



## *Biology and Genetic Endowment*

*The basic biology and organic make-up of the human body  
are a fundamental determinant of health.*

— Federal, Provincial and Territorial Advisory Committee on Population Health  
in *Strategies for Population Health: Investing in the Health of Canadians*.

**I**n the last half of the 20th century, Canadians have witnessed remarkable advances in biotechnology and genetic research that could never have been imagined 50 years ago. In 1953, scientists determined that DNA controlled heredity, setting off a race to figure out how DNA functions. In 1996, the U.S. government launched the Human Genome Project — a 15-year, \$3-billion effort to decipher DNA. The first successful heart transplant was performed in South Africa in 1967. In 1978, the first “test-tube baby” was born. Nineteen years later (1997), Scottish researchers cloned a sheep using cells from an adult sheep’s udder.

Some of the genetic and biotechnical advances we have today and can expect in the near future have the capacity to save and enhance lives. Some are repugnant to societal values. Some are too new to have been thoroughly assessed by either the scientific community or the public. However, all have the potential to affect health, family formation and the lives of subsequent generations.

At the same time, research in biology, epidemiology and social science is beginning to expand our knowledge about the links between biological pathways and the determinants of health. For example, exciting new research on brain formation has shed new light on how stimulation in a baby's environment interacts with biology to influence healthy child development in earliest infancy. As the population ages in Canada and around the world, there is growing interest in the links between the biology of aging and how an individual or a population's position on the socioeconomic ladder translates into health or disease in later life.

## Highlights

- ◆ A growing body of evidence suggests that healthy eating in the preconception period increases the chances of a safe and successful pregnancy outcome. After conception, an expectant mother's diet and use of tobacco, alcohol and other drugs can affect both her health and that of the fetus.
- ◆ When an infant is cared for by a nurturing, sensitive, involved adult, a "secure attachment" is formed. This attachment helps establish connections in the brain that can reduce anxiety and allow the brain to take in and incorporate new stimuli.
- ◆ New reproductive and genetic technologies that are designed to overcome infertility or manipulate the conventional conception process have raised many profound social, ethical, legal and health issues. These concerns will become increasingly important as science progresses in the next century.
- ◆ Aging is not synonymous with poor health. A large majority of older Canadians continue to report high levels of well-being on measures such as self-rated health and long-term activity limitations. Older Canadians, however, report significantly lower levels of health and higher rates of certain health problems than younger Canadians. This is particularly true of older Canadians living in low-income situations.
- ◆ Studies on education level and dementia suggest that exposure to education and lifelong learning may create reserve capacity in the brain that compensates for cognitive losses that occur with biological aging.
- ◆ Active living has proven potential to prevent or slow some of the declines associated with biological aging.

## Linking Biology and the Environment

While heredity is an important determinant of health, there is considerable evidence to suggest that its effects are strongly moderated by the social and physical environments. Studies of migrant populations provide some of the best evidence of this relationship. For example, Japanese who moved to California and adopted an American lifestyle had higher rates of coronary artery disease than those who maintained a more traditional Japanese lifestyle.<sup>1</sup> Their genetic makeup did not protect them from the disease patterns of their new host country. Work with rhesus monkeys has shown the powerful influence

of the social environment, particularly the effects of a loving parent. Studies have shown that monkeys born with a genetically inherited negative personality trait fare better when they are reared by a nurturing mother.<sup>2</sup>

