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2. Children health: the last frontier

Children with every lungful of air, every morsel they eat and every glass of water they drink, are increasingly at risk of chemicals poisoning their fragile bodies. At the World Health Organisation (WHO) conference on children's health held in March 2002 at Bangkok, it was estimated that globally, environmental hazards kills three million children under five every year.[1] This is a very conservative estimate. To add to this threat, are the multitudes of traditional diseases like water borne infections and infectious fevers that have never left many tropical countries, and more so in poor and developing countries – and within them the poorest of the poor.

There's nothing known as safe childhood today, one that allows the infant to grown into healthy adulthood. Today, more children suffer from asthma, cancer, learning disorders, and rare childhood diseases than ever before. The sudden increase in the number of cancer hospitals in India is an indication of how alarming the situation is. Between 1982 and 1996 itself, the prevalence of asthma in the US rose by 59 per cent, with the highest rate of increase observed in the age group of 18-44 years.[2] Add to this the burden of primitive and avoidable traditional diseases that never left India. They cause the largest numbers of death in children in India and other developing and poor countries.

"Until fifty years ago, the dominant causes of illness in kids were infectious diseases, but today, after sickness and death, chronic diseases are the major cause. Asthma has become the leading cause of hospitalisation, and cancer is the leading cause of death", says Philip Landrigan, director of the Mount Sinai Centre for Children's Health and the Environment, Toronto, Canada. The lack of access to safe water, poor domestic hygiene, usage of low-grade bio-mass fuels for cooking and heating, and continuing child labour throughout the developing world continue to impact on the health and well-being of children. Environmental degradation surrounds children in every form. From foul and dirty air, to unsafe and contaminated water, to toxin-laced soil and food. This is what today's child live on. The effects of this do not spare anyone. Environmental toxins harm even the foetus. It is obvious therefore that chances are that what is contributing to more sick and dying children is the burden of unhygienic surroundings, respiratory infections and the chemical intensive lifestyles and a toxic environment that now surrounds us.

Traditional diseases like anaemia, malnutrition, diarrhoea, malaria and kala-azar are yet to be controlled. Add to this the growing evidence of invasive chemicals that impair or retard growth of children. The way, in which these substances interact to produce new combinations, is another reason for the upsurge in cases of paediatric cancers and neurological disorders. The burden is however unequal. Traditional risks like unhealthy housing, unsafe water and lack of sanitation still continue to plague the poor. Malnourishment continues to be the biggest challenge. Thirty-six per cent of children in low-income countries are malnourished compared to just 12 per cent in the middle-income countries and 1 per cent in the United States.[3] Children, especially the unborn are more susceptible to these environmental assaults. Any minor impact on the health of the mother threatens the vulnerable foetus.

The Human Development Report 2001 states that nearly 21 per cent of India's population remains undernourished. Half of all children under the age of five suffer from malnutrition and 53

per cent of children under the age of five are underweight.[4] Anaemia also is very prevalent amongst children. The report also states that 74.3 per cent of Indian children are anaemic. Anaemia strikes early, either at birth due to starvation, infections, and poor health at birth, or toxins like lead that reduce iron levels in blood. Studies show that a 10grams/litre (g/L) decrease of haemoglobin at the age of 6 months raises the risk of death by almost 1.72 times.[5]

As one moves up the economic ladder, a change in the diseases afflicting the children is apparent. Children belonging to the high socio-economic strata suffer more from "modern" diseases--increase in respiratory disorders, exposure to chemical toxins leading to cancers and the like.[6] **(see graph: an unequal disease burden** source: D Schwela 2002, WHO strategy for air quality and health, presentation made during the *Regional workshop on household energy, indoor air pollution and health,* New Delhi, May 9-10.)

The effect of modern day environmental pollutants on children result in increased incidences of asthma, lead poisoning, cancer and developmental disabilities. It is the special vulnerability and uniqueness of children that makes them more susceptible to these modern ailments. The total health care costs of environmental diseases in children in the US has been found to be around 2.8 per cent of the total health care cost, suggesting that the costs of paediatric environmental diseases are high when compared with the limited resources that are allotted for research and prevention of these ailments.[7]

2.1. The special vulnerability of children

Today children live in a very different world than from years ago. They carry an estimated 300 or more chemical residues that were not present in their grandparent's body. Since the human body simply does not posses' enzymes or other chemical mechanisms to counter the assaults of new chemical compounds, which are structurally different from naturally occurring compounds, these chemicals tend to accumulate in the body with increasing age. They are then passed on to the next generation through the placenta and breast milk, often in high concentrations.[8]

From conception to adolescence, rapid growth and development processes occur that can easily be disrupted by exposures to toxicants. Cell growth is particularly rapid in the embryo, providing more opportunity for toxicants to cause mutations and congenital anomalies. Children's metabolic pathways, especially in the first months after birth, are immature and their ability to detoxify and excrete chemicals is also much lower. Children drink more water, eat more food and breathe more air than adults in relation to their body weight. The air intake of a resting infant is twice that of an adult and an infant in the first six months of life drinks several times as much water per kilogram of body weight as the average adult does. Children aged one to five years eat three to four times more food per unit body weight than the average adult. Absorption rates may also be greater in the child: for example infants absorb as much as 50 per cent of the lead and other heavy metal contaminants present in food while adults have an uptake of only 10 per cent.

Children have more years of life ahead of them than adults, and therefore have more time to develop chronic diseases that take several decades to appear. The diseases which may be

triggered by early environmental exposure or be determined by continuous exposure would be diseases with long latency periods like benzene-induced leukaemia, sunlight-induced skin cancer, polychlorinated biphenyls (PCBs) and radiation-induced cancers.

A child's exposure and susceptibility to environmental hazards varies with each developmental stage: preconception, embryonic and foetal period, neonatal period, first three years of life, preschool and school age, and adolescence. **(see diagram: body of evidence, DTE, june 15, 2002, p 28)**

The embryo's tissue is particularly susceptible to damage from environmental toxicants due to rapid cell growth. Greater the rate of cell divisions, greater is the risk of cell damage by the toxicants that lead to congenital anomalies and eventually cancer. The placenta in some cases acts as a barrier and in other cases allows toxicants to pass through to the foetus. Lead can diffuse through the placenta and displaces calcium, iron or other nutrient metals, and thus be transported across the placenta. Many toxicants reach the foetus independently of the placenta, including ionising radiation, electromagnetic fields, heat and noise. **(see box: Foetal sense**).

Studies now show that the foetal lung is vulnerable to smog and various other air pollutants. A 10-year-long Children's Health Study conducted by W Gauderman, associate professor of preventive medicine and his colleagues from the Keck School of Medicine, University of South California, shows that lung function growth of children living in polluted area is slower than children staying in areas having cleaner air.[9]

Polychlorinated Biphenyls (PCBs) are organic chemicals that are banned, but they persist and accumulate in fat tissue; they are found in fish in the Great Lakes regions of USA. PCBs are a family of about 200 industrial chemicals used as lubricants and coatings. A study of the offspring of women who ate Lake Michigan fish during their pregnancies began 15 years ago in Detroit, Michigan showed extremely high prevalence of mental retardation in their children. Inuit mothers in the Arctic, far from sources of industrial pollution, have some of the highest levels of PCBs in their breast milk as a result of a diet rich in marine mammal fat.

Chemicals are also known to act as endocrine disruptors-that interfere with the hormonal functions of people and animals. These disruptors have the potential to affect sexual and mental development, as well as the immune system. Endocrine disruptors like dicyclohexyl phthalate (DCHP) have been detected in the umbilical cord of infants in Japan. DCHP is used in acrylic paint, cellophane, toys and plastic gloves. The umbilical cord of five newborns that were studied showed 2,700 nanograms of DCHP per gram fat.[10] There exist no regulations on the emission of DCHP. An earlier study found evidence of another disruptor- diethylhexyl phthalate in 20 umbilical cords that were analysed. It is the high permeability of the baby's skin, which makes it more sensitive to absorption of chemicals from its surface area. A newborn baby may absorb up to three times the amount absorbed by an adult. At birth, the respiratory tract also becomes a potential route for the absorption of toxicants. Mothers who had given birth to male babies suffering from hypospadias (a case of penile abnormality) were also found to have high levels of another hormone disrupting substance called bisphenol A. An endocrine disruptor, bisphenol A is

used in the production of epoxy resins and polycarbonate plastics. Rivers, soil and foods in Japan have been found to contain bisphenol A.[11]

Children have higher rates of respiration and calorie consumption per kilogram of body weight than adults because of their higher metabolic rate. This factor makes infants and toddlers more vulnerable to inhaled and oral environmental exposure. Children's hands-to-mouth behaviour, shorter stature and their playing close to the ground increases their exposure to toxins in dust, soil, air and carpets.

The burning of garbage and waste and toxic chemicals, releases dioxins into the atmosphere. Dioxins are also produced through bleaching of paper with chlorinated compounds, production of polyvinylchloride (PVC) plastics, chlorinated pesticides and secondary smelting of copper. Humans get exposed to dioxins via milk, meat and other fatty animal products.

An 11-year study of children in Detroit, Michigan, USA, who were exposed to PCBs in the uterus, showed that the most highly exposed children were more than three times as likely to perform poorly in terms of the scores for full-scale intelligence quotient (IQ), and verbal comprehension. They were more than twice as likely to be at least two years behind their peers in reading comprehension. The study found that PCB exposure is more damaging to the foetus than to the infant. Breast-feeding could expose infants to higher concentrations of PCBs than the exposure in the uterus. **(see box: the final invasion:in breast milk).** K Senthil Kumar and his colleagues of the department of environment conservation, Ehime University, Japan, have found the dioxin levels in human tissues to be higher than those from China, Japan ad other European countries.[12]

Parental exposure to toxicants can have a major impact on pregnancy outcome. This kind of exposure threatens the health of the future human being in two ways: toxicants can directly affect the maternal or paternal reproductive organs, as in the case of ionizing radiation, or they could get accumulated in the mother's body and later mobilized during pregnancy to affect the developing foetus and the offspring, as is the case with PCBs, dichlorodiphenyltrichloroethane (DDT) and other pesticides. Intake of the antibiotic tetracycline by the mothers has been linked with tooth discolouration and enamel loss along with interference with bone growth in infants.[13] Ingestion of human milk highly contaminated with hexachlorobenzene has also resulted in infant poisoning and death. Traces of toxin can affect foetuses and neonates. Cases of lead poisoning of neonates resulting from exposure to dust carried by the father's clothing demonstrates the danger of parental occupational exposures and hazards.

Phthalates (chemicals used to make polyvinyl chloride (PVC) plastic solid and flexible) widely used in toys such as pacifiers, intravenous catheters and tracheal tubes, can produce adverse effects on the developing male reproductive tract and in the long run have a carcinogenic effect. (**see box: Toxic toys).** Deposition of chlorpyrifos, a semi-volatile insecticide commonly used in household and industrial applications has also been found on toys.

Adolescence is a time of metamorphosis. Maturation of a number of organs including the respiratory, reproductive, skeletal, immune, and central nervous systems occur during this

period. On an average, females mature one to two years ahead of males, and reach their full adult height by age 14. Nutritional deficiencies in adolescent girls may result in anaemia and this may later contribute to a delayed age of menarche and also impair their immune response. [14] Improved nutritional intake interestingly, has been known to advance the age of pubertal onset as measured by menarche in females. More worrisome, perhaps, than the physical effects of early puberty are the potential psychological effects that the experience can lead to. Before they have outgrown dollhouses, many young girls face confusing mood swings, hormonal changes and sexual attention that accompany physical maturation. Studies have found that girls who reach puberty earlier tend to have sex earlier, experience more psychological stress and are more likely to drink, smoke and commit suicide.

2.2 The double burden of children

That the traditional forms of health risks associated with the domestic environment dominate the global burden of disease, is borne out by the fact that in 1990, lower respiratory infections (in children), diarrhoea, and adverse reproductive outcomes were ranked by WHO as the three major causes of disease burden. Respiratory infections mainly linked to indoor air pollution and crowding, are responsible for 9 per cent of the global disease burden. Diarrhoea, mainly associated with poor sanitation and hygiene, is responsible for 7 per cent of the disease burden. These comparatively high percentages occur primarily because it is children who are affected, thus losing many years of their productive life ahead of them. Malnutrition is not just a concern because of its direct consequences (malnutrition contributed to roughly 12 per cent of all deaths in 1990),[15] but also because this makes women and children susceptible to other diseases as well.

The Disability Adjustment Life Year (DALY) is a widely used method to determine the quality of health based on disease incidence. DALY tallies the complete burden that a particular disease exacts. It takes into consideration the age at which the disease or disability occurs, how long its effects linger, and its impact on quality of life. Children under age 15 account for almost one half of all disease burden, in DALYs, worldwide.[16] Most of the diseases that affect children are environmentally influenced. This is borne by the fact that lower respiratory infections, diarrhoeal diseases and conditions arising in the perinatal period accounted for the top three leading causes of death worldwide in 1990.

In India, it is still the traditional health risks that are responsible for the major burden of disease. Indoor environment polluted by *chullah* smoke is the main contributory factor in the rise of respiratory illnesses in children. Malnutrition in India accounts for nearly 22 per cent of all disease and injury burden.[17] (**table on global burden of disease and injury in India attributable to various risk factors)**

Table: global burden on disease and injury in India attributable to various risk factors

Malnutrition	Water and sanitation	Tobacco	Occupation	Air pollution	
22.4	9.5	0.6	2.0	0.5	

Source: C J L Murray and A D Lopez (eds) 1996, in *The Global Burden of Disease: Volume I*, World Health Organization, Harvard School of Public Health, and the World Bank, Geneva, pp 312-315.

