and/or location of exposure to mold antigen inhalation in a non-infectious setting. Testing for antibodies to mycotoxins was not scientifically validated and should not be relied on.*

- Bulk, surface, and within-wall cavity measurement of molds or mycotoxins, although having potential relevance for other purposes, cannot be used to assess exposure.

- Testing for airborne mycotoxins in non-agricultural environments cannot be used to diagnose mold exposure.

United States Government Accountability Office (GAO) Report to the Chairman, Committee on Health, Education, Labor and Pensions, U.S. Senate. INDOOR MOLD. Better Coordination of Research on Health Effects and More Consistent Guidance Would Improve Federal Efforts. (2008)

Concurs in the main with the IOM 2004 described above; reiterates the results.

New York State Toxic Mold Taskforce Final Report to the Governor and Legislature. (December 2010)

Conclusions and recommendations regarding health effects:

Concluded the strongest evidence for association was between indoor mold exposures and upper and lower respiratory health effects such as nasal symptoms and asthma exacerbations.

Evidence for association between other health effects (such as neurological, gastro-intestinal, muscular or immunological effects) and mold exposures in buildings was much more limited and generally did not allow for clear conclusions to be drawn one way or the other.

Since mold problems in buildings are preventable with proper building construction, maintenance and housekeeping aimed at preventing excess building dampness, opportunities exist to prevent morbidity from exposure to indoor molds as an application of the precautionary principle.

Conclusions and recommendations regarding exposure limits

They concluded the development of reliable, health-based quantitative mold exposure limits was not feasible due to a number of technical challenges. However, the technical challenges to the development of reliable quantitative exposure limits for building clearance do not preclude the use of qualitative clearance guidance for water damage and mold remediation.

Conclusions and recommendations regarding control

Laboratory studies provide limited evidence that some chemical disinfectant or encapsulant treatments have utility for mitigating or preventing mold growth on building materials. These studies suggest some products (particularly those based on borate, titanium-dioxide/glycol or chlorothalonil) can prevent mold growth or re-growth on gypsum wallboard for several months. Bleach products can reduce mold growth on treated surfaces, but do not appear to be very effective at preventing longer-term re-growth. Overall, these laboratory results are not very robust, as they do not address what happens on treated surfaces after more than six months.

The evidence, although limited, suggested approaches directed toward correcting moisture problems and removing mold exposure sources can help reduce occupant respiratory symptoms.

Written mold and water-damage assessment and remediation guidelines developed by many organizations provide practical guidance focused on identifying and repairing water damage in buildings and removing mold source materials.

This approach to building mitigation was marketed as “health protective” because its goal was the minimization or elimination of exposure sources. It was considered less complicated to implement than mitigation based on attaining a numerical clearance criterion.

If water sources are properly corrected and existing sources of mold growth are treated, further treatment with disinfectants did not provide significant additional value to prevent further mold growth or exposure.

Recommendations

State and local government agencies and professional organizations addressing building performance and indoor air quality issues should continue to emphasize practical water-damage and mold mitigation approaches.

The decision to use disinfectants as part of remediation will be case-specific and should take into account potential adverse effects of disinfectant exposure to applicators and building occupants.

NIOSH: Comparison of Mold Exposures, Work-related Symptoms, and Visual Contrast Sensitivity (VCS) between Employees at a Severely Water-damaged School and Employees at a School without Significant Water Damage (2010)

NIOSH investigators compared work-related symptoms and VCS between employees at a school with severe water damage and those at a school without significant water damage.

Employees at the water-damaged school had higher prevalences of work-related rashes and nasal, lower respiratory, and constitutional symptoms than those at the school without significant water damage.

Visual contrast sensitivity (VCS) values across all spatial frequencies were lower among employees at the water-damaged school.

Further studies are needed to determine what factors could be responsible for the VCS findings and whether they have any clinical significance for affected individuals.

VCS is a test of a particular function of vision "contrast" which is not diagnostic for any currently classified medical condition. It is one of the tests advocated by proponents of CIRS.

WHO Guidelines for Indoor Air Quality: dampness and mould (2011)

Concluded that there is sufficient evidence of an association between indoor dampness-related factors and a wide range of respiratory health effects including asthma development, asthma exacerbation, current asthma, respiratory infections, upper respiratory tract symptoms, cough, wheeze and dyspnoea.

The epidemiological evidence was "not sufficient to conclude causal relationships". Although few intervention studies were available, their results show that remediation of dampness problems can reduce adverse health outcomes.

