Royal College of Paediatrics and Child Health
Leading the way in Children's Health

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# Effects of Indoor Air Quality on Children and Young People's Health
# Call for Evidence

## Background

The Royal College of Paediatrics and Child Health (RCPCH), in collaboration with the Royal College of Physicians (RCP), has established an Indoor Air Quality Working Group. The Working Group's aim is to produce an evidence-based report on the issues affecting the health of infants, children and young people exposed to poor indoor air quality in homes and schools, considering both indoor and outdoor sources of pollution. Indoor air quality refers to any airborne chemical or biological pollutants, as well as heat and moisture conditions. This work builds on the *Every breath we take: the lifelong impact of air pollution* report published by the RCP and RCPCH in 2016.

Responses to this call for evidence will feed into a report being developed by the Indoor Air Quality Working Group. The report will raise awareness of existing evidence relating to indoor air quality and child health, make recommendations based on the available evidence, and highlight key areas where future research is needed.

## Guidance for respondents

Your contribution to this consultation is greatly appreciated. Please note the following guidance for respondents:

- Please submit your response using the template provided below. Completed templates should be submitted as a MS Word file (not PDF) and not contain any logos, embedded pictures or macros.
- Submissions should be based on published literature wherever possible, with the literature referenced and electronic links provided. References may be provided in any style, as either footnotes or endnotes.
- Please submit your response as a single document. If you would like to add any annexes or appendices, please include these in the same document.
- Please try to be concise – we have given a maximum word count **for each section** below.
- Please focus on indoor air quality in **homes** and **schools**, wherever possible. For the purposes of this project, school settings include nurseries and preschools.
- Submissions specifically focused on the UK are welcomed. Where responses draw on evidence from other countries, please ensure this is clearly indicated.
- Please note which consultation question(s) you are answering where indicated in the template. If you do not do so, it may not be possible for your submission to be considered.

The consultation questions are intentionally broad, and some directed to particular professional groups in order for us to collect as comprehensive a range of perspectives as possible. **If you feel that any questions are not relevant to your knowledge or experience, you may choose to omit them.**

## Deadline

Please send your submission to iaq@rcpch.ac.uk by **midday**, **20th December 2018**. If you have any questions regarding this call for evidence or the wider project, please contact us via iaq@rcpch.ac.uk.

We very much look forward to receiving your submission, which will contribute to improving our understanding of indoor air quality to benefit the health of infants, children and young people.

## Questions for consultation (answer only applicable questions)

### About you **(required)**

1. Please provide your name and role. If you are responding on behalf of an organisation, please state this here. Please also briefly describe your motivation for submitting evidence – for example, this may be organisational or personal interest.

### Section 1: Your experience (max. 500 words)

2. Are you, and/or your organisation, aware of any issues of poor indoor air quality in home or school environments and its effects on the health of infants, children and young people? (Please provide supporting evidence)

### Section 2: Health effects (max. 1,000 words)

3. What are your views on the effects of indoor air pollution on pregnancy and the future health of children after they are born? (Please provide supporting evidence where possible)

4. We are very interested in hearing your views on the quality of indoor air in homes and schools and whether this affects the health of infants, children and young people. (Please provide supporting evidence where possible)

5. There are many substances that escape into the air indoors, including chemical and biological pollutants (those pollutants derived from living organisms such as bacterial, fungal and viral products). Which substances and/or pollutants do you believe pose the greatest risk to the health of infants, children and young people both in the short- and long-term? (Please provide supporting evidence where possible)

6. Which other indoor air quality factors (e.g. temperature, moisture) do you think pose the greatest risk to the health of infants, children and young people in the short- and long-term? (Please provide supporting evidence where possible)

### Section 3: Factors driving exposure (max. 1,000 words)

7. In your view, which sources of pollution dominate in determining the quality of indoor air in homes and schools? (Please provide supporting evidence where possible)

8. Which building materials (e.g. interior finishes, furniture) do you understand affect indoor air quality the most in homes and schools? (Please provide supporting evidence where possible)