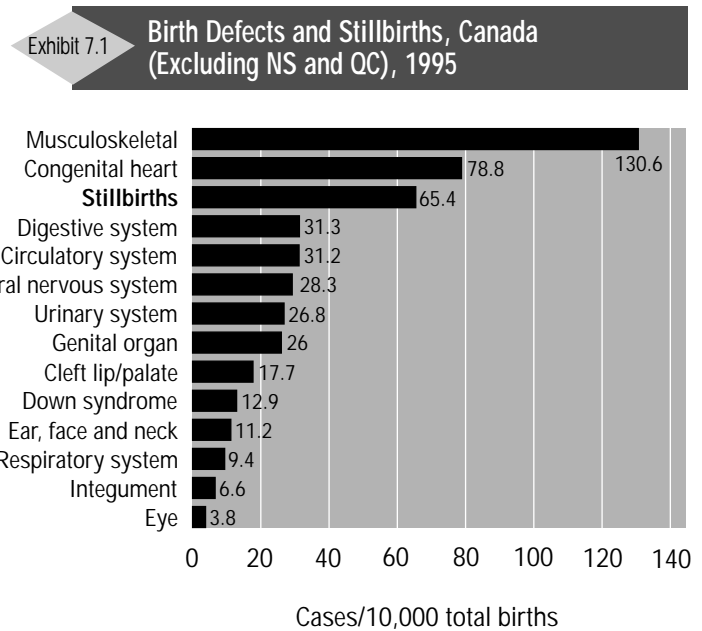
New studies have shown that the nervous system, which responds to the outside world and transfers information to the immune system, is the biological pathway that links external stimuli and the body. This link between the nervous system and the immune system (which plays a central role in guarding health) is of major importance in understanding how social and economic conditions can affect health.<sup>3</sup>

For example, we know that long-term, chronic stress in the environment has a negative effect on the immune system and, in turn, on health status. While genetics may play a role, the social environment, and more specifically, the extent of control over a life situation largely determines how successful individuals will be at turning off the stress response and protecting their immune systems from the effects of chronic stressors. People who are lower on the social scale and have less control over their environment are likely to experience more severe physiological consequences to adverse conditions than those who are higher on the social scale and have more control over circumstances in their environment.<sup>4</sup>

## Biology and Birth Defects

In 1995, there were 13,629 anomalies or birth defects recorded, with a rate of 483.5 for every 10,000 births.<sup>5</sup> This rate is the lowest recorded since monitoring began in 1989.<sup>6</sup> The most common anomalies are musculoskeletal and congenital heart defects (Exhibit 7.1). The most frequent musculoskeletal defects are congenital dislocation of the hip and clubfoot, each of which is more common than anomalies of the digestive system, the central nervous system and genital organs, and Down syndrome.

In this century, science has given us numerous important findings about how to prevent health problems. Nowhere is this research more important than in the birth of healthy babies. For example, research has shown that women who take supplementary folic acid (one of the B vitamins) around the time of conception can greatly reduce the risk of neural tube birth defects, including spina bifida and anencephalus.<sup>7</sup> Health Canada has recently published national guidelines for healthy eating throughout the preconception and prenatal period in light of a growing body of evidence that suggests that preparing for pregnancy increases the chances of a safe and successful birth outcome. Surveys are needed to determine how many women of childbearing age are



Source: Health Canada, Laboratory Centre for Disease Control, Canadian Congenital Anomaly Surveillance System.

aware of the role of preconception nutrition in preventing birth defects and how many women who are considering a pregnancy are taking steps to meet Health Canada's guidelines.

Other aspects of an expectant mother's lifestyle practices affect the likelihood that a child will be born with mental and physical disabilities. Maternal smoking and/or considerable exposure to environmental tobacco smoke during pregnancy increases the likelihood of a premature delivery and the birth of a low-weight baby who is at high risk for disabilities. In 1996–97, about 36% of new mothers who were current or former smokers acknowledged smoking during their most recent pregnancy and they smoked an average of nine cigarettes each day while pregnant. This amounts to about 146,000 women who smoked during their last pregnancy.<sup>8</sup> As discussed in Chapter 3, women with lower levels of education are much more likely to smoke during pregnancy than women who have pursued a higher level of education.

Alcohol use during pregnancy can affect the health of the mother, the fetus and the ability of the child to lead a healthy life from birth to adulthood. The most disturbing results of alcohol use during pregnancy are fetal alcohol syndrome (FAS) and fetal alcohol effects (FAE).

## Definitions

- ◆ **Fetal alcohol syndrome (FAS)** is a set of alcohol-related disabilities characterized by both physical and behavioural shortcomings, including prenatal and postnatal growth restrictions, neurological abnormalities, developmental delays, behaviour dysfunction and learning disabilities.
- ◆ **Fetal alcohol effects (FAE)** is the term used to describe children with only some of the FAS characteristics in situations where prenatal alcohol use is a possible cause.

