Chapter 2

Patterns of OVERWEIGHT/OBESITY and Diabetes Prevalence

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HIGHLIGHTS

Issue
- Diabetes is a growing public health problem with serious implications for health. Excess body weight is a major risk factor for developing diabetes.
- The purpose of this chapter is to examine patterns of prevalence of overweight/obesity and diabetes in Peel region.

Key Findings
- In 2003–08, rates of overweight and obesity in Peel were higher than in the Greater Toronto Area (GTA). Within Peel, rates were highest in Caledon (particularly near Bolton), followed by Brampton, and were lowest in Mississauga.
- Rates of diabetes in Peel were higher than in the GTA and the province as a whole. In 2007, one in 10 adults in Peel had diagnosed diabetes.
- The majority of neighbourhoods with very high rates of diabetes were located in Brampton and a smaller number was located in Mississauga.
- There was no clear correspondence between patterns of overweight/obesity and diabetes. This is likely due in large part to the distribution of ethnocultural groups across Peel, many of which develop diabetes at lower body weights.
- Higher levels of affluence and a higher proportion of the population of European descent in both Caledon and south Mississauga likely acted as protective factors against diabetes despite high rates of overweight/obesity in these areas.

Implications
- In the coming years, adequate resources will be needed to manage the rising numbers of people living with diabetes in Peel (and elsewhere) in an effort to reduce the burden of this disease and its complications.
- High-risk neighbourhoods (those with a greater prevalence of diabetes or overweight/obesity) are ideal targets for community-based interventions aimed at preventing and better managing diabetes. Such interventions should be carefully targeted to particular sub-populations belonging to the many ethno-culturally diverse groups in Peel, that are at higher risk for contracting diabetes.

INTRODUCTION
Increasing rates of overweight and obesity have played a central role in the rapid rise in diabetes and cardiovascular disease across North America.¹,² The World Health Organization (WHO) defines overweight and obesity as conditions of excess or abnormally high levels of body fat that may be harmful to health.³

Measurement of overweight/obesity
At the individual and population levels, overweight and obesity are most commonly measured using Body Mass Index (BMI). This is a simple index based on a person's height and weight that is an international standard for determining whether an individual's weight is in a healthy range based on his or her height.

Despite its widespread use, BMI serves as a rough guide because it does not reflect the distribution of fat within the body and may not correspond to the same proportion of body fat in different individuals. Other measures such as skin-fold thickness and waist circumference are correlated with BMI, but measure body fat more directly, including where it is concentrated in the body. Waist circumference is a particularly important measure because it measures levels of abdominal fat. Abdominal obesity, or excess fat around the body midsection, is an independent risk factor for serious health problems such as heart disease and type 2 diabetes.⁴,⁵
The relationship between BMI, body fat and its distribution in the body differs by ethnic origin. For example, persons of East/Southeast Asian and South Asian descent tend to have lower BMI compared with individuals of European ancestry. Despite their lower BMI, these groups are more likely to have higher levels of body fat and abdominal obesity. As a result, the WHO and the International Diabetes Federation recommend using lower cut-off points for BMI and waist circumference as markers of increased health risk among Asian populations. However, because waist circumference is challenging to measure in the general population, physicians and researchers use this measure less commonly than the BMI. Due to lack of available data, patterns of waist circumference are not presented in this atlas for Peel.

Prevalence patterns of overweight/obesity

More than one in three Canadian adults are overweight and nearly one in four are obese. In the past few decades, the waistlines of Canadian adults and youth have also grown significantly. Between 1981 and 2007–09, the prevalence of abdominal obesity among Canadian adults increased threefold (from 11.4% to 35.6%). Adult women's waistlines grew on average by 10 centimetres or more compared with five centimetres or more in adult men. In young adults aged 20 to 39, the prevalence of abdominal obesity has more than quadrupled; among youth aged 12 to 19, its prevalence increased sevenfold (from 1.8% to 12.8%).

Prevalence patterns of diabetes

Diabetes has become one of the most common chronic conditions in our society, largely because of the rising prevalence of type 2 diabetes – the form that accounts for the majority of cases (90% to 95%). Type 2 diabetes results from a complex interaction between genetic and environmental factors that lead to a state of insulin resistance. Insulin resistance refers to a condition in which the body's tissues are not able to respond normally to circulating levels of the hormone insulin. With age, the transition from insulin resistance to type 2 diabetes becomes more likely. Thus, a disproportionate number of people with diabetes are from older age groups. Also, diabetes is diagnosed more commonly in men than in women.
In addition to an aging population, overweight and obesity are considered to be the main drivers of the rising rates of diabetes across North America. Other well-recognized risk factors at the individual level include having a family history of diabetes, lower socio-economic status, non-white ethnicity, low levels of physical activity and an unhealthy diet (see Chapter 1 for a more detailed overview of risk factors for diabetes).

