

THE UNIVERSITY *of York*

**A REVIEW OF THE ENVIRONMENTAL DIMENSION OF CHILDREN
AND YOUNG PEOPLE'S WELL-BEING**

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Meg Huby & Jonathan Bradshaw

University of York

Heslington

York YO10 5DD

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SECTION 1: BACKGROUND¹

There are numerous approaches to conceptualising and measuring the well-being of children. These vary considerably, depending on whether the main objective is the monitoring of child outcomes for policy-related purposes or the understanding of the underlying factors that create well-being and the interrelationships between different components of child well-being. Likewise, as Hanafin and Brooks (2005) point out, the different frameworks reflect differences in underlying perceptions of children, for example whether children are seen as having 'rights' or 'needs', or for example being interested in 'development', 'outcomes' or 'resilience'.

While there is no consensus about frameworks and definitions, all concepts have in common that they are inherently *multi-dimensional*, taking into account the complexity of children's lives and relationships. In this, concepts of child well-being are particularly helpful in broadening the discussion on poverty among children from a mainly income-focused perspective to a more comprehensive understanding of the multiple factors influencing children's life situations. The following gives a brief overview of some multinational and national initiatives on conceptualising child well-being mainly in rich countries.

From a cross-national perspective the *Multi-National Project for Monitoring and Measuring Children's Well-Being* (Ben-Arieh *et al.*, 2001) is particularly noteworthy. It is a collaborative effort of experts from a range of disciplines and countries. During the first stage (1996-2000) they worked together to conceptualise child well-being 'beyond survival' and to identify appropriate indicators. The second stage aims at putting this framework into practice by developing a valid scientific protocol for collecting data on child well-being and by building up a network of researchers that uses this protocol and collaborates on archiving and disseminating data. The project partners agreed on five main components of the well-being of children:

- ∞ Safety and physical status
- ∞ Personal life
- ∞ Civic life
- ∞ Children's economic resources and contributions
- ∞ Children's activities.

¹ The material in this section is adapted from Bradshaw *et al.* (2006)

While being both comprehensive and open in conceptualisation, the components have so far only partly been populated with data.

National approaches to developing and monitoring sets of indicators of child well-being are above all to be found in English-speaking countries. The US *Child Well-Being Index (CWI)* for example is a composite index measuring trends in child well-being since 1975 and is updated annually. It thus offers a unique opportunity for monitoring changes in children's well-being over a long period of time. Data is compared between states but not internationally. Twenty-eight national-level key indicators are collected in seven components (Land, 2005):

- ∞ Material well-being
- ∞ Health
- ∞ Safety/behavioural concerns
- ∞ Productive activity (educational attainment)
- ∞ Place in community (participation in schooling or work institutions)
- ∞ Social relationships (family, peers)
- ∞ Emotional/spiritual well-being.

While the components seem to be comprehensive, a look at the indicators shows that most information is available on children's economic situation, health and behavioural problems as well as education. The 'social relationship' component includes indicators on children growing up in single-parent households and the rate of children having moved within the last year. Emotional and spiritual well-being is measured by the suicide rate and the importance of religion to young people. The 'quality of relationships' and 'children's personal well-being' components thus seem to be underrepresented.

In the UK, Save the Children has recently published the second report on *The Well-being of Children in the UK* (Bradshaw and Mayhew, 2005), updating data presented in the first report 2002 (Bradshaw, 2002). The authors show trends for 60 indicators in 12 components over a – so far – three-year period and thus are able to give a more comprehensive picture of child well-being in the UK, including:

- ∞ Child demography
- ∞ Child poverty and deprivation
- ∞ Child health
- ∞ Child lifestyles
- ∞ Mental health and well-being
- ∞ Child time and space

- ∞ Child maltreatment
- ∞ In and leaving care
- ∞ Childcare
- ∞ Crime and illegal drug use
- ∞ Education
- ∞ Housing and neighbourhood.

In an equally comprehensive way the Irish National Children's Office has developed a set of 42 well-being and seven socio-demographic indicators to monitor the well-being of children in Ireland (Hanafin and Brooks, 2005). Though the indicators cover a similar range of issues as the Save the Children study, they are not grouped into components. While most of the indicators are linked to existing data sources, for some indicators these remain to be developed. One of the most interesting features of this project is the process of indicator development, particularly the participation of children and young people.

Children's views were elicited in three phases. In the first phase more than 250 children aged 8-19 used disposable cameras to take pictures of what well-being means to them. These were developed and returned to the children so that they could write comments on the back. In the second phase other groups of children sorted the photographs into different categories. In the final phase a third sample of children and young people was asked to create a schema representing the relationships between the categories. A group of young people then finally developed a model of child well-being based on the different categorisations, highlighting the areas children identified as most important for their well-being.

Family is identified by the children as the most important determinant of their well-being, followed by friends, school and pets on the one hand and basic goods (food, housing, bed) on the other. Well-being is created in relationships and the places they spend most of their time. Material goods and leisure activities on the other hand are seen as less essential. Other aspects of well-being seem to be taken for granted and do not form part of children's conceptualisations, notably health and safety. Children's views, such as the importance of pets, were incorporated into the final set of indicators (NicGabhainn and Sixsmith, 2005).

The studies presented above represent different ways to conceptualise well-being. Other projects apply concepts of child well-being in analysing the impacts of poverty on children's life situations, thus broadening understandings of child poverty. Bradshaw (2001; 2002), for example, examines child poverty in relation to four components of well-being:

- ∞ Physical well-being

- ∞ Cognitive well-being
- ∞ Behavioural well-being
- ∞ Subjective/mental well-being.

Aber *et al.* (2002) propose a set of eight components of well-being useful for understanding the social exclusion of children in the US. They differentiate between components of exclusion or inclusion they see as *necessary*, *normative* for the US society or *desirable*:

- ∞ Basic living
- ∞ Family economic participation
- ∞ Housing
- ∞ Health
- ∞ Education
- ∞ Public space
- ∞ Social participation
- ∞ Subjective experience of exclusion.

A different approach to understanding child poverty can be found in German research using the concept of lifestyle deprivation (*'Lebenslage'*). In recent years this concept has been used in a number of quantitative and qualitative studies on child poverty (see, for example, Hoelscher, 2003; Chassé *et al.*, 2003). These studies differ considerably in their methodologies and their operationalisation of poverty. Nevertheless, they all take a common view of children in a double role - as independent members of society and as dependants on their families - in analysing their experience and well-being.

This overview of projects and initiatives to operationalise and measure child well-being shows much common ground concerning the components and topics that should be included – families' economic situation, children's health, safety, education, emotional well-being and risk behaviour, but also, though less unanimously, the quality of relationships with family and friends, civic participation and leisure activities. Real discrepancies are only to be found in the choice of indicators and, where applicable, the categorisation of components.

These differences reflect researchers' views of the role of children in society, but also their values as to what constitutes a good life for children in a given society and what experiences they need for healthy development. However, these decisions, though implicit in the choice of indicators, are not always discussed.

SECTION 2: THE IMPACT OF THE ENVIRONMENT – A FRAMEWORK FOR ANALYSIS

The UK government has developed an outcomes framework as a basis for monitoring the performance of government departments. While primarily designed in the context of Public Service Agreement Targets (PSA) it also offers a useful tool for the measurement of child well-being. The ‘*Every Child Matters*’ outcomes framework includes 25 indicators of five interrelated aspects of children’s well-being:²

- ∞ Be healthy
- ∞ Stay safe
- ∞ Enjoy and achieve
- ∞ Make a positive contribution
- ∞ Achieve economic well-being.

It is noteworthy that the framework and children’s outcomes are expressed in positive terms, thus encouraging local authorities and services using this framework to focus on the strengths of children. At the same time there is a strong emphasis on children’s performance, conveying a picture of children as having rights (to health, safety and enjoyment) but also duties (to make positive contributions and achieve economic well-being).

However, in common with the initiatives described in Section 1 above, the role of the environment in influencing the well-being of children and young people is barely represented in *Every Child Matters* (ECM). In this report, we examine evidence for the importance of environmental influences on children’s lives, using literature from a range disciplines including epidemiology, paediatrics, public health, environmental studies, landscape planning, psychology, education, sociology and social policy.

Our analysis uses a framework that identifies underlying requirements for the achievement of ECM outcomes and the environmental factors that influence the effectiveness with which these requirements can be met (Table 1).

Table 1: Framework for the analysis of evidence for environmental impacts on the well-being of children and young people

Environmental factors:	Influence the potential for children and young people to:	Governing the potential to attain ECM Framework outcome objectives	Covered in Report Section:
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² See http://www.everychildmatters.gov.uk/_files/0C41DA18F6F58C44AFE3EC4D41EA0F04.pdf.

to:			
Indoor air quality Outdoor air quality Toxic pollution Electromagnetic radiation Noise Water quality	Live in surroundings that are free from pollution	(1) Be healthy	3. Health and Development
Land and food quality Green space Woodland Gardens Safe roads	Have healthy diets Take exercise by playing, walking, cycling and doing outdoor sports	(1) Be healthy (2) Stay safe (3) Enjoy and achieve	4. Diet, Food and Mobility
Biodiversity Green space Woodland Gardens	Be connected to natural world through outdoor play	(3) Enjoy and achieve	5. Emotional and Social Development
Biodiversity Climate change	Feel secure about the future through education and participation	(3) Enjoy and achieve (4) Make a positive contribution	6. Participation and Education
Corporate social responsibility and environmental performance	Explore and eventually choose career paths that reflect personal sustainability values	(5) Achieve economic well-being	

Some of the impacts of the environment on children’s well-being are physical and more easily amenable to quantification. These include the effects of environmental pollution and road traffic. Others, such as the impact of natural surroundings, are much more subjective in nature. Their effects can be immediate, for example, in the influence that green space and woodland has on the form of children’s play and exercise. But they are also indirect, for example colouring and shaping the way in which children experience their play activities.

Section 3 of this report reviews the evidence for the direct impacts of environmental pollution on the health of children and young people. In the industrialised world, childhood obesity is a growing health problem while in poorer countries it is lack of food that is responsible for nutritional problems. In Section 4 we look at ways in which both clean water and food production and availability depend on the state of the environment.

Obesity, however, is also a function of lack of exercise. We next turn our attention to the role played by the environment in offering opportunities for children and young people to exercise through structured sporting activities, through informal play and through making journeys by walking or cycling. A growing limitation on the independent mobility of children is posed by parental or carers' concerns for children's safety. We review the evidence for the role played by increasing motorised road traffic in restricting children's mobility and threatening their safety.

Independent mobility and outdoor play are important for the physical health and well-being of children but their impacts on emotional and social development are often underestimated. Section 5 outlines evidence for these impacts and the influence exerted by the environment in facilitating children and young people to form connections with the natural world. Connections to nature have been shown to have an important influence on children's future life trajectories, the main topic of Section 6

The ways in which the natural environment affects children and young people's potential to achieve outcomes of well-being and well-becoming are mediated through interconnected social and economic factors. These include poverty and wealth, housing, food production and supply systems, education and the media, and family and friendship networks. In the final section of the report we recognise this mediating effect in a concluding discussion of the social and economic inequalities that shape the exact form in which environmental conditions influence, and may be influenced by, children and young people's well-being.

The Every Child Matters outcome of 'achieving economic well-being' is not treated separately in this report. The reason for this is that it is difficult to identify environmental factors that influence children's economic well-being specifically. However, this does not mean that they are not important. The state of the environment is a crucial influence on the economic well-being and livelihoods of everyone (see, for example, Huby, 1998) and children's economic well-being depends intimately on that of their parents, carers and families. A review of these influences would encompass the whole of the sustainable development literature and is beyond the scope of the report.

But the environment also affects children's economic well-being in the future. In influencing their potential to be healthy, stay safe, enjoy life, be active and make positive contributions to their neighbourhoods and to society, the environment indirectly impacts upon children's readiness and ability to engage in further education and employment and to play their part in developing sustainable communities. In this report, therefore, we regard the economic well-

being of children and of future adults as dependent on current environmental influences on physical and mental health and on personal and social development.

SECTION 3: HEALTH AND DEVELOPMENT

There is an enormous literature on the implications of environmental pollution for the health of children and young people. However, difficulties arise in establishing levels of risk. This is partly because of scientific uncertainty and partly because of the need to understand the exact relationship between exposure and risk. On the one hand exposure to pollutants can be measured in the population of interest. But the risks associated with different levels of exposure depend on toxicological data and understandings of microbiological mechanisms that often have substantial uncertainty. These difficulties have led to a great deal of debate in the literature.

Lu *et al.* (2006), for example, presented findings suggesting that organic diets significantly reduce children's exposure to organophosphorus compounds, used in pesticides for fruit and vegetable production. These elicited correspondence from Kreiger *et al.* (2006) pointing out that that higher exposure levels do not necessarily equate to higher levels of risk.

Epidemiological studies can only suggest causal links. Low level exposure to organophosphate and carbamate pesticides may be neurotoxic in children and infants but the establishment of clear evidence requires biochemical and animal studies to show mechanisms and relate toxicity to exposure. (It is interesting to note that some pesticides banned for use on food crops are still allowed for direct use on children for treatment of, for example, head lice).

Dolk and Vrijheid (2003) reviewed epidemiological studies seeking to link community exposure to environmental pollution with congenital abnormalities. The studies included pollution by heavy metals, nitrates, chlorinated and aromatic solvents, chlorination by-products, as well as contaminated food and proximity to waste disposal sites or toxic land. The authors found that the assessment of exposures was often too poor or captured by measures too indirect to allow strong conclusions to be reached. Epidemiological studies are also open to confounding effects of a wide range of other factors, again prohibiting the establishment of firm causal relationships.