Although there is no national surveillance of FAS, conservative estimates suggest that .33 cases of FAS occur in every 1,000 births in western countries.<sup>9</sup> While the incidence of FAE is about three times higher, the relative effects of alcohol use, poor nutrition and impoverished conditions are hard to decipher.

Although some case studies in specific communities suggest that fetal alcohol syndrome (FAS) is more common among Canadian Aboriginal children than non-Aboriginal children, there is yet no good evidence to support this conclusion. For example, researchers have studied FAS in Native communities without including a non-Native comparison group. When a comparison group has been introduced, it is not clear that criteria for FAS have been applied consistently to both groups. To date, a valid comparison of the overall prevalence rates of FAS for Native individuals and non-Natives has not been carried out.<sup>10</sup>

While binge drinking is the pattern associated with FAS, some women may be more susceptible to the effects of alcohol because of differences in the way that their bodies metabolize alcohol.<sup>11</sup> Other risk factors point to the links between personal behaviour, biology and socioeconomic factors. For example, women who drink heavily during pregnancy are often poor, undernourished, depressed and abused, and many are unlikely

to receive prenatal care. Thus, reasons for drinking during pregnancy are based on a mix of socioeconomic factors including the drinking patterns of family members and friends, as well as other adverse situations that lead to heavy drinking.<sup>12</sup>

Virtually all women want to have healthy babies. Most who smoke or drink during pregnancy do so as a consequence of addiction and/or high levels of stress caused by poverty, abuse or other factors. Pregnant women need the support of their partners, families and communities, as well as the recognition that their own health is as important as that of the growing fetus.

More research on the effects of alcohol consumption and smoking by fathers on fetal and infant development is required.

## New Reproductive and Genetic Technologies (NRGTs)

Reproductive technologies are designed to overcome infertility or manipulate the conventional conception process to produce a pregnancy. They include in vitro fertilization, donor insemination, assisted insemination, preconception or “surrogacy” arrangements and postmenopausal pregnancy. Applications of genetics-based technologies include sex selection, embryo research, prenatal diagnosis and human embryo cloning. Recently, the Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans stated unequivocally that some of the practices mentioned in the paragraph above are both unethical and problematic.<sup>13</sup>

The development and application of NRGTs in Canada have raised many profound social, ethical, legal and health issues. While some NRGTs can enhance health and well-being, others threaten human dignity and treat women, children and the reproductive process as commodities. Thus, the title of the 1992 report — *Proceed With Care* — from the Royal Commission on New Reproductive Technologies, was both appropriate and prescriptive.

The Royal Commission recommended a comprehensive, ethics-based approach to regulation, licensing and prohibitions. The federal government responded with a voluntary moratorium on certain procedures in 1995 and the introduction of the *Human Reproductive and Genetic Technologies Act* to regulate NRGTs. This bill died on the order paper when a federal election was called; a new replacement bill is currently being drafted, following a round of strategic consultations. It is anticipated that the new bill will be comprehensive in scope, addressing the issue of prohibitions of certain procedures, as well as proposing regulatory and management structures.

New reproductive and genetic technologies concern the future of our society. They are important to all Canadians, but particularly to women because they are practised almost exclusively on women’s bodies. Women’s relative economic status also makes them more susceptible to adverse consequences of these technologies such as the commercialization of human gametes and embryos. Other vulnerable groups include the children born as a result of these technologies who will be exposed to physical, emotional and legal risks. Canadians with disabilities are concerned that the increasing use of prenatal diagnosis, which is designed to detect genetic or other abnormalities in the embryo or fetus, may heighten negative attitudes toward people with disabilities.<sup>14</sup>

New genetic discoveries related to diseases such as cystic fibrosis and Huntington's disease offer the hope of finding new drugs to treat and cure these conditions. But presymptomatic testing and counselling for adults with a family history of disease raises some profound questions for both individuals and the health-care system. What is a young woman to do when she finds that she carries the gene for ovarian cancer? Should she have her ovaries removed? Should she have children, knowing that there is a risk that she will develop a serious illness and may pass on the gene to a daughter? Will monitoring her health as a result of this knowledge be better for her? Or will the chronic anxiety provoked by the test results make her health worse? An additional concern relates to health and life insurance. Will persons who carry a gene for a particular disease be denied insurance because of a disease they do not have now and may never have in the future? These are all questions that must be addressed by policy-makers, consumers and health-care practitioners on a one-on-one basis, in small focus groups and in public fora.

