POOR INDOOR AIR QUALITY AND LUNG DISEASE

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The damage air pollution can pose to lung health for people with existing lung conditions, the general population and those still in the womb is widely understood amongst the medical community. Awareness amongst the general population is also growing steadily, particularly in high income countries; however, we don’t always focus on the right places. This article draws attention to harmful indoor air and its global impact.

Indoor air pollution is the 8th most important risk factor for disease and is responsible for an estimated 2.7% of the global burden of all diseases.

In the short term, being exposed to air pollution can trigger respiratory symptoms and, among people with asthma or chronic obstructive pulmonary disease (COPD), can cause an attack or an exacerbation. Data from high income countries show that long-term exposure to air pollution takes an average of 6 months off a person’s life although there are major variations. Exposure to air pollution is much higher in low and middle income countries and, although we do not have the data to show it, the impact is probably much higher in these places. The impact of breathing in polluted air is more pronounced among vulnerable groups in our societies: children, older people and those with existing heart and lung conditions.

INDOOR AIR POLLUTION

Much of the research and attention regarding the effects of air pollution on health has focused on outdoor rather than indoor sources of air pollution. However, most of us spend the majority of our time in an indoor rather than an outdoor environment. Arguably we can, as individuals, exercise much more control over the quality of the air that we breathe within our homes and workplaces than in the outdoor environment, which requires high-level engagement across borders and across sectors.

In a 2016 global report on clean household energy for health, sustainable development and wellbeing, published by the World Health Organization (WHO), household air pollution was named as the single most important environmental risk factor for health worldwide. The danger is most acute for women and children, who are often at home breathing in thick smoke as they cook and heat their homes.

According to figures from the WHO, of the 7 million premature deaths attributable to exposure to air pollution worldwide in 2012, 4.3 million were linked to indoor air pollution. Household indoor air pollution comes in many different forms including second-hand tobacco smoke, smoke from the burning of biomass fuels for cooking, heating and lighting, dust, mould, and fungus. A staggering proportion of these premature
 deaths, over 99%, occurred in low and middle income countries. Here, smoke from the burning of biomass fuels within the home and second-hand tobacco smoke are the most problematic sources.

Around 50% of the world population (about 3 billion people) are exposed to indoor air pollution from open fires and wood-burning stoves.

**Addressing indoor air pollution in low and middle income countries**

The FRESH AIR project (Free Respiratory Evaluation and Smoke-exposure reduction by primary Health care Integrated gRoups) is an implementation science project funded by the European Union’s Horizon 2020 research and innovation programme. It aims to improve the prevention, diagnosis and treatment of non-communicable lung diseases in low and middle income countries, as well as other low-resource settings (figure 1). To achieve these aims the project is focusing on smoke from biomass fuels and tobacco as particular risk factors and is collaborating with local partners in four countries, all of which have a high prevalence of both household exposure to poor air quality and chronic lung conditions, namely: Uganda, Vietnam, the Kyrgyz Republic and Greece.

Education, prevention and treatment measures to help people stop smoking are widely available in higher income countries, as are cleaner fuels for cooking, lighting and heating. In lower and middle income countries, there is a lack of resources to tackle these causes of lung disease, combined with a low level of awareness of both the diseases and their risk factors. In communication terms, there is a need to address both the perception of hazard and a sense of outrage in order to make change happen.

**Figure 1.** Reproduced from Cragg L, Williams S, Chavannes NH, et al. npj Prim Care Respir Med 2016; 26: 16035 (CC BY 4.0).