The WHO found clinical evidence that exposure to mould and other dampness-related microbial agents increased the risks of rare conditions, such as hypersensitivity pneumonitis, allergic alveolitis, chronic rhinosinusitis and allergic fungal sinusitis. Toxicological evidence obtained in vivo and in vitro supports these findings, showing the occurrence of diverse inflammatory and toxic responses after exposure to microorganisms – including their spores, metabolites and components isolated from damp buildings.

The increasing prevalence of asthma and allergies in many countries increase the number of people susceptible to the effects of dampness and mould in buildings.

The report estimates that indoor dampness affects a wide range of indoor environments in Australia: 10-50.

Guidelines recommended thorough inspection for indicators of dampness, though acknowledged *no quantitative health based-guideline values or thresholds can be recommended for acceptable levels*.

Instead, prevention was recommended. This included well-designed, well-constructed and well-maintained buildings to prevent and control excess moisture and microbial growth. Appropriate temperature and ventilation controls were necessary to avoid excess humidity, condensation and moisture accumulation.

OSHA: Indoor Air Quality in Commercial and Institutional Buildings (2011)

Guidance document with practical recommendations to help prevent or minimize indoor air quality problems in commercial and institutional buildings.

ASHRAE Position Document on Limiting Indoor Mold and Dampness in Buildings. 2012 (reaffirmed 2018) American Society of Heating and Air-Conditioning Engineers

Position on health effects:

> "Currently, no quantitative, health-based exposure guideline or thresholds can be recommended for acceptable levels of contamination by microorganisms (IOM 2004). While associations between persistent dampness and adverse health effects have been observed, relationships between persistent dampness, microbial exposure, and health effects cannot be quantified precisely at this time (WHO 2009, Mendell 2011). In light of this information, ASHRAE believes the most effective course is to limit the potential for microbial growth indoors by reducing the causes of persistent dampness."

National Institute for Occupational Safety and Health (NIOSH) Alert: Preventing Occupational Respiratory Disease from Exposures Caused by Dampness in Office Buildings, Schools, and Other Nonindustrial Buildings (2012)

Alert warning that occupants within damp office buildings, schools, and other nonindustrial buildings may develop respiratory symptoms and disease.

The alert states that best current evidence suggests observations of dampness, water damage, mold, or mold odours are the best indicators of dampness-related health hazards, rather than microbiologic measurements.

They give various approaches for owners, employers, or occupants to minimize the likelihood of persistent building dampness and subsequent respiratory problems in exposed occupants.

American Industrial Hygiene Association(AIHA) Position Statement on Mold and Dampness in the Built Environment (2013)

On review of systematic reviews of the available evidence the AIHA concluded that the implementation of interventions that combine elimination of moisture intrusion and leaks and removal of moldy items helps to reduce mold exposure and respiratory symptoms and new onset asthma.

This position has also been taken by National Institute for Occupational Safety and Health (NIOSH) and many State governments, Health Canada and internationally by the World Health Organization.

The position adopted by AIHA was persistent dampness and mold damage in the non-industrial workplace, including schools and residential housing, requires prevention, management and effective remediation. If visible mold is present, it should be remediated, regardless of what species are present. Such actions are likely to reduce new onset asthma, lead to savings in health care costs, and improve public health.

Recommendations

1. While the design and location of a building have the greatest impact on the onset of serious mold damage, maintenance and effective management of mold and dampness requires an ongoing strategy involving occupants, building owners and managers, ventilation experts and occupational hygiene professionals

2. Based on the application of existing methods to analyze air or dust samples, there are no quantitative, health-based microbial exposure guidelines or thresholds. Sampling data that may be developed during an investigation must be comprehensive and communicated in a form useful to physicians and allied professionals, building occupants and decision makers

3. Investigation and remediation of mold and moisture damage in buildings must be based on an informed inspection augmented by the judicious use of existing sampling methods, primarily for the purpose of detecting any hidden damage. The protection of remediation workers and occupants during renovations is essential

Published papers, including reviews:

Evaluation of exposure–response relationships for health effects of microbial bioaerosols – A systematic review (2015)

There is a lack of health-related exposure limits based on toxicological or epidemiological studies from environmental health or from the working environment. The aim of this study was to derive health-based exposure limits for bioaerosols that can protect the general population as group “at risk” via environmental exposure using analysis of peer-reviewed studies related to occupational medicine, indoor air and environmental health.