There is also a concern that a rush to expand high-tech solutions to infertility may take away from low-tech, public health efforts to prevent sexually transmitted diseases (STDs), which are a major cause of infertility. While there has been some decrease in the rates of gonorrhoea and syphilis between 1986 and 1996, the rate of chlamydia (an infection that can cause sterility) remains high, particularly among women aged 15 to 24 (Exhibit 7.2). These high rates may be explained by a number of factors: the early onset of unprotected sexual activity; the high "pool" of STD infection among young people; the tendency of young people to change sex partners frequently; the symptomless nature of some STDs; and the vulnerability of an adolescent woman's immature genital tract to invading micro-organisms.<sup>15</sup> Since the only sensible approach to STDs is prevention, the need to counsel young people on the use of abstinence and safe sex practices is clear.

Exhibit 7.2 Sexually Transmitted Diseases, by Selected Age Groups and Sex, 1996 (Rate per 100,000 Population)

|                       | Chlamydia | Gonorrhoea | Syphilis |
|-----------------------|-----------|------------|----------|
| ◆ Age 15 to 19, total | 563.3     | 59.4       | 0.6      |
| ◆ Male                | 148.5     | 33.6       | 0.3      |
| ◆ Female              | 998.6     | 86.4       | 0.9      |
| ◆ Age 20 to 24, total | 617.4     | 65.9       | 0.8      |
| ◆ Male                | 302.7     | 66.6       | 0.7      |
| ◆ Female              | 941.2     | 65.0       | 0.9      |
| ◆ Age 25 to 29, total | 238.1     | 42.0       | 1.2      |
| ◆ Male                | 155.6     | 54.8       | 1.2      |
| ◆ Female              | 322.0     | 29.0       | 1.3      |
| ◆ Age 30 to 39, total | 66.2      | 19.5       | 0.7      |
| ◆ Male                | 51.2      | 30.6       | 1.0      |
| ◆ Female              | 81.5      | 8.0        | 0.4      |

Source: Health Canada, Laboratory Centre for Disease Control, Bureau of HIV/AIDS, STD and TB, Division of STD Prevention and Control, 1998.

## The Biology of Brain Development

In recent years, new knowledge from the science of neurobiology has expanded our understanding of how the brain develops in the early years and how nature and nurture interact to affect the short- and long-term development of emotions, thinking and behaviour.

A newborn's brain is complete with all of the brain areas and neurons, but only a portion of the brain is "wired" to go. After birth, there is a frenzy of activity in which the neurons connect with each other to form the neural networks that enable movement, talking, feeling and thinking. This process is driven in large part by the flood of sensory stimulation that a child receives from the outside world.

When an infant is cared for by a nurturing, sensitive, involved adult, a "secure attachment" is formed. This attachment helps establish connections in the brain that can reduce anxiety and allow the brain to take in and incorporate new stimuli.<sup>16</sup> On the other hand, neglecting or abusing an infant during this critical period may produce wiring patterns in the brain that can lead to heightened sensitivity to stimuli and to negative and abnormal behaviour in childhood and adulthood. In other words, the environment around an infant has a major influence on the brain's development and subsequently on a person's capacity for control over intense feelings, including anxiety and aggression.<sup>17</sup> This does not mean that a child who is maltreated cannot achieve healthy development. It does mean, however, that it will be much more difficult for that child to achieve success, and he or she will likely require more assistance in doing so.

One good example of the link between biology and the environment is language development. Children are genetically programmed to learn to talk, but their ability to communicate and the language they use depend on what they hear. Language that is part of human caring and interaction activates the brain. As these pathways become well used, a baby develops the ability to understand and use language. Pictures of the brain cortex show that babies who are not exposed to a lot of verbal stimulation have fewer connections and less activity in the brain. This translates into difficulties in communicating as a young child and a reduced readiness for school.