However these estimates are not due to low caloric intake or low protein intake. Nor is it attributed to episodes of infectious diseases that contribute to the physiological state of a low weight-for-age child. What this indicates is how the health status of children can be enhanced if more attention could be paid to the problem of malnutrition.

In 1990 in India unsafe water and poor sanitation along with lack of personal hygiene was the cause of almost 10 per cent of the DALYs. When compared to developing countries, the contribution of unsafe water to DALYs was found to be almost negligible, or of less importance as in China, wherein it was only 2 per cent.

The global burden of disease series however predicts that mortality from communicable, maternal and perinatal conditions, and nutritional deficiencies is expected to fall from almost 5 million to below 3 million a year in India by the year 2020.

Even urban areas worldwide report high cases of child mortality. The special problems of urbanisation- inadequate access to potable water, sewerage connections; income inequality within a city, lack of government commitment, especially at the city level, inadequate water services management, lack of private sector participation in sewerage system provision, and lack of sufficient revenue at the city level, all contribute to the rise in child mortality.[18] An important indicator to measure the quality of life of populations is the Infant Mortality Rate (IMR). The IMR is an index of social and environmental living conditions, and it profoundly affects issues such as nutrition and public hygiene. Though India's IMR has declined from 129 in 1971 to 80 in 1991, it has remained stagnant between 1992 (79) and 2001 (71). However, when compared with the IMR of several developing countries like Indonesia (38), China (33), Vietnam (31), Iran (37) and Sri Lanka (17), IMR in India is still very high **(to be shown graphically).** This is evident from the case of Mumbai, the commercial capital of India.

Each year, about 9,000 babies from the every two lakh babies born in Mumbai, die before their first birthday. Mumbai's IMR is 38 per 1,000 births. Surprisingly, this is higher than the state of Maharshtra's urban average of 30. Given the health infrastructure of the city and the fact that nearly 90 per cent of the babies are born in hospitals or maternity homes, Mumbai's IMR is still worse than the state's urban average. "Mumbai's IMR may seem fairly good when viewed in the national perspective, where the average IMR is 70. But it is not significantly better than the overall state figure of 48, which includes rural and tribal areas also," says Sulabha Parsuraman, professor at the International Institute of Population Sciences, Mumbai. The main causes of Mumbai's high IMR are believed to be pre-term delivery and low birth weights, both the result of poor maternal health. In fact, women are generally the worst affected by lack of drinking water and sanitation and poor access to medical facilities, combined with overall poor nutritional status and high workloads. The problem of low birth weight is exacerbated by the city's extremely polluted habitat. According to the Brihamumbai Municipal Corporation (BMC), infections linked

directly to Mumbai's environment such as pneumonia, bronchitis and gastroenteritis, cause nearly 60 per cent of the infant deaths in the city.[19]

Recent data from the National Family Health Survey, which was conducted in 1998-89 states that though there has been a decline in IMR in India, one in 15 children still die before the age of one.[20] Hyderabad has an IMR of 65 per 1000 births.[21] So on one hand where there are new cases of environmental hazards for children in the form of lead and chemical poisoning, India still, on the other hand, continues to be saddled with traditional illnesses like malnutrition and diarrhoea.

Globally when it has been possible to bring down the child mortality rates, India still lags behind. This is true despite the health goal of reducing the IMR to less than 60 per 1000 live births that were set for 2000. Initially the IMR rates did show a steady decline, but recent data now show that the decline has slowed down. What is now required is formulation of a child health policy which takes into consideration factors that hinder the steady decline in IMR. (**see box: reducing IMR in India)**

Official figures suggest that fewer children are dying at birth and many government-run nutrition programmes ensure that they reach adulthood. Government health programmes are designed to address basic health care and generate figures mostly from the areas where its programmes have achieved much success. They do not address prevalent diseases such as pre-mature death, still-born children, birth defects, mental retardation and learning disorders, asthma, systemic diseases like childhood cancers, or ailments caused by chemicals including pesticides. The true picture therefore remains hidden and undisclosed.

2.3. The impact on Children's health

The vulnerability and susceptibility of children to environmental threats begins right from conception in the womb, and continues throughout pregnancy, infancy, childhood, and adolescence. Among the traditional diseases, only a handful of infectious diseases are the cause of almost 90 per cent of deaths. Six deadly infectious diseases - pneumonia, tuberculosis, diarrhoeal diseases, malaria, measles and more recently HIV/AIDS - account for half of all premature deaths, killing mostly children and young adults. Illness is frequently a consequence of malnutrition and vice versa. Under-nutrition coupled with low socio-economic status, inadequate immunisation, low birth weight and intense indoor smoke pollution are known risk factors for acute respiratory infections amongst children.[22] Infectious diseases also have dangerous nutritional consequences for pregnant women and foetuses. Effects on the mother include anaemia, placental infection and increased mortality due to severe malaria. Effects on the foetus include increased risk of abortion, foetal death, low birth weight (LBW) due to intrauterine growth retardation and premature birth, and congenital infection.[23] This leads to high risk of poor health and weak immunity for both mother and child.

The Health Information India report published by the Ministry of Health and Family Welfare, Government of India shows that environmental reasons are now more than ever responsible for

increased mortality in women and children **(see graph: what kills India's children- from newsletter march 2002).** According to the report, 55 per cent of child mortality in India is due to conditions originating in the period before and immediately after birth. A significant proportion of the other 45 per cent, as shown in the table, are strongly related to environmental causes. This data takes into account only the recorded deaths.[24] On the other hand, the World Health Report (1999) of the WHO shows that 429,000 children in India die every year due to childhood diseases (such as pertussis, polio, diphtheria, measles and tetanus) alone. This estimate is about three times the figure given in the Health Information of India report. It reflects poorly on the coverage of the National Immunisation Programme in India. A cross-sectional study to gauge the primary immunisation status of children in Delhi finds that lack of appropriate information to mothers about the benefit of immunisation is one of the main reasons for children not being immunised.[25]

Malnourishment

Inadequate intake of protein, energy and micronutrients, which is characterized by frequent bouts of infections and diseases, results in malnutrition which could be in the form of stunting (low height for age), wasting (low weight for height) and underweight children. On the other side of the spectrum is excessive intake of protein, which results in overweight and obesity in children. Afflicting all age groups and across the world, malnutrition affects nearly every third person. In this new millennium, 800 million of the total global population remains chronically malnourished. Around 70 million children are severely malnourished and 200 million children are moderately to severely underweight.[26] Children under the age of five and belonging to the lower socio-economic strata are more vulnerable to being malnourished. Malnutrition today is responsible for nearly 5.2 million annual child deaths in the developing world. [27]

Women and children are often the first victims of environmental degradation. According to the World Bank Report, "Wasting Away: The Crisis of Malnutrition in India", 30 per cent of the newborns are underweight and 60 per cent of the women are anaemic.[28] This is also evident from the fact that in Maharashtra alone, nearly 75 per cent of the deaths of 8,000 tribal children in 2001 were due to malnutrition. The Pune-based Tribal Research and Training Institute (TRTI) conducted the survey among 143 families, of Nandurbar district, who lost children in the age groups of 0-6 years. Aseem Gupta, collector of Nandurbar says drought in the district, coupled with rapid depletion of forest and land has made women and children more prone to malnutrition.[29] The TRTI report says the deaths were a result of malnutrition, respiratory disorders, low birth weight, convulsions, fever and premature births, all of which are related to malnutrition. The extent of malnutrition that was noticed in the 27 siblings of the deceased children, who were also surveyed, was found to be as high as 72 per cent. Out of these 27 children, 15 were severely malnourished, nine had moderate malnutrition and one had mild nutrition. Only two children were found to be normal.[30]

According to the "Food Insecurity Atlas of Urban India", 38 per cent of Indian children are underweight and 36 per cent are stunted because of poor nutritional intake. Bihar accounts for

having the largest percentage of urban children whose growth is stunted because of insufficient nutrition.

Malnutrition is the result of a complex interplay of diverse elements such as household access to food, child and maternal care, access to safe water and sanitation, infections and to lack of basic health services. The effects of malnutrition also cross generations. Children of malnourished and underweight women are likely to be small at birth. The fourth report on the world nutrition situation states that nearly one-quarter of newborns in the developing world start life with some degree of impaired growth and micronutrient status.[31] Overall, 60 per cent of women of childbearing age in South Asia - where half of all children are underweight, are themselves underweight. In South-east Asia, the proportion of underweight women is 45 per cent; while it is 20 per cent in sub-Saharan Africa. (**see chart: poor nutrition throughout the life cycle/the intergenerational cycle of malnutrition**
Source: adapted from the administrative committee on coordination (ACC)/sub-committee on nutrition (SCN)-appointed Commission on the Nutrition Challenges of the 21st century)

It is a universal fact that weak, malnourished women give birth to malnourished, underweight and often premature babies. Energy consumption of pregnant women has a direct bearing on the birth weight of their babies. So much so, that the frequency of low birth weight decreases as women improve their diet and take in more energy. [32] The cycle of poor nutrition however perpetuates itself across generations. Young girls with stunted growth are more likely to give birth to babies with low birth weight. If those infants are girls, they are likely to continue the cycle of stunted growth in adulthood if necessary care is not taken to break the cycle. Adolescent pregnancy heightens the risk of low birth weight and the difficulty of breaking the cycle. The proportion of infants with low birth-weight (LBW) in India continues to be high despite many efforts and improvement of other health indicators. This is a serious and important public health issue. The cut-off point in birth-weight, below which mortality rates in infants are found to show significant increase, is generally considered to be 2,500 **grammes** (g). Therefore, the current internationally accepted criterion for LBW is a weight at birth of 2.5 **kilogrammes (**kg). Most of the LBW infants in India are pre-term (premature) infants. At the same time, in the developing countries, a considerable proportion of infants with LBW are full-term infants. LBW in the latter case is a reflection of intra-uterine growth retardation resulting from poor maternal health/nutrition during pregnancy.[33] The majority of LBW deliveries in India are attributable to such intra-uterine growth retardation. LBW is also a cause of concern since the children are more prone to developing diabetes and high blood pressure resulting in a higher prevalence of morbidity and mortality.[34]

Half of South Asia's children are malnourished. In many states of India including Jharkhand, Orissa, Chattisgarh and Bihar, one of every three children is underweight, and one of every two children is anaemic, and the nutritional status of children is only worsening. A recent survey carried out by the Family Planning Association of India finds that 72 per cent of children in India suffer from malnutrition and anaemia.[35] Malnutrition contributes to nearly 55 per cent of the main causes of death in children less than 5 years of age in developing countries. Pneumonia and diarrhoeal diseases represent 11 percent of the global burden of disease **(see graph: main causes of death in children under 5 years of age in developing countries).** The graph gives

an idea that investing in programmes aimed at furthering improvements in child health can help prevent most of these deaths.

Malnourishment is very prevalent among pre-school (age between 1-5 years) children too. In this age, children are most vulnerable to the onslaughts of malnutrition since it is in this growing period when there is high demand for proteins and calories. Studying 520 pre-school children residing in the urban slums of Varanasi, R N Mishra and colleagues found that 75 per cent of these pre-school children were malnourished with 20 per cent suffering from severe degree of malnutrition. It is therefore harder for children in this age group who have to cope with the killer triad of diarrhoeal diseases, respiratory tract infections and malnutrition. The highest morbidity and mortality is thus to be found in this age group of children.[36] The ratio of children in urban slums afflicted with energy deficiency and micronutrient is alarming; and this could very well result in a concentration of growth failure and impaired nerve response and cognitive development in the under-5s of urban slums. (**box: Stunted growth)**

K Anand and his colleagues from All India Institute of Medical Sciences (AIIMS) who looked into the nutritional status of 494 adolescent school children (age group12-18 years) in Chandawli of district Faridabad, Haryana report that stunting was prevalent amongst 37.2 per cent of girls and 41 per cent of the boys.[37] G Kapoor highlights the role that the socio-economic status of the family has on the nutritional status of adolescents. His study done on adolescent girls reported the prevalence of stunting in only 9.9 per cent of upper socio-economic class girls in comparison to 35.3 per cent of girls in the lower middle class.[38]

Besides maternal malnutrition, maternal undernutrition (deficiencies of micronutrients, such as iron, iodine and vitamin A) and the subsequent intra-uterine growth retardation in babies results in changes in the body's structure, physiology and metabolism, increasing the individual's susceptibility to degenerative cardiovascular diseases in later life.[39] Again, low birth weight babies are more likely to be affected by diarrhoea and acute respiratory infections. They are also prone to malnourishment setting in by the time they are one year old and they may be severely stunted later on.