A further difficulty stems from lack of knowledge about the potential effects of cumulative exposure and from the toxicological effects of combinations of environmental pollutants. The independent toxicity of some pollutants, such as lead is well established. The neurotoxic effects of pre and post natal exposure of children to lead in air or drinking water are without doubt (Bellinger 1994; Bellinger and Matthews, 1998). And the rate at which toxic lead compounds are absorbed by the body is highest for children and for people who live on a poor diet. However, the independent effects of other compounds are harder to unravel.

Dummer *et al.* (2003), in a multi-site study using birth data from Cumbria, found excess perinatal and infant mortality due to spina bifida and heart defects in areas close to incinerators and crematoriums but the exact compounds responsible cannot be determined.

Similarly several associations have been suggested between chlorination by-products, childhood leukaemia and congenital anomalies such as oral clefts, cardiac anomalies and urinary tract defects (Cederger *et al.*, 2002; Nieuwenhuijsen *et al.*, 2000; Bove *et al.*, 2002). Dolk and Vrijheid (2003) argue that, while results may not be conclusive, there is sufficient evidence of potential harm to children and infants to recommend a precautionary approach to environmental hazards.

Children's exposure to environmental contaminants can be different and often higher than that of adults partly due to physiological characteristics. However, differences are also due to different behaviour in interacting with the environment during development, in physical activities, in diet and eating habits, and in ways related to gender and ethnicity (Hubal *et al.*, 2000).

An essay by Lanphear (2005) argues that the rapid recent growth of children's environmental health as a topic for research, policy and clinical practice stems from the increasing recognition of the environmental influences on the health of foetuses, children and young people. He refers to evidence linking chronic low level exposure to pollution with some of the 'new morbidities of childhood' – intellectual impairment, behavioural problems, asthma and pre-term birth.

Smith *et al.* (1999) estimate that, world wide, 40 per cent or more of the environmental burden of disease falls on children under five years old. For European children, Valent *et al.* (2004) calculate disability-adjusted life years (DALYs) lost and deaths attributable to a range of environmental factors. They conclude that 'large proportions of deaths and DALYs in European children are attributable to outdoor and indoor air pollution, inadequate water and sanitation, lead exposure and injuries' (Valent *et al.*, 2004: 2032).

Indoor air pollution

Less is known in general about the health effects of indoor as opposed to outdoor air pollution. Although not specifically related to children and young people, Richardson (2005) provides a good overview of the effects of different indoor pollutants and relation to asthma. Jedrychowski *et al.* (2005) in Poland studied asthma in pre-adolescent children in relation to post-natal exposure to indoor air pollution from heating and tobacco smoke. For children

living in households with gas or coal heating, air quality was strongly inversely related to lung function at pre-adolescence.

A study of the effects of indoor tobacco smoke on children in Turkey detected no relation between exposure to environmental smoke and symptoms of respiratory tract disease (Boyaci, 2006). However, this was a retrospective study and the authors call into question the reliability of parents' reports.

(Pattenden *et al.*, 2006) reviewed research from 12 countries carrying out a pooled analysis of over 50,000 children. Their results confirmed adverse effects of both pre- and postnatal parental smoking on children's respiratory health. Asthma was most strongly associated with maternal smoking during pregnancy was strongly associated with asthma but other respiratory symptoms were also associated with exposure to tobacco smoke during the early childhood years.

Sax *et al.* (2006) calculated cumulative personal risks of exposure to indoor air pollutants in 87 teenagers in Los Angeles and New York City. The pollutants included particles, aldehydes and volatile organic compounds (VOCs), all suspected carcinogens. The results showed that indoor exposure to pollution led to calculated risks that were five times higher than those calculated only from outdoor ambient exposures. Indoor pollutant exposure thus appears to be a large determinant of cancer risk. Although the generalisability of the results is limited, they do illustrate a need for more comprehensive research on cumulative indoor and outdoor exposure to a greater suite of air pollutants.

While much research on indoor pollution focuses on physical health problems there is recent evidence that indoor conditions can also affect children's academic performance and behaviour. In a systematic review of 30 scientific research reports Mendell and Heath (2005) found that a substantial proportion of children's exposure to indoor pollutants occurs within schools. They describe their findings as insufficiently persuasive to establish specific causal relationships but do find strongly suggestive evidence to link higher levels of nitrogen dioxide with poorer school attendance and poor ventilation with reduced academic performance. The authors argue that their results, while not wholly conclusive, do establish a case for paying more attention to environmental design and planning of school premises.

Ambient Outdoor Air Pollution

Poor air quality is more likely to have its worst effects on people who are already susceptible to respiratory problems or cardio-vascular disease and on those whose age makes them particularly vulnerable. The latter group includes children, the elderly, pregnant women and

their unborn children, the very people who in general are least likely to drive private cars and who thus contribute least towards pollution problems. Exhaust fumes are emitted relatively close to the ground and kerbside pollution levels may be two or three times higher than the urban background level so that children or babies in prams receive more exposure than adults. Common pollutants include nitrogen dioxide (NO₂), smoke particles less than 10 micrometres in diameter (PM₁₀), sulphur dioxide (SO₂), carbon monoxide (CO), low level ozone (O₃) and volatile organic compounds (VOCs).

Kim (2004) summarises recent literature on the health hazards to children posed by ambient air pollution in a Policy Statement by the American Academy of Pediatrics' Committee on Environmental Health. The report finds that children and infants are most susceptible to pollution, partly because of its effects on developing tissues and partly because they experience higher levels of exposure, with higher lung ventilation rates and more time spent out of doors. It states that increasing levels of NO₂, SO₂, O₃ and PM₁₀ are known to be associated with pre-term births, infant mortality, lung growth problems, asthma exacerbation and other respiratory symptoms.

Asthma in children can be detrimental to emotional and social as well as to physical well-being. Fourteen children (aged 8 to 12 years) with asthma and 12 without were interviewed and observed in a study by Rudestam *et al.*, (2004). The children with asthma experienced it as an interruption to their daily lives influencing time spent outside, being active and being with friends. They were less likely than the children without asthma to explore new places or talk about their interactions with family and friends. Most of the children with asthma said it induced in them feelings of powerlessness.

The role of pollutants such as O₃ in the development of asthma is, however, less than clear cut. While some toxic substances, such as lead, are known to be neurotoxic especially in early childhood, others may have more complex and less direct effects. NO₂, for example, may act as a marker for combined pollution from traffic exhaust fumes and combustion rather than exerting an independent effect on health.

A number of studies have examined the impacts of road traffic-related pollution on children's health, often with mixed results. Lin *et al.* (2003) demonstrated a positive relationship between low level air pollution by carbon monoxide, sulphur dioxide and nitrogen dioxide and asthma hospitalisation in children. A study of air pollution and infant death in California in the 1990s shows that there is a significant effect of carbon monoxide on infant mortality (Currie and Neidell, 2005). In Harlem, USA a study of high school students showed that 76 per cent had been exposed to high levels of diesel exhaust, a known exacerbator of asthma

(Northridge *et al.*, 1999). Research with 138 African American children in Los Angeles revealed an association between respiratory symptoms and environmental factors, PM₁₀, NO₂ and two moulds but not with O₃ or pollen (Ostro *et al.*, 2001). The Children's Health Study in Los Angeles, studying 6,000 school children showed that lung function growth was 10 per cent slower among children living in communities with high NO₂ levels and other traffic related pollutants. There was an increase in school absence rates with daily fluctuations of O₃. Children who played sports and spent more time outside in communities with high ozone levels had higher incidences of newly diagnosed asthma (Kunzli *et al.*, 2003).

Research on air pollution and child health Brazil in 1986 and 1998 showed that in areas that had experienced reductions in levels of particulate matter and sulphur dioxide, there were also reductions in incidences of respiratory symptoms (Ribeiro and Cardoso, 2003). Other research in Brazil from 1992 to 1994 examined the short-term effects of air pollution on respiratory health, using daily counts of hospital admissions due to respiratory diseases and daily levels of meteorological variables and air pollutants. Daily admissions for respiratory disease and pneumonia significantly increased with increasing levels O₃, NO₂ and PM₁₀ (Gouveia and Fletcher, 2000).

In Austria between 1994 and 1997 a study of 975 school children examined the effects of particulate matter and other air pollutants on lung function. The results suggested that long-term exposure to particulate matter had a significant negative effect on lung function and development (Horak *et al.*, 2002). More than 40,000 children were included in a study in Italy from 1994 to 1995. No large variation in incidence of asthma was found among different Italian regions. However, mean annual levels of air pollution were associated with adverse respiratory conditions. There was a strong association between the frequency of lorry traffic and severe respiratory disorders for children living in the largest cities (Galassi *et al.*, 2005). A more recent Californian 8-year study looked at 3677 children between the ages of 10 and 18, living within 500 meters of a major road. The authors found substantial deficits in lung function compared with children living at least 1,500 meters away and report that 'local exposure to traffic on a freeway has adverse effects on children's lung development, which are independent of regional air quality' (Gauderman *et al.*, 2007).

A study of 285 children in Israel shows that the lung function of asthmatic children is negatively associated with air pollution by fine particles (Peled *et al.*, 2005). Glinianaia *et al.* (2004) carried out a systematic review of 15 studies on the association between long and short term increases in ambient particulate air pollution and increasing mortality and

morbidity of children. The evidence for impacts on infant mortality was inconsistent although some links were suggested between particulate pollution and some causes of infant death. The authors again stress the need to assess exposure by more rigorous methods and to control for confounding factors.

Neidell (2004) examined air pollution and childhood (aged 1 to 18) asthma in California. The significant effect of air pollution on child hospitalization for asthma was greater for children of lower socioeconomic status. Similarly, research into air pollution and asthma in Canadian children aged 6-12 between 1987 and 1998 found that exposure to nitrogen dioxide was significantly and positively associated with asthma hospitalization for boys in the lower socioeconomic groups but not in the higher groups (Lin *et al.*, 2004).

However, in some cities the rich as well as the poor suffer from environmental pollution around their homes. A study in Houston, one of the richest cities in the United States, looked at the health of children living in two areas of the city in relation to levels of air pollution (Cerni, 1993). The first residential area was situated close to a number of industrial plants where neighbourhoods were periodically affected by air pollutants and accidental spills of hazardous chemicals and where atmospheric levels of ozone and sulphur dioxide were high. Households were also surveyed in a less polluted residential area about 20 miles from industrial and port facilities. Although children in both areas had a higher than expected incidence of ill health, a significantly higher number of families in the more polluted area reported ill health in children, 73 per cent compared to 63 per cent in the less polluted area. This difference was not correlated with class, income or demographic variables but appeared to be associated only with the locations of the two areas.

Nevertheless, in the USA, Pastor *et al.* (2004; 2006) finds that 'children of colour are disproportionately exposed to ambient air toxins' leading to respiratory (asthma) and cancer risks and associated with diminished school attendance.

Toxic pollutants

Kim (2004) points out that children's exposure to toxic air pollutants may occur through a variety of routes as air pollution is transmitted into water soil and food. Levels of toxins that are not judged to be hazardous in their air-borne concentrations may accumulate in other media until they reach toxic levels. Mercury, for example, a developmental neurotoxin, is deposited from air onto soil and surface waters where it is taken in by fish in high concentrations. In 1983 the extent of pollution of rivers, streams and lakes in the state of New York led the Department of Health to recommend that residents should eat no more than one meal a month of freshwater fish caught in the state and that 'pregnant women, women of

child-bearing age, nursing mothers and children under 15 should eat no fish at all from the state' (Seitz, 1995:148).

Some toxic pollutants, including polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PDBEs), enter the environment from products in daily use. Others occur as waste from industrial or landfill sites.

Household products

Ribas-Fitó *et al.* (2001) reviewed seven studies evaluating the effects of prenatal exposure to PCBs. Although variations in study design precluded the assessment of degree of risk, the studies did suggest adverse effects of PCB exposure on child neurodevelopment.

Fischer *et al.* (2006) studied children's exposure to polybrominated diphenyl ethers (PDBEs), flame retardants used in the manufacture of televisions, computers and synthetic textiles and slowly released into the air over the life of these products. PDBEs are implicated in developmental neurotoxicity and the study shows that children and young people have high levels of exposure, and consequently higher PDBE-related health risks.

In the UK young children are particularly susceptible to the effects of exposure (including childhood cancer) to household and garden pesticides. The majority of children's exposure to pesticides occurs in the home. They are frequently used indoors, especially in the kitchen, and are often easy for children to get hold of (Grey *et al.*, 2004).

Waste and landfill

Exposure to metals from waste incineration and industrial use carries the potential for developmental reproductive toxicity. There is more risk in the early years of life as developing organisms are at greater risk of permanent damage. Absorption and retention is greater in children than adults yet Patriarcha *et al.* (2000) notes that few literature reports on the tissue content of potentially toxic elements include data on newborns and young children. Existing data are sometimes questionable, because of inadequate sensitivity of the analytical techniques, insufficient control of contamination and lack of validation.

Nouwen *et al.* (2001) reports that dioxin emissions from municipal waste incinerators in Belgium have led to soil contamination. The level of dioxins to which children are exposed depends on their eating habits and body weight. The research found no increased risk of exposure from living in the contaminated area. Dioxin exposure only increased for children eating locally produced food.

Ultraviolet radiation

In relatively recent years, pollution by man-made chemicals has led to a thinning of the stratospheric ozone layer with concomitant increase in the amount of ultraviolet (UV) radiation reaching the earth's surface from the sun. The most well known of these chemicals are chlorofluorocarbons (CFCs) which are used in plastic foam packaging and insulation material, refrigerants, air conditioning, aerosols, solvents and dry cleaning products. CFCs are wholly man-made but other powerful ozone depleters, such as halons used in fire extinguishers, also have natural sources.

Exposure to some UV radiation is necessary for vitamin D formation. A lack of sun exposure (along with dietary calcium deficiency) contributes to vitamin D deficiency which can cause rickets, especially in very young children (Pettifor, 2004; Raiten and Picciano, 2004).