## Aging and Health

The biological effects of aging are fairly well known. As we age, there is a normal and gradual decline in vision, nerve conduction velocity, muscular strength, bone mass and kidney functions. These functions do not all decline at the same rate and there is marked variation from person to person. Many older people develop a chronic disease (which may or may not be related to heredity) that can have dramatic effects on normal body functions. Other factors such as high stress levels associated with poverty or abuse and the social roles assigned to gender in our society can also affect the aging process.

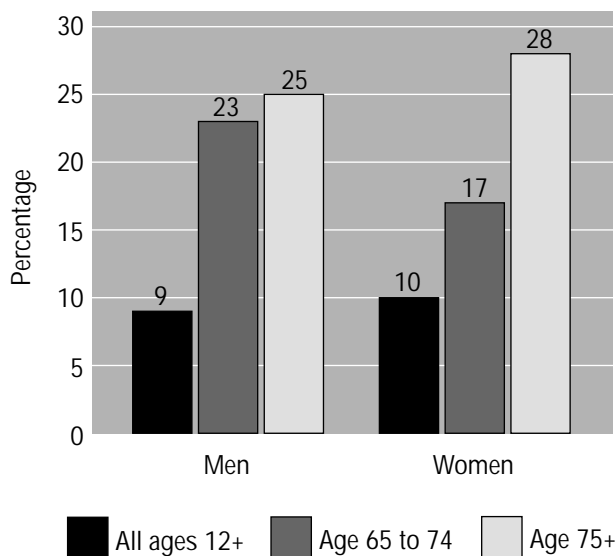
The question remains, however, as to how much of the decline associated with aging is attributable to biological aging and how much of it is the result of other factors, including socioeconomic status, social support, the physical environment and personal health practices. It has been shown, for example, that an older person who is physically active can maintain a level of general physiological functioning and energy that is 20% higher than the majority of people in the same age category.<sup>18</sup>

Information relating to the role of the various determinants of health in the aging process is extremely important today and will be more so in the next century. By the year 2001, it is projected that one-quarter of Canada's population will be over the age of 55. Within that population, an increasing number of seniors will be over the age of 75. In 2011, seniors aged 75 and over will represent nearly 7% of the population of Canada and more than 46% of the population aged 65 and over. The National Advisory Council on Aging has called the growth in this age group one of the most striking socioeconomic developments in recent years.<sup>19</sup>

Our understanding of the factors that influence biological changes associated with aging is greatly complicated by the cohort factor, and the increasing racial and ethnic diversity of Canada's seniors. Those who are old now differ in many ways from those who will be old in the new century. Most of tomorrow's seniors will have enjoyed higher incomes and higher levels of education than today's seniors. They are likely to be more knowledgeable about personal health practices. On the other hand, they may not have learned the coping and resiliency skills of the current generation of older Canadians who survived two world wars and the depression of the 1930s. The diversity we are seeing in seniors who have come to Canada will continue to increase. The waves of new immigrants and refugees from Asia, the Middle East and Africa that have arrived in the 1990s will be an integral part of tomorrow's population of seniors.

Clearly, aging is not synonymous with poor health. A large majority of older Canadians report high levels of well-being on measures such as self-rated health and long-term activity limitations. Older Canadians, however, report significantly lower levels of health and higher rates of certain health problems than younger Canadians. This is particularly true of older Canadians living on inadequate incomes.

Exhibit 7.3  
Percentage of Canadian Men and Women Reporting Fair or Poor Health, by Selected Age Groups, 1996–97



Source: Statistics Canada. *National Population Health Survey, 1996–97*.

**Self-rated health status:** Most older Canadians enjoy good to excellent health status. In the 1996–97 NPHS, 80% of Canadians aged 65 to 74 and 73% of Canadians aged 75 and over described their health as good, very good, or excellent. The percentage of older Canadians who described their health as fair or poor declined from 24% of Canadians aged 65 to 74 and 31% of those aged 75+ in 1994–95 to 20% and 27% respectively in 1996–97. Nevertheless, Canadians aged 75 and over remained nearly three times more likely to describe their health as fair or poor than younger Canadians (Exhibit 7.3).

