

CHAPTER 4: DEMOGRAPHIC, BEHAVIOURAL, AND SOCIAL DETERMINANTS AND FUTURE RISK OF TYPE 2 DIABETES

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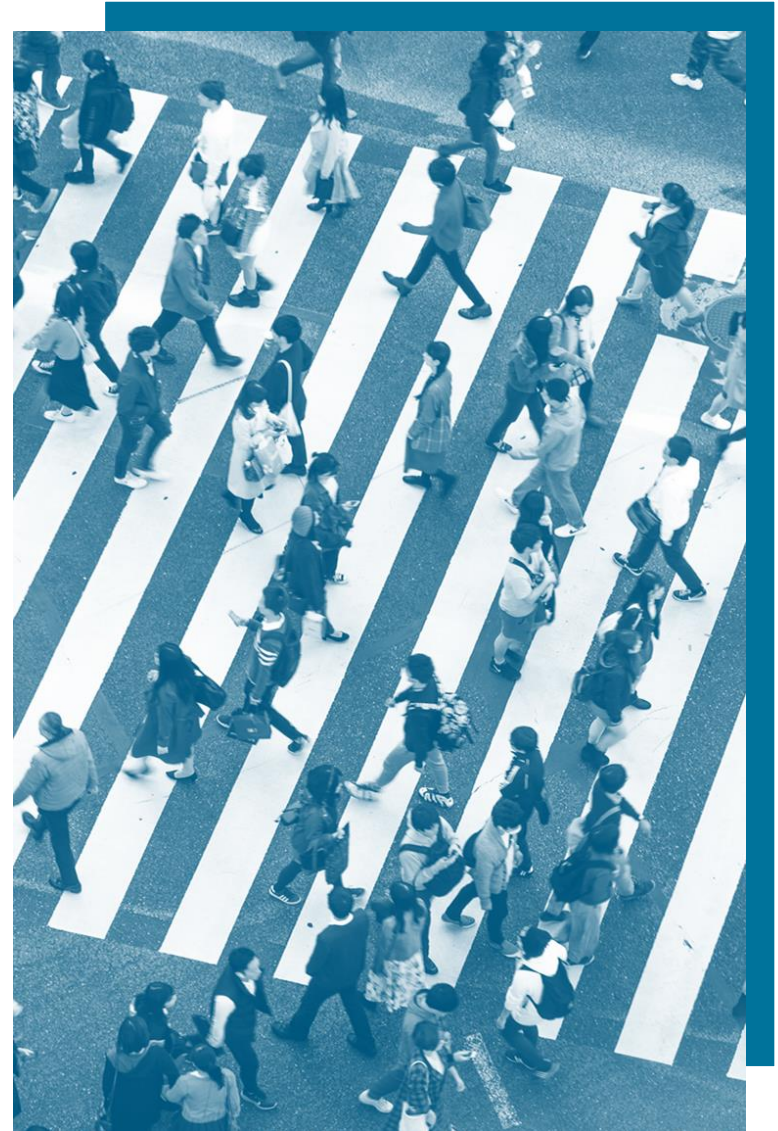
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KEY FINDINGS

- The **future risk of developing diabetes** among residents in Peel is **disproportionately elevated** among **visible minority and immigrant groups**.
- We must consider the many factors that increase type 2 diabetes risk when looking for ways to reduce this risk.
- In the coming years, **diabetes incidence** in Peel Region is **projected to rapidly increase**, particularly among those experiencing a **greater degree of socioeconomic disadvantages and health inequities**.
- Over half of the population in Peel Region is represented by those who identify as a **visible minority** (58.7% among adults with diabetes and 57.3% among those without diabetes).
- A **higher proportion of immigrants are living with diabetes** (73.3%) compared to immigrants without diabetes (56.6%).
- Among adults living with diabetes, 40.7% reported being **physically inactive** as compared to 27.3% of adults living without diabetes.
- A significant proportion of **residents reported being overweight** (37.7% with diabetes and 33.2% without diabetes).
- Over half of the residents with **hypertension** reported having diabetes (60.8%), which was comparable to those living without diabetes (57.4%).
- Although **food insecurity** is an important determinant of type 2 diabetes risk and an indicator of poverty, only a small number of residents reported experiencing severe food insecurity (3.1% among those living with diabetes and 2.0% living without diabetes)
- A small fraction of residents reported an **income** of less than \$20,000 (6.5% among those with diabetes and 5.7% of those living without diabetes).
- The **10-year risk of developing new diabetes for residents of Peel Region overall is 11.5%**, with an additional 102,000 adults aged >20 years living with diabetes by 2028.



INTRODUCTION

Several individual and community-level factors influence the development of type 2 diabetes (diabetes). Some of these risk factors include non-modifiable sociodemographic factors (e.g., age, sex, ethnicity, immigrant status); or modifiable health behaviours such as unhealthy diets, physical inactivity, sedentary living, and smoking; and their subsequent health states (e.g., obesity, hypertension) that predispose or correlate with diabetes.¹⁻² There are also underlying social determinants of health or contextual factors, such as food insecurity, housing affordability, sense of belonging, perceived health and socioeconomic status, that combine with these indicators to further contribute to the risk of developing diabetes.³⁻⁴

Previous research has demonstrated that the onset of diabetes can be delayed or prevented with tailored health promotion interventions targeting the modifiable risk factors and determinants of diabetes in clinical and community settings.⁵⁻⁸ Such efforts have the potential to reduce the risk and burden of diabetes by identifying optimal diabetes prevention strategies that are tailored, effective, and solution-oriented. Identifying those groups at the highest risk of future diabetes and their key risk factors is an essential first step in developing such interventions. In this chapter, we have mapped these risk factors to the Socio-ecological Model of Health (*Exhibit 4.1*) to understand the extent to which they are associated with the future risk of diabetes development in the Peel Region.

