How Much Do Environmental Diseases and Disabilities Cost?

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Over the past twenty years or so, epidemiologists and toxicologists have accumulated a wealth of information showing that exposure to many environmental contaminants can have significant adverse effects on public health. For example, we now know that poor air quality can worsen asthma and other respiratory conditions and that particulate matter is a risk factor for cardiovascular disease. Similarly, there is now strong or good scientific evidence that about 22 types of cancer and about 24 reproductive, birth, developmental, and neurobehavioral disorders are linked with exposure to environmental contaminants. Virtually all of us living in the US carry residues of many of these substances in our bodies.

But how much do environmental diseases and disabilities cost us in economic terms?

Until recently, this has been a difficult question to answer because of uncertainties about the proportions of different diseases and disabilities that can be attributed to environmental exposures and because the health and other costs have been difficult to quantify. But now, environmental health scientists are reaching agreement on the fractional amounts or percentages of some common diseases and disabilities that can generally be linked to exposure to environmental contaminants. At the same time, health economists are making significant advances in constructing "cost of illness" models that include direct health care costs, such as hospitalization, physician and nursing services, prescription medications, and home care and indirect costs, such as lost productivity associated with illness and premature death and needs for special educational and social services.

These two developments are paving the way for innovative research on the costs of diseases and disabilities that can be attributed to environmental contaminants. Based on cautious assumptions and limited numbers of environmentally related diseases and disabilities, this research is generating conservative estimates of cost that can be used by environmental health policy makers and others. Indeed, a recent study found that environmental health policy makers identify information on the links between environmental health and the economy as one of their key needs. However, although cost estimates of environmental diseases and disabilities are urgently needed, it is essential to acknowledge that monetary valuations cannot address the psychological and emotional costs of disease to patients or to their families, friends, and communities.

Costs in Washington State

A recent study by the author (Davies, 2005) estimated the economic costs associated with several environmentally related diseases and disabilities in Washington State, including asthma, cardiovascular disease, cancer, lead exposure, birth defects, and neurobehavioral effects. The study was based on the proportions or fractions of these diseases and disabilities that can be attributed to environmental contaminants. This is called the environmentally attributable fraction range (EAFR). The study also uses a best estimate for the proportion of disease and disability attributable to environmental contaminants. For example, the environmentally attributable fraction range (EAFR) for asthma is 10-35 percent, with a best estimate of 30 percent. All of the EAFRs and the best estimates used in the study (see figure 1) were conservative and derived from previously published studies.

Figure 1: Environmentally Attributable Fractions and Best Estimates of Selected Diseases and Disabilities

Disease/Disability	EAFR	Best Estimate
Asthma	10-35%	30%
Cardiovascular Disease	5-10%	7.5%
Cancer	2-10%	5%
Lead Exposure	100%	100%
Birth Defects	2.5-5%	2.5%
Neurobehavioral Disorders	5-20%	10%

The Washington State study also used "cost of illness" models developed by several national research organizations, including the Centers for Disease Control and Prevention and the National Heart, Lung, and Blood

Institute, and information on rates of diseases and disabilities in Washington State. Where rates in Washington State were not available, the rates were estimated using national statistics.

The study found that the best estimate of the annual cost of childhood diseases and disabilities (asthma, cancer, lead exposure, birth defects, and neurobehavioral effects) attributable to environmental contaminants in Washington State is about $1,875 million in 2004 dollars, comprising $310.6 million in direct health care costs and $1,565 million in indirect costs. The range of costs is $1,600 million to $2,200 million a year, depending on the methods and assumptions used (see figure 2).

It also found that the best estimate of the annual cost of combined adult/childhood diseases and disabilities attributable to environmental contaminants (asthma, cardiovascular disease, cancer, lead exposure, birth defects, and neurobehavioral effects) in Washington State is about $2,734 million, comprising $782.1 million in direct health care costs and $1,953 million in indirect costs. The range of costs is $2,800 million to $3,500 million a year, depending on the methods and assumptions used.

To put these costs in context, the estimate for childhood diseases and disabilities is equivalent to 0.7 percent of the total Washington Gross State Product, and the estimate for adult and childhood diseases and disabilities combined is equivalent to about 1 percent. To look at the estimates another way, every year the biotechnology industry contributes approximately the same amount of money, $2,000 million, to the state's economy.

Looking at the direct health care costs alone, the estimated costs of childhood diseases and disabilities attributable to environmental contaminants is approximately 1.9 percent of the total Washington State health expenditures, and the direct costs for child and adult diseases and disabilities are approximately 4.9 percent.

Other cost studies

The Washington State study was based on an earlier study by Philip Landrigan, of the Mount Sinai Medical School in New York and his colleagues who estimated the national costs of four types of childhood diseases and disabilities attributable to environmental contaminants, including lead poisoning, asthma, cancer, and developmental disabilities.

