Risks in Perspective

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Perhaps the most meaningful way of putting risks into perspective is to consider the loss of life expectancy (LLE) that they cause. The purpose of this paper is to present a brief catalog of these, derived from my in-depth studies.[1,2] Numbers in parentheses are LLE, calculated from life tables by a method described previously.[1]

Disease-Caused Mortality

Historically, diseases were one of the most important causes of life shortening, but now only heart disease (4.4 years), cancer (3.4 years), and stroke (250 days) cause LLE more than six months (see the left-hand side of Figure 1). The male/female mortality ratios for these are 1.10, 1.21, and 0.69 respectively, and the black/white racial differences are 0.80, 0.85, and 0.96 respectively. In other words, men are 1.1 times as likely to die of heart disease as women, and blacks are 0.8 times as likely to die of heart disease as whites.

Accident-Caused Mortality

Aside from diseases, the principal direct causes of death are accidents (366 days), suicide (115 days), and homicide (93 days), as shown in the middle third of Fig. 1. The male/female ratios are 2.3, 3.8. and 3.4, and black/white ratios, 1.09, 0.47, and 5.7, respectively.

About half of the LLE from accidents is due to motor vehicles, with the rest about equally distributed among the home, the workplace, and public places. The most important non-motor vehicle accidents are falls (28 days), suffocation (28 days), drowning (24 days) – mostly in bath tubs, poison (20 days), and fire and burns (20 days). Much less important, despite heavy media coverage, are firearms (6.5 days), airplanes (3.7 days) – only a small fraction from scheduled airlines, and railroads (1.3 days). Male/female ratios are 2.4 for motor vehicles, 2.0 for pedestrians, and 4.5 for drowning, but close to 1.0 for other accident types.

Half of all motor vehicle deaths are alcohol related, and in these alcohol-related accidents one-third of the victims are sober. Accident deaths per billion miles of travel are 45 for male drivers vs 17 for female drivers, 17 in daylight vs 42 at night, and 15 in urban areas vs 39 in rural areas.

Using seat belts reduces the LLE by 70 days. The 1987 increase in the rural interstate highway speed limit from 55 to 65 miles per hour gave the average American an LLE of 2 days. The effect was so small mainly because only 8 percent of motor-vehicle fatalities occur on rural interstate highways.

There are large variations in accident risks with geography. Accident LLE varies from 740 days in Alaska and 650 days in New Mexico to 266 days in New Hampshire and 250 days in New York State. Accident deaths per year per 100,000 population vary widely: there are 23 in England and Japan; 30-35 in Germany, Sweden, and Australia; 35-45 in the U.S., Scotland, Denmark, and Uruguay; 45-50 in Belgium, Poland, and New Zealand; 50-60 in Switzerland, Austria, and Czech Republic; 62 in France; and 73 in Cuba. The LLE due to accidents is 213 days in England vs 574 days in France, a full year of difference in life expectancy due to accidents alone.

The good news about accident rates in the U.S. is that they are declining, by about 18 percent per decade. Non-motor vehicle accident deaths were 80,000 in 1906 when the population was 86 million, vs 47,000 in 1988 when the population was 246 million, a factor of 5 reduction in the per capita rate.

Occupation-Related Mortality

From the standpoint of fatal occupational accidents, the most dangerous industries are construction (227 days) and mining (167 days); much safer are services (27 days), trade (27 days), and manufacturing (40 days).There are much larger variations within each industry; for example, construction worker accident LLE is 1,560 days for demolition workers vs 38 days for those working in heating, plumbing, and electrical wiring. But occupational diseases are much more important than occupational accidents in determining life expectancy. In England, where data are corrected for social class, postmen, government officials, and university faculty live 1.5 years longer than average, whereas printers, coal miners, pharmacists, nurses, and shoemakers have a life expectancy 2.5 to 3.5 years shorter than average. Fishermen, actors, musicians, steel workers, and riggers have a life span 4 years shorter than average, and for ship workers the difference exceeds 7 years. Choice of occupation can affect one's life span by many years.