However, UV radiation has many detrimental effects on human health. These include sunburn, ocular damage, photo-ageing, immune suppression, DNA damage and skin cancer (Godar, 2005). Skin cancer is one of the most common forms of cancer in the UK and is increasing. UV radiation exposure is a major cause (Melia *et al.*, 2000). Children are particularly vulnerable (Kirsner *et al.*, 2005) because they spend more time outdoors than adults and are less aware of the risks. They are more vulnerable to the effects of sun exposure because their skin is more sensitive to the photocarcinogenic effects of radiation.

Up to 80 per cent of a lifetime's sun exposure occurs before the age of 18 (Collins *et al.*, 2005). Older children are less likely to use protection against the sun, although girls are more likely than boys to regard using sun cream, avoiding mid-day sun and wearing a wide-brimmed hat as very important (Department of Health, 1998). Epidemiologic evidence suggests that sun exposure and sunburn in early life is associated with increased risk of melanoma and skin cancer in adulthood. Several recent studies show that as children become adolescents, their number of sunburns and levels of sun exposure increase whilst sun protection decreases relative to younger children and adults (Davis *et al.*, 2002).

Research by the Department of Health (1998) reveals that the view that sun-tanned skin looks healthy is prevalent among older children and parents and that parents' beliefs that a tan makes a child look healthy is positively associated with the prevalence of sunburn. Ironically this may help to explain why artificial UV exposure is now widespread in Western populations. A substantial minority of young people, especially females use sun lamps to tan their skin. This is particularly risky because children already spend more time outside than adults and are less likely to be aware of the risks involved. Several epidemiological studies, but not all, have shown an association between tanning devices and malignant melanoma

(Young, 2004). Indoor tanning sunlamps may be especially harmful and increase the risk of melanoma when used during childhood and early adulthood. Cokkinides *et al.* (2002) found that of 1192 US youths aged 11 to 18, ten per cent had used indoor tanning lamps in the previous year.

Other forms of electro-magnetic radiation

Concerns about the effects on children of exposure to electromagnetic fields (EMF) have been focused on the extremely low frequencies (ELF) emitted by mobile phones and radio frequencies (RF) emitted by mobile phone base stations and radio and television masts.

There is little scientific evidence of links between exposure to extremely low frequency electro-magnetic fields and effects on children (Feychting 2005). But in spite of the lack of consensus regarding the risk to children, the Stewart Report (2000) urged that children be discouraged from using mobile phones. Some countries do recommend children limit their use and others state that children do not need to be treated differently from adults (Lin, 2002). The fear is that disturbance to brain activity in children exposed to low frequency radiation could lead to impaired learning ability or behavioral problems. A recent UK study of 18 children showed no statistical effect of mobile phone use on cognitive function (Lin, 2005) but it should be noted that the research was published in the IEEE Antennas and Propagation Magazine. Some studies have revealed possible associations between ELF exposure and childhood leukaemia but little is understood about the mechanisms of such effects (Kheifets and Shimkhada, 2005).

The establishment of a high power radio station in Rome led to concerns about child and adult leukaemia because epidemiologic studies had suggested links between cancer and residential exposure to high-frequency electromagnetic fields. Research by Michelozzi *et al.* (2002) found that while risks of childhood leukemia were higher than expected for a distance up to 6km from the radio station, no causal effect could be assumed. The number of cases was small and exposure data sparse.

There is little evidence for enhanced absorption of RF by infant brains or of an enhanced susceptibility of brain tissue to exposure during development (Wood, 2006). A review of evidence of health hazards posed by EMF reveals mixed results. Woods finds that it is still debatable whether or not the evidence for potential harm caused by mobile phone use, transmission masts or electricity pylons is sufficient to trigger the application of the precautionary principle. But Ahlbom *et al.* (2004) argues that even though there is little consistent or convincing evidence, deficiencies in studies to date mean that harmful effects cannot be ruled out.

Noise

High levels of noise pollution can cause both physical and mental distress among children.

When noise levels from 25 toys commonly found in a national US toy chain store were evaluated in the 1990s, it was found that most of the toys produced sound levels equal to or above those recommended. Three types of toy produced sounds greater than 120 decibels, known to be damaging to the sensory cells of the cochlea (Yaremchuk *et al.*, 1997). In a later study of 5249 American children aged 6 to 19 years, 12.5 per cent were found to have noise-induced hearing threshold shifts (NITS) in one or both ears. This suggests that children are being exposed to excessive noise and that children's hearing is vulnerable to this exposure (Niskar *et al.*, 2001). In Norway, research with 1585 students found that noise and disturbance had a major effect on the level of reported health complaints (Torsheim and Wold, 2001). A web-based 28-question survey attracted 9693 responses in three days and the results revealed that the majority of young adult respondents had experienced tinnitus and hearing impairment after exposure to loud music (Chung *et al.*, 2005).

Aircraft and road noise can also have effects on children's blood pressure and heart rates. Van Kempen *et al.* (2006) studied 1283 children aged 9 to 11 in schools near to two European (UK and Holland) airports. At school aircraft noise was found to be linked to an increase in blood pressure and heart rate although the effect was not statistically significant. Aircraft noise exposure at home was, however, significantly associated with increased blood pressure especially at night. Evans *et al.* (2001) examined the effects of day-to-day noise on 115 children in Austria. Two samples of children were matched for parental education, housing characteristics, family size, marital status, and body mass index, and index of body fat. All of the children were prescreened for normal hearing acuity. The research found that children living in the noisier areas had higher blood pressure and symptoms of stress as measured by overnight urinary neuroendocrine indices.

The association of high noise levels with stress responses is supported by a repeated measures epidemiological field study conducted by Haines *et al.* (2001a; 2001b; 2001c). In children aged 8 to 11 chronic aircraft noise was found to be significantly associated with impaired reading comprehension and with heightened levels of annoyance but not with mental health problems. A study of the association between ambient (highway, rail and road) noise and children's mental health in Austria found that noise exposure in children aged 8 to 11 was associated with poorer classroom behaviour. It was also associated with self-reported decline in mental health in children with a history of early biological risk, for example, low birth rate (Lercher *et al.* 2002).

In Macedonia, Ristovska *et al.* (2004) studied 10 and 11 year old children exposed to community noise, noise emitted from all sources except the workplace including traffic. Children exposed to higher noise levels were shown to have significantly decreased attention, decreased social adaptability and increased oppositional behaviour in relations to other people. Research with 9 and 10 year-old children living close to major airports in Holland, Spain and the UK found that chronic exposure to aircraft noise impaired cognitive development, especially in reading comprehension (Clark *et al.* 2005; Stansfeld *et al.* 2005). Sherman *et al.* (2005) carried out a systematic review of over 40 articles on the effects of the physical health care environment on health-related quality of life (HRQL). Their findings were that reduced noise levels, access to nature, and reduced crowding all had beneficial effects on quality of life.

Water pollution

Bathing water

Alexander (1992) conducted a prospective study of children aged 6 to 11 years using a north-western English beach (Blackpool). The results revealed a significant increase in prevalence of symptoms such as vomiting, diarrhoea, itchy skin, fever, lack of energy and loss of appetite in children who came into contact with seawater contaminated with sewage. Prüss (1998) reviewed 22 studies of seas, lakes and rivers used as recreational bathing waters by adult populations in a temperate climate. Her findings strongly suggest a causal relationship between gastro-intestinal symptoms and bathing water quality. Fleisher *et al.* (1998) contend that the gastroenteritis, acute febrile respiratory illness and ear and eye infections associated with bathing in waters contaminated with domestic sewage are not minor but could have substantial implications for public health.

In recent years, European legislation on the quality of bathing waters has been tightened. But Hanley *et al.* (2003) suggest that recreational use of water for bathing is contingent upon perceptions as well as actual quality of the water.

Drinking water

Nitrates reach drinking water by leaching into groundwater from fertiliser and manure treated land. Florida's Department of Health website refers to evidence that nitrate levels in excess of 10ppm may be unsafe for young babies. The nitrates reduce the capacity of blood to carry oxygen resulting in methemoglobinemia (blue baby syndrome). However, Fewtrell (2004), on the basis of a wide review of the literature, finds that nitrates in drinking water are not a simple cause of methemoglobinemia in infants. She argues that nitrates are more likely to

constitute only one of a number of interacting factors disposing infants to the disease. In England, Parslow *et al.* (1997) have demonstrated an association between higher nitrate levels in domestic drinking water and incidence of childhood diabetes.

Bernard *et al.*, (2006) studies 341 children who spent time bathing in swimming pools in Belgium. They found that time spent in the pools was one of the most consistent predictors of asthma; the effects linked to pool use were found to be dose related for children under seven years old. The researchers suggest the cause may be trichloramine, a by-product of chlorine used in keeping the pools clean.

Summary

Schettler (2001) argued the need for preventative action to protect children and young people from the effects of toxins such as lead, mercury, PCBs, alcohol and nicotine in the environment. The reason is that the young developing brain is vulnerable to levels of these compounds that may have no lasting effects in adults. In children and young people, exposure is associated with learning disabilities, attention deficit hyperactivity disorder, delays in development and emotional and behavioural problems. Chance (2001) described the evidence for the effects of environmental contaminants on immune, endocrine and respiratory systems and on childhood cancers. Both authors argued the urgent need for a precautionary approach to be taken to protect pregnant women, children and young people from exposure to toxic substances and persistent chemicals released in the environment.

Five years later, only a few substances, such as lead and mercury, have been subject to effective regulatory control, even in the western industrialised world. Yet more chemicals have been identified as presenting possible risks to the health of children. Grandjean and Landrigan (2006) point to the inadequacies of chemical testing and high levels of scientific proof required for regulatory purposes as the main impediments to action. Once again the authors argue that the absence of proof of causality should not constitute a reason for doing nothing. Instead the precautionary principle should be applied and action to protect children should be taken wherever risks to health are recognised.

The evidence suggests that the health of children and young people may be at risk as a result of exposure to chemical pollution, electromagnetic radiation and noise. There is clearly a case for the Every Child Matters agenda to take account of the importance of the environment in influencing outcomes of physical, mental and emotional health.

SECTION 4: DIET, EXERCISE AND MOBILITY

Diet

The food people eat varies considerably and depends on a complex of social, cultural, financial, attitudinal, behavioural and biophysical factors (Lang *et al.*, 1996). Social factors play a role in determining food preferences. A birthday cake for a child in the UK for example has a value that goes beyond simply taste, health and nutrition. It confers a sense of self-esteem on the child or family, signifying 'belonging' and conforming to the norms of a particular social group. The choice of food we eat reflects a complex combination of perceptions about what tastes good, what is nutritionally valuable and free from attributes that could cause health risks and what is regarded as culturally acceptable in a wider sense. It also depends on what is available and affordable so that patterns of food consumption are conditioned by a wide range of environmental factors which determine what foods *can* be produced, and economic and political factors which influence what *is* actually produced and how it is priced.

Environmental factors such as flooding, soil degradation, lowering of water tables, pollution, climate change, acid deposition and stratospheric ozone depletion all influence access to food both directly and indirectly through effects on prices. But food consumption in turn affects the environment. A recent review by Tukker and Jansen (2006) finds that food contributes 20 to 30 per cent of the total life cycle impacts of societal consumption in the European Union. Pearce *et al.* (2005) provide a comprehensive summary of the environmental impacts of food consumption. They argue that schools have an important role to play in achieving sustainable development through influencing children's eating habits, and that action to do this will also improve the diets of Britain's children, helping to reduce the problem of obesity.

The poor quality diets of school-aged children are partly responsible for the finding of the Health Survey for England 2004 that a significant number of children are either overweight or obese. Between 1995 and 2004 the percentage of obese boys aged 2 to 15 years rose from 11 to 19 per cent. For girls the increase was slightly lower, from 12 per cent to 18 per cent (The Information Centre, National Health Service, 2006). The links between childhood obesity and adult health problems are not certain but children who are overweight do tend to follow obesity into adulthood. There are fears that obesity threatens to reverse gains in longevity made during the last hundred years. Obesity in childhood has been linked to increasing risks of premature illness and death (Gilliland *et al.*, 2003; Nugent, 2004; Shepherd *et al.*, 2006). The UK Public Health White Paper (Department of Health, 2004)

warns that if increases in obesity are not halted, the life expectancy of children and young people is likely to fall over the next hundred years. In addition to these physical effects, being overweight can also be distressing for a child who is teased by peers, losing confidence and self-esteem and feeling isolated and depressed (BUPA, 2004).

Exercise

One way that overweight children can lose weight is by exercising. The recommendation is that young people between the ages of 5 and 18 should participate in physical activity of at least moderate intensity for one hour a day, on 5 or more days a week (Currie *et al.*, 2004). Such activity may take the form of structured exercise and sports or may simply be active free play. According to the UK 2000 Time Use Survey (ONS, 2002), children in the UK aged 8 to 15 spend on average 29 minutes a day in sport and outside activities. For young people aged 16 to 25, the figure is 20 minutes. Both structured exercise and play contribute to children's emotional and mental as well as physical well-being but their effectiveness depends, at least to some extent, on access to suitable environments. Exploratory research by Timperio *et al.* (2005) in Australia suggests that parental perceptions of the safety of local environments are closely associated with obesity in 10 to 12 year old children.

Play is vitally important for children's well-being through its impact on their mental, physical and emotional development. It provides an opportunity for them to consolidate and absorb learned information and to acquire a mindset adapted to solving problems (John and Whewey, 2004). The physical activity involved in most play provides exercise, encourages coordination and develops skills for the growing child. Fjortoft (2001; 2004), in a Norwegian study, found that children who play regularly in natural environments show more advanced motor fitness with better coordination, balance and agility. Active play also reduces symptoms of depression and anxiety and contributes to increased self-esteem (Mulvihill *et al.* 2000). There is some evidence to suggest that children's perceptions of their own environments influence their levels of physical activity. But, in their study of 10 year-old children in Australia, (Hume *et al.*, 2005) highlight the need for more research to further our understanding of the likely impacts of policy interventions intended to increase children's physical activity.