9. Which building characteristics (e.g. construction, heating and ventilation systems) do you understand affect the quality of indoor air in homes and schools? (Please provide supporting evidence where possible)

10. What factors have the greatest influence on heating and/or poor moisture conditions (e.g. those related to mould growth) in homes and schools? (Please provide supporting evidence where possible)

11. What type of occupant activities (e.g. consumer product use, cooking, heating) do you understand influence indoor air quality and the heat and moisture conditions in homes and schools? (Please provide supporting evidence where possible)

## Section 4: Measuring exposure and outcomes (max. 1,000 words)

12. What do you believe are the most appropriate ways of measuring and quantifying the levels of indoor air pollution for investigating adverse health effects in communities? (Please provide supporting evidence where possible)

13. What are your views on the roles of outdoor air pollutants on the quality of indoor air in homes and schools? (Please provide supporting evidence where possible)

14. What are the levels of indoor pollutants that may cause short-term health effects, including the worsening of existing diseases, in infants, children and young people? (Please provide supporting evidence where possible)

15. What are the levels of indoor pollutants that are detrimental to the long-term health of infants, children and young people? (Please provide supporting evidence where possible)

16. At what level is indoor exposure to heat and/or damp/moisture detrimental to the short- or long-term health of infants, children and young people? (Please provide supporting evidence where possible)

## Section 5: Prevention and interventions (max. 1,000 words)

17. Can you provide evidence of which interventions can be used to prevent the presence of harmful indoor air pollutants and reduce excessive levels of heat and moisture in homes and schools? (Please provide supporting evidence where possible)

18. How should homes and schools be designed, constructed and used to improve children's exposure to cleaner air? (Please provide supporting evidence where possible)

19. How effective do you understand filtering systems, such as personal or household devices, are at reducing exposure to indoor air pollution? (Please provide supporting evidence where possible)

20. How can ventilation provision be used to minimise infants', children's and young people's exposure to poor indoor air quality in homes and schools? (Please provide supporting evidence where possible)

21. Are you aware of any evidence on the clinical efficacy and effectiveness of interventions to reduce exposure to, and/or health effects of, poor indoor air quality for infants, children and young people in homes and schools? (Please provide supporting evidence where possible)

22. Should we seek to try to remove all pollutants or just some, based on their effect on the health of infants, children and young people? (Please provide supporting evidence where possible)

## Section 6: Interacting factors (max. 1,000 words)

23. Across environmental, climate, construction and health and safety legislation in the UK, what is currently in place that relates to indoor air quality? Are you aware of any other relevant legislation or policy?

24. What do you understand is the true cost (both direct and indirect) of poor indoor air quality to infants, children and young people? What metric(s) best represents this cost?

25. How do the risks of poor indoor air quality inform building and furniture design decisions? (Please provide supporting evidence where possible)

**For built environment professionals who include indoor air quality in their design thinking:**

26. How do you do so alongside efforts to improve energy efficiency?

## Section 7: **For respondents with technical building expertise** (max. 1,000 words)

27. What do you understand are the most appropriate metrics for describing indoor air quality?

28. How are homes and schools designed to provide the best indoor air quality? What are the main drivers for design?

29. What external factors (e.g. roads, building form, urban design and urban heat island) may affect indoor air quality? (Please provide supporting evidence where possible)

30. In relation to urban environments in the UK where outdoor air is more polluted than indoor air, at what air change rate does ingress of pollutants outweigh the reduced exposure benefits of ventilation? (Please provide supporting evidence where possible)

31. Can you provide any experimental evidence (not modelled) of how different levels of air changes per hour impact on indoor air quality? (Please provide supporting evidence where possible)

32. Are there data demonstrating seasonal variation in the presence and levels of indoor air pollutants? If so, does this vary on a daily temporal basis or based on the different climate regions of the UK? (Please provide supporting evidence where possible)

