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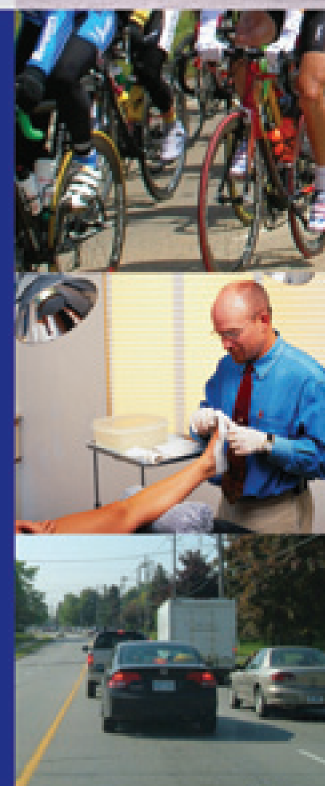
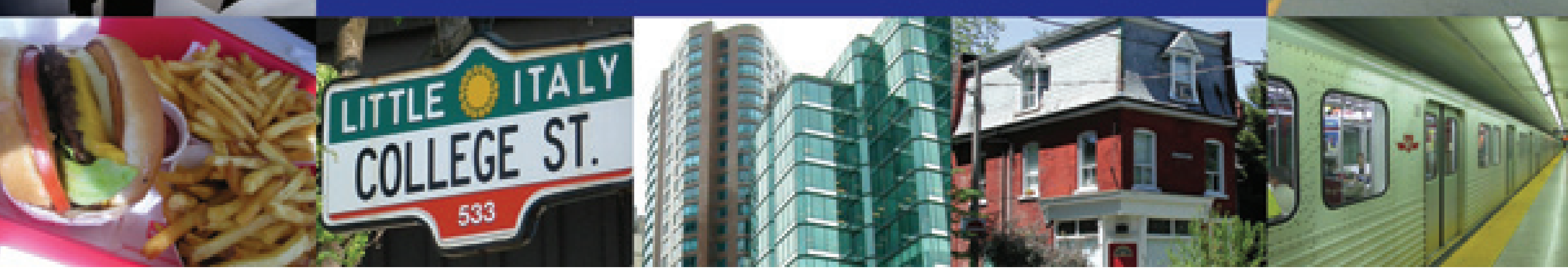
Neighbourhood Environments and Resources for Healthy Living—A Focus on Diabetes in Toronto

ICES Atlas

November 2007





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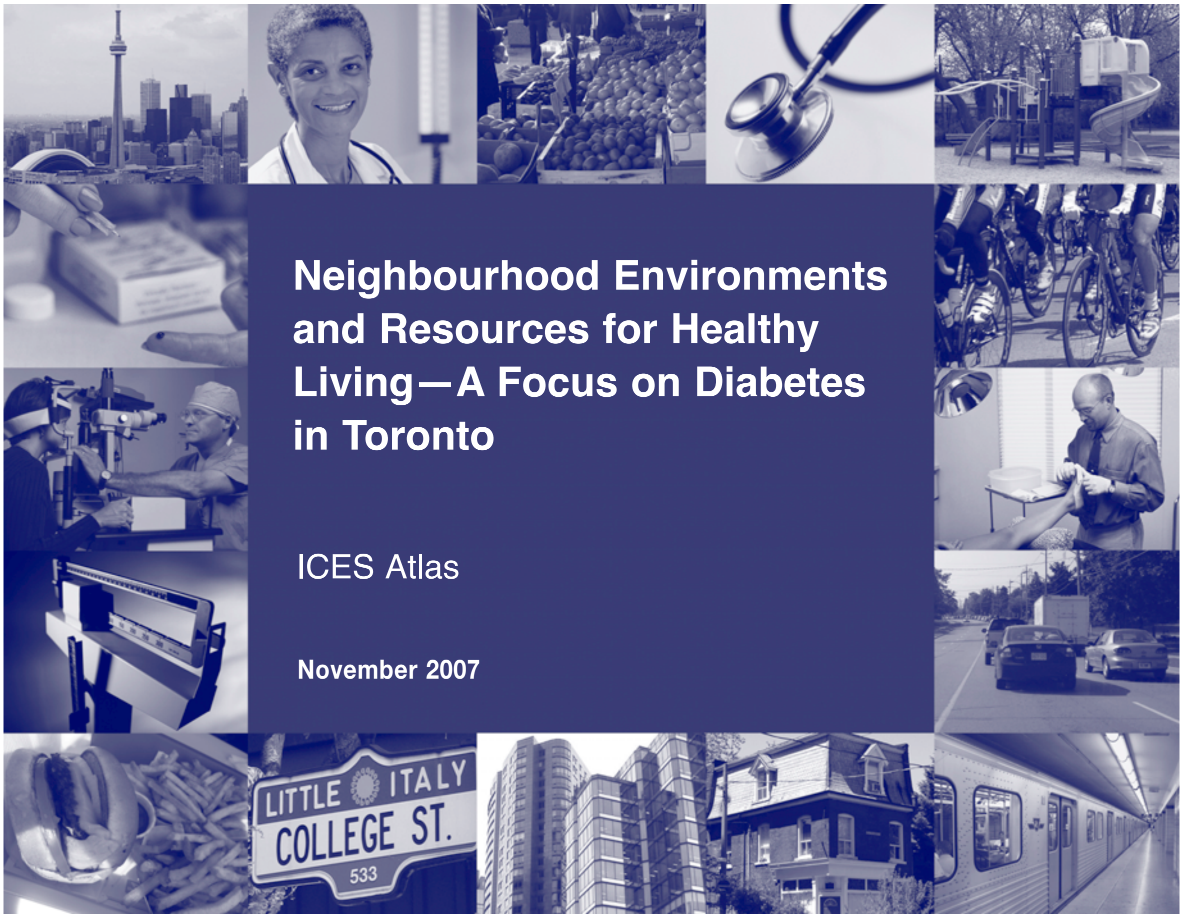

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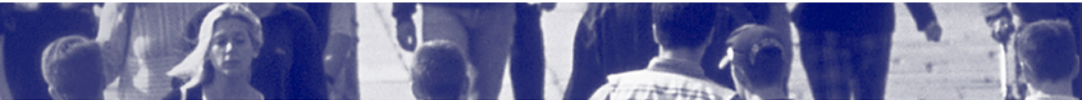

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About our Sponsoring Organizations

Institute for Clinical Evaluative Sciences (ICES)

Ontario's resource for informed health care decision-making

The Institute for Clinical Evaluative Sciences (ICES) is an independent, non-profit organization that produces knowledge to enhance the effectiveness of health care for Ontarians. Internationally recognized for its innovative use of population-based health information, ICES' evidence supports health policy development and guides changes to the organization and delivery of health care services.

Key to our work is our ability to link population-based health information, at the patient-level, in a way that ensures the privacy and confidentiality of personal health information. Linked databases reflecting 12 million of 30 million Canadians allow us to follow patient populations through diagnosis and treatment, and to evaluate outcomes.

ICES brings together the best and the brightest talent under one roof. Many of our scientists are not only internationally recognized leaders in their fields, but are also practicing clinicians who understand the grassroots of health care delivery, making the knowledge produced at ICES clinically-focused and useful in changing practice. Other team members have statistical training, epidemiological backgrounds, project management or communications expertise. The variety of skill sets and educational backgrounds ensures a multi-disciplinary approach to issues and creates a real-world mosaic of perspectives that is vital to shaping Ontario's future health care system.

ICES receives core funding from the Ontario Ministry of Health and Long-Term Care. In addition, our faculty and staff compete for peer-reviewed grants from federal funding agencies, such as the Canadian Institutes of Health Research, and project-specific funds are received from provincial and national organizations. These combined sources enable ICES to have a large number of projects underway, covering a broad range of topics. The knowledge that arises from these efforts is always produced independent of our funding bodies, which is critical to our success as Ontario's objective, credible source of *Evidence Guiding Health Care.*

Centre for Research on Inner City Health (CRICH)

The Centre for Research on Inner City Health (CRICH) at St. Michael's Hospital in Toronto is Canada's only hospital-based research organization focused on the health consequences of urban life and social inequality. Across a range of health conditions and in spite of universal health care policies, lower income populations are at greatest risk for illness and experience the greatest unmet need for health care services.

CRICH generates scientific evidence and tools to address these health-care barriers and to design effective interventions aimed at reducing health disparities. Our research priorities include: health-promoting neighbourhoods, health effects of homelessness and under-housing; and evaluating health services for marginalized groups. Our health database program maintains one of Ontario's most extensive arrays of administrative datasets pertaining to health and social services and also to community infrastructure.

Genuinely transdisciplinary, CRICH scientific strengths include economics, ethics, geography and GIS mapping techniques, health services research, medicine, psychology, psychiatry and social epidemiology. One-third of CRICH faculty members are front-line physicians at St. Michael's Hospital, providing a direct link between population research and patient care. Most issues studied at CRICH span multiple policy sectors, and CRICH researchers are called upon to collaborate with communities and decision-makers in health care, housing, community and social services, urban planning and immigration portfolios.

CRICH is affiliated with the University of Toronto and is part of the Keenan Research Centre in the Li Ka Shing Knowledge Institute of St. Michael's Hospital. CRICH is supported by the Ontario Ministry of Health and Long-Term Care to conduct research which helps ensure that Ontarians have equitable access to care services, regardless of who they are, where they live or what they own.

Preface

Why a Toronto Diabetes Atlas?

A growing body of research supports the notion that where people live has a significant impact on their health. The relationship between neighbourhood environment and health may be due, at least in part, to the availability of resources in a community, and in particular, to the availability of resources that promote a healthy lifestyle.

Historically, researchers have found a strong relationship between type 2 diabetes and lifestyle. It has been shown that a healthy diet and regular physical activity are key factors in the prevention and control of diabetes.

This Atlas describes certain observed relationships between neighbourhood characteristics and the local prevalence of diabetes, using geographic methods to illustrate and measure patterns in and across Toronto's 140 neighbourhoods. These spatial concepts and approaches have helped us quantify and better understand how the urban environment influences lifestyle choices and how this might impact rates of diabetes.

As part of our research project, we created two original tools aimed at measuring relevant characteristics of Toronto neighbourhoods:

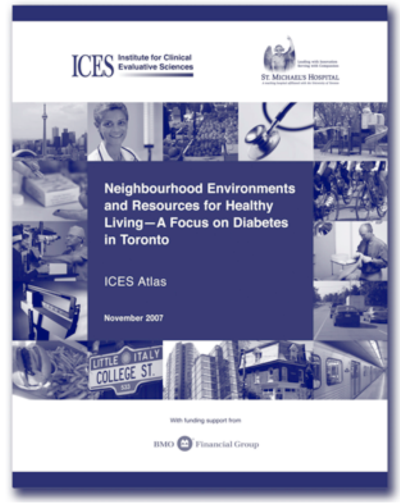
- The Activity-Friendliness Index (AFI) was developed to measure how conducive individual neighbourhoods were to walking, bicycling and other types of physical activity.

- The Healthy Resources Index (HRI) was developed to quantify the local availability of and access to health care resources within neighbourhoods, including access to diabetes treatment and education.

We collected and analyzed data on a variety of factors which we felt had the potential to influence lifestyle choices at the neighbourhood level. These included: the location of and travel time to parks, schoolyards and recreational spaces, and the locations of and travel times to grocery stores, convenience stores and fast food outlets.

Since the use of primary health care services is key to the prevention of diabetes in high-risk populations and the management of diabetes in people living with the disease, we also measured the accessibility of physicians and community diabetes programs according to people's neighbourhood of residence.

Finally, because we understand that interactions between people and their environment are extremely complex, we chose to incorporate socioeconomic and ethnoracial data into our study.



We focused on type 2 diabetes because of its relationship to obesity and also because of growing interest in the concept of "obesogenic" environments in North America (i.e., environments that promote obesity). Although we cannot reliably distinguish between type 1 and type 2 diabetes in our data, the latter accounts for the majority of all diabetes cases, and the population with type 2 diabetes is rapidly growing. While the focus of our work is on diabetes, obesity, high blood pressure and heart disease share many of the same determinants. We believe a majority of our findings might have some relevance to the prevention and control of those health problems.

Our purpose in undertaking this research project was to find out more about neighbourhood characteristics and their possible relationships to the health of Torontonians. The ultimate goal was to develop a body of evidence that would help decision-makers, planners and other stakeholder groups develop policies to promote healthier lifestyles.

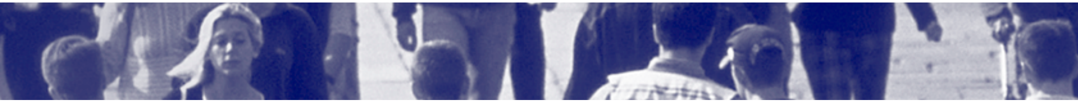
We realize that changing behaviours related to diet and activity on a population level will likely require multiple interventions across diverse sectors, as well as a fundamental shift in how the public views these issues. We also realize and emphasize that many factors which influence health are not within our control; however, we are convinced that certain features of urban and suburban environments could be altered for the long-term health benefits of local residents.

Who Should Be Reading this Atlas?

This Atlas responds in a unique way to growing concerns over rising rates of type 2 diabetes. Our approach has been to focus on potential environmental influences on health at the neighbourhood level.

We believe our findings will be relevant to a wide range of stakeholders with divergent interests. These include: municipal, provincial and federal planners, decision-makers and policy makers; health care providers, including primary care providers and specialists in diabetes; diabetes educators; nutritionists and dietitians; physical education experts; public health and health promotion departments; parks and recreation departments; public transit officials and decision-makers; public schools; the food service industry, including retailers; academics; and researchers studying a range of health, behavioural and environmental issues.

We also believe the Atlas will be of interest to people with diabetes who live in Toronto, and also to those living in similar-sized cities across Canada, the United States and elsewhere.



How to use this Atlas

The range of topics covered in this Atlas is quite broad, and for that reason the Atlas has been divided into chapters which are grouped together thematically. Each chapter contains an Executive Summary, Introduction, List of Exhibits, Findings, a Discussion section and Conclusions/ Next Steps.

Chapters

- Chapters 1 and 2 set the context for the Atlas and present important background information regarding type 2 diabetes and related conditions and risk factors in Toronto. It also explains why we have focused on health at a neighbourhood level and impresses upon the reader the value of using geographic techniques to understand health disparities across Toronto communities.

- Chapters 3, 4, 5 and 6 describe Toronto neighbourhoods with respect to their social and physical environments; how these environmental factors relate to diabetes; and how these neighbourhood characteristics may have influenced physical activity levels within neighbourhoods.

- Chapters 7–12 describe our findings about what we have named "resources for healthy living" within neighbourhoods. These include: recreational spaces (i.e., parks, schoolyards, bicycle paths) and public recreational facilities; stores that sell fresh produce; family physicians/general practitioners; and diabetes education programs. We also include data on locations of and access to convenience stores and fast food outlets. The Atlas describes how these resources were distributed across the city and how their availability related to rates of diabetes within different neighbourhoods.

- Chapter 13 summarizes our findings about neighbourhood characteristics, expressing them in the form of "neighbourhood profiles" which describe the strengths of Toronto communities and highlight neighbourhoods that might benefit from interventions.

- Chapter 14 addresses the policy implications of our research. It includes a review of our key findings and suggests specific strategies to improve the health of Toronto residents and possibly help reverse current trends in obesity and the development of type 2 diabetes.

Exhibits

This Atlas is rich in visual content and includes many exhibits, mainly in the form of maps, although some data are presented in the form of graphs and tables. Certain general reference and thematic maps may require some explanation to help readers with their interpretation. A general guide on how to read and interpret the maps can be found in Appendix A: Guide to Atlas Maps *(see page 309).*

Glossary and Technical Notes

While the analyses and results described in this Atlas are based on rigorous scientific methods, a conscious effort was made to avoid presenting complex formulae and figures, and to avoid using technical terminology more suited to specialized journals and scientific publications.

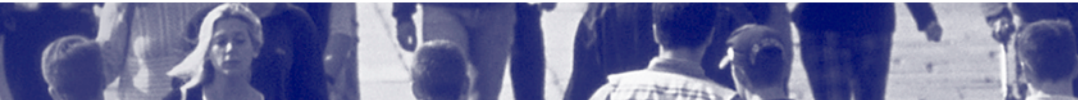
A Glossary of Terms is provided to help readers understand any unfamiliar terminology in the Atlas *(see page xv).*

A fuller explanation of our data sources, geographic methods and analyses can be found in Appendix B: Technical Notes *(see page 313).*

About the Style of the Atlas

The written text in the Atlas highlights information about the relationships we observed between diabetes and socioeconomic and environmental factors. We intentionally limited the amount of text so readers could more easily review the chapters and focus primarily on the various concepts found on the maps.

Although each chapter of this publication is distinctive in scope and subject matter, many of the patterns and general findings are revisited in subsequent chapters and are applicable throughout the Atlas.



Executive Summary

Issue

Like many other countries around the world, Canada has experienced a substantial rise in the prevalence of obesity over the past two decades. As a result of these trends, rates of type 2 diabetes (a major consequence of obesity) are soaring, and the onset of type 2 diabetes is occurring at younger and younger ages.

Poor dietary habits and an increasingly sedentary lifestyle have been major factors fuelling the obesity epidemic. Achieving broad-scale improvements in healthy eating patterns and increases in physical activity would likely offset the rise in obesity and type 2 diabetes in the general population. However, accomplishing this will be particularly challenging, given the "obesogenic" environment in much of North America.

Why study neighbourhoods?

A growing body of research supports the notion that where people live has a significant impact on their health. Neighbourhoods that are more activity-friendly (i.e., they offer more opportunities for regular physical activity) and which also encourage healthier food choices could have a favourable effect on residents' health, including their risk for obesity and diabetes.

Why focus on Toronto?

Toronto is one of the most multicultural cities in the world, with approximately half its population born outside Canada. The city is also home to some of the lowest-income neighbourhoods in the country. For these reasons, Toronto provided an excellent setting to investigate the complex interactions between urban populations and their environment, and to explore how these relationships impact the health and well-being of local residents.

Study

This Atlas describes relationships between neighbourhood characteristics and the local prevalence of diabetes, using geographic methods to illustrate and measure patterns in and across Toronto's 140 neighbourhoods.

Key Findings

- Neighbourhoods located in the northwest and east ends of Toronto had the highest rates of diabetes; these areas also had lower average annual household income levels and high proportions of residents who belonged to a visible minority group and/or who had recently immigrated to Canada.
- Outlying areas of Toronto, including those in the northwest and east ends of the city with high rates of diabetes, were built largely after the Second World War. Compared to more central parts of the city, these outlying neighbourhoods were more sparsely populated, had poorer access to public transit and retail services, and had higher rates of car ownership. Residents in these areas also reported relatively fewer walking, bicycling and public transit trips per day.
- In contrast, the south central part of Toronto and the downtown core had low diabetes rates. Even socially disadvantaged neighbourhoods in this part of the city had lower-than-expected rates of diabetes.
- Neighbourhoods in south central Toronto were built largely in the pre-war era. Compared to more outlying areas, they were characterized by a high population density, mixed residential and commercial land use, dense road and public transit networks and lower rates of car ownership. South central Toronto also had a relatively high number of bicycle lanes. Residents in these areas reported relatively more walking, bicycling and transit trips per day.
- Areas in and around south central Toronto scored highest on the Activity-Friendly Index (AFI), a unique measure of how conducive neighbourhoods are to daily physical activities. Scores were lowest in more outlying areas of the city. People living in neighbourhoods that were more activity-friendly reported more walking or bicycling trips per day and had lower rates of diabetes. This relationship between low activity-friendliness and high diabetes rates was strongest in "high-risk" neighbourhoods (i.e., those characterized by lower income levels and higher proportions of visible minority residents).
- South central Toronto scored highest on the Healthy Resources Index (HRI), another unique measure which looks at access to local healthy resources within neighbourhoods. Areas in the northwest and east ends of the city (where diabetes rates were high) scored lowest on the HRI. In outlying areas, access to the following resources was especially poor: stores selling fresh fruits and vegetables; primary care physicians; and diabetes education programs. Several of these outlying neighbourhoods also had comparatively

longer travel times to parks, schoolyards and recreation facilities (in some cases as long as 20 to 40 minutes each way by walking or public transit). Better access to healthy resources was associated with low diabetes rates, especially in low-income and other "high-risk" parts of the city.

- High income appeared to be protective against diabetes, even in parts of Toronto that scored low on activity-friendliness or had poor access to healthy resources.
- Self-reported rates of physical inactivity were highest in the east end of the city. These areas also had low rates of daily fruit and vegetable consumption.
- Fast food was readily available and easily accessible in almost all areas of the city. The downtown core had the highest density of fast food outlets. Areas that experienced both high diabetes rates and good access to fast food outlets tended to be neighbourhoods with high levels of immigration, high proportions of visible minority residents and lower average annual household incomes.

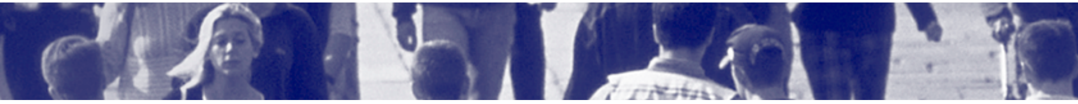
Implications

- Policies that identify neighbourhoods for attention and investment should take into account the health needs of the local population and the existing availability of resources that promote a healthy lifestyle. We noted a striking mismatch between areas of Toronto where healthy resources were most needed and where they were located.

- We suggest a number of strategies which could create more opportunities for Torontonians—particularly those living in the outer, more suburbanized areas of the city where diabetes rates were highest—to become more physically active and to consume a healthier diet. The suggested strategies include: making changes in planning, development and zoning practices to reduce urban sprawl, increase residential density, and promote mixed land use; providing incentives for stores selling fresh produce and other services to move into high-need areas; and increasing access to public transit.

- Limiting consumption of high-fat/high-calorie fast foods is important for the prevention of obesity and its consequences, including diabetes. Given the ubiquity and popularity of fast food outlets in Toronto, policies that promote healthier food choices by consumers and healthier menu offerings by food retailers should be pursued.

- Investing in high-need communities has the potential to reduce the risk for diabetes and improve the control of this disease in those affected. Such investment would also enhance the overall health of residents living in those parts of the city. High-risk neighbourhoods (i.e., those with a greater prevalence of diabetes or diabetes-related risk factors) in particular are ideal targets for community-based interventions aimed at diabetes prevention and management. A focus on community development and community action may be needed at the local level to fully capitalize on potential interventions to improve health in disadvantaged neighbourhoods.



Glossary of Terms

Abdominal obesity

Refers to the accumulation of fat within the abdominal region as typically indicated by a waist circumference ≥ 102 cm (40 inches) in men and ≥ 88 cm (35 inches) in women; these thresholds are associated with a substantially increased risk of developing an obesity-related disease.[1] Lower thresholds (≥94 cm for men and ≥80 cm for women) are also associated with increased risk.[2] These thresholds can vary depending on ethnoracial group. Abdominal obesity is associated with an increased risk of type 2 diabetes and cardiovascular disease.[1]

Aboriginal

An inclusive term which refers to all Canadian Aboriginal peoples regardless of residential location. In Chapter 4, the percent of the population that was Aboriginal in 2001 was used as a demographic variable and was derived from the 2001 census. Respondents were ask to answer the question: "To which ethnic or cultural group(s) did your ancestors belong?" For the analysis in Chapter 4, Aboriginal population refers to the people who reported at least one Aboriginal origin (e.g., North American Indian, Métis, Inuit) in responding to this question.

Access

In the context of this publication, access refers to geographic access to a resource (i.e., being able to get to a specific resource location within a specified travel time by walking, bicycling, public transit or car).

Angina

Refers to a type of chest pain that occurs when there is not enough blood flow to the heart muscle. This is usually the result of a narrowing of the arteries that supply blood to the heart.

Body Mass Index (BMI)

This refers to a method of calculating total body mass which factors in a person's weight and height according to the equation: BMI=weight (kg)/ height(m).[2] According to Health Canada, a person with a BMI below 18.5 is considered underweight; a BMI between 18.5 and 25 is considered healthy; someone with a BMI above 25 is considered overweight; someone with a BMI above 30 is considered obese.

Cardiovascular disease

This includes a number of diseases affecting the heart or blood vessels (e.g., angina, heart attack, stroke and other circulatory problems).

Census Dissemination Area (DA)

This designation was created by Statistics Canada, starting with the 2001 census. With a median population of 540 people, dissemination areas are the smallest census unit for which sociodemographic information is available.

Centre for Research on Inner City Health (CRICH)

The Centre for Research on Inner City Health, located at St. Michael's Hospital in Toronto, Ontario, is the first centre of its kind in Canada. Its mission is to improve the health of urban populations through a program of policy-relevant research, with particular emphasis on the needs of socially disadvantaged and economically deprived groups.[3]

Choropleth (shaded) map

This is a type of statistical or thematic map depicting a rate or ratio for a given attribute by representing ranges of values with different shades or colours.

City of Toronto neighbourhoods

Created by the City of Toronto, neighbourhoods consist of several adjacent census tracts demonstrating fairly homogenous demographic and socioeconomic characteristics. These neighbourhoods are the basic area unit that was used in this Atlas.

Correlation coefficient

A statistic ranging from -1 to 1 that measures the strength of the linear relationship between two variables; a value of 1 indicates perfect positive association, a value of -1 indicates perfect negative association, and a value of 0 indicates no linear association.

Daytime population

The sum of: 1) the total population by place of work status; 2) the total unemployed population; and 3) the total population not in the labour force.

Dialysis

This life-saving treatment is delivered on a regular basis to remove toxins from the blood in people with advanced kidney disease.

Diabetes (also diabetes mellitus)

Diabetes is a chronic disorder characterized by elevations in blood glucose levels that can lead to a number of long-term complications, including blindness, kidney disease, nerve damage and heart and circulatory problems. Diabetes affects more than 135 million people worldwide.

There are two basic types of diabetes:

Type 1 diabetes (formerly called insulin-dependent diabetes or "juvenile" diabetes) occurs when the pancreas no longer produces any insulin or produces very small amounts of insulin. The body needs insulin to use sugar as an energy source. Type 1 diabetes usually develops before the age of 30 and affects five to 10 percent of people with diabetes.

Type 2 diabetes (formerly known as non-insulin-dependent diabetes or "adult onset" diabetes) occurs when the pancreas does not produce enough insulin to meet the body's needs. It is typically associated with insulin resistance (see *Insulin resistance*). The risk of type 2 diabetes increases with aging and with weight gain. Although type 2 diabetes used to be considered strictly a disease of aging, its onset is occurring at younger and younger ages, and it can occur in childhood. Type 2 diabetes affects 90 to 95 percent of all people with diabetes.

Diabetes prevalence

This refers to the proportion of people in a population who have diabetes at a given point or period in time. In this Atlas, diabetes prevalence is defined as the proportion of the Toronto population in 2001/02 already diagnosed with diabetes, based on the Ontario Diabetes Database (see *Ontario Diabetes Database*).

Dot density map

This is a type of statistical or thematic map depicting count or frequency attributes (e.g., total population). Dots are usually placed randomly within an area (such as a neighbourhood or census tract) and can represent one or more cases of the variable.

Geographic Information Systems (GIS)

A computer system comprised of one or several programs allowing users to store, manage and analyze spatial data and associated attributes.

Glucose

Glucose is the main sugar produced by the body or derived from food in the diet; glucose is carried in the bloodstream to provide energy to cells in the body.

Hypertension

A condition of elevated blood pressure that if left untreated over time can lead to kidney disease, heart disease and stroke (also "high blood pressure").

Interpolated grid map

A type of statistical or thematic map depicting values of a numeric variable by shading small grid cells covering the whole study area. There are usually only a number of points where true values of the attribute are known; values in the rest of the grid cells are interpolated from these known points.

Institute for Clinical Evaluate Sciences (ICES)

The Institute for Clinical Evaluative Sciences (ICES) is an independent, non-profit organization whose core business is to conduct research that contributes to the effectiveness, quality, equity and efficiency of health care and health services in Ontario.[4]

Insulin resistance

A state in which the body's tissues are unable to respond normally to circulating insulin levels. This condition can occur many years before the onset of diabetes and may be associated with other abnormalities, such as high blood pressure, lipid problems and cardiovascular disease. If the pancreas fails to make sufficient insulin to overcome this resistance, blood glucose levels can rise, leading to abnormal glucose levels and ultimately to type 2 diabetes.

Lipids

This refers to fats produced and stored in the body, including cholesterol and triglycerides. Abnormal lipid levels are a risk factor for cardiovascular disease.

Local Indicator of Spatial Association (LISA) (bivariate)

A spatial statistical method used to measure the spatial relationships between values of two different variables in different regions of the study area. *LISA* maps illustrate spatial clustering (or "hot spots") where high values of one variable (e.g., diabetes rates) coincide with high values of another variable (e.g., unemployment rates) and this spatial association is statistically significant. Other spatial combinations of values of two analyzed variables are also shown on *LISA* maps (i.e., low and low, high and low, high and high).

Maximum exposed population

In our analyses, we found that in many neighbourhoods, the residential (nighttime) population differed significantly from the work (daytime) population. For some analyses, it was desirable to identify the maximum number of people that were exposed to a neighbourhood resource or characteristic; in these cases, the larger of the two population options (nighttime or daytime) was chosen. This population was considered the "maximum exposed population."

Mean

This refers to the sum of the values in a sample divided by the number of values (also known as the "average").

Network analysis

This refers to a spatial method of calculating travel time (or distance) from one location to another along a pre-defined network. In this Atlas, travel times were calculated from residential areas to various resources by walking, by public transit and by car.

Nighttime population

This refers to the total residential population living in a neighbourhood.

Obesogenic

This is a relatively new term used to describe environments that appear to promote obesity.

Ontario Diabetes Database (ODD)

A disease registry containing a cohort of persons diagnosed with diabetes mellitus in Ontario since 1991. The database was constructed using data on hospitalizations and physician visits.

Priority neighbourhood areas

This refers to 13 areas in Toronto defined in 2005 by the Strong Neighbourhoods Task Force as priority candidates for receiving investment funds for services and facilities.

Proportional symbol map

This refers to a type of statistical or thematic map that depicts a numeric variable by various shapes that are scaled according to the value of the depicted variable. The most common shape is a circle, but other figures such as bars and pie charts can also be used.

Recent immigrant

As defined by the 2001 Canadian census, this refers to people (excluding institutional residents) who obtained landed immigrant status in Canada between 1996 and 2001.

SMR (Standardized Mortality/Morbidity Ratio)

A widely-used method of reporting death or disease that adjusts for differences in age and sex across regions. It is a measure of higher- or lower-than-expected mortality or illness. Instead of giving an adjusted rate, the SMR gives a ratio that is a direct comparison with a standard (e.g., the rate for the entire province). SMR values range from zero to infinity: 1.0 reflects no difference between the expected value based on the standard population and that which was observed in the study population; above 1.0 reflects higher-than-expected values in the study population; and under 1.0 reflects lower-than-expected values. Thus, an SMR of 2.0 reflects mortality or morbidity twice as high as expected; an SMR of 0.5 reflects values half as high as expected.

Socioeconomic status

This describes a combination of social and economic factors experienced by a person or population, such as education and income.

Statistically significant result

In this Atlas, a result considered statistically significant has a p-value of less than 0.05. Statistically significant results could have happened purely by chance but the probability is very low. Results that are not statistically significant may still be important, but there is a higher probability that they occurred by chance.

Stroke

A serious condition characterized by the sudden occurrence of a neurological deficit, such as weakness or loss of sensation in a particular area of the body or difficulty speaking, usually related to impaired blood flow to the brain. Strokes can be either hemorrhagic (caused by bleeding into the brain) or ischemic (caused by blockages in the blood vessels to the brain).

Toronto Transit Commission (TTC)

The Toronto Transit Commission is the largest public transit service provider in the City of Toronto. The TTC consists of a linked network of subway, streetcar and bus routes.

Travel time

In this Atlas, travel time was measured in minutes from a point of residence to the location of a neighbourhood resource (e.g., a grocery store, park or doctor's office).

Visible minority

In this Atlas, data on visible minority populations came from the 2001 Canadian census. The census refers to visible minorities using the following Employment Equity Act definition: "persons other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour." This information is based on the self-report of census respondents.

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INSIDE

1

Chapter

Setting the Context

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Executive Summary

Issue

Neighbourhood Environments and Resources for Healthy Living: A Focus on Diabetes in Toronto focuses on factors related to diabetes at the neighbourhood level in Toronto, Canada. In this chapter, the reasons for choosing to examine diabetes in this context are discussed.

Study

The boundaries of Local Health Integration Networks were obtained from the Ontario Ministry of Health and Long-Term Care; boundaries of municipal wards and federal/provincial electoral districts in Toronto were obtained from the University of Toronto Map Library. Maps were then created based on this information. Toronto sociodemographic characteristics were obtained from the 2001 Census of Canada and were compared with those in Ontario and Canada.

Key Findings

- Toronto is divided into 140 distinct neighbourhoods, each with approximately 15,000–20,000 people. Neighbourhoods are small enough that they are relatively homogeneous but large enough to examine local environments and access to local resources.
- Neighbourhoods may be important contexts for access to healthy foods and for daily activity, both of which are strongly related to obesity and diabetes.
- Spatial approaches are useful for depicting boundaries, the concentration and clustering of phenomena, and visual relationships between factors. They are under-used in health research.
- The City of Toronto is similar to Ontario and Canada in its demographic composition but has much higher levels of immigration, low income and rental accommodation.

Implications

- **Toronto's size and diversity make it an ideal setting to examine the relationships between area-level factors, healthy living and diabetes. Neighbourhoods provide the context within which these phenomena will be examined using spatial methods in this Atlas.**

Introduction

Diabetes mellitus affects 180 million people worldwide and is a rapidly growing cause of disability and premature mortality.[1] Due to the aging of the population and increasing rates of obesity, the prevalence of diabetes is expected to double over the next 20 years in both industrialized and developing countries. The World Health Organization (WHO) has identified obesity and physical inactivity as among the greatest health challenges and risk factors for chronic disease in the 21st century.[1] In Ontario alone, the prevalence of diabetes among adults rose 69 percent (from 5.2 percent to 8.8 percent) between 1994/95 and 2004/05.[2] Diabetes affects approximately five percent of Canadians, but by 65 years of age nearly one in five individuals is affected. Diabetes is a leading cause of blindness, kidney disease, and heart and circulatory problems. In Ontario, people with diabetes account for one-third of all heart attacks and strokes, one-half of all people starting kidney dialysis, and two-thirds of all non-traumatic amputations.[3–6] These complications place a huge burden on Canada's health care system, as well as on individuals and their families.

The obesity epidemic is one of the major causes of the observed rise in diabetes incidence. The likelihood of developing diabetes is more than 10-fold higher among individuals whose Body Mass Index (BMI)* is in the obese category (BMI≥30).[7] Recent studies have found that more than one in three Canadian adults are now overweight (BMI of 25.0–29.9), and the prevalence of overweight and obesity among Canadian children has nearly tripled since the 1980s.[8–10] Over the last 50 years, the typical North American (or western) lifestyle has been typified by lower levels of physical activity and the consumption of excess calories. Recent studies show that lifestyle changes which promote physical activity and weight loss can delay or prevent the onset of type 2 diabetes by nearly 60 percent in people who are at high risk for developing this condition.[11,12]

Risk factors for diabetes are not distributed evenly across society. Socioeconomic status has been shown to be associated with health and with healthy lifestyle behaviours.[13] Populations with low income and less formal education are more likely to smoke and also to be overweight and physically inactive.[13] In the 1998/99 National Population Health Survey, 21 percent of Canadians with diabetes reported low income compared with only 13 percent of the general population. Moreover, two-fifths of those with diabetes did not complete secondary education compared with only one-fifth of the general population.[13] *Diabetes in Ontario*, a recently published ICES Atlas, reported a significantly greater prevalence of diabetes among those residing in lower-income neighbourhoods compared to more affluent areas.[3]

* BMI is a ratio of weight to height and can be calculated according to the equation: BMI=weight(kg)/height(m)^2

Diabetes is also more common in certain ethnocultural populations. Visible minorities, such as those of African, Hispanic or South and East Asian descent, all have a greater predisposition to diabetes than persons of European descent. (For a definition of "visible minority," see page 13 of this chapter.)[14,15] In addition, aboriginal groups have among the highest rates of diabetes in the world, with some communities having a prevalence of 30–50 percent among their adult population.[13]

Several environmental factors may play a role in the current epidemic of obesity and diabetes. The increasing number of fast food outlets and increasing portion sizes may contribute to the intake of excess calories. In the United States (US), portion sizes in restaurants have increased substantially since the 1980s in parallel with increasing body weights.[16] People who eat more frequently in restaurants or eat more fast food tend to gain more weight and are less likely to make healthy eating choices or participate in physical activity.[17–21]

The amount of time spent in sedentary behaviours, such as television viewing or sitting at a desk, is associated with the risk of obesity and type 2 diabetes.[22] The physical environment in which people live may also influence their level of activity. Residents living in urban areas that lack sidewalks, bicycle paths and parkland tend to have lower levels of physical activity.[23–26] In contrast, there is some evidence that those living in areas that are more walkable spend more minutes per day being physically active and have a lower prevalence of obesity.[27]

To date there has been little research on how neighbourhood environments and resources associated with diet, physical activity and access to health care relate to diabetes.[28] In this Atlas, the spatial distribution of factors related to diabetes prevention and control in Toronto are presented. These factors include socioeconomic status, immigration, ethnic composition, population density, service density and dispersion, crime rates, car ownership, access to healthy and unhealthy food, opportunities for physical activity, and access to health care.

Why focus on Toronto?

Urban areas in developed countries often experience high levels of immigration, with greater numbers of new residents coming from Asia, the Pacific, Africa and the Middle East. People from these regions are at an increased risk for diabetes as compared to persons of European descent. Dense metropolitan areas also tend to experience concentrated pockets of low income, another known risk factor for diabetes. This clustering of risk factors often results in high rates of diabetes in large cities. Toronto is a good example of this urban risk profile, with one of the highest rates of diabetes in Ontario.