Sallis *et al.* (2001) demonstrated the importance of school environments in promoting higher levels of physical activity among children and young people by providing opportunities, spaces and equipment for outdoor play. Outdoor places form an important part of the lives of many children, but outdoor play also depends on the availability of spaces and on the willingness of adults to let their children play or roam. There is an increasing tendency for

parents to prevent their children from playing outside without supervision largely because of fears for their safety, from other people and from traffic (Matthews and Limb, 2000; O'Brien *et al.*, 2000). But weather conditions and daylight hours also affect the extent to which children go out to play (Matthews, 2001).

Mobility

Where children are allowed autonomy in their movements and have the opportunity to be independently mobile, the benefits they derive are important to both their physical and social well-being, Whewey and Millward (1997) present an interesting calculation of the numbers of short journeys made by children each year and the consequent importance of the environment in which these are made:

“Based on our observations in this study ... we estimate that an average group of 100 children (typical of the numbers that live on a small housing association estate or in five streets on a council estate or inner city neighbourhood) make somewhere in the region of 281,000 journeys per annum. Children spend approximately 40 per cent of their play time travelling from one place to another. These places may be relatively close to each other (30 - 100 metres) and although the children tend to spend only a few minutes at them, the journeys between them are important for the children. In one hour we therefore estimate that a child might make five journeys. If we then take a population of 100 children and assume that only half of them play out and for only one hour after school on school days, this generates 250 journeys per day. As school days account for half the days in a year, this generates approximately 45,000 journeys per annum. If in the same population only 50 per cent play out for an average of two hours on each holiday and weekend day, this generates a further 90,000 journeys per annum. Finally, if we assume that in addition to all these journeys, each child is likely to make four journeys each day of the year (to school, the shop, a friend's, or the ice-cream van, and back again) this generates 146,000 journeys. Added together this gives us 281,000 journeys per 100 children per annum. Now this may prove to be an over-estimate when tested by further research. On the other hand, having witnessed children at play outside on some estates from 9.00 a.m. until 10.00 p.m. in the summer holidays, it may prove to be a serious underestimate, and the true figure might be nearer 300,000 or even 400,000. Nonetheless, whether on some estates it is 200,000 or 400,000 journeys per 100 children per annum, these are vast numbers of journeys which are vital for children's freedom to play. They are also journeys which are non-polluting and give healthy exercise” (Whewey and Millward, 1997: 17-18).

The regular physical activity entailed in making their journeys by walking and cycling can reduce mortality and morbidity from cardio-vascular disease while improving weight control, skeletal fitness, strength, mobility and mental health (Department of the Environment, 1996). The establishment of physical activity patterns in childhood is particularly important as it has been shown to be a key to reducing adult cardiovascular diseases (Kuh and Cooper, 1992). And, of course, walking and cycling help to reduce the incidence of childhood obesity (Mackett *et al.*, 2002; 2003).

However, the benefits of mobility-related exercise are offset if the routes that must be travelled are unsafe or unattractive in terms of other traffic, poor street lighting and degraded urban environments. Wide pavements in good repair are particularly important for children and pedestrian crossings must provide sufficient time for them to cross in safety. In the UK priority is increasingly given to motorists although in other European countries, such as the Netherlands and Germany, the situation for walkers and cyclists is better. Personal safety and dangers from traffic accidents and pollution are important elements in determining the extent to which children are free to use parks and other public space around their homes without parental supervision (Davis and Jones, 1996b). Hillman *et al.* (1990) found clear evidence that increasing levels of parental fears for their children's safety in relation to road traffic were resulting in the restricted independent mobility of children and concomitant reductions in their freedom and choice.

These fears are not unfounded. 'Road accidents are the major cause of death and injury to children, accounting for a quarter of all deaths of school children and two thirds of all accidental deaths' (Cahill, 1994: 91). Although the number of children killed or seriously injured in road traffic accidents in Great Britain fell by 49 per cent from the 1994-98 average, there were still 141 children under 16 killed on the roads in 2005 and another 3331 who were seriously injured (Department for Transport, 2006a).

Children themselves are aware of the dangers of road traffic. In a survey of four schools in Birmingham 'an average 43 per cent of respondents in each of the schools reported that they 'didn't feel safe' in their area, that 'traffic is bad' and it was 'dangerous crossing roads' (Davis and Jones, 1996a: 367).

The growth in car use for short journeys exacerbates this problem so that children's autonomy and opportunity for exercise through travel is even more restricted. The National Travel Survey for Great Britain shows that, in 2005, children aged 16 or under made 55 per cent of all their trips as car passengers compared with only 33 per cent by foot (Department for Transport, 2006b). The number of primary school-aged children walking to school has

declined from 67 to 49 per cent over the last 20 years (Table 2). For secondary school-aged children the fall has been slightly less, from 52 to 44 per cent. Over the same period, the percentage of children travelling to school by car has approximately doubled. These figures have implications for both the well-being of children and for the natural environment.

Table 2: Percentage of children using various methods of travel to school

	Children aged 5-10 years			Aged 11-16 years		
	1985/86	1999/2001	2005	1985/86	1999/2001	2005
Walk	67	54	49	52	43	44
Bicycle	1	1	1	6	2	2
Car	22	39	43	10	19	22
Bus	9	6	6	29	32	29
Other	2	1	1	2	4	3
All	100	100	100	100	100	100

Source: Compiled from *National Travel Survey 1999/2001 Update* (Department for Transport, 2002) and *National Travel Survey 2005* (Department for Transport, 2006b)

There is a vicious circle here. Parents' fear of road accidents, or even fear of their children's abduction by car drivers, means that many children in the UK are no longer allowed to play or cycle in the streets. Their mobility is restricted to home, school or the parental car. As a result there are more cars using the roads. This means more chance of accidents and more parental fears about road safety. Comparing their own with that of earlier studies, O'Brien *et al.* (2000) found, for example, that the number of children walking to school unaccompanied by adults fell from 94 per cent in 1970 to only 47 per cent in 1998.

Increasing restrictions on the mobility of children and young people exacerbate the very problems that cause them. But there are also wider reaching implications in reducing children's autonomy and development of self-reliance. Davis and Jones (1996a) found that many 9 and 10 year-olds would prefer to cycle to school rather than travel by car, but they are not allowed to do so. The authors review the impacts which this limited independent mobility has on children's perceptions of their relationship with their environment and on the style and extent of their social participation. They argue that the current situation reflects a power relationship in which 'adults want to teach children to be careful and to be scared of cars, rather than attempting to limit the traffic' (Davis and Jones, 1996b: 109).

Recent attempts to address this problem have been made in the UK. Gill (2006) traces the development of Home Zones, residential streets designed to allow social use of space and children's play as well as use for motor vehicles. Gill presents the results of evaluations demonstrating the significant impacts these zones are having on the lives of local residents. Reductions in the speed and volume of traffic are accompanied by increasing opportunities for the independent mobility and play of children and young people. Initial figures suggest that children's outdoor activity (walking, cycling and playing in the street) has increased in over half of the 41 schemes evaluated.

Spencer and Woolley (2000) review research conducted in towns and cities into the role of place in developing the personal identities of children and young people. They argue that an important role is played by exploration and attachment to place in social and cognitive development and that this is often overlooked in discussions that focus on social and physical dangers. Research based on interviews with 251 mothers of 7-12 year-old children in Rome demonstrated the importance of open spaces such as parks in influencing children's autonomy of movement. This greater autonomy was found to facilitate the development of social relations as children with more independent mobility played more frequently with other children (Prezza *et al.*, 2001) and Morrow (2001) discusses the importance to children of these social interactions in a neighbourhood environment.

It is important to remember, though, that while increasing car use undoubtedly has negative effects on the well-being of most children and young people, for those living on low incomes in rural areas, the only alternative to car-dependency may be social isolation. Children are unable to visit friends who do not live within walking or cycling distance and may be denied opportunities for wider social participation (Cloke *et al.* 1994: 144). Ridge (2002), in interviews with children living in families dependent on Income Support, found that their lives were often restricted by the cost and availability of public transport, especially in rural areas.

Summary

Dominant patterns of food production and consumption are currently responsible for wide ranging environmental problems and militate against sustainable development. At the same time, obesity poses threats to the health and well-being of a growing number of children and young people. Addressing childhood obesity through the promotion of fresh, chemical-free and locally produced food thus finds resonance with both the Every Child Matters and the Sustainable Development agendas.

Environmental conditions also influence levels of physical exercise taken by children and young people. Access to safe green space then represents a second means to address

obesity and other health problems. But its saliency for Every Child Matters goes beyond health and safety concerns. Safe green environments allow and encourage the independent mobility of children and young people, contributing to their self-efficacy and social development.

Increasing car use, however, threatens the well-being of children and young people through its role in reducing the physical exercise they take, the direct risks it poses through increasing road traffic accidents, and the impact it has on the independent mobility of children and young people resulting from the fears for safety it elicits in their parents and carers.

SECTION 5: THE NATURAL ENVIRONMENT AND EMOTIONAL AND SOCIAL DEVELOPMENT

Options for play

The quality of life and the personal development of children is influenced by their housing and neighbourhood environments which affect the range of their play areas and their scope for pursuing independent activities.

Whewey and Millward (1997) in a study of over 3,000 children living on 12 housing estates in the UK found that children used a wide variety of types of space for play. They reported their regular and favourite locations frequently to be outside the home (Table 3).

Table 3: Children's play space preferences (adapted from Whewey and Millward 1997 Table 8 p42)

Type of space	% of children expressing preference
Open space (park, grassy area, field)	56%
Street/road	23%
Gardens (mostly back)	23%
Play area	21%
Friend's home	19%
Trees	17%
Outside house	16%
Shops	14%

(Percentage total is greater than 100 because some children gave more than one answer)

However, the children's preferences were not always matched by their actual playing spaces:

‘When asked for their regular and favourite play places children consistently referred to green open spaces (park, fields) and, if there was one available locally, an equipped play area. If there was a single tree or a small copse of trees then these were also very popular and particularly so for climbing. These three types of location stand out well above all other locations as the regular or favourite places children say they use. The frequency of reference to these places in the interviews far exceeds the observed behaviour of the children where the majority of play was recorded as taking place in the front street ‘ (Whewey and Millward, 1997: 40).

Roads and pavement were frequently used for play, as were pedestrian and cycle paths. Valentine (1996) and Louv (2005) both note a decline in the opportunities for children and young people to access outdoor natural open spaces.

O'Brien *et al.* (2000) surveyed 1,378 children between the ages of 10 and 14 and their parents in densely populated areas with low levels of green space (London) and in a 1940s New Town garden city (Hatfield), designed originally with children in mind, to offer the beauty of nature, fields and parks. The questionnaire survey was complemented by 20 home-based case studies. Findings suggested that the plentiful green space in the Hatfield area allowed children and young people to play out close to home and call on friends more often. However, residential streets and public parks, especially if they are relatively quiet places, can be significant for young people meeting with their peers away from the adult gaze (Matthews and Limb, 2000; Dines and Cattell, 2006).

Play in natural environments

In a review of children's play in natural environments, Lester and Maudsley (2006) outline the complexities of the concept of nature. With extensive reference to ethnological literature on the role of play in the lives of young animals, they discuss the intimate interdependency between children, nature and the natural environment and the importance of this relationship for development. Drives to interact with the physical world draw children instinctively to affiliate themselves with nature in a process leading to personal fulfilment and well-being.

Children spending time playing in wild natural environments experience adventure and risk-taking as well as developing self-efficacy and a respect for the power of nature (Maan, 2005). But this kind of play can also have restorative effects.

In a paper examining the restorative effects of nature, Kaplan (1995) argues that natural settings meet four key requirements for restoring human effectiveness – being away, fascination, extent and compatibility. Nature provides the opportunity for people to feel they are 'away from it all' in a physical sense. Phenomena such as clouds, sunsets and leaf movements hold the attention without effort, relieving the attentional fatigue that inhibits information processing. Natural settings instil a sense of connection with other places and times and there are resonances between these settings and human inclinations.

A report to government, constituting an 8 month review of the play needs of young people aged 0 to 16 years in the UK, describes play as what young people do to follow their own ideas and interests, in their own way, for their own reasons (Department for Culture, Media

and Sport, 2004). Play is seen as crucial for the development of cognitive, imaginative, creative, emotional and social as well as physical and motor skills.

Thomas and Thompson (2004) interviewed 10 to 11 year-olds to examine how they saw the environment as affecting their lives and well-being. The responses clearly pointed to the vital role of the natural environment in providing space for play, but also for letting off steam, for quiet reflection, being with family members and pets and for confiding in others.

For children and young people there is a growing body of evidence that experiences of nature can bring significant benefits to children, contributing to their mental and behavioural, creative and imaginative, and social well-being.

Mental well-being and cognitive development

Taylor *et al.* (2001) show that children with symptoms of attention deficit hyperactivity disorder (ADD) are better able to concentrate following contact with nature. The more contact children have with the natural environment and the more positive their experiences of it, the higher they score in tests of concentration and self-discipline (Wells, 2000; Taylor *et al.*, 2002).

Korpela *et al.* (2002) used structured interviews with Finnish children aged 8 to 9 and 12 to 13 in a study of children's preferences for special places. They found that children and young people seek out and visit their favourite places to relax, calm down and clear their minds following emotionally negative events.

Exposure to natural environments has been shown to improve the cognitive development of children by enhancing their awareness, reasoning and observational skills (Pyle, 2002).

The more children are exposed to nature, the greater their resilience in dealing with problems. Nature appears to buffer the impacts of negative life events on children and young people (Wells and Evans, 2003).