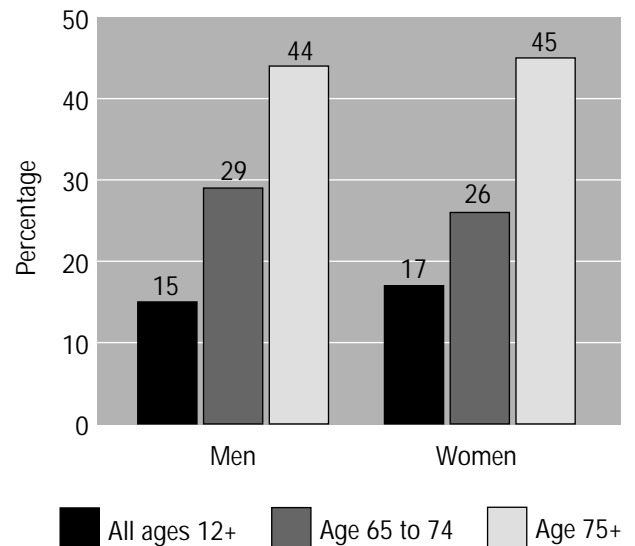
**Long-term activity limitations:** In 1996–97, 28% of Canadians aged 65 to 74 and 44% of those aged 75 and over reported a long-term activity limitation or disability resulting from a health problem (Exhibit 7.4). This reflects an improvement from 1994–95 when 36% of Canadians aged 65

to 74 and 46% of those aged 75 and over reported an activity limitation. In the age group 65 to 74, men were more likely than women to report an activity limitation; after age 75, rates of long-term activity limitations were slightly higher for women (44% for men and 45% for women).

There are significant gender and age category differences when the primary condition responsible for the activity limitation is identified. As Exhibit 7.5 shows, arthritis was the primary cause of activity limitations for women over age 55 in all three age categories. In contrast, the major causes of activity limitations for men varied in each age category: back problems for those aged 55 to 64, heart problems in the age category 65 to 74, and heart problems followed closely by nervous system problems for men aged 75 and over.

Exhibit 7.4

Percentage of Canadian Men and Women with Long-Term Activity Limitation or Disability Resulting from a Health Problem, by Selected Age Groups, 1996–97



Source: Statistics Canada. *National Population Health Survey, 1996–97*.

Exhibit 7.5

Primary Condition Responsible for Activity Limitation, Men and Women, by Age, Canada, 1996–97

|                       | Population estimate ('000) | Nervous system (%) | Back problem (%) | Limb problem (%) | Respiratory problem (%) | Arthritis (%) | Heart problem (%) |
|-----------------------|----------------------------|--------------------|------------------|------------------|-------------------------|---------------|-------------------|
| ◆ Age 55 to 64, total | 663                        | 13                 | 18               | 10               | 6                       | 17            | 11                |
| ◆ Male                | 319                        | 11                 | 23               | 11               | 7                       | 9             | 16                |
| ◆ Female              | 344                        | 14                 | 14               | 9                | 6                       | 24            | 7                 |
| ◆ Age 65 to 74, total | 578                        | 10                 | 9                | 6                | 8                       | 21            | 16                |
| ◆ Male                | 272                        | 10                 | 10               | 6                | 10                      | 10            | 20                |
| ◆ Female              | 306                        | 10                 | 9                | 7                | 6                       | 32            | 14                |
| ◆ Age 75+, total      | 585                        | 13                 | 7                | 13               | 6                       | 17            | 13                |
| ◆ Male                | 241                        | 15                 | #                | 13               | 8                       | 11            | 16                |
| ◆ Female              | 344                        | 11                 | 5                | 13               | 5                       | 21            | 12                |

# Data suppressed because of high sampling variability.

Source: Statistics Canada. *National Population Health Survey, 1996–97*, special tabulations.

