

CHAPTER 2

The Changing Environment and Disease Patterns



The 20th century witnessed profound, unprecedented changes in the natural, built, and social environments. Countless new technologies introduced into diverse societies around the globe altered the ways we live. Dramatic changes in the patterns and distribution of human disease were inevitable.

Our purpose in this chapter is to note a few trends in the U.S. during the past century that are directly relevant to the health of an aging population. We wish to make explicit what may be obvious: compared to just a few decades ago, the circumstances out of which patterns of health or disease emerge have fundamentally changed.

“Every civilization creates the conditions for its own diseases.”

René Dubos

Multi-dimensional Causal Webs of Disease

Many interdependent variables create a propensity for particular patterns of disease. These variables are woven together into multi-dimensional webs or networks, comprised of strands from the natural, built, and social environments, which in turn powerfully influence the practices and choices of our daily lives. Genetic changes in populations occur slowly and do not explain disease patterns that shift over years or decades. Environmental changes influence disease patterns much more rapidly and through many different pathways or mechanisms, some of which are discussed in subsequent chapters of this report.

Scientists long ago acquired the habit of taking complex systems apart in order to study individual components. That approach has been enormously fruitful in many respects but has limited value for predicting novel, emergent properties of complex, interactive systems. To be more fully understood, causal webs of disease must ultimately be considered not only as a collection of individual strands but also in their integrated complexity.



The plum blossom is a symbol of longevity in Asian cultures.

To be more fully understood, causal webs of disease must ultimately be considered not only as a collection of individual strands but also in their integrated complexity.

Today's disease patterns are quite different from those of a century ago. Changes in the built and social environments, as well as public health and medical advances, have contributed to longer life expectancies. But independent of longevity, some of these changes have also profoundly influenced the nature of diseases throughout the lifespan. Obviously, people must ultimately die of something, but today's disease patterns are not an inevitable price that must be paid for longer life. Rather, many of today's diseases, including those that disproportionately affect the quality of life in an aging population, could be delayed or prevented.

The Epidemiologic Transition

The growth of cities throughout the 1800s created conditions at the beginning of the 20th century in which infectious diseases flourished.¹ Life expectancy at birth in the U.S. in 1900 was 47 years. Infant mortality from infectious disease was common, and pneumonia, tuberculosis, and influenza were leading causes of death in adulthood. Improved sanitation, housing, standards of living, vaccines, antibiotics, and other medical interventions led to dramatic declines in infectious disease morbidity and mortality. Biomedical research and education made important contributions to shifting disease patterns and the outcomes of many diseases, but most historians give public health interventions credit for the largest impacts. By the end of the 20th century, life expectancy at birth had reached 77 years, although significant disparities remained among races and classes.

This increase in life expectancy was accompanied by an "epidemiologic transition" to new patterns and distribution of disease, from high mortality among infants and children, along with episodic famine and infectious epidemics affecting all age groups, to more chronic, degenerative diseases.² Among children in the U.S. in the latter part of the 20th century, premature birth, injuries, asthma, neurodevelopmental disorders, birth defects, cancer, and obesity became principal causes of morbidity and mortality. In adults, diabetes, obesity, cardiovascular disease, cancer, respiratory diseases, mental illness, and neurodegenerative diseases became major concerns. Similar transitions are underway in other parts of the world where cardiovascular disease, cancer, mental health disorders, obesity, and diabetes are becoming increasingly common. In developing countries, however, infectious diseases continue to be a major cause of morbidity and mortality.

An Overview of 20th Century Environmental Change

During the 20th century, human activity began to dominate the world's ecosystems in unprecedented ways. Rapidly developing new technologies exponentially leveraged human power and ingenuity, but technological advancement was on a steep learning curve and unintended consequences were common. Development and use of the atomic bomb in the 1940s put humanity on notice that we are capable of destroying planetary life as we know it.

In the late 1960s Rachel Carson warned that rapid development and deployment of industrial chemicals in agriculture threatened the entire food web and health of ecological systems. Photos from space travel cemented in people's minds the realization that we live on a small, hospitable planet in a forbidding universe. The discovery of a hole in the stratospheric ozone layer related to using chlorofluorocarbon refrigerants shocked many people into understanding that we were capable of destroying planetary control mechanisms before we even knew that they existed. We discovered a kind of mistake born out of profound ignorance—not even knowing what question to ask when considering the impact of a new technology. Ethical constraints on technological advancements became an increasingly urgent topic of public debate.

In 2005 the United Nations released the Millennium Assessment, the most comprehensive survey of the status of global ecosystems ever attempted. It began by reminding us how dependent we are on ecosystems for services such as climate control, air and water cleansing, soil fertility, pollination, and the like. It told us that in the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period in human history. During that time, global population has increased from 2.5 to over 6 billion people. Planetary systems are being stressed in novel ways and are increasingly unstable. Many are approaching thresholds beyond which lie little prospect for returning to previous operating conditions.

In summary, human activity has altered virtually every aspect of ecological systems throughout the world in unprecedented ways. Climate instability with periods of extreme heat, degraded soil, air, and water quality, and loss of biodiversity and ecosystem services





United Nations Millennium Assessment: Highlights of Key Findings³

IN 2005, THE UNITED NATIONS and collaborating partners released the Millennium Assessment, the largest evaluation of the health of the earth's ecosystems ever undertaken. Over 1300 experts from 95 countries prepared the extensively peer-reviewed report.

Among the key findings:

- Between one-third and one-half of the land surface of the earth has been transformed by human activity.
- The changes have contributed to net gains in human well-being and economic development but these gains are not evenly distributed. They have been achieved at growing costs in the form of the degradation of many ecosystem services and the exacerbation of poverty for many groups of people.
- UN researchers estimate that there were at least 921 million slum dwellers in 2001 and more than one billion in 2005, with slum populations growing by 25 million per year.
- Growing pressures from over-harvesting, climate change, invasive species, and nutrient loading push ecosystems toward thresholds that they might otherwise not encounter.
- Approximately 60 percent (15 out of 24) of the ecosystem services evaluated in this assessment are being degraded or used unsustainably.
- The degradation of ecosystem services often causes significant harm to human well-being and represents a loss of a natural asset or wealth of a country.
- Changes in ecosystems increase the likelihood of nonlinear changes (including accelerating, abrupt, and potentially irreversible changes), with important consequences for human well-being.
- Loss of species and genetic diversity decreases the resilience of ecosystems.
- The climate is warming with more extreme events such as flooding, hurricanes, and drought.
- Carbon is in positive balance; carbon is released into atmosphere and oceans; CO₂ concentration in the atmosphere has increased by about 30 percent since the beginning of the industrial revolution and is now at 380 ppm—near a critical tipping point.
- More atmospheric nitrogen is fixed by humanity than by all natural terrestrial sources combined. Fertilizer production and fossil fuel combustion are largely responsible. Nitrogen dioxide is a greenhouse gas and ozone precursor.
- Greenhouse gas effects cause melting of glaciers and permafrost and release of methane from peat bogs, resulting in more warming.