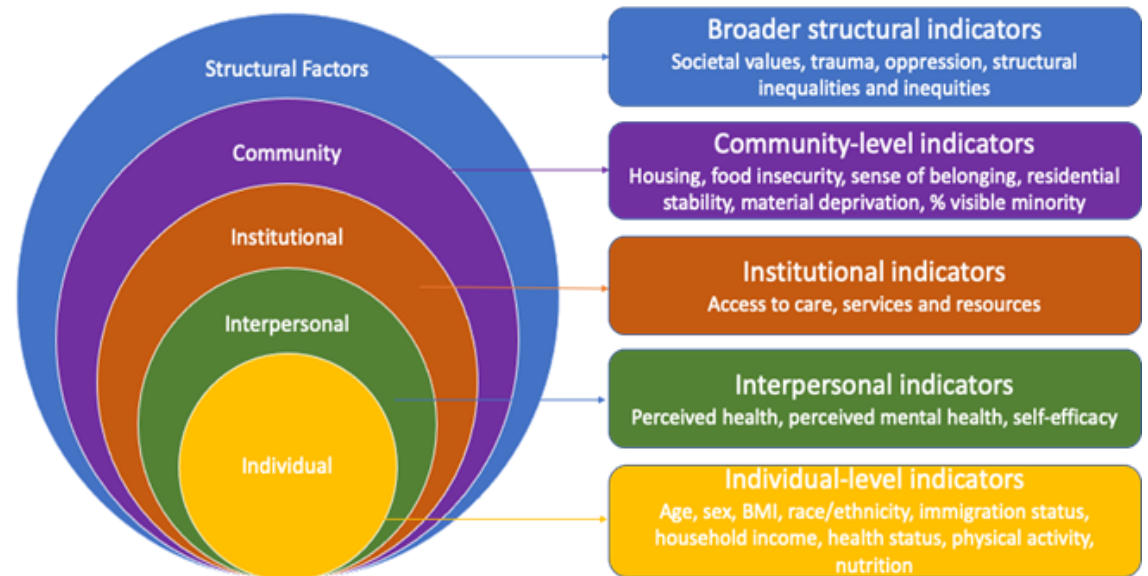


Exhibit 4.1 Mapping the risk factors of type 2 diabetes to the Socio-ecological Model of Health.

This chapter uses the data from the Canadian Community Health Survey (CCHS), a national population-based survey, to 1) describe the distribution of the sociodemographic and behavioural risk factors in persons with and without self-reported diagnosis of diabetes and 2) estimate the 10-year risk of diabetes based on the risk factors among residents living in Peel Region, in Ontario, Canada.

METHODS

The CCHS is a national cross-sectional survey questionnaire developed by Statistics Canada and administered every 1-2 years to collect health-related information from a sample of the Canadian population aged 12 years and above.¹¹ The CCHS is designed to allow for accurate population estimates at the level of a health region, in our case, Peel Region. We used the public use version of the 2017/2018 CCHS survey data, accessed through the University of Toronto and Statistic's Canada Data Liberation Initiative (DLI).

1. Distribution of risk factors in persons with and without diabetes

We used descriptive statistics to calculate the distribution of the risk factors among persons with and without diabetes (as defined by self-report of diagnosed diabetes). The total number of respondents in this sample was 1,462 (167 without diabetes and 1,295 with diabetes) for Peel Region. Due to the small sample size, we were not able to calculate diabetes prevalence by risk factor status.

2. The influence of risk factors on 10-year risk of diabetes

The Diabetes Population Risk Tool (DPoRT) used CCHS survey data to estimate risk of diabetes for different groups. DPoRT provides a unique opportunity to estimate the future risk of developing diabetes based on key risk factors of diabetes and to inform future population-wide diabetes prevention strategies.⁹⁻¹⁰

DPoRT is a population-based risk prediction algorithm that aims to estimate the future risk of type 2 diabetes based on self-reported data on key risk factors, including age, sex, ethnicity, immigration status, body mass index, hypertension, income, food insecurity, social capital, perceived physical health, and access to care among others.⁹⁻¹⁰ The tool has been previously validated in various populations across different ethnic compositions and settings (local, provincial governments and health agencies) and has been an integral component of conceptualizing and

developing population-based interventions by local public health agencies and governments to reduce the future risk of diabetes.¹²⁻¹⁴ Additional details on the creation and validation of the DPoRT tool have been described elsewhere.⁹⁻¹⁰

Risk estimates were calculated among adults in Peel Region who were aged 20 and above and did not self-report previous diabetes or pregnancy at the time the survey was completed. We computed DPoRT risk equations based on risk factor information from the CCHS to predict future diabetes risk and the number of new cases in the 10 years after the most recent CCHS survey in 2017/2018. Survey weights based on Peel Region's population were applied to the estimates to ensure population generalizability. All analyses were completed using SAS Studio 9.4 version. See the Technical Appendix for more details.

RESULTS

1) Distribution of Risk Factors in Persons With & Without Diabetes

The prevalence of key risk factors among those living with and without diabetes is shown in *Exhibits 4.2* and *4.3*. Among residents living in Peel Region, physical inactivity, smoking, overweight/obesity, and hypertension were highly prevalent among those living with diabetes, as shown in *Exhibit 4.2* and described below.

Key Findings:

- Over half of the population in Peel Region are represented by those who identify as a visible minority (58.7% among adults with diabetes and 57.3% among those without diabetes)
- A higher proportion of immigrants are living with diabetes (73.3%) compared to immigrants without diabetes (56.6%)
- Among adults living with diabetes, 40.7% reported being physically inactive, as compared to 27.3% of adults living without diabetes
- A substantial proportion of residents reported being overweight (37.7% with diabetes and 33.2% without diabetes)
- Over half of the residents with hypertension reported having diabetes (60.8%), which was comparable to those living without diabetes (57.4%)
- Generally, food insecurity is an important determinant of diabetes risk and an indicator of poverty; however, in Peel Region, a small proportion of residents reported experiencing severe food insecurity (3.1% among those living with diabetes and 2.0% living without diabetes)
- A small fraction of residents reported an income of <\$20,000 (6.5% among those with diabetes and 5.7% of those living without diabetes).

Table 3.1. List of risk factors categories and indicators from the 2017-2018 Canadian Community Health Survey

Risk Factor Category	Indicator*
Sociodemographic	Age Sex Visible Minority Immigration Status
Health Behaviour	Smoking Physical activity
Health Status	BMI Obesity Hypertension
Social Determinants of Health	Household income Sense of belonging Food insecurity Perceived health Perceived mental health