Waterborne diseases

Dirty water is still the biggest killer in India. In a 2000 study done by Hughes and Dunleavy, dirty water accounted for 2.06 million deaths in children. And 90 per cent of them belonged to poor rural households. What is more shameful is that the study clearly shows if the households had clean fuel, access to private and clean water and clean toilet, childhood mortality rates would be nearly half.[40] Unsafe water affects children more than adults. Diarrhoea is the most common ailment of unsafe water. Rotavirus, a large diversity of bacteria and viruses, considered to be the main cause of severe diarrhoea, causes over 800,000 deaths annually in children aged less than five years in developing countries, and almost 25 per cent of these deaths occur in India.[41] The pathogens of diarrhoea originate in human faeces, domestic garbage and manure heaps where there are no proper latrines. Malnourished children exposed to contaminated water are more susceptible to a diarrhoea attack. An estimated 60-70 per cent of diarrhoeal diseases are caused by dehydration.[42]

The onset of summer in India brings along with it a rise in waterborne diseases. According to Ritu Gupta, Medical Superintendent, Shri Raghunath Charitable Hospital, Ludhiana, a city in the state of Punjab, the number of patients attending the out door patient department (OPD) of the hospital increase daily. She says, " There are cases of viral diarrhoea and dehydration. Patients come up with symptoms of vomiting, mild fever followed by loose motions. Most of the patients are below the age of three."[43] Rajkot in Gujarat reported a quantum leap in waterborne diseases. The number of diarrhoeal and dysentery cases in March 2002, which were registered at the civil hospital, were around 195, as compared to just 104 in March 2001.[44] Similar rise has been noticed in Faridabad also.[45]

Acute and persistent diarrhoea are not two separate diseases but form a continuum. Most episodes of diarrhoea last less than one week, however a small proportion of episodes last for two or more weeks. The definition of persistent diarrhoea has varied, therefore it is helpful to have a standard one so that different studies can be compared, and recommendations made for treatment. **(see box: Diarrhoeal details)**

Persistent diarrhoea is becoming recognised as an important child health problem in developing countries, although its control and prevention have received less attention than acute diarrhoea. In the mid-1980s the WHO recognised that efforts to control persistent diarrhoea were inadequate. One of the strategies that it put forth relates to the formulation of oral rehydration salts (ORS). Apathy towards neglected diseases that affect children most can be seen with the research done on ORS. In 1975, the WHO and UNICEF agreed to promote a single, orally administered solution of ORS to prevent dehydration caused by diarrhoea. However, the ideal composition of this solution has been a bone of controversy for many years. Standard ORS has caused several deaths mainly in children because of its high salt concentration. The new ORS has reduced osmolarity or concentration of salts and has proved to be more effective in children and adults with cholera.

Overall a total of 14,000 deaths per million episode of **diarrhoea** could have been avoided had the reduced osmolarity ORS solution been produced earlier. This would have also resulted in cost savings of US $500 per death, or US $7.1 million per million episodes. [46]Though many donors and organisations like WHO claim to have been working towards a more effective ORS solution, in reality, most of the research has been intermittent and lacks political will.[47]

The role of various infant food-manufacturing companies also cannot be discounted at the strategies that they adopt to wean children away from breast milk. Nestle, the Swiss transnational corporation, has been known to promote infant food substitutes that make mothers switch babies over from breast feeding to bottle feeding. Claiming that besides ORT, there is really no way to cure diarrhoea, the company has developed a carbo-based baby food, which it says, helps remove diarrhoea-causing bacteria from the intestines.

In the absence of clean drinking water, a bottle-fed baby is 25 times more likely to die of diarrhoea and four times more likely to die of acute respiratory infections (ARI) as compared to a baby who is exclusively breastfed. By aggressively promoting infant food, Nestle has been

accused of violating the 1981 WHO-UNICEF code of International Marketing of Breastmilk Substitutes.[48]

Studies show that most of the diarrhoeal and respiratory infection deaths can be prevented by exclusive breastfeeding among infants aged 0-3 months and partial breast feeding throughout the remainder of infancy. This has been found to be true in a study undertaken to assess the impact of breastfeeding on low weight babies of an urban slum in Kolkata. Exclusive breast fed infants were found to experience fewer episodes of diarrhoea as compared to those who were weaned away early.[49] A similar study conducted in Latin America found that exclusive breast feeding in infants aged 0-3 months, prevents 66 per cent of deaths by these causes; among infants aged 4-11 months, 32 per cent of such deaths are preventable by partial breast feeding and 13.9 per cent of all infant deaths from all causes can be prevented by these breastfeeding patterns. Breastfeeding accounts for more than 5,000 preventable deaths in this region.[50] Studies also show that zinc and vitamin A in combination are effective in reducing persistent diarrhoea and dysentery.[51]

Roundworm, tapeworm, hookworm, threadworm, and whipworm infections are usually associated with malnourishment in tropical countries. In India, infestation from worms is widespread, especially in rural areas, where it is estimated that 20 per cent of outpatient morbidity is due to helminth infestation. Since no regular monitoring of such diseases ever takes place, very little reliable data is available. But it is believed that only 10 per cent of the population in India carries heavy worm loads with mild symptoms, while one per cent is severely affected. Worldwide, worm-related diseases, often with multiple infections, affect about 400 million schoolchildren. Of these, the two most significant in terms of mortality are roundworm and hookworm, each believed to cause about 60,000 deaths globally every year. **Cholera**, another waterborne diarrhoeal disease, causes the death of about 700,000 people every year.[52]

Another dimension of waterborne diseases in children relates to its scarcity and contamination by arsenic or fluoride or due to industrial effluents. Water quality problems affect some 45 million people in India.[53] With water being scarce children may avoid washing and cleaning of their face, revealed by a study undertaken of 15187 children under the age of 10 years, belonging to Mali, in Africa. The incidence of trachoma was directly related to the distance of the nearest water source available. Less availability of water led to a decreased frequency of both face washing and bathing, which attracted files on the child's face.[54] Industrial effluents have also been known to kill children. The recent deaths of two children at Ganganpahad colony in the Rajendranagar area of Hyderabad has been attributed to contaminated water. The entire area surrounding the colony has polluted water contaminated with effluents from the neighbouring oil and textile mills. More than 25 children were taken ill.[55]

"Groundwater contamination is an irreversible act that will deprive future generations of one of life's basic resources," said Payal Sampat. "In the next 50 years, an additional three billion people are expected to inhabit the Earth, creating even more demand for water for drinking, irrigation and industry. But we're polluting our cheapest and most easily accessible supply of water," Sampat said. "Most groundwater is still pristine, but unless we take immediate action, clean groundwater will not be there when we need it."[56]

Exposure to hard water is a risk factor for eczema. A significant direct relation between lifetime prevalence of eczema and water hardness has been found in Nottinghamshire schoolchildren in UK.[57] By far the most serious natural groundwater-quality problem known in India derives from high fluoride concentrations, which are dissolved from the bedrocks by geochemical processes and have resulted in severe fluorosis in large populations.

In parts of Karnataka, nearly 50 per cent of the water is unfit for human consumption. A survey of districts of the state by the Rural Development and Panchayat Raj (RDPR) found that water in nearly 5,822 villages were contaminated with excess fluoride, 6,621 villages had excess iron, nitrate level was high in 4,077 villages and in 4,411 villages, the water was brackish. In Kolar in Karnataka, skeletal and dental fluorosis affects more than 80 per cent of the children. The high fluoride concentration in the groundwater (2.8 to 4.3 mg/L as against the permissible limit of 1.5 mg/L which has been set by the WHO) explains why Kolar has so many of fluorosis cases.[58]

The widespread pollution of surface and groundwater is reducing the quality of available fresh water resources. It is now more than 20 years ago that arsenic was first deducted in two districts of West Bengal. According to Dipankar Chakraborti, Head, School of Environmental Sciences, Jhadavpur University, Kolkata, arsenic toxicity today affects 9 out of the total 18 districts of West Bengal. After Bangladesh, West Bengal in India is severely affected by arsenic toxicity. Around 6 million people out of which 2 million are children, drink water which has arsenic above the WHO standard limit of 50 mg/L. Nearly 300,000 already suffer from arsenic related diseases. [59] The symptoms of arsenic toxicity include skin pigmentation, darkening of the skin, keratosis, and development of skin cancer. Children are more susceptible to arsenic toxicity. A sample of 1500 hair and nail samples from children below the age of 11 years residing in arsenic affected villages of West Bengal and Bangladesh showed that nearly 90 per cent of them had hair and nail arsenic above the accepted level.[60]

Polio

Polio is a debilitating disease of the limbs, which impairs children for life. The polio virus is found in unsafe drinking water and targets children under the age of three. Nearly 50 per cent of polio cases are found in children belonging to this age group. Young children, pregnant women and people with low immunity are especially at risk. However, recently there has been a decline in the number of polio cases. Concentrated efforts of the government by launching the Pulse Polio programme have resulted in the reduction of polio cases. As compared to 29,709 polio cases reported in 1981, India had only 265 cases of polio in the year 2000.[61] This shows a ray of hope in the grim scenario. India however still accounts for 40 per cent of world's polio cases with poor performance being recorded in the states of Uttar Pradesh, Bihar, West Bengal and Delhi.[62] Shatrughan Sinha, Minister for Health and Family Welfare admits that there has been a sudden rise in the number of polio cases recently. Out of the 344 cases detected upto September 2002, as many as 293 were in UP. "Sixty per cent of the world's polio cases are to be found in Uttar Pradesh," says Sinha.[63] But are these data reliable? True? Most of the polio cases in Uttar Pradesh are reported from districts where people claim the polio teams do not visit at all.[64] Opines noted virologist and advisor to the Indian state of Kerala, Jacob John, “National level

immunisation coverage values are a myth." According to him, year after year India reported vaccinating hundreds of thousands of children against polio, but these figures were much more than the number of doses the country purchased. What is more, independent experts say this has been going on since the 1970s. "Everybody knows about it," says Pierre Claquin, an epidemiologist working in Bangladesh. There, the reported figure for measles immunisation in 1999 was 96 per cent, as compared with 61 per cent from an independent survey.[65] This is also concurred by B K Dutt, senior pediatrician of Moradabad, in Uttar Pradesh, who says that government health agencies report 100 per cent immunisation coverage, whereas in actuality it is only 15-20 per cent. Says he, "Polio cannot be eradicated unless this false reporting is discontinued."[66] Breakdown of the cold storage chain has been attributed to be the main reason for the failure of the pulse polio programme in UP and Bihar. The detection of the poliovirus in two infants of Muzaffarpur, Bihar, within a span of one month is seen as a major setback for the whole programme in that state. "It is no more safe to give pulse polio drop," says Harihar Singh, resident of Brahampur, a neighbourhood of Muzaffarpur. In Murshidabad district of West Bengal, the alarming increase of polio cases have made the parents refuse health workers from administrating polio drops to their children. Cultural taboos like polio drops can lead to infertility later in life and that these drops actually cause polio have made the pulse polio campaign come to a halt.[67]

Polio eradication however continues to be a success in other regions of the world. Mynamar has been implementing the National Immunisation Days (NIDs) for oral polio vaccine since 1996. Survey conducted in the centre of the 'Golden Triangle' surrounding Mynamar and Thailand shows that the programme has been highly successful in even preventing cross border transmission of the virus. All that requires than for the programme to succeed is dedication to the drive.[68]

On the other side there is the failure of the vitamin A programme, which complemented the pulse polio campaign. The pulse polio programme ran into troubled waters when at least 10 children died and more than 500 children were admitted to hospitals in Assam due to side effects of a polio vaccine. In the **polio** immunisation programme of November 2001, thousands of children throughout India were administered polio vaccine. A day later, large-scale side effects in and around the city of Silchar in southern Assam were reported. Outdated vaccines were cited as the most possible cause of the failure. On the heels of the polio vaccine-related deaths, came news about deaths due to overdose of vitamin A to children in Assam. Fourteen children died and more than 900 children showed symptoms of vitamin A hypertoxicity. (**see box: blinded by medicine)**

Indoor household environment

Another silent and persistent killer is the indoor household environment. The use of biomass wood and dung as fuel releases a number of harmful pollutants in the air that have serious health implications for those exposed to them. Since women spend the maximum time in the kitchen area, and young children spend time around with their mothers, the quality of household fuel has a substantial impact on the survival of children. The National Sample Survey conducted in 1999-2000 covered 120,000 households and found that 86 per cent of the rural households

and 24 per cent of the urban households used biomass as their primary source of cooking fuel. The survey finds that in India every year, indoor air pollution (IAP) is estimated to cause about 500,000 deaths, 500 million incidences of illness and 16 million Disability Adjusted Life Years (DALYs) lost among children and women. This amounts to almost 30 per cent of the global disease burden from IAP. According to the World Bank, IAP is the fourth highest global risk to health after malnutrition, bad water and sanitation, and HIV/AIDS.[69] The health effects of IAP include increased incidences of acute lower respiratory infections and chronic obstructive pulmonary diseases in children. Evidence has also emerged that IAP results in tuberculosis in individuals, produce low birth weight babies, cause cataract and can lead to exacerbate asthma. **(see also air pollution and ill-health chapter)**

Unlike the highly visible pollution from vehicles, exhausts or smokestacks, which is heavily diluted by the time it travels from the source to the lungs, domestic pollution due to biomass burning is inhaled much closer to the source, and in far more concentrated levels. Exposure to high levels of this smoke during pregnancy has been associated with a 50 per cent increase in stillbirths. An association between birth weight and exposure to wood fuels has been found in rural India and rural Guatemala. [70]Inhalation of Carbon monoxide released by biomass combustion limits oxygen delivery to haemoglobin of both mother and foetus. Considerable amounts of this toxic gas have been detected in the bloodstream of rural women in these two countries. The presence of IAP is also known to depress the immune system of newborns. Nitrogen dioxide produced during cooking may damage the lung directly or may cause indirect harm by increasing susceptibility to respiratory infections. Since children spend a lot of time indoors, IAP from houses using kerosene or mixed fuels affects the general respiratory function. Symptoms such as cough, cold, congestion or phlegm are more common in these children.[71] In a Delhi slum children exposed to fuels from kerosene and wood smoke were found to have a higher incidence of acute lower respiratory infections than children residing in other areas of the city.[72] Even low levels of exposure to some pollutants may be dangerous for children. Children belonging to lower socio-economic income groups are more prone to exposure from IAP because of housing quality which lets the pollutant persist in the house environment.[73]

Improvements in use of cooking fuel can bring about drastic reductions in child mortality rates. A mere change from fuel wood to clean energy sources like liquid petroleum gas (LPG), reduces the childhood mortality rate by half for children under five. Infant and child mortality rates could be reduced by about 0.96 million per year, including 0.70 million infants under the age of 12 months. This translates into almost 95 per cent of the deaths in rural areas in children being avoided.[74]

The other source of indoor air pollutant is environmental tobacco smoke (ETS). At least 43 per cent of children, the world over, live in a home with at least one smoker. These children involuntarily inhale the many pollutants present in cigarette smoke, which are smoked inside homes. Environmental tobacco smoke contains more than 4,000 chemicals, including carbon monoxide, nicotine, tars, formaldehyde and hydrogen cyanide. Exposure of children to ETS is known to result in increased incidences of bronchitis, pneumonia, respiratory infections and **asthma** symptoms. Estimates made by the Centres for Disease Control and Prevention (CDC), Atlanta, USA, show that children exposed to tobacco smoke have 18 million more days of

restricted activity, 10 million more days of bed confinement, and miss seven million more school days annually than other children, primarily due to acute and chronic respiratory conditions.[75] Prevalence of bronchial asthma has been found to be more prominent in children exposed to ETS. D Gupta from the department of pulmonary medicine, Postgraduate Institute of Medical Education and Research, Chandigarh, India, in his study of 9,090 students in the age group of 9-20 years, finds ETS to be positively associated with prevalence of all the respiratory symptoms.[76] A similar finding has been noticed in the prevalence of bronchial asthma in school going children of rural Haryana.[77] . New research done among 900 adolescents living in Delhi reinforces the theory that air pollution and smoking perpetrate asthma in children. (**box: No breather in sight,** DTE, vol 11, no 13, November 15, 2002)

Box: No breather in sight

A study of 900 adolescents living in Delhi and surrounding areas such as Sohna and Rewari in Haryana has once agai reinforced that exposure to air pollution is one of the main perpetrators of asthma. According to the study conducted by K Chugh, pediatrician and his researchers from Sir Ganga Ram Hospital, New Delhi, children residing near congested traffic areas or market places are more likely to suffer from the disease, than those living in smaller towns. It is applicable for those regularly commuting long distances.