- Twenty-five percent of mammals and thirty percent of amphibians are threatened with extinction.
- One-quarter of the bird species on earth have been driven to extinction; twelve percent of those left are threatened with extinction.
- Novel synthetic industrial chemicals contaminate the world's ecosystems, humans, and other species.
- The food supply of humans and other creatures is contaminated at levels of concern.

Food

- Food production has more than doubled since 1960.
- Food production per capita has grown; for many people, food prices fell and were relatively low at the time of the Millennium Assessment. This is now changing with the increasing costs of fossil fuels and pressure on agricultural land to produce biomass for fuel production.
- Forty percent of the earth's land is in agriculture. Clearing land results in loss of valuable ecosystem services from forests and wetlands.
- Industrialization of agriculture leads to change in nutritional composition of food.
- Air, water, and soil are contaminated with pesticides, hormones, growth promoters, antibiotics, nitrates, and manure effluents.
- Rural communities have undergone social disruption.
- Approximately two-thirds of major marine fisheries are fully exploited, overexploited, or depleted.
- An estimated ninety percent of the total weight of the ocean's large predators—tuna, swordfish, and sharks—has disappeared in recent years.

Water

- One billion people lack access to fresh water.
- More than one-half of all accessible fresh water is used by humans; much of it is contaminated.
- Digestive-tract diseases arising from poor sanitation and the pollution of drinking water are the leading cause of death in the world, affecting mainly infants and small children.
- Oceans have been acidified by CO₂ released by fossil fuel combustion; the marine food web is threatened.
- Nitrates contaminate groundwater and surface water; nitrates, along with phosphorous, cause eutrophication (excessive nutrient loading and oxygen depletion) of water systems.



Virtually all people and wildlife are regularly exposed to a complex mixture of industrial chemicals that did not previously exist in human history.

collectively increase the risks of a number of diseases or conditions in all people. Economic inequities and disparities in healthcare access put poor, unempowered people at greater risk from both chronic illness and environmental threats. Within this context, the elderly population is often particularly vulnerable because of normal functional decline in some adaptive regulatory mechanisms as well as underlying chronic disease conditions.

The Chemical, Built, and Social Environments

Where and how we live, eat, work, play, and socialize profoundly influence our physical and mental health. During the 20th century, as infectious diseases were better controlled through public health measures and medical advances, new disease patterns developed related to changes in activities, diet, work, housing, exposure to environmental contaminants, and social organization.^{a 4}



Rapid industrialization and nearly ubiquitous contamination of air, soil, and water with hazardous waste, byproducts of resource extraction, fossil fuel combustion, and synthetic chemicals continued in the U.S. during the 20th century. Pesticides and other industrial chemicals, some of them persistent and bioaccumulative (concentrating themselves in living organisms), contaminate people, wildlife, and the general environment.

The Pervasive Spread of Synthetic Chemicals

From its pre–World War II infancy the chemical industry grew to account for about 2 percent of the U.S. GDP.⁵ Now the U.S. imports or produces approximately 42 billion pounds of chemicals daily.⁶ Global chemical production is expected to double every 25 years. Over 77,000 hazardous waste sites in the U.S. are an enduring legacy of the mismanagement of industrial chemicals over many decades. Synthetic chemicals contaminate every ecosystem in the world. Virtually all people and wildlife are regularly exposed to a complex

^a *Rural-to-urban migration, the industrialization of agriculture, changes in the scope and scale of resource extraction, materials manufacture, construction, transportation, communication, and birth of the military-industrial, medical-industrial, and academic-industrial complexes are among the most dramatic shifts.*

mixture of industrial chemicals that did not previously exist in human history.⁷ Babies are now born having already been exposed to industrial chemicals in the womb.⁸

Most industrial chemicals in the workplace and in consumer products have not undergone even basic toxicity screening.⁹ Only a few of 200 chemicals that are neurotoxic in humans have been evaluated for their impacts on the developing brains of children or aging brains of adults.¹⁰ Data that do exist show that exposures to environmental chemicals can increase the risk of many diseases and conditions relevant to an aging population, including neurodegenerative disorders, cardiovascular disease, hypertension, and diabetes.¹¹

When restrictions on hazardous chemical production, use, and disposal have been successful, public health has benefited. For example, a ban on the use of tetraethyl lead in gasoline resulted in marked declines in average blood lead levels in the U.S. Yet many children continue to be exposed to unsafe levels, and adults carry the lead legacy of the past imbedded within them. As we will show, early life exposures to lead are likely to increase the risk of Alzheimer's disease and Parkinson's disease later in life. Unfortunately, restrictions on hazardous chemicals have been extremely limited, and ongoing exposures continue to pose health risks.

Racial differences in the location of hazardous waste sites and exposures to hazardous environmental substances have created unequal health risks for low income groups and ethnic and racial-minority communities.^{12,13} Known as environmental injustice, this trend is one among many factors that are likely to contribute to racial health disparities.

The Clean Air Act and Clean Water Act of the 1970s led to improvements in some aspects of air and water quality.¹⁴ Nonetheless, hazardous levels of particulate air pollution, ozone, agricultural and industrial chemicals, and greenhouse gases continue to cause disease in the U.S. and globally. The ozone 8-hour standard was exceeded for nearly half of elderly adults in 2002, and this proportion has been increasing since the year 2000.¹⁵ Particulate air pollution is directly associated with increases in markers of inflammation in both young and elderly individuals.^{16,17} People with underlying diabetes, obesity, and hypertension appear to be particularly susceptible. Air pollution is a commonly encountered risk factor for neurodegenerative diseases.¹⁸ A large body of evidence also links particulate air pollution to premature deaths from cardiovascular disease.¹⁹ Later

Commonly used sewage treatment technologies do not remove many pharmaceuticals from the waste stream before discharge into the environment.



People who live in neighborhoods that lack social cohesion, sidewalks, or safety limit their exercise and have an increased risk of depression and possibly obesity.

chapters of this report explain what happens at the cellular level when the body encounters pollutants and other stressors.