**Health service utilization:** A wealth of research carried out over the last two decades has shown that the vast majority of care given to older adults — at least three-quarters of it — comes from their informal networks, such as family and friends. Most of this informal care is provided by women, especially daughters and wives.<sup>20</sup>

At the same time, Canada's older citizens understandably continue to rank at or near the top of categories of certain health-care services, including visits to a physician, admissions and lengths of stay in hospitals, use of medications and use of home-care services. While there was a substantial reduction in hospital visits by Canadians over the age of 65 from 1991 (35,233 per 100,000 Canadians) to 1995–96 (30,832 per 100,000 Canadians), reductions in length of stay were slight, probably due to the chronic nature of most older people's health problems.<sup>21</sup>

As Exhibit 7.6 shows, the rates of hospital admissions for older Canadians are substantially greater than those for all Canadians in general, in each diagnostic category except pregnancy (data not shown). The largest differentials occur in the categories for circulatory, respiratory and digestive diseases, injuries and neoplasms. Patterns of utilization also vary substantially for men and women: men had substantially greater numbers of hospital admissions due to circulatory, respiratory and genitourinary diseases, and neoplasms, while women had higher admission rates for injuries and musculoskeletal disorders.

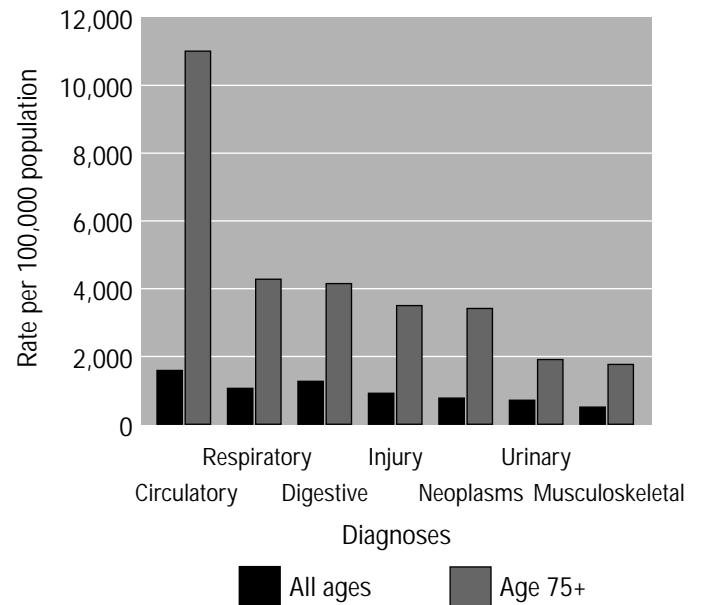
Seniors are the largest consumers of publicly funded home-care services. In 1996–97, 5% of seniors aged 65 to 74 and 17% of those aged 75 and over used home-care services. Women aged 75 and over were the largest consumers of publicly funded home-care services: 20% reported the use of such services. This is not surprising as most women in this age group either provide care to a spouse or live alone, without a partner to care for them. There was a slight reduction in the proportion of seniors receiving publicly funded home-care services from 1994–95 to 1996–97.<sup>22</sup> The extent to which the reduction translated into increased demands on family members has not been determined.

### ***Effects of Other Determinants of Health on Healthy Aging***

**Income:** Data from the 1996–97 NPHS across all age groups show that all three of the previously discussed health status indicators are related to income level: mean scores increase with each successive income level.

Exhibit 7.6

Hospital Separations by Diagnostic Group, Rates per 100,000 Population, All Ages and Age 75+, 1995–96



Source: Canadian Institute for Health Information. *Hospital Morbidity Database, 1995–96.*

**Education:** While education and income are highly correlated, education is also related independently to health status. People with low levels of education tend to have more disabilities and chronic illnesses, regardless of age. Recent research also suggests that a low level of education is a significant predictor of having dementia in old age.<sup>23</sup> While initially this finding was not taken seriously, it is now receiving much attention. As discussed in the previous section, learning and memory depend on connections between nerve cells in various parts of the brain; dementia involves the loss of these connections. Education and ongoing learning enriches these interconnections, creating reserve capacity that may compensate for losses that occur with biological aging.<sup>24</sup>

**Personal health practices:** The potential of active living to prevent the declines associated with biological aging has major implications for maintaining health, mobility and independence in old age. Regular physical activity can reduce risk for back problems and heart disease, which are the two major causes of disability in older men. It also has an important role in the management of arthritis, the number one cause of disability in older women; however, more research on the appropriate use of exercise to manage arthritis is needed. The relationship between physiology and medication use is another area that has received increasing attention in the past several years. Age, size and gender can all affect how the body metabolizes medications. Yet as we saw in Chapter 6, seniors are the most likely of any age group to be prescribed and to use multiple drugs.

