

# 4

Chapter

## Diabetes Health Status and Risk Factors

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## Key Messages

- Diabetes mellitus (DM) is the cause of significant burden of illness in Ontario.
- As the prevalence of DM grows, providers need to be prepared to deal with the substantive impact that DM may have on a person's life expectancy and health-related quality of life (HRQOL).
- Providers should be prepared to address the restrictions in activities of daily living and limitations to social participation in the management of DM.
- The increasing evidence of effective DM preventive measures and the large number of people at risk of developing DM suggest that prevention can play an important role in reducing the burden of disease from DM.

## Background

Diabetes mellitus (DM) affects a person's health in many different ways. From the simplest disease perspective, DM results in high blood sugar levels that can lead to vital organ damage. However, current definitions of health consider a broader context—beyond just the absence of disease, health comprises physical, emotional and mental well-being that acts as a resource for everyday living.<sup>1,2</sup>

In this context, high blood sugar levels can influence health in a variety of ways. For many people with DM, sustained high blood sugar levels may affect the function of many organs including the circulatory, nervous and immune systems, eyes, and kidneys. Changes in physical functioning may result in restrictions in the ability to perform activities of daily living, such as housekeeping, shopping, eating or getting dressed. In turn, complications may impair one's ability to participate in social functions and society. For some, the condition may become so severe that they require hospital treatment; for others DM may result in premature death.

This chapter examines the health of people in Ontario with DM from these different perspectives of functional health, restrictions in activities of daily living, and mortality (death). Summary measures are estimated that combine mortality with morbidity (illness) to examine the overall health of people with DM and the proportion of life lived in a healthy state. This chapter also examines lifestyle and sociodemographic factors related to DM and associated chronic diseases.

## Data Sources

The health status information used in this chapter comes from the 1996/97 Ontario Health Survey (OHS II), which comprises the Ontario portion of the National Population Health Survey (NPHS).<sup>3</sup> There were 37,247 respondents in the OHS II; 36,892 of them were 12 years old and over. The response rate at the selected respondent level was 94%. While the OHS II contains a question which asks whether the respondent has DM, this question was not relied upon due to concern that self-reports of DM tend to underestimate the number of people with the disease.<sup>4</sup> Instead, the Ontario Diabetes Database (ODD) (see Chapter 1 Technical Appendix TA1.A) was directly and individually linked to the OHS II. Although 96% of respondents agreed to allow their survey responses to be linked to administrative data, only 23,403 (65.6%) were actually linkable due to technical difficulties. Population estimates for Ontario were generated from this linked sample using special analytic weights provided by Statistics Canada.

Mortality measures were calculated using mortality data from the ODD and Statistics Canada. The Office of the Registrar General is responsible for collecting and maintaining Vital Statistics including death certificates. Records of deaths are transferred to Statistics Canada and the Ministry of Health and Long-term Care (MOHL-TC) in Ontario. Deaths for people with DM in the ODD were estimated by linking vital statistics data to the MOHL-TC's Registered Persons

Database (RPDB). The linking process resulted in approximately 7% under-counting, and the death rates calculated using these data were adjusted to compensate for this (see Technical Appendix TA4.A for details).

## How the analysis was done

In this chapter, the associations between DM and a number of different factors were examined in two different ways. In the first type of analysis, the distribution of socio-demographic characteristics, health status indicators and risk factors among the populations with and without DM were compared. In the second type of analysis, changes in the prevalence of DM across different levels or categories of a risk factor were examined. To illustrate the difference, the table below lists the number of people with and without DM by income level (fictional data).

Income Level	Diabetes	No Diabetes	Total
Low	250	750	1,000
High	150	850	1,000
<b>Total</b>	<b>400</b>	<b>1,600</b>	<b>2,000</b>

The first analysis looks at these fictional data vertically, so the comparison would be: 250/400 or 62.5% of people with DM have low income compared with 750/1600 or 46.9% of those without DM. In the second analysis, the comparisons are done by rows horizontally. In this analysis, 250/1000 or 25% of people with low income have DM compared with 150/1000 or 15% of high-income people.

The risk factors and socio-demographic characteristics examined included age, self-defined ethnic origin, highest level of education attained, adjusted household income, body mass index (BMI) and level of physical activity. With respect to ethnic origin, respondents were assigned to one of five ethnic origin groups based on three survey questions dealing with country of birth, ethnic origin and race, using the algorithm described in the Technical Appendix TA4.A at the end of this chapter. Education was grouped into three categories and income into four categories, adjusted for household size.

BMI is a measure commonly used to determine if an individual is in a healthy weight range. It is calculated by dividing a person's weight in kilograms by the square of their height in metres. A BMI of 20.0 to 24.9 is generally considered to be within the healthy weight range. A person with a BMI of 25.0 to 26.9 has some excess weight, 27.0 to 29.9 is considered overweight and 30.0 is the threshold for obesity. BMI was calculated for everyone over the age of 12, recognizing that BMI scores in the teenage years may not be a good predictor of adult BMI, and that the loss of height among seniors may also result in some loss of validity of BMI for this group.

## Key Research Findings

- The life expectancy of people with diabetes mellitus (DM) in Ontario is about 13 years less than people without DM.
- Twelve per cent of men with DM and 18 per cent of women with DM need assistance with activities such as shopping, cooking and cleaning. This is over twice the likelihood of those without DM.
- Men with DM are three times more likely than men without the condition to report disability as their reason for not working.
- Sixty-nine per cent of people without DM in Ontario have at least one of the following risk factors for type 2 DM: BMI>27, physical inactivity, and low income.
- Although complications such as blindness and amputation are important, most people with DM have a fairly high level of physical functioning.

The analysis of health status included examinations of both mortality and morbidity, beginning with a comparison of the numbers and rates of deaths among people with and without DM. Using life table analyses, the life and health-adjusted life expectancies of people with and without DM were then examined. Finally, the Health-Related Quality of Life (HRQOL) of those with and without DM were compared using a number of indicators, including measures of physical function such as vision and mobility; measures of activity such as activity restriction and impairment (see Technical Appendix TA4.C for a definition of impairment) and measures of social participation such as employment status. For more information on the different health status measures used in this chapter, see Technical Appendix TA4.D.

There is a strong positive association between DM prevalence and age. To examine the associations between DM and other factors independent of age, all analyses were age standardized to the total 1991 Canadian population using the direct method. As well, all analyses, with the exception of those by ethnic origin, were run separately for men and women. The analyses by ethnic origin were not stratified by sex due to small cell sizes and high sampling variability.