Medical pharmaceuticals have their own environmental impacts. A number of prescription and non-prescription drugs or their metabolic byproducts, including antibiotics, anti-inflammatories, antidepressants, cholesterol-lowering agents, and hormones are present in surface waters and drinking water sources around the country.^{20 21} Commonly used sewage treatment technologies do not remove many pharmaceuticals from the waste stream before discharge into the environment.

Concentrations of detected drugs are low, but the health risks resulting from exposure to the complex mixture in people and wildlife are uncertain.



The Workplace

Workplace conditions and hazardous exposures have always been major determinants of health risks among workers and in communities where hazardous substances are released. Occupational medicine was slow to develop in the U.S. because of opposition from corporations, cheap immigrant labor, and lack of union organizing.²² Alice Hamilton was the first American physician to devote her career to occupational medicine. She studied and described effects of workplace exposures in her classic *Industrial Poisons in the United States* (1925).

Union organizing along with increased government oversight helped to improve working conditions in many ways in the 20th century, but over the past 40 years in the U.S., union membership and influence has steadily declined. Many occupations continue to expose workers to elevated risks of injury and disease. Occupational diseases and injuries have probably always been under-recognized and under-reported, and estimates of the degree to which workplace conditions contribute to disease patterns vary widely. Multifactorial diseases such as cancer, heart disease, and neurodegenerative disorders are

probably always under-represented. One estimate in the 1990s concluded that direct and indirect costs of occupational diseases and injuries in the U.S. totaled \$171 billion annually. This estimate is almost certain to be low.²³

The Indoor Environment

Many people now spend more than 90 percent of their time in buildings, and the indoor environment has recently received much-needed attention. New construction techniques and materials introduced in the latter half of the 20th century, along with the widespread use of central heating and air-conditioning, dramatically changed the indoor environment in homes, commercial, and public buildings. In many buildings, indoor air is contaminated with a complex mixture of chemicals from many sources, including emissions from building materials and other consumer products, fuel combustion, and mold. Studies show that indoor air pollution often exceeds outdoor levels.^{24 25} Disease risks related to the indoor environment vary with levels of specific contaminants but can include asthma, bronchitis, cancer, and reproductive, developmental, and neurological disorders.

Poverty rates among older people living alone are higher than those of people living with others.

Activity and Isolation

Regular exercise has undeniable health benefits. Exercise levels are in large measure a matter of individual choice but are also influenced by competing time demands and community features. People who live in neighborhoods that lack social cohesion, sidewalks, or safety limit their exercise and have an increased risk of depression and possibly obesity.^{26 27 28 29}

Not surprisingly, higher “walkability” ratings of neighborhoods are associated with significantly more walking.^{30 31} Suburban sprawl has contributed to a marked decline in exercise levels in children and adults who are increasingly dependent on cars to get where they want to go.

Sprawl, television, computers, and internet access also contribute to increasing social isolation.³² We have largely shifted from being a communal to a more individualistic society and have created a world where we often live among strangers.³³

Increasing numbers of elders are living alone, although this varies according to gender and ethnicity. Over the past 30 years, the proportion of elderly people over 75 years of age living alone has increased for men (from 19.1 to 23.1 percent) and women (from 37 to 49.9 percent).³⁴ Women over 65 are more than twice as likely as

men to live alone (40 percent vs. 19 percent), although the numbers are lower among Asian women (20 percent) and Hispanic women (26 percent) and Asian men (8 percent) and Hispanic men (15 percent). Twenty-nine percent of black men over 65 live alone.

Although the number has declined in recent years, about 1.5 million people live in nursing homes, and an unknown number live in assisted living facilities.³⁵

Economic Status

Poverty rates among older people living alone are higher than those of people living with others.³⁶ In the U.S., the growing income gap between the rich and poor is one of the most significant recent trends with striking medical and public health implications.³⁷ Before World War II large income disparities were common, but in the post-war years, that gap began to narrow and a large middle class emerged. Since the late 1960s, however, that gap has steadily grown so that today, the disparities resemble those of the 1930s.³⁸ In 1970, according to the Census Bureau, the bottom fifth of families received 5.4 percent of total national income while the richest fifth received 40.9 percent of the total. Twenty-five years later the bottom fifth's share had fallen to 4.4 percent while the top fifth had increased to 46.5 percent. By 2001 the top 1 percent of households held 33.4 percent of all net worth in the U.S..

While most people are aging, their incomes are declining. The number of older people living in poverty has dramatically declined over the past half-century, from 35 percent in 1959 to 9 percent in 2006. However, even now, this increases to 35 percent when those living on a low income are added. Older non-Hispanic whites are much less likely than their Hispanic and black counterparts to be living in poverty, about 7 percent compared to 19 percent and 23 percent respectively. In all groups, older women are poorer than older men. For all Americans over 65 in 2006, Social Security constituted 37 percent of their aggregate income, but it is 80 percent of total income for those in the lowest quintile.^{39 40} Collectively, social and economic conditions are powerful predictors of stress levels, health status, disease risk, and life expectancy.⁴¹

Nutrition

During the 20th century dramatic changes in food technologies altered food availability and dietary patterns. Commercial canning, freezing, and packaging techniques advanced. Home refrigeration lengthened storage life and many foods became more widely available, including meat and poultry. In the middle decades of the century, in response to increased understanding of the role of specific nutrient deficiencies in human disease, some foods were fortified with vitamins and minerals.

Shaped by the industrial model in other sectors, agricultural practices underwent profound changes during the 20th century. New plant and animal hybrids; increased reliance on mechanization; high inputs of petrochemical fertilizers, pesticides, and fuels; and the involvement of large corporations in all phases of food production and marketing progressively industrialized food production in the U.S. and other countries. Yields increased, many foods became routinely available to larger numbers of people, and food prices declined, particularly as a percentage of income.

More and more acreage was shifted into large commodity crops of corn, soybeans, and wheat. Beef, pork, and poultry production became more concentrated in large confined feedlots where animals are more rapidly grown and brought to market with grain-based diets, often supplemented with routine use of growth-promoting antibiotics and hormones.

This approach came with costs that have never adequately been reflected in the price of food. Industrial agriculture forever changed the rural landscape and rural communities. Topsoil loss; pollution of air and water with agricultural chemicals; eutrophication of lakes, rivers, and coastal waters; loss of habitat and biodiversity; and economic hardship in farming communities are the legacy of this agricultural revolution.