A study by Milligan and Bingley (2004) highlights the benefits of woodland areas to mental health and shows that recreational use of woodlands as a child is associated with more frequent use in adulthood.

Creative and imaginative well-being

Imaginative and creative play that fosters language and collaborative skills is encouraged by the diverse options for play offered by natural environments (Moore and Wong, 1997; Taylor *et al.*, 1998; Fjortoft and Sageie, 2000). Blinkert (2004) argues that the environments of children and young people are crucial if they are to develop into creative human beings.

Crain (2001) suggests that nature helps children to develop powers of observation and creativity and instils in them a sense of peace and being at one with the world. Early experiences with the natural environment have been positively linked with the development of imagination and a sense of wonder (Louv, 1991; Kahn, 1999), an important motivator for lifelong learning (Wilson, 1997).

Creativity and imagination are themselves fostered by the raw materials offered to children and young people by the natural environment. Even waste or derelict ground, cemeteries, quarries, allotments, building sites and reservoirs can be rich sources of what Fjortoft (2004) calls 'affordances' – the functions that environmental objects provide to the individual. White and Stoeklin (1998) identify children's liking for loose and malleable materials in the spaces where they play. Water, trees, bushes, flowers, animals, pond life, sand can all be changed and modified. Grass is particularly useful:

“Young children appreciate grass, its aesthetic, its feel, smell, and function as a building material. They fight with grass and they mark their boundaries with grass. Grass left after a mowing can transform a landscape into a new play opportunity” (Burke, 2005:46).

Children like colour, diversity and change in their surroundings and places that provide features to sit in, on or under, lean against, or that offer shelter, shade, privacy or views (White and Stoeklin, 1998).

Thomas and Thompson (2004) found that the idea of secret or 'special' places was particularly important to children, even when those places might be close to home, at the bottom of a garden or in local parkland. The unofficial, ambiguous social connotations of such places allowed children to invest them with their own meanings.

Social well-being

The importance of spaces in providing freedom to explore, play and meet with friends is emphasised by Speak (2000). Experiences of living in rural environments may be characterised by loneliness and isolation stemming from the absence of means to visit and play with friends (Cloke *et al.* 1994). As well as bringing the physical benefits of play, the frequent contact with friends encouraged by access to green space may have other advantages. Morrow (1999) suggests that regular face-to-face contact facilitates the building of feelings of trust, sense of belonging and mutual support that have major effects on well-being.

Natural environments appear to stimulate easier social interaction between children and young people (Bixler *et al.*, 2002) and children who play there tend to develop more positive feelings about one another (Moore, 1996). In research using systematic observation and mapping with 50 children aged 8 to 10 years in five Australian primary schools, Malone and Tranter (2003) found that play in more diverse areas such as those provided by natural environments could reduce or eliminate problems of bullying at school.

Outdoor environments are also important in allowing children to develop independence and autonomy. Natural spaces can be used for free play and independent exploration of the environment without the constraints of parental fears (National Children's Bureau, 2006). Children need choice and control over their play in order to achieve freedom and satisfaction. A safe yet wild environment allows them to test their boundaries, fostering independence and self-esteem and respect for others as well as offering opportunities for social interaction (Department for Culture, Media and Sport, 2004).

“Children, through their play, encounter their physical and social environments; they express their ideas, perceive possibilities and pose questions that invite a response. Through this dynamic, constantly changing process both player and the environment have the potential to be transformed. The child, through playing in the world, is both a being and a becoming” (Lester and Maudsley, 2006: 6).

Summary

The state of the natural environment is crucially important to children and young people. The positive influence of nature on personal and social development is essential for the Every Child Matters outcomes of enjoyment and achievement.

Connections with nature, established through play in natural environments, have been shown to benefit the mental well-being and cognitive development of children and young people as well as fostering creativity and imagination. These features, together with the independence, self-esteem and respect for others associated with play in outdoor environments, nurture the capacity of young people to build positive social relationships and friendships.

SECTION 6: PARTICIPATION AND EDUCATION

Concern for the environment

Much existing research focuses on children and young people as the cause rather than the victims of environmental problems. Hastings *et al.* (2005:13), for example, claim that 'High densities of children and young people in a household, and in a neighbourhood more generally, will, of necessity, produce environmental challenges. Children generate rubbish and high volumes of rubbish can be problematic'. Results of interviews with adults representing residents and organisations in the neighbourhoods suggest that the dropping of litter, drawing of graffiti and causing minor damage to bus shelters, play equipment and trees is seen as a normal activity or even a 'rite of passage' for young people.

Yet Thomas and Thompson (2004) found that children and young people do care about their environments. Their research suggests that attachments to environmental issues are formed even before children necessarily have a proper grasp of the concepts involved, indicating the strength of their links with nature.

Louv (2005) goes further and argues that the outdoor environment is 'as essential to a child's health and well-being as good nutrition and plenty of sleep'. He uses the term 'nature-deficit disorder' to describe the negative result of a separation from nature and suggests this threatens the well-being of everyone. According to Quilgars (2005: 308) 'children and young people have strong views about their localities, in part possibly because they have fewer opportunities to escape their immediate neighbourhood than adults'. Valentine (1996) and Barratt and Barratt Hacking (2000) also present findings that reveal the concern of children for their own and future environments.

Opportunities for participation

Children who are concerned about the environment can be frustrated by limited opportunities to act on their concerns. Barratt Hacking *et al.* (2006) remark on striking findings that indicate the importance of the local environment to children. However they highlight a gap between children's desires to improve their environments and the extent to which are able to act on these desires. One problem identified by the research is a lack of recognition by schools of children's local knowledge. 'The children have a strong desire to be more involved in local improvement; for example, they are concerned about environmental quality and would like to see more habitats for wildlife. They feel that the school could support their involvement but that the gap between their own knowledge and that favoured by the school militates against this happening'.

An interesting difference between the views of rural and urban children was revealed in research by Robertson and Walford (2000). While rural children generally wanted their environments to remain as they were, children in urban areas expressed strong desires for change.

Spencer and Woolley (2000) found that places for quiet reflection and free from pollution and litter were important to children. Yet their concerns about anti-social behaviour in these matters are frequently characterised by anger and frustration at the apparent indifference of the adult population.

Sustainable development relies on the full participation of everyone in decision-making process. Yet Cutler (2003) found important weaknesses in the structures and resources for youth participation in the UK. Participatory projects, for example, were often organised on adults' terms rather than reflecting the agendas of young people and socially excluded young people were least likely to be heard. Indeed it is children likely to be most in need who most often fall outside the well-being discourse. These include children seeking asylum, refugees, Gypsy and Traveller children and those with disabilities. They are difficult to study because they are small in number and tend not to be picked up in surveys or administrative statistics (Bradshaw and Mayhew, 2005).

Making a positive contribution

Matthews and Limb (1999) highlight the significant role that children can play as social actors in their own right and Jans (2004) extends ideas about the influence children exert over their own environments. This influence can operate through education.

In the UK, for example, utilities have been involved in designing and seeking to quantify the effect of educational programmes, as part of the Energy Efficiency Standards of Performance (now called the Energy Efficiency Commitment) scheme. Powergen's Bright Sparks programme, for example, involved giving school children a free, low-energy lamp and a questionnaire on energy use to take home. Families were able to buy a second lamp at the reduced price of £3, with £1.50 of this going to the school. According to Powergen's promotional material, 'The project increased energy awareness among children aged between seven and 11, saved energy and is reducing electricity bills by £3.1 million. Over 47,000 customers are benefiting' (Shove, 2003: 3).

Children and young people can also influence their environment as educators themselves. Ballantyne *et al.* (1998) reviewed the education and social science literature examining intergenerational effects of education about environmental issues, problems and solutions.

They found that while the majority of research focuses on the impacts of environmental education on children, there is also evidence that children and young people who are better informed about environmental matters can exert an influence on their families and wider communities.

Devine-Wright *et al.* (2004) examined children's' perceptions of self-responsibility for, concern about and awareness of global warming and energy use. They also investigated the children's perceptions of their own self-efficacy in responding to the environmental challenges posed by global warming. The results indicate that more co-operative learning environments - operationalised as membership of the Woodcraft Folk, a UK organisation that emphasises the value of cooperation and the empowerment of young people – can have significant positive effects. A comparison of members and non-members revealed that a significantly higher percentage of the former (38.2%) estimated that they could make a great personal contribution to reduce the effects of global warming than did non-members (12.5%). Furthermore, 56.9 per cent of Woodland Folk members declared that they felt a sense of responsibility for using renewable energy compared to only 33.9 per cent of non-members.

Educating adults of the future

Simply learning through environmental education broadens children's prospects for the future. Ernst and Monroe (2004) start from the premise that environmental education, rather than advocating particular solutions or actions, encourages students to select and synthesize information and skills from a wide range of sources in order to follow logical lines of enquiry, address problems and take decisions leading to informed and responsible action. Their research examines the critical thinking skills developed through environmental education compared to more traditional educational programmes. While not wholly conclusive, the findings suggest that environmental studies may play a valuable role in improving student learning.

But children and young people of today are also the adults of the future and there is evidence to show that their present experiences will be important in determining how well the environment is protected for future generations of children.

Wells and Lekies (2006) interviewed 2,000 adults aged 18 to 90 years in the urban USA. Their topics covered experiences of nature in childhood and later attitudes and behaviour. The results show that natural play as a child makes a significant contribution to knowledge about the environment and to the development of positive environmental attitudes and behaviour in adulthood.

Similarly, Bixler *et al.* (2002), in research with more than 1,700 young people found that those with more experience of play in wilderness areas had significantly more positive perceptions of the natural environment in adulthood. This extended to their views about outdoor recreation and future occupations and was related to environmental competencies and preferences for work and leisure.

Lohr and Pearson-Mims (2005) suggest that children and young people's contact with nature is a significant predictor of adults' beliefs about the benefits of nature. In arguing for the improvement of schoolyards to incorporate more natural features, White (2004) suggests that they will 'offer the hope that future generations will develop the environmental values to become stewards of the Earth and the diversity of Nature'.

Summary

Children and young people clearly have the capacity to achieve the Every Child Matters outcome of making a positive contribution by engaging in decision-making and supporting the community and environment. Their concern for the environment provides the potential for them to make very real contributions to local and global communities. These contributions can be made through children's education of their parents, families and friends, or through direct actions and participation in environmental affairs.

However, if children and young people are to develop informed environmental concerns in the first place, they also rely on education about the environment and on their own experience of the natural world. Such education and experience in childhood has been shown to have far reaching effects on environmental attitudes and behaviour in later life. It is, therefore, paramount in making a contribution to the well-being not just of current children and young people, but of future adults and their own children, locally and globally.

SECTION 7: ENVIRONMENTAL INEQUALITY

We have presented evidence that demonstrates the crucial importance of the environment for virtually all aspects of the well-being and well-becoming of children and young people and have shown its salience for the Every Child Matters agenda. However, it is important to remember the ways in which environmental influences on the achievement of positive outcomes are mediated through interconnected social and economic factors.

Impacts of the environment on children's well-being are exacerbated by poverty, for example, where environmental inequalities are correlated positively with inequalities in family income and other forms of deprivation. Housing and neighbourhood environments affect all residents but children in particular. The World Health Organisation identifies groups of people who are especially at risk when their homes are situated in environmentally degraded areas. These include women, children, the elderly and people with disabilities or ill health, the homeless and street children. Problems are not confined to physical risks but also include factors affecting social relations.

'Many of the physical characteristics of the housing and living environment have a major influence on mental disorder and social pathology through such stressful factors as noise, air, soil or water pollution, overcrowding, inappropriate design, inadequate maintenance of the physical structure and services, poor sanitation, or a high concentration of specific toxic substances.'

(World Health Organisation, 1992: 215)

There is a growing recognition in the UK that environmental degradation of neighbourhoods can have a corrosive influence on the quality of residents' lives (Millie *et al.*, 2005). The Office of the Deputy Prime Minister (ODPM, now the Department for Communities and Local Government) has a Public Service Agreement (PSA8) that aims to 'lead to the delivery of cleaner, safer and greener public spaces and improvement of the quality of the built environment in deprived areas, and across the country, with measurable improvement by 2008' (odpm.gov.uk/index.asp?id=1123017; Accessed 27 October 2006).

A number of studies have examined levels of adult satisfaction with neighbourhood environments (see, for example, Burrows and Rhodes, 1998; Mumford, 2000; Mumford and Power, 2003; Adelman *et al.*, 2003; Monteith and McLaughlin, 2004) and established links between poor environments and other indicators of material poverty and deprivation. However, as Quilgars (2005) points out, there is little research that systematically captures the experiences of children at a neighbourhood level.

Assessments of neighbourhood environmental problems are provided by the English House Condition Survey 2001 (Office of the Deputy Prime Minister, 2003). An estimated 2.4 million dwellings are located in environmentally 'poor' neighbourhoods where there are problems with the condition, use or upkeep of buildings and public spaces. These areas are characterised by litter and rubbish in the streets as well as by signs of vandalism. They are home to proportionately more households with children (28%) than are non-'poor' areas (23%).

A study of 29,133 children in Sweden showed that exposure to nitrogen dioxide in their homes and schools increased regularly as the socioeconomic status of their neighbourhoods decreased (Chaix et al, 2006). The authors conclude that this provides evidence of environmental injustice in a country noted for its egalitarian welfare state. However, the research does not equate exposure to pollution with risk to health (see Section 3).

Corburn *et al.* (2006) examined environmental neighbourhood effects in relation to childhood asthma hospitalisation in poor neighbourhoods in New York City between 1997 and 2000. The study mapped the spatial distribution of hazards and found positive correlations between asthma hospitalisation rates and poor housing conditions, density of polluting facilities, noxious land uses and truck routes.