Toronto also provides an excellent setting to investigate the complex interactions between urban populations and their environment, and how these relationships impact the health and well-being of local residents. Toronto experiences very high population mobility and is known as one of the most multicultural cities in the world—approximately half the population is foreign-born. Over a third of Toronto residents speak a language other than English at home, and one in five residents arrived in Canada during the 1990s.[29] In 1996, 37 percent of the city's population classified themselves as being part of a visible minority; by 2001, this number had climbed to 43 percent.[29] The top four visible minority groups within the city include Chinese (10.6 percent of visible minorities), South Asian (10.3 percent of visible minorities), black (8.3 percent of visible minorities) and Filipino (3.5 percent of visible minorities).[29]

Toronto is also home to some of the greatest extremes of neighbourhood wealth and poverty in the country. In 1995, one in four Toronto households experienced poverty; in the last decade, most low-income Canadians had fallen further below the poverty line.[30] Groups at risk for poverty include unattached individuals, lone parents, renters, recent immigrants, those with low educational attainment and the unemployed.[31] Toronto's low-income population relies heavily on the city's public transit system, rental and social housing and social support services. Income polarization is increasing, and the spatial distribution of poverty is changing over time.[32]

The tremendous social and economic diversity of Toronto facilitates an examination of the social determinants of health, such as immigration and low income, and how they may affect rates of diabetes in an urban environment.

Why focus on neighbourhoods?

Neighbourhoods can be defined in various ways, and the concept means different things to different people. For the purpose of this Atlas, we have adopted the City of Toronto neighbourhood definitions that were developed to assist government and community agencies with local planning and policy decisions. These are established geographic areas using Statistics Canada census tracts as building blocks and are described by the City of Toronto.[33]

Neighbourhood boundaries were designed to follow natural boundaries, such as rivers; they also respect major roads and historically recognized distinctions between communities. The average population in each of the City of Toronto's 140 neighbourhoods, each comprising several city blocks, is 17,700—small enough to capture the rich heterogeneity of a city such as Toronto, but large enough to provide meaningful geographic areas for analysis, reporting and planning. This neighbourhood size is also appropriate for identifying local resources available to individuals near their homes which could contribute to their health and behaviour. Too large an area would provide an unrealistic view of what was available to people within a convenient and walkable distance. Too small an area would fail to capture the richness of local resources that may be scattered within a community.

Why study environmental factors?

The control of diabetes requires continuous access to high quality health care—preferably from a multidisciplinary team. It also requires a high degree of knowledge, as well as the ability to self-regulate one's diet, physical activity and medications, and to monitor blood sugar levels on a regular basis. Eating a healthy balanced diet and being physically active are key aspects of diabetes self-management and are critical to the prevention of diabetes.[34] Little attention has been paid to environmental factors such as the accessibility of healthy foods and opportunities for physical activity, factors that are likely to be of fundamental importance in controlling the current obesity epidemic and its attendant consequences.

Incorporating physical activity into daily routines is a key strategy for improving fitness and reducing obesity, but this may be extremely difficult in neighbourhoods without walkable destinations or with poor access to public transit. Excessive reliance on cars as a primary mode of moving around is common for a large portion of Toronto's residents.[35] While owning a car may lower the probability of leading a more active daily lifestyle, not having one can make it more difficult for a person to access healthy resources, such as stores selling fresh fruits and vegetables—foods that are important in the prevention and management of diabetes.

Among the many environmental factors supporting more active lifestyles, neighbourhood safety may play an important role. Areas where crime is more prevalent are less desirable places for physical activities, such as walking or bicycling. Accessibility to health services is also a crucial factor in managing many health conditions, including diabetes. In the case of another current epidemic, that of tobacco-related diseases, a combined approach involving clinical preventive strategies (e.g., counselling, patches, gums and cessation programs) together with environmental and other policy changes (e.g., smoking bans, high tobacco taxes) has been successful in reducing population tobacco use.[36] It is likely that a similar mix of environmental and public policy interventions is required in the current fight against obesity and related health conditions such as diabetes.

Why use spatial approaches?

"…despite epidemiology's longstanding concern with time, place, and person…, place had receded into the background by the mid-20th century … Fortunately, GIS has contributed in recent years to a reviving awareness that any epidemiologic explanation worth its salt must encompass geographic- and temporal-variations in population health."*[37]

Spatial analytical and descriptive methods were initially created for use in geography and cartography. However, in recent decades these techniques have increasingly been used in epidemiology and public health. Spatial methods take into account the physical location of areas, boundaries, people, and services, as well as types of land use and natural features. These techniques provide the ability to create maps, measure distances and travel times, and define the extent and nature of spatial relationships.

To generate this Atlas, spatial methods were used to examine relationships between the neighbourhood prevalence of diabetes and various factors that could influence the development and management of this disease. Environmental factors were considered to include: car ownership, population density, density and dispersion of commercial services, and crime. We also identified resources for healthy living which included access to healthy food, locations where people could take part in physical activity, and access to diabetes-related health services.

Spatial approaches empower health professionals, decision-makers, community groups and individuals with a new set of informative tools:

- Front-line health care providers can learn more about their patients/clients and the environments they live in.
- Local residents can learn to identify environmental contributors to their health conditions and where to look for appropriate care.
- Health service planners and policy makers can use spatial information to assess the effectiveness of existing service provision levels and to design new programs to address unmet service needs in the most optimal way given available budgets and other constraints.
- Community groups and individuals can employ spatial knowledge in their advocacy, fundraising efforts and promotion of healthy living behaviours.

Spatial approaches are rapidly becoming an essential part of health research. This Atlas was produced using GIS tools that allow spatial exploration and interpretation of findings. Such techniques allowed us to develop a unique perspective about diabetes in Toronto which includes new data and observations about contributory social, environmental and behavioural factors. We were then able to suggest how certain negative factors might be addressed and ameliorated.

* GIS = Geographic Information Systems

Chapter 1—List of Exhibits

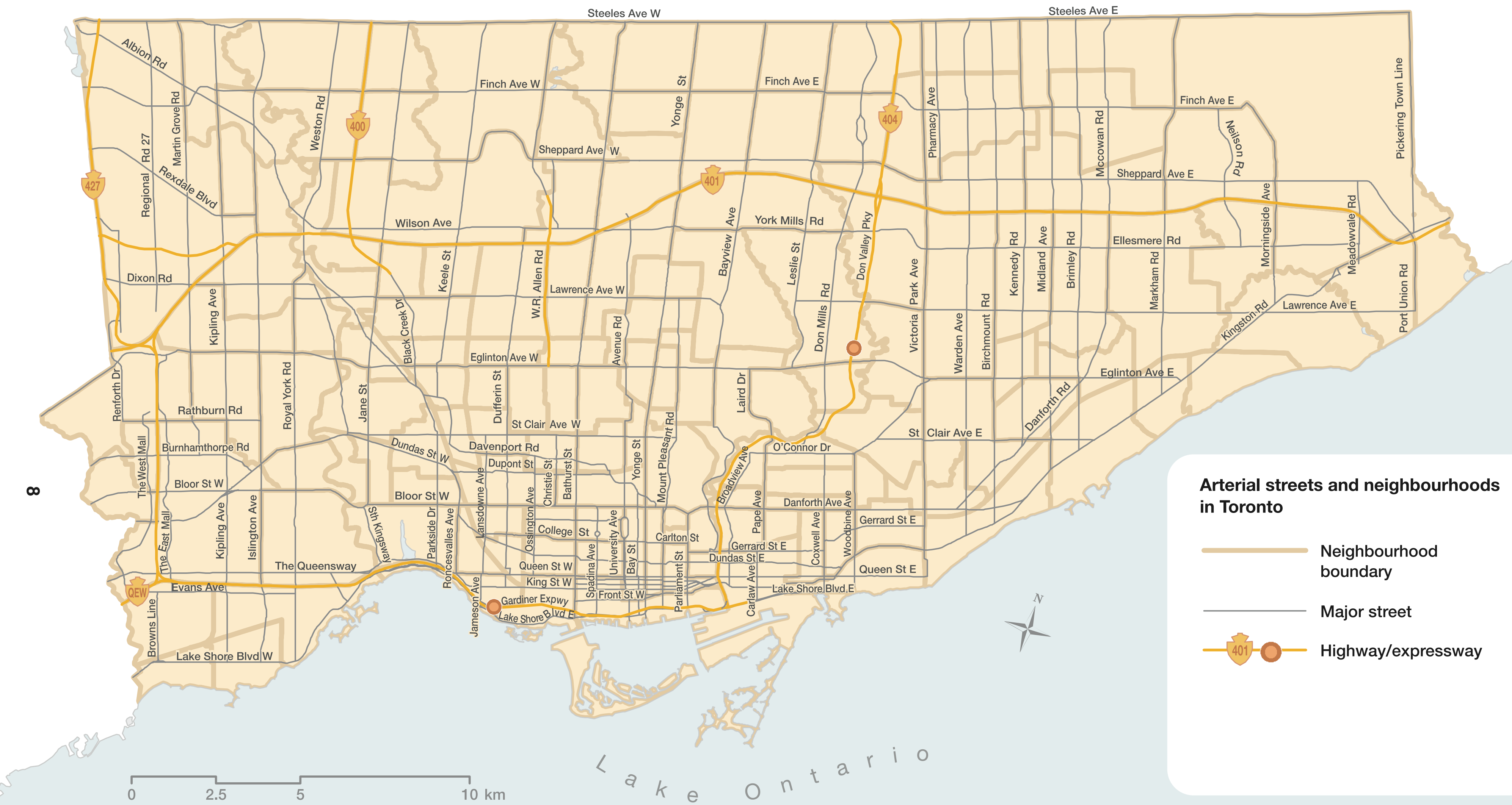
Exhibits and Findings

Exhibit 1.1 Toronto study area: location within North America and 2001 population

Findings

- Toronto is located on the north shore of Lake Ontario and is Canada's largest urban centre.
- The population of Toronto was 2.48 million people in 2001.

Exhibit 1.2 Arterial streets and neighbourhoods, in Toronto, 2001



Findings

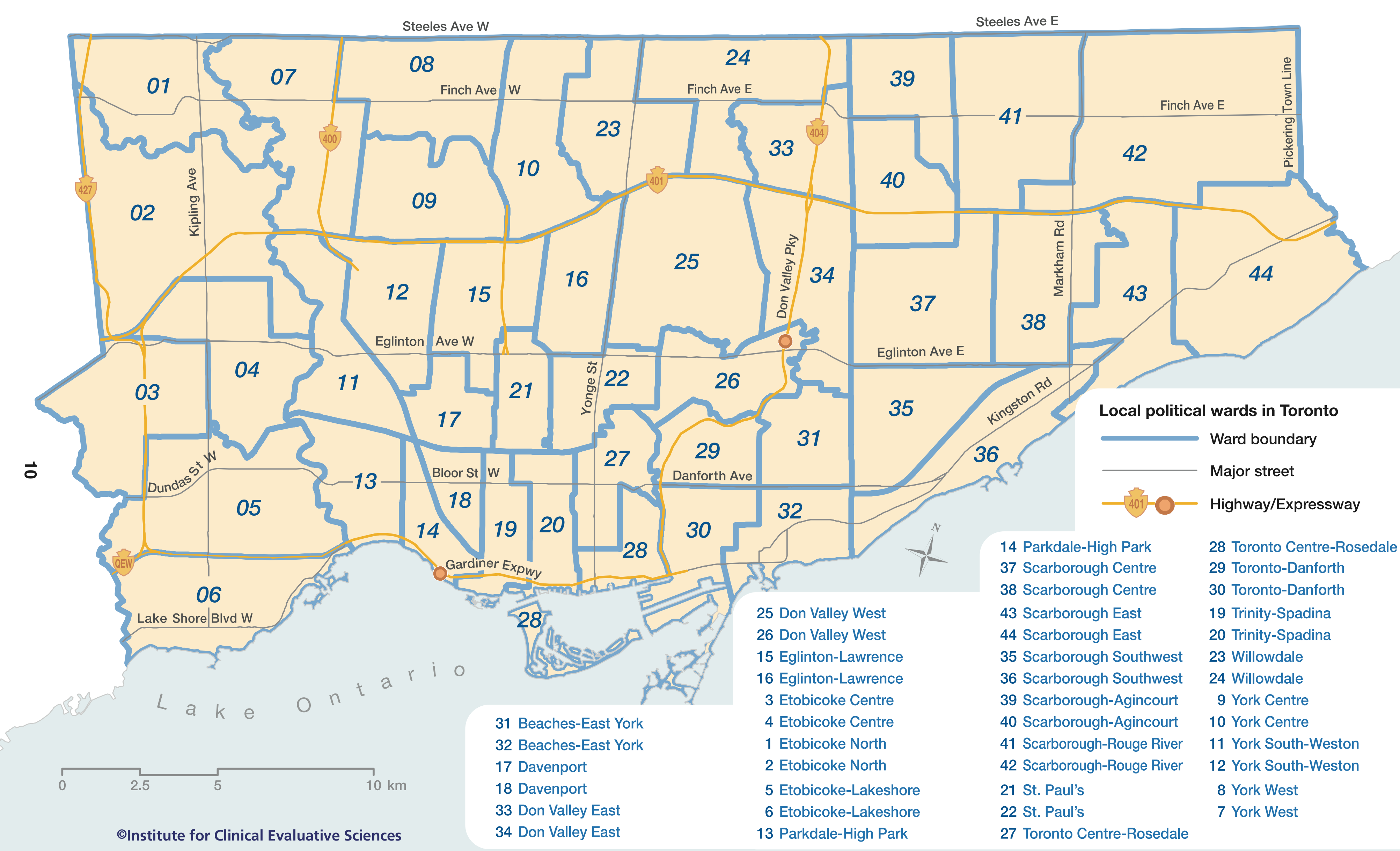
- This exhibit shows arterial streets and highways, as well as boundaries of Toronto neighbourhoods as they appeared in 2001.

Exhibit 1.3 Ontario Local Health Integration Networks (LHINs) and neighbourhoods, in Toronto, 2005

Findings

- This exhibit shows boundaries of Ontario's Local Health Integration Networks (LHINs) and also neighbourhood boundaries within Toronto as they existed in 2005. These organizations do not directly provide health care services. Instead, their mandate is to plan, integrate and fund health care services in the province.
- Neighbourhood and LHIN boundaries generally corresponded, but there were some inconsistencies.

Exhibit 1.4 Local political wards, in Toronto, 2001



Findings

- Exhibits 1.4 and 1.5 show local political boundaries (wards) and federal electoral districts as they appeared in 2001.
- The boundaries did not align with each other, nor did they align with Local Health Integration Networks (LHINs), adding to the challenges of inter-sectoral and municipal/provincial/federal cooperative efforts.

Exhibit 1.5 Federal electoral districts, in Toronto, 2001

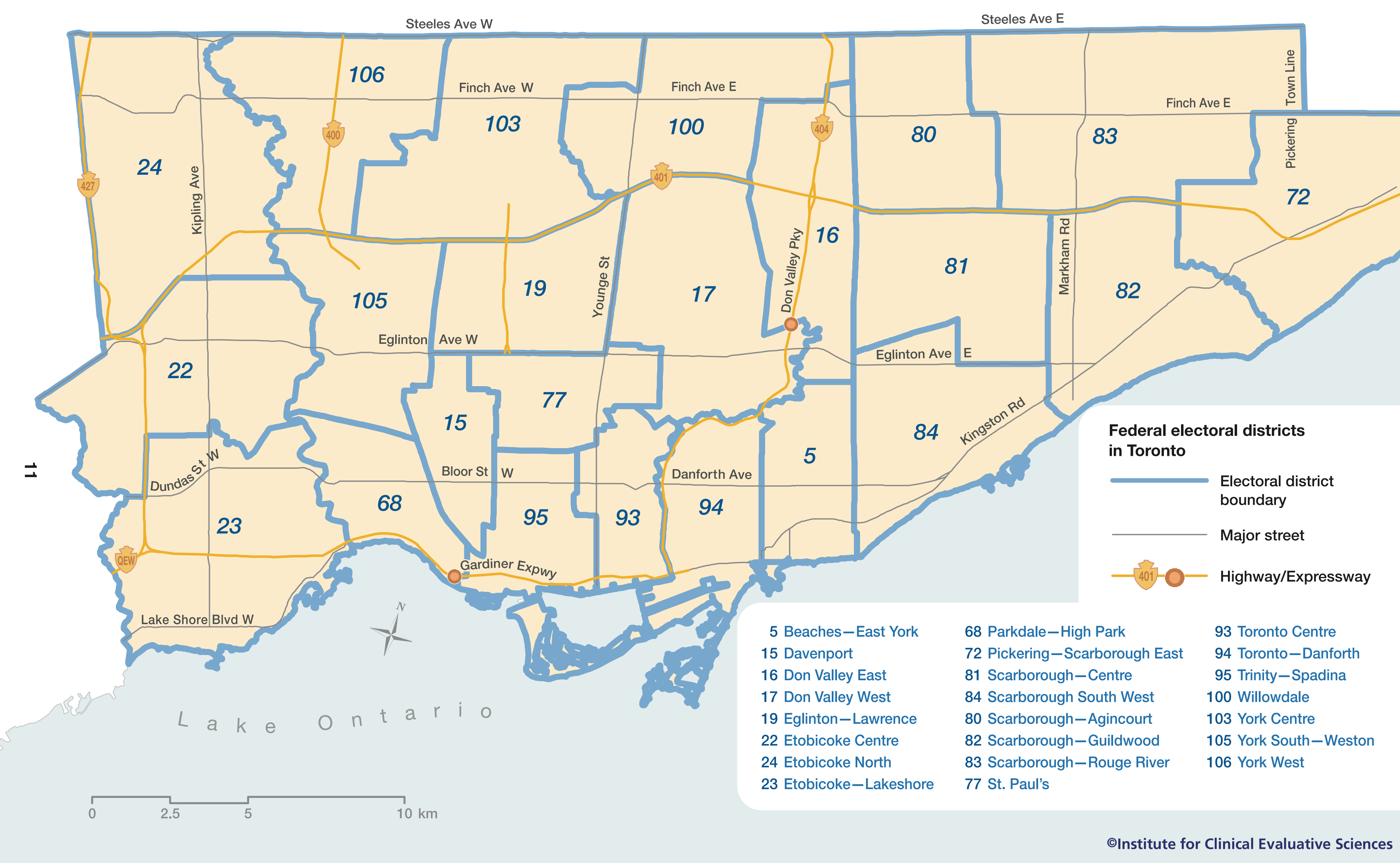


Exhibit 1.6 Demographic and social characteristics of Toronto, Ontario and Canada, 2001

Sociodemographic composition	City of Toronto	Ontario	Canada
Total Population	**2,481,560**	**11,410,045**	**30,007,090**
Demographics			
Age under 19 years	23.3	26.3	25.9
Age 65 years and older	13.6	12.9	13.0
Living alone	10.8	8.8	10.1
Age 65 years and older *and* living alone	26.6	26.8	28.9
Lone parent families	19.7	15.2	15.7
One-year population mobility	14.6	13.9	14.3
Language and immigration (%)			
No knowledge of English/French	5.1	2.1	1.5
Recent immigrants—within five years	11.4	4.8	3.3
Recent immigrants—within 10 years	21.0	9.1	6.2
Immigrants	49.5	26.8	18.4
Visible minority	42.8	19.1	13.4
Top three countries of origin for people immigrating within last five years	China India Pakistan	China India Pakistan	China India Philippines
Socioeconomic status			
Average annual household income ($)	69,194	66,836	58,360
Incidence of low income (% of families)	19.4	11.7	12.8
Incidence of low income (% of individuals)	22.5	14.4	16.2
Rented dwellings (%)	49.2	32.0	33.8
Unemployment rate (%)*	7.0	6.1	7.4
Not in labour force (%)*	34.7	32.7	33.6
Less than high school education (%)*	23.3	25.7	27.9
With a university degree (%)*	25.3	17.5	15.4

* Refers to population aged 20 years and older.

Findings

- In 2001, the City of Toronto was similar to Ontario and Canada in its demographic composition, but it differed substantially in socioeconomic status and cultural diversity.
- While average annual household income and education levels were relatively high, Toronto had substantially larger proportions of its population living below Statistics Canada's low income cut-offs (LICOs) and living in rented dwellings.
- Toronto was also considerably more culturally diverse than Ontario or Canada with respect to both the degree of immigration and the proportion of the population that self-identified as visible minorities. (For a definition of "visible minority," see page 13 of this chapter.)

Discussion

By themselves, spatial analyses do not provide information about actual behaviour among populations and/or individuals—for example, what foods people really eat, how much and how often they exercise, how frequently they use health care services. Nor do they provide information about non-spatial barriers, such as the appropriateness or acceptability of services, hours of operation, languages spoken, ability to get time off work or to obtain child care, the cost of medications or devices, or the cost of buying healthy foods. Spatial approaches also entail heavy reliance on secondary data sources—some of which may be outdated, inaccurate or incomplete. The spatial approaches in this Atlas also make assumptions about walking, public transit and driving times that may not accurately reflect real world conditions (e.g., bad weather, traffic jams or lack of parking).

Despite these limitations, spatial approaches are an excellent starting point for understanding availability and accessibility of neighbourhood resources and environments. For example, the appropriateness of activities at a community centre is secondary to whether a neighbourhood has access to a community centre at all. In this Atlas, spatial methods are used to address these kinds of fundamental issues, as a starting point for further research. Additional research about appropriateness, acceptability, affordability and actual use will be essential to knowing whether and how neighbourhood environments and resources can be modified to improve residents' health.

Conclusions and Next Steps

Diabetes is a rapidly increasing health concern that disproportionately affects ethnoracial groups of non-European heritage and low-income populations—two groups that are well represented in the City of Toronto. The growing rate of obesity is a major contributor to the recent rise in diabetes. Our society has become increasingly sedentary and has abundant access to calorie-dense foods.

Neighbourhood environments and resources are likely to be important for providing access to healthy foods, opportunities for physical activity and access to community-based health services. In this Atlas, extensive use is made of spatial methods for locating and visualizing these phenomena in relation to each other in space. Toronto neighbourhoods are ideal settings for examining these relationships as they have highly diverse populations, environments and resources.

The proportion of visible minorities living in each neighbourhood was derived from the 2001 Census of Canada, which uses the following definition based on the Employment Equity Act: visible minorities are "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour."

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INSIDE

2
Chapter

Patterns of Diabetes Prevalence, Complications and Risk Factors

Gillian L. Booth, MD, MSc, Maria I. Creatore, MSc, PhD (candidate), Peter Gozdyra, MA, and Richard H. Glazier, MD, MPH

Executive Summary

Issue

Diabetes is a growing public health problem and a major risk factor for cardiovascular disease. The purpose of this chapter is to examine patterns of prevalence of diabetes, its complications and related risk factors in Toronto.

Study

Records for hospital admissions and physician services were used to calculate the age- and sex-adjusted rates of diabetes and cardiovascular disease (hospital admissions for heart attack and stroke) in Toronto neighbourhoods during 2001/02. Data from Statistics Canada's 2000/01 and 2003 Canadian Community Health Surveys (CCHSs) were used to estimate the underlying rate of overweight or obesity, hypertension, and smoking in groups of neighbourhoods that made up the 15 Minor Health Planning Areas within Toronto. Maps were created to explore the spatial patterns of each of these factors within the city.

Key Findings

- Despite a higher prevalence of diabetes in Toronto, diabetes-related complication rates appeared to be generally lower in the city than for the province as a whole. Access to physicians treating diabetes was greater in Toronto than elsewhere in the province.
- Neighbourhoods located in the northwest and east areas of Toronto had the highest rates of diabetes, while those located in the central and southwest areas had the lowest rates in the city.
- Patterns of overweight and obesity corresponded well to patterns of diabetes. This was true except for parts of east-end Toronto where a larger proportion of residents were of Asian heritage, a group that develops diabetes at lower body weights.
- Heart attack and stroke admission rates were generally higher in areas of Toronto that had higher rates of diabetes, obesity and hypertension (the northwest and east ends of the city), and higher rates of smoking (central west and downtown Toronto). Cardiovascular risk factors and outcomes were lowest in central neighbourhoods.

Implications

- **In the coming years, adequate resources will be needed to manage the rising numbers of people with diabetes living in Toronto (and elsewhere) in an effort to reduce the burden of cardiovascular disease and other diabetes-related complications resulting from this epidemic.**
- **High-risk neighbourhoods (those with a greater prevalence of diabetes or diabetes-related risk factors) are ideal targets for community-based interventions aimed at diabetes prevention and management.**

Introduction

Risk factors for type 2 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 subtype that accounts for the vast majority (90–95 percent) of people with diabetes. Type 2 diabetes results from a complex interaction between genetic and environmental factors that leads to a state of insulin resistance. 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.[1,2] In addition to the aging of the population, increasing rates of overweight and obesity have led to a substantial increase in diabetes rates in North America.[3] With the rise in obesity, the onset of diabetes has now shifted towards younger ages. In Canada and the United States (US), adults under 50 years of age have experienced the greatest relative rise in diabetes incidence, with an approximate doubling in the prevalence rate over the past decade.[4,5]

Genetic factors also play an important role in the development of type 2 diabetes. As a result, a number of ethnic groups experience higher rates of type 2 diabetes. This association is explored in more depth in Chapter 4. Some ethnic groups, such as those from South and Southeast Asia, develop abdominal obesity at a lower body weight. Thus, the World Health Organization has recommended lower thresholds for diagnosing overweight (based on Body Mass Index or BMI*) and abdominal obesity (based on measurements of waist circumference) in these populations.[6]

In addition to obesity and genetic factors being important risk factors for diabetes, various studies suggest a relationship between diabetes and both low education levels and low income that is consistent across all adult age groups.[7] The relationship between diabetes and socioeconomic status is explored further in Chapter 3.

Diabetes complications

Diabetes can lead to a number of long-term complications, primarily through its effect on small blood vessels (microvascular disease) and large blood vessels (macrovascular disease). Diabetes is a leading cause of blindness, kidney failure necessitating dialysis, and cardiovascular disease (including heart attacks, angina, strokes and other circulatory problems).[8–12] These complications can lead to long-term disability, reduced quality of life and premature death.[13]

Complications arising from diabetes create a major burden, both in terms of human suffering and costs to the health care system. In 2003, between 30–40 percent of all hospital admissions for heart attack, stroke and heart failure in Ontario occurred in people with diabetes. Seven out of 10 non-traumatic amputations—resulting from circulatory blockages in the legs—

also affected people with diabetes.[10–12] However, these figures likely underestimate the overall proportion of cardiovascular disease resulting from diabetes and related metabolic conditions. A Scandinavian study showed that one-third or more of individuals admitted to hospital for heart attacks had either previously unrecognized diabetes or prediabetes based on the presence of high blood sugar levels.[14] Together, these figures suggest that the continuum from prediabetes to the full-blown disease state accounts for a large proportion of heart attacks, strokes and circulatory problems in our population.

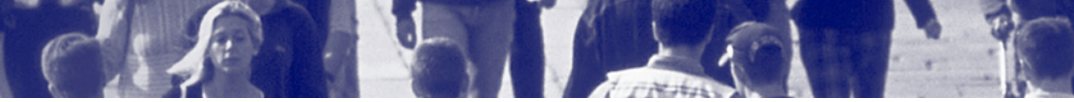
The risk of cardiovascular disease is between two and four times greater among people with diabetes compared to those without this condition; it is estimated that having diabetes is equivalent to aging 15 years.[15] There are a number of reasons for this association. Blood sugar levels are directly correlated to the risk of death from heart attacks and strokes, suggesting that high blood sugar itself may play a role.[16] In addition, people with diabetes often have other risk factors for cardiovascular disease which pre-date the onset of their diabetes—for example, high blood pressure, abnormal blood lipids and abdominal obesity.[17] While rates of smoking (another major risk factor for cardiovascular disease) are close to or below average in those with diabetes, smoking and other cardiovascular risk factors add to the elevated risk of heart disease and stroke in this population.[18]

Randomized controlled trials have demonstrated that long-term complications of diabetes can be delayed or prevented through specific interventions, such as tight control of blood sugar, cholesterol and blood pressure levels.[19–23] The optimal management of diabetes requires access to diabetes services and regular checkups with a primary care provider, specialists and other health care professionals.[24]

The purpose of this chapter is to examine patterns of prevalence of diabetes, its complications and related risk factors in Toronto.

* BMI is a ratio of weight to height and can be calculated according to the equation: $BMI=weight(kg)/height(m)^2$

Chapter 2—List of Exhibits



Exhibits and Findings

Exhibit 2.1 **Age- and sex-adjusted diabetes prevalence rates in persons aged 20 years and older, and rates of various complications and procedures in persons aged 20 years and older with diabetes, in Toronto and Ontario, 1994/95 to 1998/99***

Indicator	Toronto rate	Ontario rate	Rate ratio**
Diabetes rates¥ (per 100 adults)			
Prevalence	**7.6**	**6.2**	**1.20**
Complication/procedure rates¥ (per 100,000 adults with diabetes)			
Hospitalizations for hyperglycemia	470.0	541.2	0.87
Emergency department visits for diabetes	3,808.0	4,794.8	0.79
Hospitalizations for hypoglycemia	30.0	55.5	0.54
Hospitalizations for acute myocardial infarction	708.0	832.8	0.85
Hospitalizations for congestive heart failure	911.0	1,055.0	0.86
Hospitalizations for coronary angiography	1,074.0	1,240.0	0.87
Hospitalizations for angioplasty and related procedures	175.0	227.8	0.77
Hospitalizations for coronary artery bypass graft surgery	285.0	326.1	0.87
Total amputation rates	136.0	182.0	0.75
Lower extremity revascularization rates	220.0	230.8	0.95
Hospitalizations for stroke	551.0	588.0	0.94
Incidence of chronic dialysis (new cases per year)	83.0	91.0	0.91
Prevalence of chronic dialysis (all existing cases)	320.0	319.0	1.00
Eye procedure rates¥ (per 1,000 adults with diabetes)			
Retinal photocoagulation (laser treatments)	17.1	18.7	0.91
Vitrectomy	2.4	2.2	1.10
Cataract surgery	24.6	27.3	0.90

* Diabetes prevalence rates are based on 1998/99 only; complication and procedure rates were averaged over five years (1994/95–1998/99), with the exception of chronic dialysis rates which were averaged over six years (1994/95–1999/00).

** Ratio of Toronto rate to Ontario rate.

¥ Age- and sex-adjusted.

Findings

- In 1998/99, the prevalence of diabetes was 20 percent greater in Toronto than it was in Ontario as a whole.
- During the study period, the population with diabetes living in Toronto experienced lower overall rates of many diabetes-related complications compared to provincial averages—including lower rates of hospital admission for heart disease and poor control of blood sugar levels.

Exhibit 2.2 **Utilization rates of health care services by persons aged 20 years and older with diabetes, and supply of health care professionals, in Toronto and Ontario (for various time periods)**

Indicator	Toronto rate	Ontario rate	Rate ratio*
Average rates of health services utilization (per 100 persons aged 20 years and older with diabetes)**			
Care from FPs/GPs + diabetes specialist, 1998/99 to 1999/00	**20.3**	**17.8**	**1.14**
Care from FPs/GPs only, 1998/99 to 1999/00	**71.9**	**74.4**	**0.97**
No diabetes physician care, 1998/99 to 1999/00	**6.9**	**6.9**	**1.00**
Annual eye examinations, 1994/95 to 1998/99	**47.9**	**50.4**	**0.95**
Average number of visits to health care providers in 2000/01 (per person aged 20 years and older with diabetes)			
FPs/GPs	7.3	7.1	1.03
Eye care specialists	0.6	0.7	0.86
Internal medicine specialists	1.5	1.4	1.14
Endocrinologists	0.7	0.6	1.10
Supply of health care professionals (FTEs/10,000 population) in 2000/01			
FPs/GPs	10.5	7.3	1.43
Optometrists	0.5	0.6	0.77
Internal medicine specialists	3.2	1.6	1.95
Endocrinologists	0.3	0.1	2.36
Ophthalmologists	0.6	0.3	1.87

* Ratio of Toronto rate to Ontario rate

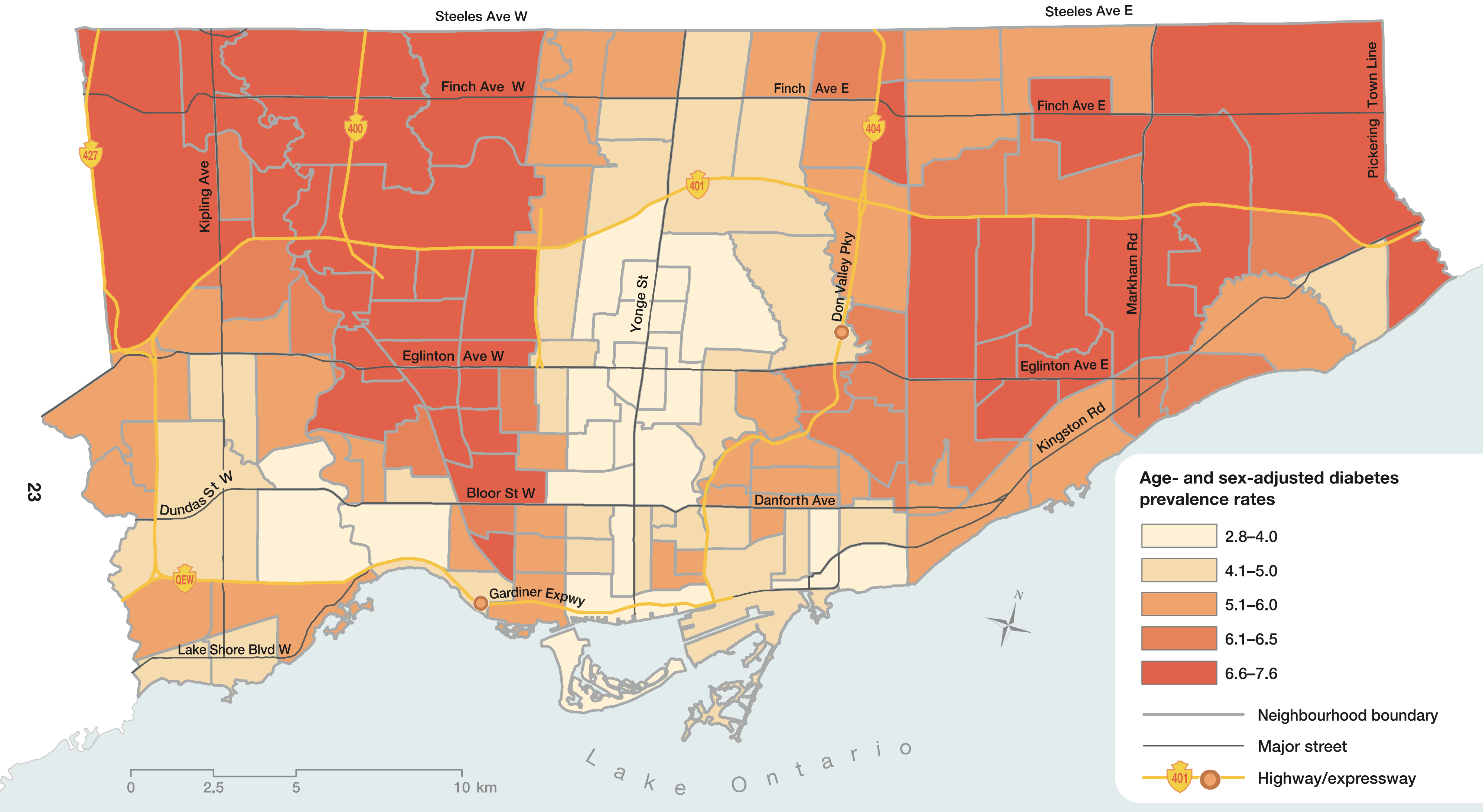
** Rates are age- and sex-adjusted

FP/GP = Family physician/general practitioner; **FTE** = Full-time equivalent

Findings

- During the study period, people with diabetes living in Toronto had similar or slightly higher visit rates to primary care physicians (FPs/GPs) and endocrinologists compared to those living in Ontario as a whole.
- In 2000/01, the supply of primary care physicians was 43 percent higher in Toronto compared to Ontario as a whole. The numbers of endocrinologists, internal medicine specialists, and ophthalmologists per capita in Toronto were nearly twice the provincial average.