Changes in food production systems also brought change in the composition of food. The meat of animals raised in confined feedlots has significantly higher ratios of omega-6 to omega-3 fatty acids than do pasture-fed or free-range counterparts.⁴² Industrial-style production of poultry has had a similar impact. A 2006 report of 43 garden crops, based on USDA data, noted a significant decline in protein, calcium, iron, phosphorus, riboflavin and ascorbic acid over the past 50 years, with no decline in vitamin A, thiamin, niacin, fat,

Topsoil loss; pollution of air and water with agricultural chemicals; eutrophication of lakes, rivers, and coastal waters; loss of habitat and biodiversity; and economic hardship in farming communities are the legacy of this agricultural revolution.

Table 1: Foods available in U.S. food supply (per person per year), by major food group for selected years.

Year	1909	1945	1975	1999
		<i>(Lbs. per person)</i>		
Meat	228	257	261	298
<i>Meat, poultry, and fish</i>	176	188	207	245
Red meat	148	153	148	134
Poultry	17	26	47	95
Fish	11	10	12	15
Milk and milk products	345	552	453	502
Whole milk	229	344	181	72
Lowfat milks	65	40	60	131
Cheese	4	9	19	32
Other dairy	29	130	129	138
Vegetables and vegetable juices	414	400	279	302
White potatoes	188	120	82	87
Deep-yellow and dark-green vegetables	35	46	25	36
Other vegetables	145	174	127	134
Tomatoes	46	61	44	45
Fruit and fruit juices	173	207	189	232
Citrus fruits	16	71	77	78
Noncitrus fruits	157	135	112	153
Grain products	300	204	139	200
Sugars and sweeteners	84	92	118	158
Fats and oils	41	42	56	73
Butter	18	11	5	5
Margarine	1	4	11	8
Shortening	8	9	17	22
Lard and beef tallow	13	12	3	6
Salad, cooking, and other oils	2	6	20	32

or carbohydrate.⁴³ Highly processed food that is calorie rich and nutrient poor became widely available and is heavily promoted, especially to children.⁴⁴

From 1970 to 2003, the average caloric intake per person per day increased from 2,234 to 2,757, after adjusting for waste and spoilage.⁴⁵ Table 1 shows foods available in the U.S. food supply (per person annually), by major food group over a longer time frame.⁴⁶



Several trends are noteworthy:

- Grain product availability was considerably lower in 1999 than in 1909, although it increased after 1975.
- The use of sugars and sweeteners has increased by over 30 percent in the past 25 years. Corn sweeteners surpassed the use of sugar in the 1980s and per-capita consumption of corn syrup increased to 79 pounds in 2003, up 400 percent from 1970.⁴⁷
- Deep yellow and dark green vegetable consumption stayed relatively constant. (These are major sources of dietary antioxidants.) White potato consumption declined dramatically during the first half of the 20th century but has increased in recent years, primarily because of the popularity of frozen and French fried potatoes.
- The consumption of fats and oils remained relatively constant through the first half of the 20th century but then began to increase dramatically. By 1999 annual per-person consumption of fats and oils had increased by 78 percent.

Various forces, including dramatic increases in fried foods in the fast-food industry, raised fat consumption.⁴⁸ During the 20th century, the incidence of heart disease rapidly increased, and in the last 50 years, the role of dietary fats has received much attention.

In the 1960s an ongoing landmark epidemiologic study (the Framingham study) established a link between serum cholesterol levels and heart disease risk. Saturated fats were thought to play a

Trans fats are now believed to be major contributors to heart disease risk, and food producers are under increasing pressure to eliminate them.

dominant role, and many nutritionists recommended a shift from butter and lard to vegetable oils and margarine containing polyunsaturated fatty acids (PUFAs).

For some time, important differences among PUFAs were not understood. PUFAs are much more susceptible to oxidation than saturated fatty acids, making them more likely to turn rancid. Among the PUFAs, however, linoleic acid (an omega-6 fatty acid) is much less susceptible to oxidative damage than linolenic acid (an omega-3 fatty acid). Thus, linolenic acid is much less likely to be used in processed food. Although it is true that many polyunsaturated oils lower serum cholesterol and do not contain cholesterol themselves, it was not realized until more recently that some forms of linoleic acid, the most prevalent fatty acid in many vegetable oils, can contribute to inflammation, particularly when intake of omega-3 fatty acids is not adequate.^{49, 50}

The shift to unsaturated cooking oils brought yet another unintended consequence. Early in the 20th century, the process of hydrogenating vegetable oils came into widespread use when the resulting semi-solid products were noted to extend the shelf life and, according to some people, improve the taste of baked goods. Later, partially hydrogenated oils were also promoted because they lacked saturated fat. As was later learned, however, the process of partially hydrogenating oils also created trans fats, a particularly unhealthy form of unsaturated fatty acids. Trans fats not only lower levels of good cholesterol and raise bad cholesterol but they also sharply increase markers of inflammation.⁵¹ Trans fats are now believed to be major contributors to heart disease risk, and food producers are under increasing pressure to eliminate them.

As we will later discuss in more detail, today's diet containing trans and saturated fats and inadequate levels of omega-6s and omega-3s is virtually certain to directly contribute to risks of cancer, heart disease, arthritis, obesity, cognitive decline, and in all likelihood, numerous other diseases.⁵²

Given their economic conditions, older Americans often have less choice about where they live, what they eat and drink, and how active they can be. Consequently, their nutrition may suffer. Indeed, according to the Healthy Eating Index, the diets of over 75 percent of older Americans need improvement. This rises to over 90 percent for those living below the poverty level.⁵³

Select Disease Trends in the 20th Century

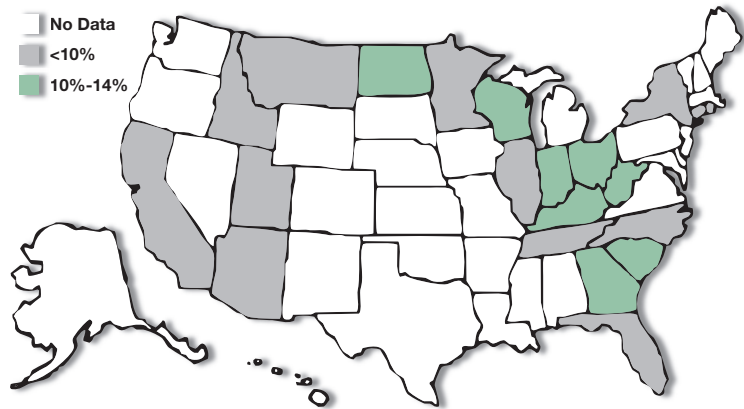
Of the new disease patterns that mark the 20th century we will highlight obesity, diabetes, cardiovascular disease, and hypertension because of their relevance to neurodegenerative conditions later in life. Trends in cancer incidence are available from the National Cancer Institute.⁵⁴ Trends in Alzheimer’s disease and Parkinson’s disease are discussed in later chapters.