The study data was collected through a detailed questionnaire, which pertained to environmental and social risk factors. Children exhibiting symptoms such as cough and shortness of breath were diagnosed as having asthma. Along with air pollution, the group also identified other risk factors such as cigarette smoking. After scrutinising their data, the researchers found that the risk was lower in children living in cleaner environment and those who did not travel long distances.

“The magnitude of problem makes it vital that the disease is diagnosed in early stages so that proper treatment can be given at the right time,” concludes Anupam Sachdeva, paediatric hematologist and oncologist, who was part of the study.

The presence of household allergens like moulds are also being now recognised as environmental hazards for children.[78] Researchers from the Federal University of Sao Paulo, Brazil have found that schools and daycare centers are sources of exposure to allergens, which are derived from mites, cockroaches, cats and dogs. It is the bedding in daycare centers and pre-schools that accounted for increased levels of mite allergens.[79]

The World Health Organisation (WHO) now identifies malnutrition, smoking and poor sanitation as among the top 10 avoidable risk factors that account for nearly 40 per cent of global deaths each year. “The report provides a road map on how societies can tackle a range of preventable conditions that kill millions of people prematurely and rob tens of millions of healthy life,” says Gro Harlem Brundtland, who director-general.

The risks are starkly different between 'haves' and 'have-nots'. Whereas poor people typically die because of lack of food and clean water, the rich die due to diseases of overindulgence. These reasons may be obvious, but who describes them as "shocking". Of the 10 risk factors, the five that dominate in poor countries are: abnormally low body weight, unsafe sex, iron deficiency, unsafe water and exposure to indoor smoke from solid fuels. "Indoor air pollution was a complete surprise," says Christopher Murray, overall director of the report. The smoke causes pneumonia in children and lung disease in women. In richer countries, the five key killers identified are tobacco smoking, alcohol drinking, high blood pressure, high blood cholesterol and obesity. These are the perils of the burden of modern living.[80]

2.4 The modern diseases burden in children

Even places that were presumed to be safe like schools; crèches and nurseries have shown to pose toxic threats to children. For example, studies conducted over five states in the US and covering a large school-age population reveal that more than 600,000 students attend schools that are located within a half mile of contaminated landfill sites. These toxic sites put the children at greater risk of developing asthma, cancer and learning disabilities.[81] Landfill sites have long been recognised as environmental hazards. Waste-disposal sites have been linked with raising the risk of congenital anomalies in babies whose mothers live close to landfill sites that handles various hazardous chemical wastes.[82]

More than 100,000 chemicals are in use worldwide. And almost daily, the world gets introduced t another new chemical. Out of these, even the US admits that only 1.5 to 3 per cent are tested for safety. Very little is known about the carcinogenicity of the others. According to the chemical hazard data availability study done in 1998 by the US-Environmental Protection Agency (EPA), thre is no basic toxicity information on the 2,863 high production volume (HPV) chemicals that are produced every year. Information is available for only 43 per cent of these high production volume chemicals. And a full set of toxicity information is publicly available fro only 7 per cent of HPV chemicals.

Chemicals have been known to affect brain development and function, and have serious effects on children's learning and behavioural abilities. Compared to other organs, the human brain forms over a long period of time – beginning in the first weeks after conception. Brain weight at birth is about one-third of adult weight. Brain growth is rapid from the third trimester of pregnancy, which continues until age two. Brain development continues during the early years, some systems maturing at puberty and beyond. The developing human brain is much more vulnerable to toxic insult than the mature brain in most cases and the after effects of these are felt later on also in adulthood.

Lead and other heavy metals like cadmium, arsenic and mercury are the most studied neurotoxicants. The deleterious effect of lead on children have led to revisions in its levels within the US–from about 60 microgrammes per decilitre of blood (μg/dl) in the late 1960s to 10 μg/dl today. Lead is nonbiodegradeable, therefore it gets accumulated and never disappears. In comparison to adults, children absorb lead more readily: i.e., 42-48 per cent as against 8-10 per cent in adults.

The accumulative and storage properties of lead present a special problem for pregnant women with past lead exposure. Adverse developmental effects have been noticed in young children wherein pregnant women have transferred their skeletal lead burden across the placenta to the developing foetus.**(see box: the problem of lead)** This is further evidenced by a Lucknow-based study, which found high concentrations of lead in maternal blood lead level in cases of abnormal delivery (22.52g/dl) whereas normal delivery cases had 19.4g/dl of lead. However, no significant difference was observed in normal and abnormal delivery cases with regards to placental cord blood and foetal membrane lead levels.

Research now equates a 10-point drop in blood lead levels with an average 2.8-point gain in IQ. Ganesh Murthy, psychometric specialist at the Institute for Children with Learning Disability, Dehradun, warns: “If the (environmental) source is not identified, then it gets too late to reverse the damage". Measuring blood lead levels in 82 children suffering from various neurological disorders (cerebral palsy, seizure disorders), A Kumar and his colleagues from the department of paediatrics, Banaras Hindu University, found that in comparison to the control group of healthy children, blood lead levels were elevated in children with cerebral palsy.[83]

Children are exposed to lead via vehicle emissions, chewing of lead pencils, recycling of lead batteries, soil, ambient cigarette smoke, lead-laced drinking water pipes and paint. In many countries, lead exposure due to vehicles accounts for nearly 90 per cent of air-borne lead contamination. The correlation between the blood lead of children and air lead reveals that the BLL in children increases by 0.3 parts per billion (ppb) for every incremental rise of 1 part per million of lead of air.[84] The pollution of water bodies due to the ritual immersion of idols (during Durga puja and Ganesh Chaturthi) painted with chemical colours is another source. A community-based cross-sectional study of 297 children aged 6 months to 6 years finds positive correlations between the prevalence of elevated lead levels in the blood and the lead contents in potential environmental sources such as paint, pencils, crayons and clay.[85]

Working children exposed to lead occupationally also have high BLL. A 1998 study showed that more than 35 per cent of children working at petrol pumps had BLL above 35g/dl, 17 per cent of those working in the bangle industry had BLL more than 30g/dl; and in pica (mud) eating children 47 per cent of them had BLL around 29g/dl.[86] Children living in close proximity to industries engaged in preparation of packing material were found to have one-and-a-half times higher BLL (35.2g/dl) as compared to those children living further away (23 to 28g/dl). Complaints of low appetite levels, gum-line and anaemia were common in these children.[87]

Other heavy metals, such as cadmium and aluminium, are known to be neurotoxic. However, there is very little research to date on their potential to affect the developing brain. Relatively high levels of mercury in mothers are known to cause developmental problems in their children. An examination of 44 mothers having less than 10 parts per million (ppm) of mercury in their hair and the development of their infants show that for every 1 ppm increase in mercury, children started walking 1.58 months later than usual. The normal mercury level for women is around 2 ppm.[88] "Methyl mercury appears to be most neurotoxic prenatally when the brain is developing rapidly", says neurologist Gary Meyers and psychologist Philip Davidson, from the University of

Rochester in New York. Methylmercury is formed when elemental mercury forms complexes with organic molecules in the environment. Exposure of most people to methylmercury comes through eating contaminated fish. Children born to women who had traces of mercury levels in their blood were found to be deficient in learning and had shorter attention span, memory and other skills. "Children with increased exposure performed as though they were a few months behind their age," says Philippe Grandjean who conducted the study.[89] In India, caustic-chlorine companies using mercury cell technology do not even know where 90 per cent of mercury goes. There is simply no data available. No monitoring done. No research carried out.

Almost 18 years ago, on the night of December 2, 1984, about 40 tonnes of methyl isocyanate (MIC) from the Union Carbide India Limited's (UCIL) pesticide factory in Bhopal in central India, leaked into the surrounding environment. It affected more than 200,000 of the city's total population of 700,000. The chemical affected the eyes, lungs and gastro-intestinal systems. What also became apparent were gynaecological and obstetric complications, immunological changes, neurological disorders, accelerated rates of cancer and emotional and mental stress. So many years down the line, children still continue to be the silent sufferers.

According to a fact finding report bought out by a New Delhi based NGO Srishti, ""not only the soil, but also the groundwater, vegetables and even breast milk is contaminated to various degrees by heavy metals like nickel, chromium, mercury and lead, volatile organic compounds (VOCs) like dichlorobenzene and halo-organics like dichloromethane and chloroform." What is of more concern and worry is the fact that these metals and VOCs can be easily passed on to the next generation through breast milk. The fact finding report which collected samples taken from women in the area, found high concentrations of VOCs and a higher concentration of pesticide in breast milk. "This poses a serious concern to infants, as it is the easiest and shortest route of exposure to these potentially carcinogenic chemicals," says the report.[90]

There exists at present no acceptable level for these toxic compounds. Children are especially susceptible to even low levels of toxicity, which can lead to endocrine disruption, and hormonal malfunctions, effects of which may only emerge at puberty. The human fetus and the early infancy days are more vulnerable to the effects and this can lead to serious health problems in the future. What is frightening is that these toxic chemicals can result in mutations and chromosomal aberrations. Birth defects in babies born to the exposed population indicate that there may as well be more cases of congenital malformations in the near future. Spontaneous abortions among pregnant women exposed to the gas have been reported. When compared to a control group, the incidence of perinatal and neonatal mortalities was found to be 6.9 and 6.1 per cent (in the control group it was 5 and 4.5 per cent respectively)[91] and that of foetal loss as high as 26.3 per cent against 7.8 per cent in the control group.[92] However there exists no documents on the long term health effects of MIC gas on those who were children at the time of the disaster; or the health of children born after the disaster; long term abortion rates; pathologicanatomical examination of aborted foetuses.[93] The findings of the International Medical Commission on Bhopal (IMCB) released in 1996 says that it is vital that there is ongoing monitoring of those survivors who were in utero, or under age 18 at the time of the disaster (those now under 30 years of age), and of the children of the survivors.[94]

Asthma and cancer is growing

Global figures suggest that since 1990 childhood cancer has risen by 12 percent, asthma in children has grown by a whopping 17 per cent, and systemic disorders have grown from 4 per cent to 16 per cent, depending on where people reside. Clearly, environmental disasters like Chernobyl had immense impact on global cancers figures. Asthma is more prevalent in the rich industrialised countries. But these figures are conservative estimates – since countries like India do not have authoritative registries, guestimates are filled in to arrive at conclusive numbers.

"Purely on the basis of statistics, India's incidence of cancer, asthma and other childhood diseases indicators of modern disease are lower than industrialised and many developing countries. But this does not mean that we need not take preventive action now", say leading paediatrician H N Billimoria. "This also does not mean that the level of disease is decreasing in India", he adds with caution.

In India, increasingly new syndromes in childhood diseases are being reported. The recently produced Indian report on cancer by the Indian Council of Medical Research (ICMR) shows that childhood cancer cases grew from 4,124 in 1988 to 6,187 in 1996. But the same report finds nothing to report on the trend or does not make any recommendations for future interventions. "These figures in many ways reflect the poor environment we live in," says Anupam Sachdev, paediatric oncologist at the Sir Ganga Ram Hospital, New Delhi. The greatest surge has been noticeable in leukaemia, says L S Arya of the All India Institute of Medical Sciences (AIIMS), New Delhi. Arya, who has worked extensively on such illnesses, adds that greater awareness amongst parents is giving rise to their seeking early treatment for their children. This could be one of the reasons for the upward trend in cancer registries in hospitals. However, no specific data exists that documents this increasing trend and links it with environmental changes. The concern worldwide has however grown. WHO has created a task force in children's environmental health. And since 1998, 12 children's health research and disease prevention centre have been set up all across the US.

A study conducted among 15-year-old children residing in Denver, USA, found a strong association between the use of pesticides in the backyard of homes and soft-tissue sarcoma, and between the use of pest strips and leukaemia. A positive relationship has also been found between family pesticide use and childhood brain cancer cases, especially in families using these compounds at homes for control of pests or termites. The increase in testicular cancer in younger men of industrialised countries is causing speculation that environmental carcinogens may be the reason. In utero exposure of the foetus to chemicals transmitted through oestrogen may be causing a rise in this cancer and other male reproductive disorders. Further evidence about the carcinogenic properties of chemicals and pesticides comes from the finding of unusually high number of bone, bladder and brain cancers among children living in a residential area near three petrochemical plants in China. The petrochemical plant was found to release chemical pollutants like vinyl chloride and acrylonitrile as well as polycylic aromatic hydrocarbons.