33. Is there experimental evidence (not modelled) of how pollutants in homes and schools travel in space from their source, how they dilute and mix, and how long they persist? Do meteorological or ventilation conditions or other building characteristics influence this? If so, how? (Please provide supporting evidence where possible)

34. Is there experimental evidence (not modelled) of how pollutants infiltrate from outdoors into indoor home or school environments? (Please provide supporting evidence where possible)

35. Are there any other specific issues relating to indoor air quality in homes and schools that you wish to draw to the Working Group's attention, that are not covered by the questions above? (Please limit to 200 words)

## Submission template

Please use the template below to record your responses. Please remember to indicate which question(s) you are responding to, and include your references.

**About you (required)**

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| **Name** | **Dr Anna Watson** |
| **Role** | **Head of Advocacy** |
| **Organisation (if applicable)** | **CHEM Trust -** |
| **Contact email** | **anna.watson@chemtrust.org** |
| **Motivation for submission** | CHEM Trust is a UK registered charity that works at European, UK and International levels to prevent man-made chemicals from causing long term damage to wildlife or humans, by ensuring that chemicals which cause such harm are substituted with safer alternatives.<br><br>We particularly focus on endocrine disrupting chemicals (EDCs), and on the EU's main chemicals regulation REACH. |

| **Question number:** | **Response:** |
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| 2, 3, 4, 5, 6. | Are you, and/or your organisation, aware of any issues of poor indoor air quality in home or school environments and its effects on the health of infants, children and young people? (Please provide supporting evidence)<br><br>We welcome the opportunity to input to this consultation as we know there is strong evidence of a link between chemicals in indoor air and human health concerns. However, there has been little debate about this in the public health sphere in the UK. |

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| | Both children and adults in the Western Hemisphere spend a large amount of their time indoors. This means that we need to understand the link between indoor air quality and public health.<br><br>Many everyday consumer products and building materials including soft furnishings, electronic goods, cleaning products, wall and floor coverings contain chemicals that leach, migrate, off-gas and are worn off products resulting in exposure to humans. (1,2). Chemicals such as phthalates, phenols, perfluoroalkyl substances (PFASs) and flame retardants have all been found in household dust (3). And subsequently adults, children and the unborn child are exposed to these chemicals within the home environment.<br><br>**Some chemicals of concern in household dust.**<br><br>**Brominated flame retardants, including polybrominated diphenyl ethers (PBDEs)** are widespread contaminants of the environment and the human body. Although Octa and Penta BDE are now banned, and DecaBDE is also being restricted in the EU, exposure to PBDEs is still widespread from their use as flame retardants in existing consumer products such as furniture, building materials, textiles and electronics. They are blended physically and not chemically in these products which leads them to migrate into the environment and build up in household dust (4) These chemicals persist in the environment and some bioaccumulate, building up in the body over time.<br><br>PBDEs induce neurodevelopmental effects in rodents (5), and a recent Dutch review reported that PBDEs were associated with lower mental and psychomotor development and IQ in preschool children, and poorer attention in those of school age (6). Studies in US children also found decreases in attention, processing speed, fine motor coordination and cognition and poor working memory in pre-adolescent children (7). Earlier studies in the US had already reported that younger children, 1 to 6 years, showed lower mental and physical development (8). Researchers have also found a correlation between plasma PBDE levels and prevalence of hypothyroidism in Canadian women aged 30–50 years (9).<br><br>Research in Birmingham (10) has also found so-called ‘novel’ brominated flame retardants in dust, illustrative of the problem of companies moving from one chemical that is restricted to similar ones that are not (yet) restricted |