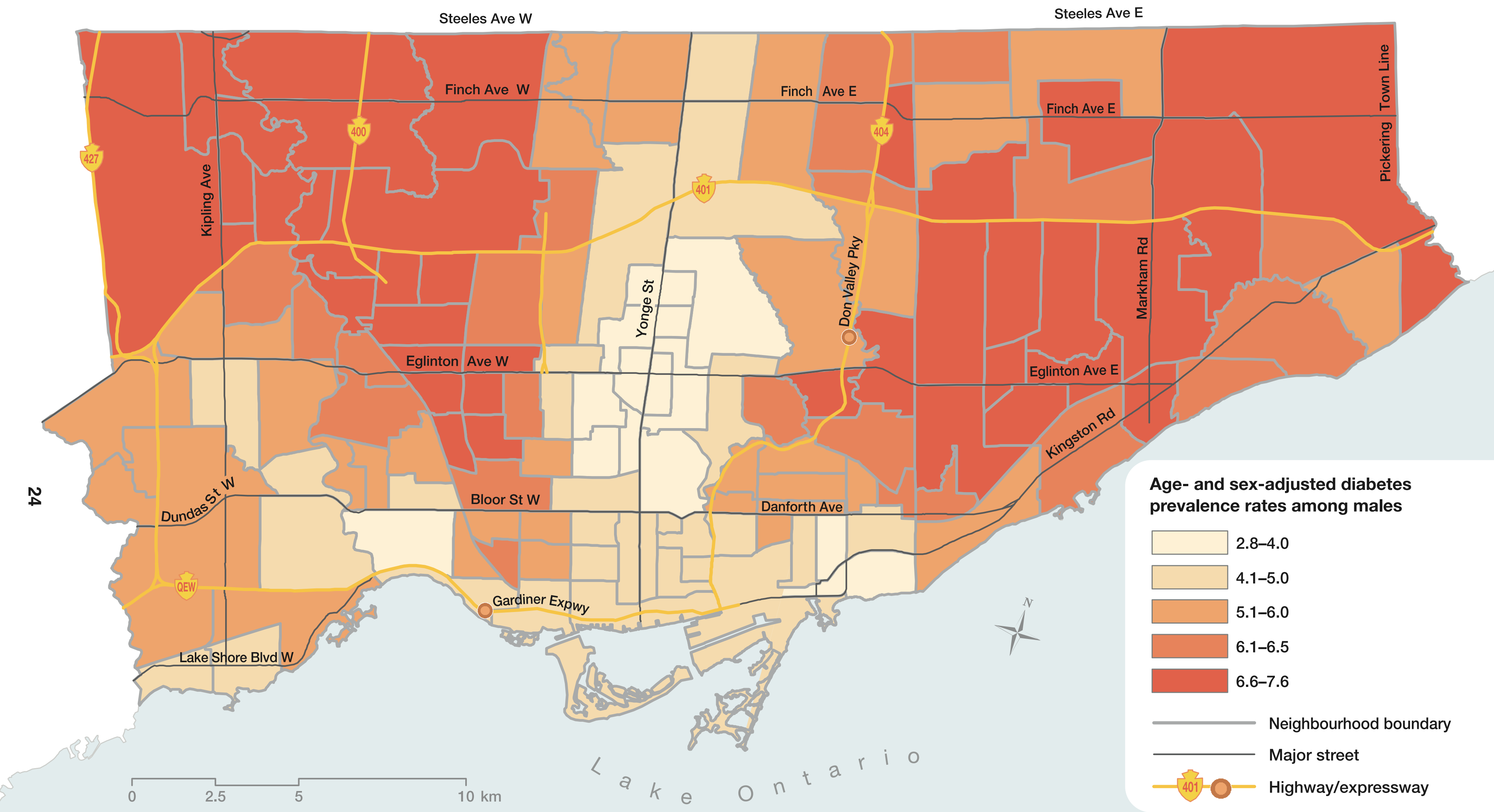
Exhibit 2.3 Age- and sex-adjusted diabetes prevalence rates per 100 persons of all ages, by neighbourhood, in Toronto, 2001/02



Findings

- In 2001/02, the overall age- and sex-adjusted diabetes prevalence rate (per 100 persons of all ages) was 5.5; rates were highest in the northwest and east of the city. In contrast, rates were lowest in neighbourhoods in central and southwestern parts of the city.

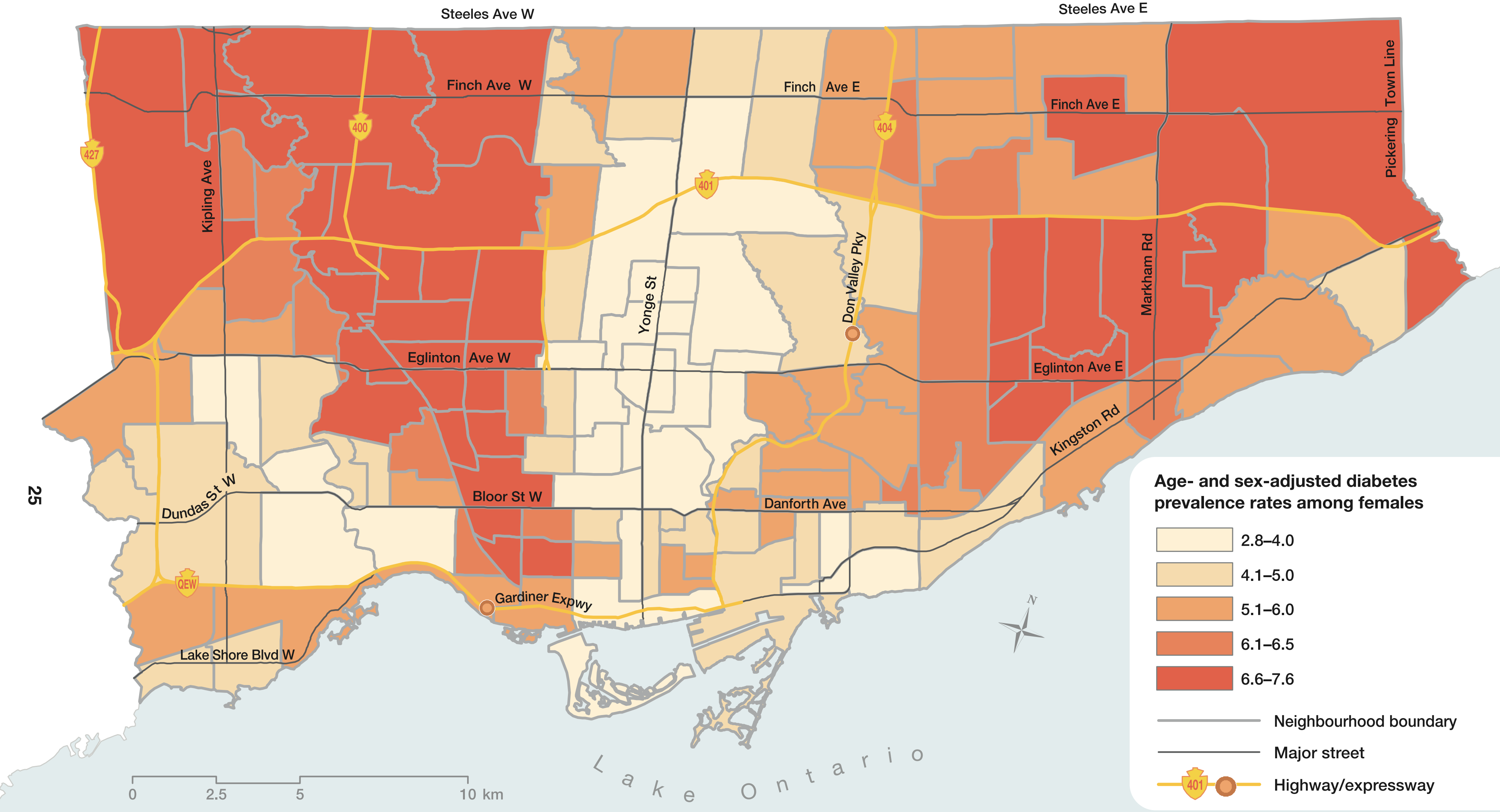
Exhibit 2.4 Age-adjusted diabetes prevalence rates per 100 males of all ages, by neighbourhood, in Toronto, 2001/02



Findings

- In 2001/02, the overall age-adjusted diabetes prevalence rate among males in Toronto was 5.6 per 100 males of all ages. Rates were highest in neighbourhoods in the northwest and east ends of the city, and lowest in neighbourhoods within the centre and southwest of Toronto.
- Rates in some areas tended to be higher for males than for females (Exhibit 2.5).

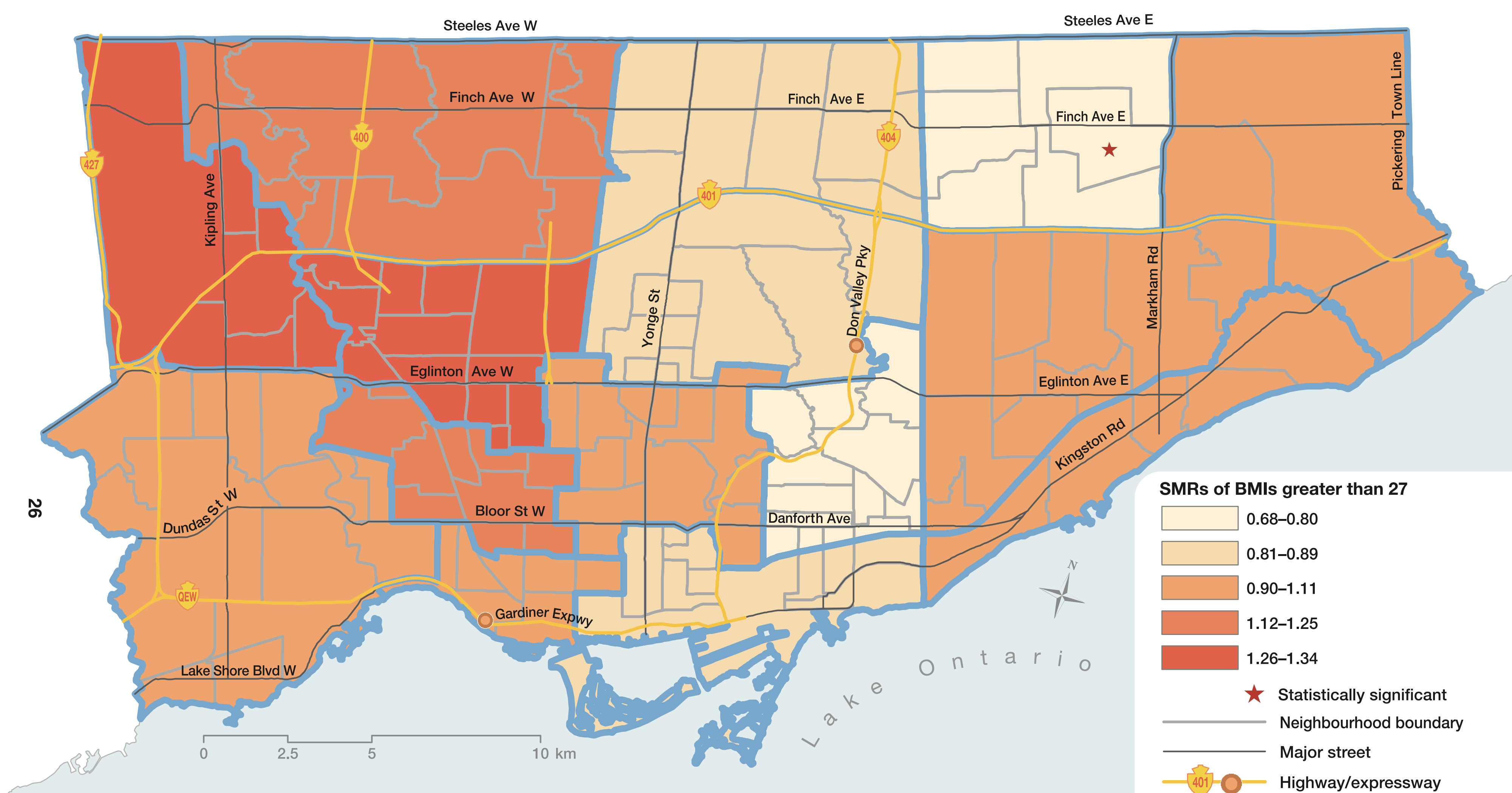
Exhibit 2.5 Age-adjusted diabetes prevalence rates per 100 females of all ages, by neighbourhood, in Toronto, 2001/02



Findings

- In 2001/02, the overall age-adjusted diabetes prevalence rate among females in Toronto was 5.6 per 100 females of all ages. Rates were highest in neighbourhoods in the northwest and east ends of the city, and lowest in neighbourhoods within the centre and southwest of Toronto.
- Rates in some areas tended to be lower for females than for males (Exhibit 2.4).

Exhibit 2.6 Standardized morbidity ratios (SMRs)* of Body Mass Index (BMI)** greater than (>) 27 among persons aged 12 years and older, by Minor Health Planning Area, in Toronto, 2000/01 and 2002/03¥



* SMR is a ratio of the number of people reporting being overweight/obese in each neighbourhood compared to the number expected based on age-specific rates of reported overweight/obesity across the city.

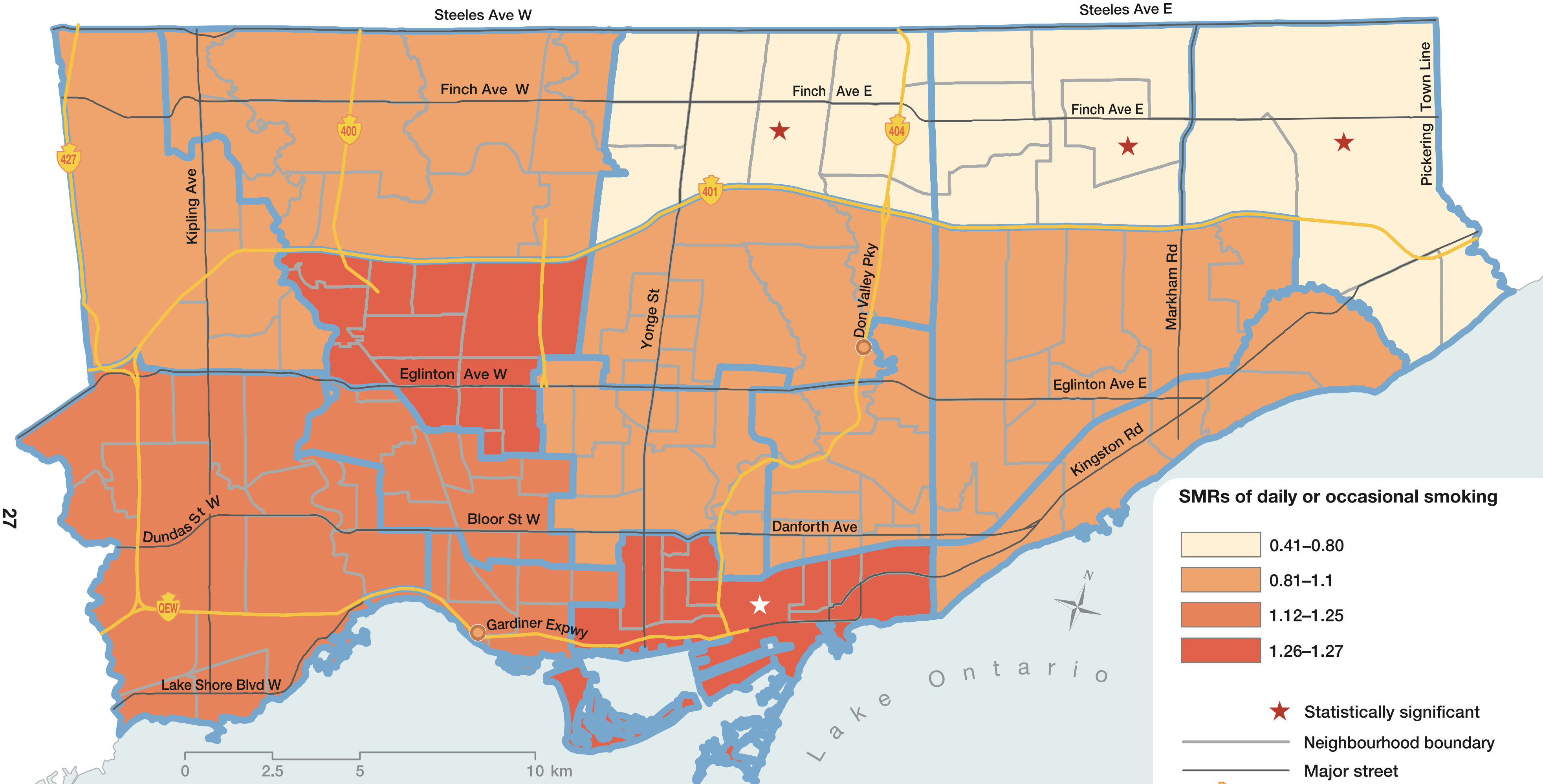
** BMI is a ratio of weight to height and can be calculated according to the equation: BMI=weight(kg)/height(m)^2.

¥ Data were combined from the 2000/01 and 2003 Canadian Community Health Surveys (CCHSs).

Findings

- In 2001/03, a greater proportion of Canadian Community Health Survey (CCHS) respondents living in the northwest portion of Toronto reported being overweight or obese compared to those living in other areas of the city.
- Reported rates of overweight or obesity in the eastern portion of the city were equivalent to the Toronto average, despite the higher prevalence of diabetes in these areas (Exhibits 2.3–2.5).
- Reported rates of overweight and obesity were lower than the average in central neighbourhoods.

Exhibit 2.7 Standardized morbidity ratios (SMRs)* of daily or occasional smoking among persons aged 12 years and older, by Minor Health Planning Area, in Toronto, 2000/01 and 2002/03**



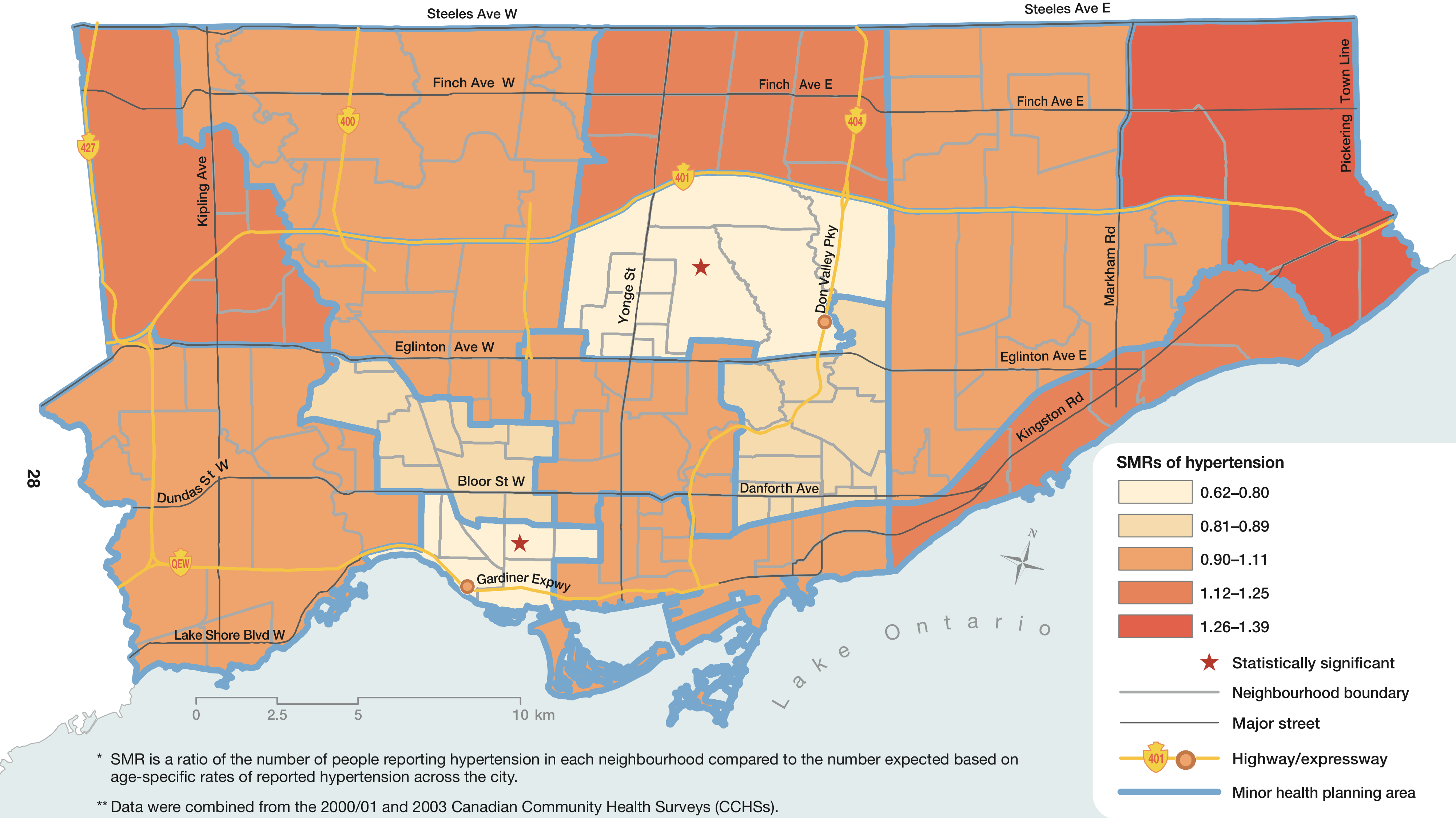
* SMR is a ratio of the number of people reporting daily or occasional smoking in each neighbourhood compared to the number expected based on age-specific rates of reported daily or occasional smoking across the city.

** Data were combined from the 2000/01 and 2003 Canadian Community Health Surveys (CCHSs).

Findings

- Between 2001/03, approximately one in five Toronto participants who responded to the Canadian Community Health Survey (CCHS) reported smoking on a daily or occasional basis.
- A greater proportion of CCHS respondents living in downtown Toronto and in the central west portion of the city reported the highest rates of smoking. The north and northeast ends of the city had the lowest reported smoking rates—up to 59 percent lower than the Toronto average.

Exhibit 2.8 Standardized morbidity ratios (SMRs)* of hypertension among persons aged 12 years and older, by Minor Health Planning Area, in Toronto, 2000/01 and 2002/03**



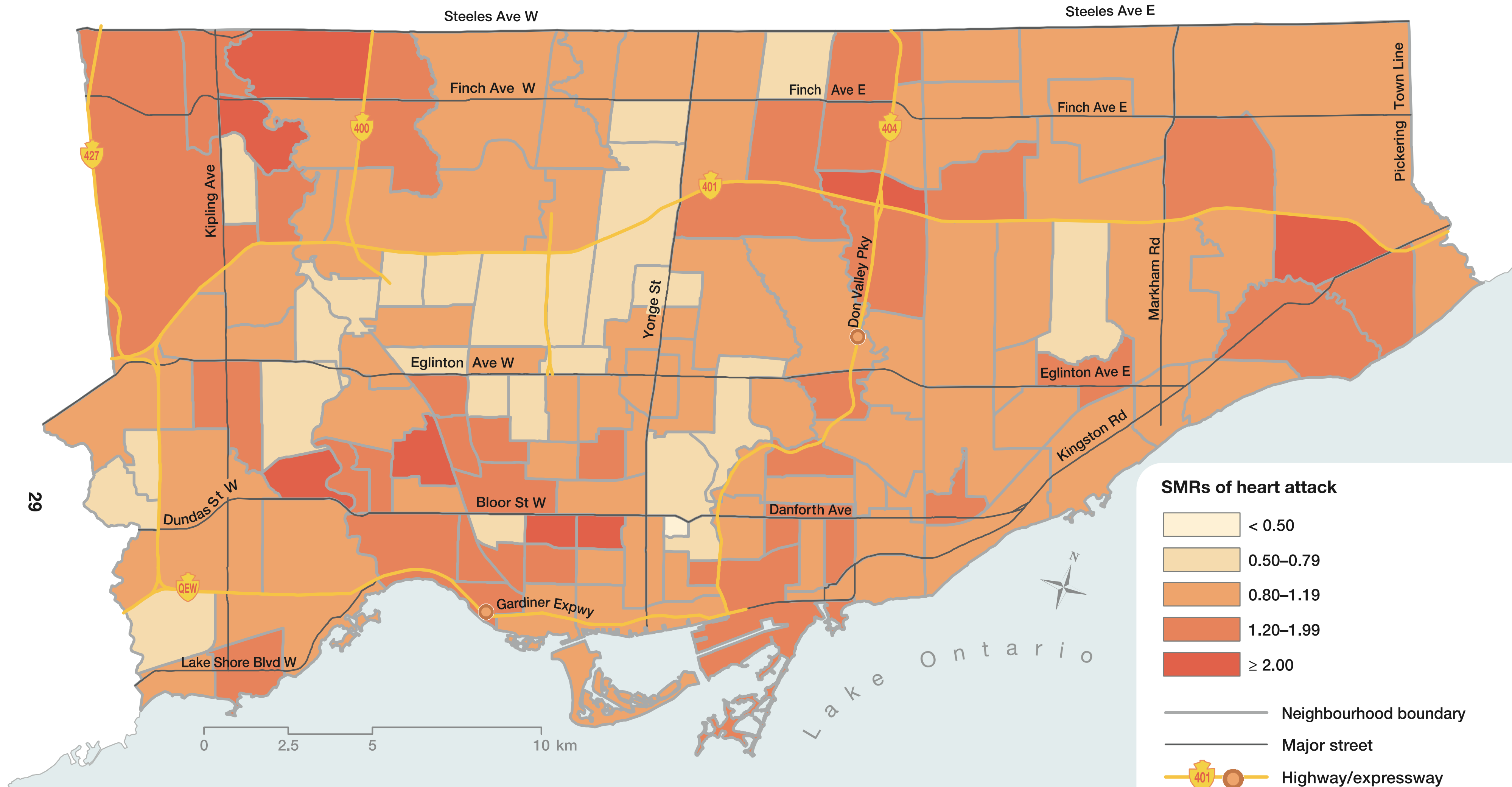
* SMR is a ratio of the number of people reporting hypertension in each neighbourhood compared to the number expected based on age-specific rates of reported hypertension across the city.

** Data were combined from the 2000/01 and 2003 Canadian Community Health Surveys (CCHSs).

Findings

- Between 2001/03, some Toronto neighbourhoods had higher-than-average reported rates of hypertension than others. These included the nothwestern, eastern and north central parts of the city.
- Central neighbourhoods had lower-than-average reported rates of hypertension.

Exhibit 2.9 Standardized morbidity ratios (SMRs)* of heart attack among persons aged 40 years and older, by neighbourhood, in Toronto, 1999/00 to 2001/02**



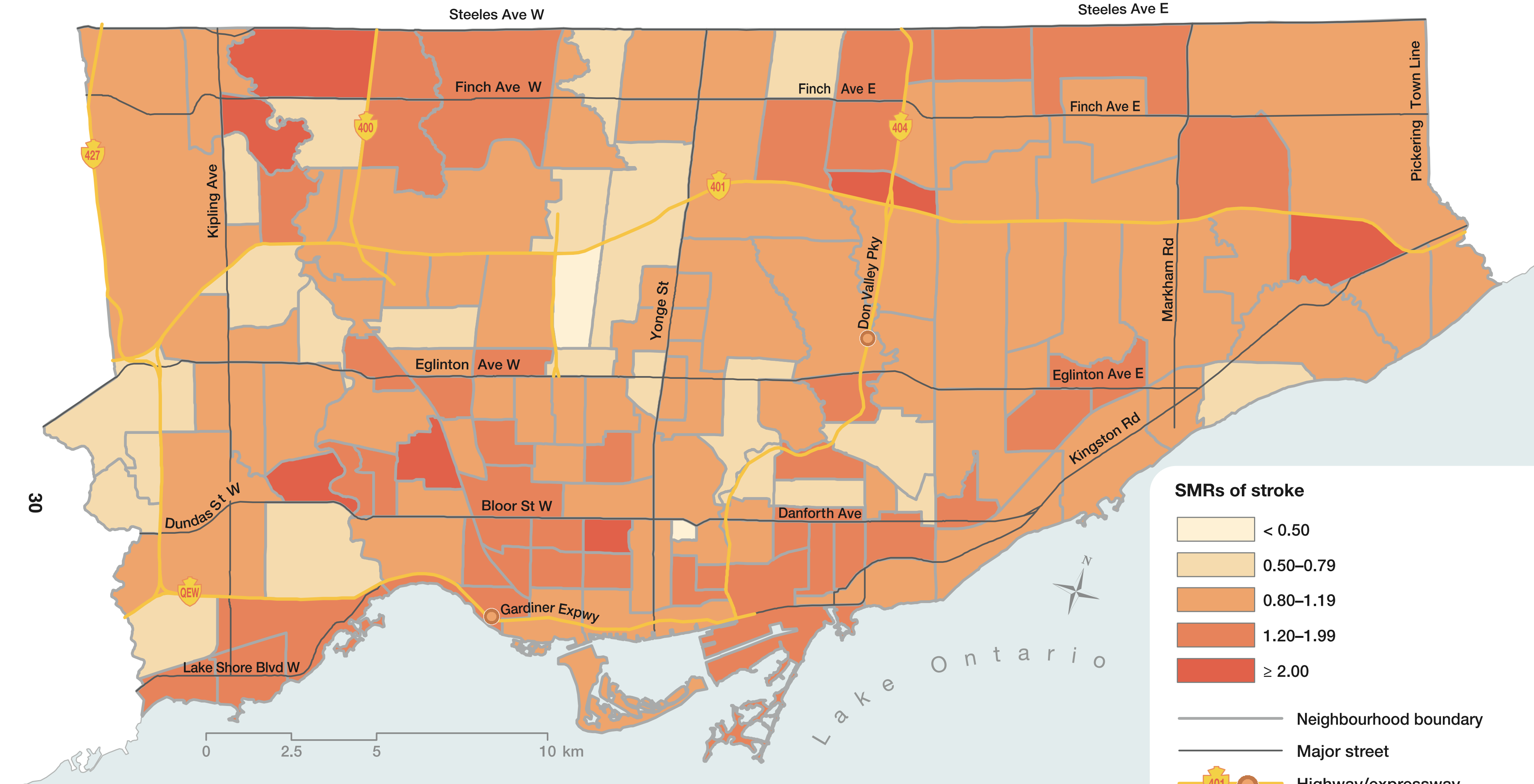
* SMR is a ratio of the number of heart attacks that occurred in each neighbourhood to the number that might be expected, based on the overall age-specific rates of heart attack across the city.

** Rates were averaged over the three-year period.

Findings

- Between 1999 and 2002, rates of admission to hospital due to heart attack varied considerably throughout the city.
- Neighbourhoods with the highest heart attack admission rates were located in the northwest and east ends of the city, with additional pockets located in downtown areas and those west of the downtown core.
- Neighbourhoods with the lowest heart attack admission rates tended to be located more centrally.

Exhibit 2.10 **Standardized morbidity ratios (SMRs)* of stroke among persons aged 40 years and older, by neighbourhood, in Toronto, 1999/00 to 2001/02****



* SMR is a ratio of the number of observed heart attacks in each neighbourhood to that expected based on the overall age-specific rates of heart attack across the city.

** Rates were averaged over the three-year period.

Findings

- Similar to findings on heart attacks (Exhibit 2.9), between 1999 and 2002, rates of admission to hospital due to stroke were generally highest in areas outside of the centre of the city (west, east, and downtown neighbourhoods), and lowest in the central core.

Discussion

Despite a higher prevalence of diabetes in Toronto—compared to the rest of Ontario—diabetes-related complication rates seemed to be generally lower for the city than for the province as a whole. This may be due, in part, to a greater supply of physicians treating diabetes in Toronto, leading to enhanced access to health care services. Another possible explanation is that, overall, Toronto's population is healthier than people living elsewhere in Ontario. For instance, a higher proportion of Toronto's population are recent immigrants (11 percent vs. five percent in Ontario), and although these groups have a higher risk of diabetes based on their ethnicity, they may be in better overall health than the general Canadian public (a phenomenon known as the "healthy migrant" effect).[26]

In Toronto, there were large clusters of neighbourhoods with high diabetes rates in the northwest and east ends of the city. Body Mass Index (BMI) is one of the strongest risk factors for diabetes in epidemiological studies. Therefore, it is not surprising that there was concordance between the prevalence of overweight/obesity and the prevalence of diabetes in most areas of Toronto. However, neighbourhoods in the east end of the city were an exception to this rule. A higher proportion of residents in these neighbourhoods were of Southeast and East Asian heritage (Chapter 4), groups that are known to have higher rates of diabetes but who develop the disease when their BMI scores are relatively lower (compared to those in other ethnic groups). This fact may explain the lack of an association between diabetes and obesity in these parts of the city. Additionally, abdominal obesity is a more important risk factor for diabetes than BMI, particularly in Asian populations; however, measures of abdominal obesity (e.g., waist circumference) were not available for this study.

There was considerable variation across the city in rates of admission to hospital for heart attack and stroke. In addition, the distribution of risk factors contributing to the underlying rate of cardiovascular disease in a given area varied by region. Some neighbourhoods that had higher-than-average rates of admission for heart attack and stroke were within the northwest and eastern ends of the city, where the prevalence of both diabetes and hypertension was greater; others were in the downtown and southwest portions of the city where the rate of smoking was higher.

All the examined health outcomes and related risk factors were less common in the central neighbourhoods of the city. The latter areas tended to be wealthier, with fewer visible minority* residents and recent immigrants.

Since Canadian Community Health Survey data were based on self-report, cultural and other inherent differences between participants living in various parts of the city may have influenced their survey response. In this case, the likelihood of detecting various risk factors may have also been affected. If so, the differences between neighbourhoods with greater or lesser numbers of visible minorities or recent immigrants may be even larger than observed. Other risk factors not accounted for in the current analysis could also have contributed to variations in neighbourhood rates of cardiovascular disease.

*The proportion of visible minorities living in each neighbourhood was derived from the 2001 Census of Canada, which uses the following definition based on the Employment Equity Act: visible minorities are "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour."

Conclusions and Next Steps

Diabetes is a rapidly increasing public health problem. The prevalence of diabetes in Ontario has grown by 69 percent over the past decade, and the numbers of persons with diabetes affected by cardiovascular disease have grown accordingly.[4,27] In the current study, there was a high burden of diabetes and related risk factors in areas of Toronto outside of the central core. These high-risk neighbourhoods are ideal targets for community-based program planning and intervention. These could include local strategies to prevent the development of diabetes and cardiovascular disease among area residents, as well as the provision of health care programs and services related to managing these conditions. The relationships between diabetes and both neighbourhood design/infrastructure, and the availability of resources related to diabetes prevention and control are discussed further in upcoming sections of this Atlas.

Appendix 2.A—How the Research was Done

Data sources

Provincial health claims databases were used to examine patterns of diabetes and cardiovascular disease in Toronto neighbourhoods. The Ontario Diabetes Database, a validated registry held at the Institute for Clinical Evaluative Sciences, was used to identify residents diagnosed with diabetes in 2001/02 (April 1, 2001 to March 31, 2002).[1] The Registered Persons Database was used to derive population denominators. Age- and sex-adjusted diabetes prevalence rates were calculated per 100 population for each neighbourhood in Toronto. Similar steps were used to calculate age-adjusted rates by neighbourhood for men and women separately. Information on hospital admissions for heart attack and stroke that occurred during 2001/02 were obtained for each neighbourhood from provincial hospitalization records. Indirect standardization was used to convert each event rate to a standard morbidity ratio (SMR), which reflects the ratio of the number of observed heart attacks or strokes in each neighbourhood to that expected, based on the overall age-specific rates of each across the city.

Data from Statistic Canada's 2000/01 and 2003 Canadian Community Health Surveys (CCHSs) were combined to examine the percentage of adult residents (aged 20 to 64 years) within Minor Health Planning Areas who reported being overweight or obese (BMI>27). Health Canada currently defines overweight and obesity based on a BMI threshold of 25 and 30, respectively. In the current study, the decision was made to examine the proportion of the population with a BMI greater than or equal to 27 (the cut-off used to define overweight prior to 2003) because otherwise there were too few CCHS participants per neighbourhood to report the rate of obesity.

Data from CCHS respondents aged 12 years and older were also used to determine the percentage of residents in each Minor Health Planning Area who reported being daily or occasional smokers or having a history of hypertension. In order to ensure that different age or sex distributions in neighbourhoods did not account for the differences seen between areas, statistical methods were used to adjust for age and sex differences across the city.

Analysis

Area rates of each of the above variables were depicted using shaded (choropleth) maps. Neighbourhoods where the SMR for heart attack or stroke was greater or less than 1.0 (indicating higher or lower than average rates of hospitalization, respectively) were highlighted. Similarly, those Minor Health Planning Areas where the rate of overweight or smoking was higher or lower than the overall city rate were depicted.

More detailed information about data sources, rate calculations and analyses is available in "Appendix B: Technical Notes" at the end of this Atlas.

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3 Chapter

Socioeconomic Status and Diabetes

Maria I. Creatore, MSc, PhD (candidate), Peter Gozdyra, MA,
Gillian L. Booth, MD, MSc, Kelly Ross, BSc, MSA, and Richard H. Glazier, MD, MPH

Executive Summary

Issue

Socioeconomic factors including income, education and employment are related to a wide range of health conditions, with low socioeconomic status associated with worse health outcomes. This relationship has also been found for diabetes, but it is unclear how strong these relationships are at the neighbourhood level in a large metropolitan area. This chapter presents the spatial distribution of socioeconomic characteristics in Toronto neighbourhoods along with associated diabetes rates.

Study

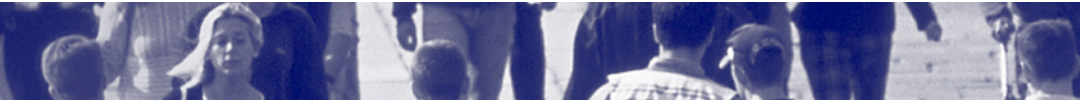
The 2001 Canadian census was used to examine the distribution of socioeconomic characteristics across Toronto's 140 neighbourhoods, including mean annual household income, percent of individuals falling below Statistics Canada's low income cut-off (LICO), percent of adults without a high school diploma and percent unemployment. Age- and sex-standardized diabetes prevalence rates were derived from the Ontario Diabetes Database. Maps were generated to depict many of these variables individually. As well, bivariate *Local Indicator of Spatial Association (LISA)* maps were created to display clustering of diabetes rates with various socioeconomic factors.

Key Findings

- The spatial distribution of socioeconomic factors followed a doughnut-shaped pattern around the central core of the city. These factors included lower annual household income, less formal education, higher unemployment and a higher percent living below LICO.
- Areas with lower socioeconomic status (SES) had a strong spatial concordance with higher diabetes rates. These neighbourhoods clustered in the northwest and eastern parts of the city. Conversely, neighbourhoods with a more advantaged SES profile tended to be clustered in the centre of the city and had lower diabetes rates.