**Social support:** There is both theoretical and empirical support for the notion that social support and social ties positively influence health in old age. There is also evidence that social support protects individuals from the negative effects of highly stressful situations such as getting a serious illness. The positive effects of interaction are more apparent for women and vary from one subculture to another.<sup>25</sup> Based on the responses to the 1994–95 NPHS, Statistics Canada recently combined a number of indicators (social participation, contacts with friends, relatives and neighbours, and perceived social support) to determine which groups of Canadians were at increased risk for social isolation. They found that adults over the age of 74 accounted for 74% of those at risk, although they account for only 5% of the population as a whole. Other factors that contributed to a high risk for social isolation included disability, widowhood, having a low level of education, being a newcomer to Canada, and having a cultural background other than French or British.<sup>26</sup> For this reason, some writers consider foreign-born seniors to be victims of double jeopardy. Older ethnic women who are widowed may be triply disadvantaged.<sup>27</sup>

## Discussion

### *Interdisciplinary Research*

This chapter is filled with the hope of what can be achieved by learning more about the relationship between biology and genetics, health status and the other determinants of health. This will require that researchers in social science, epidemiology and biology work together and continue to explore how the findings from the various fields of science are linked. Policy-makers and research-funding bodies need to support and encourage this kind of collaborative work.

## ***New Reproductive and Genetic Technologies***

While a national consensus on how to handle new reproductive and genetic technologies (NRGTs) has not yet emerged, Canadians are clearly looking to the federal, provincial and territorial governments to legislate, regulate, monitor and manage these new technologies in a way that protects and respects those most affected and reflects our collective values and ethics. Thus, governments need to ensure that women of all income levels and races and people with disabilities are fairly represented in consultations, focus groups and public discussions related to the drafting and implementation of regulations, legislation and standards. These groups will be joined by bioethicists and consumer advocates who want to make sure that decisions about the use of NRGTs are grounded in ethics and public health, not commercial interests.

Canada is well placed to play a leadership role in the further development of biotechnology; however, ethical and economic considerations are unavoidable. Would spending more to prevent the known causes of disabilities be a wiser investment than devising more tests to detect fetal conditions and the presence of genes that carry a particular disease? Would increased spending on public health efforts to prevent sexually transmitted diseases and to determine the effects of environmental contaminants on infertility be a wiser investment than rushing toward more high-tech, expensive treatments for infertility? While no one denies the right and need of an infertile couple to seek a solution to their problem, that same couple would have been happier if there had been a way to prevent the problem in the first place.

## ***Brain Development***

Studies in neurobiology have now confirmed that what happens in the first few years of life can have major, long-lasting effects on the capacity of a person to be healthy, to learn and to cope with life's challenges. When optimum conditions for a child's development are provided in the investment phase between conception and age 5, the brain develops in a way that has positive outcomes for a lifetime. This points to the need to provide new parents with adequate social supports during the neonatal and toddler periods, to provide effective prenatal care and treatment for maternal depression, and to support mothers and families who are faced with abandonment, abuse, chronic friction or the psychosocial stresses that are often associated with poverty.<sup>28</sup> It also speaks to the need to educate young people and young parents about the importance of caregiving style and the value of early stimulation, and to help them learn positive parenting skills.

Many children show remarkable resiliency despite exposure to high-risk conditions in the early years. A supportive and stimulating environment combined with loving care from adults in schools and communities can help children achieve positive development outcomes. In the preschool years, opportunities to play with peers and to enjoy stimulating, high-quality preschool or "head start" programs may be particularly important, especially for children from disadvantaged communities (see Chapter 3).

## Promoting Healthy Aging

When it comes to healthy aging, biology is not destiny. Promoting healthy aging means taking action on the broad determinants of health, including socioeconomic status, education and lifelong learning, social support and an active lifestyle. Gender differences need to be taken into account when addressing these determinants and when looking for ways to prevent and reduce activity limitations among seniors. Older women who are poor and live alone, and older adults who are immigrants and refugees are particularly vulnerable to social isolation. Community initiatives to involve and empower these groups are especially important if health inequities are to be reduced.

## Endnotes for Chapter 7

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