Over the past two decades, the number of people with diabetes in Canada and Ontario has increased dramatically. The prevalence of diabetes in Ontario increased by 69% in the 10 years between 1994/95 and 2004/05 and has already surpassed predictions made for global prevalence for the year 2030 by the World Health Organization. In 2006/07, approximately two million Canadians were living with diabetes. In 2013, an estimated 3.1 million Canadian (8.6%) are living with diagnosed diabetes. Projections indicate that by 2020, diabetes prevalence will rise to 4.2 million (10.8%).

Overweight/obesity and diabetes

The likelihood of developing diabetes is more than seven times higher among individuals whose BMI is in the obese category (BMI ≥30) and three times as high among those whose BMI is classified as overweight (BMI of 25.0 to 29.9) compared with individuals whose BMI is in the normal range (BMI of 18.5 to 24.9). This association, however, is not the same for all ethnic groups: South Asians, for example, have a genetic susceptibility to developing diabetes at a lower BMI and younger ages compared to White Caucasians.

With the rise in obesity and waistlines in all age groups, the onset of diabetes has now shifted toward younger ages. In Canada and the United States, the greatest relative increase in new diagnoses of diabetes has occurred among adults under 50 years of age. In this age group, the number of people living with diabetes has approximately doubled over the past decade. Rising rates of obesity are also driving an increase in type 2 diabetes among Canadian children and youth. Such trends have important implications for population health promotion because being diagnosed with diabetes earlier in life predisposes individuals to an earlier onset of serious conditions like cardiovascular disease.

The purpose of this chapter is to examine patterns of prevalence of diabetes and its main risk factors – overweight and obesity (measured using BMI) – in Peel region.
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EXHIBITS AND FINDINGS

Exhibit 2A.1. Age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by census subdivision (CSD) [2006], in Ontario

Findings:

- Areas with high diabetes prevalence rates (9.8 or higher per 100 people aged 20+) were concentrated in parts of northern Ontario and the Greater Toronto Area, and scattered in other parts of southern and northern Ontario.

- Areas with lower diabetes prevalence (4.6–7.0 per 100 people aged 20+) were found throughout much of southern Ontario.

- It should be noted that even the third lowest category of diabetes prevalence shown on this map contains values that are higher than the Ontario average prevalence rate of 8.3 per 100 people aged 20+.
Findings:

• Areas with high diabetes prevalence rates (10.7-15.6 per 100 people aged 20+) were found in Mississauga, Brampton, southwest and southeast York, northwest and northeast Toronto, and parts of Durham.

• Areas with lower diabetes rates (8.7 or less per 100 people aged 20+) were found in parts of Toronto, Mississauga, Caledon, York and Durham.

This exhibit demonstrates that high diabetes prevalence rates, similar to those found in parts of Peel, are also found in other specific areas of the GTA.
### Exhibit 2.1 (a). Age- and sex-standardized overweight and obesity prevalence rates and associated 95% confidence intervals in persons aged 18 years or older [2003–08], in Peel region, the Greater Toronto Area (GTA) and Ontario