Implications

- **The full health implications of Toronto's clustered areas of low socioeconomic status are poorly understood. Diabetes appears to be one of many adverse health outcomes in these areas.**
- **Diabetes is a final pathway for poor quality diets and lack of physical activity, both of which need to be addressed in the general population. The needs of people living in low socioeconomic status neighbourhoods should be specifically kept in mind when tackling these important issues.**



Introduction

There is an established and well-documented association between socioeconomic status (SES) and chronic diseases.[1] Low SES has been consistently linked to worse health outcomes, and individuals living in low-income areas have higher rates of mortality and morbidity related to chronic disease.[2,3]

Low income and low education have both been associated with higher diabetes rates in adults of all ages.[4] Individuals residing in lower-income neighbourhoods in Ontario have diabetes rates that are 50 percent higher than diabetes rates among those living in more affluent neighbourhoods.[5]

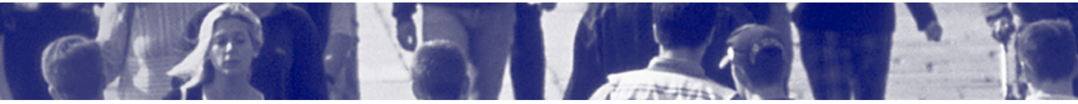
While underlying causes are not well understood, various factors could contribute to income-related variations in diabetes prevalence. For instance, people with low SES have higher rates of obesity than more advantaged groups.[6–8] This may be related to poor diets and lack of physical activity. In one study from the United States (US),[4] the prevalence of obesity (defined as a Body Mass Index* of 30 or greater) was directly proportional to the underlying income of the population (20 percent, 18 percent and 14 percent in low-, medium- and high-income groups, respectively). It has been suggested that low-income populations consume more fast food and fewer fruits and vegetables, and that this contributes to their higher rates of obesity.[9] Even among those employed in the public sector, lower income is associated with poor diet quality.[10] The underlying causes of poor diet quality among low-income groups likely include the higher cost (actual or perceived) of healthy foods (e.g., fresh fruit and vegetables).[11]

With its mix of lowest- and highest-income areas, Toronto is one of the most socioeconomically diverse places in Canada. In such a setting, one would expect to find variations in the rates of diabetes.

The purpose of this chapter is to present the spatial distribution of socioeconomic characteristics in Toronto neighbourhoods and associations with diabetes rates.

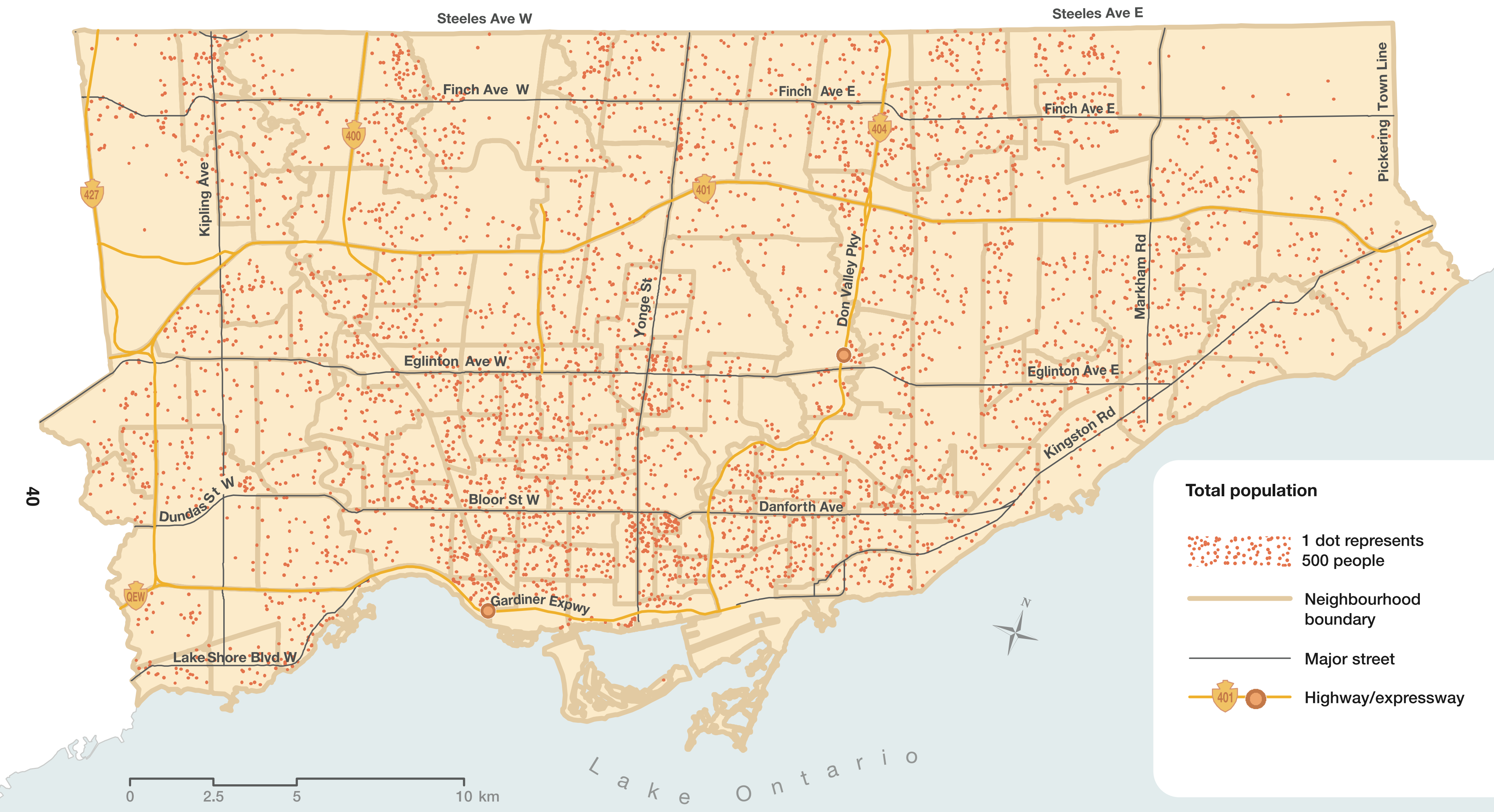
* BMI is a ratio of weight to height and can be calculated according to the equation: $BMI = weight(kg)/height(m)^2$

Chapter 3—List of Exhibits



Exhibits and Findings

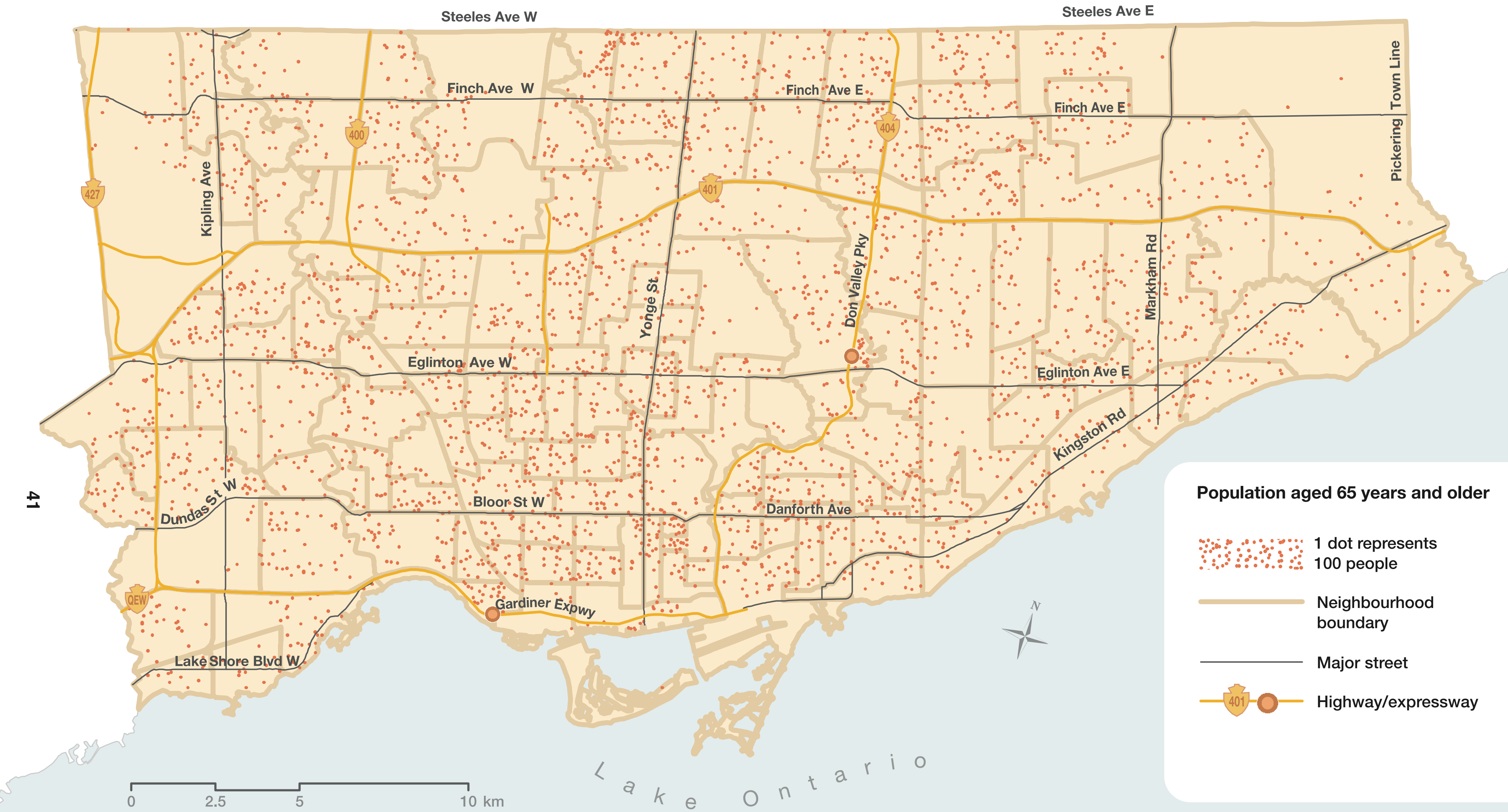
Exhibit 3.1 Distribution of the total population, in Toronto, 2001



Findings

- The distribution of Toronto's population in 2001 is illustrated by a series of dots across the city (dot density map), where one dot represents 500 people in the general population.

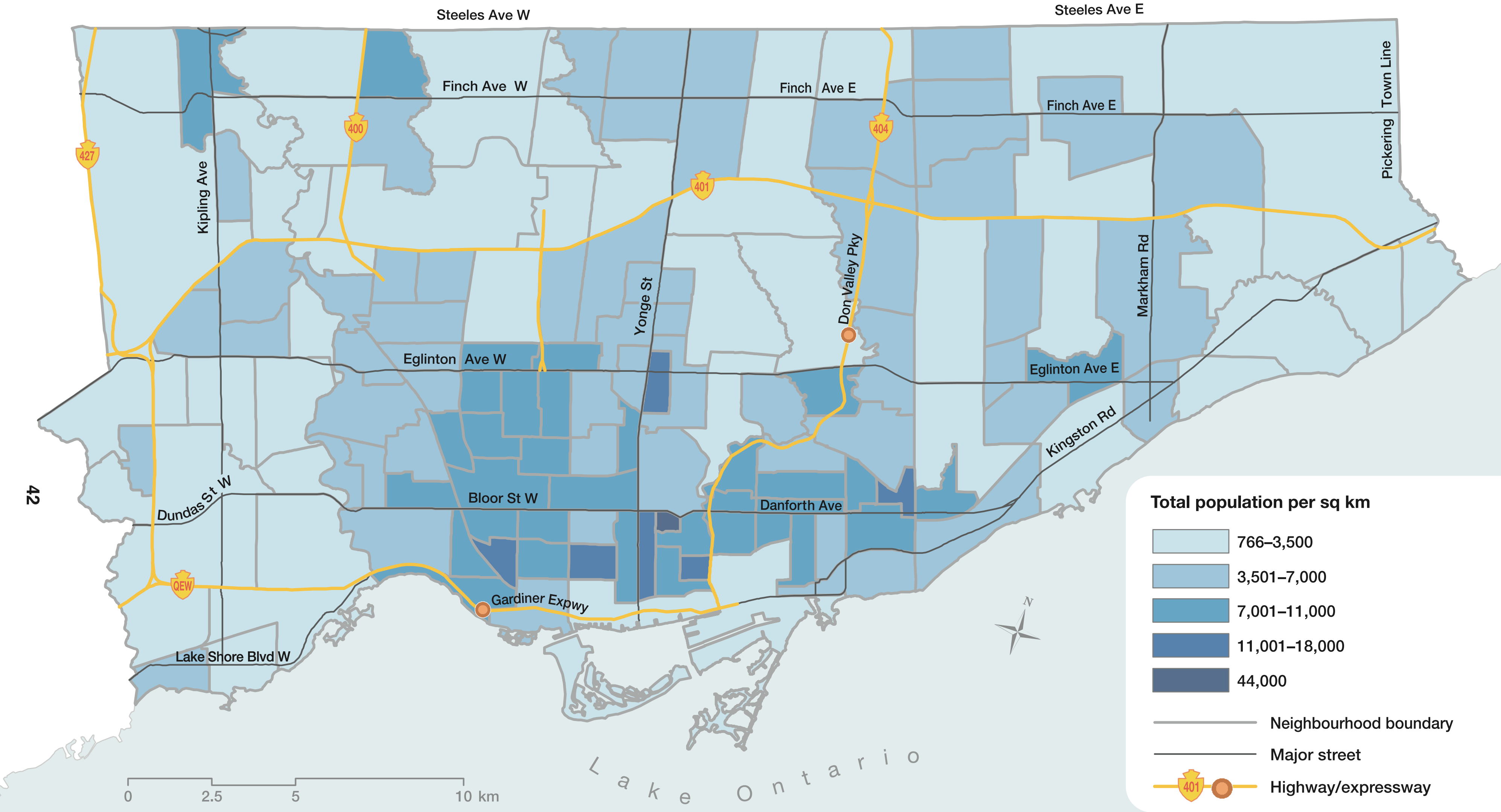
Exhibit 3.2 Distribution of the population aged 65 years and older, in Toronto, 2001



Findings

- In 2001, the concentration of the population appeared to be highest in the downtown core (south central Toronto) and central Toronto, for both the total population (Exhibit 3.1) and persons aged 65 years and older. The latter group showed slightly less clustering in the downtown core.

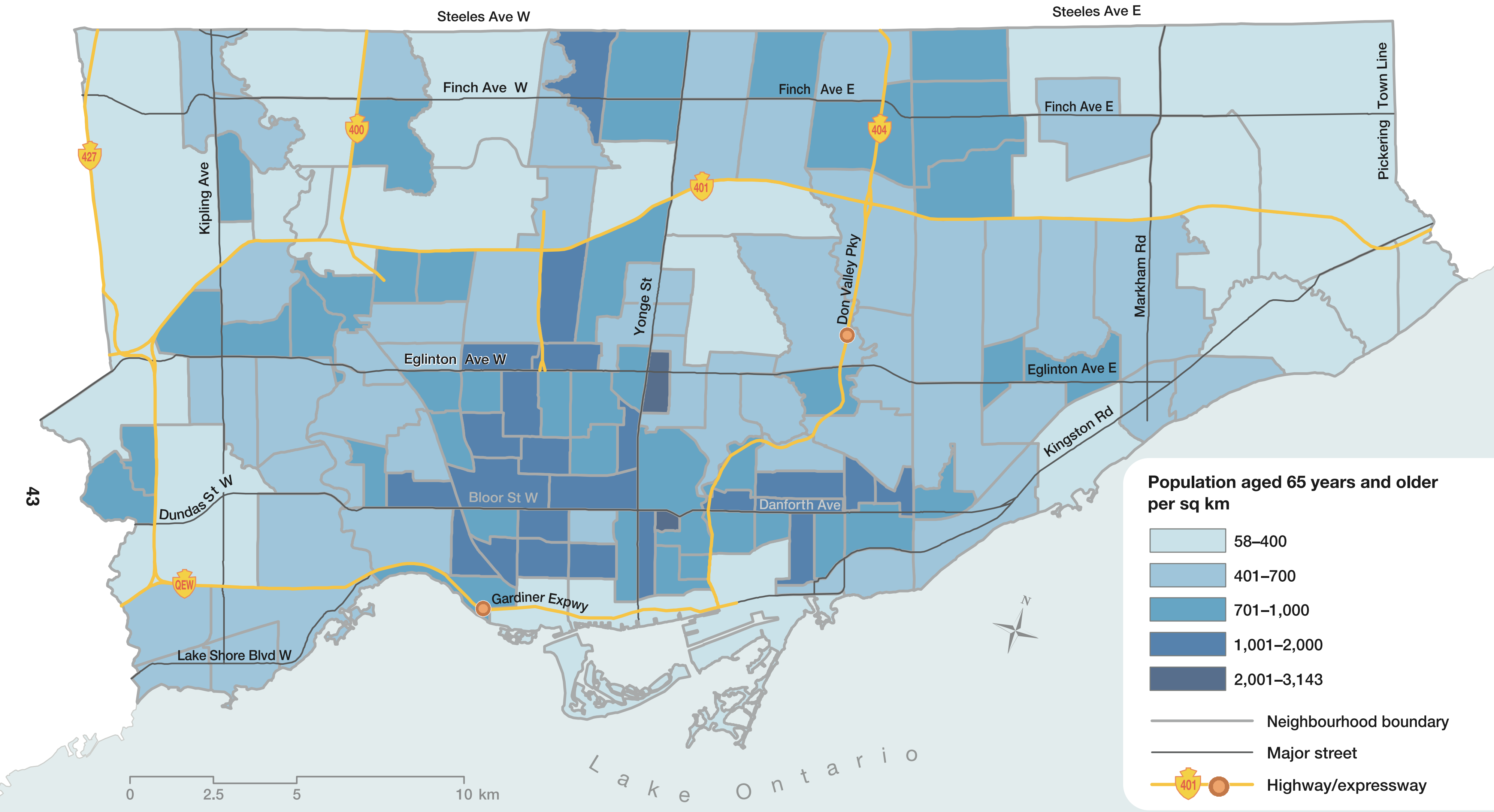
Exhibit 3.3 Total population per square kilometre (sq km) by neighbourhood, in Toronto, 2001



Findings

- This chloropleth shaded map of population density showed a great deal of variation in Toronto's population per square kilometre; in 2001 this ranged from under 800 people to 44,000 people.

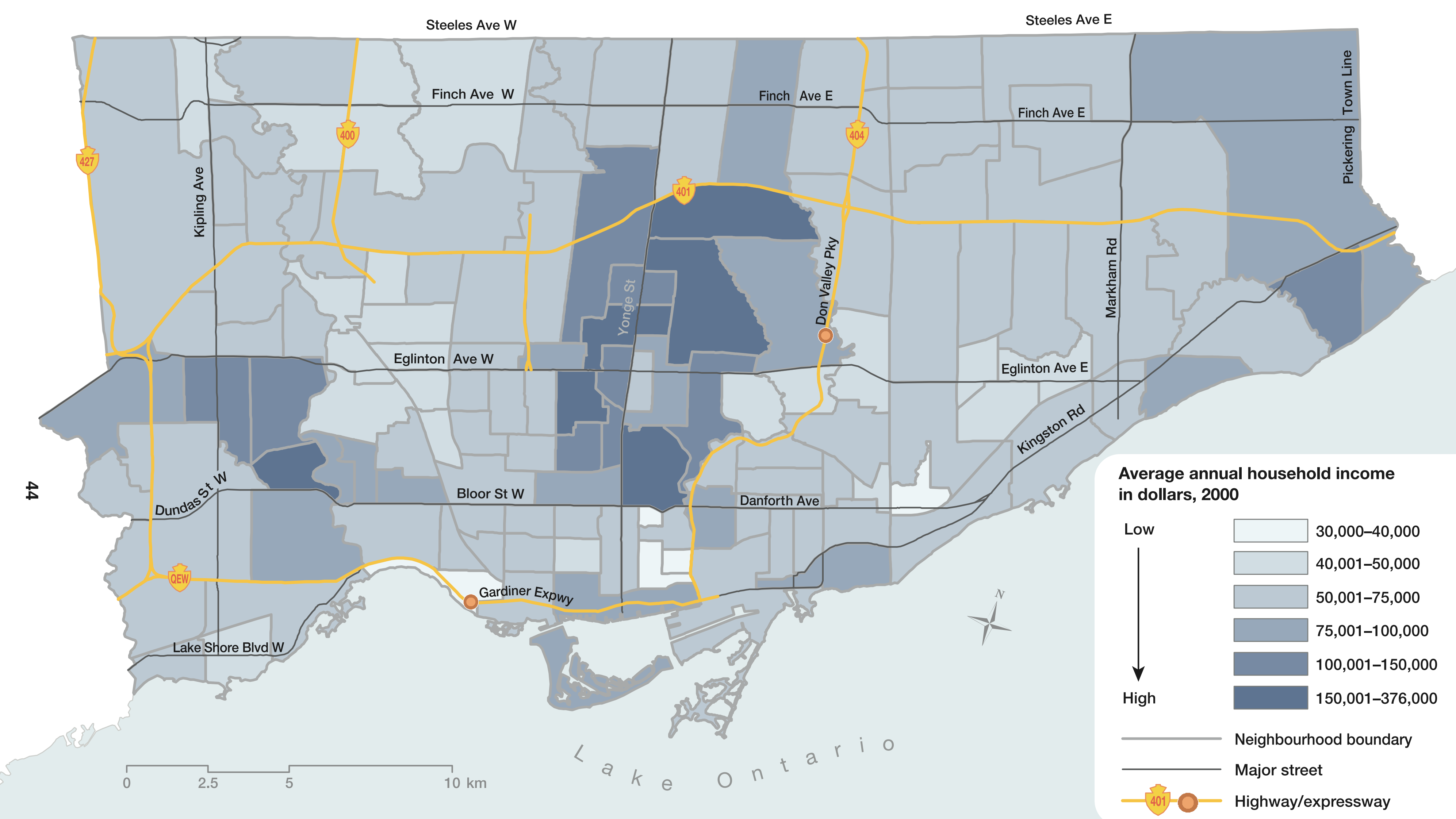
Exhibit 3.4 Population aged 65 years and older per square kilometre (sq km), by neighbourhood, in Toronto, 2001



Findings

- In 2001, there was a concentration of residents aged 65 and older in areas extending north from the city's downtown core.

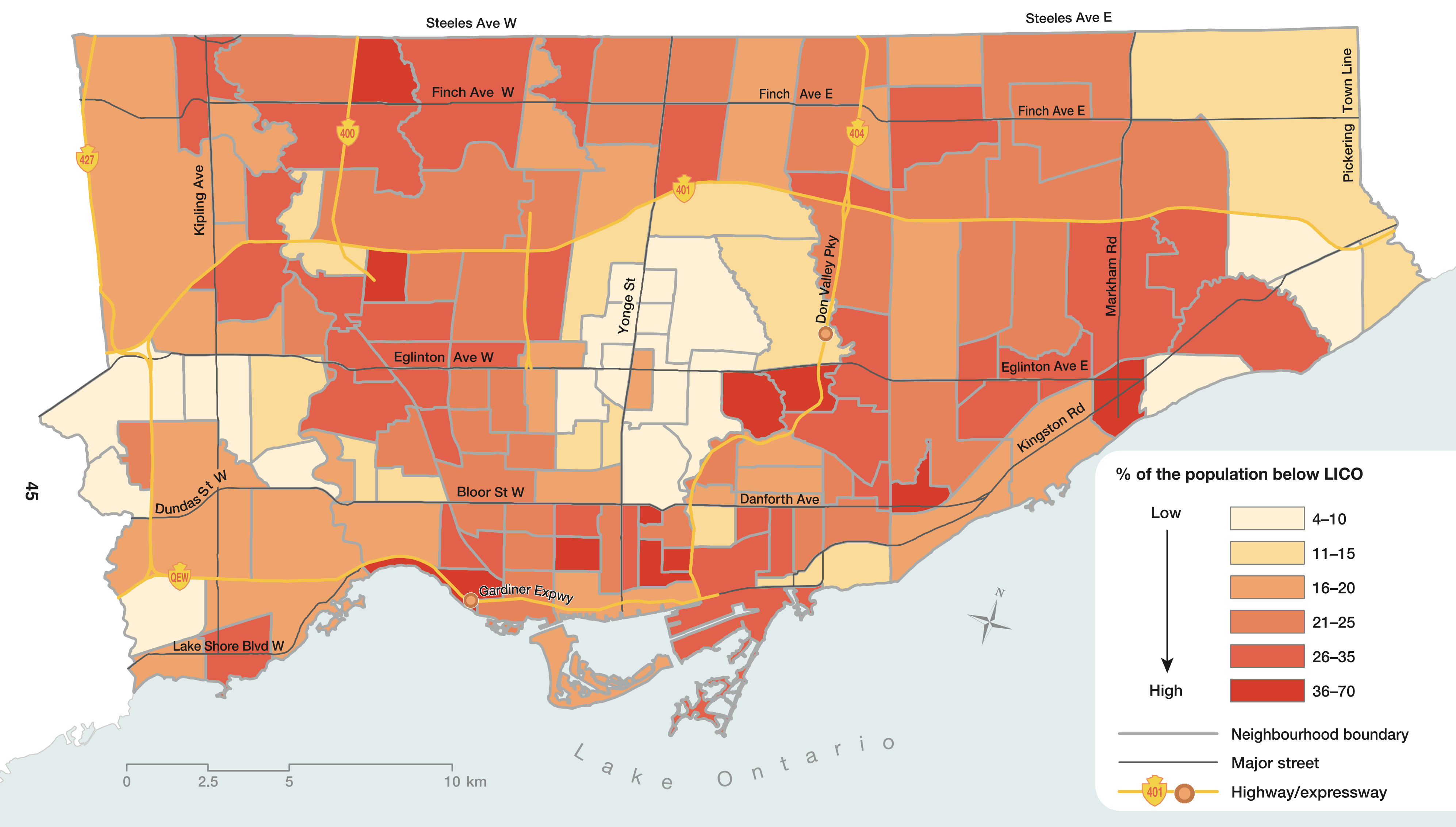
Exhibit 3.5 Average annual household income (in dollars), by neighbourhood, in Toronto, 2000



Findings

- This chloropleth (shaded) map shows the distribution of average annual household income across Toronto in 2000. High socioeconomic areas were visible within central Toronto, along with some areas in the southeast and southwest parts of the city.

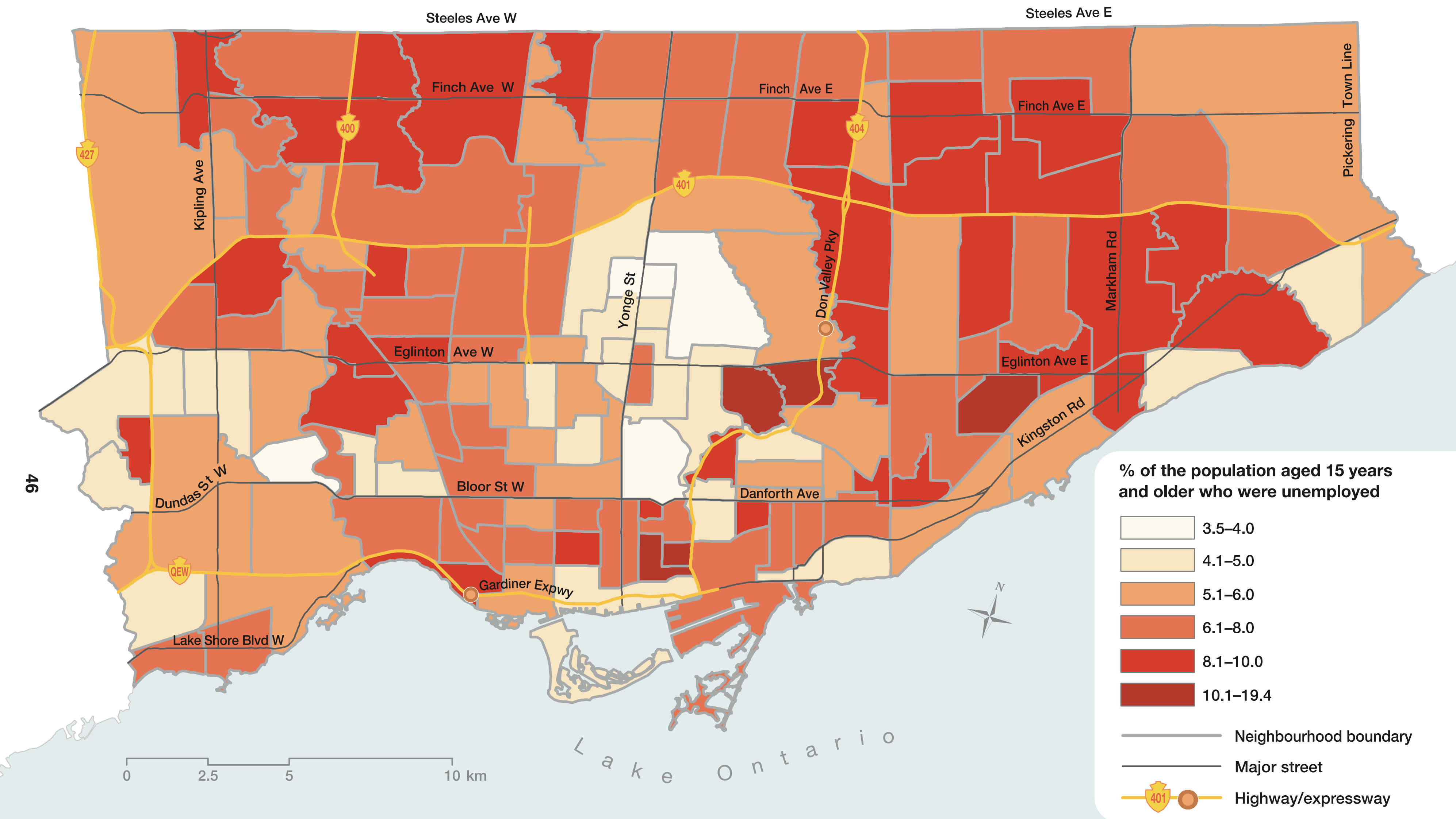
Exhibit 3.6 **Percent of the population aged 15 years and older who fell below Statistics Canada's low income cut-off (LICO), by neighbourhood, in Toronto, 2000**



Findings

- This chloropleth (shaded) map shows the percentage of Toronto's population that fell below Statistics Canada's low income cut-off (LICO) in 2000. High socioeconomic areas were visible within central Toronto, along with some areas in the southeast and southwest parts of the city.

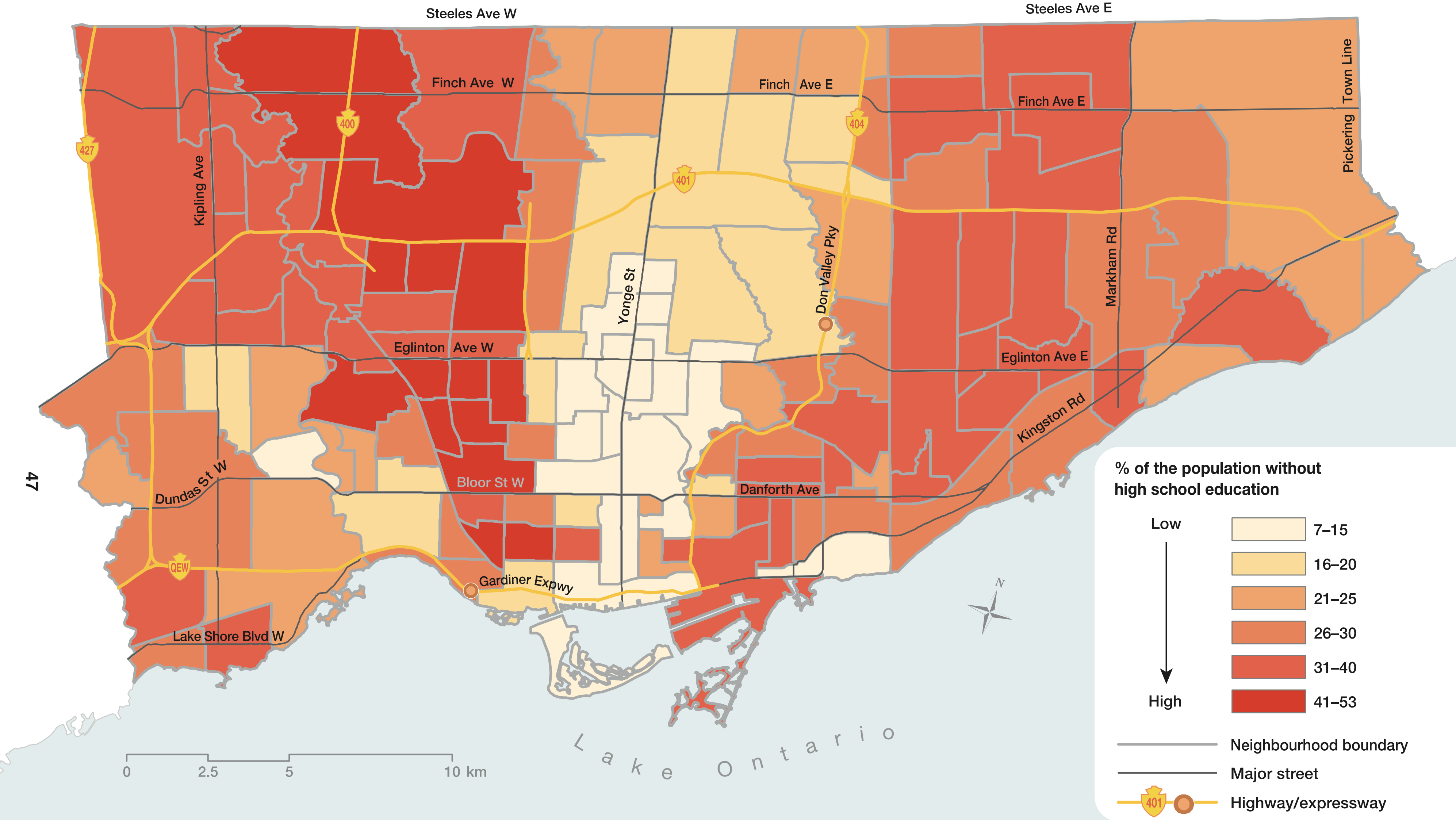
Exhibit 3.7 Percent of the population aged 15 years and older who were unemployed, by neighbourhood, in Toronto, 2001



Findings

- This chloropleth (shaded) map shows the percent of Toronto residents, by neighbourhood, aged 15 years and older who reported being unemployed in 2001.
- The distribution of unemployment followed a pattern similar to the one for low income (Exhibit 3.6).

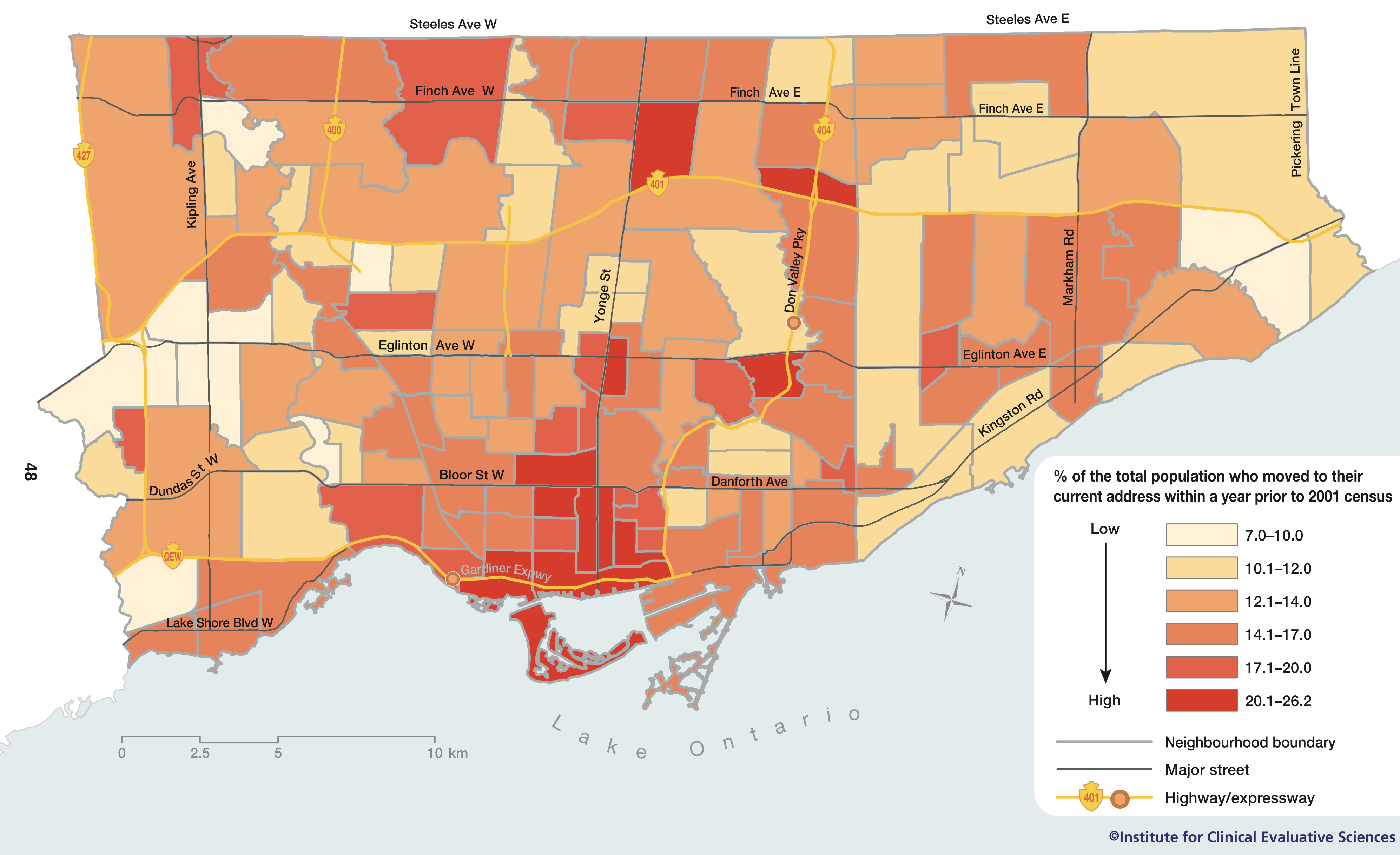
Exhibit 3.8 Percent of the population aged 20 years and older who did not complete their high school education, by neighbourhood, in Toronto, 2001



Findings

- This chloropleth (shaded) map shows the percentage of Toronto residents, by neighbourhood, aged 20 years and older who in 2001 said they did not complete their high school education.
- The areas of Toronto with lowest level of educational attainment (secondary school) were in the west and northwest.