**Empowering people through education**

Awareness of noncommunicable diseases tends to be low among many of the communities involved in FRESH AIR. While there is a general
understanding of the risks for infectious diseases such as malaria, HIV and tuberculosis, of the interventions available, and of the success stories in terms of behaviour change and access to treatment, education about long-term chronic diseases like COPD and asthma lags behind, particularly when symptoms such as cough and fatigue have many alternative explanations. In order to educate people about how chronic diseases like asthma and COPD develop, and how to manage them, it is first necessary to teach them about how the body functions and the impact of smoke upon it. Education as a low-technology solution is an essential component of the FRESH AIR project. Many of the actions taken across the different locations involve a “teach the teacher” approach, both working with and also educating healthcare professionals, community health workers and other volunteers about possible interventions, so that these local leaders can devise solutions appropriate for their context and resources.

In the Masindi district of Uganda, community health workers have been taught about lung health and use specially designed flip-over books, approved by the Ministry of Health, to teach the local communities. This is accompanied by a project introducing several new types of stove, supported by the energy partnership Energising Development (EnDev), to see which are preferred by the women and which are most effective in reducing smoke exposure.

**Stoves for cooking and heating**

All locations involved in the FRESH AIR project fall on the lower rungs of the energy ladder (figure 2), relying on the burning of different biomass fuels including animal dung and wood for cooking and/or heating or kerosene lamps for lighting. Until cleaner fuel is available, improved ventilation and improved stoves need to be found.

The situation is particularly extreme in the highlands of the Kyrgyz Republic, where biomass is burned indoors for both cooking and heating purposes. Highlanders stay indoors for the coldest 8 months of the year, keeping the ventilation holes of their yurts closed to retain heat while also increasing their exposure to indoor air pollution. To tackle this, it has been necessary to work with the World Bank, which is testing a number of stoves to improve fuel efficiency as part of poverty reduction measures, in order to find a low-cost stove that can generate heat without increasing air pollution (figure 3).

In a FRESH AIR associated project, Prof. Onno van Schayck has been leading research on tackling indoor air pollution from stoves and its effects on respiratory health in Bangalore, taking a co-creational approach with local women. His team has looked at previous unsuccessful new stove interventions and they found a common factor; namely that new stoves were not affordable and women were not involved in defining their needs. The new stoves cooked food too fast, when a long, slow cooking period was required, and the ring on the stove was too small for the pots the women used. This lack of understanding meant that people either never used the new stove, or initially used it before switching back to the old one. Professor van Schayck’s team has been working with local families to co-design a stove.
that meets their cooking needs as well as having an impact on their lung health.

Results from the “Up in Smoke” project in India suggest that improved cooking stoves can reduce indoor air pollution, improve health and decrease emissions. However, while smoke inhalation initially falls, this effect is reduced by year two. The project, which had a primary objective of fuel economy rather than health, found that households did not clean or maintain the stoves and that usage declined over time. This study underscores the need to test new environmental technologies in real-world settings where behaviour may undermine impact. Ultimately, the evidence suggests that changing stoves is not the long-term answer but that changing fuels is. However, this is even more challenging to governments and communities.

Smoking cessation

Second-hand smoke is often overlooked as a major source of air pollution. Not only does tobacco smoke compromise the lung health of the person actively smoking but also those around them who breathe it in. This effect is particularly pronounced in the womb and for infants and children. Exposure to second-hand smoke at such crucial stages of development can limit overall lung capacity which can never be recovered. Many high-income countries are deploying the various interventions that have been proven effective in treating tobacco dependence to help people quit smoking with great success, including the “five A’s”, counselling and pharmacotherapy. However, these interventions are not being used widely enough, especially in low and middle income countries. In the context of FRESH AIR, tobacco smoking rates are particularly concerning in the Kyrgyz Republic, Vietnam and Greece. While all of the countries grow some tobacco the acceptability of smoking is higher than in many high-income countries, which creates an additional hurdle.

If Article 14 of the World Health Organization Framework Convention on Tobacco Control, which focuses on reducing tobacco dependence and encouraging smoking cessation, is to be fully implemented to benefit as many people as possible, more resources must be invested into helping people quit smoking. This should include clinical education, reframing smoking as tobacco dependence for which there are effective treatments, and improving access to low-cost pharmacotherapy which significantly improves the chances of quitting. The FRESH AIR project’s “Teach the Teacher” model is used to introduce “Very Brief Advice”, the “three A’s”, which is adapted to fit the local context in terms of the availability of specialist staff and of pharmacotherapy.

