



Child survival and environmental health

Abstract

This fact sheet looks at the role of environmental health in improving child survival, focussing on three important causes of child mortality; acute respiratory infection (ARI), diarrhoeal disease and unintentional injury (including drowning and poisoning). A broad overview is presented. Specific details of implementing interventions are not considered.

Introduction

As one of the Millennium Development Goals, the United Nations have agreed to the target of reducing the mortality rate of children under five by two-thirds by the year 2015. The magnitude of this challenge is illustrated in Figure 1. The graph also highlights the enormous disparity between child mortality rates in ‘developing’ and ‘developed’ countries (as defined by UNICEF and WHO).

Causes of child mortality

Figure 2 below shows child mortality figures by cause for 2002. The picture will be a familiar one to many, with almost half of child mortality being caused by five preventable infectious diseases. A substantial proportion of the category ‘Other’ is made up of unintentional injuries.

What may be less familiar is the important role played by environmental health hazards in maintaining this situation, and hence the great potential of environmental health interventions to improve it. It has been estimated that environmental health hazards account for at least 25 per cent of the overall burden of disease worldwide (Smith et al., 1999), the vast majority of this being borne by developing countries. Diarrhoeal disease and ARI between them account for half of the global burden of *environmentally related* disease, with children accounting for most of the mortality from these causes. Unintentional injuries make up a further 14 per cent of the global *environmentally related* disease burden, and these too are important causes of child mortality.

The sections below consider in more detail the role of environmental health in reducing child mortality from three important causes: ARI, diarrhoea and unintentional injuries.

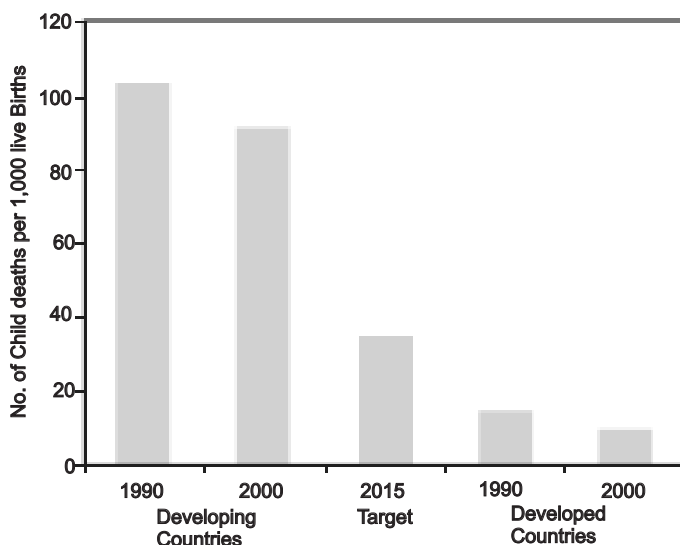


Figure 1: Morality rates for children under five

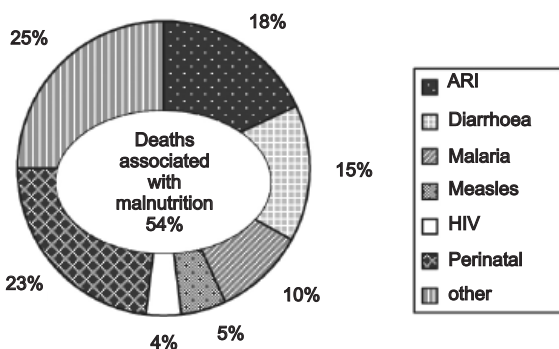


Figure 2. Mortality among children under five, worldwide, 2002
Source: Cause-specific mortality rates from EIP/WHO

Acute respiratory infection

Indoor air pollution: an environmental risk factor. ARI is the leading cause of death in children under five years in developing countries. The evidence for a link between indoor air pollution (IAP) and ARI in children has grown over the past ten years (Bruce et al., 2000; Smith et al., 2000) and according to WHO, nearly half of ARI mortality among under-fives can be attributed to IAP (WHO, 2004).