Infants and children are more vulnerable than adults to carcinogens because they have rapidly dividing cells. Children also pick up chemical residues while playing on lawns sprayed with herbicides and on benches coated with wood preservatives, and while tumbling with pets treated for fleas and ticks. Chernobyl is being linked to nearly 2,000 thyroid cancer cases. "Four years after the accident, an excess of thyroid cancers is being noted among children who have been exposed to the fallout of the disaster," says Dillwyn Williams, professor at the Strangeways Research Laboratory at England's Cambridge University.[95] Scientists studying the incidence of childhood cancers among children whose father work at the Sellafield nuclear plant, Cumbria, report that these children have twice the normal risk of developing leukaemia which may be due in part to the dose of radiation the men received.[96] The small body size of children and their relatively high consumption of fruits and juices make them more prone to receive higher dietary exposures to carcinogenic pesticides than do adults.

“ More people die due to malnourishment and diarrhoeal diseases -who cares about cancer in children? " opines D S Rawat, chief medical officer of Unnao, a small industrial town where chromium and mercury in water has been incriminated with mental retardation in children and liver and kidney failure in young children.

Even pesticides have been known to affect children. But there is no data available. The study on pesticide residue in food has not even been released. A study in Rajasthan has shown pesticides being linked to the high incidences of babies being born with neural tube disorders (NTDs) in Rajasthan. An estimated 8,000 babies are born with neural defects every year in Rajasthan. Most of them die within a few months of birth. They are lucky because those who survive suffer from grave deformities. S G Kabra, physician at the Indian Institute of Health Management Research in Jaipur, links the malady to pesticide use. Pesticides are known to negate the action of folic acid, vital for brain development, he says. Pesticide residues in food can inhibit the intake of folic acid leading to birth of babies with congenital defects. The risk is higher if conceived at the time the kharif (summer) and rabi (winter) crops reach the market, a time when pesticide residue is very high.

NTDs affect half-a-million babies per year around the globe — an estimated 8,000 babies per year in Rajasthan alone, according to A J Babineau, a medical student from the US who conducted a study in Rajasthan. “The situation is a little different in other countries, especially in the developed world, because pre-natal care and maternal nutrition are much better,” she says. Consequently, NTD rates have been declining worldwide in recent years. However, Rajasthan continues to show some of the highest rates of NTDs, as much as 10 times higher than those in developed nations, says Babineau.

A survey of the labour room records of 24 maternity centres in Jaipur, conducted by Kabra and his team, reveals 137 grossly visible and most fatal birth defects for the 22,618 live births — that is six congenital malformations per 1,000 live births. Of the 137 gross defects recorded in the labour room register, 81 per cent were NTDs. (**see box: neural tube defects)**

Signs of gender and sexual disorders

Chemicals in the environment can alter the sex ratio dramatically. A study of the population of Seveso in northern Italy, the scene of a devastating explosion at a chemical factory in 1976, which released large quantities of dioxins into the atmosphere, found that children born to families living within a 12-kilometer radius of the factory had more number of girls being born than boys. The effect was evident even at very low levels of 20 nanograms per kilogram of bodyweight.[97] However, opposite findings have been found in a **cohort** study of 1,177 Michigan anglers who had been exposed to PCBs. The study of children born after 1963 found paternal exposure linked to a higher proportion of male offspring.[98]

Says Shikha Reddy, researcher at Barkins Institute, Hereford, U.K: "The real challenge is in infants. Breast-fed infants are exposed to levels of dioxins that exceed adult exposure by as much as a factor of 50."

A study carried out by a number of Belgium universities has shown that even a moderate exposure to pollutants like polychlorinated aromatic hydrocarbons (pahs) can retard sexual maturation in children. Till date only occupational or accidental exposure had been implicated for such problems. The study was conducted on 200 adolescents living in two polluted areas and a rural unpolluted area. To test the effect of pahs, markers such as levels of polychlorinated biphenyls (pcbs) and dioxin-like compounds were measured in the blood. Trained school physician took blood samples along with measuring testicular volume.

In boys, genital development and pubic hair growth was inversely proportional to the amount of PCB markers in the blood. Testicular volume was also lower in boys living in polluted areas. Even in girls, small breasts were related to the higher amount of dioxins in their blood. According to the authors, the results suggest that measures to control environmental pollution are insufficient.[99]

Even consumer products have these toxic compounds. Shampoos containing female hormones may be causing girls to go through puberty at an earlier age. They contain small amounts of hormones that could cause premature sexual development in girls. Girls are reaching puberty earlier in every developed country, a phenomenon that has been blamed on such things as improved diet and chemical or hormone pollutants in the environment. However, African-American girls are developing even earlier than their white counterparts. Chandra Tiwary, retired former head of paediatric endocrinology at Brooke Army Medical Centre in Texas, who conducted the study among the four girls, said these hormones were probably absorbed into the bloodstream via the scalp. "With persistent use, they could cause a girl to go through premature puberty", says Tiwary. Even in a less chemical-intensive country like Puerto Rico, researchers have found that eight in 1,000 children face premature sexual development.[100]

Male fish have been found to be changing sex due to pollution in water and questions are now being raised as to what happens when the pollution gets into drinking water. Does it affect human fertility? High levels of the estrogen ethanol oestradiol, which is used in contraceptive pills, when flushed through urine reaches rivers through sewage works. Conventional sewage treatment has been found to be ineffective in removing the estrogen from water. Scientists

conducting research feel that years of drinking water containing high levels of the estrogens may result in falling sperm counts in men.[101] Lynn Fraser at the King's College, London suggests that a definite link exists between environmental estrogens, testicular problems and low sperm counts.[102]

2.5 Life style changes and diseases

Indians face an increasing threat from "lifestyle" diseases, of which inactivity alone claims two million lives globally every year, warns a recently launched WHO report. Indians, particularly the younger generation, are increasingly facing problems due to overweight, blood pressure, stress, high cholesterol and diabetes, all of which are fallouts of physical inactivity.[103] Increasingly children too are succumbing to the pressures of lifestyle stresses. Studies show that up to 80 per cent of coronary heart disease, 90 per cent of diabetes and about one third of **cancers** can be avoided through a change in lifestyle. Globally, non-communicable or "lifestyle" diseases account for nearly 60 per cent of deaths. By 2020, this is expected to rise to 73 per cent. Surprisingly, it is not the industrially developed but the developing countries that have recorded a greater increase in non-communicable diseases. In 1999, developing countries accounted for 79 per cent of deaths from non-communicable diseases. The figure is expected to rise to 85 per cent by 2020.

Among non-communicable diseases, cardiovascular diseases caused by obesity account for the highest number of deaths. Of the 15 million deaths due to cardiovascular disease worldwide in 1990, 2.5 million occurred in India alone. In the year 2000, some over 3,000,000 Americans died of obesity-related causes.[104] Several studies in India have shown that changes in dietary patterns, physical activity levels, life styles associated with affluence, and migration to urban areas are related to increasing frequencies of obesity and the risk of diseases, such as coronary heart disease and diabetes **(see box : The underfed and the overfed).**

By 2020, around seven million Indians are expected to die of heart-related diseases if they do not change their sedentary lifestyle, warns K Srinath Reddy, professor of cardiology at AIIMS. All these effects begin to manifest even in childhood if the child is stressed, eats non-nutritive food and does not exercise. Another risk factor for heart disease striking early is the low birth weight, a problem that is not uncommon in the country. Experts say that children with birth weight of 2.5 kilogrammes (kg) and less are prone to heart problems in early adulthood. Recent studies have, in fact, indicated that a mother's poor diet may place the baby in the womb at a higher risk of getting heart disease later in life. Such infants would not only be underweight but could also have a disproportionately large head or a narrow waist. These features, experts point out, indicate damage to the baby's organ systems and may affect the way the body regulates cholesterol and blood clotting later in life.

Nutrition Foundation of India's (NFI) study titled "Current prevalence, nature and etiology of obesity in urban communities", found that obesity was more prevalent in the upper-middle class than among slum dwellers. A study of 4,000 children aged between four and 18 years in a public school in Delhi and belonging to affluent sections of society found that the incidence of overweight reached its peak in boys by 12-14 years and in girls by 9-11 years and showed some

decline in later age groups. This suggests that overweight and obesity in the affluent are evident in childhood than in adolescence. Apart from the physiological or metabolic changes involved in the transition from childhood to adolescence this could partly be due to a greater degree of dietary discipline with respect to adolescents as compared to children in affluent homes.[105] Umesh Kapil and his colleagues also report of similar findings in their study done on 870 affluent adolescent schoolchildren of Delhi. As per the international cut off points, the overall prevalence of obesity was found to be 7.4 per cent, with the prevalence more common in boys (about 8 per cent as compared to 6 per cent in girls).[106]

Studies conducted by Rakhee Thakkar, paediatrician at the Sitaram Bhartia Institute of Science and Research (SBISR), and another by Umesh Kapil, additional professor, department of gastroenterology and human nutrition at the All India Institute of Medical Sciences (AIIMS), shows that a majority of school going children belonging to affluent schools in Delhi are overweight. Out of the 750 children studied by Thakkar, nearly 22 per cent were found to be overweight. Refractive error was also on the increase with 35 per cent of the children having a subnormal visual acuity of 6/9 or less. More than 40 per cent of the children suffered from oral hygiene problems. Umesh Kapil blames the changing lifestyle patterns coupled with overprotective parents, more disposable income as contributory factors to this increase in obesity in children. Says SC L Gupta, president of the Delhi Medical Association (DMA), "It is the overindulgence of parents that is giving rise to more obesity. They have only one child now and want to give him/her everything, which includes high calorie food." Admits Abhishek Bhartia, director of SBISR, " Look at our hospital canteen. That also stocks high calorie food. So in one way, we are perpetuating obesity in children. We are simply not giving them the choice of having healthy, nutritious food."

Obesity in children is a phenomenon causing concern the world over. According to Jennifer Zebrack, assistant professor of medicine at the Medical College of Wisconsin, USA, 13 per cent of all children and adolescents in the US are now seriously overweight. India however has no baseline data at all to say what the increase has been like. There is simply no funding available for such a type of study. When over 40 per cent of the population is under poverty, obesity is hardly considered to be a problem.

2.6 Air pollution, asthma and other respiratory diseases

Decreased lung function, exacerbation of asthma and increase in other respiratory illnesses has been directly correlated to childhood exposure to air pollutants such as ozone, particulate matter, sulphur dioxide and nitrogen dioxide. Overall, the development of childhood asthma would be the result of foetal environment and genetic influences along with subsequent interactions with external environment exposures.

A critical review published in the Journal of American Medical Association (JAMA) showed that doctors in India under-diagnose asthma by 15 per cent. “ If even a well-documented and researched disease like asthma is under-reported, is there a possibility of others not being identified at all?” questions Anupam Sachdeva, paediatrician at Sir Ganga Ram Hospital, New

Delhi. He further says he is unsure whether symptoms he identifies could be communicated to patients as those arising due to environmental causes.

Globally the incidence of childhood **asthma** is on the rise and a cause of major concern. Even in cities and countries with decreasing levels of ambient air pollution, there has been a noticeable rise in the incidence of respiratory morbidity in children. Differences in the living environment in urban and rural areas may be the cause responsible for the increased prevalence of childhood asthma in urban areas. City children are more exposed to the effects of pollution by both industrial and motor vehicle exhaust emissions. A cross-sectional analysis of over 100 Dutch children has found that children who reside near 100 metres of busy roads, suffer from more cough, wheeze and doctor diagnosed asthma.[107] As against this, rural children are generally exposed to much lower levels of these pollutants, whereas their exposure to indoor air pollution is much more. The consequences of exposure to outdoor and indoor air pollutants range from small transient changes in pulmonary function to increased cough and wheeze, increased use of asthma medication, increased rates of asthma attacks, increased physician and hospital visits, permanent reduction of lung capacity, and an increase in risk for sudden infant mortality (SIDS).(**see diagram**). Exposure of infants to particulate matter of size less than 10 microgrammes per cubic metre (PM10) has been associated with SIDS and mortality as a result of respiratory causes.[108] There is now clear evidence that each 10μg/cum increase in PM10, results in a 1.23 per cent increase in asthma in children. Children, by virtue of their being more physically active and spending more time outdoors, are also more likely to be exposed to air pollution than adults.[109]

H Paramesh of the Lakeside Medical Centre, Bangalore, recently presented his study using 20-year data for asthma in 20,000 cases in children under 18 years. He found that in Bangalore, a city with comparatively cleaner environment showed a rise of asthma prevalence of 9 per cent in 1979 to 29.5 per cent in 1999. He attributes the rise in asthma due increasing urbanisation, industrialisation and more importantly exhaust from vehicles.

There is an increase in intrauterine growth retardation and slow-birth-weight babies born to women exposed to air pollutants during pregnancy. An epidemiological study done in Tripura to assess the incidence of acute respiratory disease (ARI) in children below five years of age found more cases of ARI in urban areas (23 per cent) as compared to rural areas (17.65 per cent).