Life and health expectancy measures used age- and sex-specific mortality rates from both the ODD and Statistics Canada. An adapted version of Chaing's method was used for life table calculations.<sup>5</sup> The life table template that was used for the analysis is available at: <http://www.cehip.org>. Health-adjusted life expectancy was calculated using a modified Sullivan method and the Health Utilities Index 3 (see Technical Appendix TA4.D).<sup>6,7</sup>

## Interpretative Cautions

The OHS II excludes people living in long-term care facilities, remote communities and on reserves; therefore, estimates from these surveys should not be interpreted to represent the entire population. This is especially important in the case of DM, since DM prevalence is higher among the Aboriginal population and the elderly. The OHS II was a self-report survey and therefore the questions may be subject to differing interpretation by individual respondents. In addition, linkage was only possible for 66.5% of those who gave permission for their data to be linked. However, while there are some differences between the linkable and total samples, these do not appear to be systematic.<sup>8</sup>

Data from cross-sectional studies such as the OHS II generally do not yield accurate estimates of risk because they measure a person's current health practices, which may have changed as a result of being diagnosed with the condition. Ideally, people with DM make lifestyle changes to reduce complications from the

disease; therefore current prevalence estimates may not reflect the lifestyle risks present before they developed the disease.

## Findings and Discussion

### Sociodemographic Characteristics

Exhibit 4.1 shows the sociodemographic characteristics of people with and without DM in Ontario. About 60 per cent of Ontarians with DM are over the age of 55 years compared to less than 25 per cent for the rest of the population. The older age of people with DM and increasing prevalence with age (see also Exhibit 4.6) is typical of many chronic diseases. A greater proportion of people with DM have less than a high school diploma, even after controlling for age, and they are more likely to be in the low-income category. The latter is particularly true for women, with 21 per cent of females with DM classified as low income compared to only 10 per cent for those without DM. The exact reasons for this association between DM and low socio-economic status (SES) are not known but may be related to a higher prevalence of risk factors such as obesity and sedentary lifestyle (see section on Diabetes Risk Factors) among people in lower SES groups.

### Mortality, Life and Health Expectancy

Death from DM can be measured in two ways. First, physicians complete death certificates that identify the main underlying cause of death. Thus, DM will only be identified in cause of death statistics when a physician believes DM is the most important disease related to an individual's death.<sup>9,10</sup> Since people with DM often die from other related conditions such as heart disease, death certificates likely under-represent the burden of mortality from DM. For this reason, deaths were also examined from all causes in people who were diagnosed with DM (people identified with DM in the ODD). This number may also under-represent the burden of DM since many people die without ever being diagnosed with or treated for DM. In Ontario in 1997, 18,320 people, or almost one quarter of all people who died, had DM (see Exhibit 4.2). However, only 12.5 per cent of people dying with DM were identified as dying from DM on their death certificates.

The age-standardized mortality rate for people with DM is more than twice that of people without the disease (see Exhibit 4.2). This increased death rate translates into a life expectancy of 64.7 years for men with DM compared with 77.5 years for those without the disease (Exhibit 4.3). For women, life expectancy is only 70.6 years for those with DM, compared with 82.9 years for those without the disease. The difference in life expectancy is about 13 years for both men and women. Put another way, the chances of men and women with DM surviving to age 65 years of age are 60 and 71 per cent respectively, compared to 83 and 90 per cent for men and women without DM.

### Exhibit 4.1 Distribution of Socio-demographic Characteristics Among Ontarians with/without DM, 1996–1997

Sixty-one per cent of people with DM are 55 years or older. Twenty-one per cent of women with DM have a low income.

	MEN						WOMEN					
	With DM			Without DM			With DM			Without DM		
	N <sup>2</sup> (unwtd)	N <sup>3</sup> (wtd)	% (wtd)	N <sup>2</sup> (unwtd)	N <sup>3</sup> (wtd)	% (wtd)	N <sup>2</sup> (unwtd)	N <sup>3</sup> (wtd)	% (wtd)	N <sup>2</sup> (unwtd)	N <sup>3</sup> (wtd)	% (wtd)
<b>Age</b>												
12–39	78	40,920	12.8	4,916	2,331,855	54.9	100	46,277	16.9	5,300	2,299,996	51.4
40–54	196	85,218	26.6	2,444	1,062,570	25.0	148	64,826	23.7	2,557	1,095,743	24.5
55–69	338	119,093	37.2	1,636	574,374	13.5	266	81,905	29.9	2,033	665,569	14.9
70+	251	74,738	23.4	916	282,488	6.6	293	80,608	29.5	1,591	418,159	9.3
<b>Highest Level of Education<sup>1</sup></b>												
College/University Graduation	223	91,588	33.6	3,043	1,428,049	33.5	162	61,980	28.5	3,735	1,439,909	31.9
High School Graduation+	254	97,707	32.3	3,441	1,480,259	35.2	261	92,177	37.6	4,316	1,676,009	37.5
< High School Graduation	366	122,739	34.2	3,343	1,296,068	31.4	377	117,903	33.9	3,364	1,332,369	30.6
<b>Adjusted Household Income<sup>1</sup></b>												
High	94	26,193	13.1 <sup>a</sup>	316,757	684	15.6	188	53,909	8.2 <sup>a</sup>	1,686	457,582	14.2
Upper-middle	248	84,716	26.6	804,118	1,736	30.0	232	66,200	23.3	2,761	931,365	27.3
Low-middle	262	88,888	29.5	1,279,966	2,764	19.1	188	64,312	23.7	3,450	1,233,493	21.1
Low	105	37,192	5.4 <sup>a</sup>	673,007	1,453	7.5	48	17,684	21.0	1,500	647,182	10.4
Unknown	154	82,980	25.9	1,177,439	2,542	27.7	151	71,511	26.1 <sup>a</sup>	2,084	1,209,844	27.0
<b>TOTAL POPULATION</b>												
<b>Ethnic Origin<sup>1</sup></b>												
Canadian/US	370	119,853	24.6	6,523	2,585,886	30.1						
European	1,048	329,172	44.4	12,055	4,515,142	52.2						
Aboriginal/Black/ Latin American	46	17,735	3.8 <sup>a</sup>	406	222,980	2.6						
South or West Asian	55	47,473	12.1	401	338,007	3.9						
Other	139	73,169	15.1	1,786	972,028	11.2						

<sup>1</sup>Standardized to the 1991 Canadian population.

<sup>2</sup>The unweighted (unwtd) N refers to the number of survey respondents (actual observations).

<sup>3</sup>The weighted (wtd) N is the survey sample weighted up to the community dwelling Ontario population (does not include people in institutions, living in remote communities, on reserves, or in the Armed Forces). All analyses in this chapter have been carried out on the weighted data.

<sup>a</sup>Estimates should be treated with caution due to high sampling variability (coefficient of variation between 16.5–33.0).

Sources: 1996/97 Ontario Health Survey (OHS II), Ontario Diabetes Database (ODD)

**Exhibit 4.2 Mortality Rates in Ontarians with/without DM, 1996–1997**

The death rate (age-adjusted) for people with DM is more than twice as high as that for people without DM.