Globally, the most important source of indoor air pollution, with regard to childhood ARI, is biomass fuels used in domestic stoves and fires. Currently around three billion people rely on biomass fuels (Bruce et al., 2000). The majority of published studies report that children who are exposed to IAP are between two and five times more likely to experience ARI (Bruce et al., 2000; Smith et al., 2000). The problem is particularly acute for poor households who lack adequate household ventilation, lack efficient stoves and whose income restricts their choice of fuel type.

Child survival and environmental health

At present all of the available data on health impacts come from observational studies. In these studies health measures are compared across households that already use different stoves or fuels. Such studies suffer a major drawback because households that use different stoves or fuels may also differ with respect to other factors that influence their health (wealth being one common example). This problem is known as confounding. To overcome this problem there is a need for rigorous intervention studies in which participating households are assigned at random to either receive or not receive the different stove or fuel types under investigation. There is also an urgent need for information on the dose response rates for different pollutants. These in turn require the development of effective standardised techniques for measuring exposure (von Schirnding et al., 2002).

Reducing exposure to IAP. Possible environmental and behavioural interventions to reduce exposure to IAP from biomass fuels include: reducing pollution by switching to cleaner fuels, and/or by using cleaner stoves, removing pollution through increased ventilation and the use of hoods or chimneys, and reducing the exposure of children by excluding them from the cooking area.

Although no study of the health impact of any intervention has yet been completed, one study is currently underway in Guatemala looking at the effectiveness of an improved wood-burning stove (<http://ehs.sph.berkeley.edu/guat/>). A small study in Kenya (ITDG, 2002) found that smoke hoods were more effective at reducing IAP than improved stoves. However, the Kenyan stoves were very different from those being trialled in Guatemala. Cultural variations in cooking practices, house design and patterns of fuel use rule out the possibility of a one-size-fits-all solution and necessitate close attention to local preferences. This complicates the search for effective interventions.

The switch from biomass to a cleaner fuel such as charcoal, kerosene, liquid petroleum gas or electricity can reduce levels of indoor air pollution. However, this option is not likely to be affordable for the vast majority of poor households in the foreseeable future (USAID, 2000). Fuel switching is a long-term strategy (15-30 years) that would need to be implemented within an appropriate policy framework (Goldemberg, 2000).

One lesson that has emerged from interventions to date is that the indiscriminate use of government subsidies to encourage fuel switching tends to bring the greatest benefits to the wealthier urban households that consume more fuel (Ballard-Tremere and Mathee, 2000), and who are unlikely to use biomass fuels anyway.

Handwashing to prevent ARI? Washing hands thoroughly at critical times is accepted as an effective intervention against diarrhoeal disease (see below). Evidence is now growing for its effectiveness against respiratory infections. Published studies to date relate to the less severe, viral infections in developed country populations so the potential for this intervention to reduce deadly bacterial pneumonia in developing countries is not known although an initial study is currently underway (Cairncross, 2003).

Diarrhoeal disease

Diarrhoeal disease causes 15% of all child deaths worldwide. There are environmental interventions for the control of diarrhoeal disease that are accepted as effective and feasible. The most important among these are safe sanitation and hygiene practices, the latter of which depend on the provision of an adequate water supply (Huttly et al., 1997). It is estimated that 1.7 million deaths annually result from inadequate access to water and sanitation and inadequate hygiene practices (WHO, 2002). The majority of these deaths are from diarrhoeal disease in children. The majority of this disease is endemic and hygiene related and is not due to waterborne epidemics.

A recent literature review (Curtis and Cairncross, 2003) suggests that washing hands with soap at key times can reduce severe diarrhoea by over 50% and could thus prevent one million diarrhoeal deaths annually.

Improvements in domestic hygiene practices can be brought about by hygiene promotion. Delivering effective hygiene promotion on a large scale is now a major public health challenge and there is growing interest in applying commercial marketing techniques to this problem (Curtis, 2002). Effective hygiene practices rely on access to convenient water supplies. Domestic water use declines when collection times exceed about 30 minutes and increases dramatically when household connections are provided (Cairncross et al., 2003). Water supply interventions need to take this pattern into account, recognizing that improving access over the intervening range will have a minimal effect on consumption patterns.