Overweight and Obesity

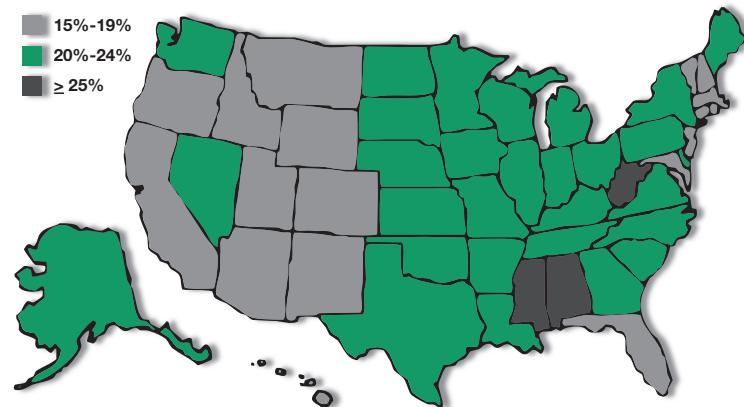
By themselves, overweight and obesity are not necessarily diseases, but they increase the risk of hypertension, type 2 diabetes, coronary heart disease, abnormal lipid profile, stroke, gall bladder disease, some cancers (endometrial, breast, colon), sleep apnea, osteoarthritis, and Alzheimer’s disease.⁵⁵ In many people, obesity is also associated with increased levels of markers of inflammation and oxidative stress. For these reasons, trends in these conditions are highly relevant to disease patterns in human populations. As we can see from the accompanying figures, the prevalence of obesity among adults in the U.S. has increased dramatically in recent years.^b

^b For adults, overweight and obesity ranges are determined by using weight and height to calculate a number called the “body mass index” (BMI). An adult who has a BMI between 25 and 29.9 is considered overweight. An adult who has a BMI of 30 or higher is considered obese. A BMI calculator is available at: <http://www.cdc.gov/nccdphp/dnpa/bmi/index.htm>. Map trends source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends Among U.S. Adults 1985



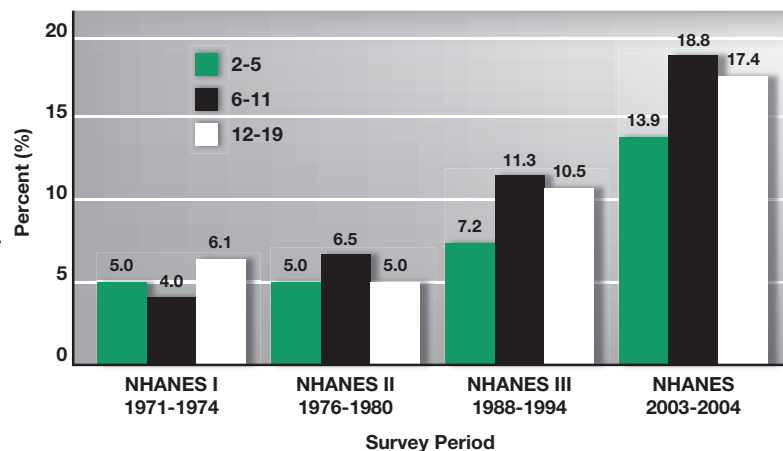
Obesity Trends Among U.S. Adults 2002



Prevalence of Overweight* Among U.S. Children and Adolescents (Aged 2 –19 Years) National Health and Nutrition Examination Surveys

*Sex-and age-specific BMI > 95th percentile based on the CDC growth charts.

Source: Centers for Disease Control and Prevention. *Overweight and obesity*. Available at: "<http://www.cdc.gov/nccdphp/dnpa/obesity/>" Accessed 5/30/08



Childhood Overweight and Obesity

Overweight is also a serious health concern for children and adolescents. Data from two NHANES surveys (1976–1980 and 2003–2004) show that the prevalence of overweight is increasing: for children aged 2–5 years, prevalence increased from 5.0 percent to 13.9 percent; for those aged 6–11 years, prevalence increased from 6.5 percent to 18.8 percent; and for those aged 12–19 years, prevalence increased from 5.0 percent to 17.4 percent.⁵⁶

Healthy People 2010 identified overweight and obesity as one of ten leading health indicators and called for a reduction in the proportion of children and adolescents who are overweight or obese.⁵⁷ A recent report concludes that the upward trend in childhood obesity may have leveled off.⁵⁸

Diabetes

The accompanying figures, from the Centers for Disease Control and Prevention, show the extent to which diabetes has become more prevalent in all age groups in the U.S. in the past twenty-five years.⁵⁹

The best available evidence suggests that childhood type 1 diabetes showed a stable and relatively low incidence over the first half of the 20th century, followed by a clear increase that began at some time around or soon after the middle of the century, with an incidence now of three or four in a thousand.⁶⁰ In recent years, type 2

diabetes, previously a phenomenon of later life and frequently associated with obesity, has become a significant and growing problem even among children.⁶¹

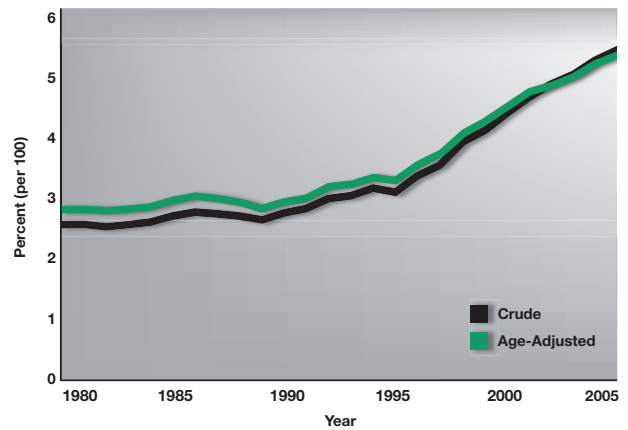
Cardiovascular Disease

Cardiovascular disease and its associated risk factors are increasingly recognized as risk factors for both Alzheimer’s disease and vascular dementia. A sharp upturn in the incidence of cardiovascular disease during the middle of the 20th century led to considerable research into its origins and measures to prevent it. Declines in death from cardiovascular disease during the past 25 years are due to a combination of factors including early detection, smoking reduction (the first surgeon general’s report on smoking and health was issued in 1964), blood pressure control, decrease in blood cholesterol levels through dietary changes, and improvements in medical care, including emergency management and pharmaceutical interventions.⁶² According to one analysis, about half of the reduction in cardiovascular mortality can be explained by reduction in risk factors, and the other half by pharmaceutical and other therapeutic interventions.⁶³ Heart disease, however, remains the leading cause of death in men and women in the U.S.⁶⁴