Evans and Marcynyszyn (2004) found that cumulative environmental exposure to noise, crowding and housing problems was substantially greater for children in lower income households. By using overnight urinary neuroendocrine levels as an indicator they were able to correlate these exposures positively with chronic stress in children.

Weiss and Bellinger (2006) Argue that social aspects of a child's environment (for example, family income, social class or socio-economic deprivation) usually treated as confounding factors in analyses of the outcomes of exposure to toxic chemicals in early life may in fact affect the child's biology and hence modify the effects of neurotoxins on health. This may help to explain evidence that negative impacts are often more marked in children from more deprived backgrounds (see, for example, Bellinger and Matthews, 1998 on lead; Vreugdenhil, 2002 on PCBs; and Rauh *et al.*, 2004 on environmental tobacco smoke). Weiss and Bellinger point to evidence that enrichment and impoverishment of the environmental conditions of young rats can alter neurochemical and morphological characteristics of the brain, as can exposure to different stresses during infancy and certain forms of maternal pre-natal stress. Some early research suggests that similar factors in humans are associated with developmental delays, attention deficits and neurobehavioural effects (Evans, 2004).

Whatever the reason, it seems clear that more adverse environmental conditions are associated with childhood poverty. In the USA examples include proximity to toxic waste dumps, exposure to pesticides, ambient air pollution, parental smoking and indoor air pollution and noise.

‘Poor children reside in more polluted, unhealthy environments. They breathe air and drink water that are more polluted. Their households are more crowded, noisier, and more physically deteriorated, and they contain more safety hazards. Low-income neighborhoods are more dangerous, have poorer services, and are more physically deteriorated. The neighborhoods where poor children live are more hazardous (e.g. greater traffic volume, more crime, less playground safety) and less likely to contain elements of nature’ (Evans, 2004: 88).

The research suggests that the accumulation of multiple environmental risks for poor children is the key aspect of the environment of poverty.

REFERENCES

- Aber, L., Gershoff, E. T. and Brooks-Gunn, J. (2002) Social exclusion of children in the US: compiling indicators of factors from which and by which children are excluded, Paper presented to the *Conference on Social Exclusion and Children*. 3-4 May 2001 Columbia University.
- Adelman, L., Middleton, S. and Ashworth, K. (2003) *Britain's Poorest Children: severe and persistent poverty and social exclusion*, London: Save the Children.
- Ahlbom, A., Green, A., Kheifets, L., Savitz, D. and Swerdlow, A. (2004) Epidemiology of health effects of radiofrequency exposure, *Environmental Health Perspectives* **112**(17): 1741-1754.
- Alexander, L. M. (1992) Symptomatology of children in contact with sea water contaminated with sewage, *Journal of Epidemiology and Community Health* **46**: 340-344.
- Ballantyne, R., Connell, S. and Fien, J. (1998) Students as catalysts of environmental change: a framework for researching intergenerational influence through environmental education, *Environmental Education Research* **4**(3): 285-298.
- Barnes, B., Mathee, A. and Moilola, K. (2005) Assessing child time - activity patterns in relation to indoor cooking fires in developing countries: A methodological comparison, *International Journal of Hygiene and Environmental Health* **208**(3): 219-225.
- Barratt, R. and Barratt Hacking, E. (2000) Changing my locality: conceptions of the future, *Teaching Geography* **25**(1): 17-21.
- Barratt Hacking, E. C., Scott, W. A. H., Barratt, R. J., Talbot, W., Nicholls, D. and Davies, K. (2006) Education for Sustainability: schools and their communities, in J. Chi-Lee and M. Williams (eds) *Environmental and Geographical Education for Sustainability: cultural contexts* New York: Nova Science Publishers Inc.
- Bellinger, D. (1994) Teratogen update: lead, *Teratology* **50**: 367-373.
- Bellinger, D. C. and Matthews, J. A. (1998) Social and economic dimensions of environmental policy: lead poisoning as a case study, *Perspectives in Biology and Medicine* **41**: 307-326.
- Ben-Arieh, A., Kaufman, N. H., Andrews, A. B., Goerge, R. M., Lee, B. J. and Aber, J. L. (2001) *Measuring and monitoring children's well-being, Social Indicators Research Volume 7*, Dordrecht: Kluwer Academic Publishers.
- Bernard, A., Carbonelle, S., Burbure, C. D., Michel, O. and Nickmilder, M. (2006) Chlorinated pool attendance, atopy and the risk of asthma during childhood, *Environmental Health Perspectives* **114**(10): 1567-1573.
- Bixler, R. D., Floyd, M. F. and Hammitt, W. E. (2002) Environmental socialization: quantitative tests of the childhood play hypothesis, *Environment and Behaviour* **34**(6): 795-818.
- Blinkert, B. (2004) Quality of the city for children: chaos and order, *Children, Youth and Environments* **14**(2): 99-112.

- Bove, F., Shim, Y. and Zeitz, P. (2002) Drinking water contaminants and adverse pregnancy outcomes: a review, *Environmental Health Perspectives* **110**: 61-74.
- Boyaci, H., Etiler, N., Duman, C., Basyigit, I. and Pala, A. (2006) Environmental tobacco smoke exposure in school children: parent report and urine cotinine measures, *Pediatrics International* **48**(4): 382-389.
- Bradshaw, J. (2001) *Poverty: the outcomes for children*, London: Family Policy Studies Centre/National Children's Bureau.
- Bradshaw, J. (2002) Child poverty and child outcomes, *Children and Society* **16**: 131-140.
- Bradshaw, J., Hoelscher, P. and Richardson, D. (2006) Comparing Child Well-Being in OECD Countries: Concepts and Methods, York: Background Paper for UNICEF Innocenti Report Card 7.
- Bradshaw, J. and Mayhew, E. (eds) (2005) *The Well-being of Children in the UK* London: Save the Children.
- BUPA (2004) Avoiding Childhood Obesity, http://hcd2.bupa.co.uk/fact_sheets/html/child_obesity.html, Accessed 17 October 2006.
- Burrows, R. and Rhodes, D. (1998) *Unpopular Places? Area disadvantage and the geography of misery in England*, Bristol: The Policy Press.
- Cahill, M. (1994) *The New Social Policy*, Oxford: Blackwell.
- Cedergren, M. I., Selbing, A. J., Lofman, O. and Kallen, B. A. (2002) Chlorination byproducts and nitrate in drinking water and risk for congenital heart defects, *Environmental Research* **89**: 124-130.
- Cerni, J. (1993) Urban environmental pollution and child health in Houston, USA: the links to economic growth, in J. Holder, P. Lane, S. Eden, R. Reeve, U. Collier and K. Anderson (eds) *Perspectives on the Environment* Aldershot: Avebury.
- Chaix, B., Gustafsson, S., Jerrett, M., Kristersson, H., Lithman, T., Boalt, A. and Merlo, J. (2006) Children's exposure to nitrogen dioxide in Sweden: investigating environmental injustice in an egalitarian country, *Journal of Epidemiology and Community Health* **60**(3): 234-241.
- Chance, G. W. (2001) Environmental contaminants and children's health: cause for concern, time for action, *Paediatrics & Child Health* **6**(10): 731-743.
- Chassé, K. A., Zander, M. and Rasch, K. (2003) *Meine familie ist arme. Wie kinder im grundschulalter armut erleben und bewältigen*, Opladen: Leske und Budrich.
- Chung, J. H., Des Roches, C. M., Meunier, J. and Eavey, R. D. (2005) Evaluation of noise-induced hearing loss in young people using a web-based survey technique, *Pediatrics* **115**(4): 861-867.
- Clark, C., Martin, R., Van Kempen, E., Alfred, T., Head, J., Davies, H. W., Haines, M. M., Barrio, I. L., Matheson, M. and Stansfeld, S. A. (2005) Exposure-effect relations between aircraft and road traffic noise exposure at school and reading comprehension - The RANCH project, *American Journal of Epidemiology* **163**(1): 27-37.

- Cloke, P., Milbourne, P. and Thomas, C. (1994) *Lifestyles in Rural England*. Rural Development Commission, London: HMSO.
- Cokkinides, V. E., Weinstock, M. A., O'Connell, M. C. and Thun, M. J. (2002) Use of indoor tanning sunlamps by US youth, ages 11-18 years, and by their parent or guardian caregivers: Prevalence and correlates, *Pediatrics* **109**(6): 1124-1130.
- Collins, D. C. A., Kearns, R. A. and Mitchell, H. (2005) "An integral part of the children's education": placing sun protection in Auckland primary schools, *Health & Place* **12**(4): 436-448.
- Corburn, J., Osleeb, J. and Porter, M. (2006) Urban asthma and the neighbourhood environment in New York City, *Health & Place* **12**(2): 167-179.
- Crain, W. (2001) How nature helps children develop, *Montessori Life* **13**(3).
- Currie, C., Roberts, C., Morgan, A., Smith, R., Settertobulte, W., Samdal, O. and Ramussen, V. B. (2004) *Young people's health in context. Health Behaviour in School-aged Children (HBSC) Study: International Report from the 2001/02 survey*. Copenhagen: World Health Organisation Regional Office for Europe.
- Currie, J. and Neidell, M. (2005) Air pollution and infant health: What can we learn from California's recent experience? *Quarterly Journal of Economics* **120**(3): 1003-1030.
- Cutler, D. (2003) *Organisational Standards and Young People's Participation in Public Decision Making*, Fife: Carnegie Young People's Initiative.
- Davis, A. and Jones, L. (1996a) Environmental constraints on health: listening to children's views, *Health Education Journal* **55**: 363-374.
- Davis, A. A. J., L. (1996b) Children in the urban environment: an issue for the new public health agenda, *Health and Place* **2**(2): 107-113.
- Davis, K. J., Cokkinides, V. E., Weinstock, M. A., O'Connell, M. C. and Wingo, P. A. (2002) Summer sunburn and sun exposure among US youths ages 11 to 18: National prevalence and associated factors, *Pediatrics* **110**(1): 27-35.
- Department for Communities and Local Government (2005) *Public Service Agreement 2005-2008: Technical Notes. PSA Target 8 - Liveability*, <http://odpm.gov.uk/index.asp?id=1123014>, Accessed 18 October 2006.
- Department for Culture Media and Sport (2004) *Getting Serious About Play: a review of children's play*, http://www.culture.gov.uk/Reference_library/Publications/archive_2004/children_play_review_report.htm, Accessed 28 October 2006.
- Department of the Environment (1996) *United Kingdom National Environmental Health Action Plan*, Cm 3323, London: HMSO.
- Department of Health (1998) *Health Survey for England: the Health of Young People 1995-1997*, http://www.dh.gov.uk/PublicationsAndStatistics/PublishedSurvey/HealthSurveyForEngland/HealthSurveyResults/HealthSurveyResultsArticle/fs/en?CONTENT_ID=4015514&chk=TKRANW, Accessed 17 October 2006.

Department of Health (2004) Choosing Health: making healthy choices easier, London: Department of Health.

Department for Transport (2002) National Travel Survey 1999-2001 Update, Transport Statistics Bulletin, London: The Stationery Office.

Department for Transport (2006a) Transport Statistics Bulletin: Road Casualties in Great Britain Main Results 2005, London: Office for National Statistics.

Department for Transport (2006b) Transport Statistics Bulletin: National Travel Survey 2005, London: Office for National Statistics.

Devine-Wright, P., Wright, H. D. and Fleming, P. (2004) Situational influences upon children's beliefs about global warming and energy, *Environmental Education Research* **10**(4): 493-506.

Dines, N. and Cattell, V. (2006) *Public spaces, social relations and well-being in East London*, Bristol: The Policy Press.

Dolk, H. and Vrijheid, M. (2003) The impact of environmental pollution on congenital abnormalities, *British Medical Bulletin* **68**: 25-45.

Dummer, T. J., Dickinson, H. O. and Parker, L. (2003) Adverse pregnancy outcomes around incinerators and crematoriums in Cumbria, north west England, 1956-93, *Journal of Epidemiology and Community Health* **57**: 456-461.

Ernst, J. and Monroe, M. (2004) The effects of environment-based education on students' critical thinking skills and disposition toward critical thinking, *Environmental Education Research* **10**(4): 507-522.

Evans, G. W. (2004) The environment of childhood poverty, *American Psychologist* **59**(2): 77-92.

Evans, G. W., Lercher, P., Meis, M., Ising, H. and Kofler, W. W. (2001) Community noise exposure and stress in children, *Journal of the Acoustical Society of America* **109**(3): 1023-1027.

Evans, G. W. and Marcynyszyn, L. A. (2004) Environmental justice, cumulative environmental risk, and health among low- and middle-income children in upstate New York, *American Journal of Public Health* **94**(11): 1942-1944.

Fewtrell, L. (2004) Drinking-water nitrate, methemoglobinemia, and global burden of disease: a discussion, *Environmental Health Perspectives* **112**: 1371-1374.

Feychting, M. (2005) Non-cancer EMF effects related to children, *Bioelectromagnetics*: S69-S74.

Fischer, D., Hooper, K., Athanasiadou, M., Athanassiadis, I. and Bergman, A. (2006) Children show highest levels of polybrominated diphenyl ethers in a California family of four: a case study, *Environmental Health Perspectives* **114**(10): 1581-1584.

Fitzgerald, E. F., Schell, L. M., Marshall, E. G., Carpenter, D. O., Suk, W. A. and Zejda, J. E. (1998) Environmental pollution and child health in Central and Eastern Europe, *Environmental Health Perspectives* **106**(6): 307-311.

Fjortoft, I. (2001). "The natural environment as playground for children: the impact of outdoor play activities in pre-primary school children." *Early Childhood Education Journal* 29(2): 111-117.

Fjortoft, I. (2004) Landscape as Playscape: the effects of natural environments on children's play and motor development, *Children, Youth and Environments* 14(2): 21-44.

Fjortoft, I. and Sageie, J. (2000) The natural environment as a playground for children: landscape description and analysis of a natural landscape, *Landscape and Urban Planning* 48(1/2): 83-97.