Landrigan et al. (2002) estimated the total national costs of the environmentally attributable proportion of these four conditions as approximately $55 billion a year in 1997. The results of the Washington State study are consistent with Landrigan et al. given that Washington State comprises about 2 percent of the US population, that the Washington study included more health conditions, and that it included some adult health conditions as well as the childhood ones.

A study in Massachusetts by Massey and Ackerman (2003) estimated the costs of the four childhood conditions that Landrigan et al. considered at $1.1 billion to $1.6 billion a year. This estimate is consistent with the findings of the Washington study, given that the Massachusetts study focused on a smaller number of health conditions in children and did not include any adult outcomes.

Several other studies have focused on the health and related costs associated with exposure to lead and mercury. A study by Korfmacher (2003) looked at how much New York could save by eliminating lead poisoning. It estimated the costs of lead poisoning in terms of lost future income, neonatal mortality, health care costs, special education, juvenile justice, and the state infrastructure that deals with lead poisoning. A study by Stefanak, Diorio, and Frisch (2005) estimated the costs of child lead poisoning in Mahoning County, Ohio. What makes these two studies particularly innovative is that they include costs of juvenile justice services and costs for public health education about reducing lead exposure. None of the other studies consider these costs.

Figure 2: Summary of Economic Costs of Diseases and Disabilities Attributable to Environmental Contaminants in Washington State

Disease/Disability	Best Estimate (2004 $ million)	Direct Costs (2004 $ million)	Indirect Costs (2004 $ million)	Range (2004 $ million)
Childhood Asthma	$48.9	$34.1	$14.8	$16.3 – 57.1
Adult and Childhood Asthma	$127.8	$75.5	$52.3	$42.6 – 149.2
Cardiovascular Disease[1]	$564.3	$335.8	$228.5	$376.2 - $752.4
	$592.8	$364.8	$54.1 + $173.9	$395.2 – 790.4
Childhood Cancer[2]	$11.2	$9.1	$2.0	$4.5-22.3
	$15.4	$9.1	$6.2	$6.2 – 30.7
Adult and Childhood Cancer	$203.5	$74.4	$129.1	$81.4 – 407.2
Lead Exposure	$1,500		$1,500	-
Birth Defects[3]	$4.2	-	-	$4.2 - 8.4
	$5.5	$1.5	$4.0	$5.5 – 10.9
Neurobehavioral Disorders[4]	$226.4	-	-	$113.2 – 452.7
	$72.4	-	-	$36.2 – 144.7
	$305.6	$265.9	$39.7	$152.8 – 611.1
Total Childhood	$1,875	$310.6	$1,565	$1,600-2,200
Total Adult & Child	$2,734	$782.1	$1,953	$2,800-3,500

[1] Two different methods were used to estimate the costs of cardiovascular disease attributed to particulates.
[2] Two different methods were used to estimate the costs of childhood cancer.
[3] Two different methods were used to estimate the costs of birth defects.
[4] Three different methods were used to estimate the costs of neurobehavioral disorders.

Trasande et al. (2003) have examined the economic consequences of methyl mercury to brain development. This study shows that lost productivity associated with methyl mercury toxicity in the US amounts to about $8.7 billion a year, with $1.3 billion of this being attributable to mercury emissions from coal-fired power plants.

Final thoughts

What makes these studies so important is that they highlight the health and related costs of the continued use of toxic chemicals in the US. Until recently, policy makers have not been able to take account of these costs in cost-benefit analyses because the costs could not be readily estimated. Consequently, cost-benefit analyses usually focus on the costs of environmental health protection measures, seldom quantifying the health and related costs associated with not taking action on environmental protection. These studies provide the first economic estimates of the public health and related benefits that would accrue from taking environmental health protection measures to reduce or eliminate exposures to toxic chemicals. Cost-benefit analyses can only be useful if they are comprehensive and include the health and related costs of the continued use of toxic chemicals as well as the costs of environmental protection measures.

A further inequity emphasized by these studies is that the health and related costs of chemical exposures are mostly borne by us as a society, rather than by the individual companies and industrial sectors that produce, use, dispose of, and release toxic chemicals into the environment. These costs include costs to educational and social services, costs in lost productivity to society, and costs to health care systems. In contrast, the economic benefits of the continued use of toxic chemicals accrue mostly to individual companies or industrial sectors. Hence, there is an imbalance between who benefits and who pays the price for the continued use of toxic chemicals in our society.

Some may argue that we can never know the precise economic costs of environmental diseases and disabilities or that the estimates can never be 100 percent accurate. These points are valid, but the new studies clearly show that the costs are very significant and that they are likely to outweigh the costs of many environmental protection measures. Moreover, the estimated costs of environmental protection measures used in cost-benefit analyses are themselves based on many assumptions that may not always be completely precise or accurate.

At the heart of these new economic studies is the recognition that the costs of environmentally related diseases and disabilities are largely preventable. By taking action to reduce or eliminate exposures to toxic chemicals, the US could save billions of dollars a year in health and related costs and significantly improve public health. ■

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