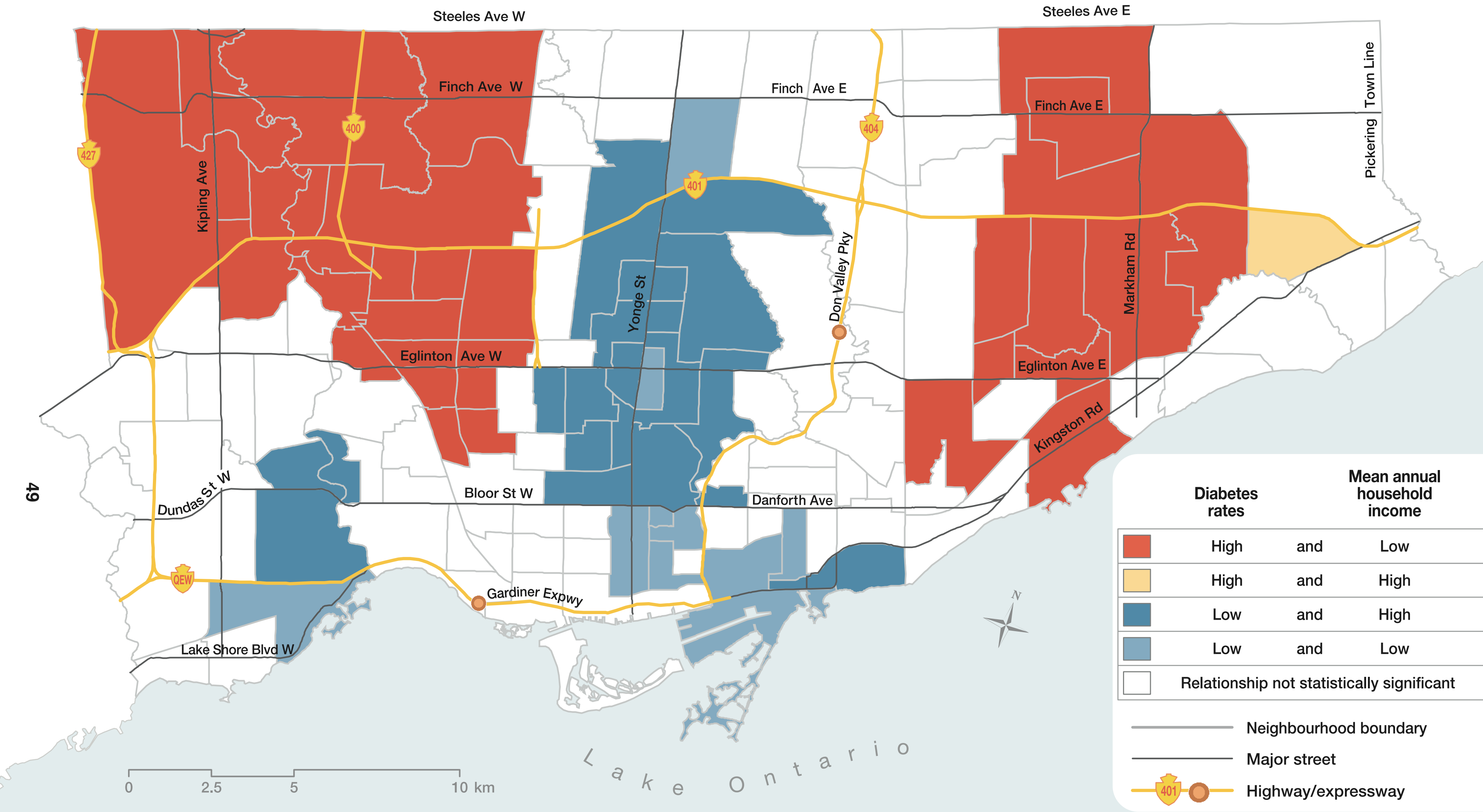
Exhibit 3.9 **Percent of the total population who moved to their current address within a year prior to the 2001 Census of Canada, by neighbourhood, in Toronto, 2001**



Findings

- In 2001, residents in the downtown core reported the highest levels of one-year mobility; those who lived in the southwest were least likely to have moved to their current address within the previous year.

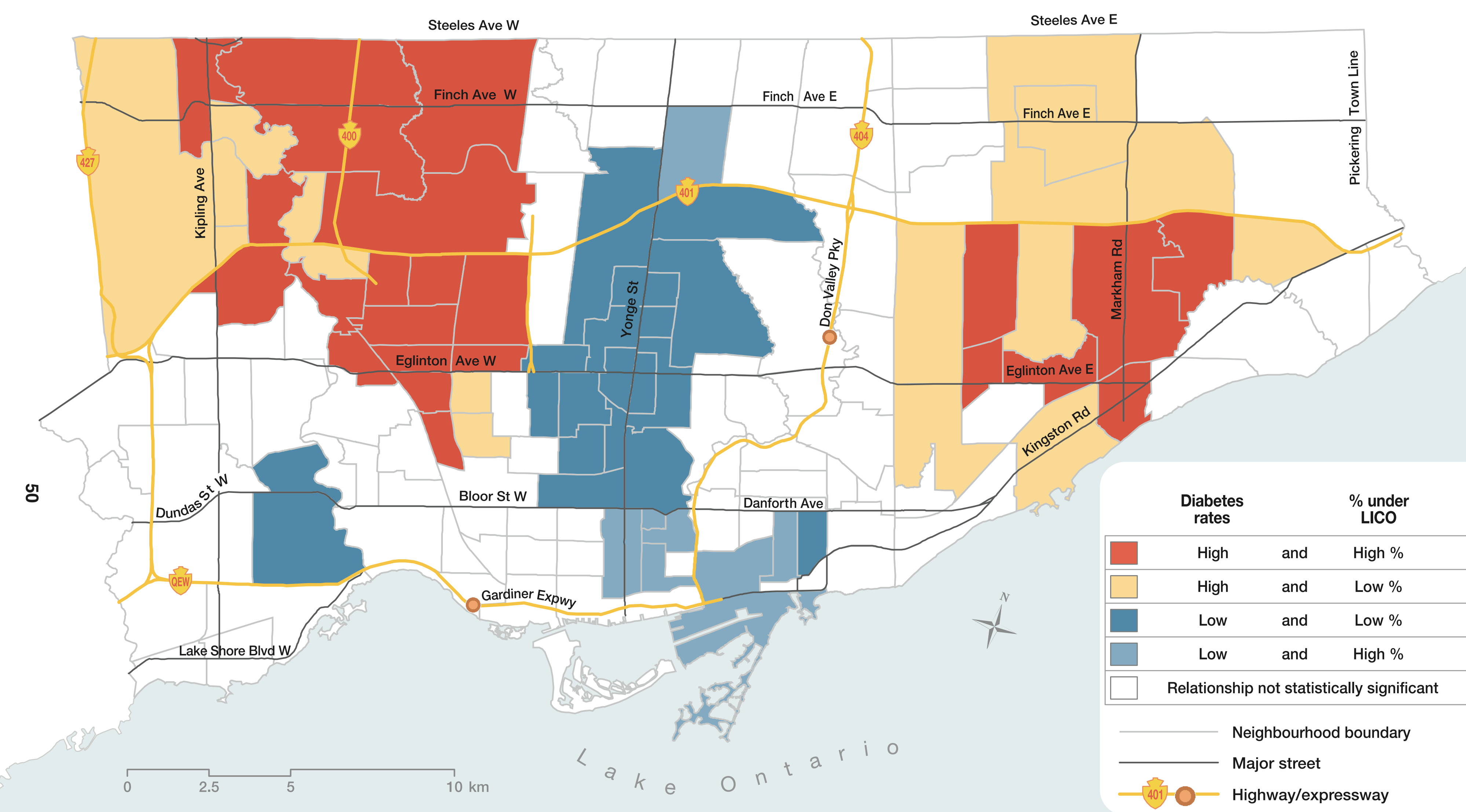
Exhibit 3.10 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and mean annual household income [2001] (high or low), by neighbourhood, in Toronto



Findings

- The spatial relationships between diabetes rates and average annual household income illustrate a distinct pattern of high diabetes rates associated with lower socioeconomic status (SES) in the northwest and the east of Toronto. With the exception of a few neighbourhoods, the centre of the city had low diabetes rates and higher SES.
- Several neighbourhoods in downtown Toronto had both low income and low diabetes rates.

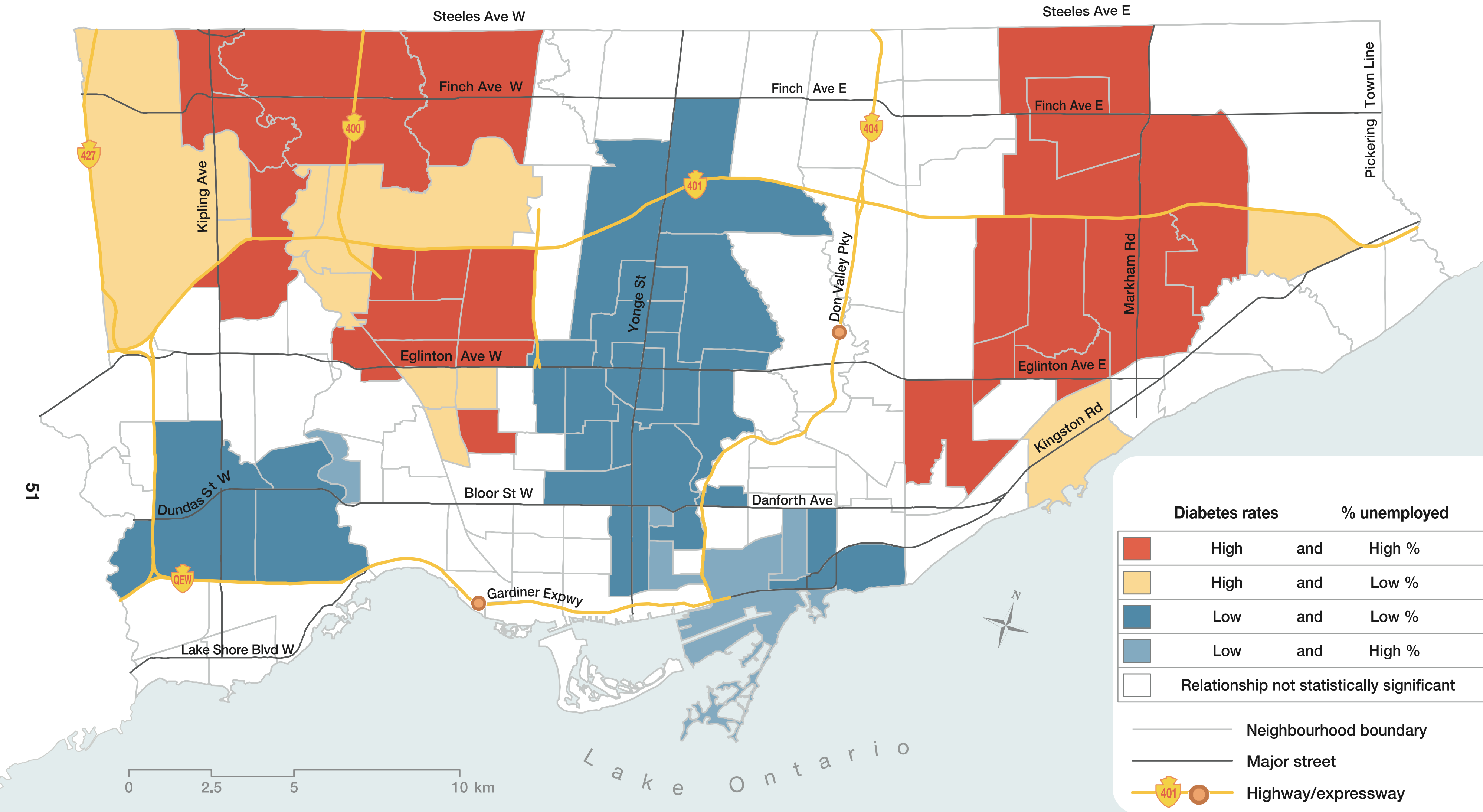
Exhibit 3.11 **Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the population under Statistics Canada's low income cut-off (LICO) [2001] (high or low), by neighbourhood, in Toronto**



Findings

- Many high-diabetes areas in the northwest and east had a high percentage of residents falling below Statistics Canada's low income cut-off (LICO) level (i.e., they spent a significant proportion of total income on food, shelter and clothing).
- However, several neighbourhoods in the far northwest and east end of the city had high diabetes rates and a low percentage of residents below the low income cut-off.

Exhibit 3.12 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the population aged 15 years and older who were unemployed [2001] (high or low), by neighbourhood, in Toronto



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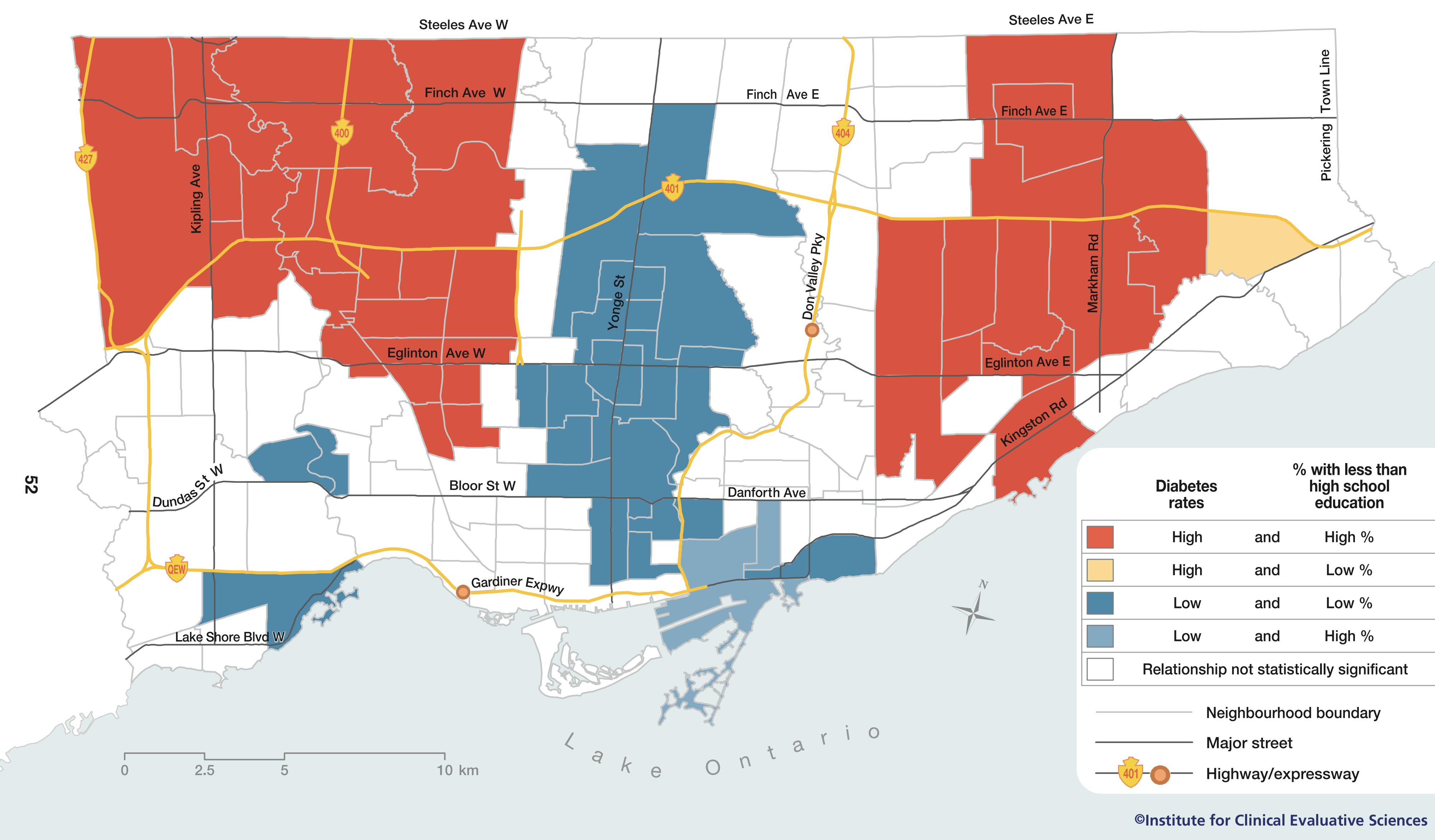
Findings

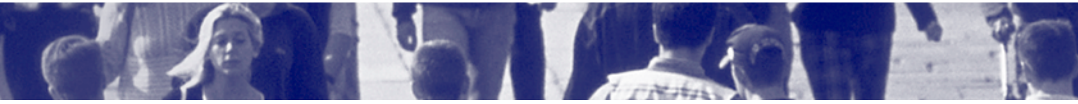
- In 2001, the spatial relationships between diabetes rates and percent unemployment illustrated a distinct pattern of high diabetes rates associated with lower socioeconomic status (SES) in the northwest and the east end of Toronto. With the exception of a few neighbourhoods, the centre of the city had low diabetes rates and higher SES.
- Several neighbourhoods in downtown Toronto had both high unemployment and low diabetes rates.

Exhibit 3.13 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the population aged 20 years and older who did not complete their high school education [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, the spatial relationships between diabetes rates and percent of residents who did not complete their high school education illustrated a distinct pattern of high diabetes rates associated with lower levels of educational attainment. This relationship was especially prevalent in neighbourhoods located in northwest and northeast parts of the city.



Discussion

In Toronto, there was a clearly defined spatial distribution of low socioeconomic status (SES) represented by a doughnut-shaped pattern around the central core of the city. The inner core of Toronto was characterized by higher SES and lower rates of diabetes, while neighbourhoods with lower SES had higher rates of diabetes. Lower-income neighbourhoods in the outer suburbs of the city (clustered in the northwest and northeast ends of Toronto) shared a disproportionately high burden of diabetes.

There are many potential reasons for the association between SES and diabetes prevalence. Firstly, risk factors for diabetes such as obesity, less healthy eating patterns and sedentary lifestyles appear to be more common in lower SES groups.[6–9] Also, Toronto is home to the largest number of immigrants in Canada, which could partly explain the link between SES and diabetes. Many new immigrants to Canada are from ethnic groups that have an increased risk of developing diabetes, including those of Asian, African and Hispanic ancestry.[12,13] New immigrants tend, at least initially, to settle in low-income areas.

The cross-sectional nature of this research cannot prove a causal link between lower SES and diabetes, because lower SES may occur after the development of diabetes. Persons with diabetes have higher rates of unemployment due to disability, so socioeconomic status may deteriorate as a direct consequence of the disease.[14,15]

There are a number of implications related to these findings. Previous research has shown that lower SES groups experience a higher rate of cardiovascular disease and are more likely to be hospitalized for an acute complication of diabetes.[16–18] Therefore, the consequences of developing diabetes may be more severe for those with low income. In addition, diabetes is a costly condition to manage, requiring the use of multiple medications and supplies necessary for regular home monitoring of blood sugar levels. As such, an even greater burden is placed on persons in lower income groups who have fewer resources to purchase these medications and supplies.[19]

The cost of maintaining a healthy lifestyle can pose an additional barrier to persons with lower incomes. Regular exercise can help prevent weight gain, a major risk factor for the development of diabetes. Furthermore, physical activity is an essential component of the intensive lifestyle measures that have been shown in randomized trials to reduce the incidence of diabetes in high-risk populations.[20,21] The costs associated with sports and other leisure activities could give wealthier individuals a health advantage over those in lower income groups who simply cannot afford to engage in certain sporting activities or to join health clubs. The higher cost (actual or perceived) of a healthy diet (including fresh fruits and vegetables) may cause lower-income individuals and families to select cheaper, calorie-dense foods with less nutritional value.[22] This is also likely to contribute to obesity and diabetes among people with low incomes.[11]

The association between SES and the risk of diabetes may also be driven by neighbourhood-related differences in access to healthy resources (e.g., stores selling fresh fruits and vegetables) and opportunities to engage in physical activities (e.g., recreation centres located within easy walking distance). Lower-income neighbourhoods may also be less conducive environments for healthy living due to higher rates of crime and pollution. These factors may make residents more reluctant to attend exercise classes in the evening and even discourage them from taking regular walks after dinner or as a mode of travel within the neighbourhood.

Public health interventions focused on reducing the risk of diabetes in low-income parts of the city may be more challenging to implement than public health measures in other high-risk populations. Such measures will likely require a multifaceted approach by policy makers and politicians in order for problems to be successfully remedied.

Conclusions and Next Steps

We noted a strong spatial relationship between rates of diabetes in Toronto and certain socioeconomic variables. Higher diabetes rates were consistently found in neighbourhoods with higher percentages of low-income residents, higher rates of unemployment, and greater numbers of residents who did not complete their secondary education. These neighbourhoods were clustered in the northwest and eastern parts of the city. Conversely, neighbourhoods with a more advantaged socioeconomic status (SES) profile tended to be clustered in the centre of the city and to have lower diabetes rates. Many factors may explain the relationship between SES and diabetes prevalence, including the distribution of ethnoracial groups within neighbourhoods, as well as local access to healthy foods and opportunities for physical activity. The relationship between these factors and diabetes in high- vs. low-SES neighbourhoods will be explored in later chapters of this Atlas.

Appendix 3.A—How the Research was Done

Data sources

The socioeconomic factors examined in this chapter and population estimates for the City of Toronto were gathered from the 2001 Canadian census for each neighbourhood in the city. The total population included Canadian citizens, landed immigrants, refugees, students, people with work permits and Minister's permits (whose usual place of residence is in Canada).

The average annual household income for a given neighbourhood was based on the weighted mean total income of corresponding households in 2000. The percentage of individuals living below Statistics Canada's low income cut-off (LICO) was derived from the population in private households. Individuals who live at this income level spend a significantly higher-than-average proportion of their total income on food, shelter and clothing.

The unemployment rate for the city was calculated based on the percentage of the non-institutionalized population aged 15 years and older who reported being unemployed in the week prior to May 15, 2001.

The proportion of residents who did not complete their high school education was based on the percentage of the non-institutionalized population aged 20 years and older who did not receive their secondary school graduation certificate. One-year population mobility was assessed by examining the percentage of the non-institutionalized population aged one year and older whose current address as of May 15, 2001 differed from their address a year earlier (on May 15, 2000).

Age- and sex-adjusted diabetes rates were calculated using the Ontario Diabetes Database and other administrative data held at the Institute for Clinical Evaluative Sciences (ICES).

The proportion of visible minorities living in each neighbourhood was derived from the 2001 Census of Canada, which uses the following definition based on the Employment Equity Act: visible minorities are "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour." Visible minority status was self-reported.

Analysis

The distribution of the total population and persons aged 65 years and older living in Toronto in 2001 was examined using dot density maps. For the whole population, each dot represented 500 people, and for persons aged 65 years and older each dot represented 100 people. To maintain confidentiality, dots were placed at random locations in each census dissemination area and not in the actual location corresponding with the residential postal code. Dissemination areas are small census units, each containing about 300 households. Population density per square kilometre was shown on choropleth (shaded) maps. This mapping technique was also used to depict patterns of several sociodemographic variables. The relationships between these variables and diabetes prevalence were evaluated using bivariate *Local Indicator of Spatial Association (LISA)* maps.

More detailed information about data sources, rate calculations and analyses is available in "Appendix B: Technical Notes" at the end of this Atlas.

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4

Chapter

Ethnicity, Immigration and Diabetes

Gillian L. Booth, MD, MSc, Maria I. Creatore, MSc, PhD (candidate), Peter Gozdyra, MA, and Richard H. Glazier, MD, MPH

Executive Summary

Issue

Type 2 diabetes occurs more commonly in non-European ethnoracial groups, due in part to ethnic differences in genetic susceptibility. This chapter presents the spatial distribution of ethnoracial characteristics in Toronto neighbourhoods and associations with diabetes rates.

Study

The 2001 Canadian census was used to examine the spatial distribution of ethnoracial groups across Toronto's 140 neighbourhoods. This included the percentage of residents who identified themselves as being from an individual visible minority group, and who reported having immigrated to Canada either recently (1996–2001) or prior to 1996. Age- and sex-adjusted diabetes prevalence rates were derived from the Ontario Diabetes Database. Maps depicting these variables individually were generated. Bivariate *Local Indicator of Spatial Association (LISA)* maps were also created to illustrate the spatial clustering of diabetes rates for various ethnoracial groups.

Key Findings

- Although patterns of settlement in Toronto differed by ethnic group, neighbourhoods with higher proportions of visible minorities and recent immigrants tended to coincide with patterns of social disadvantage.
- Neighbourhoods with high diabetes rates in the northwest and east end of Toronto also had high proportions of visible minorities, immigrants and recent immigrants.

Implications

- **Diabetes programs need to be culturally appropriate and accessible to groups for whom English is not their first language.**
- **Strategies to reduce the risk of diabetes in high-risk communities need to consider the underlying ethnicity and culture of the target population.**

Introduction

Type 2 diabetes occurs more commonly in non-European ethnoracial groups, due in part to ethnic differences in genetic susceptibility. The highest rate of diabetes worldwide has been reported in Aboriginal populations, where the prevalence may be as high as 25–50 percent.[1,2] In Ontario, the prevalence of diabetes among adults in First Nations (FN) communities was 13 percent—a rate that is three times that of non-FN residents.[3] Some other populations are also at particularly high risk.

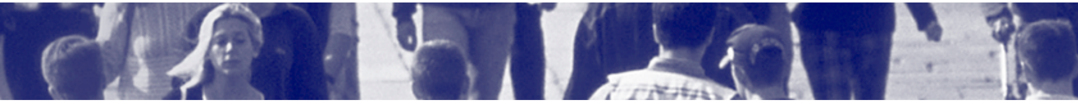
In the United States (US), epidemiologic studies have found the prevalence of diabetes in African and Hispanic Americans to be twice that of non-Hispanic whites.[4–6] Diabetes rates are also higher among Asian Americans and appear to be rising in this group at a faster rate than in other ethnic groups.[7] Studies from the United Kingdom have illustrated a higher burden of diabetes among people of South Asian descent (Indian, Pakistani and Bangladeshi), in whom the prevalence of diabetes appears to be three to six times that of the white, British population.[8,9] In Ontario, South Asians and West Asians comprise 12 percent of the population with diabetes, yet they account for less than four percent of the overall population.[10]

Ethnicity largely alters the risk of diabetes through genetic factors, which can influence the propensity to gain weight, the pattern of weight gained, and the likelihood that increased body fat will result in insulin resistance. However, cultural aspects may also modify this risk through their effect on eating patterns and physical activity levels. In one analysis, racial differences in potentially modifiable risk factors, particularly the level of obesity, accounted for nearly 50 percent of the excess risk of diabetes in African-American women.[11]

The higher risk experienced by certain groups may be further compounded by differences in socioeconomic status. Recent immigrants and visible minorities tend to have lower incomes than Canadian-born people of European descent and this may further exacerbate any health disparities.[12,13] (For a definition of "visible minority," see section 4.A at the end of this chapter). There is also evidence that recent immigrants and visible minorities have poorer access to health services, which may impair the quality of diabetes care they receive.[14–16]

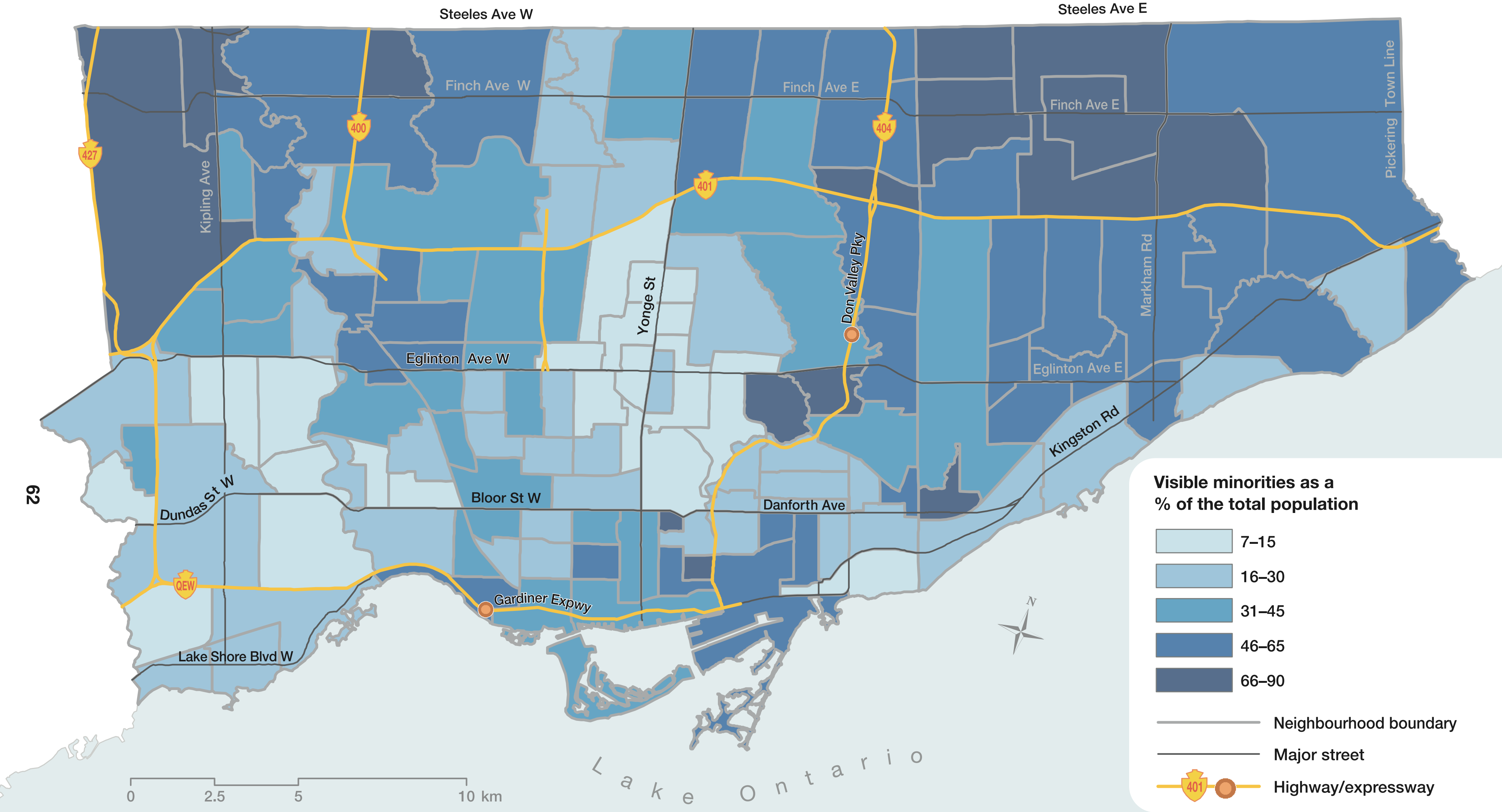
Toronto is a culturally and ethnically diverse city. According to the 2001 Census of Canada, 43 percent of Toronto residents identified themselves as being from a visible minority.[17] While immigrants comprised 18.4 percent of Canada's total population in 2001, they accounted for nearly half of all residents in the city of Toronto.[17] Most recent immigrants to Canada originated from non-European countries,[18] and many of these groups are genetically more susceptible to develop diabetes. The purpose of this chapter is to examine the relationship between the prevalence of diabetes, immigration and ethnicity in Toronto.

Chapter 4—List of Exhibits



Exhibits and Findings

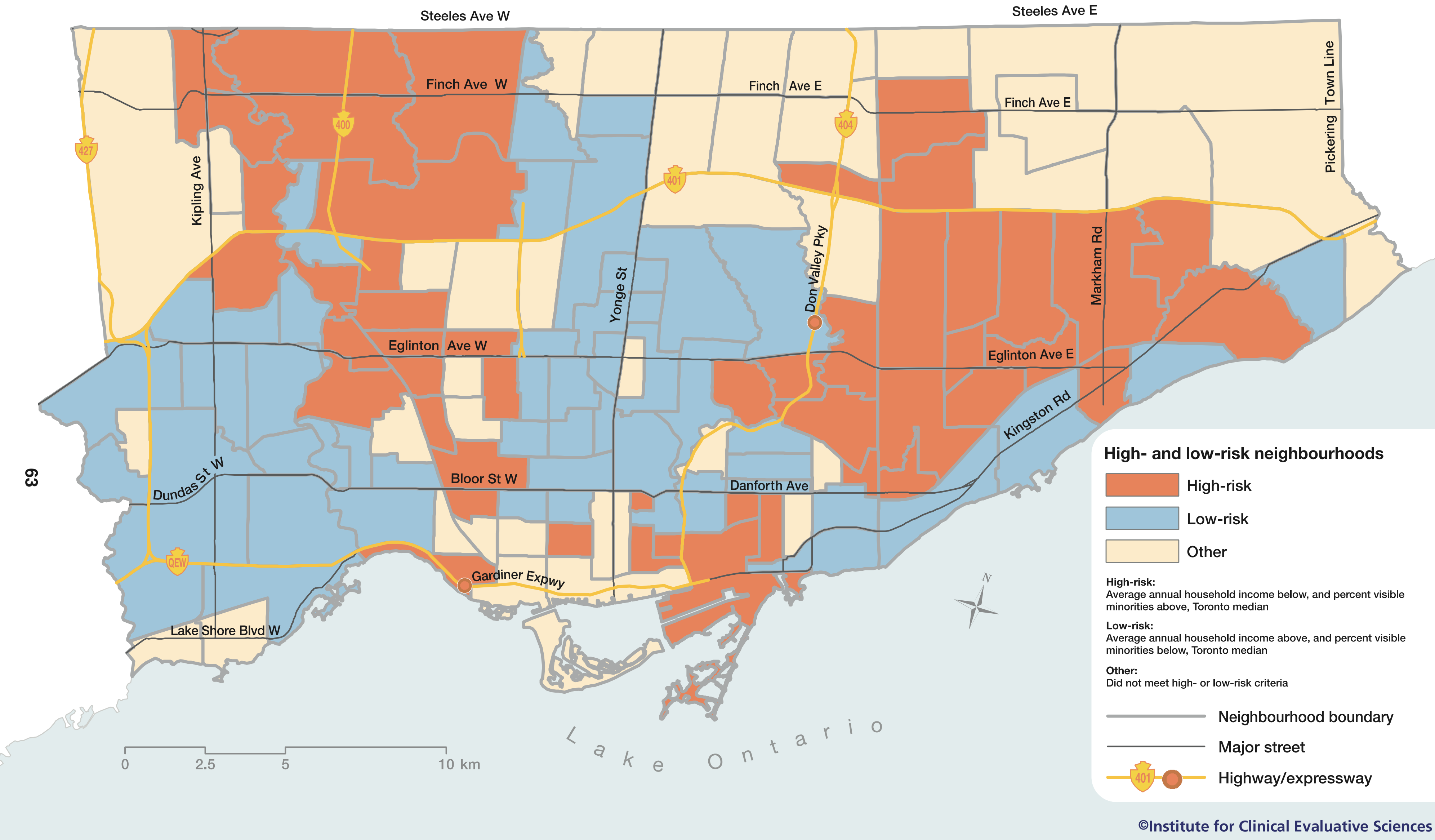
Exhibit 4.1 Visible minorities (self-reported) as a percent of the total population, by neighbourhood, in Toronto, 2001



Findings

- In 2001, neighbourhoods with high proportions of visible minorities were located in the eastern and northwestern sections of Toronto and parts of downtown (south central Toronto). In some of these areas, more than two-thirds of the population was from a non-white ethnoracial group.

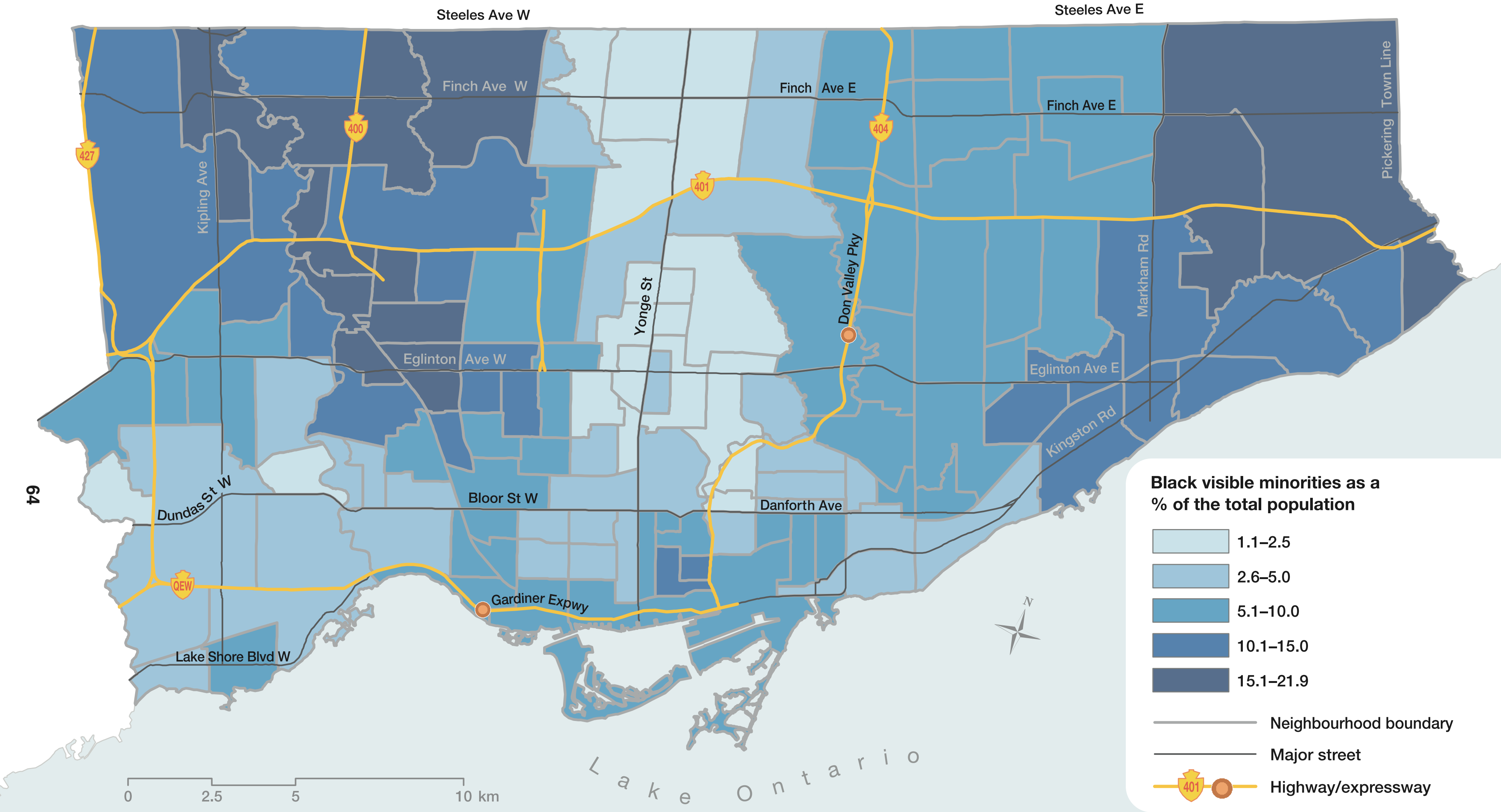
Exhibit 4.2 High- and low-risk neighbourhoods, in Toronto, 2001



Findings

- In 2001, high-risk neighbourhoods were concentrated in the downtown core of Toronto, and the northwest and east end of the city.
- Low-risk neighbourhoods were located within central Toronto, along with some areas in the southwest and southeast areas of the city.
- This pattern is similar to what was observed for socioeconomic factors in general (Chapter 3).