Fleisher, J. M., Kay, D., Wyer, M. D. and Godfree, A. F. (1998) Estimates of the severity of illnesses associated with bathing in marine recreational waters contaminated with domestic sewage, *International Journal of Epidemiology* 27(4): 722-726.

Galassi, C., Biggeri, A., Ciccone, G. and Forastiere, F. (2005) Environment and respiratory diseases in childhood: The Italian experience, *International Journal of Occupational and Environmental Health* 11(1): 103-106.

Gauderman, W. J., Vora, H., McConnell, R., Berhane, K., Gilliland, F., Thomas, D., Lurmann, F., Avol, E., Nino, K., Jerrett, M., Peters, J. (2007) Effect of exposure to traffic on lung development from 10 to 18 years of age: a cohort study, *The Lancet* (early online publication) 26th January 2007.

Gill, T. (2006) Home Zones in the UK: history, policy and impact on children and youth, *Children, Youth and Environments* 16(1): 90-103.

Gilliland, F. D., Berhane, K., Islam, T., McConnell, R., Gauderman, W. J., Gilliland, S. S., Avol, E. and Peters, J. M. (2003) Obesity and the risk of newly diagnosed asthma in school-age children, *American Journal of Epidemiology* 157(5): 406-415.

Glinianaia, S. V., Rankin, J., Bell, R., Pless-Mulloli, T. and Howel, D. (2004) Does particulate air pollution contribute to infant death? *Environmental Health Perspectives* 112(14): 1365-1370.

Godar, D. E. (2005) UV doses worldwide, *Photochemistry and Photobiology* 81(4): 736-749.

Gouveia, N. and Fletcher, T. (2000) Respiratory diseases in children and outdoor air pollution in Sao Paulo, Brazil: a time series analysis, *Occupational and Environmental Medicine* 57(7): 477-483.

Grandjean, P. and Landrigan, P. J. (2006) Developmental neurotoxicology of industrial chemicals, DOI:10.1016/S0140-6736(06)69665-7, Accessed 9 November 2006.

Grey, C. N. B., Nieuwenhuijsen, M. J. and Golding, J. (2004) The use and disposal of household pesticides, *Environmental Research* 97(1): 109-115.

Haines, M. M., Stansfeld, S. A., Brentnall, S., Head, J., Berry, B., Jiggins, M. and Hygge, S. (2001a) The West London Schools Study: the effects of chronic aircraft noise exposure on child health, *Psychological Medicine* 31(8): 1385-1396.

Haines, M. M., Stansfeld, S. A., Job, R. F. S., Berglund, B. and Head, J. (2001b) Chronic aircraft noise exposure, stress responses, mental health and cognitive performance in school

children, *Psychological Medicine* **31**(2): 265-277.

Haines, M. M., Stansfeld, S. A., Job, R. S., Berglund, B. and Head, J. (2001c) A follow-up study of effects of chronic aircraft noise exposure on child stress responses and cognition, *International Journal of Epidemiology* **30**(4): 839-845.

Hanafin, S. and Brooks, A. M. (2005) *The Delphi Technique: a methodology to support the development of a National Set of Child Well-Being Indicators*, Dublin: The National Children's Office, <http://www.nco.ie>, Accessed 5 November 2005.

Hanley, N., Bell, D. and Alvarez-Farizo, B. (2003) Valuing the Benefits of Coastal Water Quality Improvements Using Contingent and Real Behaviour, *Environmental and Resource Economics* **24**(3): 273.

Hastings, A., Flint, J., Mckenzie, C. and Mills, C. (2005) *Cleaning up neighbourhoods: environmental problems and service provision in deprived areas*, Bristol: The Policy Press.

Hertzman, C. (1995) *Environment and Health in Central and Eastern Europe*, Washington DC: The World Bank.

Hillman, M. J., Adams, J. and Whitelegg, J. (1990) *One False Move: A study of children's independent mobility*, London: Policy Studies Institute.

Hoelscher, P. (2003) *"Immer musst du hingehen und praktisch betteln". Wie Jugendliche Armut Erleben*, Frankfurt: Campus Verlag.

Horak, F., Studnicka, M., Gartner, C., Spengler, J. D., Tauber, E., Urbanek, R., Veiter, A. and Frischer, T. (2002) Particulate matter and lung function growth in children: a 3-yr follow-up study in Austrian schoolchildren, *European Respiratory Journal* **19**(5): 838-845.

Hubal, E. A. C., Sheldon, L. S., Burke, J. M., Mccurdy, T. R., Barry, M. R., Rigas, M. L., Zartarian, V. G. and Freeman, N. C. G. (2000) Children's exposure assessment: A review of factors influencing children's exposure, and the data available to characterize and assess that exposure, *Environmental Health Perspectives* **108**(6): 475-486.

Huby, M. (1998) *Social Policy and the Environment*, Buckingham: Open University Press.

Hume, C., Salmon, J. and Ball, K. (2005) Children's perceptions of their home and neighborhood environments, and their association with objectively measured physical activity: a qualitative and quantitative study, *Health Education Research* **20**(1): 1-13.

The Information Centre (2006) *Health Survey for England 2004. Updating of trend tables to include childhood obesity*. London, National Health Service.

International Bank for Reconstruction and Development (1992) *World Development Report 1992: Development and the Environment*, Washington DC: Oxford University Press.

Jans, M. (2004) Children as citizens: towards a contemporary notion of child participation, *Childhood* **11**: 27-44.

Jedrychowski, W., Maugeri, U., Jedrychowska-Bianchi, I. and Flak, E. (2005) Effect of indoor air quality in the postnatal period on lung function in pre-adolescent children: a retrospective cohort study in Poland, *Public Health* **119**(6): 535-541.

John, A. and Wheway, R. (2004) *Can Play Will Play: Disabled children and access to outdoor*

playgrounds, London: National Playing Fields Association.

Kahn, P. (1999) *The Human Relationship with Nature*, Cambridge: The MIT Press.

Kaplan, S. (1995) The restorative benefits of nature: toward an integrative framework, *Journal of Environmental Psychology* **15**(3): 169-182.

Kheifets, L. and Shimkhada, R. (2005) Childhood leukaemia and EMF: review of the epidemiologic evidence, *Bioelectromagnetics Supplement 7*: S51-S59.

Kim, J. J. (2004) Ambient Air Pollution: Health Hazards to Children: Committee on Environmental Health, *Pediatrics* **114**: 1699-1707.

Kirsner, R. S., Parker, D. F., Brathwaite, N., Thomas, A., Tejada, F. and Trapido, E. J. (2005) Sun protection policies in Miami-Dade County public schools: Opportunities for skin cancer prevention, *Pediatric Dermatology* **22**(6): 513-519.

Korpela, K., Kyttä, M. and Hartig, T. (2002) Restorative experience, self-regulation and children's place preferences, *Journal of Environmental Psychology* **22**: 387-398.

Krieger, R. I., Keenan, J. J., Yanhong, L. and Vega, H. M. (2006) OP pesticides, organic diets and children's health, *Environmental Health Perspectives* **114**(10): A572-A573.

Kuh, D. J. L. and Cooper, C. (1992) Physical activity at 36 years: patterns and childhood predictors in a longitudinal study, *Journal of Epidemiology* **46**: 114-119.

Kunzli, N., McConnell, R., Bates, D., Bastain, T., Hricko, A., Lurmann, F., Avol, E., Gilliland, F. and Peters, J. (2003) Breathless in Los Angeles: The exhausting search for clean air, *American Journal of Public Health* **93**(9): 1494-1499.

Land, K. C. (2005) The Foundation for Child Development Index of Child Well-Being (CWI). 1975-2003 with projections for 2004. 2005 Report, www.soc.duke.edu/~cwi/, Accessed 3 November 2006.

Lang, T., Caraher, M., Dixon, P. and Hill, R. C.-. (1996) Class, income and gender in cooking: results from an English survey, in J. S. A. Edwards (ed.) *Culinary Arts and Sciences* Southampton: Computational Mechanics Publications.

Lanphear, B. P. (2005) Origins and evolution of children's environmental health, *Environmental Health Perspectives*: 24-32.

Lercher, P., Evans, G. W., Meis, M. and Kofler, W. W. (2002) Ambient neighbourhood noise and children's mental health, *Occupational and Environmental Medicine* **59**(6): 380-386.

Lester, S. and Maudsley, M. (2006) Play, naturally: a review of children's natural play, <http://www.playday.org.uk/view.asp?ID=51>, Accessed 28 October 2006.

Lin, J. C. (2002) Cellular mobile telephones and children, *Ieee Antennas and Propagation Magazine* **44**(5): 142-145.

Lin, J. C. (2005) Children's cognitive function and cell-phone electromagnetic fields, *Ieee Antennas and Propagation Magazine* **47**(6): 118-120.

Lin, M., Chen, Y., Burnett, R. T., Villeneuve, P. J. and Krewski, D. (2003) Effect of short-term exposure to gaseous pollution on asthma hospitalisation in children; a bi-directional case-

crossover analysis, *Journal of Epidemiology and Community Health* **57**: 50-55.

Lin, M., Chen, Y., Villeneuve, P. J., Burnett, R. T., Lemyre, L., Hertzman, C., Mcgrail, K. M. and Krewski, D. (2004) Gaseous air pollutants and asthma hospitalization of children with low household income in Vancouver, British Columbia, Canada, *American Journal of Epidemiology* **159**(3): 294-303.

Lohr, V. I. and Pearson-Mims, C. H. (2005) Children's active and passive interactions with plants influence their attitudes and actions towards trees and gardening as adults, *Horticultural Technology* **15**(3): 472-476.

Louv, R. (1991) *Childhood's Future*, New York: Doubleday.

Louv, R. (2005) *Last Child in the Woods: saving our children from nature-deficit disorder*, Chapel Hill: Algonquin Books.

Lu, C., Toepel, K., Irish, R., Fenske, R. A., Barr, D. B. and Bravo, R. (2006) Organic diets significantly lower children's dietary exposure to organophosphorous pesticides, *Environmental Health Perspectives* **114**: 260-263.

Maan, N. (2005) The delivery of environmental play projects by the Better Play funded organisations, http://www.barnardos.org.uk/briefing_paper_4_-_environmental_play_.pdf, Accessed 30 October 2006.

Mackett, R. L., Lucas, L., Paskins, J. and Turbin, J. (2002) Children's car use: The implications for health and sustainability *Proceedings of the European Transport Conference*. Cambridge, London: PTRC.

Mackett, R. L., Lucas, L., Paskins, J. and Turbin, J. (2003) The health benefits of walking to school. Paper presented at *Championing Safe Routes to School: citizenship in action*. September 2003, De Montfort Hall, Leicester.

Malone, K. and Tranter, P. (2003) Children's environmental learning and the use, design and management of schoolgrounds, *Children, Youth and Environments* **13**(2).

Matthews, H. (2001) *Children and Community Regeneration: Creating Better Neighbourhoods*, London: Save the Children.

Matthews, H. and Limb, M. (1999) Defining an agenda for the geography of children: review and prospect, *Progress in Human Geography* **23**(1): 61-90.

Matthews, H. and Limb, M. (2000) Exploring the 'Fourth Environment': Young people's use of place and views on their environment, <http://www.hull.ac.uk/children5to16programme/briefings.htm>, Accessed 17 October 2006.

Melia, J., Pendry, L., Eiser, J. R., Harland, C. and Moss, S. (2000) Evaluation of primary prevention initiatives for skin cancer: a review from a UK perspective, *British Journal of Dermatology* **143**(4): 701-708.

Mendell, M. J. and Heath, G. A. (2005) Do indoor pollutants and thermal conditions in schools influence student performance? A critical review of the literature, *Indoor Air* **15**(1): 27-52.

Michelozzi, P., Capon, A., Kirchmayer, U., Forastiere, F., Biggeri, A., Barca, A. and Perucci,

- C. A. (2002) Adult and childhood leukemia near a high-power radio station in Rome, Italy, *American Journal of Epidemiology* **155**(12): 1096-1103.
- Millie, A., Jacobson, J., McDonald, E. and Hough, M. (2005) *Antisocial behaviour strategies: Finding a balance*, Bristol/ York: The Policy Press/ Joseph Rowntree Foundation.
- Milligan, C. and Bingley, A. (2004) Climbing trees and building dens: mental health and well-being in young adults and the long-term effects of childhood play experience, Lancaster University: Institute for Health Research.
- Minh, N. H., Minh, T. B., Watanabe, M., Kunisue, T., Monirith, I., Tanabe, S., Sakai, S., Subramanian, A., Sasikumar, K., Viet, P. H., Tuyen, B. C., Tana, T. S. and Prudente, M. S. (2003) Open dumping site in Asian developing countries: A potential source of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans, *Environmental Science & Technology* **37**(8): 1493-1502.
- Monteith, M. and McLaughlin, E. (2004) *Children and Severe Poverty in Northern Ireland*, Belfast: Save the Children.
- Moore, R. (1996) Compact Nature: the role of playing and learning gardens on children's lives, *Journal of Therapeutic Horticulture* **8**: 72-82.
- Moore, R. and Wong, H. (1997) *Natural Learning; rediscovering Nature's Way of Teaching*, Berkeley: CA MIG Communications.
- Morrow, V. (1999) Conceptualising social capital in relation to the well-being of children and young people: a critical review, *The Sociological Review* **1999**: 744-761.
- Morrow, V. (2001) Using qualitative methods to elicit young people's perspectives on their environments: some ideas for community health initiatives, *Health Education Research* **16**: 255-268.
- Mulvihill, C., Rivers, K. and Aggleton, P. (2000) A qualitative study investigating the views of primary-age children and parents on physical activity, *Health Education Journal* **59**: 166-179.
- Mumford, K. (2000) Talking to Families in East London, CASE Brief 19, London: London School of Economics.
- Mumford, K. and Power, A. (2003) *East Enders: Family and Community in East London*, Bristol: The Policy Press.
- National Children's Bureau (2006) Children's Play Information Service Factsheet: Where do children play? <http://www.ncb.org.uk/library/cpis>, Accessed 28 October 2006.
- Neidell, M. J. (2004) Air pollution, health, and socio-economic status: the effect of outdoor air quality on childhood asthma, *Journal of Health Economics* **23**(6): 1209-1236.
- NicGabhainn, S. and Sixsmith, J. (2005) Children's Understanding of Well-Being, www.nco.ie, Accessed 5 November 2005.
- Nieuwenhuijsen, M. J., Toledano, M. B. and Eaton, N. E. (2000) Chlorination disinfection byproducts in water and their association with adverse reproductive outcomes: a review, *Occupational and Environmental Medicine* **57**: 73-85.
- Niskar, A. S., Kieszak, S. M., Holmes, A. E., Esteban, E., Rubin, C. and Brody, D. J. (2001)

Estimated prevalence of noise-induced hearing threshold shifts among children 6 to 19 years of age: The Third National Health and Nutrition Examination Survey, 1988-1994, United States, *Pediatrics* **108**(1): 40-43.