*Definitions of the indicators are listed in the Technical Appendix

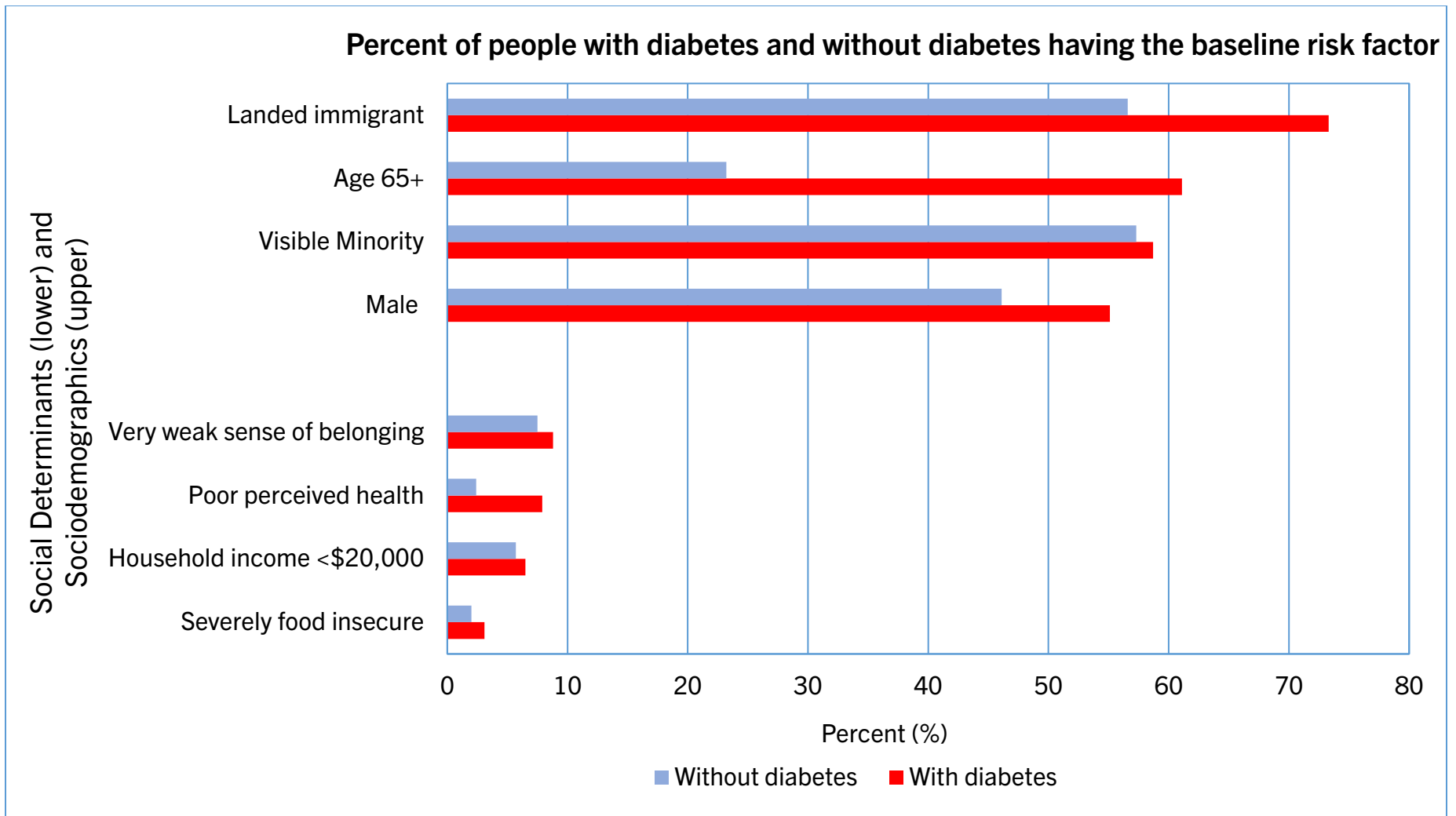


Exhibit 4.2 Proportion (%) of adults aged 20+ living in Peel Region, with (red bar) and without diabetes (blue bar), with unfavorable risk factors: sociodemographic factors and social determinants of health.

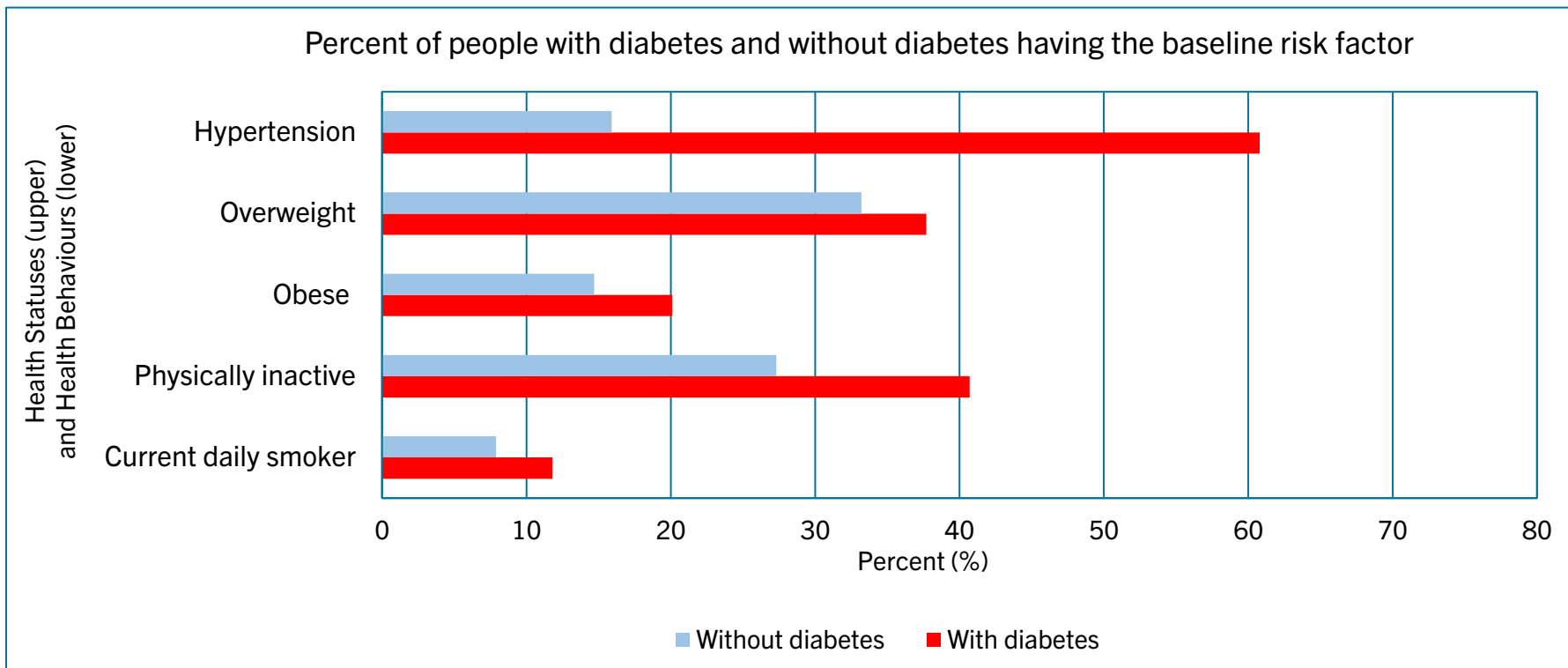


Exhibit 4.3 Proportion (%) of adults aged 20+ living in Peel Region, with (red bar) and without diabetes (blue bar), with unfavorable risk factors: health status and health behaviours.