<table>
<thead>
<tr>
<th>Prevalence of overweight or obese per 100 adults(^b)</th>
<th>Peel (95% confidence interval)</th>
<th>Mississauga</th>
<th>Brampton</th>
<th>Caledon</th>
<th>Greater Toronto Area(^a)</th>
<th>Ontario (GTA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ages</td>
<td>47.0 (45.3-48.7)</td>
<td>45.1</td>
<td>49.9</td>
<td>54.7</td>
<td>44.4 (43.5-45.2)</td>
<td>48.6</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ages 18-39</td>
<td>54.2 (51.8-56.6)</td>
<td>51.8</td>
<td>58.3</td>
<td>61.5</td>
<td>52.4 (51.1-53.7)</td>
<td>56.9</td>
</tr>
<tr>
<td>Ages 40-64</td>
<td>48.0 (44.2-51.8)</td>
<td>44.1</td>
<td>53.7</td>
<td>63.4</td>
<td>45.0 (43.1-46.9)</td>
<td>49.1</td>
</tr>
<tr>
<td>Ages 65+</td>
<td>62.1 (57.8-66.3)</td>
<td>61.0</td>
<td>64.5</td>
<td>61.1</td>
<td>60.6 (58.6-62.6)</td>
<td>65.9</td>
</tr>
<tr>
<td>Women</td>
<td></td>
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<td></td>
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<tr>
<td>Ages 18-39</td>
<td>39.8 (37.5-42.1)</td>
<td>38.9</td>
<td>41.1</td>
<td>47.8</td>
<td>36.4 (35.3-37.5)</td>
<td>40.5</td>
</tr>
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<td>30.1 (26.8-33.5)</td>
<td>29.9</td>
<td>31.2</td>
<td>43.1*</td>
<td>25.7 (24.1-27.3)</td>
<td>30.4</td>
</tr>
<tr>
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<td>48.2 (44.2-52.2)</td>
<td>47.1</td>
<td>50.3</td>
<td>52.5</td>
<td>45.5 (43.5-47.4)</td>
<td>49.1</td>
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<tr>
<td>Prevalence of obese per 100 adults(^b)</td>
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<tr>
<td>All ages</td>
<td>13.3 (12.1-14.6)</td>
<td>12.6</td>
<td>14.1</td>
<td>19.9</td>
<td>12.5 (11.9-13.0)</td>
<td>15.4</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Ages 18-39</td>
<td>14.5 (12.8-16.3)</td>
<td>14.0</td>
<td>14.6</td>
<td>21.6</td>
<td>13.4 (12.5-14.2)</td>
<td>16.4</td>
</tr>
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<td>Ages 40-64</td>
<td>13.0 (10.6-15.5)</td>
<td>11.8</td>
<td>13.7*</td>
<td>28.6*</td>
<td>11.2 (9.9-12.4)</td>
<td>13.9</td>
</tr>
<tr>
<td>Ages 65+</td>
<td>15.6 (12.4-18.8)</td>
<td>16.5</td>
<td>14.3</td>
<td>†</td>
<td>16.3 (14.7-18.0)</td>
<td>20.4</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Ages 18-39</td>
<td>12.2 (10.6-13.8)</td>
<td>11.2</td>
<td>13.8</td>
<td>18.3</td>
<td>11.5 (10.8-12.2)</td>
<td>14.3</td>
</tr>
<tr>
<td>Ages 40-64</td>
<td>8.7 (6.7-10.7)</td>
<td>7.3*</td>
<td>10.9*</td>
<td>†</td>
<td>7.7 (6.8-8.7)</td>
<td>11.1</td>
</tr>
<tr>
<td>Ages 65+</td>
<td>16.4 (13.6-19.3)</td>
<td>15.2</td>
<td>18.6</td>
<td>†</td>
<td>15.1 (13.7-16.4)</td>
<td>17.8</td>
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<tr>
<td>Prevalence of obese per 100 adults(^b)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>All ages</td>
<td>13.5 (9.6-17.4)</td>
<td>14.1*</td>
<td>11.5*</td>
<td>†</td>
<td>15.2 (13.3-17.14)</td>
<td>16.4</td>
</tr>
</tbody>
</table>

\(^a\) Greater Toronto Area (GTA) consists of the regional municipalities of Durham, Halton, Peel and York, and the City of Toronto.

\(^b\) The overall overweight and obesity rates represent age- and sex-standardized prevalence rates in persons aged 18 years or older.

Rates were standardized to the 1991 Canada Census population.

\* Estimate based on small numbers (coefficient of variation = 16.6-33.3) and should be used with caution.

† Estimates of unacceptable quality for reporting (coefficient of variation > 33.3).

Bolded estimates represent rates in Peel region that are statistically different from the GTA rate in the same age/sex category.

Peel region rates are not compared to overall Ontario rates in this table.

**General notes:**

Overweight/obesity is defined as a Body Mass Index (BMI, weight in kg / height in m\(^2\)) of ≥25. Obesity is defined as BMI of ≥30.

Data Source: Canadian Community Health Survey combined cycles 2.1 (2003), 3.1 (2005) and 2007/08.
Exhibit 2.1 (b). Age- and sex-standardized overweight and obesity prevalence rates and associated 95% confidence intervals (CIs) in persons aged 18 years or older [2003–08], in Peel Health Data Zones (PHDZs)

<table>
<thead>
<tr>
<th>PHDZ</th>
<th>Prevalence of overweight/obesity per 100 adults (95% CI)</th>
<th>Prevalence of obesity per 100 adults (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>49.0 (37.7-60.4)</td>
<td>13.9 (7.3-20.6)</td>
</tr>
<tr>
<td>2</td>
<td>48.4 (43.8-53.0)</td>
<td>15.2 (10.6-19.7)</td>
</tr>
<tr>
<td>3</td>
<td>46.4 (41.3-51.6)</td>
<td>11.8 (8.2-15.4)</td>
</tr>
<tr>
<td>4</td>
<td>44.5 (37.2-51.9)</td>
<td>12.6 (8.6-16.7)</td>
</tr>
<tr>
<td>5</td>
<td>43.7 (35.9-51.6)</td>
<td>14.7 (8.9-20.5)</td>
</tr>
<tr>
<td>6</td>
<td>45.8 (39.8-51.8)</td>
<td>12.4 (8.6-16.2)</td>
</tr>
<tr>
<td>7</td>
<td>42.0 (35.6-48.5)</td>
<td>11.3 (8.3-14.2)</td>
</tr>
<tr>
<td>8</td>
<td>47.6 (36.5-58.6)</td>
<td>13.6 (6.1-21.2)</td>
</tr>
<tr>
<td>9</td>
<td>42.7 (37.9-47.5)</td>
<td>11.0 (7.8-14.2)</td>
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<td>10</td>
<td>46.6 (40.9-52.3)</td>
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<td>11</td>
<td>53.8 (48.7-58.9)</td>
<td>14.7 (11.2-18.2)</td>
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<td>12</td>
<td>50.4 (43.6-57.2)</td>
<td>15.3 (10.7-20.0)</td>
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<tr>
<td>13</td>
<td>51.6 (42.9-60.2)</td>
<td>19.1 (11.6-26.6)</td>
</tr>
<tr>
<td>14</td>
<td>50.0 (41.4-58.6)</td>
<td>15.8 (10.0-21.6)</td>
</tr>
<tr>
<td>15</td>
<td>63.5 (52.0-75.0)</td>
<td>26.6 (15.8-37.4)</td>
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</tbody>
</table>