	Male			Female			Total		
	Without DM	With DM	Rate Ratio	Without DM	With DM	Rate Ratio	Without DM	With DM	Rate Ratio
Population 1997	5,365,841	232,553	--	5,515,006	216,658	***	10,880,847	449,211	--
Deaths, All-cause	31,022	9,646	--	29,900	8,750	***	60,922	18,396	--
Crude Death Rate (per 100,000) <sup>1</sup>	578	4,148	7.2	542	4,039	7.4	560	4,095	7.3
Age-adjusted Death Rate (per 100,000) <sup>1,2</sup>	588	1,369	2.3	533	1,315	2.5	559	1,358	2.4

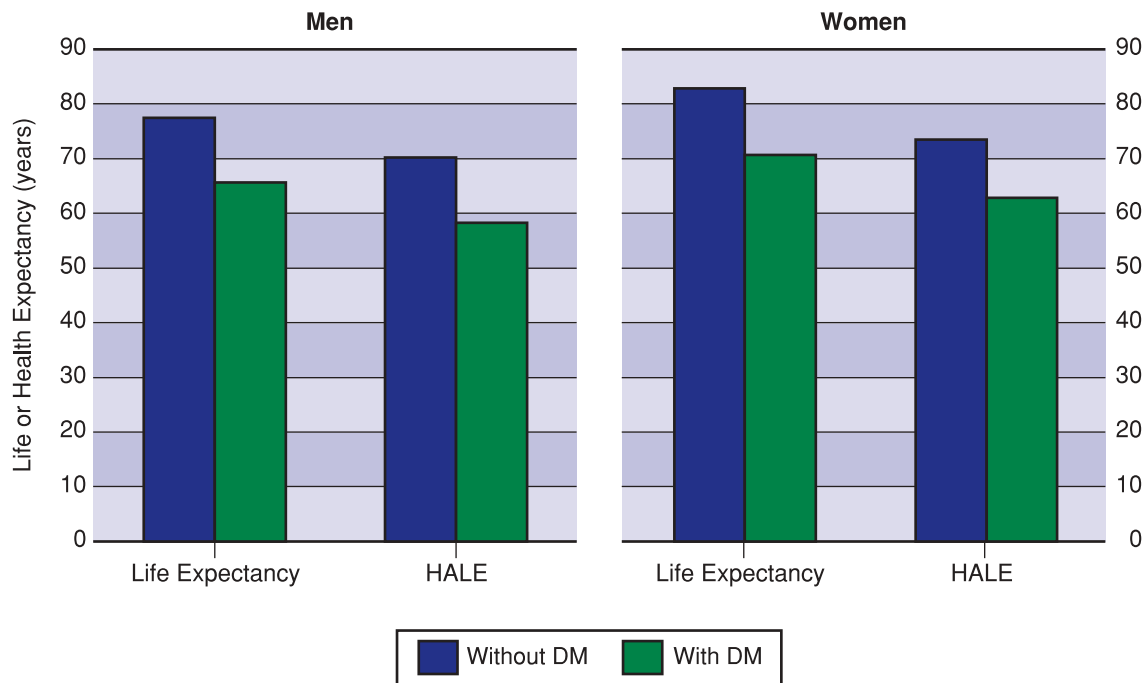
<sup>1</sup> Crude and age-adjusted rates calculated for all-cause mortality.

<sup>2</sup> Rates age-adjusted to 1991 Canadian population.

Sources: Ontario Diabetes Database (ODD), Registered Persons Database (RPDB), Statistics Canada

**Exhibit 4.3 Differences in Life and Health-adjusted Life Expectancy (HALE) in Ontarians with/without DM by Sex, 1996–1997**

Life expectancy for people with DM is 13 years less than those without DM. Health-adjusted life expectancy, the amount of life lived in good health, for people with DM is 12 years less those people without DM.



Sources: Ontario Diabetes Database (ODD), 1996/97 Ontario Health Survey (OHS II), Registered Persons Database (RPDB), Statistics Canada

### Exhibit 4.4 Impact of Eliminating DM on Life and Health-adjusted Life Expectancy (HALE) in Ontarians by Sex, 1996–1997

If DM were eliminated, life expectancy would rise 2.7 years and HALE would rise 1.0 years.



Sources: Ontario Diabetes Database (ODD), 1996/97 Ontario Health Survey (OHS II), Registered Persons Database (RPDB), Statistics Canada

Exhibit 4.4 shows that overall life expectancy in Ontario would be 2.7 years longer for both men and women if excess deaths among people with DM were eliminated. This estimate assumes that once these excess deaths were eliminated, the death rates of people who would have died from DM-related causes would become equivalent to that of other Ontarians of the same age and sex. Gains in life expectancy from eliminating DM-related deaths might be even larger if the deaths were prevented through a reduction in the prevalence of such risk factors as poor diet, obesity and lack of physical activity designed to prevent DM, because such a change could also reduce deaths from chronic conditions such as heart disease among people without DM. Conversely, if the DM-related deaths were reduced or eliminated primarily through improvements in medical or hospital care that target diabetic complications, the gains in life expectancy might actually be smaller, since people would continue to suffer from other chronic conditions related to DM lifestyle risks.

Health-adjusted life expectancy (HALE) is a measure that combines both mortality and morbidity by adjusting years of life

expectancy according to the amount of time spent in less than perfect health. HALE was 58.3 years for men with DM, compared to 70 years for those without; and 63.8 years for women with DM compared to 73.5 years for those without (Exhibit 4.3).

The ratio of HALE to life expectancy is the proportion of life spent in good health. For men and women with DM, these proportions were 90 and 89 per cent, respectively. Men and women without DM can expect to spend similar proportions of their lives in good health. The fact that the proportion of life spent in good health is very similar for people with and without DM suggests that the impact of DM on length of life is similar to or slightly larger than its impact on years of healthy life. The proportion of life spent in good health for people with DM is similar to that of people with heart disease and cancer, although there is a larger burden of mortality and morbidity from these diseases. Disease such as arthritis and depression result in a lower proportion of life spent in good health, but the impact on life expectancy from these diseases is much lower than that of DM.

It is important to not only add “years to life”, but also add “life to years”, meaning improvements in life expectancy should ideally be accompanied by improvements in health-related quality of life (HRQOL).<sup>10</sup> Efforts to reduce diseases that are fatal will add “years to life”; reducing diseases that affect HRQOL will add “life to years”. Because diseases such as arthritis and mental health largely affect HRQOL, more so than mortality, reducing or eliminating them will mostly add “life to years”. Since diseases such as DM, cancer and heart disease impact life expectancy more than HRQOL, reducing these diseases has the potential of adding more “years to life” than “life to years”. Given the present burden of disease, eliminating DM will extend Ontario life expectancy by 2.7 years, but less than half of this time would be in a healthy state (1.0 years). The potential for extending life expectancy without correspondingly large increases in HALE results in a greater number of years lived in poor health and is referred to as an “expansion of morbidity”.<sup>11</sup> In Ontario, there has been an overall contraction of morbidity.<sup>10</sup> Although we do not know why HALE has been increasing faster than life expectancy, it is likely from a combination of overall reduction in the age-standardized prevalence of chronic diseases, in particular heart disease in both men and women and cancer in men, and an increasing availability of health care interventions that either delay the progression of disease or focus on improving HRQOL. Because many preventative and health care interventions for DM target HRQOL, it is possible that addressing the health needs of persons with DM will result in greater improvements in HALE than life expectancy.