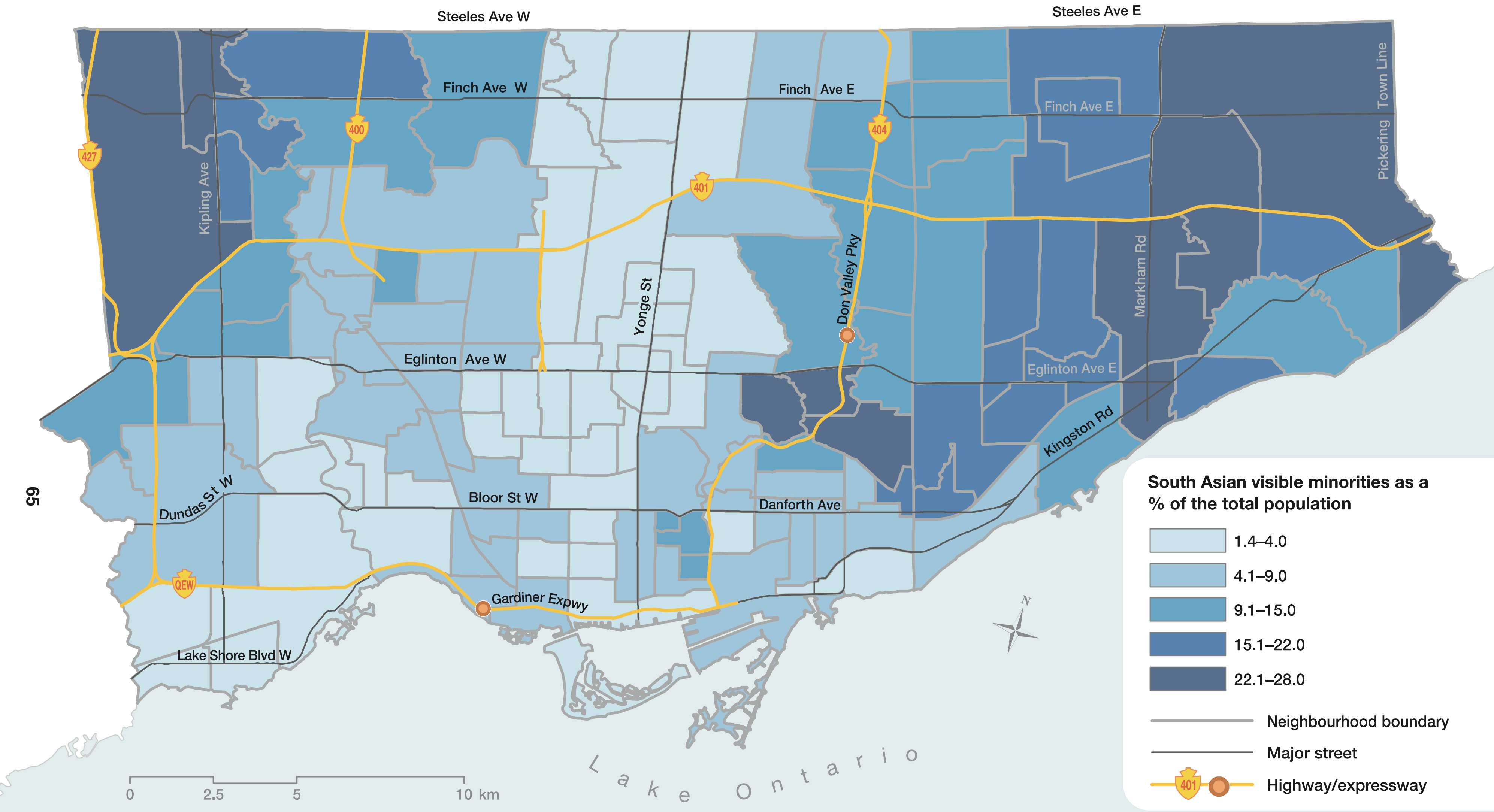
Exhibit 4.3 Black visible minorities (self-identified) as a percent of the total population, by neighbourhood, in Toronto, 2001



Findings

- In 2001, neighbourhoods where a higher proportion of residents identified themselves as being from a black ethnoracial group were located predominantly in the northwest and east ends of the city, as well as in two downtown neighbourhoods (south central Toronto).

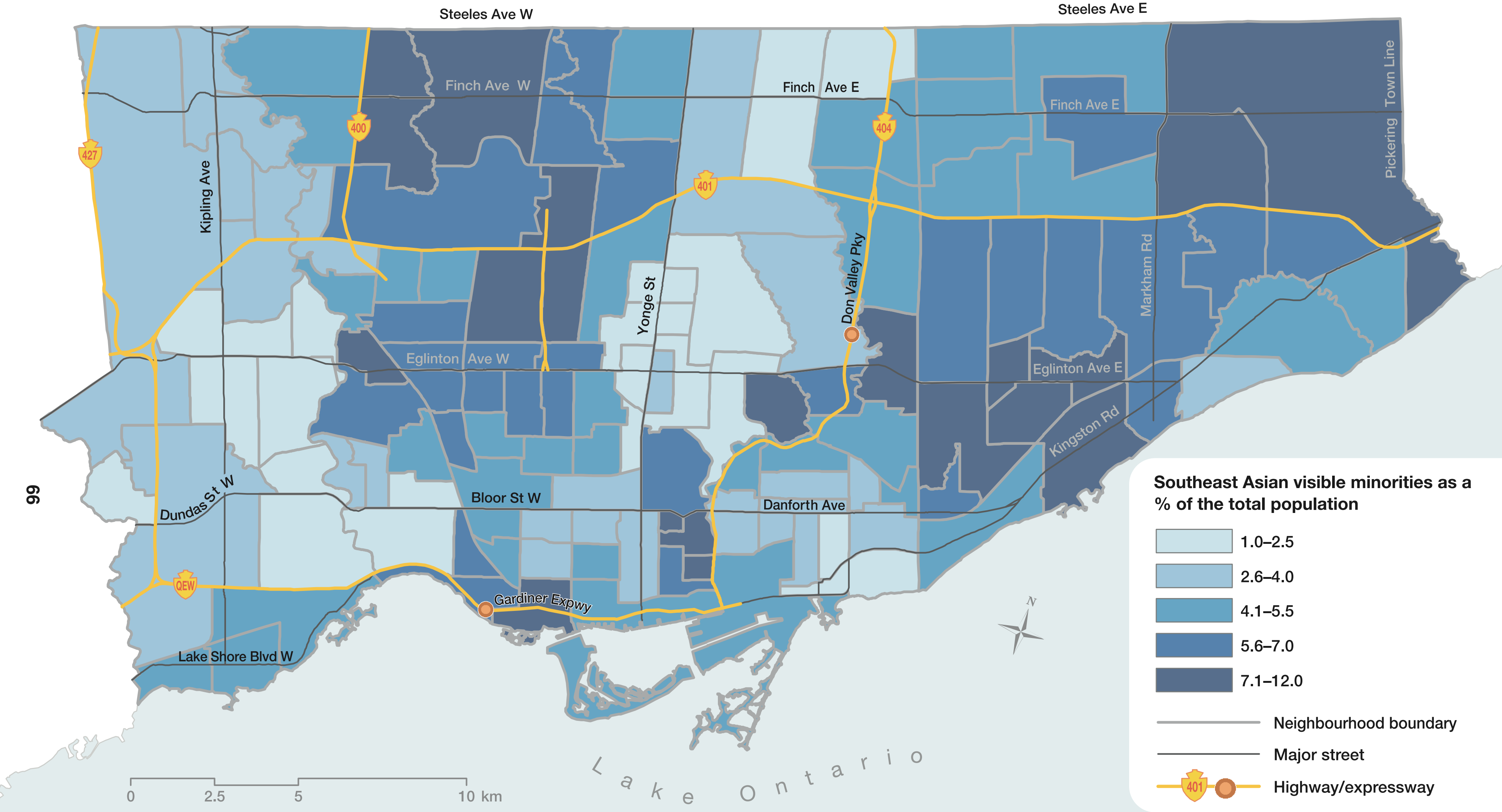
Exhibit 4.4 South Asian visible minorities (self-identified) as a percent of the total population, by neighbourhood, in Toronto, 2001



Findings

- In 2001, neighbourhoods where a higher proportion of residents identified themselves as being from a South Asian ethnoracial group were located predominantly in the far northwest and east ends of the city.

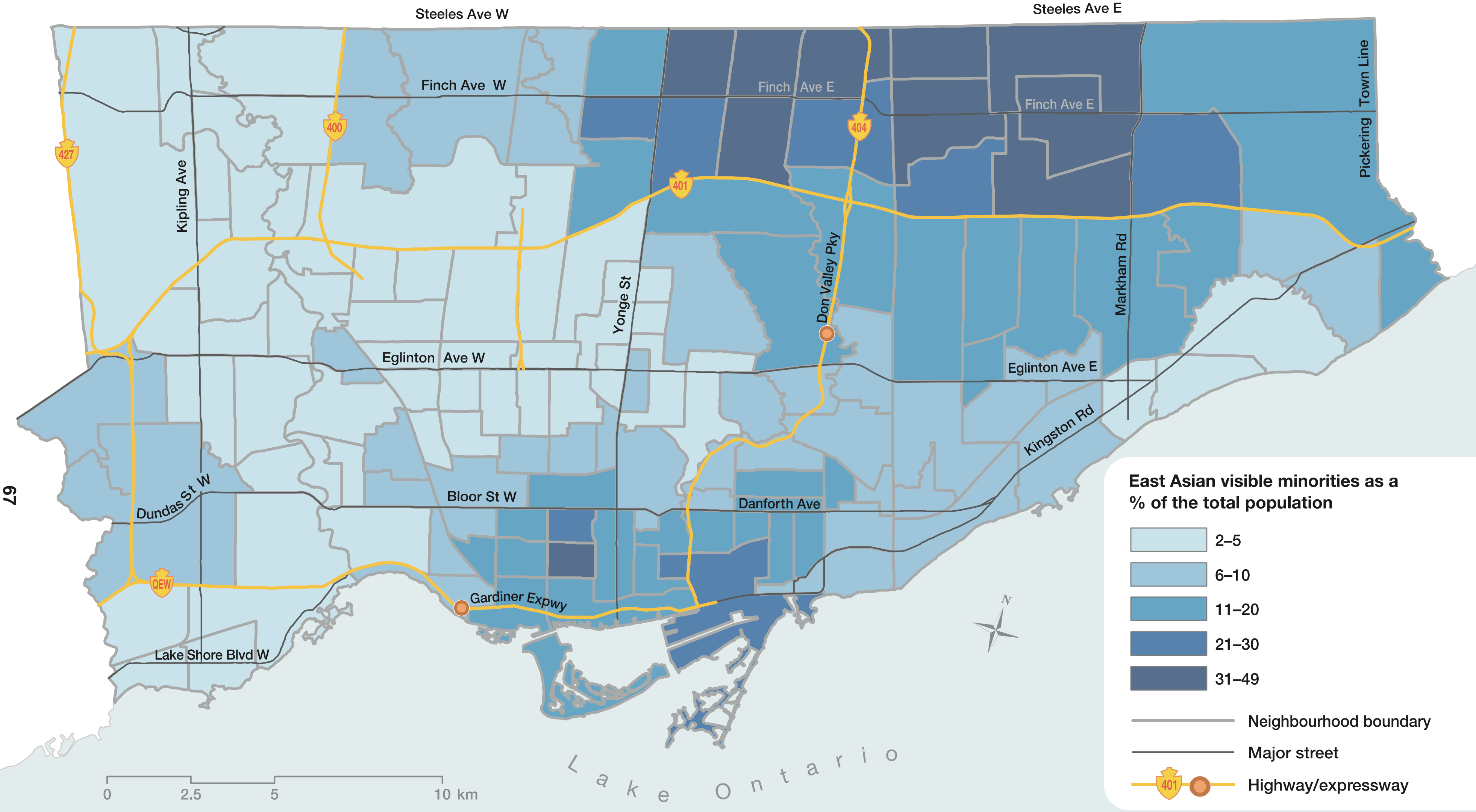
Exhibit 4.5 Southeast Asian visible minorities (self-identified) as a percent of the total population, by neighbourhood, in Toronto, 2001



Findings

- In 2001, neighbourhoods where a higher proportion of residents identified themselves as being from a Southeast Asian ethnoracial group were concentrated in the east and central west ends of the city, with additional pockets in the downtown core (south central Toronto).

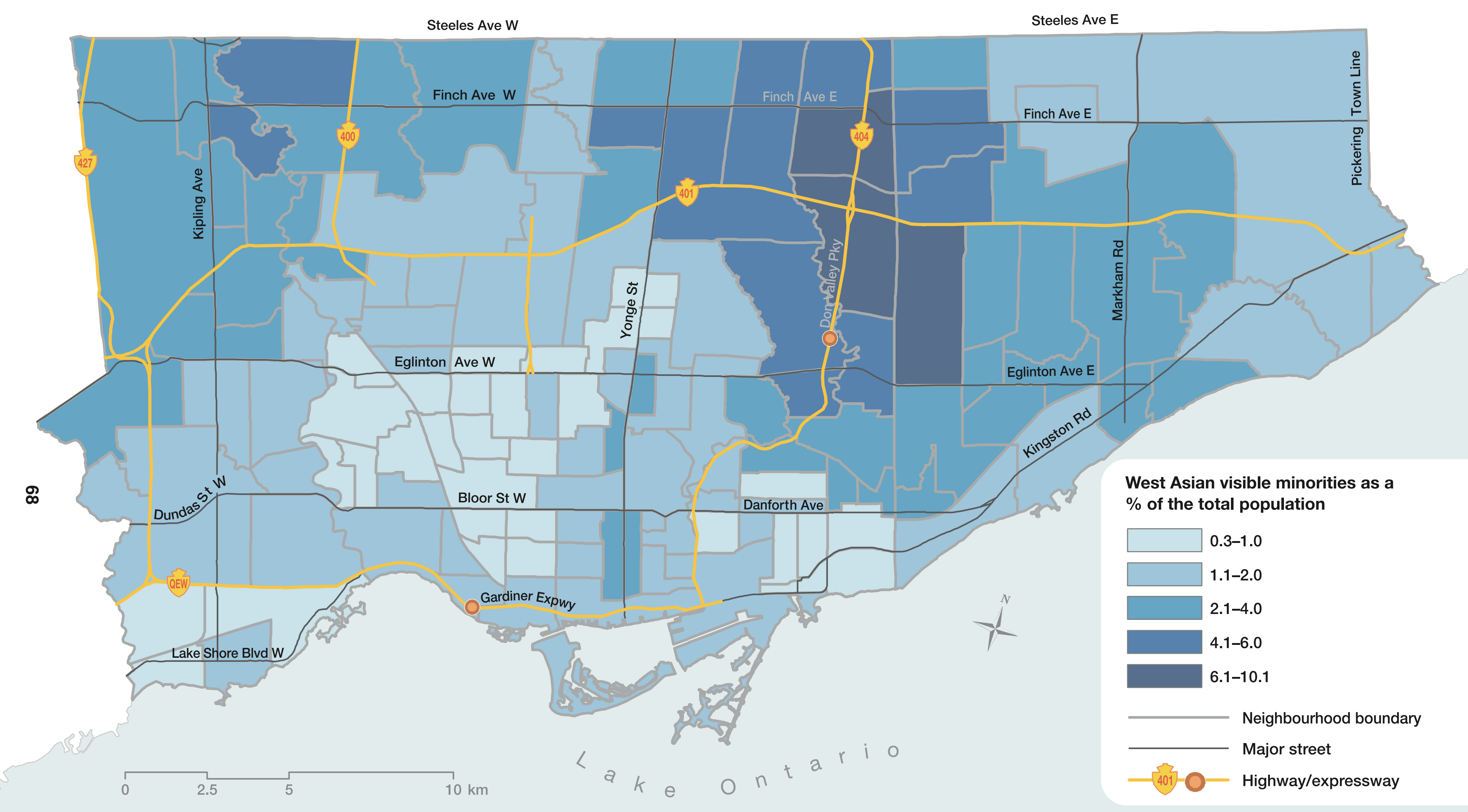
Exhibit 4.6 East Asian visible minorities (self-identified) as a percent of the total population, by neighbourhood, in Toronto, 2001



Findings

- In 2001, neighbourhoods where a higher proportion of residents identified themselves as being from an East Asian ethnoracial group were located predominantly in the north central and northeast areas of the city, and to a lesser extent in downtown (south central) Toronto.

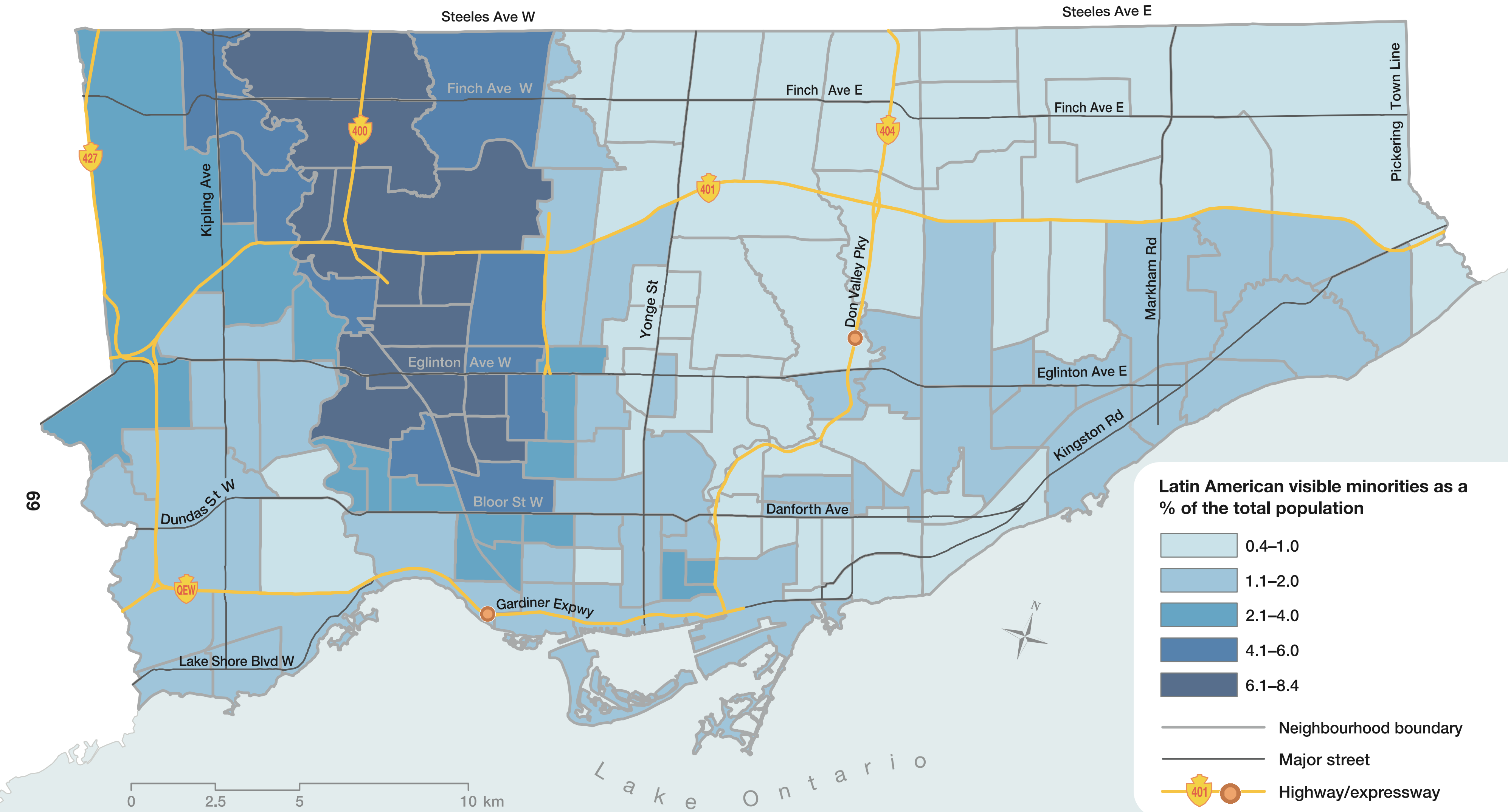
Exhibit 4.7 West Asian visible minorities (self-identified) as a percent of the total population, by neighbourhood, in Toronto, 2001



Findings

- In 2001, the neighbourhoods that had a significant proportion of residents from a West Asian ethnoracial group were concentrated in the north central and northeast areas of the city.

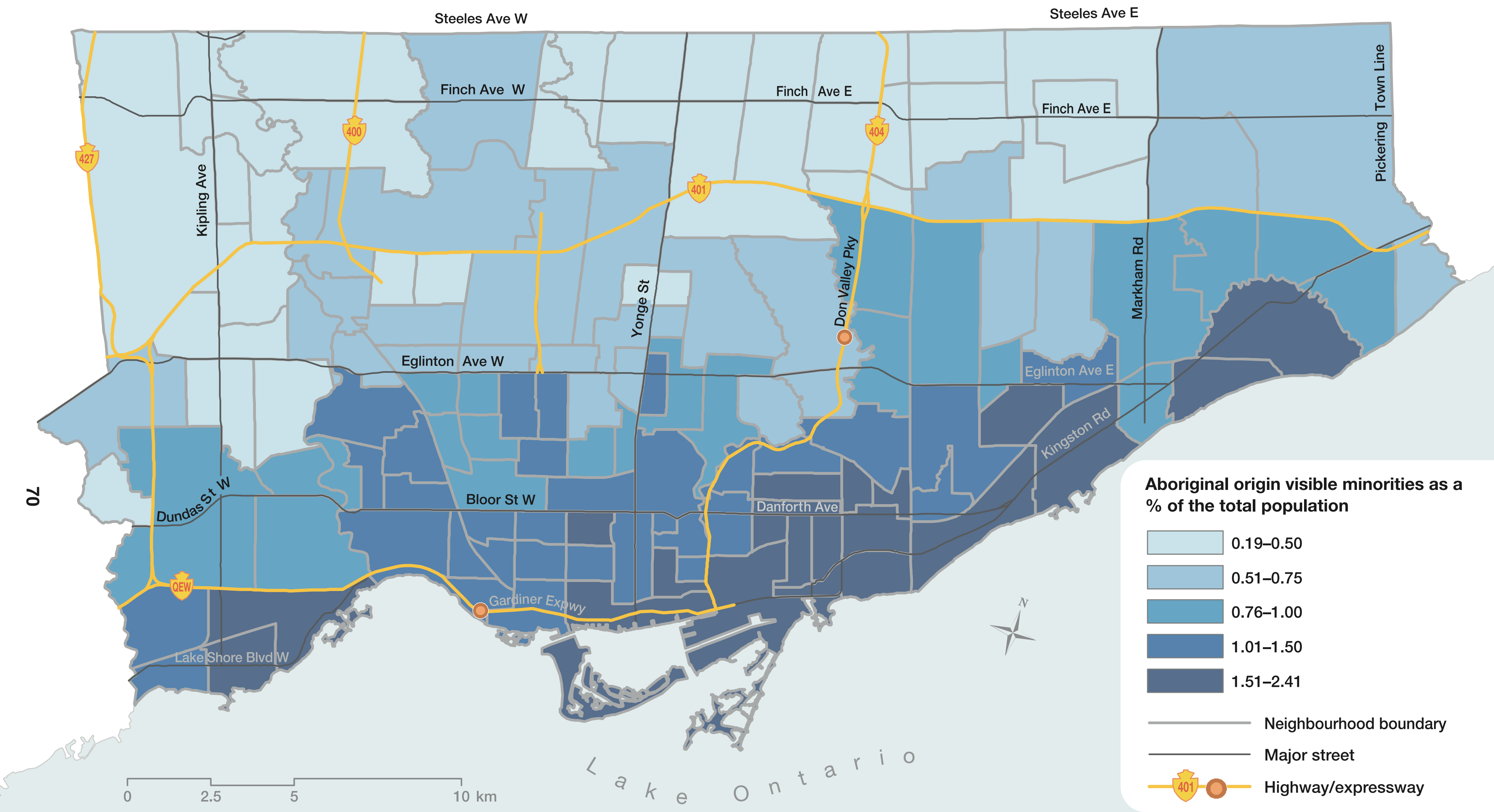
Exhibit 4.8 Latin American visible minorities (self-identified) as a percent of the total population, by neighbourhood, in Toronto, 2001



Findings

- In 2001, neighbourhoods where a higher proportion of residents identified themselves as being from a Latin American ethnocultural group were found in the central west and northwest areas of Toronto.

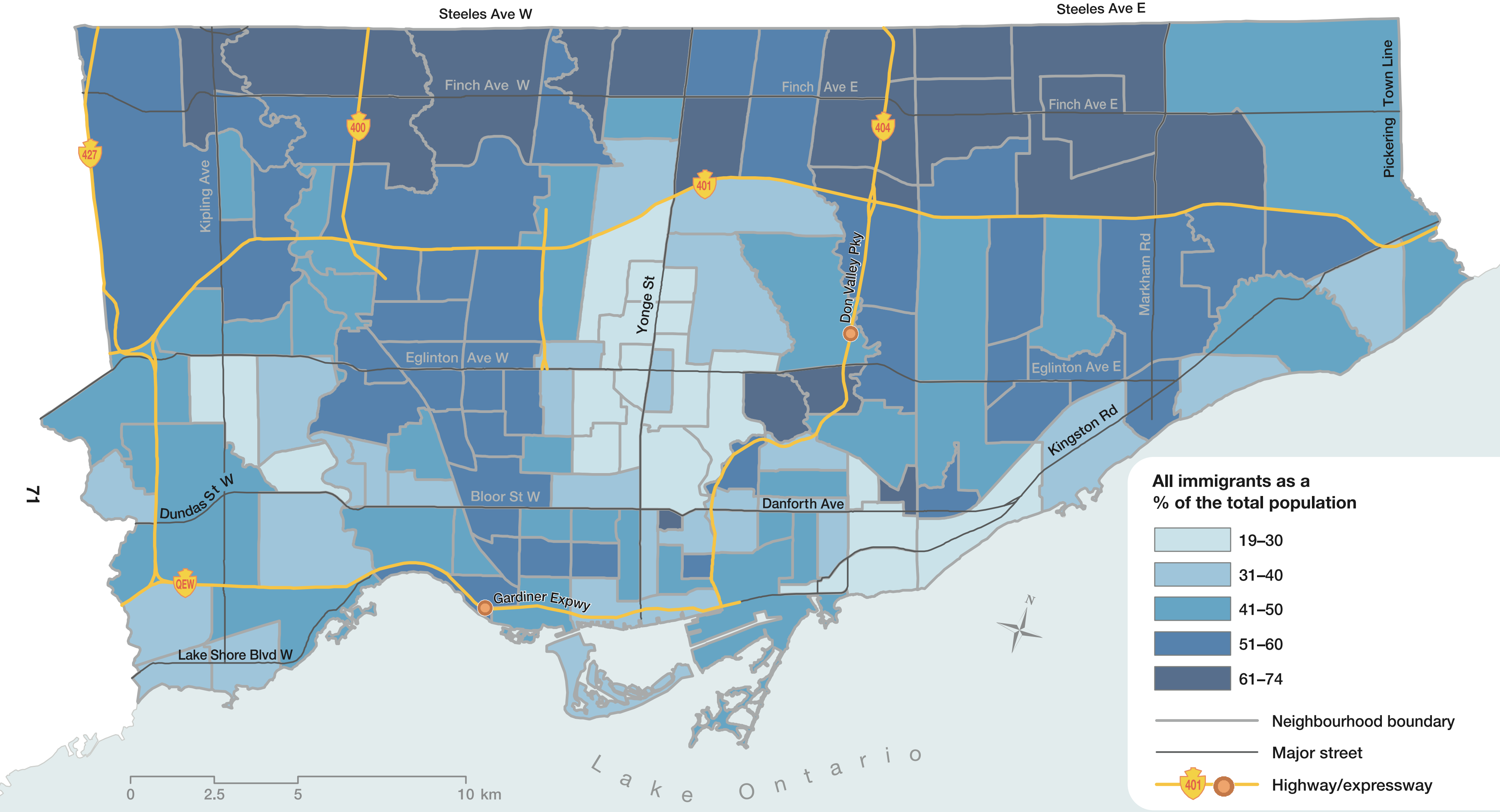
Exhibit 4.9 Individuals of Aboriginal origin (self-identified) as a percent of the total population, by neighbourhood, in Toronto, 2001



Findings

- In 2001, residents who identified themselves as being of Aboriginal origin made up a small proportion of the Toronto population.
- Neighbourhoods with a relatively higher proportion of Aboriginal residents were located in the downtown (south central), southwest and southeast areas of the city.

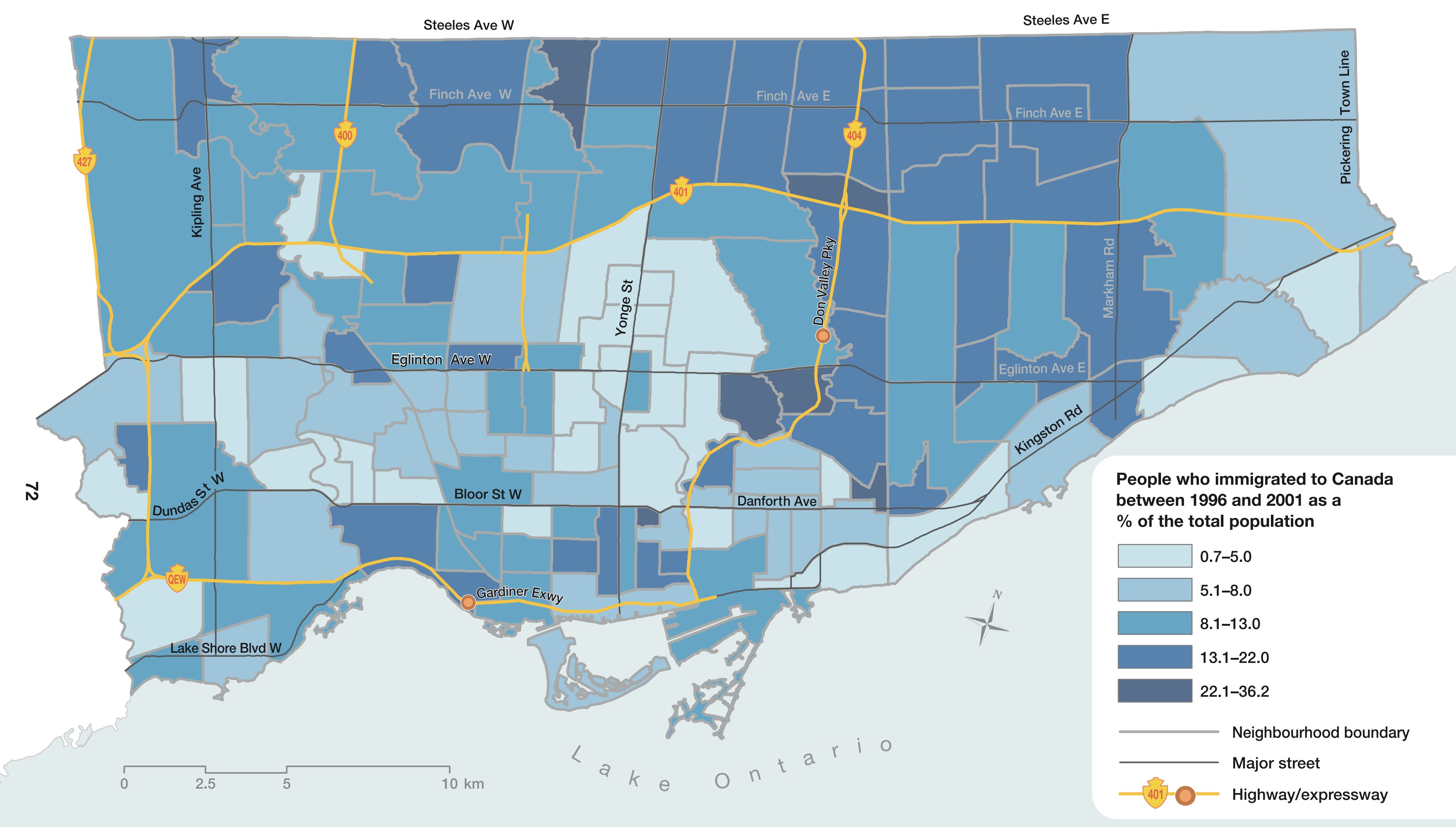
Exhibit 4.10 People who immigrated to Canada as a percent of the total population, by neighbourhood, in Toronto, 2001



Findings

- In 2001, neighbourhoods with very high proportions of immigrant residents (≥40%) were found throughout the northwest, north central and eastern regions of the city, as well as in areas within and just northwest of downtown (south central) Toronto.
- In 2001, the most affluent neighbourhoods in Toronto, which were located centrally and in the southwest (Chapter 3), had the lowest proportion of immigrant residents (≤30%).

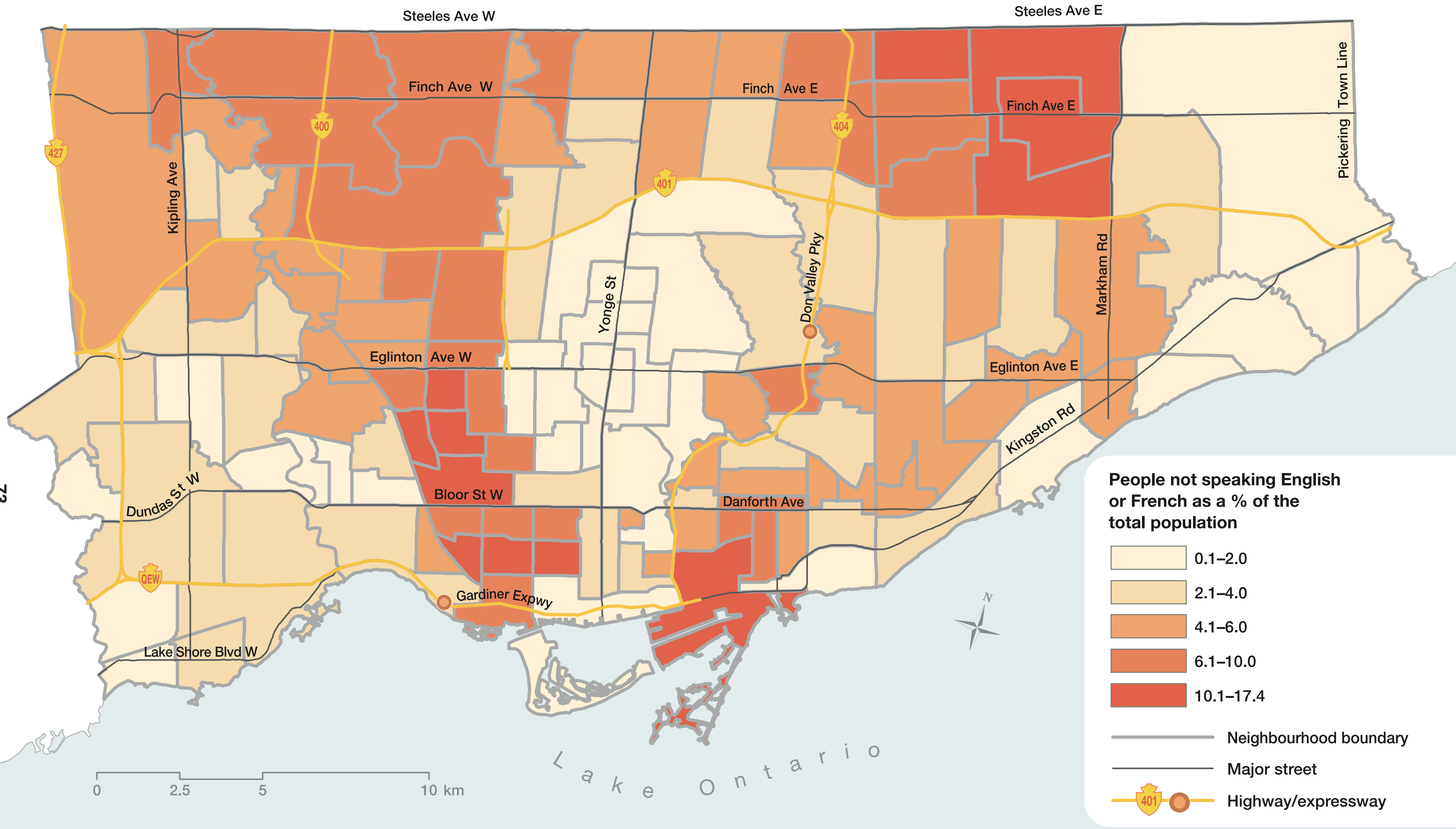
Exhibit 4.11 People who immigrated to Canada between 1996 and 2001 as a percent of the total population, by neighbourhood, in Toronto, 2001



Findings

- The pattern of recent immigration in Toronto neighbourhoods was similar to that for total immigration (Exhibit 4.10).
- The most affluent neighbourhoods in Toronto, which were located centrally and in the southwest (Chapter 3), had the lowest proportion (≤5%) of recent immigrants (those who came to Canada between 1996 and 2001).