2) Estimated Future Type 2 Diabetes Cases

In Peel Region, it is predicted that in the subsequent 10 years, according to the most recent CCHS survey in 2017/2018, an additional 102,000 adults aged older than 20 years will be newly diagnosed with type 2 diabetes. Similarly, the 10-year risk of developing new diabetes for residents of Peel Region overall is 11.5% (*Exhibit 4.4*), which corresponds to what has been previously predicted for the region.¹⁴ This projected increase in diabetes risk in Peel will pose significant challenges to the sustainability of the healthcare system due to the increased number of people living with diabetes and needing care.¹⁵

Predicted Diabetes Cases by Sociodemographic Factors

The future risk of diabetes is similar in males and females but increases with age (*Exhibit 4.4*). Between 2017/2018 and 2027/2028, older adults above the age of 65 years are estimated to have the greatest 10-year risk of developing type 2 diabetes, with 1 in 5 seniors being diagnosed over that time period (*Exhibit 4.3*). However, the highest number of new cases of diabetes is expected to be among those aged 45-64 years (42,590 cases) compared to adults older than 65 years (24,968 cases) and younger adults aged 20-44 years (28,730).

The large number of predicted new cases of diabetes among younger adults may be related to the rising incidence of prediabetes,¹⁶ early progression from prediabetes to type 2 diabetes,¹⁷ and young-onset diabetes,¹⁸ which may be amplified with exposure to socioeconomic disadvantages. Moreover, while females currently have a lower burden of diabetes, as shown in Chapter 2, their predicted increase in new cases over the next 10 years is similar to males. Overall, these trends also suggest that the rising diabetes rates in working-age populations contribute to indirect costs to health systems and the economy due to loss of productivity, disability, and absenteeism.

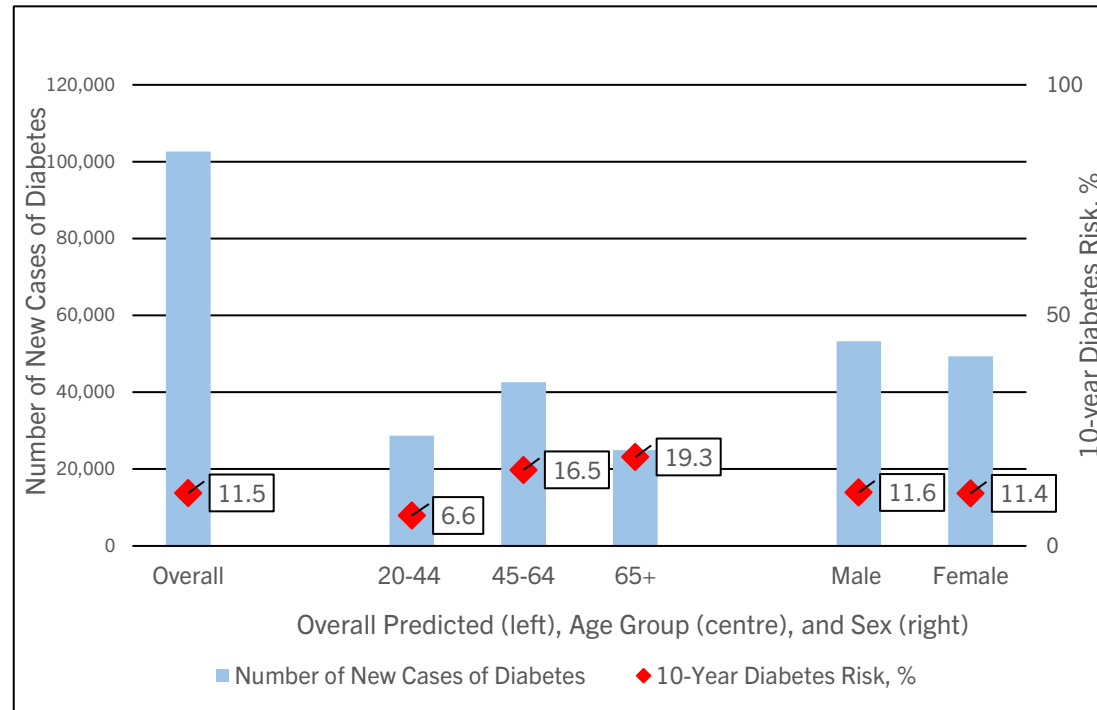


Exhibit 4.4 Predicted number of new diabetes cases and 10-year incidence risk among adults aged 20+ living in Peel Region, overall, and by age group and sex, between 2017-18 and 2027-28.

Visible minority* populations have a 32% greater risk of developing diabetes and twice as many predicted new cases (71,417 cases) compared to non-visible minority counterparts (*Exhibit 4.5*). Similarly, immigrants in Peel Region have a 54% higher risk of developing diabetes, and over one-third more cases are estimated to be diagnosed in immigrants compared to non-immigrant groups. These estimates indicate the future burden of diabetes in Peel will continue to be significant and pose a large burden for individuals, communities, and the health system. Moreover, diabetes health services and prevention strategies will need to prioritize the unique needs and circumstances of visible minority and immigrant populations, who are not only overrepresented in the region but also carry the greatest burden of diabetes.

**Visible minority*: is a CCHS variable that refers to “persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour”, please refer to the technical appendix for a more detailed definition.¹⁹