Bolded estimates represent PHDZ rates that are statistically different from the overall Greater Toronto Area (GTA) rate.
The overall GTA rate of overweight/obesity per 100 adults was 44.4 (95% CI: 43.5-45.2); the GTA obesity rate per 100 adults was 12.5 (95% CI: 11.9-13.0).
The GTA is comprised of the regional municipalities of Durham, Halton, Peel, York and the City of Toronto.
Rates were standardized to the 1991 Canada Census population.

General notes:
Overweight/obesity is defined as a Body Mass Index (BMI, weight in kg / height in m^2) of ≥25. Obesity is defined as BMI of ≥30.
Data Source: Canadian Community Health Survey combined cycles 2.1 (2003), 3.1 (2005) and 2007/08.

Exhibit 2.2. Age-standardized diabetes prevalence rates in persons aged 20 years and older [2007], in Peel region, the Greater Toronto Area and Ontario

<table>
<thead>
<tr>
<th>Diabetes prevalence rate per 100 adultsa</th>
<th>Peel</th>
<th>Mississauga</th>
<th>Brampton</th>
<th>Caledon</th>
<th>Greater Toronto Area (GTA)a</th>
<th>Ontario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All ages</td>
<td>10.24</td>
<td>9.77</td>
<td>11.34</td>
<td>7.88</td>
<td>9.28</td>
<td>8.56</td>
</tr>
<tr>
<td>Ages 20-44</td>
<td>3.04</td>
<td>2.69</td>
<td>3.62</td>
<td>2.43</td>
<td>2.63</td>
<td>2.31</td>
</tr>
<tr>
<td>Ages 45-64</td>
<td>15.20</td>
<td>14.32</td>
<td>17.35</td>
<td>10.94</td>
<td>13.31</td>
<td>12.29</td>
</tr>
<tr>
<td>Ages 65+</td>
<td>31.55</td>
<td>31.37</td>
<td>32.82</td>
<td>25.43</td>
<td>30.12</td>
<td>28.27</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>All ages</td>
<td>9.68</td>
<td>9.12</td>
<td>10.96</td>
<td>7.33</td>
<td>8.79</td>
<td>7.98</td>
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<td>Ages 20-44</td>
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<td>2.80</td>
<td>3.61</td>
<td>2.86</td>
<td>2.68</td>
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<td>Ages 45-64</td>
<td>12.06</td>
<td>11.15</td>
<td>14.22</td>
<td>8.09</td>
<td>10.74</td>
<td>9.75</td>
</tr>
<tr>
<td>Ages 65+</td>
<td>25.56</td>
<td>25.74</td>
<td>28.93</td>
<td>20.10</td>
<td>24.85</td>
<td>22.54</td>
</tr>
</tbody>
</table>

a Greater Toronto Area (GTA) consists of the regional municipalities of Durham, Halton, Peel and York and the City of Toronto.
b The overall diabetes prevalence rate represents age- and sex-standardized prevalence rates in persons aged 20 years or older.
Diabetes rates were standardized to the 1991 Canada Census population.
**Exhibit 2.3.** Age- and sex-standardized rate of overweight/obesity* per 100 persons aged 18+ [2003–08] and age- and sex-standardized diabetes prevalence rates per 100 persons aged 20+ [2007], by Peel Health Data Zone (PHDZ) [2006], in Peel region

**Findings:**

- Between 2003–08, the overall rate of overweight/obesity in Peel was 47.0 per 100 adults. This was significantly higher than the overall GTA rate of 44.4 per 100 adults.
- The highest rates of overweight/obesity were found throughout Caledon (particularly near Bolton), in west and southwest Brampton and in southeast Mississauga.
- Lower rates of overweight/obesity were seen in west, central and northeast Mississauga.

*Overweight/obesity was defined as having a Body Mass Index (BMI) ≥ 25*
Findings:

- The overall rate [2003–08] of overweight/obesity among Peel males was 54.2 per 100 males. This rate was slightly higher than the overall GTA rate of 52.4 per 100 males although the difference was not statistically significant.

- In the majority of PHDZs, more than half of all adult males were overweight or obese. Only four PHDZs, all of which were in Mississauga, had rates of overweight/obesity below 50 per 100 males.

- Areas with very high rates of overweight/obesity (above 60 per 100 males) were found in east Caledon (near Bolton), west Brampton and southeast Mississauga.
Findings:

• The overall rate [2003-08] of overweight/obesity among Peel females aged 18 years or older was 39.8 per 100 females. This rate was not statistically different from the overall GTA rate of 36.4 per 100 females but was much lower than the rate among Peel males (Exhibit 2.4).