### Health-related Quality of Life (HRQOL)

Life expectancy and health-adjusted life expectancy paint a broad picture of the health of people with DM. It is also important to understand the impact of DM on day-to-day living. A new framework developed by the World Health Organization divides HRQOL into overlapping domains that begin at the level of the body’s physiological or psychological function and extend to an individual’s participation in real life situations.<sup>10</sup>

Exhibit 4.5 shows that people with DM generally reported moderately higher levels of major functional limitation compared to those without DM. For example, people with DM have a much higher risk of being disabled and impaired. Twenty per cent of men with DM and 15 per cent of women with DM reported having a long-term disability. Impairment takes into account both the need to restrict one’s activities due to a long-term health problem and need for assistance with various activities of daily living. Twenty-five per cent of men with DM and 19 per cent of women with DM reported that they restrict their activities either at home, school, work or leisure. While the age-adjusted proportion of the population 20–64 years of age currently working was 74 per cent for men without DM, it was only 67 per cent for those with the disease.

The proportions for women were 62 per cent and 43 per cent, respectively. Women with DM were more than three times more likely than men without DM to report disability or illness as the reason they were not currently working.

People with DM were about twice as likely to rate their health as fair or poor compared to non-diabetic individuals. Self-rated health is a useful measure because it allows people to gauge their health from their own perspective. Studies have shown that functional status is one of the main criteria used by individuals to rate their health, but that self-rated health is also influenced by a person’s judgment about the severity of current illness, personal resource to maintain well-being, health behaviour, and family health history.<sup>9</sup> Self-rated health is strongly predictive of future health, including the likelihood of dying.<sup>12</sup>

Commonly, medical tests and other examinations evaluate organ and body function. The broader measures of HRQOL such as impairment, self-rated health, and social participation often indicate a larger burden of disease than the measures of body function. Thus, medical examinations and tests may underestimate the impact of DM on health. These findings suggest that having DM results not only in increased medical needs, but also in increased need for non-medical resources such as assistive devices and home care to ensure that people with DM are able to maximize their participation in society. It is not known to what degree people with DM are receiving the help they need; however, in Canada it is estimated that half the people with limitations in activities of daily living have unmet needs for health-related personal assistance.<sup>13</sup>

### Diabetes Risk Factors

A number of important risk factors for DM have been identified, some of which can be modified while others cannot. Among the non-modifiable risk factors is ethnic origin (Exhibit 4.6). It is believed that some ethnic groups are more likely to have a “thrifty” gene that helps store body energy reserves for times of famine.<sup>14</sup> This predisposition may have had a historical evolutionary advantage in societies that were affected by wide seasonal variations in food availability. However, in recent years there has been an increase in obesity in most developed and many developing countries which, in turn, has contributed to a particularly high DM prevalence in some ethnic groups.<sup>15</sup> For example, people of South or West Asian origin make up only 3.9 per cent of the non-diabetic Ontario population, but 12 per cent of the population with DM (Exhibit 4.1). A similarly high prevalence of DM is seen in North American aboriginal communities;<sup>16</sup> however, it was not possible to examine this particular link due to the small number of aboriginal respondents in the OHS II survey (see section on Interpretive Cautions).

Exhibit 4.5 Health-related Quality of Life of Ontarians with/without DM, 1996–1997<sup>1</sup>

DM has a larger impact on social participation and the ability to live an active life—especially for men—than it does on physical function.

	MEN			WOMEN		
	Prevalence among those with DM (%)	Prevalence among those without DM (%)	Prevalence Ratio <sup>2,3</sup>	Prevalence among those with DM (%)	Prevalence among those without DM (%)	Prevalence Ratio <sup>2,3</sup>
<b>Measures of Physical Functioning</b>						
Vision (% with vision problems not corrected by lenses)	1.9 <sup>a</sup>	1.7	1.1	4.4 <sup>a</sup>	2.4	1.8
Mobility (% with mobility problems)	4.1	2.5	1.6*	4.9	3.1	1.6*
Dexterity (% with dexterity problems)	1.0 <sup>a</sup>	0.6	1.6	1.3 <sup>a</sup>	1.0	1.4
Pain (% reporting chronic pain)	13.6 <sup>a</sup>	9.8	1.4	17.3	12.7	1.4
<b>Measures of Mental/Psychological Functioning</b>						
Emotion (% reporting less than perfect emotional state)	17.5	14.4	1.2	20.3	14.1	1.4*
Cognition (% reporting less than perfect cognition)	17.5 <sup>a</sup>	17.9	1.0	21.3	20.9	1.0
<b>Distress Level</b>						
None	39.3	41.3	1.0	25.3	34.8	0.7**
Low	21.8	27.3	0.8	24.7	27.2	0.9
Medium	24.4 <sup>a</sup>	21.1	1.2	22.8	23.3	1.0
High	14.5 <sup>a</sup>	10.3	1.4	27.3	14.7	1.9**
<b>Measures of Activity</b>						
Has Long-term Disability (lasting six months or more)	20.3	8.5	2.4**	15.1	9.6	1.6**
Needs Assistance with Basic Activities of Daily Living	2.3 <sup>a</sup>	1.4	1.6	2.9 <sup>a</sup>	1.9	1.6
Needs Assistance with Instrumental Activities of Daily Living	12.3	5.6	2.2**	17.9	10.0	1.8**
<b>Level of Impairment</b>						
None	72.4	87.3	0.8**	74.7	83.5	0.9**
Mild	16.9	7.8	2.2**	13.0	8.4	1.6*
Moderate	9.0 <sup>a</sup>	3.6	2.5**	9.5	6.3	1.5*
Severe	1.7 <sup>a</sup>	1.3	1.3	2.8 <sup>a</sup>	1.8	1.6
<b>Measures of Social Participation</b>						
Restriction of Normal Activities	25.4	11.7	2.2**	19.4	14.3	1.4**
<b>Current Working Status (those less than 70 years of age only)</b>						
Currently working	66.5	74.1	0.9	43.3	61.5	0.7**
Not working—illness/disability	10.5 <sup>a</sup>	3.0	3.5**	7.9	3.7	2.1*
Not working—family responsibilities	---	---	---	25.9	11.7	2.2**
Not working—other reasons	23.0 <sup>a</sup>	22.6	1.0	22.9	23.1	1.0
<b>Global Measures of Health Status</b>						
Self-Rated Health of "Good" or more	84.8	92.1	0.9**	80.7	90.9	0.9**
Mean Health Utilities Index Score	0.896	0.924		0.886	0.909	

<sup>1</sup>All estimates age standardized to the 1991 Canadian population. <sup>2</sup>Prevalence ratio is the ratio of the prevalence of each characteristic among those with DM to the prevalence among those without. <sup>3</sup>\* = p<.05; \*\* = p<.005. <sup>a</sup>Estimate should be treated with caution due to high sampling variability (coefficient of variation between 16.5–33.0).