One other environmental intervention that may offer possibilities for the reduction of diarrhoeal disease mortality is fly control. Recent studies (Chavasse et al., 1999), Emerson et al., 1999) found significant reductions in diarrhoea incidence during the peak fly season, following spraying of villages with insecticide. As a long-term solution, the use of insecticide sprays is not an option because of its high cost and the likely development of resistance among the fly population. The use of baited fly traps may offer an alternative. However, findings relating to the effectiveness of traps have so far been contradictory, and effective sanitation may present a better option for long-term fly control.

Unintentional injuries, drowning and poisoning

Historically, injuries have received little attention as a public health problem and have tended to be viewed as random events allowing little scope for intervention. However, there are patterns in the burden of injury related to exposure to hazards in the environment and there have been successful interventions to reduce injury (Sethi and Zwi, 1999).

Children suffer a disproportionate share of injuries. The under-fives, for example make up 10% of the population but account for 22% of the total global burden of injury-related ill-health (Murray and Lopez, 1996). Children's behaviour makes them more

susceptible to accidental injury while their physical characteristics, such as large head to body ratio, thin epidermis and smaller airways, increase the likelihood of serious or fatal outcomes. The importance of childhood injuries as a public health issue in developing countries is growing. This is partly a reflection of the declining importance of infectious disease, but also a result of increasing urbanization and motorization of societies, and the additional risks that these changes bring (Deen et al., 1999). Low- and middle-income countries have rates of child deaths by injury that are five times higher than those in higher-income countries and account for 98% of all child injury mortality (Bartlett, 2002).

Falls, poisoning, drowning and burns are seen as the greatest accidental mortality risks for the under-fives (Zwi et al., 2001). However, the types of injury that occur are context specific. For example, kerosene poisoning is related to the use of kerosene as a domestic fuel and drowning requires exposure to water. This means that the choice of interventions to prevent accidental injury will also be context-specific.

The literature is characterized by a lack of data from developing countries. There is thus an urgent need for improved monitoring and surveillance of injuries in developing countries to help fill this information gap.

Possible synergies with other environmental health interventions

Interestingly, among the suggested interventions listed by Bartlett (2002) for reducing childhood injuries are improved stove designs and improved sanitation. These are suggested to reduce the risks of burns and falls respectively. Bartlett (2002) also cites evidence that lack of parental supervision increases the risk of injury. Improved water supplies and more efficient stoves both have the potential to reduce the time spent, predominantly by women, away from the home collecting wood and water. This could conceivably allow more time for child supervision. Thus the potential for synergies between environmental health interventions exists. However, the specifics of different contexts, such as the nature of an improved stove, or a woman's priorities for her use of time, mean that these should not be taken for granted.

Some useful websites for further information

www.who.int/indoorair/en
(Indoor air pollution)

<http://www.practicalaction.org/>
(indoor air pollution, sanitation, hygiene and water supply)

www.lshtm.ac.uk/dcvbu/hygiencentre/
(Hygiene and sanitation)

www.lboro.ac.uk/well/
(Hygiene, sanitation, water supply and environmental health)