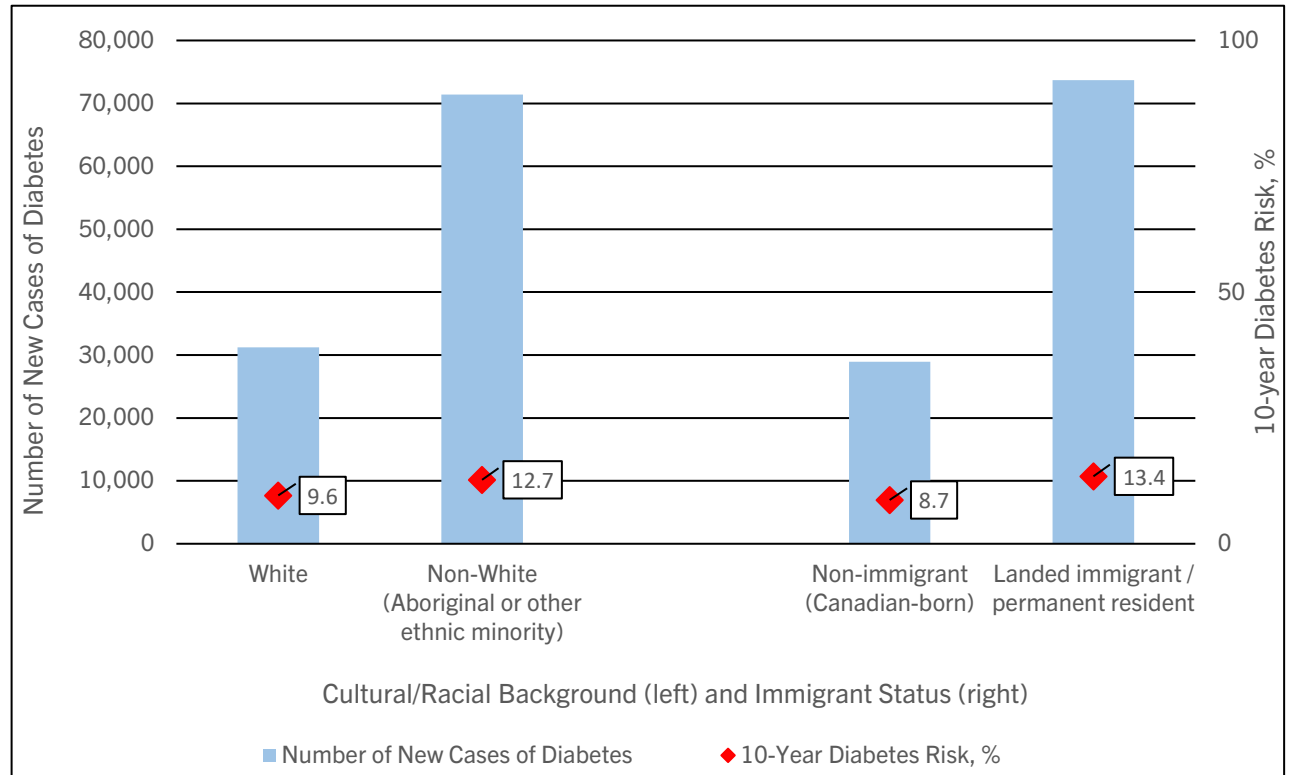


Exhibit 4.5 Predicted number of new diabetes cases and 10-year incidence risk among adults aged 20+ living in Peel Region, by visible minority* and immigrant status, between 2017-18 and 2027-28.

Diabetes Cases by Health Behaviours and Health Status

Between 2017/2018 and 2027/2028, the risk of developing diabetes and the number of new cases among residents living in Peel Region varied across levels of smoking and physical activity (*Exhibit 4.6*). For example, nearly 50% of new cases of diabetes (42,026 cases) are projected to be among those who are physically inactive and have an estimated 40% greater risk of diabetes than their active counterparts (*Exhibit 4.6*). Furthermore, while the 10-year risk of developing diabetes was highest among occasional smokers, the number of new cases of diabetes is projected to be highest among non-smokers (63,667 cases), reflecting the patterns of smoking in the population (*Exhibit 4.6*). There is evidence that suggests that smoking is associated with an increased risk of developing diabetes.²⁰ Future research and policy solutions will need to explore this finding more deeply to determine how best to intervene and reduce future risk of diabetes in this group.

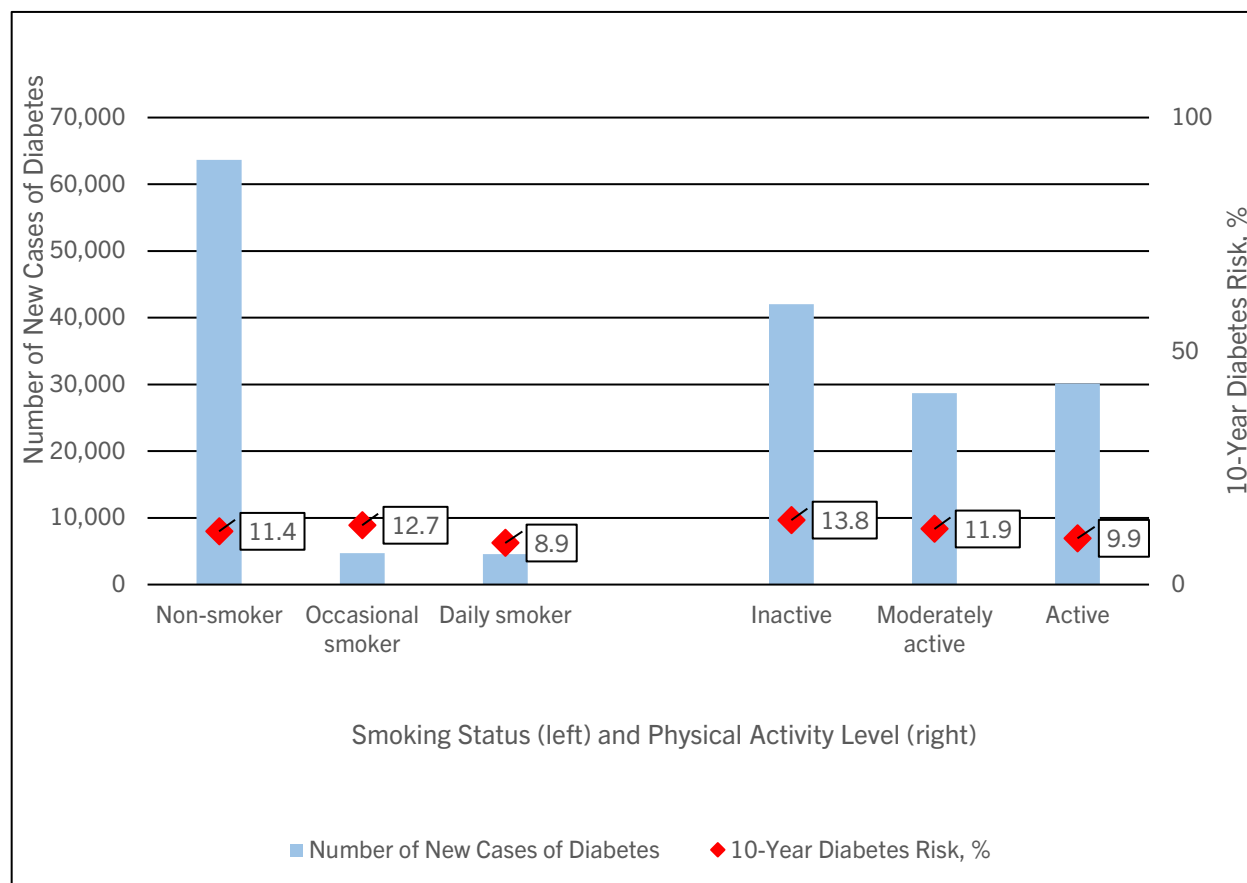


Exhibit 4.6 Predicted number of new diabetes cases and 10-year incidence risk among adults aged 20+ living in Peel Region, by smoking status and physical activity level, between 2017-18 and 2027-28.