Sources: Ontario Diabetes Database (ODD), 1996/97 Ontario Health Survey (OHS II)

Exhibit 4.6 Risk Factors Associated with DM in Ontario, 1996–1997<sup>1</sup>

Obesity and increasing age are the two most important risk factors associated with DM. Obesity is the most important modifiable risk factor associated with DM.

	MEN		WOMEN	
	DM Prevalence Rate (%)	Prevalence Ratio <sup>2,3</sup>	DM Prevalence Rate (%)	Prevalence Ratio <sup>2,3</sup>
<b>Age (years)</b>				
12–39 <sup>2</sup>	1.7	1.0	2.0	1.0
40–54	7.4	4.3**	5.6	2.8**
55–69	17.2	10.0**	11.0	5.6**
70+	20.9	12.2**	16.2	8.2**
<b>Highest Level of Education</b>				
College/University Graduation <sup>2</sup>	5.7	1.0	4.4	1.0
High School Graduation +	6.3	1.1	5.3	1.2
< High School Graduation	7.6	1.3*	7.2	1.6**
<b>Adjusted Household Income</b>				
High <sup>2</sup>	5.5	1.0	2.6 <sup>a</sup>	1.0
Upper-middle	6.4	1.2	5.1	2.0*
Low-middle	8.0	1.5*	6.0	2.3*
Low	7.9	1.4	9.9	3.8**
<b>Body Mass Index (ratio of height to weight; kg/m<sup>2</sup>)</b>				
<20	2.4 <sup>a</sup>	0.6*	--- <sup>a</sup>	---
20–24.9 <sup>2</sup>	4.4	1.0	3.3	1.0
25–26.9	5.2	1.2	4.8	1.5*
27–29.9	7.5	1.7**	8.3	2.5**
30+	12.3	2.8**	13.0	4.0**
<b>Physical Activity</b>				
Active <sup>2</sup>	5.2	1.0	4.1	1.0
Moderately Active	5.5	1.0	4.5	1.1
Inactive	7.4	1.4*	6.2	1.5
<b>Alcohol Consumption (Type of Drinker)</b>				
Regular Drinker <sup>2</sup>	5.2	1.0	2.7	1.0
Occasional Drinker	7.3	1.4*	6.1	2.3
Former Drinker	9.4	1.8**	8.4	3.1
Abstainer	10.6	2.0**	8.7	3.2
	<b>TOTAL POPULATION</b>			
	DM Prevalence Rate (%)	Prevalence Ratio <sup>2,3</sup>		
<b>Ethnic Origin</b>				
Canadian/US <sup>2</sup>	5.2	1.0		
European	5.5	1.1		
South or West Asian	14.1	2.7**		
Aboriginal, Black or Latin American	8.9 <sup>a</sup>	1.7*		
Other	7.2	1.4*		

<sup>1</sup>Standardized to the 1991 Canadian population. <sup>2</sup>Reference category. Prevalence ratio is the ratio of all other categories to the reference category. <sup>3</sup>\* = p<.05; \*\* = p<.005. <sup>a</sup>Estimate should be treated with caution due to high sampling variability (coefficient of variation between 16.5–33.0). <sup>b</sup> Estimate not reportable due to coefficient of variation > 33.0

Sources: Ontario Diabetes Database, 1996/97 Ontario Health Survey (OHS II)

### Exhibit 4.7 Selected Conditions and Risk Factors Among Ontarians with/without DM, 1996–1997<sup>1</sup>

People with DM commonly have other related health conditions and risks.

	MEN			WOMEN		
	Prevalence among those with DM (%)	Prevalence among those without DM (%)	Prevalence Ratio <sup>2,3</sup>	Prevalence among those with DM (%)	Prevalence among those without DM (%)	Prevalence Ratio <sup>2,3</sup>
Hypertension	18.8	8.0	2.3**	22.8	10.0	2.3**
Heart Disease	9.3	3.8	2.5**	6.5	3.5	1.8**
Depression	3.6 <sup>a</sup>	2.5	1.5	8.3 <sup>a</sup>	5.3	1.6
Obesity						
BMI 27.0–29.9	20.2	19.3	1.0	18.2	10.1	1.8*
BMI >30	26.7	11.4	2.3**	30.5	9.8	3.1**
Smoking						
Current Smoker	26.5	28.2	0.9	22.1	23.1	1.0
Former Smoker	32.5	30.4	1.1	20.8	25.6	0.8*
Never Smoker	41.0	41.3	1.0	57.1	51.3	1.1
Multiple Risk Factors (BMI>27, Physical Inactivity, Low Income)						
At Least One Risk Factor	80.2	66.6	1.2**	87.0	67.4	1.3**
One Risk Factor	47.7	46.3	1.0	49.6	49.5	1.0
Two Risk Factors	30.5	19.2	1.6**	30.3	16.5	1.8**
All Three Risk Factors	2.1 <sup>a</sup>	1.1	1.8	7.1 <sup>a</sup>	1.4	5.2**

<sup>1</sup>Standardized to the 1991 Canadian population. <sup>2</sup>Prevalence ratio is the ratio of the prevalence in those with DM to the prevalence in those without DM. <sup>3</sup>\* = p<.05; \*\* = p<.005. <sup>a</sup>Estimate should be treated with caution due to high sampling variability (coefficient of variation between 16.5–33.0).

Sources: Ontario Diabetes Database (ODD), 1996/97 Ontario Health Survey (OHS II)

Important modifiable risk factors for the development of type 2 DM include obesity, lack of physical exercise and diet. Results from the Nurses Health Study, a prospective study of 120,000 female nurses that began in 1976, found the group defined as low risk on all three risk factors (BMI<25, 30 min/day of vigorous exercise and a diet high in fibre and low in saturated fat and sugar) had an incidence of type 2 DM that was approximately 90 per cent lower than the rest of the study population.<sup>17</sup> Recent randomized clinical trials in Finland,<sup>18</sup> China<sup>19</sup> and the United States<sup>20</sup> have found that modification of some or all of these risk factors, and modest weight loss in particular, can be effective in preventing type 2 DM, at least among individuals with impaired glucose tolerance.

Associations between DM and obesity and lack of physical activity were also found in these data. The prevalence of DM increased with BMI and decreasing exercise (Exhibit 4.6). Of perhaps even more concern, approximately 67 per cent of the Ontario population without DM has one or more modifiable risk factors for the disease (Exhibit 4.7).