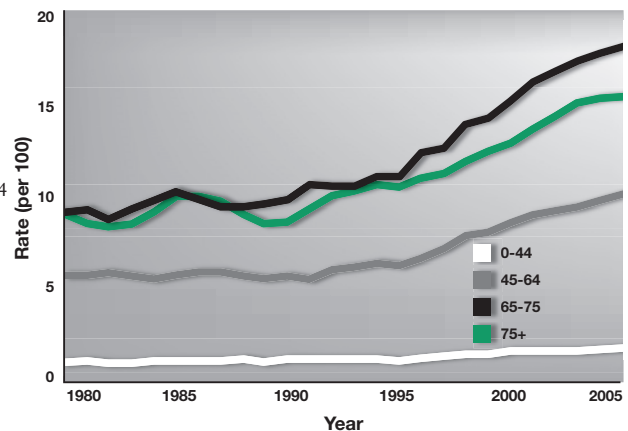
Hypertension

According to the Centers for Disease Control, the prevalence of hypertension, defined as elevated blood pressure or taking antihypertensive medication, increases with age. In 2001–2004, 30 percent of men and 33 percent of women age 45–54 years had hypertension. This increases to 69 percent of men and 82 percent of women age 75 years and over.⁶⁵ Although data gaps make it difficult to determine changes in prevalence over many decades, evidence is sufficient to conclude that age-adjusted hypertension increased in the U.S. population during the years 1988–2000.⁶⁶

Percent of people with diabetes:



Age adjusted prevalence of diabetes:



Source: Center for Disease Control and Prevention. Diabetes data and trends. Available at: “<http://apps.nccd.cdc.gov/DDTSTRS/default.aspx>” Accessed 5/30/08

While many features of today's world promote health and enjoyment, some also increase the risk of chronic, degenerative diseases later in life.



Conclusion

We have briefly described significant changes in many aspects of the natural, built, and social environments that have occurred over the past 50–100 years. Public health and medical advances have contributed to increased longevity. The epidemiologic transition to today's disease patterns has occurred within that context.

In this broad overview of macro-level variables, we begin to see some of the drivers of health and disease patterns. While many features of today's world promote health and enjoyment, some also increase the risk of chronic, degenerative diseases later in life—

widespread exposure to toxic chemicals and other environmental contaminants, increasing social stress and isolation, inactivity, and diets heavily influenced by an agricultural system that is dependent on high inputs of fuels, chemicals, and fertilizers and geared more to shelf-life and transportability than to nutrient balance.

We will soon look more closely at the details of how some of these pose threats to healthy brain aging and contribute to other associated chronic illnesses. In preparation for that we turn first to a short primer on brain function.

Endnotes

1. Frumkin H, Frank L, Jackson R. *Urban Sprawl and Public Health: Designing, Planning, and Building for Healthy Communities*. Washington, DC: Island Press; 2004.
2. Omran A. The epidemiologic transition: a theory of the epidemiology of population change. *Milbank Quarterly*. 1971;49:509-538. Available at <http://www.milbank.org/quarterly/830418omran.pdf> Accessed Aug, 2007.
3. The Millennium Ecosystem Assessment. Available at: <http://www.millenniumassessment.org/en/Index.aspx> Accessed July 5, 2008.
4. Kenneth Johnson. *Demographic trends in rural and small town America*. University of New Hampshire, 2006. Available at: http://www.luc.edu/sociology/pdfs/Demographics_complete_file.pdf. Accessed August 13, 2007.
5. Lenz A, LaFrance J. Meeting the challenge: U.S. industry faces the 21st century. The chemical industry. US Dept of Commerce, 1996. Available at: <http://www.technology.gov/Reports/chemicals/chemical.pdf>. Accessed May 29, 2008.
6. Wilson M. *Green chemistry in California: a framework for leadership in chemicals policy and innovation*. California Policy Research Center. University of California, 2006. Available at: http://coeh.berkeley.edu/docs/news/06_wilson_policy.pdf Accessed May 29, 2008.
7. National Report on Human Exposure to Environmental Chemicals. Centers for Disease Control. Dept of HHS. Available at: http://www.cdc.gov/exposurereport/results_02.htm. Accessed May 28, 2008.
8. Environmental Working Group. *Body burden: the pollution in newborns*. 2005. Available at: <http://archive.ewg.org/reports/bodyburden2/> Accessed May 28, 2008.
9. US Government Accounting Office. *Chemical regulation: actions are needed to improve the effectiveness of EPA's chemical review program*. GAO-06-1032T. 2006. Available at: <http://www.gao.gov/new.items/d061032t.pdf> Accessed June 1, 2008.
10. Grandjean P, Landrigan P. Developmental neurotoxicity of industrial chemicals. *Lancet*. 2006;368(9553):2167-78.
11. Collaborative on Health and Environment Toxicant and Disease Database. Available at: <http://database.healthandenvironment.org/>. Accessed May 30, 2008.
12. Bullard R. *Dumping in Dixie: Race, Class, and Environmental Quality*. Third edition. Boulder CO: Westview Press; 2000.
13. Montague T. The dangers of being poor and nonwhite. *Rachel's Democracy and Health News #848*. Available at: <http://www.rachel.org/en/node/6405>. Accessed May 30, 2008.
14. US EPA. *National air pollutant emission trends 1900-1998*. US EPA Document Number 454/R-00-002, March 2000. Available at: <http://www.epa.gov/ttn/chieftrends/trends98/>. Accessed October 2, 2007.
15. US EPA. *Aging and toxic response: issues relevant to risk assessment*. National Center for Environmental Assessment, Washington DC, 2005; EPA/600/P-03/00A. Available at: <http://cfpub.epa.gov/ncea/cfm/recorddisplay.cfm?deid=156648>. Accessed December 3, 2007.
16. Calderón-Garcidueñas L, Solt AC, Henríquez-Roldán C. et al. Long-term air pollution exposure is associated with neuroinflammation, an altered innate immune response, disruption of the blood-brain barrier, ultrafine particulate deposition, and accumulation of amyloid beta-42 and alpha-synuclein in children and young adults. *Toxicol Pathol* 2008; 36(2): 289-310.
17. Dubowsky S, Suh H, Schwartz J, Coull B, Gold D. Diabetes, obesity, and hypertension may enhance associations between air pollution and markers of systemic inflammation. *Environ Health Perspect*. 2006;114(7):992-998.
18. Calderón-Garcidueñas L, Reed W, Maronpot R, et al. Brain inflammation and Alzheimer's-like pathology in individuals exposed to severe air pollution. *Toxicol Pathol*. 2004;32(6):650-658.
19. Reviewed in: Pope C, Dockery D. Health effects of fine particulate air pollution: lines that connect. *J Air Waste Manag Assoc*. 2006;56(6):709-742.
20. Daughton, C.G. Pharmaceuticals in the environment: sources and their management. In: M. Petrovic and D. Barcelo, eds. *Analysis, Fate and Removal of Pharmaceuticals in the Water Cycle*, Wilson & Wilson's Comprehensive Analytical Chemistry series, Volume 50. Elsevier Science; 2007:1-58. Non-copyrighted web version. Available at: http://www.epa.gov/esd/bios/daughton/Chap1_Petrovic&Barcelo.pdf Accessed May 30, 2008.
21. US EPA. *Pharmaceuticals and Personal Care Products*. Available at: <http://epa.gov/ppcp/faq.html#Inwhattypes>. Accessed May 31, 2008.
22. Rom W. The discipline of environmental and occupational medicine. In: Rom W, ed: *Environmental and Occupational Medicine*. Second Ed. Boston, MA: Little, Brown; 1992.
23. Leigh J, Markowitz S, Fahs M, Shin C, Landrigan P. Occupational injury and illness in the United States: estimates of costs, morbidity, and mortality. *Arch Intern Med*. 1997;157(14):1557-1568.
24. US EPA's 2007 Report on the Environment: Highlights of National Trends. Peer review and public comment draft, August 2007. Available at: <http://www.epa.gov/indicators/>. Accessed December 3, 2007.
25. US EPA. Fact Sheet "Age Healthier Breathe Easier" June, 2007. Available at: http://www.epa.gov/aging/resources/factsheets/ahbe_english_2007_06.pdf. Accessed December 3, 2007.
26. Molnar BE, Gortmaker SL, Bull FC, Buka SL. Unsafe to play? Neighborhood disorder and lack of safety predict reduced physical activity among urban children and adolescents. *Am J Health Promot*. 2004.18(5):378-86.
27. Fisher KJ, Li F, Michael Y, Cleveland M. et al. Neighborhood-level influences on physical activity. *J Aging Phys Act*. Jan 2004;12(1):45-63.
28. Berke EM, Gottlieb LM, Moudon A, Larson EB. Protective association between neighborhood walkability and depression in older men. *Journal of the American Geriatrics Society* 55 (4),526-533. doi:10.1111/j.1532-5415.2007.01108.x
29. Hybels CF et al. Sociodemographic characteristics of the neighborhood and depressive symptoms in older adults: using multilevel modeling in geriatric psychiatry. *Am J Geriatr Psychiatry*. 2006;14:498-506.
30. Berke EM, Koepsell TD, Moudon AV, Hoskins RE, Larson EB. Association of the built environment with physical activity and obesity in older persons. *Am J Public Health*. Mar 2007;97(3):486-92. Epub 2007 Jan 31.
31. King WC, Belle SH, Brach JS, Simkin-Silverman LR, Soska T, Kriska AM. Objective measures of neighborhood environment and physical activity in older women. *Am J Prev Med*. Jun 2005;28(5):461-9.
32. Putnam R.D. *Bowling Alone: The Collapse and Revival of American Community*. New York: Simon & Schuster; 2000:210