Not surprisingly, the future risk of developing diabetes increased substantially with increasing weight categories. Compared to a 10-year risk of 7.7% among those with normal weight, the risk of diabetes was 50% higher, close to 3-fold higher, and over 4-fold higher for those who were classified as overweight, obese, and severely obese, respectively (*Exhibit 4.7*). However, of the total number of new cases of diabetes projected over 10 years, over one-third (41.3%) are among those who were overweight (39,002 cases) compared to those who were classified as obese (18,974 cases) and severely obese (11,450 cases). This reflects the fact that the largest proportion (over 30%) of Peel residents without diabetes are overweight rather than being in other body mass index (BMI) categories (*Exhibit 4.3*). This finding further emphasizes the importance of considering population-wide strategies for diabetes prevention along with targeted high-risk approaches tailored to different populations.

Similarly, hypertension is another important risk factor for diabetes incidence, whereby the 10-year risk of developing diabetes among those with hypertension was over 2-fold higher than those with normal blood pressure. The largest number of new cases of diabetes is projected to be among those with normal blood pressure (68,066 cases) compared to those with elevated blood pressure (34,549 cases) (*Exhibit 4.7*). This again emphasizes that those with risk factors are at high risk, but the distribution of risk in the population must also be considered such that population-wide interventions that reach all segments of the population to promote healthy behaviours and ensure that the overall burden of diabetes is reduced.

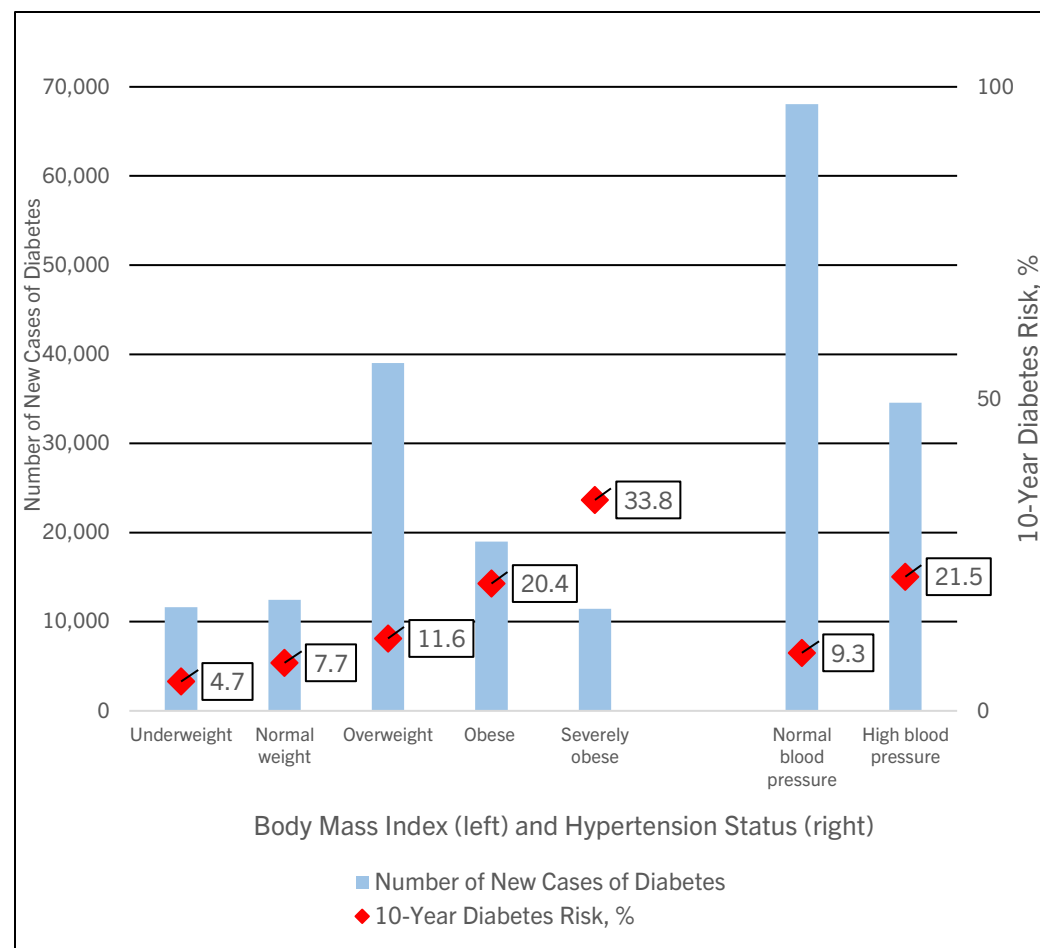


Exhibit 4.7 Predicted number of new diabetes cases and 10-year incidence risk among adults aged 20+ living in Peel Region, by Body Mass Index (BMI) and hypertension status, between 2017-18 and 2027-28.

Diabetes cases by social determinants of health

In Peel Region, the predicted risk of diabetes is highest in populations with the lowest household income. Between 2017/2018 and 2027/2028, the 10-year risk of developing diabetes is approximately 40% higher among those in the lowest income bracket (<\$20,000) than all other income groups. Furthermore, the highest number of 28,187 new cases will be diagnosed in those with the lowest household income (*Exhibit 4.8*). This indicates that the greatest burden of diabetes will be felt in marginalized populations and will require combined efforts between the healthcare and social systems to adequately reduce risk and manage the condition in the years to come.

While the number of new diabetes cases was most pronounced among food-secure households and accounted for 91.6% of new cases of diabetes (94,189 cases), 10-year risk of developing diabetes is disproportionately larger in Peel residents experiencing food insecurity (*Exhibit 4.9*). Food insecurity still remains one of the most potent determinants of health and poverty and particularly of future diabetes risk and burden.²¹

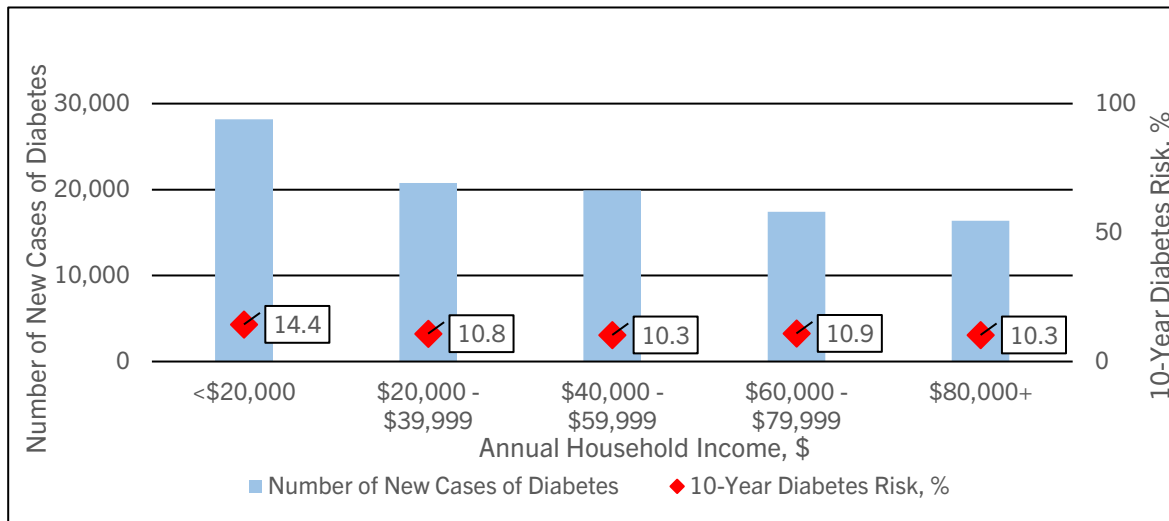


Exhibit 4.8 Predicted number of new diabetes cases and 10-year incidence risk among adults aged 20+ living in Peel Region, by annual household income, between 2017-18 and 2027-28.