• Areas with high rates of overweight/obesity (above 40 per 100 females) were found throughout Caledon (particularly near Bolton), Brampton and in south, central, north and northeast Mississauga.

• Areas where rates of overweight/obesity were highest differed somewhat for males and females.

Exhibit 2.5. Age-standardized rate of overweight/obesity* per 100 females aged 18+ [2003–08], by Peel Health Data Zone (PHDZ) [2006], in Peel region.
Exhibit 2.6. Age- and sex-standardized rate of obesity* per 100 persons aged 18+ [2003–08] and age- and sex-standardized diabetes prevalence rate per 100 persons aged 20+ [2007], by Peel Health Data Zone (PHDZ) [2006], in Peel region

Findings:

- The overall rate of obesity in Peel was 13.3 per 100 adults aged 18 or older. This was slightly higher (although not statistically significant) than the overall GTA rate of 12.5 per 100 adults.

- Areas with high rates of obesity (above 14 per 100 adults) were found in east Caledon (near Bolton), northeast, west and northwest Brampton, and in northwest and southeast Mississauga.

- Lower rates of obesity were seen in east Brampton and in south, central and northeast Mississauga.

Obesity* rate per 100 aged 18+

- 11.0 – 12.0
- 12.1 – 14.0
- 14.1 – 16.0
- 16.1 – 26.6

Interpret with caution due to high sampling variability

Overall Greater Toronto Area (GTA) rate of obesity*: 12.5%

*Obesity was defined as having a Body Mass Index (BMI) ≥ 30

Diabetes rate per 100 aged 20+

- 7.1 – 9.1
- 9.2 – 10.9
- 11.0 – 12.9
Exhibit 2.7. Age- and sex-standardized diabetes prevalence rate per 100 persons aged 20+ [2007], by Peel Health Data Zone (PHDZ) [2006], in Peel region

Findings:
• Diabetes rates were highest throughout Brampton (particularly in the northeast PHDZ) and in northwest, central and northeast Mississauga.
• The lowest rates of diabetes in Peel were seen in Caledon.

Diabetes rate per 100 aged 20+
- 7.1 – 9.1
- 9.2 – 10.9
- 11.0 – 12.9

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%
Findings:

- In 2007, the overall rate of diabetes in Peel was 10%.
- Diabetes rates were highest throughout Brampton and in northeast Mississauga. Medium-to-high rates were also seen in central, north and west Mississauga.
- Rates were lowest throughout Caledon and in central-west and south Mississauga.
Findings:

- Areas with diabetes rates at least 20% higher than in the GTA (rate-ratio of 1.2 or higher) were found in many areas of Brampton, particularly in the northeast portion. Rates higher than in the GTA were also seen in central and northeast Mississauga.

- Areas with diabetes rates substantially lower than in the GTA (rate-ratio of 0.80 or lower) were found in north and west Caledon and in south Mississauga.

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Exhibit 2.9. Rate-ratio comparison of age- and sex-standardized diabetes prevalence rate per 100 persons aged 20+ [2007] in Peel region, to the overall Greater Toronto Area (GTA) age- and sex-standardized diabetes prevalence rate per 100 persons aged 20+ [2007], by census tract.

<table>
<thead>
<tr>
<th>Diabetes rate-ratio*</th>
<th>Number of CTS in class</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.51 – 0.70</td>
<td>(n = 6)</td>
</tr>
<tr>
<td>0.71 – 0.80</td>
<td>(n = 11)</td>
</tr>
<tr>
<td>0.81 – 1.19</td>
<td>(n = 128)</td>
</tr>
<tr>
<td>1.20 – 1.49</td>
<td>(n = 58)</td>
</tr>
<tr>
<td>1.50 – 1.58</td>
<td>(n = 2)</td>
</tr>
</tbody>
</table>

*Rate-ratio calculated as:

census tract rate for pop. aged 20+

GTA rate for pop. aged 20+

Overall Greater Toronto Area (GTA) diabetes rate: 9.0%
Findings:

- In 2007, the overall age-standardized prevalence rate of diabetes among males in Peel was 10.2 per 100 males aged 20 or older.

- Diabetes rates among males were highest in many parts of Brampton and in north, northeast and central Mississauga.

- Lower rates were seen throughout Caledon and in south and central-west Mississauga.

Exhibit 2.10. Age-standardized diabetes prevalence rate per 100 males aged 20+ [2007], by census tract [2006], in Peel region.
Findings:

• In 2007, the overall age-standardized diabetes rate among females in Peel was 9.7 per 100 females aged 20 or older.

• Diabetes prevalence rates among females were highest throughout Brampton and in central and north Mississauga, particularly in the northeast portion.

• Rates were lower throughout Caledon and in south and central-west Mississauga.