References

- Ballard-Tremeeer, G. and A. Mathee (2000) 'Review of interventions to reduce the exposure of women and young children to indoor air pollution in developing countries' paper prepared for US Agency for International Development (USAID) and World Health Organization (WHO) Global Consultation, *Health Impacts of Indoor Air Pollution and Household Energy in Developing Countries: Setting the Agenda for Action*, May 3-4, Washington D.C.
- Bartlett, S.N. (2002) 'The problem of children's injuries in low-income countries: a review'. *Health Policy Plan.* 17(1):1-13.
- Bruce, N., R. Perez-Padilla & R. Albalak (2000) 'Indoor air pollution in developing countries: a major environmental and public health challenge' in *Bulletin of the World Health Organization*, 78 (9), pp. 1078-1092.
- Cairncross, S. (2003) 'Handwashing with soap – a new way to prevent ARIs?' *Tropical Medicine and International Health* 8 (8) 677-679 Aug.
- Cairncross, S., O'Neill, D., McCoy, A., and Sethi, D., (2003) 'Health, Environment and the Burden of Disease; A Guidance Note'. Department for International Development. London.
- Chavasse, D.C., Shler, R.P., Murphy, O.A., Huttly, S.R.A., Cousens, S.N. and Akhtar, (1999) T. 'Impact of fly control on childhood diarrhoea in Pakistan: community-randomised trial', *The Lancet* 353 (9146): 22-25 Jan 2.
- Curtis, V., (2002). *Health in Your Hands: Lessons from Building Public-Private Partnerships for Washing Hands with Soap*. Water and Sanitation Program, World Bank, Washington.
- Curtis, V., and Cairncross, S. (2003). 'Effect of washing hands with soap on diarrhoea risk in the community: a systematic review'. *The Lancet Infectious Diseases*, 3, 275-281, May.
- Deen, J.L., Vos, T., Huttly, S.R.A., and Tulloch, J., (1999) 'Injuries and noncommunicable diseases: emerging health problems of children in developing countries'. *Bulletin of the World Health Organization*, 77 (6) 518-524.
- Emerson, P.M., Lindsay, S. W., Walraven, G.E.L., Faal, H., Bogh, C., Lowe, K., and Baily, R.L. (1999) *The Lancet* 353 1401-1403, April 24.
- Goldemberg, J. (2000) 'Rural energy in developing countries' Chapter 10 in *UNDP World Energy Assessment: Energy and the challenge of sustainability*, UNDP, New York.
- Huttly, S.R.A., Morris, S.S. and Pisani, V., (1997) 'Prevention of diarrhoea in young children in developing countries'. *Bulletin of the World Health Organization*, 75 (2): 163-174.
- ITDG (2002) 'Reducing indoor air pollution in rural households in Kenya: working with communities to find solutions'. ITDG project 1998-2001, January.

Child survival and environmental health

- Sethi, D. and Zwi, A.B. (1999) 'Accidents and other injuries'. In (eds.) Chamie J, Cliquet RL. *Health and Mortality Issues of Global Concern*. Proceedings of Symposium on Health and Mortality, Brussels, 19-22 November 1997, organised by the Population Division United Nations and CBGS. 412-441.
- Smith, K.R., Corvalan, C.F., and Kjellstrom, T. (1999). 'How much global ill health is attributable to environmental factors?' *Epidemiology* 10 (5): 573-584, Sept.
- Smith, K.R., J.M. Samet, I. Romieu & N. Bruce (2000) 'Indoor Air Pollution in Developing Countries and Acute Lower Respiratory Infections in Children' in *Thorax*, 55, pp. 518-532.
- USAID (2000) *Consultation on the Health Impacts of Indoor Air Pollution and Household Energy in Developing Countries: Setting the Agenda for Action*: summary report for participants, USAID and World Health Organization, May 3-4, Washington.
- von Schirnding, Y., Bruce, N., Smith, K., Ballard-Tremeer, G., Ezzati, M., and Lvovsky, K., (2002) *Addressing the impact of Household Energy and Indoor Air Pollution on the Health of the Poor: Implications for Policy Action and Intervention Measures*. Paper prepared for the Commission on Macroeconomics and Health. World Health Organization, Geneva. [online] http://www.who.int/mediacentre/events/H&SD_Plaq_no9.pdf [2004 March 17]. WHO (2004) [Online] http://www.who.int/indoorair/health_impacts/burden_global/en/ [2004 March 17].
- Zwi, A.B., Leon, D., Koupilova, I., Sethi, D., and McKee, M. (2001) 'Injuries, inequalities and health in Europe'. *Injury Control and Safety Promotion*, 8 (3) 143-148.

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