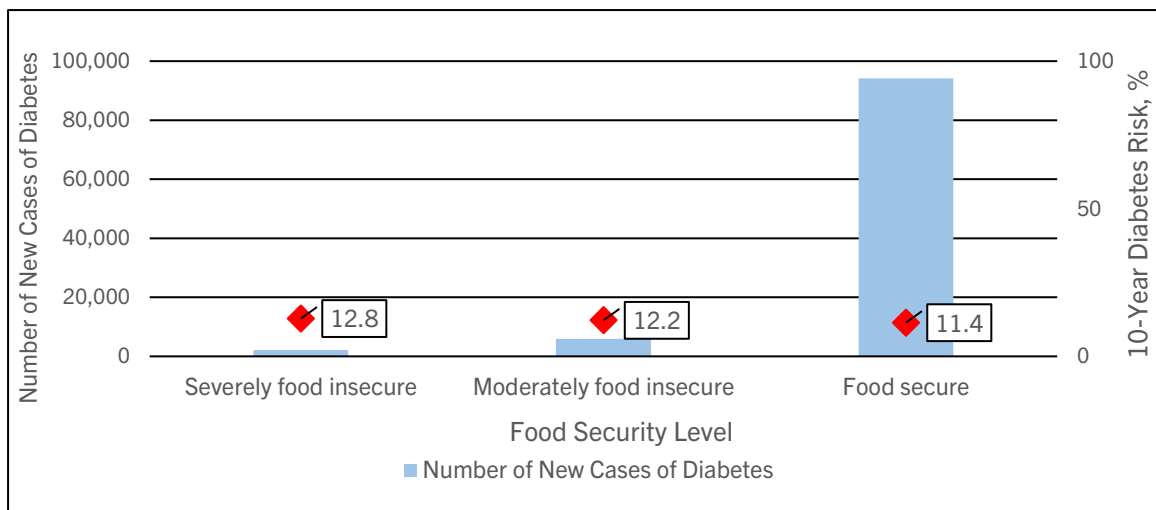


Exhibit 4.9 Predicted number of new diabetes cases and 10-year incidence risk among adults aged 20+ living in Peel Region, by food security level, between 2017-18 and 2027-28.

Over the next 10 years, the future estimated risk of developing diabetes was 1.5 to 2-fold higher for persons who reported fair or poor perceived health. On the other hand, the largest number of new cases are predicted to occur in those who perceive their health as good, indicating a need for broad population-based education regarding diabetes risk (*Exhibit 4.10*). A sense of belonging in one's community is an important indicator of social capital. Self-reported sense of belonging did not appreciably influence the 10-year estimated risk of diabetes for Peel residents. Further research may be needed to explore more deeply how improving or targeting a sense of belonging in future community-based interventions may help to curb diabetes risk in the region.

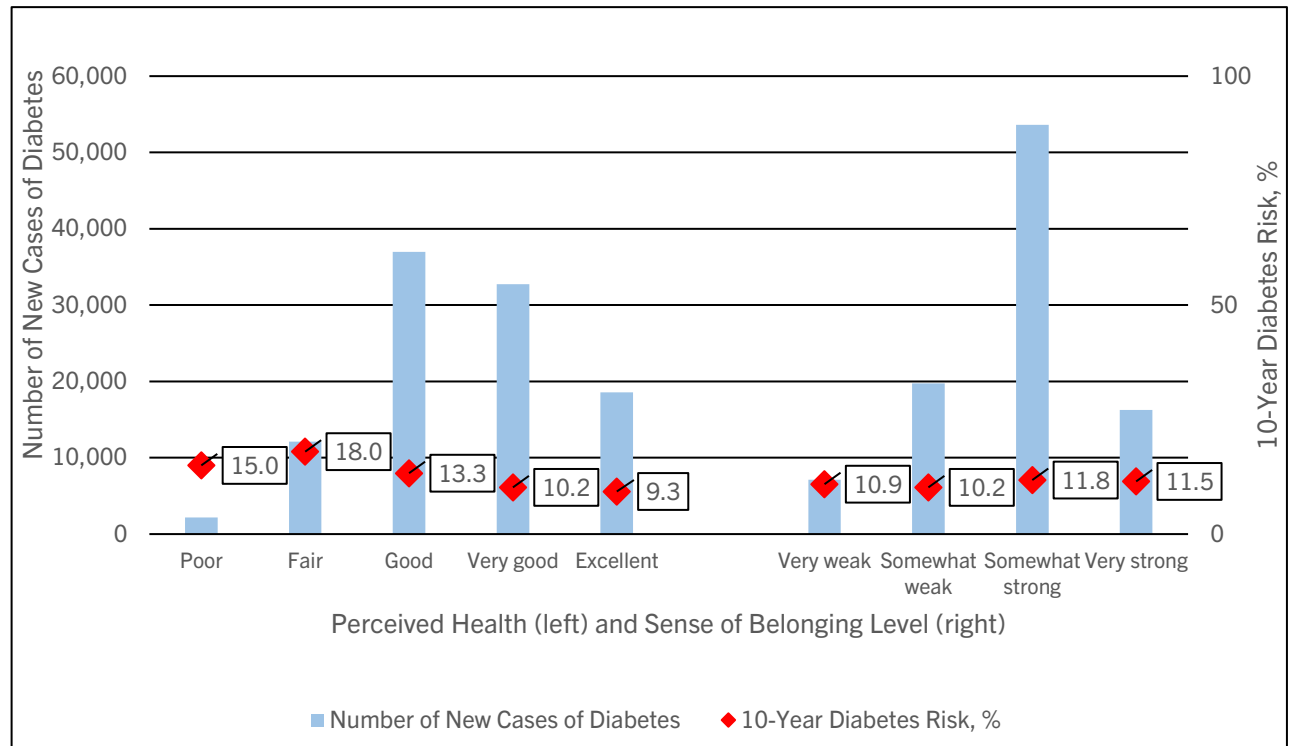


Exhibit 4.10 Predicted number of new diabetes cases and 10-year incidence risk among adults aged 20+ living in Peel Region, by perceived health and sense of belonging, between 2017-18 and 2027-28.