• Areas that were home to a higher percentage of female residents diagnosed with diabetes generally coincided with the location of higher diabetes areas among males (Exhibit 2.10).

Exhibit 2.11. Age-standardized diabetes prevalence rate per 100 females aged 20+ [2007], by census tract [2006], in Peel region

<table>
<thead>
<tr>
<th>Diabetes rate</th>
<th>Number of CTs in class</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8 – 8.2</td>
<td>(n = 47)</td>
</tr>
<tr>
<td>8.3 – 9.4</td>
<td>(n = 46)</td>
</tr>
<tr>
<td>9.5 – 10.5</td>
<td>(n = 40)</td>
</tr>
<tr>
<td>10.6 – 11.7</td>
<td>(n = 38)</td>
</tr>
<tr>
<td>11.8 – 14.5</td>
<td>(n = 34)</td>
</tr>
</tbody>
</table>

Overall Greater Toronto Area (GTA) diabetes rate among females aged 20+: 8.8%
Findings:

- Diabetes rates at least 20% higher than in the GTA were seen in many areas of Brampton and in central, north and northeast Mississauga. Rates substantially lower than in the GTA (rate-ratio of 0.80 or lower) were seen in south Mississauga and in most areas of Caledon.

- Compared to females (Exhibit 2.13), there were slightly fewer areas in Brampton and Mississauga where diabetes prevalence among males was substantially higher than in the GTA.
Findings:

• Diabetes rates at least 20% higher than in the GTA were seen in many areas of Brampton and throughout central and northeast Mississauga. Rates substantially lower than in the GTA (rate-ratio of 0.80 or lower) were seen in south Mississauga and in most areas of Caledon.

• Compared to males (Exhibit 2.12), there were slightly more areas in Brampton and Mississauga where diabetes prevalence among females was higher than in the GTA.

Exhibit 2.13. Rate-ratio comparison of age-standardized diabetes prevalence rate per 100 females aged 20+ [2007] in Peel region, to the overall Greater Toronto Area (GTA) age-standardized diabetes prevalence rate per 100 females aged 20+ [2007], by census tract.
DISCUSSION

Between 2003–08, the rates of overweight and obesity among Peel adults were high – nearly half of Peel residents reported being either overweight or obese according to standard BMI classification. The overall rate of overweight/obesity in Peel was significantly higher than in the Greater Toronto Area (GTA) overall (47.0% in Peel vs. 44.4% in the GTA). The proportion of residents who were overweight or obese was highest in Caledon (especially near Bolton), followed by Brampton; these rates were higher than in the GTA, but similar to the province as a whole. There were also high rates of overweight/obesity among younger adult (under age 40) men and women living in Caledon and among younger adult men in Brampton. This is concerning because being overweight or obese at a younger age is a risk factor for developing diabetes earlier in life.

In 2007, one in 10 adult residents of Peel had diagnosed diabetes. This represented a higher prevalence than in the GTA and the province as a whole. Rates were highest in Brampton (11.5%), followed by Mississauga (9.5%); the lowest rates were observed in Caledon (7.7%). These patterns were consistent for both men and women. There was a particularly high prevalence of diabetes among younger adult men and women in Brampton compared with the rest of Peel, the GTA and Ontario. This is cause for concern because younger adults have longer to live with the disease and thus have a greater opportunity to develop serious complications such as heart attack, stroke and kidney disease.16

Although epidemiologic studies consistently show a high BMI to be among the leading risk factors for developing diabetes, there was no strong spatial concordance observed between rates of overweight/obesity and diabetes in Peel. An important factor in this lack of association is likely the distribution of immigrant and ethnocultural groups across Peel (for a more detailed discussion of immigration, ethnicity and diabetes, see Chapter 4). Some ethnic groups, such as individuals of East Asian and South Asian heritage, have a higher risk of developing diabetes at lower body weight and/or at younger ages than other ethnic groups.20, 23 Thus, using the standard BMI cut-off points to determine overweight or obesity does not appropriately identify high-risk individuals belonging to these and other ethnoracial groups.

In 2007 in Peel, virtually all neighbourhoods with high rates of diabetes were also home to a large proportion of residents belonging to visible minority groups such as South Asians, who are known to have a higher risk of developing diabetes at lower body weights. This pattern of spatial distribution of ethnic groups across Peel is likely to be an important reason for the lack of a strong spatial association between rates of overweight/obesity and diabetes. Additionally, abdominal obesity is a more important risk factor for diabetes than BMI, particularly in Asian populations.14 Unfortunately, measures such as waist circumference were not available for this study.

In Peel, rates of diabetes were lowest throughout Caledon and in south Mississauga. These areas tended to be wealthier, with fewer visible minority residents and recent immigrants (see Chapters 3 and 4 for patterns of socio-economic status and immigrant/ethnicity in relation to diabetes in Peel).