Pulmonary rehabilitation

Pulmonary rehabilitation programmes, often in the form of 6–8 week intensive programmes delivered by healthcare professionals in clinical settings, have proved highly effective in many high-income countries. Indeed tailoring an exercise and education programme to a patient can reduce the participant’s breathlessness and help to increase their coping abilities. In Crete, implementation of pulmonary rehabilitation has been tested and has met with an enthusiastic response from healthcare professionals and the community (figure 4). However, since the health centres lack the funds to run them, and people are often unable to afford to travel to the centres, the local partners are experimenting with offering home-based pulmonary rehabilitation. If successful, this could be an example of a pared-down intervention that benefits people’s lung health despite living in a resource-limited area.

Using technology

There are many technical challenges for the FRESH AIR project, but there are also a number of technical solutions.

Technology to measure the problem

One challenge for FRESH AIR has been how to measure the problem of air pollution in low and middle income settings. Air quality monitors are useful in defining the problem and also in keeping track of whether air quality is improving through the intervention of the project. Particulate exposure monitors have been used to measure fine particulate matter (PM$_{2.5}$) but the project has found it difficult to find a product that is affordable, portable and robust, as well as being able to cope with very high densities of PM$_{2.5}$.

In August 2017 we will be introducing each of the project teams to Spirosmart® smartphone technology. This technology, developed at the University of Washington, uses the microphone of a smartphone as a spirometer. The university is already working with the FRESH AIR countries, providing distance learning on a programme called Spirometry 360, which supports the learners by giving remote online review and interpretation of spirometry curves from a normal spirometer so that clinicians can improve their ability to interpret spirometry.
Technology to treat the problem

Relatively low cost devices, such as expired air carbon monoxide (CO) monitors, are now becoming more widely available in high income countries and are proving an effective motivational tool to help people quit smoking. However, these are not as yet available for testing in the FRESH AIR project.

The BabyClear study, which was published recently in Tobacco Control, looked at whether using CO monitors could support pregnant women with quitting smoking. It was carried out in the North East of England where one in five pregnant women are smokers. Most pregnant women in the UK know about the health implications of smoking during pregnancy, for both themselves and their babies, and so are not likely to admit to being smokers.

As part of the BabyClear study, midwives used CO monitors to screen pregnant women for their smoking status, which facilitated an open conversation about the risks of smoking while pregnant and enabled the midwives to refer them to smoking cessation services. This process was found to double a woman’s chances of quitting smoking and, by the end of the study, smoking rates among pregnant women were down by a third.

CONCLUSIONS

According to the World Health Organization, over 90% of COPD deaths and over 80% of asthma deaths occur in low and middle income countries. In these countries, individuals need to be aware of indoor air pollution, including tobacco smoke and biomass smoke, and its impact on their health and on the health of their children. There are effective treatments for tobacco dependence and it is a clinical responsibility to diagnose and treat it. Dealing with indoor air pollution from cooking and heating sits within a wider socio-economic context and this must be accomplished in concert with other agencies.

FRESH AIR is partly about helping people to understand why indoor air pollution is an issue and improving health may be the best motivation for change. Indeed, helping people understand that they need to protect their children’s health may be an important driver.

For FRESH AIR, the models that are likely to work are about co-creating solutions and using technology that is both affordable and sustainable (easy to use, easy to clean and easy to repair). Such processes should also involve local people, so that the findings regarding implementation are useful and can therefore be scaled up. Many of us find using new technology hard at first and it’s easy to give up on it. Let’s make it easy to do the things that will improve lung health and reduce early death!

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CONFLICT OF INTEREST

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RECOMMENDED READING