33. Pipher M. In *Another Country. Navigating the Emotional Terrain of Our Elders*. New York: Penguin Putnam Inc.; 1999:69.
34. Federal Interagency Forum on Age-Related Statistics. *Older Americans Update 2008: Key Indicators of Well-being*. Washington, DC. US Government Printing Office. March 2008.
35. National Center for Health Statistics. Available at: http://www.cdc.gov/nchs/data/nnhds/Estimates/Estimates_Demographics_Tables.pdf#Table01 Accessed July 22, 2008.
36. The American Geriatric Society. *Trends in the Elderly Population*. March 2005. Available at: http://www.healthinaging.org/agingintheknow/chapters_ch_trial.asp?ch=2#Livingpercent20Arrangements. Accessed August 13, 2007.
37. Gudrais E. *Unequal America*. Harvard Magazine. July-Aug, 2008. Available at: <http://harvardmagazine.com/2008/07/unequal-america.html> Accessed July 5, 2008.
38. US Census Bureau. US Dept of Commerce. *The changing shape of the nation's income distribution*. June 2000. Available at: <http://www.census.gov/prod/2000pubs/p60-204.pdf>. Accessed May 30, 2008.
39. Association on Aging. *A Profile of Older Americans:2007*. Available at: <http://www.aoa.gov/PROF/Statistics/profile/2007/2.asp>. Accessed June 1, 2008
40. Federal Interagency Forum on Aging-Related Statistics. *Older Americans Update 2008: Key Indicators of Well-being*. Washington, DC. US Government Printing Office. March 2008. Available at: http://agingstats.gov/Agingstatsdotnet/Main_Site/Data/Data_2008.aspx. Accessed June 1, 2008.
41. Adler N, Rehkopf D. U.S. disparities in health: descriptions, causes, and mechanisms. *Annu Rev Public Health* 2008;29:235-252.
42. Wood J, Enser M, Fisher A, et al. Manipulating meat quality and composition. *Proc Nutr Soc*. 1999;58(2):363-370.
43. Davis D, Epp M, Riordan H. Changes in USDA food composition data for 43 garden crops, 1950 to 1999. *J Am Coll Nutrition*. 2004;23(6): 669-682.
44. Nestle M. Food marketing and childhood obesity—a matter of policy. *N Engl J Med*. 2006;354(24):2527-2529.
45. USDA. *U.S. Food Consumption Up 16 Percent Since 1970*. Available at <http://www.ers.usda.gov/AmberWaves/November05/Findings/USFoodConsumption.htm>. Accessed December 3, 2007.
46. Bente L, Gerrior S. Selected food and nutrient highlights of the 20th century: U.S. food supply series. *Family Economics Nutrition Rev* 2002;14(1):43-51.
47. USDA. *U.S. Food Consumption Up 16 Percent Since 1970*. Available at <http://www.ers.usda.gov/AmberWaves/November05/Findings/USFoodConsumption.htm>. Accessed December 3, 2007.
48. Gerrior S, Bente L. *The nutrient content of the U.S. food supply, 1909-97*. Home Economics Report. No. 54. U.S. Department of Agriculture, Center for Nutrition Policy and Promotion. 2001.
49. Simopoulos A. The importance of the omega-6/omega-3 fatty acid ratio in cardiovascular disease and other chronic diseases. *Exp Biol Med (Maywood)*. 2008;233(6):674-688.
50. Willett W. The role of dietary n-6 fatty acids in the prevention of cardiovascular disease. *J Cardiovasc Med (Hagerstown)*. 2007;8 Suppl 1:S42-45.
51. Willett W. Trans fatty acids and cardiovascular disease—epidemiologic data. *Atheroscler Suppl*. 2006;7(2):5-8.
52. Allport S. *The Queen of Fats: Why Omega-3s Were Removed from the Western Diet and What We Can Do to Replace Them*. Berkeley: University of CA Press; 2006.
53. Federal Interagency Forum on Aging-Related Statistics. *Older Americans Update 2006: Key Indicators of Well-being*. Washington, DC. US Government Printing Office. March 2006.
54. Cancer Statistics. National Cancer Institute. Available at: <http://www.cancer.gov/statistics/>. Accessed May 30, 2008.
55. Centers for Disease Control and Prevention. *Overweight and obesity*. Available at: <http://www.cdc.gov/nccdphp/dnpa/obesity/>. Accessed May 30, 2008.
56. Centers for Disease Control and Prevention. *Overweight and obesity*. Available at: <http://www.cdc.gov/nccdphp/dnpa/obesity/trend/index.htm>
57. US Dept of Health and Human Services. Available at <http://www.healthypeople.gov/> Accessed July 21, 2008.
58. Ogden C, Carroll M, Flegal K. High body mass index for age among US children and adolescents, 2003-2006. *JAMA*. 2008; 299(20):2401-2405.
59. Centers for Disease Control and Prevention. *Diabetes data and trends*. Available at: <http://apps.nccd.cdc.gov/DDTSTRS/default.aspx> Accessed May 30, 2008.
60. Gale E. The rise of childhood type 1 diabetes in the 20th century. *Diabetes*. 2002;51(12):3353-3361. Available at http://www.medscape.com/viewarticle/445672_print
61. Centers for Disease Control and Prevention. *Diabetes Projects*. Available at: <http://www.cdc.gov/diabetes/projects/cda2.htm>. Accessed May 30, 2008.
62. Centers for Disease Control and Prevention. *Achievements in Public Health, 1900-1999: Decline in Deaths from Heart Disease and Stroke -- United States, 1900-1999*. Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm4830a1.htm>. Accessed December 3, 2007.
63. Ford E, Ajani U, Croft J, Critchley J, et al. Explaining the decrease in U.S. deaths from coronary disease, 1980-2000. *N Engl J Med*. 2007;356(23):2388-2398.
64. Centers for Disease Control and Prevention. National Center for Health Statistics. Available at: <http://www.cdc.gov/nchs/fastats/lcod.htm> Accessed July 5, 2008.
65. Centers for Disease Control and Prevention, National Center for Health Statistics. *Health, United States, 2006, With Chartbook on Trends in the Health of Americans*. Hyattsville, MD:2006. Available at: <http://www.cdc.gov/nchs/data/hus/hus06acc.pdf>. Accessed December 3, 2007.
66. Hajjar I, Kotchen T. Trends in prevalence, awareness, treatment, and control of hypertension in the United States, 1988-2000. *JAMA*. 2003;290:199-206.