The bioaerosol expert network concluded that none of the analyzed studies provided suitable dose–response relationships for derivation of exposure limits.

The main reasons were:

1. lack of studies with valid dose–response data;
2. diversity of employed measuring methods for microorganisms and bioaerosol-emitting facilities;
3. heterogeneity of health effects;
4. insufficient exposure assessment.

Fungal secondary metabolites as harmful indoor air contaminants: 10 years on. (Miller 2014)

This was a mini-review – summarised the available data on the low molecular weight (LMW) toxins reliably known from fungi common to damp building materials, the toxins that had been measured on mouldy building materials, and the health effects to those living or working in damp and mouldy buildings.

It discussed particular associations of species with different building materials.

Respiratory and allergic health effects of dampness, mold, and dampness-related agents: a review of the epidemiologic evidence. Mendell Environ. Health Perspect. (2011).

The authors reported evidence from epidemiologic studies and meta-analyses showed indoor dampness or mould to be associated consistently with increased asthma development and exacerbation, current and ever diagnosis of asthma, dyspnoea, wheeze, cough, respiratory infections, bronchitis, allergic rhinitis, eczema, and upper respiratory tract symptoms.

Associations were found in allergic and non-allergic individuals. Evidence strongly suggested causation of asthma “exacerbation” in children.

Measured microbiologic agents in dust had limited suggestive associations, including both positive and negative associations for some agents.

Concluded the prevention and remediation of indoor dampness and mould are likely to reduce health risks, but current evidence does not support measuring specific indoor microbiologic factors to guide health-protective actions.

Residential dampness and molds and the risk of developing asthma: a systematic review and meta-analysis. **Quansah, R PLoS One.(2012).**

The authors concluded based on the evidence that dampness and molds in the home are determinants of developing asthma. The association of the presence of visible mold and especially mold odor to the risk of asthma points towards mold-related causal agents.

Associations between Fungal Species and Water-Damaged Building Materials. Andersen. (2011)

This is a commonly quoted publication. The aim of the study was to estimate the qualitative and quantitative diversity of fungi growing on damp or water-damaged building materials.

More than 5,000 samples were taken from building materials with visible fungal growth and they found that *Penicillium chrysogenum* and *Aspergillus versicolor* to be the most common fungal species in water-damaged buildings. The results also showed *Chaetomium* spp., *Acremonium* spp., and *Ulocladium* spp.to be very common on damp building materials

Health Effects of Mycotoxins: A toxicological Overview. Fung. Journal of Toxicology. 2004

This review of scientific literature revealed a linkage between ingesting mycotoxin contaminated food and illness, especially hepatic, gastrointestinal, and carcinogenic diseases.

They concluded that although there is agreement that diet is the main source of mycotoxin exposure, specific health effects and risk assessment from indoor non-agricultural exposure are limited by the paucity of scientific evidence currently available.

Further research on the health effects of inhaling mycotoxins in indoor settings is needed.

Knibbs, Luke D., et al. "Damp housing, gas stoves, and the burden of childhood asthma in Australia." *The Medical Journal of Australia* 208.7 (2018): 299-302.

“Objective: To determine the proportion of the national childhood asthma burden associated with exposure to dampness and gas stoves in Australian homes.

Design: Comparative risk assessment modelling study. Setting, participants: Australian children aged 14 years or less, 2011.

Main outcome measures: The population attributable fractions (PAFs) and number of disability-adjusted life years (DALYs) for childhood asthma associated with exposure to damp housing and gas stoves.

Results: 26.1% of Australian homes have dampness problems and 38.2% have natural gas as the main energy source for cooktop stoves.

The PAF for childhood asthma attributable to damp housing was 7.9% (95% CI, 3.2e12.6%), causing 1760 disability-adjusted life years (DALYs; 95% CI, 416e3104 DALYs), or 42 DALYs/100 000 children.

The PAF associated with gas stoves was 12.3% (95% CI, 8.9e15.8%), corresponding to 2756 DALYs (95% CI, 1271e4242), or 67 DALYs/100 000 children.

If all homes with gas stoves were fitted with high efficiency range hoods to vent gas combustion products outdoors, the PAF and burden estimates were reduced to 3.4% (95% CI, 2.2e4.6%) and 761 DALYs (95% CI, 322e1199).

Conclusions: Exposure to damp housing and gas stoves is common in Australia, and is associated with a considerable proportion of the childhood asthma burden. Strategies for reducing exposure to indoor dampness and gas combustion products should be communicated to parents of children with or at risk of asthma.”

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