Despite the substantial variation in rates of diabetes across Peel, it is important to note that rates were higher than the provincial average throughout most of the region. In fact, because of the way that neighbourhoods were divided into categories (see Appendix 2.A for details), some neighbourhoods with rates of diabetes higher than the provincial average were included in the “lowest” category of diabetes prevalence (for example, in Exhibit 2.8 the lowest category of diabetes prevalence ranged from 4.7% to 8.7%, which included census tracts with rates above the Ontario average of 8.0%).

An important limitation of these analyses is that BMI was calculated based on self-reported height and weight measurements of Peel residents who responded to the Canadian Community Health Survey (CCHS). Because survey respondents tend
to overestimate height and underestimate weight, self-reported BMI leads to an underestimation of overweight and obesity. For example, in Canada in 2005, the prevalence of obesity was 15.2% by self-report compared with 22.6% by measurement.24 This suggests that the rates of overweight/obesity shown in these analyses are likely underestimated.

CONCLUSIONS AND IMPLICATIONS

Diabetes is a significant public health problem. Excess body weight is a major risk factor for developing diabetes. The prevalence of diabetes in Ontario has already surpassed the World Health Organization’s predictions for global prevalence for the year 2030.16 In 2007 in Peel, rates of diabetes among both men and women exceeded those of the GTA and Ontario. The majority of neighbourhoods where rates of diabetes were very high were located in Brampton, with a smaller number located in Mississauga.

In Peel, there was no clear correspondence between patterns of diabetes and overweight/obesity. This is likely due to the distribution of ethnocultural groups across Peel, many of which develop diabetes at lower body weights. There were high rates of diabetes among younger adults, particularly in Brampton. This is concerning because younger adults have longer to live with the disease and thus have a greater opportunity to develop serious complications.

Neighbourhoods with high rates of overweight/obesity or diabetes are ideal settings for community-based program planning and intervention.14 This could include local strategies to prevent the development of diabetes among residents, as well as the provision of health care programs and services to help manage this condition. The relationships between diabetes and both neighbourhood design/infrastructure and the availability of resources related to diabetes prevention and control are discussed in upcoming sections of this atlas.
APPENDIX 2.A – RESEARCH METHODOLOGY

Data Sources

Overweight/Obesity Rates

Data from Statistics Canada’s 2003 (Cycle 2.1), 2005 (Cycle 3.1) and 2007/2008 Canadian Community Health Surveys (CCHS) were combined to examine the percentage of adult residents within Peel Health Data Zones (PHDZs) who reported being either overweight/obese (BMI ≥ 25) or obese (BMI ≥ 30). The larger PHDZs were used as the geographical unit of analysis because there were too few CCHS respondents at the census tract level to ensure Statistics Canada’s data quality and reporting standards.

All data on height and weight used to calculate the BMI were self-reported by respondents to the CCHS. These data were collected on all respondents excluding pregnant women and people less than 0.91 metres (3 feet) or greater than 2.11 metres (6 feet, 11 inches) tall. This analysis was restricted to persons aged 18 and over. Due to some incidents of extreme data outliers (e.g., extremely high or low values of BMI) which may have been due to reporting errors, the analyses were restricted to individuals whose BMIs fell between 15 and 60. These values were selected to represent the normal range of possible BMIs in the population. Statistical methods were used to standardize the rates in order to remove any age and sex differences across the region and to ensure that different age or sex distributions in census tracts and PHDZs did not account for the differences seen between areas.

Some prevalence rates of overweight/obesity in some sub-groups of Peel’s population (particularly in Caledon) were not presented or were identified as estimates that should be interpreted with caution. This occurred because Statistics Canada imposes specific guidelines for reporting estimates based on CCHS data – guidelines that were followed for the current analyses. First, the number of sampled respondents contributing to the calculation of an estimate had to be greater than or equal to 30. If an estimate met this requirement, the coefficient of variation (CV) was calculated using the same weighted bootstrapping techniques that were used to produce the point estimate (i.e., prevalence rate) and 95% confidence intervals. As per Statistics Canada guidelines, estimates with a CV greater than 33.3% were suppressed (not shown) due to extreme sampling variability. Estimates with a CV between 16.6 and 33.3% were accompanied by a caution that the estimate is subject to high variability.

Diabetes Rates

Provincial administrative health databases were used to examine patterns of diabetes in Peel neighbourhoods. People aged 20 and older who had been diagnosed with diabetes on or before March 31, 2007 were identified from the Ontario Diabetes Database (ODD). The ODD is a population-based and validated disease registry created from hospital records and physician services claims. This database is held at the Institute for Clinical Evaluative Sciences (ICES). An individual is said to have physician-diagnosed diabetes (excluding gestational diabetes) if at least one of the following criteria is met within a two-year period: (i) two primary care visits for diabetes or (ii) one admission to hospital with a new or pre-existing diagnosis of diabetes. This selection criteria has a sensitivity of 86% and a specificity of 97% in identifying patients with confirmed diabetes (i.e., this algorithm correctly identifies 86% of people who have diabetes and correctly omits 97% of people who do not have diabetes).25 Once it has been registered in the ODD, an individual’s record remains there until death.