Research undertaken by the Chittaranjan National Cancer Institute (CNCI), Kolkata, points to genetic changes that occur in lung tissues exposed to air pollution. The report includes a study of 153 children residing in Kolkata and compares their lung function with 116 children from rural West Bengal, where it identifies a marked rise in respiratory symptoms and sputum alveolar macrophages in the urban group. The bronchoalveolar lavage fluid present in the lungs consists of alveolar macrophages (AM)–cells that consume all foreign particles, including particulate matter from air pollutants. What the study found most significant was the prevalence of iron-laden macrophages in the sputum of the children from Kolkata. Children generally do not produce sputum samples unless they are habitual smokers, but only 5.5 per cent of children in the study were occasional smokers. Therefore, the increase in sputum may also be linked to the high level of ambient air pollution. Since the lung capillaries of children are more prone to

irritation, the presence of air pollutants may have caused capillary haemorrhages, which accounts for the high iron content in the macrophages **(graph…the urban curse, dte sept 15, 2001).** The high micronucleus count in the lungs of urban children has been linked to the high levels of pollution. This is suggestive of genetic damage to the exposed tissues.

Foetuses are also affected by air pollution. Exposure of pregnant women to high levels of carbon monoxide and ozone has been related to their risk of having a child with heart defects. The risk is three times in areas having high levels of pollution and twice in moderately polluted areas than in clean or unpolluted areas.[110] Exposure to particulate matter has also been linked with low birth weight babies.[111]

Assessing the health impacts of ambient air pollution, a study of 664 preschool children between the ages of 1 month and 4.5 years, selected from 28 slums of Lucknow, revealed an increased association between respiratory symptoms and ambient air levels. A six-month follow-up study found 33 probable cases of pneumonia per 1,000 children. Exposure to indoor smoke from the use of wood/dung/coal/kerosene for cooking was also found to be responsible for ARIs in the children.

S K Chhabra, from the Patel Chest Institute, New Delhi, who examined residents of Delhi to determine the role of ambient air pollution and chronic respiratory morbidity have found contradictory evidences. Although there is no clear correlation between air pollution and respiratory morbidity, a definite decrease in lung function was noticed. Significant differences were found in the lung functions of residents of highly polluted areas of Delhi, when compared to the lung functions of people in less polluted areas.

2.7 Polluted water and children

Waterborne diseases, caused by the intake of chemicals and contaminated water, affects around 3.4 million people globally. In India, around 5,63,000 people are affected annually, one-fourth of which are children, according to the Union ministry of health and family welfare.

Water gets contaminated due to sewage from households, industrial effluents, human excreta and even groundwater contaminants like arsenic, fluoride and nitrates. Fluoride in water is essential to protect teeth but higher levels can adversely impact health. Groundwater contamination due to fluorine affects six million children in India.[112] Respiratory disorders like cough and shortness of breath have been noticed in people and children staying in arsenic affected regions of West Bengal.[113] There is now evidence that use of disinfectants like chlorine in drinking water may contribute to the formation of carcinogenic chemicals in tap water. Chlorine reacts with the naturally occurring organic matter found in water to form disinfection by-products (DBPs), which has been linked with cancer of the bladder and colon.[114] Even volatile organic chemicals and industrial solvents, which enter drinking water through various streams have been linked with causing cancer.[115]

Modern technology has bought along with it different set of problems. The flush toilet is an ecological mindless system. It uses clean water to flush a little bit of human excreta (nitrogen) and disposes off this biological waste into waterways, from which it reaches millions of home. It is ultimately the poor who have to pay the cost with their health. Bacterial contamination with water is one of the most immediate health risks. With pesticide and chemical pollution growing and no treatment plant for chemicals, one can well imagine the magnitude of health problems that the children are being exposed to.

High levels of nitrates have been found in the waters of Rajasthan. Children who drink powdered milk are at risk due to the presence of high level of nitrates in the water **(see box: nitrates in water).**

2.8 The way ahead

All over the world, there is a growing concern for children. In the US, a national policy exists to protect children's health from environmental threats. Top priority is given to funding of researches, which address children's health issues. Children's environmental health research centres are being set up to study links between childhood diseases and environmental toxins." These researches can help us take children's health protection to a new level," says Christie Whitman, administrator with the Environmental Protection Agency (EPA), USA. In India however, there is still no official environmental health policy. ICMR, India's apex medical research body has no clear strategy for health, let alone children's health. Ranbir Singh, spokesperson of ICMR, says: " There is no research allocation earmarked for children's health."
Extensive international studies clearly show a causal relationship between environmental pollutants and children's health. Although there are only a handful of such studies in India, the correlation between disease and the environment is clear. Way back in 1995, B K Verma and his colleague from the department of medicine, Birsa University, Ranchi, found clear linkages between unfavourable environmental conditions and adverse affects on the immune system of neonates. The study shows that unfavourable environmental conditions can adversely affect the immune system at neonatal stages, and can increase their susceptibility to subsequent acute or chronic events.[116]

Fifty-two years ago, the directive principles of state policy in the Indian Constitution clearly laid down children's right to food and education and vowed never to abuse the tender age of children. Ironically, children continue to be employed as child labour. In 1974, the Union government unveiled a national policy for children, declaring the nation's children as " supremely important assets." This affirmed the state's commitment to provide "adequate services to children, both before and after birth and through the period of growth, to ensure their full physical, mental and social development. The state also promised its children, "optimum conditions for their balanced growth." Yet, today, 40 per cent of the world's malnourished children are in India.

In 1989-90, India joined the world in making a commitment to the cause of children. It pledged to protect and educate children before the global community at the United Nations Convention on the Rights of the Child in November 1989, the World Summit on children in 1990 and soon after

at the South Asian Association for Regional Cooperation (SAARC) summit on children. However, today, 59 million Indian children do not attend school.

In 1992, within its boundaries, the Union government made a national plan of action for children. In 1996, the plan of action went through a heavy reprint order. In this, the government clearly admitted that “inadequacy in the availability of safe drinking water, improper disposal of human excreta, solid and liquid waste leading to unfavourable environmental conditions and lack of personal hygiene have been major causes of disease and disability among children.”

Later in the document, the government declared that it would conserve and protect the environment to make it conducive to the health and well being of the children. Sadly, this is the only paragraph relating to environmental hazards in this policy paper on Indian children. Even this promise remains unfulfilled.

To make the environment safe, instead of vowing to make industries conform to environmental norms, the government only pledges to create awareness among children about environmental protection. It is a double paradox therefore that children continue to be clandestinely employed as menial labour in polluting industries.

In 2001, the Indian government set up the National Commission for Children. This body meant to oversee implementation of existing laws and policies for children, besides welfare programmes, has precious little to do with curbing environmental pollution.[117] A draft has also been prepared for the National Policy and Charter for Children, 2001, wherein emphasis is given to child labour and right of the girl child, but again, contains no mention about protecting children from environmental hazards. The government may need to take a look at the policy statements of the developed countries before it makes more pledges. **(see box: What Indian children deserve**)

Meanwhile, doctors, especially paediatricians continue to feel the dearth of research work on children’s health in India. They also insist that there is a need for the right to information about impact of environmental pollution. They agree that awareness and activism are needed to fight environmental pollution to protect children. "What's hindering better knowledge is the lack of good data about what kids are actually exposed to in their lives," adds Daniel Swartz, executive director of the Children's Environmental Health Network (CEHN), a public interest organisation in the US devoted to improving children's health.[118]

A K Dutta, head of the paediatrics department at the Lady Harding College, New Delhi, insists, “Organisations should conduct epidemiological studies on the link between environmental pollutants and children’s health. This research should be linked with public policy.” According to Subhash Arya, paediatrician at the Sri Gangaram Hospital in Delhi, “There is a need to educate children and their parents about health problems. There should be a curriculum on environment and health. But more important, parents must become aware of the dangers their child is exposed to. They have a right to information.”

Of course, as Dutta states: “plenty of water, environmental sanitation and social development including female literacy and better primary health care would go a long way to contain medical problems in children.”

Toxic exposures deserve special scrutiny because they are avoidable causes of harm. These disabilities are clearly the result of complex interactions among genetic, environmental and social factors that impact children during vulnerable periods of development.

Although government statistics suggest that under-five mortality (the number of death of children under five per 1,000 born) has fallen to 110 deaths in 1980 to about 60 in 2000, India still has the highest number of under-5-year-old deaths in the world, roughly 2.5 million. For most well known diseases the government does not have an authoritative figure. For example, in case of diarrhoeal diseases that are caused by many different types of organisms, the government does not have a break up of which organisms or what infections the child succumbed to. There is little wonder, that the government is unable to target preventive strategies or nutrition projects or malaria control programmes, given the fact that it does not know how many children, where and when these children are suffering from these basic preventable diseases. There is no data on the number of children, their location and/or the age when they contract the diseases.

Some government programmes have been successful in reducing the morbidity in children. Most of this has been achieved after considerable amount of investment. Nutrition programmes like the Tamil Nadu Integrated Nutrition Programme and guinea worm eradication programme improved child health commendably. But there are very few such success stories and much is left to desire. Very few links are established between programmes that could improve their effectiveness, make them more acceptable to people and reduce costs. For example, the malaria control programme should work closely with vitamin A supplementation done by the blindness control programme, which can serve the dual purpose of reducing malaria, and raising immunity of pregnant women through timely dosage of vitamin A. Similarly, the Integrated Child Development Scheme (ICDS) is a resounding failure. The important shortcomings of the ICDS were poor management, specially lack of adequate decentralization and intrasectoral coordination, failure to accord dignity and prestige to voluntary work, inadequate emphasis on antenatal care, and failure to promote effective community leadership and participation.

Under the New Health Policy, the government has now targeted to bring down infant mortality from 70 to 30 per 1,000 and maternal mortality rate from 408 to 100 per 100,000. These are impractical goals, which look impossible to achieve considering there is no definitive framework to address these challenges. There are no guidelines or roadmaps, responsibilities or partnerships forged that would lead to these goals. Modern diseases have been ignored in the National Health Policy. The only "modern" diseases mentioned are deaths due to car accidents, for which the policy suggests the creation of trauma centres (and not better driving, education or rule enforcement). It is more of a 'cure/remedial policy' than a preventive one. Lifestyle diseases bear a mention as the policy generally states that "an increase in mortality through ‘life-style’ diseases- diabetes, cancer and cardiovascular diseases" is seen, however there is no mention of any kind of responsibility to be taken to manage the diseases.

In May 2002, the Planning Commission brought out the National Human Development Report-2001, which threw up some puzzling trends. Childhood anaemia for example has a higher prevalence in richer and more prosperous states than many of the poorer states. But the report fails to observe this in its report. The year 2001 was called the "year of implementation". It was the most dismal year for health in general and children in particular. The constant failure to utilise development assistance and central government ear-marked funds for food and nutrition, environment, health and emergency purposes show that many more children suffered due to callous bureaucratic planning and corruption.

India's scientific community too has been a big let down. Not a single authoritative study has been done by the apex medical science organisation - the ICMR or its many specialised institutions and a battery of scientists and staff working on toxic compounds in children. Some work has been done on DDT and breast milk, lead in children's blood and few others on asbestos and child labour in the glass industry. Few independent studies have been done like the recent dioxin study on animal and human tissues. But very little follow up ensues from scientists. Clinicians too are languid and lack the enquiring nature in reporting new syndromes and seldom track the development of their patients for scientific records. Tracking birth defects, mapping cancer hotspots or studying trends in asthma, is virtually unheard of in India. Even birth defects since the Bhopal gas tragedy have not been followed up in the affected area. Thus, due to lack of data, there is very little to feed into policy due to which very little financial and policy commitments are made. Even the recently released ICMR cancer registry has not made any effort to identify hotspots or individual populations or types of cancers for their trends.

Other agencies like the pollution control boards do not report health and chemical hazards. The Bureau of Indian Standards, which is responsible for ensuring safe products including toys, does not pro-actively pursue on developing stringent standards since it has enforcement power. Many preservatives, colouring agents and food additives that are banned in the West for their confirmed health risk are openly used in foods in India- even by reputed western food companies in whose parent country these additives are banned. The children's health and environment centre, USA has now come out with as series of advertisements which highlight the risks of chemicals (**see box: posterity at peril).**

There is no denying that children are at grave risk of being adversely impacted by environmental health outcomes. The current policy framework and clinical practice do not address these issues and do not show any serious efforts to counter the rising numbers of unexplained and untreatable, diseases that are preventable. The least that the individual can do is take caution against the assault of chemicals and hope for the best.

But there have been success stories also. The endosulfan case has been a feather in the cap. On being made aware of the perils of the pesticide endosulfan and its effect on children, the Kerala government recently banned the pesticide. Paediatric diseases of toxic environmental origin are the consequence of man- made exposures. These diseases can therefore be prevented by the reduction or elimination of toxic exposures. There has now been a 90 per cent reduction in lead poisoning cases. Positive lessons of these success stories are that research can drive prevention and prevention of disease in children is a powerful incentive to societal

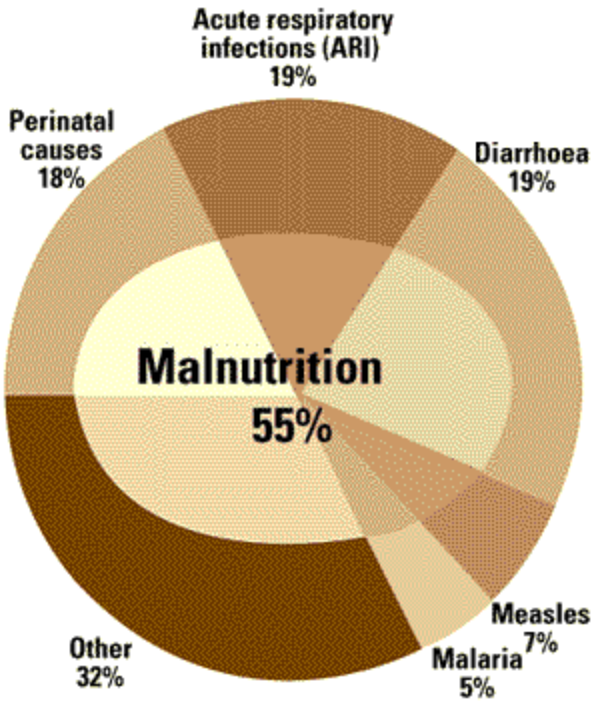
action. There is today a need to improve toxicity testing – because there are more chemicals; we need more sensitive test procedures. The Stockholm treaty of 2000 on banning of 12 persistent organic pollutants (POPs) is a step in that direction. Risk assessment has to become more child- protective and there have to be standards set that protect children's health. The precautionary principle has to be invoked. We have to act before it is too late. Build a strong base of research and professional education in environmental paediatrics is the need of the hour. The training workshop for paediatrics on environmental health conducted jointly by the Indian Association of Pediatrics, New Delhi, and the WHO in October 2002, is a step in that direction. Says G Sethi, paediatrician from Maulana Azad Medical College, New Delhi, "These type of trainings help doctors to be sensitised to environmental health issues and assists them in correlating health with environment."