In the U.S., the most dangerous job situation of all is unemployment. According to one estimate, a 1 percent increase in U.S. unemployment results in 37,000 deaths per year, plus 4,200 admissions to mental hospitals and 3,300 admissions to prisons.

In the U.S., professional, technical, administrative, and managerial people live 2.7 years longer than average, whereas unskilled laborers live 2.4 years fewer than average. Life expectancy for college graduates is 2.6 years longer than average, and for white grade-school dropouts, 1.7 years shorter than average. For white males below age 65, the ratio of mortality rates of unskilled laborers to professionals is 1.48 for all causes; it is 0.90 for arteriosclerosis, 1.08

for stroke, 1.30 for cancer, 4.4 for tuberculosis, 2.7 for influenza and pneumonia, 3.4 for accidents, 1.6 for suicide, and 1.75 for cirrhosis of the liver.

Lifestyle-Related Mortality

Perhaps the best known risky behavior is smoking cigarettes (6.6 years for men, 3.9 years for women). For men who inhale deeply, LLE is 8.6 years for cigarettes, 3.2 years for cigars, and 1.4 years for pipes, but without inhalation, LLE is reduced to 4.5 years for cigarettes and zero for cigars and pipes. Those who smoke more than 2 packs per day have a mortality rate relative to that for nonsmokers of 24 for lung cancer, 9.3 for cancer of the mouth, 15 for bronchitis, 2.0 for heart disease, 1.9 for stroke, and 9.2 for ulcers.

Even more dangerous is being an alcoholic (12 years); alcoholics have mortality rates at a given age 2.5-3 times higher than average. Another major risk is overeating, which gives an LLE of about 36 days per pound, or one year for each 10 pounds above optimal weight. Being 25 percent overweight (for example weighing 200 lb if optimum weight for one's height is 160 lb) increases the fatality risk of heart disease by 35 percent, of cancer by 14 percent, of stroke by 17 percent, and of diabetes by 195 percent.

Having very poor, vs very good, social connections gives an LLE of 9 years. As one manifestation of this, at age 55 being single rather than married has an LLE of 3.2 years for males and 1.9 years for females; for widowed persons the LLE is 3.9 and 2.7 years, and for divorced persons, 6.2 and 2.5 years, respectively. For all of these factors, the LLE is larger for blacks than for whites. A divorced man's risk is 1.77 times greater than that of a married man for fatal heart disease, and this ratio is 1.55 for stomach and intestinal cancer, 2.13 for lung cancer, 1.81 for stroke, 1.92 for diabetes, 6.2 for cirrhosis of liver, 4.0 for accidents, 4.1 for suicide, and 7.2 for homicide. The least affected of the unmarried are single women for whom this ratio is 1.26 for heart disease, 1.15 for stomach and intestinal cancer, 1.04 for lung cancer, 1.28 for stroke, 0.66 for diabetes, 0.84 for cirrhosis, 1.4 for accidents, 1.16 for suicide, and 0.51 for homicide.

The Effect of Economic Status

One of the greatest risks to an individual is living in poverty: LLE is 9 years for 19 large U.S. cities and for Montreal. In Britain, the difference in life expectancy between professional people and unskilled laborers is 7.2 years, and in Finland it is also 7.2 years. When Canadian men are ranked by income, those in the 90th percentile live 6 years longer than those in the 10th percentile. The latter have a higher mortality rate by 32 percent for heart disease and stroke, by 34 percent for cancer, and by 88 percent for accidents, poison, and violence. On an international scale, poverty plays a much bigger role – life expectancy is typically 30 years longer in affluent countries than in poor countries. For example, in 1990 it was 77 years in Japan, Sweden, and Canada compared with 38 years in Afghanistan and Gambia and 42 years in Ethiopia and Guinea; the world average was 61 years. In one of the most advanced African countries, Ghana, where average life expectancy is 55 years, LLE in years for a few diseases for which it is 0.0 in the U.S. are: measles, 1.3; malaria, 1.2; malnutrition, 1.2; sickle cell disease, 1.2; diarrhea, 1.0; tetanus, 0.5; tuberculosis, 0.5; cirrhosis, 0.5; schistosomiasis, 0.4; typhoid, 0.3; pertussis, 0.3; pregnancy complications, 0.65; intestinal obstructions, 0.35. On the other hand, the LLE for heart disease and cancer is only 0.35 and 0.25 years compared with 4.4 and 3.4 years respectively in U.S.