Northridge, M. E., Yankura, J., Kinney, P. L., Santella, R. M., Shepard, P., Riojas, Y., Aggarwal, M. and Strickland, P. (1999) Diesel exhaust exposure among adolescents in Harlem: A community-driven study, *American Journal of Public Health* **89**(7): 998-1002.

Nouwen, J., Cornelis, C., De Fre, R., Wevers, M., Viaene, P., Mensink, C., Patyn, J., Verschaeve, L., Hooghe, R., Maes, A., Collier, M., Schoeters, G., Van Cleuvenbergen, R. and Geuzens, P. (2001) Health risk assessment of dioxin emissions from municipal waste incinerators: the Neerlandquarter (Wilrijk, Belgium), *Chemosphere* **43**(4-7): 909-923.

Nugent, A. (2004) The Metabolic Syndrome, *Nutrition Bulletin* **29**: 36-44.

O'Brien, M., Jones, D., Sloan, D. and Rustin, M. (2000) Children's independent spatial mobility in the urban public realm, *Childhood* **7**(3): 253-277.

Office of the Deputy Prime Minister (2003) English House Condition Survey 2001, London: ODPM.

ONS (2002) UK 2000 Time Use Survey, London: Office for National Statistics.

Ostro, B., Lipsett, M., Mann, J., Braxton-Owens, H. and White, M. (2001) Air pollution and exacerbation of asthma in African-American children in Los Angeles, *Epidemiology* **12**(2): 200-208.

Parslow, R. C., McKinney, P. A., Law, G. R., Staines, A., Williams, R. and Bodansky, H. J. (1997) Incidence of childhood diabetes mellitus in Yorkshire, northern England, is associated with nitrate in drinking water, *Diabetologia* **40**: 550-556.

Pastor, M., Morello-Frosch, R. and Sadd, J. L. (2006) Breathless: Schools, air toxics, and environmental justice in California, *Policy Studies Journal* **34**(3): 337-362.

Pastor, M., Sadd, J. L. and Morello-Frosch, R. (2004) Reading, writing, and toxics: children's health, academic performance, and environmental justice in Los Angeles, *Environment and Planning C-Government and Policy* **22**(2): 271-290.

Patriarca, M., Menditto, A., Rossi, B., Lyon, T. D. B. and Fell, G. S. (2000) Environmental exposure to metals of newborns, infants and young children, *Microchemical Journal* **67**(1-3): 351-361.

Pattenden, S., Antova, T., Neuberger, M., Nikiforov, B., De Sario, M., Grize, L., Heinrich, J., Hrubá, F., Janssen, N., Luttmann-Gibson, H., Privalova, L., Rudnai, P., Splichalova, A., Zlotkowska, R. and Fletcher, T. (2006) Parental smoking and children's respiratory health: independent effects of prenatal and postnatal exposure, *Tobacco Control* **15**(4).

Pearce, H., Green, M. and Noble, E. (2005) Double Dividend: promoting good nutrition and sustainable consumption through healthy school meals, London: Sustainable Consumption Roundtable.

Peled, R., Friger, M., Bolotin, A., Bibi, H., Epstein, L., Pilpel, D. and Scharf, S. (2005) Fine particles and meteorological conditions are associated with lung function in children with asthma living near two power plants, *Public Health* **119**(5): 418-425.

- Pettifor, J. M. (2004) Nutritional rickets: deficiency of vitamin D, calcium, or both? *American Journal of Clinical Nutrition* **80**(6): 1725S-1729S.
- Prezza, M., Pilloni, S., Morabito, C., Sersante, C., Alparone, F. R. and Giuliani, M. V. (2001) The influence of psychosocial and environmental factors on children's independent mobility and relationship to peer frequentation, *Journal of Community & Applied Social Psychology* **11**: 435-450.
- Prüss, A. (1998) Review of epidemiological studies on health effects from exposure to recreational water, *International Journal of Epidemiology* **27**(1): 1-9.
- Pyle, R. (2002) Eden in a Vacant Lot: Special Places, Species and Kids in the Community of Life, in P. H. Kahn and S. R. Kellert (eds) *Children and Nature: Psychological, Sociocultural and Evolutionary Investigations* Cambridge: The MIT Press.
- Quilgars, D. (2005) Children, housing and neighbourhoods, in J. Bradshaw and E. Mayhew (eds) *The Well-being of Children in the UK* London: Save the Children.
- Raiten, D. J. and Picciano, M. F. (2004) Vitamin D and health in the 21st century: bone and beyond. Executive summary, *American Journal of Clinical Nutrition* **80**(6): 1673S-1677S.
- Rauh, V. A., Whyatt, R. M., Garfinkel, R., Andrews, H., Hoepner, L. and Reyes, A. (2004) Developmental effects of exposure to environmental tobacco smoke and material hardship among inner city children, *Neurotoxicol Teratol* **26**: 373-385.
- Ribas-Fito, N., Sala, M. and Sunyer, M. K. A. J. (2001) Polychlorinated biphenyls (PCBs) and neurological development in children: a systematic review, *Journal of Epidemiology and Community Health* **55**: 537-546.
- Ribeiro, H. and Cardoso, M. R. A. (2003) Air pollution and children's health in Sao Paulo (1986-1998), *Social Science & Medicine* **57**(11): 2013-2022.
- Richardson, G., Eick, S. and Jones, R. (2005) How is the indoor environment related to asthma? literature review, *Journal of Advanced Nursing* **52**(3): 328-339.
- Ridge, T. (2002) *Childhood Poverty and Social Exclusion: from a child's perspective*, Bristol: Policy Press.
- Ristovska, G., Gjorgjev, D. and Jordanova, N. P. (2004) Psychosocial effects of community noise: Cross sectional study of school children in urban center of Skopje, Macedonia, *Croatian Medical Journal* **45**(4): 473-476.
- Robertson, M. and Walford, R. (2000) Views and visions of land use in the UK, *The Geographical Journal* **166**(3): 239-254.
- Rudestam, K., Brown, P., Zarcadoolas, C. and Mansell, C. (2004) Children's asthma experience and the importance of place, *Health* **8**(4): 423-444.
- Sallis, J. F., Conway, T. L., Prochaska, J. J., McKenzie, T. L., Marshall, S. J. and Brown, M. (2001) The association of school environments with youth physical activity, *American Journal of Public Health* **91**: 618-620.
- Sax, S. N., Bennett, D. H., Chillrud, S. N., Ross, J., Kinney, P. L. and Spengler, J. D. (2006) A cancer risk assessment of inner-city teenagers living in New York City and Los Angeles,

Environmental Health Perspectives **114**(10): 1558-1566.

Schettler, T. (2001) Toxic threats to neurologic development of children, *Environmental Health Perspectives* **109** (Supplement 6): 813-816.

Seitz, J. L. (1995) *Global Issues*, Oxford: Blackwell.

Shepherd, J., Harden, A., Rees, R., Brunton, G., Garcia, J., Oliver, S. and Oakley, A. (2006) Young people and healthy eating: a systematic review of research on barriers and facilitators, *Health Education Research* **21**(2): 239-257.

Sherman, S. A., Shepley, M. M. and Varni, J. W. (2005) Children's environments and health-related quality of life: evidence informing pediatric healthcare environmental design, *Children, Youth and Environments* **15**(1): 186-223.

Shove, E. (2003) Changing human behaviour and lifestyle: a challenge for sustainable consumption, www.psi.org.uk/ehb/docs/shove-changinghumanbehaviourandlifestyle-200308.pdf, Accessed 3 November 2006.

Smith, K. R., Corvalan, C. F. and Kjellstrom, T. (1999) How much global ill health is attributable to environmental factors? *Epidemiology* **10**: 573-584.

Smith, K. R., Samet, J. M., Romieu, I. and Bruce, N. (2000) Indoor air pollution in developing countries and acute lower respiratory infections in children, *Thorax* **55**(6): 518-532.

Speak, S. (2000) Children in urban regeneration: Foundations for sustainable participation, *Community Development Journal* **35**(1): 31-40.

Spencer, C. and Woolley, H. (2000) Children and the city: a summary of recent environmental psychology research, *Child Care Health and Development* **26**(3): 181-198.

Stansfeld, S. A., Berglund, B., Clark, C., Lopez-Barrio, I., Fischer, P., Ohrstrom, E., Haines, M. M., Head, J., Hygge, S., Van Kamp, I. and Berry, B. F. (2005) Aircraft and road traffic noise and children's cognition and health: a cross-national study, *Lancet* **365**(9475): 1942-1949.

Taylor, A. F., Awiley, Kuo, F. E. and Sullivan, W. C. (1998) Growing up in the inner city: green spaces as places to grow, *Environment and Behaviour* **30**(1): 3-27.

Taylor, A. F., Kuo, F. E. and Sullivan, W. C. (2002) Views of nature and self-discipline: evidence from inner city children, *Journal of Environmental Psychology* **22**: 49-63.

Taylor, A. F., Wiley, A., Kuo, F. E. and Sullivan, W. C. (2001) Coping with ADD: the surprising connection to green park settings, *Environment and Behaviour* **33**(1): 54-77.

Thomas, G. and Thompson, G. (2004) *A Child's Place: Why Environment Matters to Children*, London: Green Alliance/DEMOS.

Timperio, A., Salmon, J., Telford, A. and Crawford, D. (2005) Perceptions of local neighbourhood environments and their relationship to childhood overweight and obesity, *International Journal of Obesity* **29**: 170-175.

Torsheim, T. and Wold, B. (2001) School-related stress, support, and subjective health complaints among early adolescents: a multilevel approach, *Journal of Adolescence* **24**(6): 701-713.

- Tukker, A. and Jansen, B. (2006) Environmental impacts of products, *Journal of Industrial Ecology* **10**(3): 159-182.
- Valent, F., Little, D., Bertollini, R., Nemer, L. E., Barbone, F. and Tamburini, G. (2004) Burden of disease attributable to selected environmental factors and injury among children and adolescents in Europe, *The Lancet* **363**: 2032-2039.
- Valentine, G. (1996) Angels and devils: moral landscapes of childhood, *Environment and Planning D: Society and Space* **14**(5): 581-599.
- Van Kempen, E., Van Kamp, I., Fischer, P., Davies, H., Houthuijs, D., Stellato, R., Clark, C. and Stansfeld, S. (2006) Noise exposure and children's blood pressure and heart rate: the RANCH project, *Occupational and Environmental Medicine* **63**(9): 632-639.
- Vreugdenhil, H. J., Slijper, F. M., Mulder, P. G. and Weisglas-Kuperus, N. (2002) Effects of perinatal exposure to PCBs and dioxins on play behaviour in Dutch children at school age, *Environmental Health Perspectives* **110**: A593-A598.
- Weiss, B. and Bellinger, D. C. (2006) Social ecology of children's vulnerability to environmental pollutants, *Environmental Health Perspectives* **114**(10): 1479-1485.
- Wells, N. M. (2000) At home with nature: effects of "greenness" on children's cognitive functioning, *Environment and Behaviour* **32**(6): 775-795.
- Wells, N. M. and Evans, G. W. (2003) Nearby Nature: A buffer of life stress among rural children, *Environment and Behaviour* **35**(3): 311-330.
- Wells, N. M. and Lekies, K. S. (2006) Nature and the Life Course: pathways from Childhood Nature Experiences to Adult Environmentalism, *Children, Youth and Environments* **16**(1): 1-24.
- Whewey, R. and Millward, A. (1997) *Child's Play: Facilitating play on housing estates*, London: Chartered Institute of Housing.
- White, R. (2004) Interaction with nature during the middle years: its importance in children's development and nature's future, www.whitehutchinson.com/children/articles/nature.shtml, Accessed 31 October 2006.
- White, R. and Stoeklin, V. (1998) *Children's Outdoor Play & Learning Environments: Returning to Nature*, www.whitehutchinson.com/children/articles/outdoor.shtml, Accessed 31 October 2006.
- Wilson, R. (1997) *Fostering a Sense of Wonder During the Early Childhood Years*, Columbus, OH: Greyden.
- Wood, A. W. (2006) How dangerous are mobile phones, transmission masts and electricity pylons? *Arch. Dis. Child.* **91**: 361-366.
- World Health Organisation (1992) *Our Planet, Our Health. Report of the WHO Commission on Health and Environment*, London: HMSO.
- Yaremchuk, K., Dickson, L., Burk, K. and Shivapuja, B. G. (1997) Noise level analysis of commercially available toys, *International Journal of Pediatric Otorhinolaryngology* **41**(2): 187-197.

Young, A. R. (2004) Tanning devices - Fast track to skin cancer? *Pigment Cell Research* **17**(1): 2-9.