There are steps needed to prevent paediatric diseases of environmental origin. Support centres for Children's Environmental Health and Prevention Research, which would help promote translation of basic research findings into applied intervention, and prevention methods need to be set up across the country. The 12 centres which have been set up in the US report the seeing of thousands of children with disease of environmental origin as well as children who have sustained toxic environmental exposures. The Pew Environmental Health Commission recommends the setting up of systems which can track critically important diseases in children like asthma, birth defects, learning disabilities and the recognition of geographic clusters of disease and monitoring of time trends in incidence.

What India needs is a coalition between various organisations, government, NGOs, and paediatricians to bring this issue to the forefront. There ought to be a clear-cut research agenda wherein information is shared and actions identified, policies set for change and actually carried out. Public health research has to become a reality, wherein it becomes the tool to bring about change and regulation. Most importantly, it is the trigger that is needed to build a stronger public support for change. As the Supreme Court of India's ruling in March 2002 rightly said, "Children do not agitate or hold rallies. Their voice is not heard and the only interest of the government seems to be to protect the financial health of polluters, at the cost of public health. "Children do not agitate or hold rallies. Their voice is not heard and the only interest of the government seems to be to protect the financial health of polluters, at the cost of public health." The time has come for action wherein the country can avoid the slow and deliberate murder of young Indians.

Boxes and graphs

Main causes of death in children less than 5 years of age in developing countries



Source: WHO 1996, based on C.J.L. Murray and A.D. Lopez, The Global Burden of Disease, Harvard University Press, Cambridge (USA) and 'Epidemiological evidence for a potentiating effect of malnutrition on child mortality' in *American Journal of Public Health* 1993-83.

Box 1 Adult children

The Child Labour Prohibition and Regulation Act, 1986 prohibits the employment of children below the age of 14 in hazardous industries, including carpet weaving. Child labour still exists. Because it is cheap and the nimble fingers of children are more suited to tasks which require intricate skills like carpet weaving and bangle making. Today, India has a population of more than 80 million child labourers. These are the children who contribute to the economy of the nation. Unofficially, the figures may well be above 111 million children. The real figures may never been known since there are no universally accepted figures. Children working in the unorganized sector are often unaccounted for. Kurnool district of Andhra Pradesh alone has more than 1.5 lakh child labourers. Many of these children work for cement quarries, cotton grading units, beedi rolling centres, hotels and bakeries. The Commission on Labour Standards, India, estimates a 4 per cent rise in child labour every year.

The main concerns are the health hazards to which the young children are exposed. A study conducted by Save the Children, UK, on children working in the bangle factories of Ferozabad in Uttar Pradesh found that due to the appalling work conditions children suffered from asthma and anaemia. In these factories, children work in the intense heat of the furnace at temperatures

between 1400-1600 Celsius. There is no ventilation. There is broken glass all over the working place, electric wires dangles around them, and children have no protective equipments like shoes, gloves or goggles.

Sivakasi, Tamil Nadu produces 75 percent of India's matches and 90 percent of its firecrackers, and has been described as having one of the largest concentrations of child workers in the world.

In the match and fireworks industry, the tasks are repetitive and low-skilled. Girls as young as three fill matchboxes, stack boxes for packaging and paste labels on boxes. Older girls make and label boxes. Boys mix chemicals used for match tips, and dip the tips in the chemicals. Children in the fireworks industry dye the outer paper, roll the ground powder and pack the finished product.

They work in cramped, dark sheds in crouched positions and are exposed to dangerous chemicals such as chlorates, phosphorous and sulphur. There is a constant risk of fire and explosions, yet the children wear no protective gear. Children suffer from chronic bronchitis, broncho-pneumonia, tuberculosis, malnutrition, gastrointestinal disorders, skin disorders, over-exhaustion, burns, water-borne diseases and eye infections. Harsh treatment by employers is common, and girls as young as seven and eight are reportedly sexually assaulted by supervisors outside of factory premises.

Children who work as scavengers are not only exposed to contaminated food and water but are also vulnerable to being bitten by mosquitoes carrying diseases such as malaria and dengue, and are susceptible to plague from infected rats inhabiting garbage dumps. On a positive note, the Indian government is now working towards declaring Kerala as the first "child labour-free state" in the country by the end of 2002. However, until that is accomplished and other states follow suit, what remains is missed schools and lost childhood with no dreams, but only ill-health. This is the future that awaits these children.

Box 2 Diarrhoeal details

In 1987, a meeting sponsored by WHO defined persistent diarrhoea as an episode that starts acutely but which lasts for at least 14 days. Most investigators and programmes have adopted this definition.
For every 100 children aged 4 years or less, seven cases of persistent diarrhoea are seen per year in India, and 150 cases in north-eastern Brazil. In all studies the incidence is much higher in children under 2 years than in older children. Persistent diarrhoea may account for a large proportion of all deaths due to diarrhoea. WHO and UNICEF estimated that in 1991 persistent diarrhoea accounted for only 10 per cent of diarrhoeal episodes, but as many as 35 per cent of diarrhoeal deaths were in children under 5 years of age. Evidence from studies in Bangladesh, India, Peru and Brazil indicate that approximately 45 per cent (range 23 per cent to 62 per cent) of diarrhoea-associated deaths are due to persistent diarrhoea.
Although findings from some studies indicate that persistent diarrhoea often occurs in children below 2 years of age, most of the deaths occur in children aged 1 to 4 years old when

malnutrition is most common. This is because deaths from persistent diarrhoea are frequently associated with malnutrition**.(see table: persistence of diarrhoeal diseases in children)**

Persistence of diarrhoeal diseases in children

Table 1: Incidence (per 100 child-years) of persistent diarrhoea by age group

Country	Age group						
	<1 year	1 year	2 years		3 years (0-4) years	4 years	Overall
India	31	9	6	2	0	7	
Nepal	15	17	12	10	14		
Peru	31	22	16	-	-	26	
Bangladesh	72	25	29	28	6	34	
Brazil	171	216	160	90	60	150	

(source : http://nand.org/dd/su48.htm#page1)

Several factors have been identified as possibly increasing the risk of persistent diarrhoea. These are:

Previous diarrhoea infection: A relatively small proportion of children have many episodes of diarrhoea, and it is predominantly these children who develop persistent diarrhoea.

Nutritional status: Evidence from Bangladesh, India and Brazil shows that malnutrition is strongly associated with persistent diarrhoea. Researchers have found a small increased risk of diarrhoea incidence in malnourished children, but a large increased risk of prolongation of the episode. In Bangladesh, for example among persistent diarrhoea deaths, 81 per cent were associated with malnutrition. These findings suggest that malnutrition significantly increases the risk of dying in children suffering from persistent diarrhoea.

Feeding practice: Breastfeeding shortens the duration of diarrhoeal episodes, and lack of breastfeeding has been associated with persistent diarrhoea. In Peru, for example, infants aged from 9 months to 11 months who were not breastfed had average diarrhoeal durations that were 49 per cent longer than those of infants who continued to receive some breast milk. One reason for this is that diarrhoea infections can reduce a child's capability to digest lactose, a sugar found in milk. When this happens, drinking animal milk can cause diarrhoea to worsen or be prolonged.

Access to safe water: A World Bank study found the prevalence and duration of diarrhoea for children living in households with piped water much lower as compared to those without piped water. The study found a striking difference in the child-health gains from piped water according to family income and adult female education. While there are significant health gains overall from access to piped water, there is no evidence of significant gains for the poorest 40 per cent in terms of incomes. Surprisingly health gains from piped water tend to be lower for children with less well-educated women in the household.[119]

Other factors: Research is continuing on the relation of various factors linked to persistent diarrhoea. These include deficiency of vitamin A, zinc, iron and other micronutrients; behaviour related to water source and use, food preparation and consumption and hygiene; presence of other diseases such as measles; suppression of immunity; and the interaction of these factors.

Box 3 Toxic toys

Something as innocuous as giving your child a plastic toy to chew during those difficult teething times could lead to impaired mental development and growth retardation.

The chemical responsible for this is called phthalate, which is found in a range of consumer products, including soft and "chewy" toys made of recycled poly vinyl chloride (PVC). Since PVC is a hard, brittle and unusable material, softeners are added. These softeners contain dangerous additives that can leak out of the plastic and be ingested by children. Basically two types of hazardous additives are added to all PVC products. These are stabilisers and plasticisers. Stabilisers include chemicals like lead and cadmium. Lead is known to cause permanent damage to the brain and cadmium is linked to kidney damage and even cancer. Phthalates are plasticisers that are added to make PVC soft. Large amounts of phthalates may be added that they can account for nearly half the weight of vinyl products such as teethers. The three most common phthalates added to toys are DINP (disononyl phthalate), DEHP (diethyl hexyl phthalate) and DNOP (di-n-octylphthalate). In fact the softest and most chewable toys could be the most poisonous and toxic.

Phthalate is an endocrine disruptor. This means that it is a chemical that can upset the endocrine system, which regulates hormone production in the body. This chemical can mimic a natural body hormone and send improper signals to fool the body to overproduce or underproduce hormones. Even adults are susceptible to its effects, more so pregnant woman. It can result in the birth of immature babies, lower birth weight and depressed immune responses. It is also a known carcinogen. Its adverse effects, especially on children, do not become apparent until many years after the exposure occurs.

According to Health Canada, a Canadian government agency, the chewing of a soft PVC teether or rattle for more than three hours on a daily basis by young children weighing less than eight kilo gram would result in them ingesting enough phthalates to pose a potential health risk.

A Greenpeace investigation into 71 soft PVC toys, including 5 toys from India found that two contained DEHP in levels as high as 11.4 and 13.9 per cent of the weight of the toys. This was the highest found in all the toys sampled.

Manufacturers of toys in Mumbai, New Delhi and Chennai confirm that most of the toys are made from virgin and recycled plastics and PVC. Chemical pacifiers and teethers now rule the day. Gone are the traditional "Marapachi" dolls made of red sandal wood or medicinal teethers made of "Vasambu" wood.

Say David Santillo, staff scientist with Greenpeace International and also associated with the Exeter University, UK, " The toy industry is unnecessarily exposing small children to hazardous chemicals at one of the most vulnerable periods of their development."[120]

Box 4 The problem of lead

The George Foundation at Bangalore carried out a comprehensive study all over India to assess the level of lead poisoning in children. Project Lead-Free was initiated in 1997 to cover 14,667 children below the age of 12, and 6,809 older children and adults in seven major Indian cities. Evaluations of zinc protoporphrin (ZnPP) and blood lead levels (BLL) were done. Of the 4,250 children testing positive for elevated ZnPP, 34 per cent had BLL of 10g/dl or higher. Most of these children (64.4 per cent) were residents of Delhi. Random testing for BLL in 1,852 children revealed that 51.4 per cent of them had BLL over 10g/dl, whereas 12.6 per cent had BLL of over 20g/dl. Of these, 61.9 per cent were from Mumbai. Children living in larger cities of India presently have been found to have over 10g/dl of blood lead.

Box 5 The final invasion: in breast milk

Breast-feeding today means not only the communion between the mother and her child but also connotes "a transfer of chemicals". During lactation, a portion of a mother's body fat, and along with it the dioxins that are accumulated therein since birth,get transferred to her breast milk. Since many infants initially subsist entirely on breast milk this means that they consume a large quantity of food relative to their body weight. With breast milk more contaminated with dioxin compared to other foods, breastfeeding infants can receive a higher dose of dioxin per unit body weight than any other population. A breastfed infant receives 4 to 12 per cent of its lifetime exposure to dioxin during the first year of life and this could still have a significant delayed impact on future generations.

A recent report submitted to Britain's Department of Health showed that breast-fed infants receive 17 times the tolerable amounts of dioxins and polychlorinated biphenyls (PCBs). Dutch children of 42 months of age and that are exposed to PCB through breast milk were found to have poor cognitive functioning in preschool.

Though breast milk is undoubtedly the very best that mothers can give to their children, it is no longer as good as it used to be. " Over the past 25 to 30 years, a number of toxic chemicals have found their way into breast milk–PCBs, DDT, solvents and heavy metals", opines Philip Landrigan.

Across the world with falling levels in DDT, levels of these dioxins in breast milk have also reduced. The Indian scenario may well be different since India has not taken any viable measures to cut down on DDT. Despite the partial ban on DDT, a toxic insecticide, India still has one of the highest concentrations of DDT in breast milk in the world, i.e., 6.55 mg/kg of milk fat as compared to 1.88 mg/kg of milk fat in Japan and the US.[121] New toxins seem to resurface now at an alarming rate, which brings into focus the need to have more research-based studies on breast milk. Besides DDT, polybrominated diphenyl ethers (PBDEs) used as flame-retardants in computers, furniture, upholstery, plastic casings and other consumer products are being found in large amounts in breast milk. "Levels are still low now, but if use of PBDEs are not limited, levels are expected to rise to potentially dangerous levels", warns Gina Solomon, a senior scientist associated with the Natural Defense Council, based in San Francisco, USA. Studies also show that women having high levels of dichlorodiphenyldichloroethylene (DDE), the DDT breakdown product experiences more difficulty in breast-feeding. A recent finding that breastfed infants

whose mothers' milk contains higher levels of dioxins are more like to have tooth defects is consistent with the pollutant's developmental impacts. The time has come to question on how to get these environmental contaminants out of breast milk.