Environmental Risk Factors

Some significant environmental problems for the average American, according to very rough EPA estimates, include air pollution (40 days), drinking water pollution (20 days), chemical residues in food (20 days), and chemicals released from consumer products (20 days). News media give wide publicity to cancer-causing pollutants. Some of these are pesticide residues in food (12 days), tobacco smoke (8 days), other indoor pollutants (2 days), industrial air pollution (4 days), hazardous waste sites (2.5 days), and drinking water contaminants (1.3 days).

It is estimated[2] that all radioactivity releases from nuclear power, including accidents and wastes, will eventually give the average American an LLE of 0.06 days. Nuclear power is an insignificant contributor to radiation exposure compared to radon in homes (25 days), other natural sources of radiation (10 days), and medical exposures (10 days). Citizens living near the Three Mile Island plant get more radiation from radon in their homes every day than they got in total from the nuclear reactor accident there in 1979. Of course, the Chernobyl reactor accident involved far larger releases of radioactivity, far more than is imaginable from any possible accident in a reactor of American design, but still, 20 million Americans get more radiation from radon in their homes over their lifetimes than the most exposed members of the public got from the Chernobyl accident.

Great concern has been expressed about health impacts from our use of energy. The LLE from various components are: coal burning, 15 days; oil burning, 5 days; natural gas, 3 days (mostly from asphyxiation); hydroelectric dam failures, 0.2 days; and nuclear power, 0.06 days. The solution often proposed to avoid these risks is conservation – using less energy. But this has its own risks with substantial LLE, for example: using smaller automobiles, 60 days; greatly reducing air leakage in buildings thereby increasing levels of indoor air pollution, 50 days; doubling use of bicycles, 6 days; and reduced lighting, 11 days if it causes 5 percent more automobile accidents, 5 days if it results in 5 percent more murders, and 1.5 days if it leads to 5 percent more falls. A much greater effect would probably be seen if reduced energy use reduced our wealth. As demonstrated above, wealth brings health. From the figures quoted above it is abundantly clear that over-zealous energy conservation is the most dangerous energy strategy. There are many good reasons for conserving energy, but improving health is not one of them.