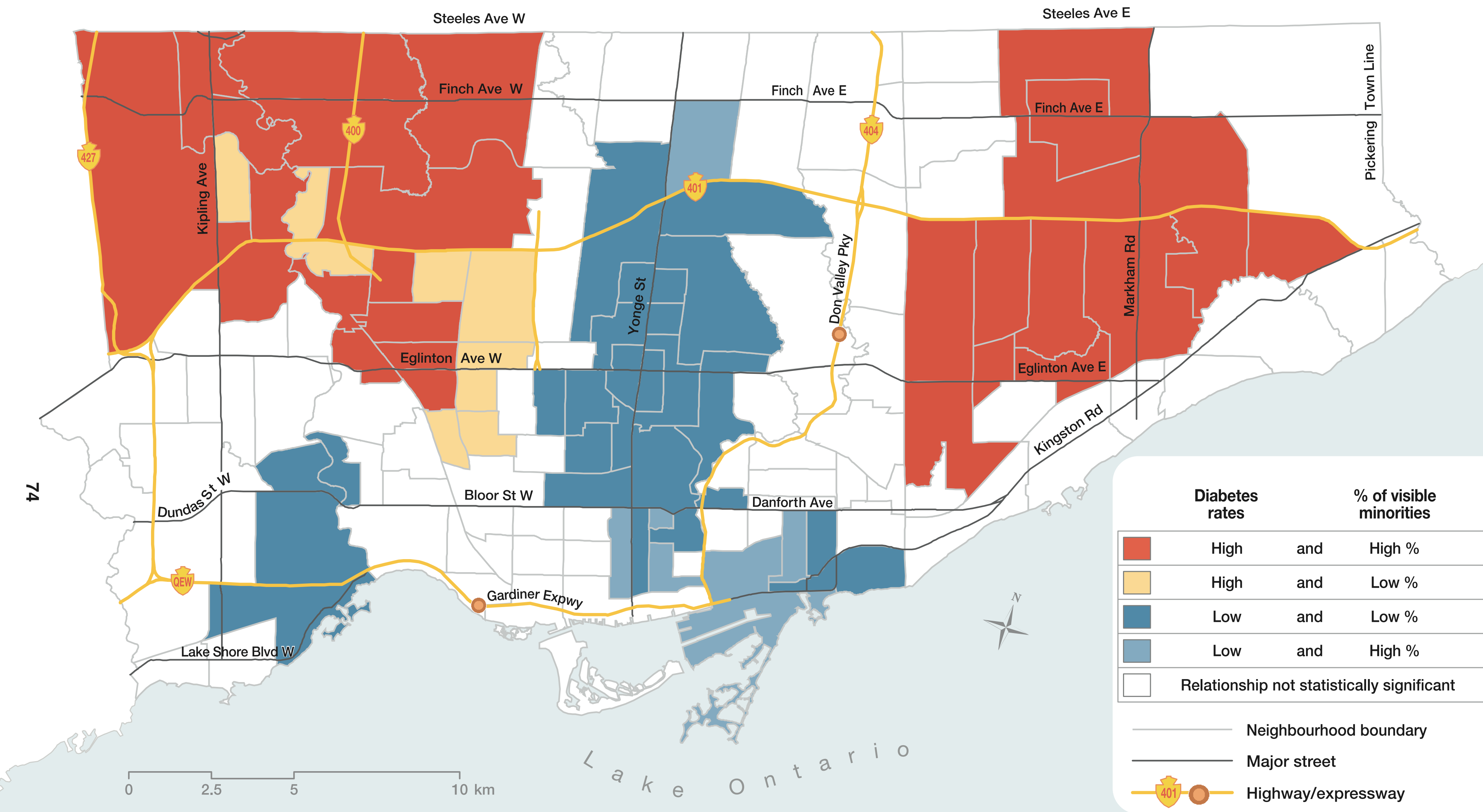
Exhibit 4.12 People not speaking English or French as a percent of the total population, by neighbourhood, in Toronto, 2001



Findings

- In 2001, neighbourhoods where a high proportion (≥10%) of residents reported being non-English or non-French speaking were located in downtown (south central) Toronto, northwest of downtown, and in the northeast section of the city.

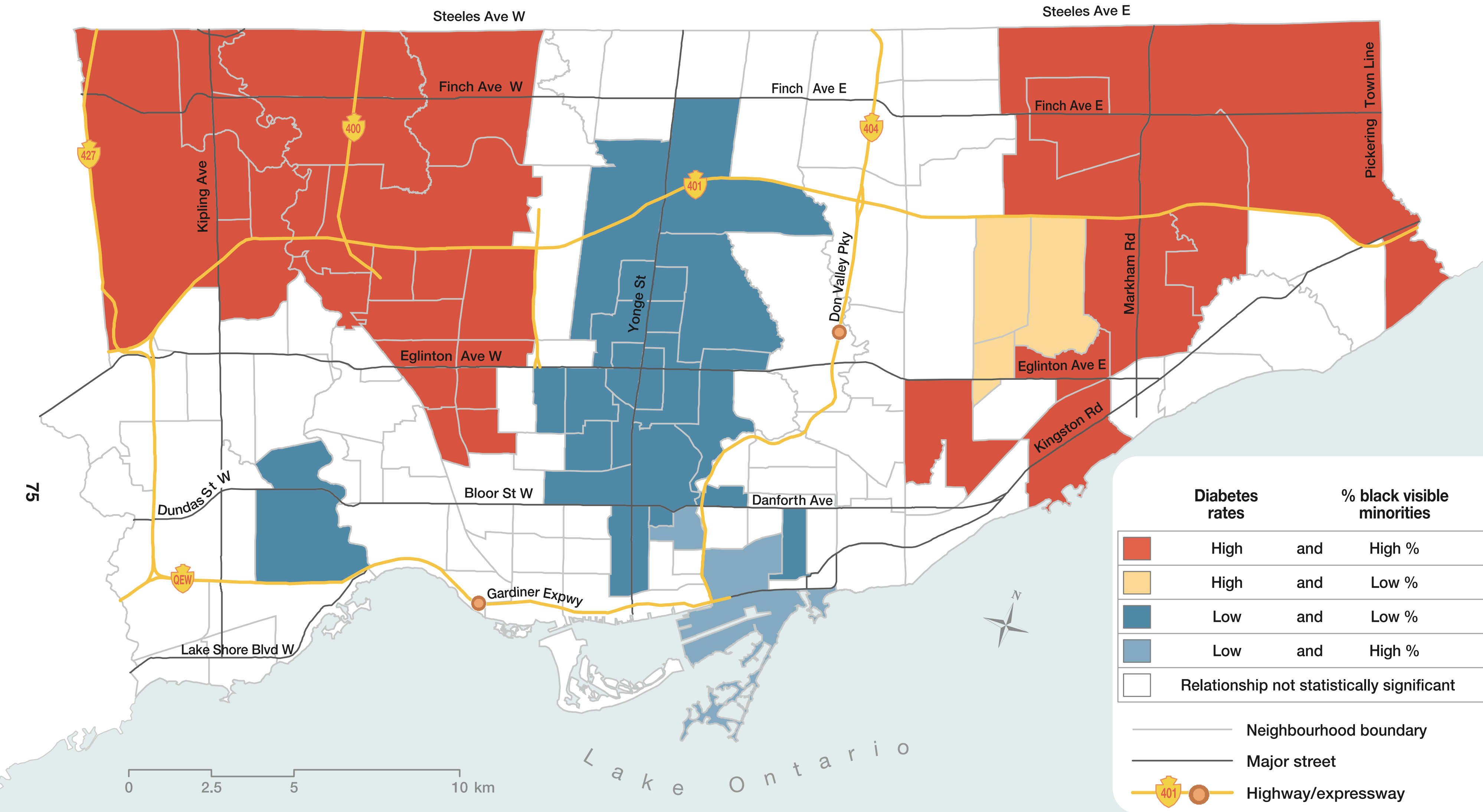
Exhibit 4.13 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the total population that self-identified as belonging to a visible minority [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, areas in the northwest and east ends of the city had both high diabetes rates and a high percentage of residents who identified themselves as belonging to a visible minority.
- Affluent neighbourhoods in the central and southwest areas of the city had both low diabetes rates and a low percent of the population from a visible minority group.

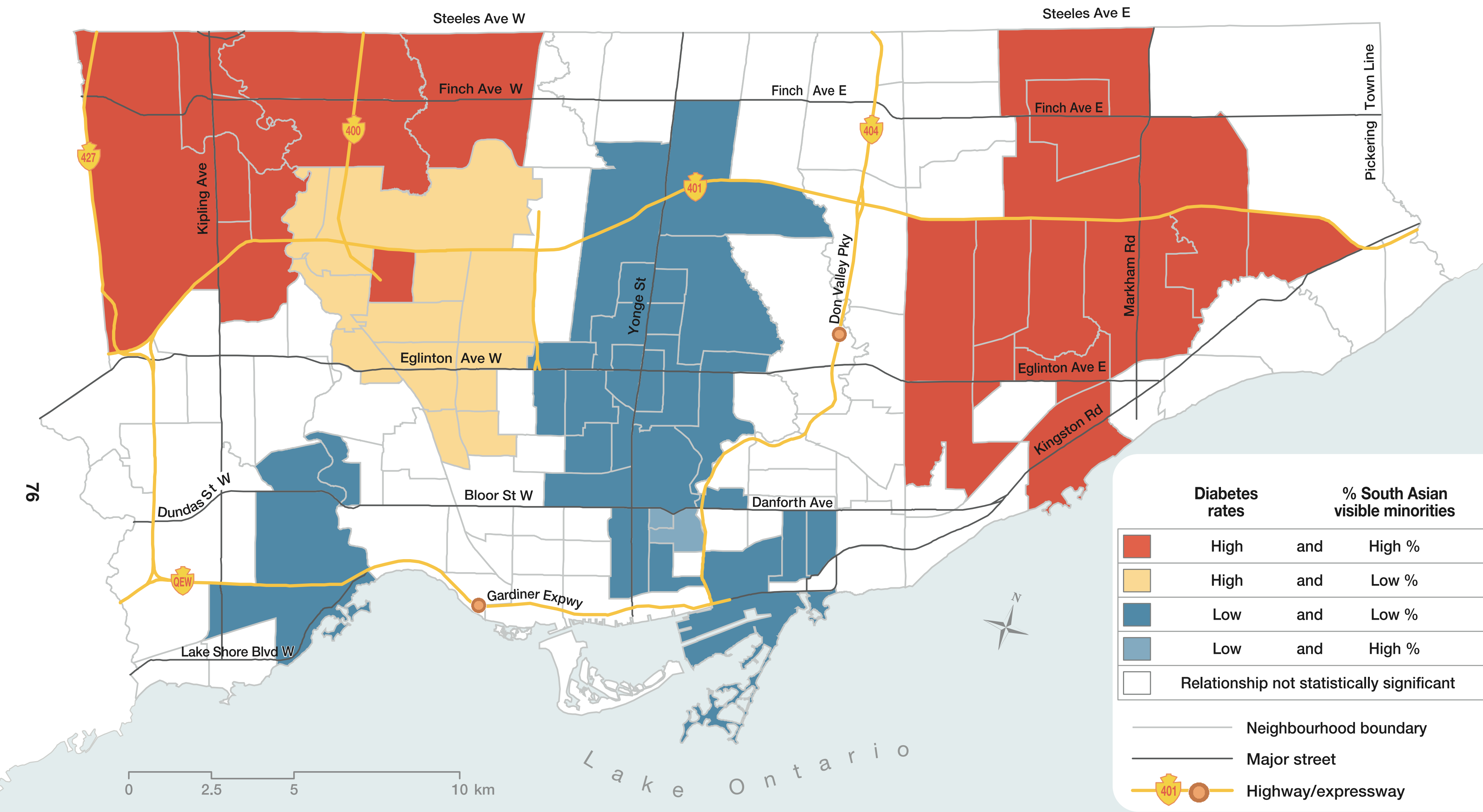
Exhibit 4.14 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the total population that self-identified as black visible minority [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, areas in the northwest and east ends of the city had both high diabetes rates and a higher percentage of residents who identified themselves as belonging to a black visible minority.

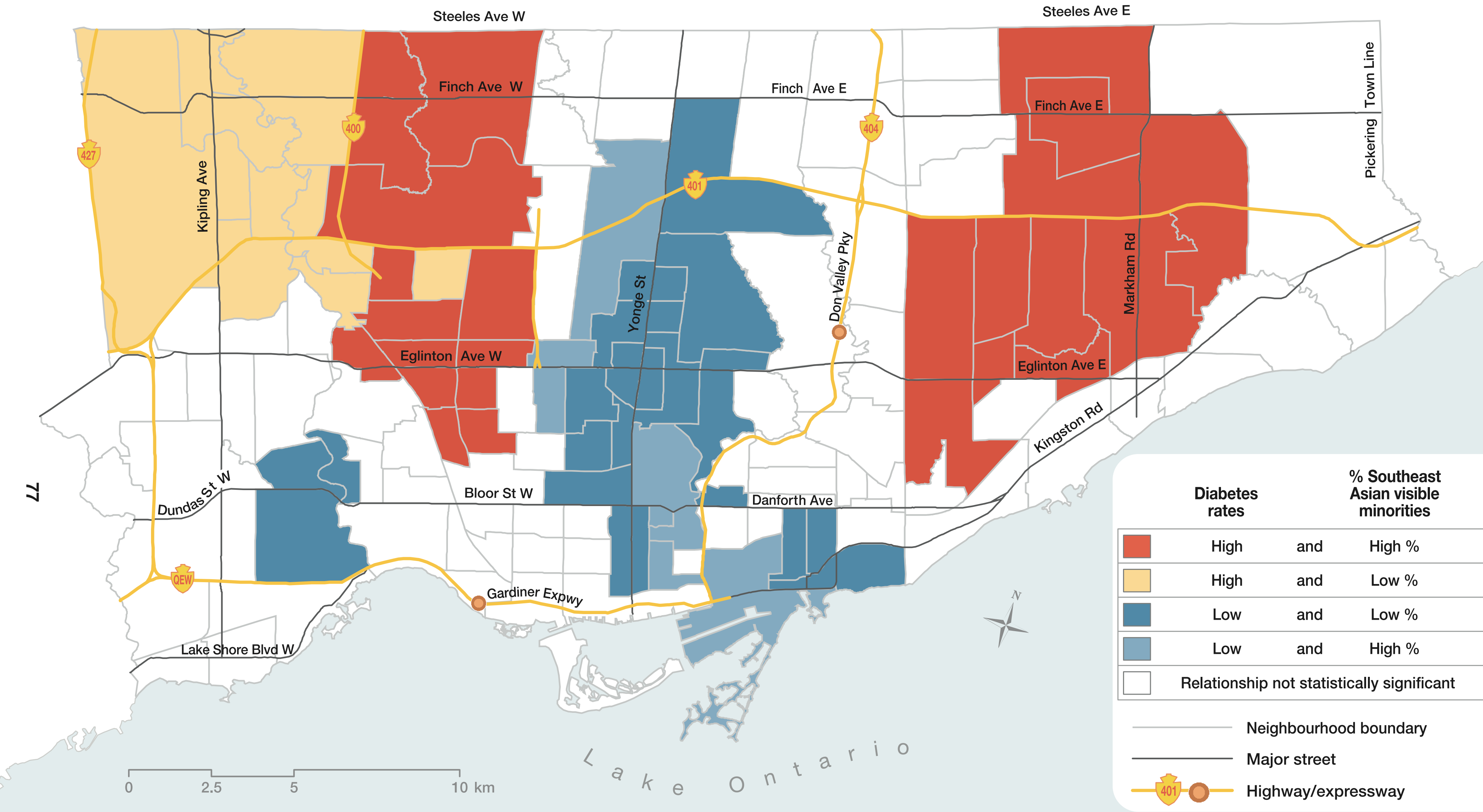
Exhibit 4.15 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the total population that self-identified as South Asian visible minority [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, areas in the far northwest and east ends of the city had both high diabetes rates and a higher percentage of residents who identified themselves as belonging to a South Asian visible minority.

Exhibit 4.16 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the total population that self-identified as Southeast Asian visible minority [2001] (high or low), by neighbourhood, in Toronto



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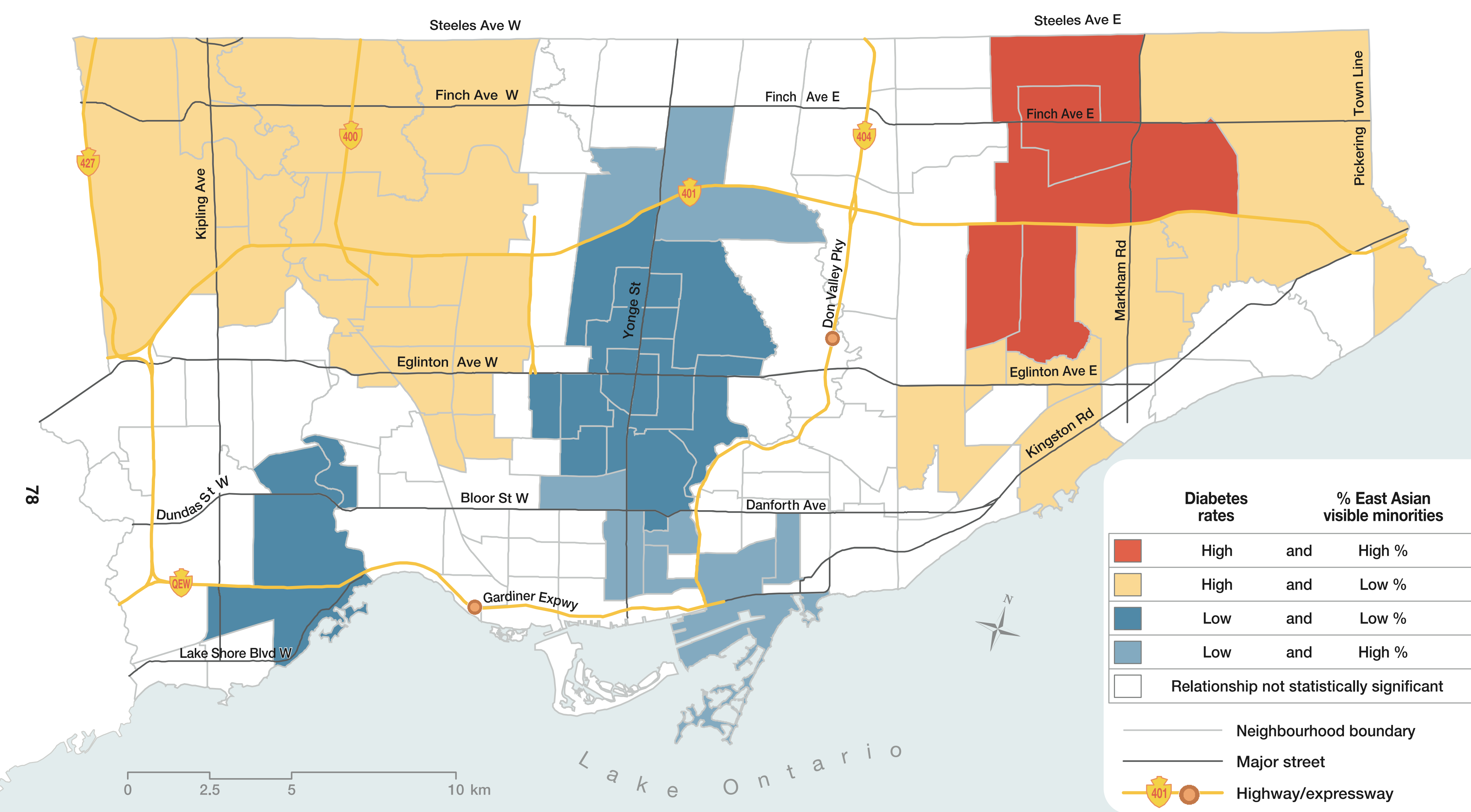
Findings

- In 2001, areas in the northwest and east ends of the city had both high diabetes rates and a higher percentage of residents who identified themselves as belonging to a Southeast Asian visible minority.

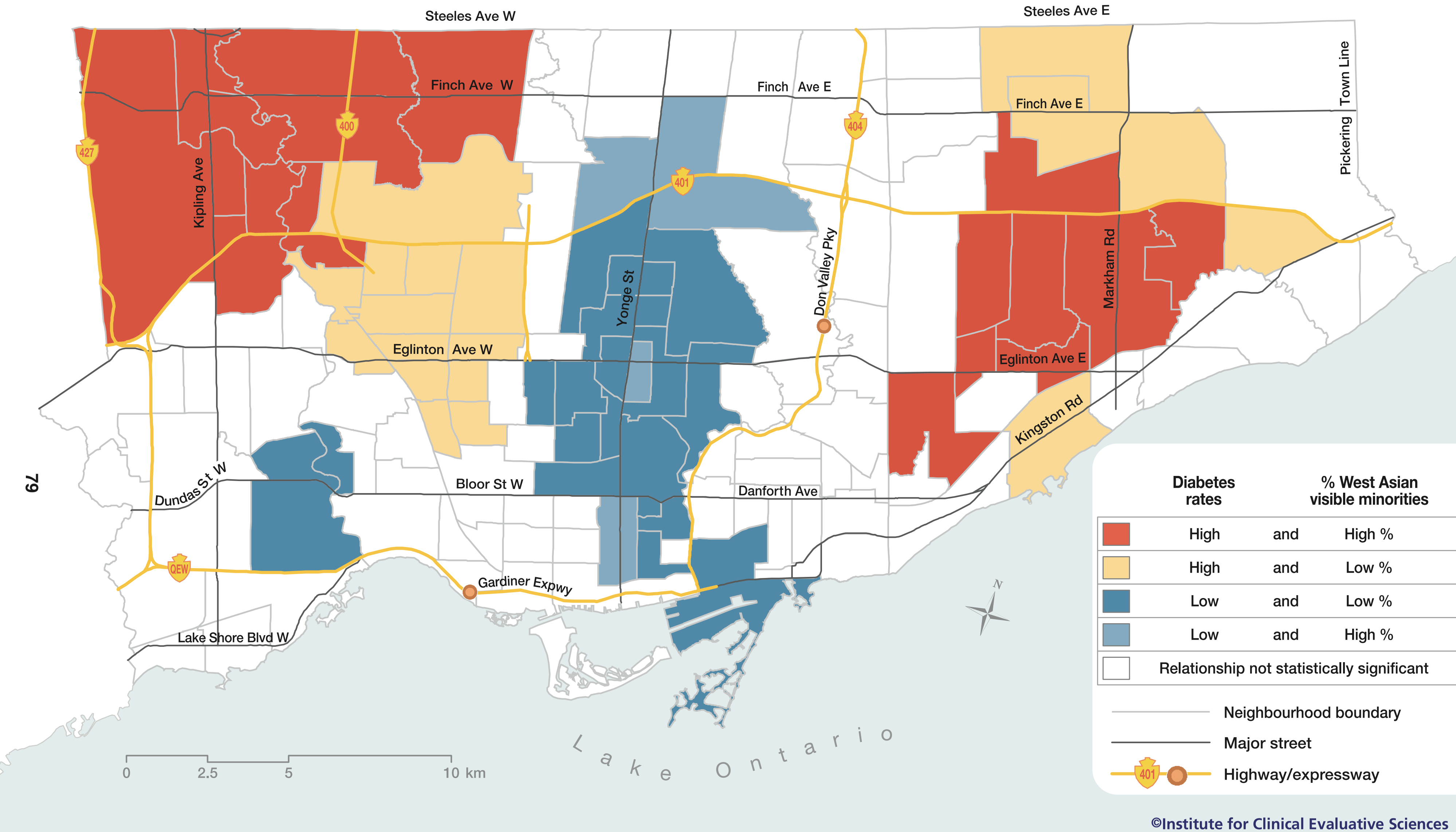
Exhibit 4.17 **Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the total population that self-identified as East Asian visible minority [2001] (high or low), by neighbourhood, in Toronto**



Findings

- In 2001, areas within the east end of the city had both high diabetes rates and a higher percentage of residents who identified themselves as belonging to an East Asian visible minority.

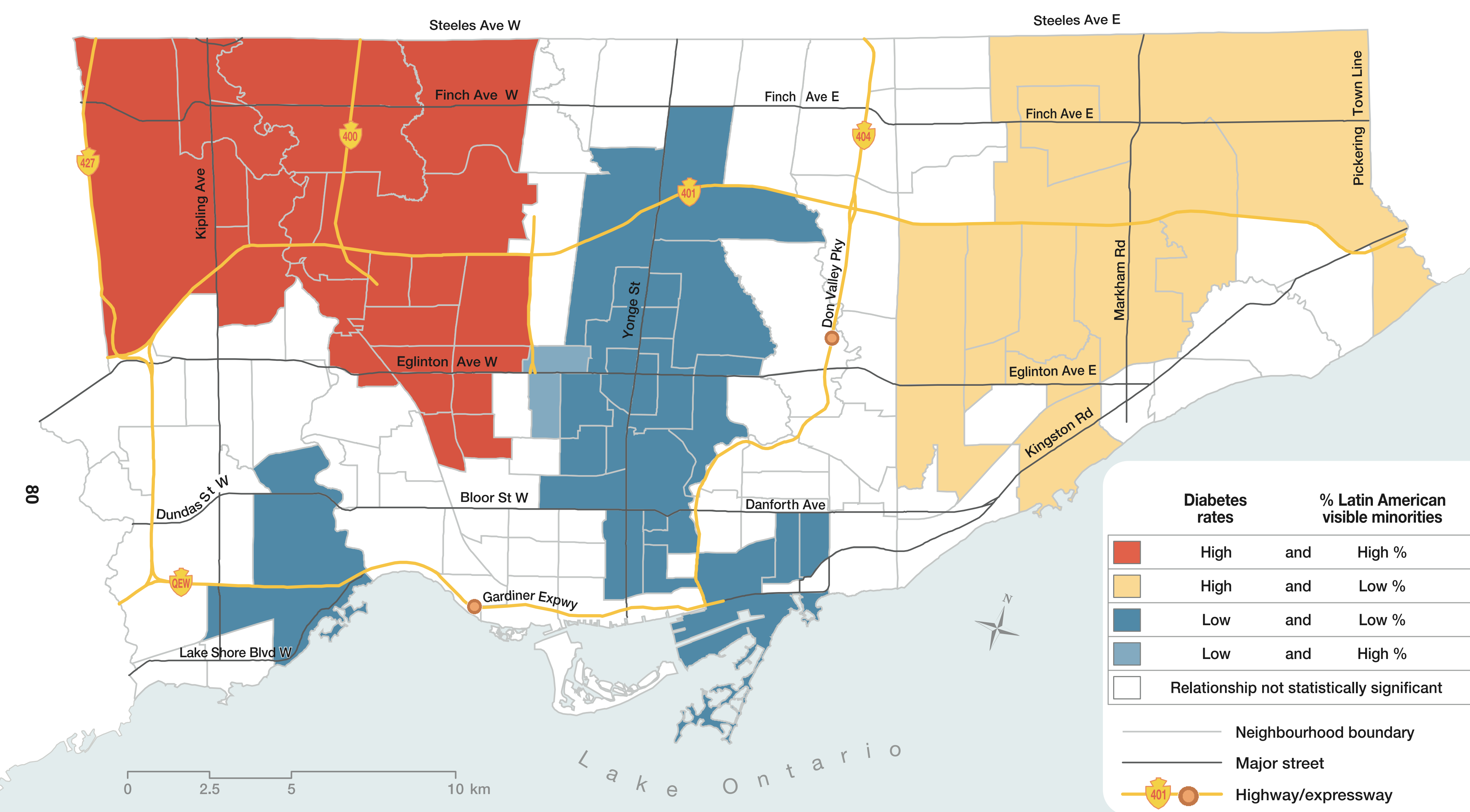
Exhibit 4.18 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the total population that self-identified as West Asian visible minority [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, areas within the northwest and east ends of the city had both high diabetes rates and a higher percentage of residents who identified themselves as belonging to a West Asian visible minority.

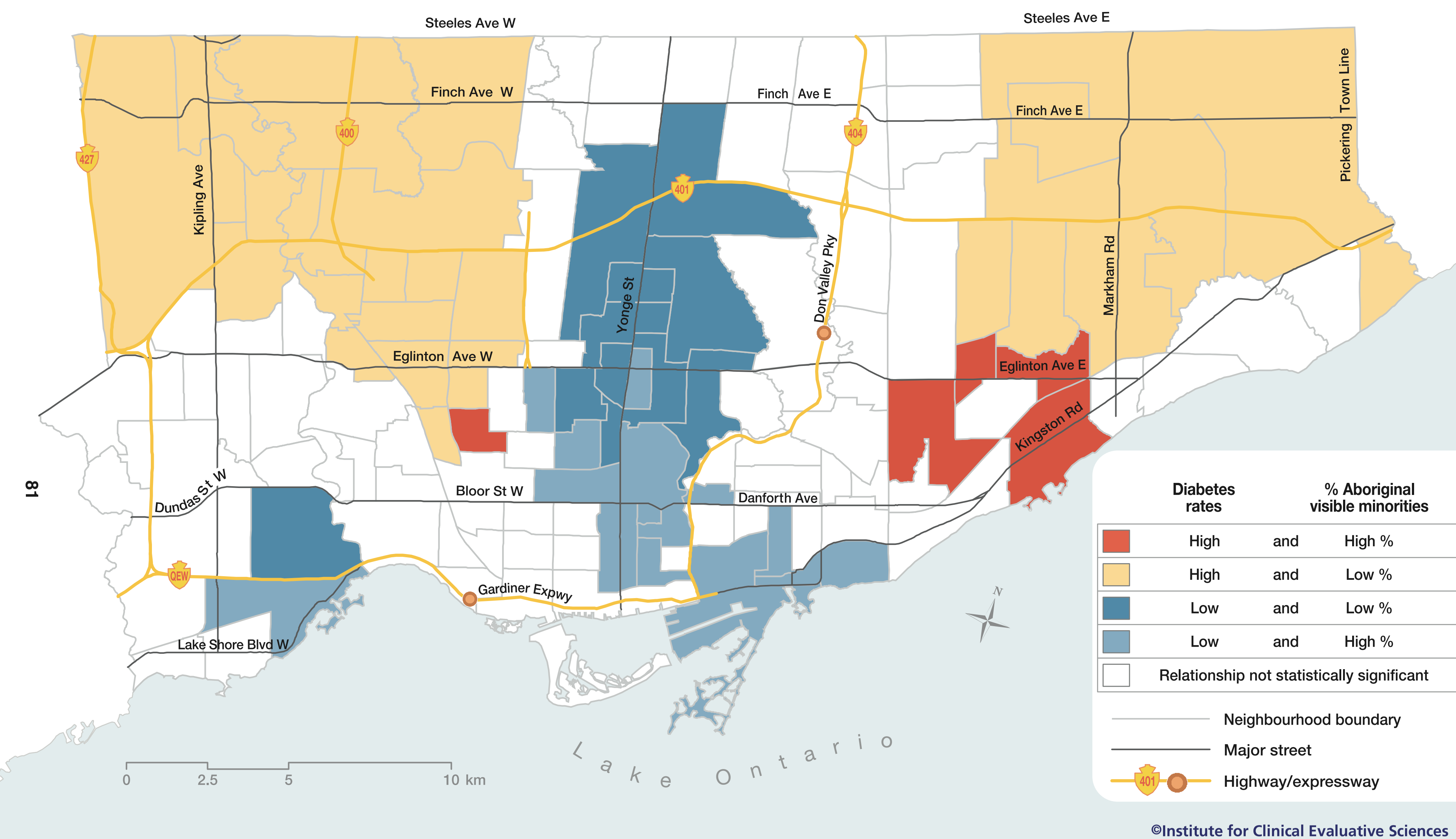
Exhibit 4.19 **Spatial relationship between age- and sex- adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the total population that self-identified as Latin American visible minority [2001] (high or low), by neighbourhood, in Toronto**



Findings

- In 2001, areas within the northwest of the city had both high diabetes rates and a higher percentage of residents who identified themselves as belonging to a Latin American visible minority.

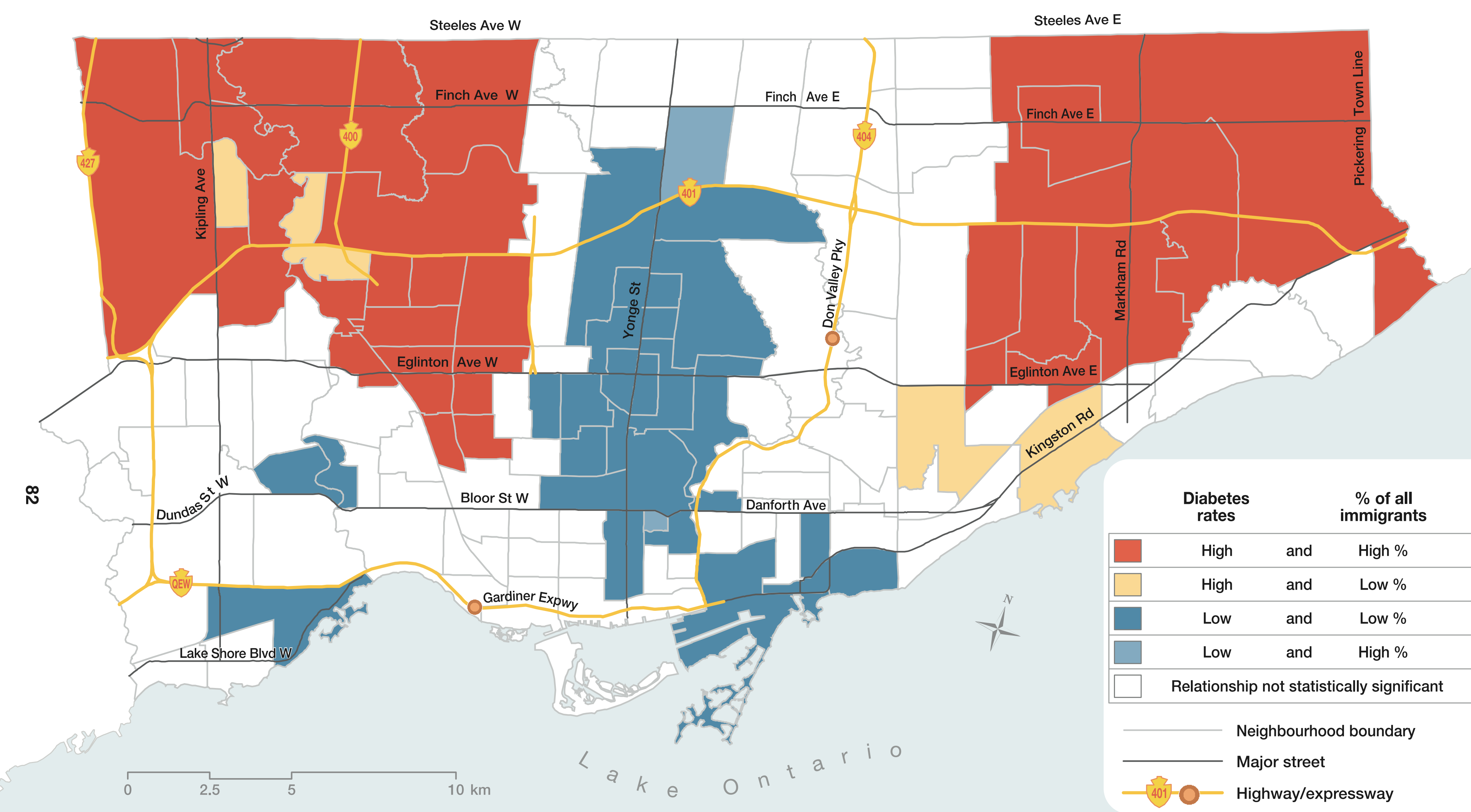
Exhibit 4.20 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the total population that self-identified as being of Aboriginal origin [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, several neighbourhoods just northwest and northeast of downtown (south central Toronto) had both high diabetes rates and a higher percentage of residents who identified themselves as belonging to an Aboriginal visible minority.