Box 6 The underfed and the overfed

With India facing a fast growing epidemic of obese children, hooked to junk food, it will not be long before the number of overweight children equals that of the underweight and malnourished children. And diseases of excess may soon overshadow diseases of poverty.

Both the underfed and the overfed have high levels of sickness and disability, shortened life expectancies, and comparatively lower standards of productivity. Obesity results in lack of vital nutrients and vitamins and iron and calcium resulting in anaemia.

The risk of accumulation of fat in the abdomen can begin early in life and may be concurrent with the development of obesity in childhood. Obesity in children is also associated with higher insulin levels that lead to accumulation of abdominal fat accumulation. Prenatal influences other than malnutrition can increase the risk of later obesity. These include the fact that children of diabetic mothers are fatter at birth and at ages 5 to 9 years, 10-14 years and 15-19 years.

Abdominal Obesity can be caused by prenatal malnutrition that is the effects due to food restriction, its timing and duration of presence in the mother and its effect on subsequent obesity in the child in adulthood. In contrast, the increased prevalence of obesity among individuals who were born to mothers exposed to famine in the first and second trimester may be explained by their increase in subsequent energy metabolism and feeding behaviour. Strong links also exist between childhood undernutrition and abdominal obesity.

There is considerable evidence now that suggests a close link between increase in stunted growth in populations in developing societies and the emerging epidemic of obesity. Stunted growth in children is likely to alter the alter the healthy 'height-to-weight ratio' in individuals with short stature and thus exaggerate the apparent prevalence of obesity in a population.
Malnourished populations in developing societies, particularly in Asia, have an increased predisposition to obesity and, more especially, to abdominal obesity. Recovery from one or several episodes of undernutrition results in alterations in body composition, increase in the amount of fat gained and a probable increase in intra-abdominal fat deposition also. All these changes, as a result of prenatal and post-natal malnutrition, will increase susceptibility to obesity under the right environmental influences such as an increased intake of fat in the diet and reduced levels of physical activity.

A diet rich with carbohydrates and fat is also being linked to the onset of early menarche (beginning of puberty) in girls. Evidence now points to a possible linkage between breast cancer and diet and early menarche.[122] Amrita Bagga from the Anthropology department of the university of Pune studied 366 girls to test the correlation between menarcheal age and physical growth. Finding a positive relationship between the two, the study concluded that there was a steady increase in the menarcheal age of girls as their food habits changed from vegetarian to

eggatarian. Also, the maximum number of girls experiencing early menarche was reported in the non-vegetarian group.

Box 7 Stunted growth

Nearly 20 per cent of the world's total out-of-school children (age 6-14 years) are in India. Almost one-half of these children under the age of four are malnourished and 30 per cent significantly underweight. The World Bank estimates that malnutrition costs India at least US $10 billion annually in terms of lost productivity, illness, and death, while seriously obstructing human development.

In rural India, nutritional deficiency is one of the most widespread and prevailing health problems among women. This has a fall-out not only on their health but also on the health of the infant child. The birth of a low-weight baby increases the risk of these babies of dying from diarrhoeal diseases and respiratory infections.

In a recent study involving 775 students in the age group of 5-15 years studying in a secondary school of Ludhiana city of Punjab, P Panda and his colleagues from the Christian Medical College, Ludhiana came to the conclusion that

- more than 52 per cent of the children had "wasted" growth whereas 26 per cent were stunted.
- more than 30 per cent of the girls had anaemia
- almost 73 per cent of all the children were found to be suffering from some sickness or the other at the time of the study.
- girls of all ages except the 14 years old had lower mean weight
- the expected height for boys was also less for all ages except the 15 and 16 year old.

Box 8 Nitrates in water

Do nitrates in water cause infant deaths and diabetes?
The poor have no option but to make do with contaminated water that may be a carrier of industrial effluents, human excreta and even groundwater contaminants like arsenic, fluorine and nitrates. High levels of nitrates are found naturally in the waters of Rajasthan.

High levels of nitrates can prove fatal for infants who drink formula milk. Nitrates restrict the amount of oxygen that reaches the brain, causing the "blue baby" syndrome. It is also linked to digestive tract cancers and changes in bronchi and lungs. Groundwater contamination by nitrate has risen dramatically due to increased agricultural use of nitrogen-based fertilizers and intensive livestock operations. The maximum contaminant level (MCL) for nitrate established by environmental protection agency (EPA), USA, is 10 milligrams per liter (mg/L) of drinking water. Ingested nitrate is absorbed in the small intestine, secreted by the salivary glands, and converted to nitrite. In the stomach, nitrite can form N-nitrosoamines and N-nitrosoamides, among the strongest known carcinogens. Recent studies have reported evidence of an association between long-term consumption of nitrate-contaminated drinking water and increased risk of non-Hodgkin's lymphoma, and cancers of the stomach and liver.

A random study was conducted on 88 children belonging to five different villages in Rajasthan, which had access to water high in nitrate. The average nitrate concentration was 26, 45, 95, 222 and 459 mg nitrate ions/litre in drinking water. The study found that a strong association between the blue baby syndrome or methemoglobinemia, that resulted in acute respiratory tract infection.[123]

However, certain scientists believe that the role of drinking water nitrates in causing the blue baby syndrome needs to be re-examined.

According to Alexander Austin Avery, of the Hudson Institute, USA, gastrointestinal infection and inflammation may also play a role since it leads to overproduction of nitric oxide.

Whether a link exists between nitrates and childhood diabetes is still being debated.

In 1993-1995, 1,104 children of Netherlands in the age group of 0-14 years were diagnosed with type I diabetes. A drinking water analysis was done in an attempt to establish an association between nitrates in drinking water and the incidence of diabetes.

Although there was no convincing evidence, scientists did not rule out that the threshold value of nitrates greater than 25mg per litre of water could be the underlying cause for the occurrence of the disease.

Box 9 What Indian Children Deserve

The world is concerned about a polluted environment impacting the health of its children. The developed world has taken giant strides in ensuring environmental safety for children. Some of these steps are:

- Better assessment of risks unique to children including growth and developmental vulnerabilities, especially concerning in utero exposure
- Interdisciplinary research on children, health and environment
- Fostering education and awareness of the environmental threats to children's health among policy-makers, medical doctors and public health professionals, researchers, citizens and children
- Expansion of community right to know and public education programmes to help families make informed choices. For example, the right to know about tap water contaminants or pesticide health risks.
- Promotion of exposure prevention policies and actions to prevent the occurrence of diseases of environmental origin. For example, prevention of dangerous ultraviolet light overexposure thorough education (this is where sunburns experienced in childhood are linked to the onset of skin cancer later in life)
- Advocacy of children's rights
- Protection of children from lead based paint poisoning
- Food Safety legislation

There is a dire need for replicating these initiatives in the developing world. Early childhood interventions can help provide proper growth opportunities to children in terms of their mental, emotional and motor development skills.

Box 10 Blinded by medicine: the story of vitamin A supplementation

The United Nation's Children's Fund (UNICEF) sponsored a campaign of "high dose vitamin A supplementation" to children in the age group of one to five years on November 11, 2001 in all the districts of Assam. An estimated 2.8 million children were given "High dose" of vitamin A (more than 25,000 International Units (IUs) of vitamin A - One IU equals 0.3 microgram of retinol, the active chemical - in a single dose. The objective was to increase the coverage of the national programme of vitamin A prophylaxis (VAP) to nearly 90 per cent.

With the aim of increasing the coverage of vitamin A dosage amongst the children of the age group of 1-3 years, since 1997 vitamin A deficiency (VAD) programmes have been linked with the pulse polio immunization (PPI) programmes. This has the active support UNICEF, WHO, the Micronutrient Initiative (MI) and the International Vitamin A Consultancy Group (IVACG).

UNICEF justifies its stance of using high-dose vitamin A by stating that high IMR (greater than 55 per cent) and low measles coverage (less than 50 per cent) are proxy factors that indicate regions at risk of high vitamin A deficiency (VAD). The fact that Assam has an IMR of 76.9 per cent (highest risk of VAD according to UNICEF) and measles coverage of only 38.9 per cent made it the perfect choice for administering the high-dose vitamin A.

Umesh Kapil, convener of the Delhi chapter of the Nutrition Society of India and additional professor of nutrition at the AIIMS says that IMR can be attributed to several reasons including micronutrient deficiencies. "Over the years there is an effort on the part of international agencies to push the campaign to include neonates and infants under one year by claiming that synthetic vitamin A supplementation brings about a reduction in IMR when there is no clear evidence to that effect," says C. Gopalan, president of the Nutrition Foundation of India (NFI) and former director of the National Institute of Nutrition (NIN), Hyderabad.

Explaining the deaths, Union Health Minister C P Thakur indicates, "In most of these cases, the death was due to causes unrelated to vitamin A". "The deaths have taken place due to... cardiac failure, foreign body aspiration, severe anaemia, fever of indeterminate cause, etc. It seems that the panic created due to the side effects has resulted in all deaths being attributed to vitamin A".

Whatever may have been the logic behind the programme, what is certain now is that immunization programmes are today no longer considered to be safe and protective. After all, what do you do when the very medicine that is supposed to protect you, instead kills you?[124]

Box 11 Reducing IMR in India

Although, over the last few decades' child mortality rates have been reduced tremendously globally, the scene in some countries such as India is not encouraging. This is a deviance from the long-term trend of child-mortality rates in India. In 1998, the child mortality figure in India was the highest total of any country—about 2.5 million. In the year 2000, India was determined to reduce the infant mortality rate to less that 60 per 1000 live births. Between mid-1980s and early

1990s, similar goal had been successfully met. However, in the later 1990s, the efficacy declined.

As for the causes for the slowing decline, a study carried out by M Claeson and her colleagues for the WHO pointes out the reason for decline in the deaths to the lack of following facilities in the susceptible Indian societies: reproductive health services, perinatal care, improved breast-feeding practices, immunization, home-based treatment of diarrhoea, and timely introduction of supplementary foods. In addition, the study highlights some other factors affecting child mortality such as women health, awareness, and education.

The study suggests a new strategic framework for childhood health. It urges the government of India to reassess the country's current child mortality reduction goals and proceed with integrated approaches for child health and nutrition. The main determinants of the health and nutrition cycle for mothers and children should be paid primary attention to develop more effective strategies for child survival, health and development.[125]

Box 12 Neural tube defects: what is it

Neural tube defect (NTD) is the most common birth defect affecting the central nervous system. It results from incomplete closure of the neural tube during embryonic development. Beginning as a flat plate of cells that during normal growth folds down the centre, the two edges then loop to form a tube. Normally, this tube seals, but a defect in this process can leave part or all of the tube unsealed. Some of its manifestations are:

ANENCEPHALY: a universally fatal deformity, where the brain is partially formed. In this, the upper end of the tube near where the brain develops remains open. It comprises between 50 per cent and 80 per cent of all NTDs.

ENCEPHALOCELE: a defect in the skull that results in protrusion of the meninges — a three-fold layer which covers the brain and spinal cord — and sometimes of the brain tissue.

SPINA BIFIDA: a congenital defect in the vertebral column. In one or more vertebrae, the bony area behind and enclosing the spinal cord fails to form completely. The cord and its membranes may bulge into the gap. Although these infants usually survive, they have varying degrees of disability, including loss of bladder and bowel control or paralysis.

Deficiency of folic acid is the primary reason for NTDs. The prevalence of NTD from different parts of India varies from 0.5 to 11 per 1000 births. The prevalence is much higher in northern states, namely, Punjab, Haryana, Delhi, Rajasthan, UP and Bihar (3.9-9.0/1000) compared to eastern, western and southern parts of the country (0.5-2.64/1000).[126]

One of the most easiest and simplest ways to prevent NTDs is to take folic acid vitamins. "Vitamin folic acid, if taken before pregnancy or during the first few weeks of pregnancy can reduce the risk of having a baby with a neural tube defect by up to 70 per cent", says Ashok K

Antony, a renowned professor of medicine at the Indiana University School of Medicine, Indiana, USA.[127]

Box 13 Posterity at peril

In what is being termed as the most extensive advertising campaign ever done to promote environmental health, seven spine-chilling one-page ads were displayed in the New York Times. The ads alerted the readers about the toxic dangers that their children reel under. Brought out by the Centre for Children's Health and the Environment (CCHE), the ads examined the links between exposure to toxic pollutants and childhood illness such as learning disabilities, cancer, endocrine disruption and reproductive system abnormalities.

The CCHE, in its advertisement, also puts forth suggestions to protect children from the obnoxious chemicals. It advises parents to eliminate pesticides outside and inside their homes. Buying organic produce and avoiding consumption of fish from contaminated water would also help. "We must demand for new chemicals to be tested for safety before being allowed to be sold in the market," says one of the ads. Another ad that warns about DDT in mother's milk says that unless the classes of chemicals that accumulate in breast milk are phased out, the risk to infants would continue to increase.

The centre provides a summary supporting scientific evidence and a list of scientific endorsers at www.childenvironment.org. According to Philip Landrigan, the director of CCHE, hits on this website increased more than 10-fold after the first ad ran, from less than 100 hits per day to more than 1,000. And even though industry groups feel the ads are exaggerated, the medical fraternity has come in support of the ads. Former assistant secretary of health at US Department of Health and Human Services praised the ad saying they are well done, not overstated.

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