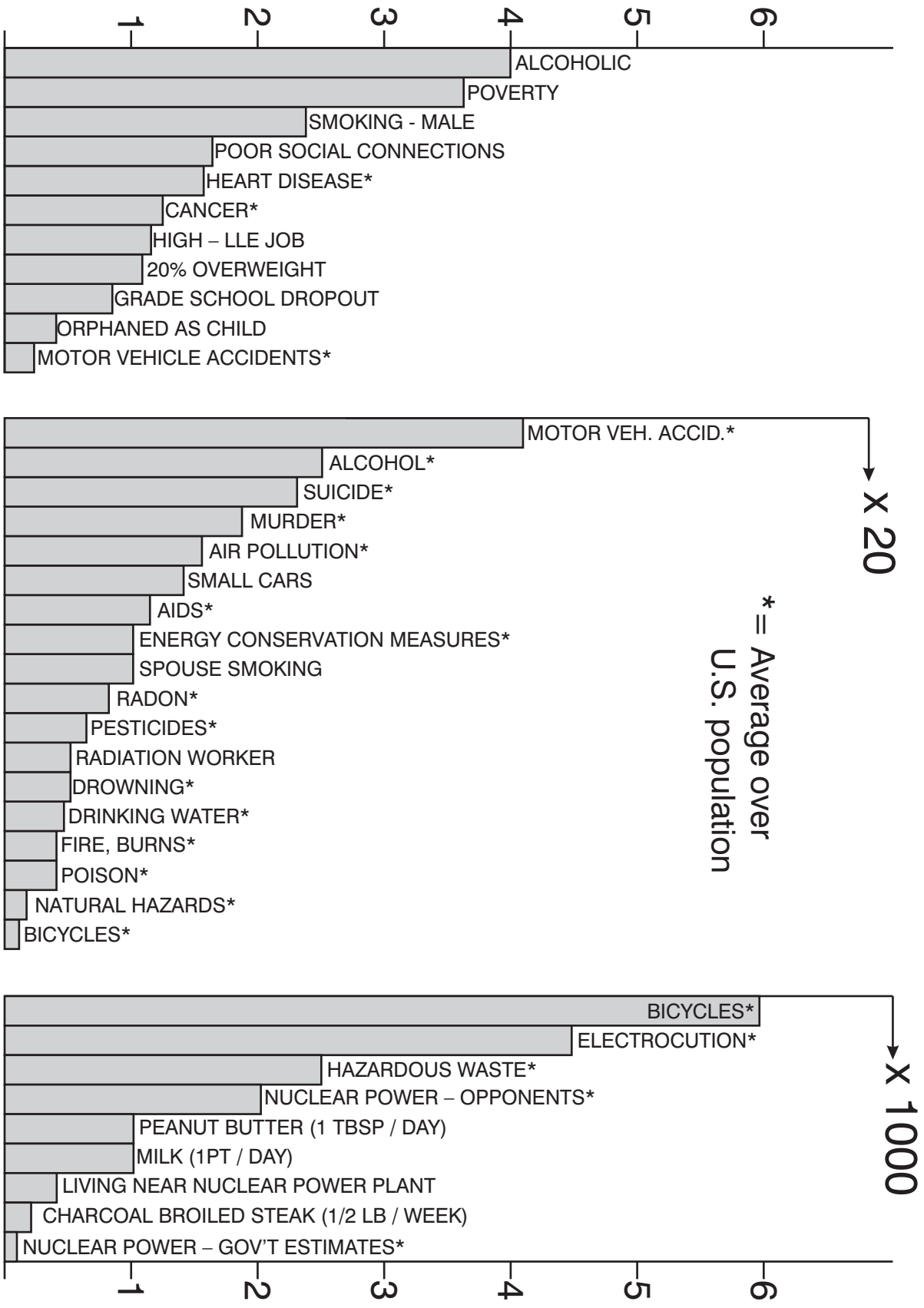
Thousands of Days Lost Life Expectancy
1
2
3
4
5
6
ALCOHOLIC
POVERTY
SMOKING - MALE
POOR SOCIAL CONNECTIONS
HEART DISEASE*
CANCER*
HIGH – LLE JOB
20% OVERWEIGHT
GRADE SCHOOL DROPOUT
ORPHANED AS CHILD
MOTOR VEHICLE ACCIDENTS*
MOTOR VEH. ACCID.*
ALCOHOL*
SUICIDE*
MURDER*
AIR POLLUTION*
SMALL CARS
AIDS*
ENERGY CONSERVATION MEASURES*
SPOUSE SMOKING
RADON*
PESTICIDES*
RADIATION WORKER
DROWNING*
DRINKING WATER*
FIRE, BURNS*
POISON*
NATURAL HAZARDS*
BICYCLES*
x 20
* = Average over U.S. population
BICYCLES*
ELECTROCUTION*
HAZARDOUS WASTE*
NUCLEAR POWER – OPPONENTS*
PEANUT BUTTER (1 TBSP / DAY)
MILK (1PT / DAY)
LIVING NEAR NUCLEAR POWER PLANT
CHARCOAL BROILED STEAK (1/2 LB / WEEK)
NUCLEAR POWER – GOV'T ESTIMATES*
x 1000
1
2
3
4
5
6
Days of Lost Life Expectancy

Figure 1

The very small LLE for nuclear power allows us to put it into perspective as follows: The risk to the average American from having all of our electricity generated from nuclear power is equal to the risk of a regular smoker smoking one extra cigarette every 15 years, or to the risk of an overweight person increasing his weight by 0.012 ounces, or to the risk of raising the national speed limit from 55 miles per hour to 55.006 miles per hour, or to the risk of driving a small car rather than a mid-size car one day every six years.