These results also suggest an association between DM and income, particularly for women. The prevalence of DM in the lowest income category was nearly four times higher than

in the highest category. In addition, this analysis suggested that moderate alcohol consumption might offer some protective benefit, a finding also noted in the Nurses Study and elsewhere.<sup>21,22</sup>

### Other Conditions and Risk Factors

Diabetes is best thought of not as a single disease but as a collection of metabolic and lifestyle conditions that in combination result in damage to many vital organs.<sup>23–25</sup> Exhibit 4.7 shows that 19 per cent of men and 23 per cent of women with DM report that a doctor diagnosed them with high blood pressure, compared with 10 per cent or less of non-diabetic individuals (prevalence ratio = 2.3 for both sexes). Furthermore, 9.3 per cent of men with DM and 6.5 per cent of women with DM reported that they had heart disease (Prevalence Ratio = 2.5 and 1.8 respectively compared to people without DM).

Living with a chronic condition such as DM can also contribute to increased psychological difficulties. Men and women with DM were at 50–60 per cent greater risk of having had a depressive episode (Exhibit 4.7) and were also more likely than those without DM to be experiencing high levels of distress.

Smoking is one of the most important risk factors for heart disease, peripheral vascular disease and lower extremity amputations. Exhibit 4.7 shows that people with DM frequently smoke and that there is no difference in rates of smoking between people with and without DM.

### Differences Between Men and Women

This analysis shows that there are a number of differences in both health outcomes and risk factors between men and women. Compared to men, women who have DM are older and live longer, but are much more likely to have lower income and generally have a lower HRQOL. The combined effect of mortality and morbidity is a narrowing of the gender difference in HALE. However, the gender difference in HRQOL varies depending on which measure is used. In the general population, women tend to score lower on measures of activity limitation and social participation; however, this difference is narrowed or reversed in people with DM. For example, more men with DM report having a long-term disability or activity restriction compared to women with DM. With respect to risk factors, the most notable difference is a higher prevalence of obesity among women with DM compared to men with DM.

## Conclusions

DM has a major impact on the health of people with the disease. Life expectancy is much lower, reflecting not only the deaths from DM, but also from related diseases and complications such as heart disease. However, DM not only affects length of life, but also HRQOL. In particular, people with DM have a higher need for assistance with activities of daily living.

A high BMI, physical inactivity and low income are strong, modifiable risk factors for type 2 DM. Low income, obese women are particularly at risk. Trends in the prevalence of such risk factors over time will undoubtedly affect the future incidence and prevalence of DM in Ontario. For example, studies of obesity report that its prevalence has been increasing over time, suggesting that the prevalence of DM will also continue to increase.<sup>26</sup> Even more worrisome are the changes in risk factors among children and youth.<sup>27</sup> Some people worry that the increase in childhood obesity and low levels of physical activity will be the public health epidemic of the 21st century.<sup>28,29</sup> Already there is an increase in type 2 DM in young people, especially in native children.<sup>30,31</sup>

Through an examination of the health status and modifiable risk factors of people with DM, this chapter also provides some insight into different ways to reduce the burden of disease from type 2 DM. Broadly speaking, this involves a three-pronged approach: primary (disease) prevention, which targets risk factors so as to delay or prevent the onset of disease; secondary prevention, which aims to slow the progression of disease and

lessen complications; and supportive care, the purpose of which is to improve the ability of people with diabetic complications to live a rewarding life. For instance, as the results from clinical trials have demonstrated, relatively small improvements in risk factors have the potential to delay or even prevent the onset of type 2 DM and subsequent related chronic conditions such as heart disease.<sup>18,20,26</sup> In Ontario, the province's Chief Medical Officer of Health recently published a report outlining a public health strategy for the prevention of DM.<sup>32</sup> In addition to reducing the incidence of DM, another benefit of a preventive approach that targets lifestyle risks is a reduction in other related conditions such as heart disease.

For those who develop DM, medical and health care services first focus on maintaining healthy blood sugar levels in order to reduce the severity and progression of disease and to prevent or minimize complications. For those with complications, the goal is to prevent premature mortality and to minimize limitations in activities and social participation. In this way, health interventions for DM are designed to both reduce mortality and improve HRQOL. The final component necessary for reducing the impact of DM is adequate supportive care for those with complications. As the prevalence of DM grows, so too will the need for personal assistance from programs such as home care. This is already an area of urgent need.<sup>13</sup>

This chapter demonstrated that DM is the cause of significant burden of illness in Ontario. However, a balanced approach as outlined above has the potential to reduce this burden by reducing the number of new cases, reducing mortality among those with the disease and enabling those living with DM to participate fully in their communities.

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## Technical Appendices (Exhibits TA4.A, TA4.B, TA4.C and TA4.D)

### Diabetes Health Status and Risk Factors

#### Exhibit TA4.A Methods, Definitions and Algorithm

## Methods

### Adjustment for Undercounting of Deaths in the Registered Persons Database (RPDB)

When the number of deaths in Ontario in Fiscal 1997 according to the RPDB was compared with the numbers reported by Statistics Canada, the RPDB total was lower by approximately 7 per cent. Taking the Statistics Canada numbers as the 'gold standard', an adjustment factor consisting of the ratio of StatsCan deaths to RPDB deaths was calculated for each 5-year age-sex group in the total population. These adjustment factors were then applied to the RPDB subpopulations with and without DM.

## Definitions

### Depression

Based on the work of Kessler and Mroczek (from the University of Michigan), the 1997 Ontario Health Survey II contains a subset of questions from the Composite International Diagnostic Interview (CIDI) that measure the probability of having had a major depressive episode.<sup>1</sup> For this analysis, respondents are considered to have had a depressive episode if the probability is 0.9 or greater.

### Distress

The OHS II also includes a subset of questions from the CIDI designed to identify psychological distress. The questions yield a score between 0 and 24, with a higher score indicating more distress. For this analysis, the scores were then grouped into four categories: none (0), low (1–2), medium (3–5), high (6–24).

### Health-Adjusted Life Expectancy

Health-adjusted life expectancy (HALE) is life expectancy weighted or adjusted for the level of health-related quality of life (HRQOL). In this analysis HALE was estimated by the period life table approach<sup>2</sup> using a modified Sullivan method.<sup>3</sup> Age-specific life-years lived were weighted by the age-specific mean Health Utilities Index 3 (HUI 3) 4 scores, which were obtained from the OHS II. As there were few respondents under 10 years of age and the OHS II only contains HUI 3 scores for those over four years of age, the Canadian HUI 3 estimates for ages four to nine years were used for all ages under 10.