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| | **PFASs** are highly persistent and bioaccumulative chemicals with multiple industrial and food applications, in particular as non-stick or breathable coatings. Although some PFCs have been restricted, many are still in routine use. PFOA (perfluorooctanoic acid) and PFOS (perfluorooctane sulfonic acid) are the most researched members of this family, but there are a very large number of other PFCs in use. Blood stocks across the world have been shown to be contaminated with PFOA and PFOS. Human studies have found that certain PFCs interfere with normal thyroid hormone action (11). Thyroid hormones play a fundamental role in brain development during gestation and early life, and a decrease in thyroid hormone during pregnancy has been associated with impaired brain development. There is also evidence of negative effects on the immune system, with PFOA and PFOS at normal population levels been found to decrease the antibody response to tetanus vaccine in children in a cohort study in the Faroe islands (12).<br><br>**Phthalates** are a family of chemicals with multiple uses, the most common of which is as plasticizer to make hard plastic materials soft and flexible. Many consumer products including building materials, furnishings, clothing, paints, toys, medical devices, and pharmaceuticals (13) contain phthalates. Three members of this class of chemicals, dibutyl phthalate (DBP), benzylbutyl phthalate (BBP) and diethylhexyl phthalate (DEHP), are best known for their anti-androgenic properties and association with altered reproductive organ development in boys (14). Emerging human evidence shows suggestive but not consistent data regarding the relationship between exposure to phthalates before birth and children's cognitive development. A US study showed persistent association between certain maternal urinary phthalates and IQ loss in children age 7 years (15). However, a European study found no association with cognitive, psychomotor or behavioural development (16). Another US study found that urine levels of some phthalates in children were associated with increased odds of attention deficit disorder (ADD) and learning disabilities at ages 6-15 years (17). The use of a number of phthalates is the process of being restricted at EU level but, as with brominated flame retardants, they will remain as contaminants of our houses and workplaces.<br><br>**Bisphenol A (BPA)** is a well-known endocrine disruptor due to both its current widespread use in consumer products as well as the extraordinary number of studies demonstrating its adverse health effects, often at low doses, in animals, as well as studies that associate exposure with health effects in people. BPA has been found in people's urine |

worldwide, with most studies showing a detection frequency of over 90% (18). A study published by the German Environment Agency in 2009 found BPA in the urine of in 591 out of 599 children between 3 and 14 years old (19). BPA is a high-production volume chemical used to make plastics and polymers commonly used in food manufacturing and packaging and many consumer products. BPA's effects on animal behaviour have been reported for many years (20,21). More recently, emerging human data suggests that similar adverse effects may occur in children. For example, it has been described that Spanish children with higher concentrations of BPA in urine had worse behavioural scores and social problems (22). In the US, pre-teen and teenage children with higher BPA in urine had a higher prevalence of ADHD (23). A 2016 systematic review of studies in children younger than 12 years found that prenatal exposure to maternal BPA was related to higher levels of anxiety, depression, aggression, hyperactivity, inattention, and conduct problems in children (24). A number of other bisphenols are also in use, with similar toxic properties (see http://www.chemtrust.org/toxicsoup/ )

## Regulation of these chemicals

The chemicals of concern mentioned above are all regulated in the EU by REACH (Regulation, Evaluation, Authorisation and restriction of chemicals) and related laws. It aims to ensure that chemicals are safely manufactured and used, so as to protect human health and the environment, at the same time as enhancing innovation and the competitiveness of EU industry. REACH includes requirements on companies to provide - and use - safety information on chemicals, and provides mechanisms to ban or control the use of particularly problematic chemicals.

The European Union has the most sophisticated regulations in the world for controlling chemical use. However, there are a number of key flaws in this system to protect the most vulnerable in society – children and the unborn child:

- There's often inadequate safety information about individual chemicals, including a lack of information about neurodevelopmental effects.
- The processes to ban chemicals are too slow, and the restrictions created often have big loopholes as a result of industry lobbying.
- Chemicals are addressed one at a time, so one chemical may have its use restricted, but closely related chemicals remain in use (with use often increasing due to the restriction on the other chemical).

- We are always exposed to multiple chemicals, but regulations almost always assume we are only exposed to one at a time, even though numerous scientists have shown that chemical effects can add together in our bodies.

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Thank you for your response. Please send your submission to: iaq@rcpch.ac.uk