 FOOD for
THOUGHT

Nature and Healthy Aging: Green is Good for Your Health

BURGEONING MOVEMENTS SUCH AS urban gardening, horticultural therapy, reconnecting kids with nature, and green roofs on office buildings are rooted in the reawakened understanding that the natural environment is good for the health of people and the planet.

A growing body of scientific evidence indicates that nature can help heal people's minds and bodies, and the benefits of both looking *at* nature and being *in* nature.

In settings where health is a top priority, such as hospitals, views of nature from hospital beds can speed healing, reduce need for pain medications, and improve mood. Healing gardens in hospitals are therapeutic for patients, visitors and health professionals alike. Looking at plants, trees and animals is good for mental and emotional health, and can even sustain attention. Interacting with nature is also a health tonic. Gardening reduces stress and builds social networks. Wilderness experiences are beneficial for cognitive disabilities and improve the self-esteem and wellbeing of inner city children. Jogging in the green outdoors seems to provide greater positive feelings than the same activity in a gym. Horticultural therapy can be a beneficial influence on everything from heart disease to dementia. The growing body of evidence suggests that people benefit so much both physically and mentally from contact with nature that it should be considered a public health strategy.^{1 2}

The American Public Health Association (APHA) apparently agrees. A recent APHA article states that the "intersections between healthy people and a healthy environment are becoming clearer every day." Addressing the movement to reconnect kids with nature, a clarion call sounded by Richard Louv's book *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*, the APHA notes that the recent trend away from outdoor play and activities is troubling both environmentalists and public health experts. It goes on to say that "experts predict that good health will be a major motivator in bringing families back to nature."³

Although bringing nature back into children's lives is a larger movement at present, in part because of the epidemic of obesity and other conditions linked to lack of exercise, we know major benefits also accrue to adults and elders from contacts with the natural world and exercise. This should become a priority in and around places where many aging people spend time, such as nursing homes, assisted-living facilities, and lower-income housing.

Economically distressed families and communities, who are already at greater risk of health problems, also tend to have less access to nature. We must ensure that urban environments include ample green spaces, parks, and safe playgrounds. (See chapter 2).

A growing body of scientific evidence indicates that nature can help heal people's minds and bodies.

Using the experience of nature as a prevention tactic makes good environmental and economic sense. There is a growing consensus that interdisciplinary dialogue and innovative social policy need to be fostered to advance efforts to once again bring nature into people's lives at home, at work, at school, and in health care facilities, especially for the neediest and most vulnerable members of our communities. However, "public health strategies are yet to maximize the untapped resource nature provides."⁴

If we routinely plant the seeds of this prevention strategy, we can reap great rewards.

Resources:

Children and Nature Network:
<http://www.cnaturenet.org/>

Endnotes

1. Frumkin H, Louv R. The powerful link between conserving land and preserving health. Land Trust Alliance Special Anniversary Report 2007. Available at: <http://www.cnaturenet.org/resourcestools/FrumkinLouv.pdf>. Accessed May 15, 2008.
2. St. Leger L. Health and nature—new challenges for health promotion. *Health Promotion International* 2003;18:173-175.
3. American Public Health Association. *The Nation's Health*. Washington DC. October 2007.
4. Maller C, Townsend M, Pryor A, St. Leger L. Healthy nature, healthy people: contact with nature as an upstream health promotion intervention for populations. *Health Promotion International* 2006; 21(1):45-54.