## Ethnic Origin

There is no "gold standard" for assigning an individual to an ethnic group or for determining someone's ethnicity as part of a population-based survey. Canadian population-based surveys and the census tend to take an open-ended approach, allowing individuals to 'self-define' their ethnic origins and then developing categories based on the range of responses. In the OHS II, information on ethnicity is available from five questions in which respondents were asked to give their country of birth, their "ethnic origins" (multiple responses accepted), the languages in which they are able to conduct a conversation, their first language learned and still understood, and their "race or colour." All questions were asked in an open-ended manner, but the responses were slotted into predetermined categories. In this study, the classification algorithms outlined in Exhibits TA4.A and TA4.B were used to assign each individual to an ethnic group primarily on the basis of the "ethnic origin" question, but in some cases also on the "country of birth" and the "race or colour" questions. The initial classification had 10 categories, but small numbers of diabetic individuals in some groups forced a final re-aggregation into five categories: Canadian/US, European, South or West Asian, Aboriginal/Black/Latin American and Other. Of the 23,063 in the linked sample, 234 (1.1%) did not respond to the questions and a further 558 (2.5%) could not be classified.

## Level of Impairment

Level of impairment is determined based on two variables: the presence of long-term activity restriction and the need for assistance with activities of daily living. Four levels of impairment were defined using the algorithm presented in Exhibit TA4.C.

## References

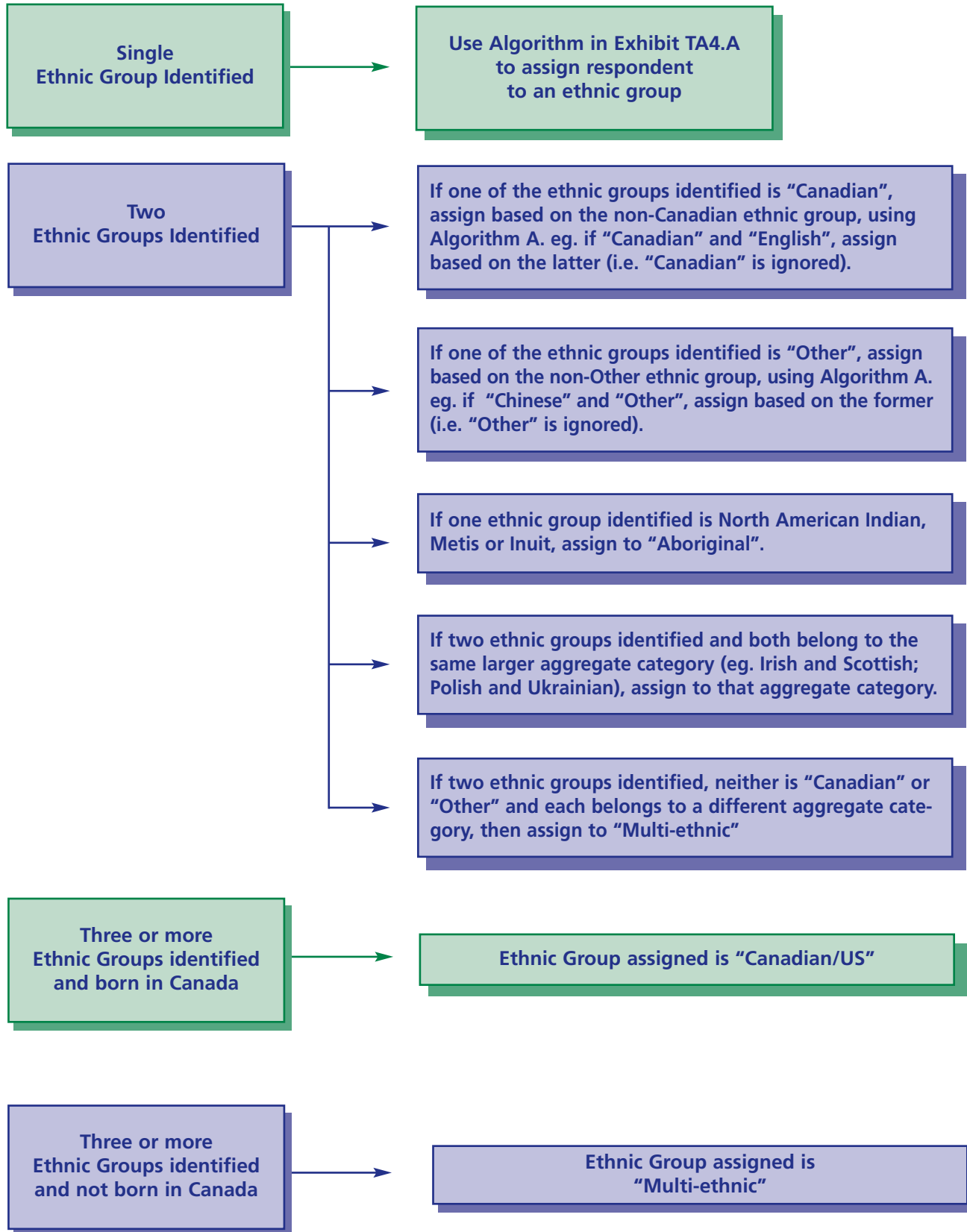
1. Statistics Canada. 1996–97 NPHS Public Use Microdata Documentation. Ottawa; 1999.
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Exhibit TA4.A (Cont'd) Algorithm Used to Assign OHS II Respondents to a Single Ethnic Group