It is estimated[2] that all radioactivity releases from nuclear power, including accidents and waste disposal will eventually give the average American an LLE of 0.06 days. This estimate, and all estimates of risks from radiation discussed above, is based on assuming the validity of the linear-no threshold theory of radiation-induced cancer, which is now widely believed to give a gross overestimate of risks from low doses.[3,4] In any case, based on dosage alone, nuclear power is an insignificant contributor to radiation exposure compared to other factors noted above.

Natural Hazards

Broiling meat produces carcinogens (1 day) and we ingest similar carcinogens in bread crusts, toast, and fried potatoes. But everything man does, purposely or through pollution, is trivial in comparison with nature's contribution. All plants contain toxic chemicals to protect them from their natural enemies. Many of these chemicals can cause cancer, for example: nitrosamines in beets, celery and lettuce; aflatoxin in peanuts, corn, and milk; sterigmatocystine in salami, ham, and wheat; hydrazines in mushrooms; allyl isothiocyanate in mustard, broccoli, and cabbage; safrole in pepper; tannins in coffee, tea, and wines; psoralens in celery and parsley; ethyl carbamate in bread, yogurt, beer, and wine; formaldehyde in fruits; benzene in eggs; methylene chloride in fats; coumarin in candy; diacetyl in coffee and butter; and flavonoids in fruits and vegetables. These are nature's pesticides, and per quantity ingested, they are typically as carcinogenic as man-made pesticides. However, our food contains 10,000 times as much of nature's pesticides as of man-made pesticides.

Natural catastrophes in the U.S. give the following LLE: hurricanes and tornadoes, 1.1 days; lightning, 0.7 day; storms and floods, 0.9 day; earthquakes and volcanoes, 0.2 day; heat waves, 0.7 day; cold waves, 2.1 days. Some similarly low risks are venomous plants and animals, 0.5 day (half from bee stings, and only 15 percent from snakes, lizards, and spiders) and dog bites, 0.12 day.

The Great Killers of History

Historically, the great killers have been pestilence, war, and famine, with war often causing the other two. The best-known epidemics have been the "Plague of Justinian" in AD 500-650, which killed 100 million; the "Black Death" in 1347-1351, which killed 75 million in Europe plus perhaps more than that in Asia; various diseases among American Indians due to contact with Europeans after 1492, which killed untold millions (a large fraction of the Indian population); and the influenza epidemic of 1918-1919, which killed 20-50 million including a half million in the U.S. Adult Immunodeficiency Syndrome (AIDS) is killing 12,000 Americans per year (55 days for the average American). Fortunately, it does not spread through such efficient channels as coughing or food, but we have no guarantee against the development of a new equally powerful virus that does spread efficiently. The best understood natural disaster that could wipe out a large fraction of mankind is the impact on the Earth of a large asteroid, expected once in a million years.

A Perspective

Fig. 1 helps put some of the risks we have described, plus others, in perspective. In the bar graph, the height of the bars gives the LLE. Effects marked with asterisks (*) are those averaged over the entire population, while those without asterisks refer to people involved in the activity. The largest risks are shown at the left – alcohol, poverty, smoking, poor social connections, heart disease, and cancer each take years off a person's life expectancy. The smallest risk in the left section, motor vehicle accidents, is also shown as the largest risk in the middle group, for which bar heights have been multiplied by 20. This middle group consists mostly of risks widely recognized but not greatly feared. The lowest risk in this middle group, bicycles (the most dangerous transport per mile traveled), is also shown by the largest bar in the right-side group, for which bar heights have been multiplied by another factor of 50. Thus, a bar on the left-hand side represents an LLE 1000 times (50 x 20) greater than a bar of the same height in the right-hand section.

In a rational society, the low risks shown on the right should receive little consideration, but the public's attention is determined more by media coverage than by results of scientific risk analysis. The most glaring example of this is nuclear power, which is widely perceived by the public as being dangerous. We see from the bar diagrams that its perceived risk is inflated by a factor of many thousands.

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