INTERPRETATION

Summary of Findings

In this chapter, we have shown the high future diabetes risk expected in Peel region and the key individual and community-level determinants of health that are associated with this future risk. Specifically, along with increasing age and being from a visible minority or immigrant population, social disadvantages due to low socioeconomic status and food insecurity, in combination with being overweight or obese and physically inactive, were highly prevalent risk factors for future diabetes burden among those living in Peel Region.

In particular, the highest predicted risk (%) of diabetes will occur among those with the following risk factor characteristics:

- Older age
- Visible minority
- Low household income (<20,000 per year)
- Food insecurity
- Physically inactive
- Overweight or obese
- Hypertension

Our findings reveal that in the coming years, diabetes incidence in Peel Region is projected to rapidly increase, particularly among those experiencing a greater degree of socioeconomic disadvantages and health inequities. Inequities in access to income, employment, housing, and food security are major drivers of chronic disease risk and burden.²² Thus, these findings have important implications for addressing the future onset of diabetes and potential complications. Specifically, disparities in household income, food insecurity and modifiable risk factors such as physical inactivity, overweight and obesity, and hypertension will require multi-faceted and tailored policy interventions to curb the projected incidence of diabetes in the region and improve the quality of life.

The future risk of developing diabetes among residents in Peel was disproportionately elevated among visible minority and immigrant groups. This unequal distribution and projected risk of diabetes in these populations are important prompts for developing and implementing culturally tailored policy and programmatic interventions that consider the unique

needs and circumstances of these groups. Strategies will need to target the macro-level determinants (i.e., living environments, social policies, and structural inequalities) as well as the meso-level determinants (i.e., health literacy and beliefs, food insecurity, housing affordability) of diabetes risk to optimize opportunities and empower individuals to adopt healthy behaviours (i.e., physical activity, healthy eating, etc.).

Health behaviours such as physical inactivity, sedentary lifestyles, unhealthy eating patterns, and consequent overweight and obesity are more common among those living in low socioeconomic status, thereby increasing the future risk of developing diabetes.²³⁻²⁵ Previous research has shown that those living in lower socioeconomic status experience significant inequities and barriers to adopting healthy behaviours.²²⁻²⁴ This is largely due to living in areas with limited -to no- access to healthy resources (i.e. healthy food options, parks and greenspace, public transit, and community resources) and lack of policies and interventions that target the social indicators of poverty and diabetes risk such

as food insecurity and housing affordability.²⁶⁻²⁸ This is particularly important because our findings revealed that future risk of diabetes will disproportionately occur among those who have a lower household income and, are physically inactive, overweight, or obese, and are experiencing severe food insecurity.

Limitations

There are a few limitations to consider in this chapter. First, the analysis was limited to one CCHS cycle, which limited the ability to explore diabetes prevalence across risk groups or regional variation in risk factors and estimated future risk due to a smaller sample size and representation. Second, the findings presented are based on self-reported data collected by the CCHS, and thus, there may be some degree of reporting bias, including recall of risk factor information, social desirability in reporting certain information and overreporting some health and health behaviour information. Thus, it is possible that the estimates generated from DPoRT may underestimate the true diabetes risk among those living in Peel Region. Future research should explore the risk and burden of diabetes

using a combination of large population-based datasets as well as additional cycles of survey information to gain a deeper understanding of the future risk of diabetes in the population.

Implications & Future Directions

This chapter presented new information on the future risk of diabetes among residents living in Peel Region. This was calculated using individual-level risk factor information, including sociodemographic, health behaviour and social determinants of health and a validated diabetes risk prediction algorithm. In particular, we found that low household income, physical inactivity, overweight and obesity, hypertension, and food insecurity are significant drivers of future diabetes risk. As well the projected risk of diabetes is also disproportionately high among racialized communities (visible minority and immigrant populations). In future efforts, this information is integral for gaining a deeper understanding of the inequities that drive diabetes risk in these communities and for identifying future research priorities and policy interventions to address them.

Future policy interventions will need to consider the interconnected nature of the

many socioeconomic disadvantages that drive diabetes risk and identify prevention strategies that target the macro, meso, and micro-level determinants of diabetes through individual (high-risk) and population-level approaches. For instance, the distribution of the projected incidence of diabetes observed across various risk factors suggests that diabetes prevention strategies may need to include a combination of individual and population-wide approaches across different healthcare and public health programming and policies.

Examples of individual approaches may involve identifying high-risk populations across different settings (clinics, community, workplaces), incorporating diabetes prevention efforts into routine preventive health care services, and empowering individuals to identify and adopt healthy behaviours (i.e., physical activity and healthy eating).²⁹⁻³¹ Furthermore, action at the population level is required to support individuals such as interventions and policies targeting food insecurity, taxation of unhealthy foods, housing affordability, socioeconomic status, workplace wellness and improving the built environment through healthy

neighbourhood design may help to achieve a greater impact on diabetes risk reduction and prevention.²⁹⁻³¹

In doing so, policymakers and health planners may need to consider the contexts and environments (i.e. social and physical environments) that may influence the future onset of diabetes in Peel. Given the wide distribution of risk in the population, interventions that consider reaching whole populations (e.g., policies and built environment) will have the greatest impact on reducing the overall diabetes burden. Thus, combined efforts between individual and population-level approaches are required to shift the distribution of diabetes risk and achieve substantial benefits for health systems and economies.

Because Peel's population is heterogeneous and ethnically and culturally very diverse, it offers a unique

opportunity for future research and policy interventions to collaborate with community partners across different sectors and agencies and engage with patients and community members in all stages of the research and policymaking process. This step is vital to better understand the implications and meaning of these findings for the community and to co-create knowledge to determine 'research needs and scope', 'what intervention and prevention strategies are necessary', 'what works for whom' and 'under what local contexts' in order to meet the needs of the community and to achieve the greatest impact in reducing diabetes risk. Thus, moving forward, such engagements are integral for current and future diabetes research and policy efforts to collectively identify multi-faceted approaches to addressing the projected risk of diabetes in the Peel Region.

In summary, population-based risk prediction algorithms are promising avenues to inform diabetes prevention strategies and the development and implementation of potential local health-promoting interventions. DPoRT has been integral in guiding and supporting local health decision-making and planning initiatives across several settings and populations. The projected incidence of diabetes for Peel Region across several modifiable risk factors can help to prompt and direct where future policy interventions will need to target through individual and population-level approaches and community engagement efforts in order to reduce the future risk and burden of diabetes, promote healthier living and improve quality of life.

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