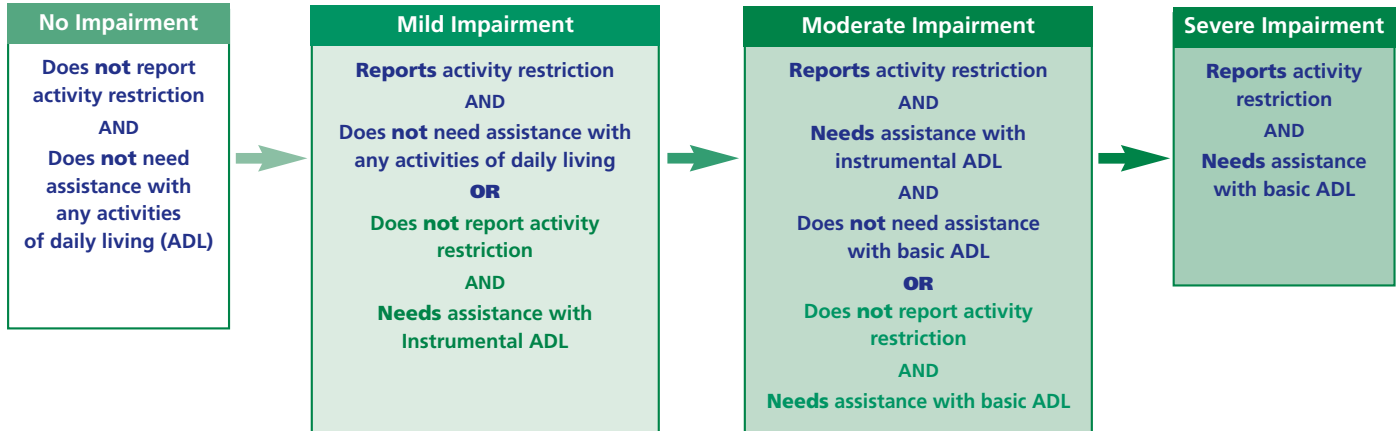
Possible Ethnic Groups (sdc6_4a-s)+ (may select more than 1)	Country of Birth* (sdc6_1)	Race* (sdc6drac)	Ethnic Group 1 (10 categories)	Final Aggregations (5 categories)
Canadian			Canadian/US	Canadian/US
North American Indian Métis Inuit/Eskimo			Aboriginal	Aboriginal/Black/Latin American
French English German Scottish Irish Dutch (Netherlands)			Northern/Western European	European
Italian Ukrainian Polish Portuguese			Southern/Eastern European	European
Chinese			East Asian	Other
South Asian			South/West Asian	South or West Asian
Jewish			Jewish	Other
Black			Black	Aboriginal/Black/Latin American
Other:	Country of Birth* (sdc6_1)			
	Canada		Canadian/US	Canadian/US
	China		East Asian	Other
	France		Northern/Western European	European
	Germany		Northern/Western European	European
	Greece		Southern/Eastern European	European
	Guyana		Caribbean/South Am/ Central Am/ Latin Am.	Aboriginal/Black/Latin American
	Hong Kong		East Asian	Other
	Hungary		Southern/Eastern European	European
	India		South/West Asian	South or West Asian
	Italy		Southern/Eastern European	European
	Jamaica		Caribbean/South Am/ Central Am/ Latin Am.	Aboriginal/Black/Latin American
	Netherlands/Holland		Northern/Western European	European
	Philippines		East Asian	Other
	Poland		Southern/Eastern European	European
	Portugal		Southern/Eastern European	European
	United Kingdom		Northern/Western Europe	Europe
	United States		Canadian/US	Canadian/US
	Vietnam		East Asian	Other
	Other:	Race* (sdc6drac)		
		White	Undefined	Unknown
		Black	Black	Aboriginal/Black/Latin American
		Korean	East Asian	Other
		Filipino	East Asian	Other
		Japanese	East Asian	Other
		Chinese	East Asian	Other
		Aboriginal	Aboriginal	Aboriginal/Black/Latin American
		South Asian	South/West Asian	South or West Asian
		South East Asian	East Asian	Other
		Arab and West Asian	South/West Asian	South or West Asian
		Latin American	Caribb./South Am/ Cent. Am. /Latin American	Aboriginal/Black/Latin American
		Multiple Race	Multi	Other
		Not Stated	Undefined	Unknown
	Don't Know			Unknown
	Refusal			Unknown

\* Variable name. Additional information from sdc6\_1 and sdc6drac were used only in cases where a respondent gave only one ethnic group and that group was coded as "Other." When more than one ethnic group was identified, one of which was "Other," the latter was ignored.

Exhibit TA4.B Classification by Ethnic Group when Single and Multiple Ethnicity Reported



## Exhibit TA4.C Levels of Impairment



Basic ADL = eating, washing, dressing, personal care

Instrumental ADL = shopping, cooking, cleaning

Source: Manuel D, Schultz S. *Atlas Report: The Health of Ontarians—Adding Life to Years and Years to Life: Life and Health Expectancy in Ontario*. Institute for Clinical Evaluative Sciences. Toronto, 2001.

**Exhibit TA4.D Measures of Health Status**

**Mortality**

Mortality indicators are derived from vital statistics from the Office of the Registrar General. Since 1991 these data exclude deaths for residents outside Ontario.

Measure	What it Captures	Limitations
Total Deaths	A summary measure of “negative” health. Total deaths are associated with absolute health care demand.	Poor reflection of population health status since there is no adjustment for population size or age distribution.
Crude Death Rate	Similar to total deaths with adjustment for population size.	Poor reflection of population health status since there is no adjustment for age distribution.
Age-standardized Death Rate	Similar to total deaths with adjustment for population size and age-distribution. Useful for comparing health status to a standard population when size and age distribution varies.	Requires an arbitrary standard population.
Life Expectancy	Intuitive summary measure of mortality expressed in terms of years. Useful for comparing mortality between different populations without need for a standard, comparison population.	Generally should not be used to predict the future or potential life expectancy.
% Survival to 65 Years	A summary measure of premature mortality.	Same as for life expectancy.

**Health-related Quality of Life (HRQOL)**

HRQOL indicators are derived from the OHS and NPHS. These surveys exclude certain populations including people living in long-term care institutions.

Measure	What it Captures	Limitations
Health Utilities Index (HUI)	Functional health status or health.	1/3 of respondents have perfect scores, implying perfect health. Does not capture functional health that is not represented within the eight attributes.
Activities of Daily Living (ADL)	Restrictions in activities of daily living including eating, bathing, dressing, or moving about a residence.	Does not capture whether or not needs are being met.
Instrumental Activities of Daily Living (IADL)	Need for assistance with activities of daily living including shopping for groceries, meal preparation, light or heavy work.	Same as for ADL.
Activity Restrictions	Need for assistance with instrumental activities of daily living or limitations in activities in the home, school, work, or other leisure time activities.	Same as for ADL.
Long-term Disability and Handicap	Long-term disability and handicap as defined by the respondent.	Respondents may interpret disability and handicap differently, including concepts of abnormal body function or disease status.
Self-rated Health Status	Respondents’ own evaluations of their health.	Respondents may use different criteria for evaluating their health, such as future expectations, health behaviour, etc.

**Combined Measures of Morbidity and Mortality**

Measure	What it Captures	Limitations
Health-adjusted Life Expectancy	Life expectancy in good health. Health status is measured using utility-based measures such as the Health Utilities Index.	Calculation requires several different data sources each with their own limitations. Currently, difficult to compare results to other countries.

**Disease-specific Measures**

Measure	What it Captures	Limitations
Cause-deleted Life Expectancy	Potential life expectancy if individual diseases are eliminated. Provides an intuitive and realistic measure of the impact on a population’s health if a disease is reduced. Deaths at younger ages will have a larger impact on life expectancy than older deaths.	Overestimates the impact of reducing disease for chronic conditions since a person may more likely have other potential fatal diseases.
Cause-deleted Health Expectancy	Potential health expectancy if individual diseases are eliminated. Useful for comparing diseases with varying measures of mortality and morbidity.	This report relies on self-report of chronic conditions, and likely under represents acute conditions. Comorbidity is considered for only those respondents with no leading cause of disability.

Source: Manuel D, Schultz S. *Atlas Report: The Health of Ontarians—Adding Life to Years and Years to Life: Life and Health Expectancy in Ontario*. Institute for Clinical Evaluative Sciences. Toronto, 2001.