The ODD does not differentiate type 1 from type 2 diabetes. However, type 1 diabetes represents a very small proportion (5 -10%) of all diabetes cases. Administrative data may also understate the true prevalence of diabetes because up to 30% of diabetes cases in the Ontario population may be undiagnosed by a physician.26
The Registered Persons Database (RPDB) was used to derive population denominators. The RPDB is an electronic registry of all individuals who are eligible for coverage under the Ontario Health Insurance Plan (OHIP) in a given year. Since numerators for diabetes rates are linked to addresses in the RPDB, for consistency, the RPDB was used to create the population denominators for this study. Patients’ addresses are normally updated either at the time of hospitalization or when patients renew their provincial health card every five years.

If a person does not renew his/her health card or moves residences without notifying the Ministry of Health and Long-Term Care about the change of address, his/her address in the OHIP system can be out-of-date. This represents a limitation of the data.

The RPDB may include people who left Ontario, but did not inform the Ministry of Health and Long-Term Care. The RPDB may also include a few people who died, but whose records have not yet been updated. In an attempt to exclude individuals who have died, seniors who did not have a single health claim in the previous three-year period were excluded from the analyses. Despite potential inaccuracies, the RPDB is still a more appropriate denominator for OHIP-based numerators than census counts because physician claims from OHIP are derived from the RPDB population. Using census counts in the denominator is likely to inflate rates and create bias in estimates.

Age- and sex-standardized diabetes prevalence rates were calculated per 100 population for each census tract in Peel. The diabetes prevalence categories displayed on the maps in this chapter were derived by ordering the census tracts from lowest to highest prevalence and then dividing them into five groups with equal populations (i.e., population-weighted quintiles). Diabetes rates for the larger Peel Health Data Zones (PHDZs) were also calculated. This was done to provide a common geographical unit of analysis with overweight/obesity analyses and all other analyses using data from the CCHS in subsequent chapters. The diabetes prevalence categories displayed on PHDZ maps were generated by ordering the PHDZs from lowest to highest prevalence and then dividing them into three groups with equal populations (i.e., populations-weighted tertiles). In order to remove any influence due to differences in the population’s age and sex distribution across census tracts or PHDZs, the diabetes rates were standardized to the 1991 Canada Census population. Similar steps were used to calculate separate, age-standardized rates by census tract for men and women.

The categories of diabetes prevalence rates displayed on the Greater Toronto Area (GTA) map of diabetes prevalence (Exhibit 2A.2) were calculated based on population-weighted quintiles of diabetes prevalence for Peel. This was done to make categories on this map comparable to Exhibit 2.8, which displays diabetes prevalence rates in Peel. The same category cut-offs used for Exhibit 2.8 were used on the GTA map, except the maximum and minimum values for the highest and lowest categories, respectively, were extended due to the greater range of diabetes prevalence rates found within the GTA.

The categories of diabetes prevalence rates displayed on the Ontario map of diabetes prevalence (Exhibit 2A.2) were calculated based on natural breaks. Categories were determined through examination of the distribution of rates to find natural “breakpoints” in the data. Due to the wide range of population denominators in census subdivisions, use of other methods such as population-based quintiles was not appropriate. Where possible, however, category breaks were made similar to other diabetes prevalence rate maps in this atlas to facilitate comparison. All census subdivisions with denominators less than 100 and numerators less than 20 were excluded prior to classification and are marked accordingly on the map.

**Definitions**

- **Body Mass Index (BMI)** is a ratio of weight to height and can be calculated according to the equation: \( \text{BMI} = \frac{\text{weight (kilograms)}}{\text{height (metres)}^2} \). In adults aged 18 or
older, overweight is defined by having a BMI between 25.0 and 29.9. Obesity is defined by a BMI of 30.0 or higher.

- Statistics Canada defines visible minorities as “persons, other than Aboriginal persons, who are non-White in race or colour,” in accordance with Canada’s Employment Equity Act.

Analysis
This analysis involved two types of maps. The first type shows area rates of overweight/obesity or diabetes rate variables depicted using shaded (choropleth) maps. A second type of map was created in order to highlight areas of Peel where diabetes rates were substantially higher or lower than the overall prevalence rate in the Greater Toronto Area (GTA) of 9.0%. Because these analyses use population-based data, even small differences in rates could easily reach statistical significance. Thus, in order to identify areas of Peel where rates of diabetes were meaningfully different from the GTA rate, a difference of at least 20% was chosen because a difference of this magnitude is likely to have public health significance. For each Peel census tract, the diabetes rate was divided by the overall GTA rate in order to calculate a rate-ratio. Census tracts with diabetes rates at least 20 per cent higher than the GTA rate (rate-ratio of ≥1.2) were depicted in shades of red, while tracts with rates at least 20% below the GTA rate (rate-ratio of ≤ 0.80) were depicted in shades of blue. All census tracts where rates did not differ substantially from the GTA rate (rate-ratio between 0.81 and 1.19) were depicted using a single grey colour.

REFERENCES