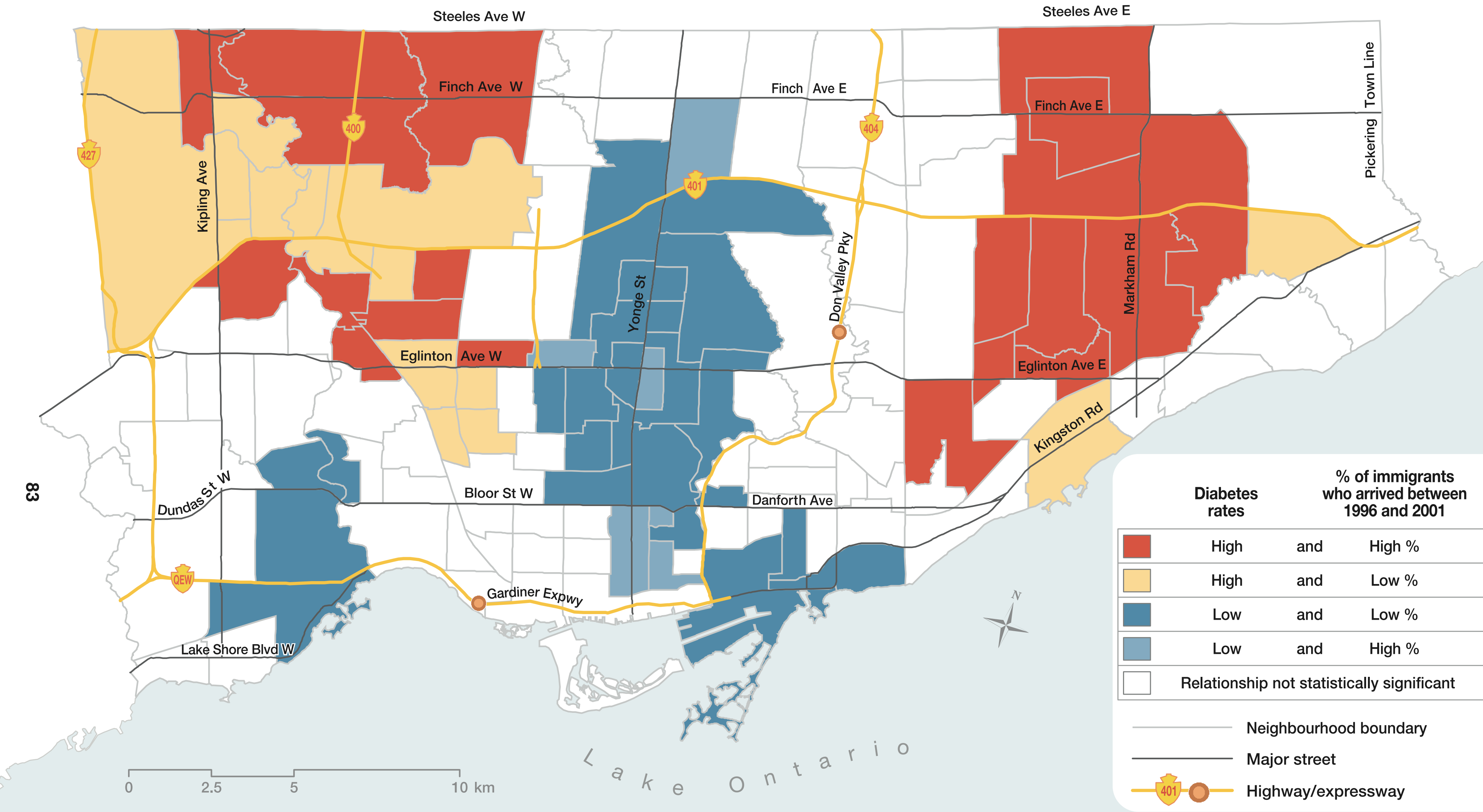
Exhibit 4.21 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the total population that immigrated to Canada [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, large areas within the northwest and east ends of the city had both high diabetes rates and a high percentage of residents who said they had immigrated to Canada.
- Affluent neighbourhoods in the centre and southwest areas of the city, as well as an area just east of the downtown core (south central Toronto), had both low diabetes rates and a low percentage of residents who said they had immigrated to Canada.

Exhibit 4.22 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of the total population that immigrated to Canada between 1996 and 2001 [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, areas within the northwest and east ends of the city had both high diabetes rates and a high percentage of residents who said they had recently immigrated to Canada (i.e., within the past five years).
- Affluent neighbourhoods in the centre and southwest areas of the city, as well as an area just east of the downtown core (south central Toronto), had both low diabetes rates and a low percentage of residents who said they had recently immigrated to Canada.

Discussion

We found a strong concordance between the ethnoracial and ethnocultural composition of Toronto neighbourhoods and the underlying rate of diabetes. Neighbourhoods in the northwest and east ends of the city, in particular, had higher diabetes rates, as well as a higher percentage of the population from a non-white ethnoracial group. Neighbourhoods with high rates of diabetes varied with respect to the predominant ethnic group living in that area. However, these communities shared the common characteristic of having a significant proportion of their residents from groups at high risk for developing diabetes (Asian, black or Latin American). These same neighbourhoods also had higher rates of immigration and poverty—factors that could influence the underlying health of high-risk populations.

The clustering of low socioeconomic status (SES) and high immigration rates in the same areas makes it difficult to separate the effects of these two factors. SES is inversely related to the rate of diabetes in urban areas, including Toronto (Chapter 3), and this in itself may influence the propensity of residents in different neighbourhoods to develop diabetes.[10]

Economic constraints make it more difficult to achieve a healthy lifestyle because of the costs of purchasing healthy food or of participating in sports and other types of physical activity. Residents in disadvantaged areas may also experience reduced access to healthy resources, such as stores selling fruits and vegetables, or fewer opportunities for physical activity.[19,20] These factors together may compound the risk for diabetes in genetically susceptible individuals. The SES of many recent immigrants is complex, as they tend to have high educational attainment but low income on first arriving in Canada. New immigrants appear to have worse access to health care and may be less able to negotiate the health care system or advocate for their health needs—potentially resulting in worse access to preventive health measures.[15,21] Language may serve as an additional barrier to accessing medical care and local resources.[22]

The consequences of developing diabetes may be particularly difficult for socially disadvantaged groups. American studies have demonstrated racial differences in the degree of diabetes self-management and quality of care indicators.[14,23–27] Rates of hospitalization for diabetes-related conditions tend to be higher in non-Hispanic blacks and Hispanics compared to non-Hispanic whites.[28] However, the extent to which these disparities are driven by differences in SES and/or insurance status is not clear.[29] Canadian research on diabetes-related outcomes in different ethnoracial groups is lacking. However, health information and services that are sensitive to a range of cultures, faiths and languages are often not available. This may further reduce access to services and quality of care for a number of groups.

The current analysis used health claims data to identify individuals for whom diabetes had been already diagnosed. The rate of diabetes among new immigrant groups may have been underestimated since individuals who experience barriers to accessing medical care may not have had the opportunity to be diagnosed. The rate of diabetes may also be lower in new immigrants, who tend to be healthier than the general Canadian population—an observation known as the "healthy migrant" phenomenon.[30] However, the health of recent immigrants tends to decline to Canadian levels within a few years.[31] The adoption of a typical North American or western diet may accelerate the development of insulin resistance and diabetes in these groups.

Local policy makers and planners need to take genetic, cultural and language issues into account when devising community-based interventions, prevention programs, and health services aimed at reducing the burden of obesity and diabetes in urban communities. There is evidence to suggest that maintaining a more traditional pattern of diet and activity could reduce obesity and diabetes in high-risk immigrant and ethnoracial groups.[32] Interventions that enable recent immigrants to do so may be particularly helpful in urban communities, such as Toronto. However, the heterogeneity of Toronto neighbourhoods makes it likely that community-specific solutions to reduce diabetes risk factors will be required. It may be especially difficult to separate the effects of genetic susceptibility to diabetes from cultural and lifestyle factors when designing interventions. Further research in this area is needed.

Conclusions and Next Steps

Building on the findings from Chapter 3, we observed a strong relationship between diabetes, social disadvantage and visible minority status among residents in various Toronto neighbourhoods. Mapping of these relationships showed that diabetes was most prevalent in the east and northwest of Toronto and that high prevalence areas coincided, to a large extent, with high levels of immigration and high proportions of visible minorities. Individuals living in areas of relative socioeconomic disadvantage (Chapter 3) are also likely to experience barriers to accessing health care and other resources. These issues will be explored in subsequent chapters of this Atlas.

Appendix 4.A—How the Research was Done

Data sources

The immigration and visible minority status of Toronto residents were abstracted at the census tract level from the 2001 Canadian census using standard definitions created by Statistics Canada.

An "immigrant" is defined by Statistics Canada as a person born outside of Canada who has been granted the right to live in Canada permanently by immigration authorities. Recent immigration refers to those who gained immigrant status in the preceding five years (i.e., between 1996 and 2001).

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*. For this analysis, ethnic groups were identified according to how respondents described their own ethnic origins. Aboriginal ethnicity was derived from the census ethnic origin question, and persons who reported at least one ethnic origin as Aboriginal were considered to be of Aboriginal ancestry.

Data from the 2001 Canadian census were also used to derive the average annual household income for a given neighbourhood, based on the weighted mean total income of corresponding households in the year 2000.

Age- and sex-adjusted diabetes rates were calculated using the Ontario Diabetes Database and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES).

Analysis

The distribution of immigration and ethnicity variables was examined across Toronto neighbourhoods using choropleth (shaded) maps. The relationships between these variables and diabetes prevalence were evaluated using bivariate *Local Indicator of Spatial Association (LISA)* maps. Neighbourhoods were further characterized based on their risk of diabetes and their degree of social advantage or disadvantage. Neighbourhoods were considered to be high-risk if the mean annual household income was lower and if the percent of visible minority residents was higher than the Toronto median. Conversely, neighbourhoods were considered to be low-risk if the mean annual household income was higher and the percentage of visible minorities was lower than the Toronto median.

More detailed information about data sources, rate calculations and analyses is available in "Appendix B: Technical Notes" at the end of this Atlas.

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INSIDE

5 Chapter

Neighbourhood Infrastructure

Richard H. Glazier, MD, MPH, Kelly Ross, BSc, MSA, Peter Gozdyra, MA, Maria I. Creatore, MSc, PhD (candidate), and Gillian L. Booth, MD, MSc

Executive Summary

Issue

The physical features of urban environments are increasingly being recognized as important determinants of health. Neighbourhoods in which walking is difficult and cars are needed for daily activities may contribute to low levels of physical activity, and subsequently to obesity and its consequences, such as diabetes. Conversely, neighbourhoods with dense street networks, good access to transit and low use of cars may be environments that stimulate daily physical activity and thereby lead to better health. In Toronto, it is not known whether these patterns exist, and how the distribution of these neighbourhood characteristics relates to diabetes.

Study

Maps of land use, period of dwelling construction, road and transit networks, transit schedules and bicycle routes were created. Information about daily walking, bicycling and car trips was obtained from the 2001 Transportation Tomorrow Survey and mapped by the average number of trips per person in each neighbourhood. Bivariate *Local Indicator of Spatial Association (LISA)* maps were used to examine clustering of these measures with each other and with age- and sex-adjusted diabetes rates (derived from the Ontario Diabetes Database).

Key Findings

- The south central part of Toronto and its downtown core had low diabetes rates. It also had dense road and transit networks, an older period of dwelling construction, a relatively high number of bicycle lanes, high numbers of daily walking, bicycling and transit trips, and a low number of car trips.
- The opposite was true—in terms of neighbourhood infrastructure and opportunities for physical activity—in the city's northwest and east ends, where diabetes rates were high.

Implications

- **There was a strong and consistent association between Toronto neighbourhood characteristics, daily activity and rates of diabetes.**
- **Over time, intensification of density, improved public transit and more bicycle routes in high diabetes areas may serve to increase residents' daily physical activity. Higher levels of physical activity are known to contribute to the prevention and improved control of diabetes.**

Introduction

There is increasing awareness that features of the urban environment can serve as barriers to or facilitators of physical activity. Compared with those living in the rest of Canada, residents of major urban centres are more likely to be at a healthy weight and to find their community convenient to do the following: to walk or bicycle; to walk or bicycle to do daily chores; and to walk, bicycle or take public transit as their primary means of getting to work.[1] Individuals living in moderate- to high-density neighbourhoods with community and commercial services within walking distance of home are 2.4 times more likely to meet a 30-minute recommended daily minimum of physical activity.[1] Within urban areas, there is evidence that greater residential density, mixed land use and greater street connectivity are features of walkable neighbourhoods.[2–4]

Lack of physical activity and sedentary living have been linked with obesity—the most important risk factor for diabetes.[5,6] Canada's Physical Activity Guide to Healthy Active Living recommends that adults participate in 30 to 60 minutes of physical activity daily in order to maintain or improve health. Yet only half of Canadians report being this active.[7] The Heart and Stroke Foundation notes that each additional kilometre walked per day reduces a person's likelihood of becoming obese by nearly five percent, while each hour per day spent in a car increases the likelihood of obesity by six percent.[1] Dependence on cars for transportation, watching television, spending time on computers and playing video games are among the major factors contributing to the lack of physical activity in our society.

In this chapter, we describe several aspects of the urban environment that are thought to affect levels of physical activity among residents. Building on this information, the following chapter (Chapter 6) will focus on factors of particular importance for local populations and for the prevention and control of diabetes.

Within the City of Toronto, there is a large variety of land uses. These range from agricultural fields and natural green spaces to high-density urbanized areas and industrial parks. If we look only at residential areas, there are great differences between sparsely developed suburbs and very densely populated zones downtown.

The built environment in Toronto follows historical land use patterns. The development of the pre-amalgamation City of Toronto occurred largely prior to the Second World War. The city was densely built and included mixed residential and commercial land uses. However, post-war development followed the tenets of more modern urban planning, which separated larger residential lots from commercial areas. This resulted in more suburbanized areas outside of Toronto's downtown core.

Residents of such suburban areas are far more dependent on cars than people who live in denser neighbourhoods. Suburban dwellers live much farther away from services, which often makes it impractical for them to walk to their destinations. Grid street patterns are less common in these areas; there are also more cul-de-sacs and crescents which results in more indirect, and often longer, travel routes. Also, lower density often means fewer public transit lines with less frequent service.

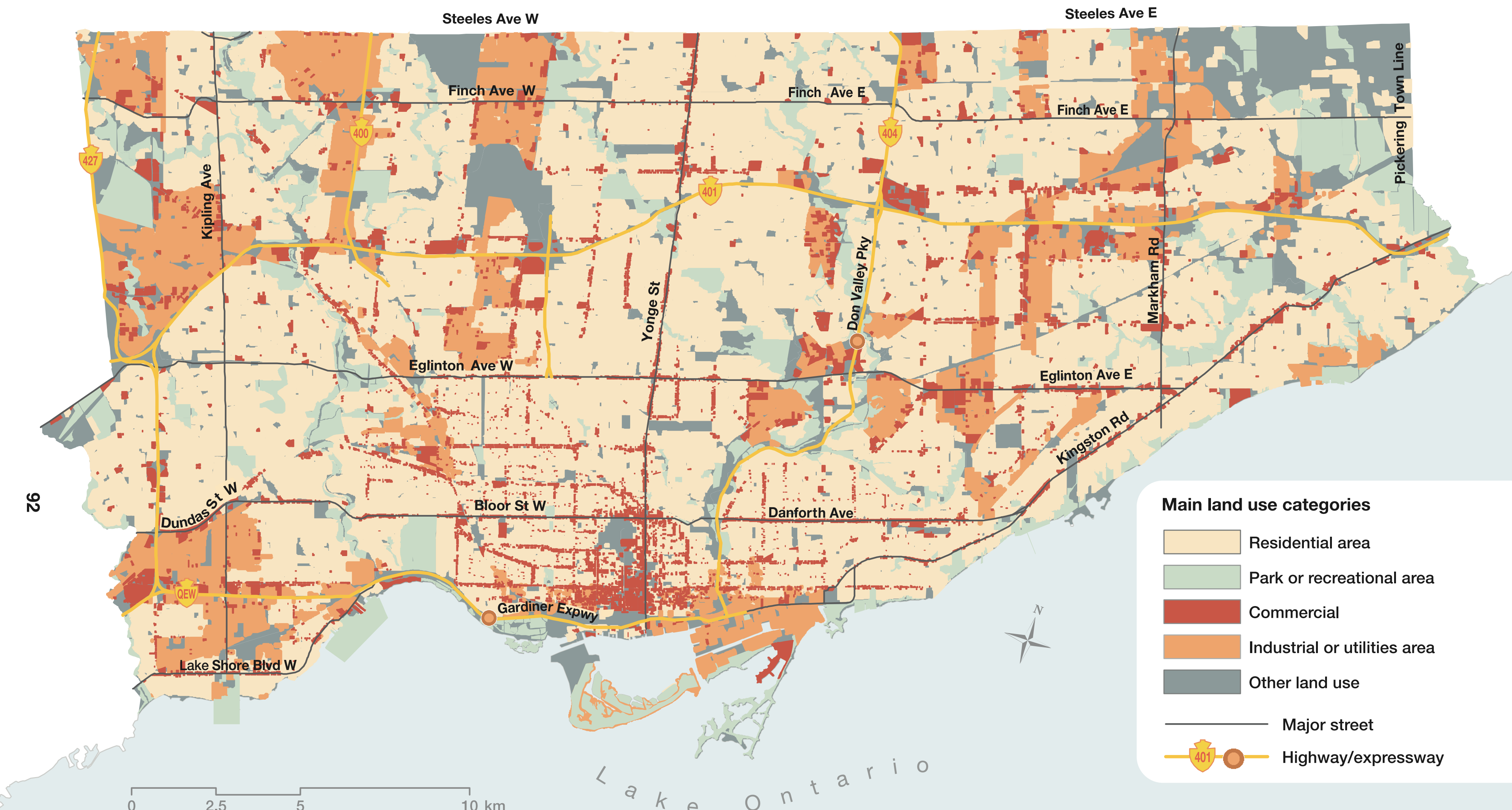
Over time, these development patterns seem to have influenced activity in many urban settings. The National Health and Nutrition Examination Survey (NHANES) found that Americans living in urban developments built before 1974 were substantially more likely to report walking on a regular basis than those living in more recently developed areas.[8]

These urban design features may be important facilitators of and barriers to healthy active lifestyles. Living in a car-dependent neighbourhood with few services within walking distance—and other features that discourage walking, bicycling and using public transit—may be an important independent risk factor for the development of obesity and diabetes. This chapter explores relationships between these factors in Toronto.

Chapter 5—List of Exhibits

Exhibits and Findings

Exhibit 5.1 Main land use categories, in Toronto, 2002



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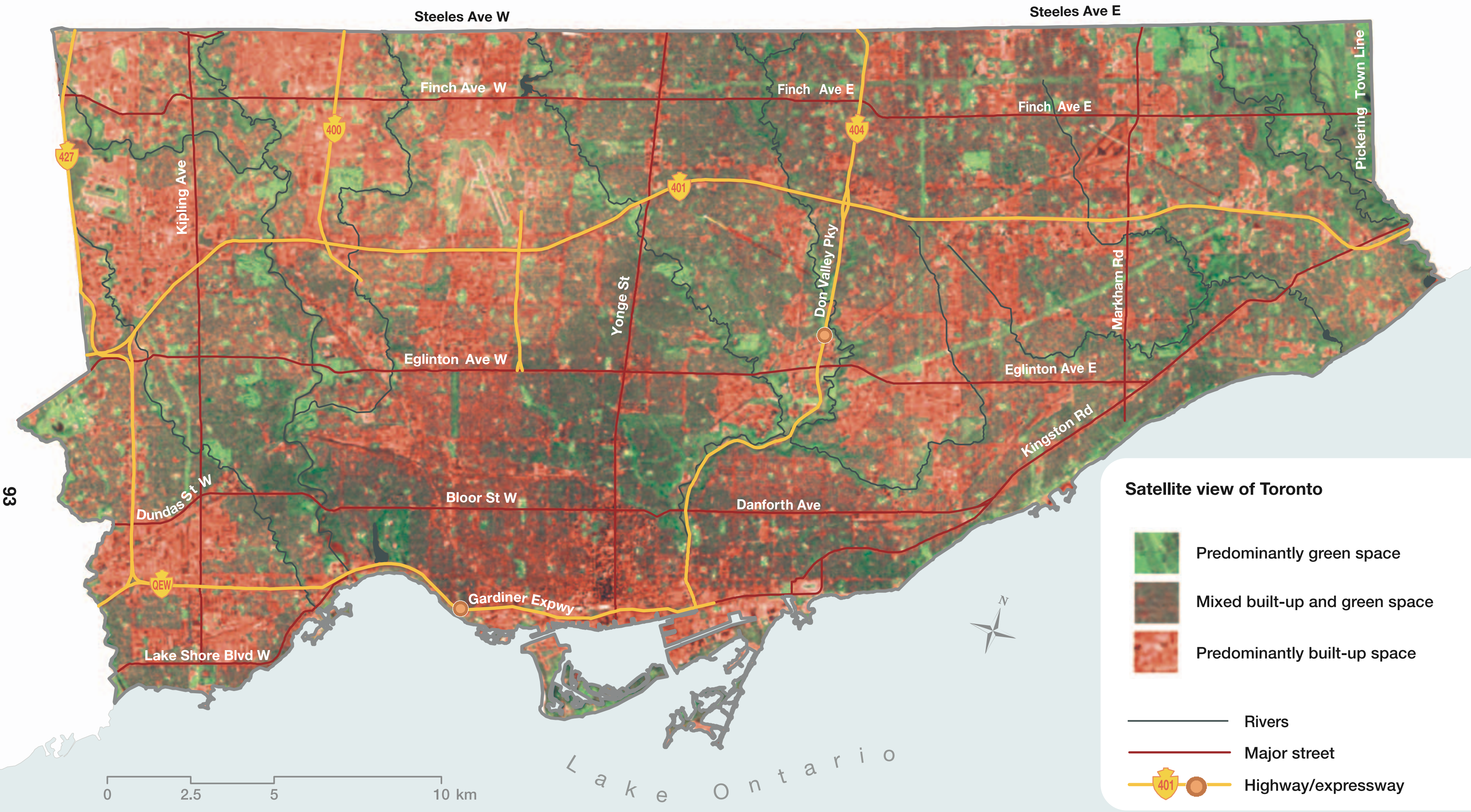
Findings

- This exhibit shows residential areas, parks and recreational spaces as they were in 2002; it also shows lands allocated for commercial activities and industrial purposes or utilities.
- Larger parks tended to be concentrated along rivers, ravines, the lakefront, and in other areas in the far east and west of the city.
- The south central portion of the city had a large area that was mainly residential with very few large parks.

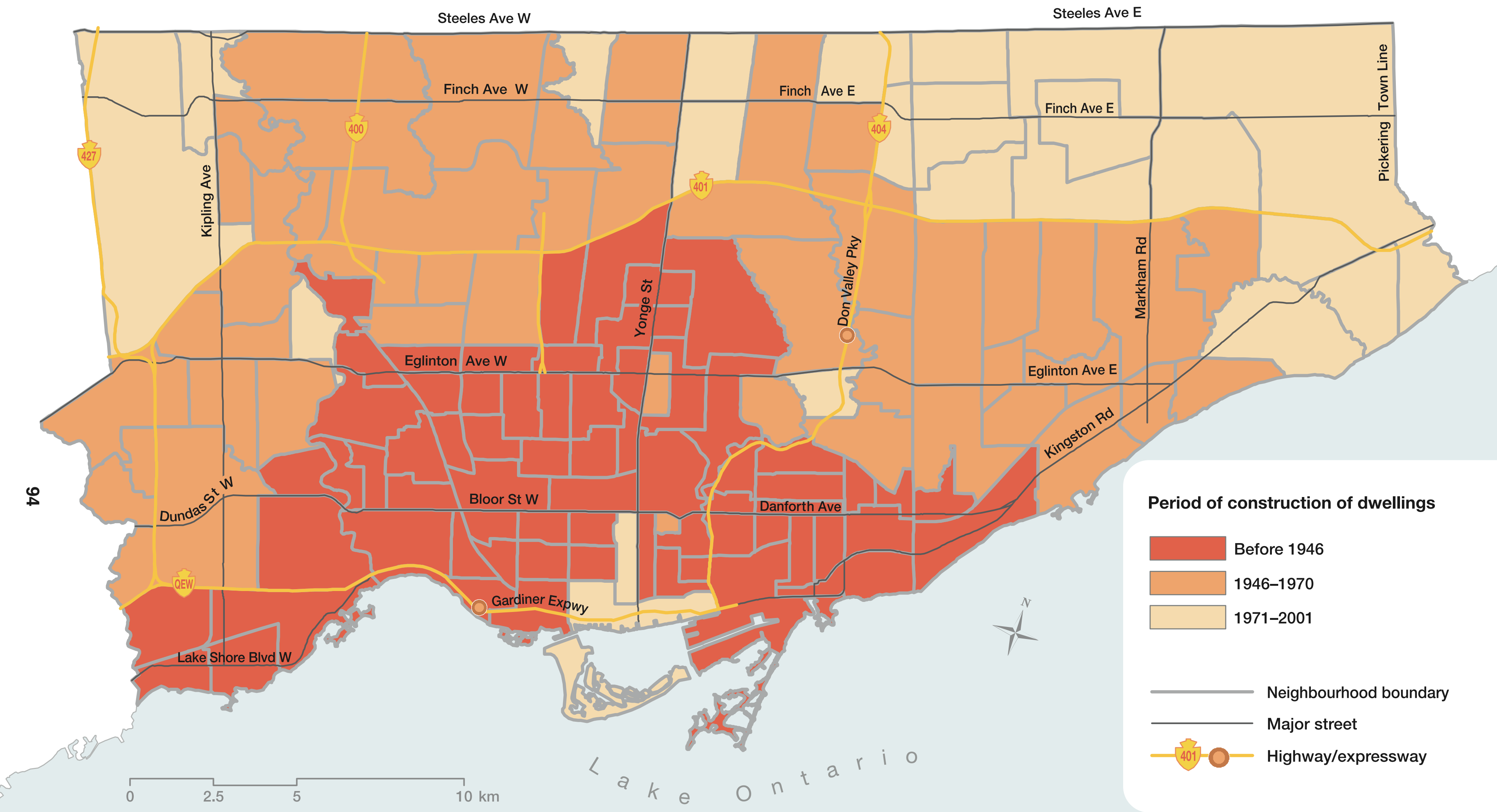
Exhibit 5.2 Satellite view of Toronto, 1989–1991



Findings

- Built-up areas and green spaces can be easily distinguished on this satellite photograph (1989–1991).

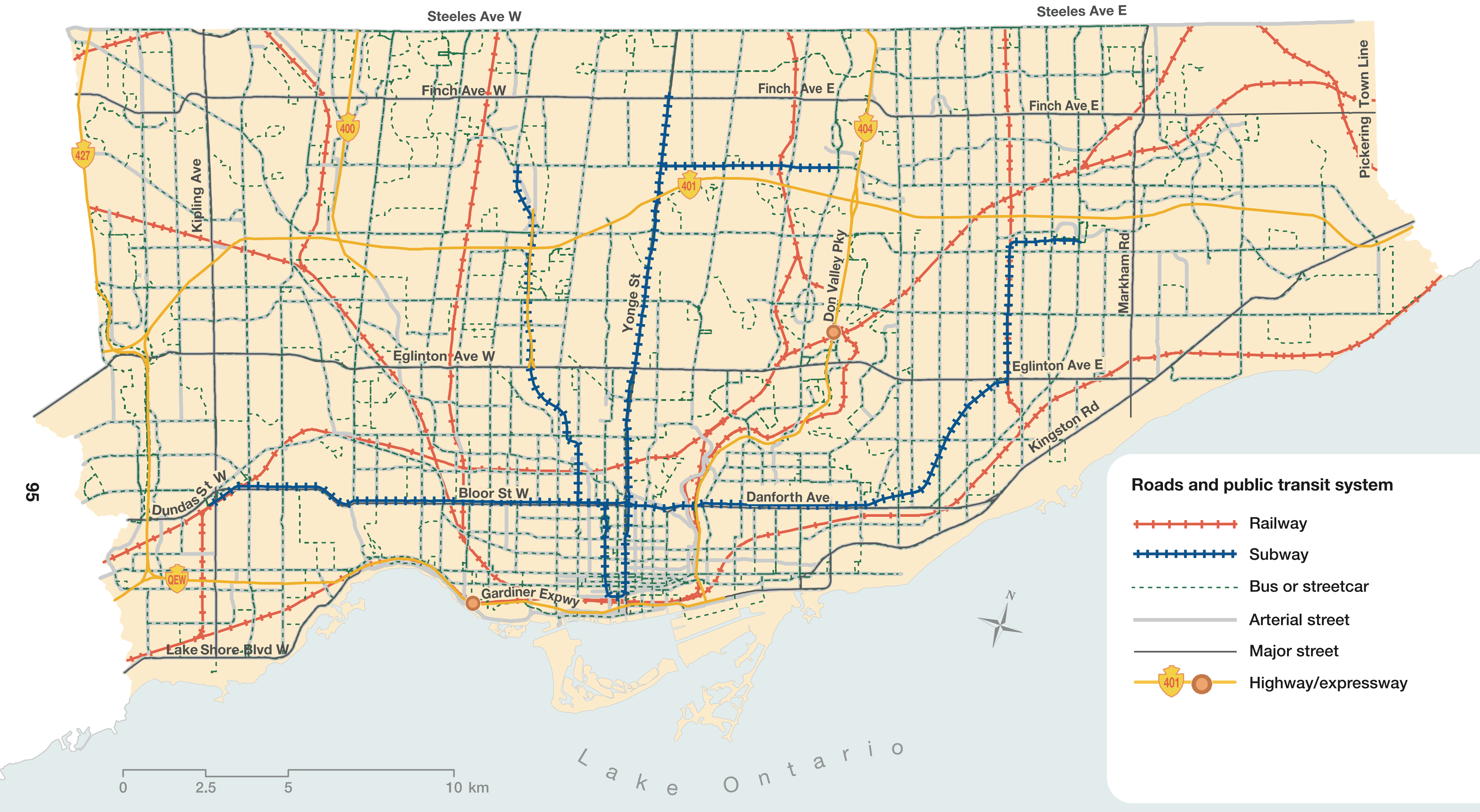
Exhibit 5.3 Period of construction of dwellings, by neighbourhood, in Toronto, 2001



Findings

- In 2001, pre-war housing areas were concentrated in the south central portion of the city (the pre-amalgamation City of Toronto).
- Much of the remainder of housing was built between 1946 and 1970.
- The most recently constructed residential areas were built in or after 1971. In 2001, these could be found in the northeast part of the city, as well as in some areas in the west end of Toronto and in the central region of downtown.

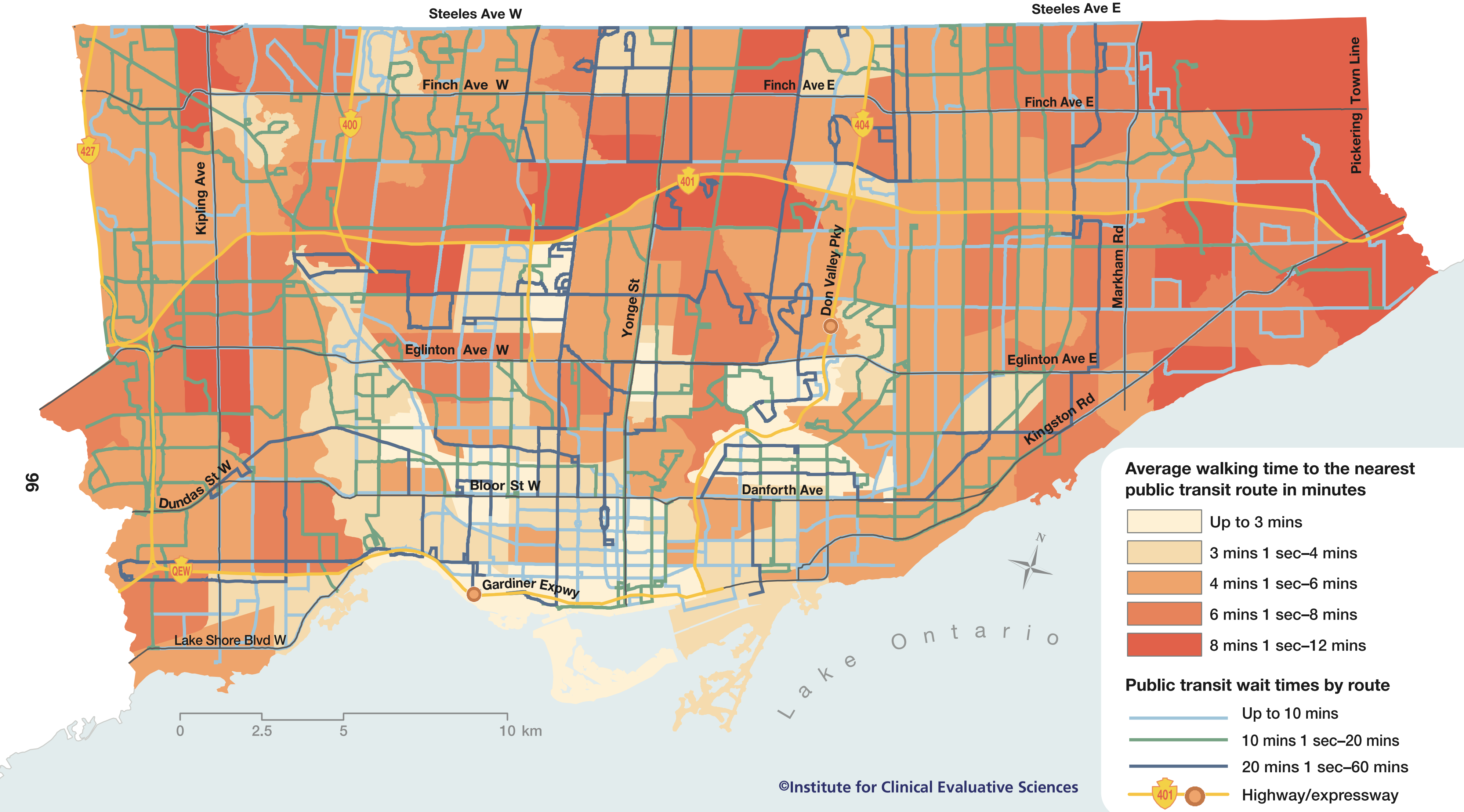
Exhibit 5.4 Roads and public transit system, in Toronto, 2003



Findings

- In 2003, the downtown core of the city had the densest concentration of roads and public transit lines. Concentrations decreased away from downtown Toronto—especially towards the north central, western and eastern parts of the city.

Exhibit 5.5 Public transit wait times and walking times to the nearest transit route, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

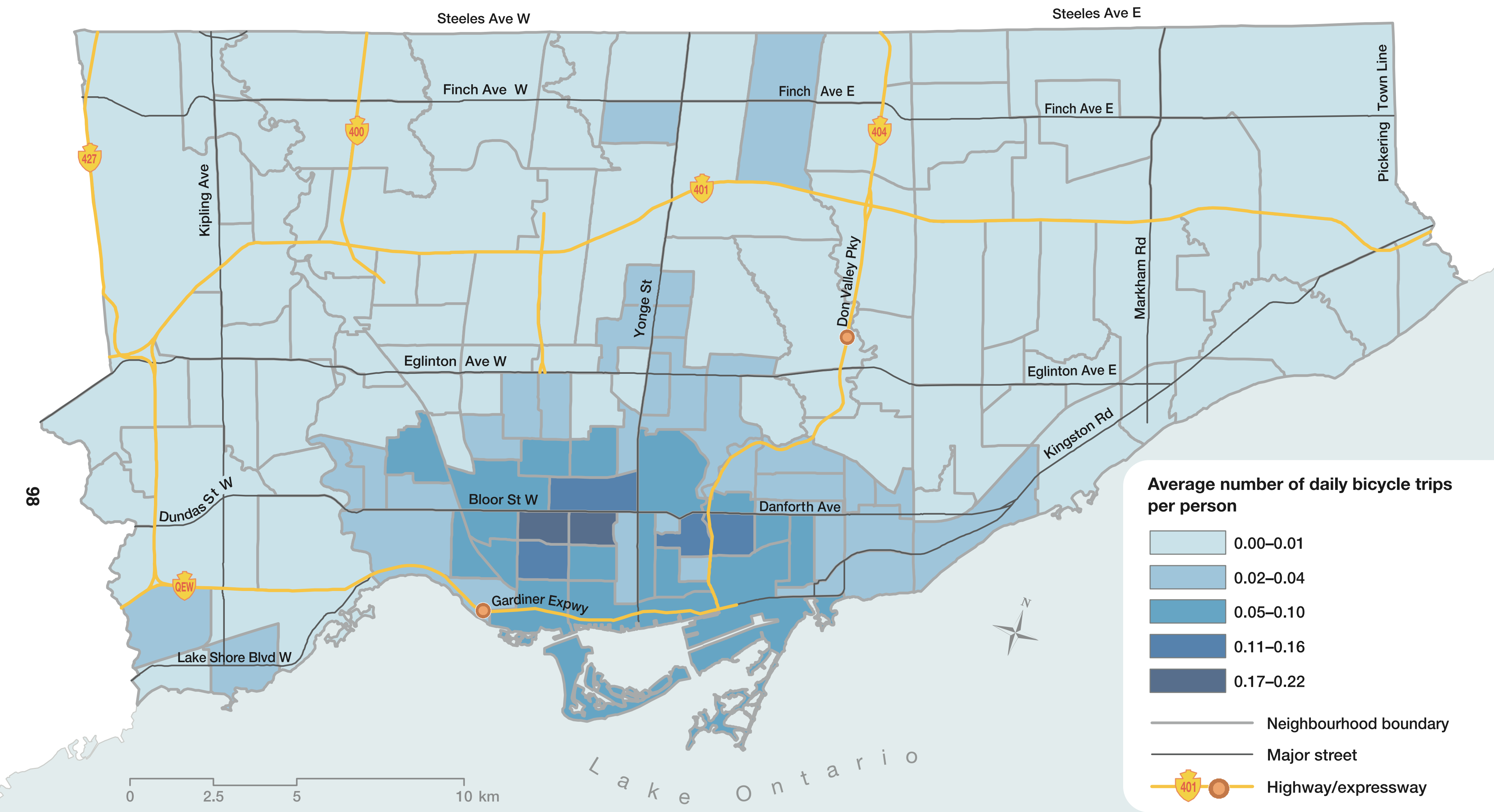
- In 2004, residents in most of the downtown core had good access to public transit routes, with walking times under six minutes. Areas in the east and west and along the western portion of Highway 401 had the longest walking times (up to 12 minutes).
- Residents living downtown and along major roads experienced up to 10-minute waits for public transit, on average. Those living along many outlying routes and smaller roads waited between 10 and 20 minutes. Waiting for buses and streetcars on some less serviced routes could take up to one hour.
- Some parts of central and central north Toronto and areas in the east and west ends had both long walks to reach transit stops and long wait times for transit vehicles.

Exhibit 5.6 Bicycle routes in Toronto, 2007

Findings

- In 2007, designated bicycle lanes are predominantly found in south central Toronto.
- Major multi-use pathways follow river systems, including the Don in central Toronto and the Humber in the west. The east end of the city has some major and multi-use pathways, but these tend to be disconnected segments.
- Few bicycle paths form continuous systems that would facilitate commuting or longer trips.

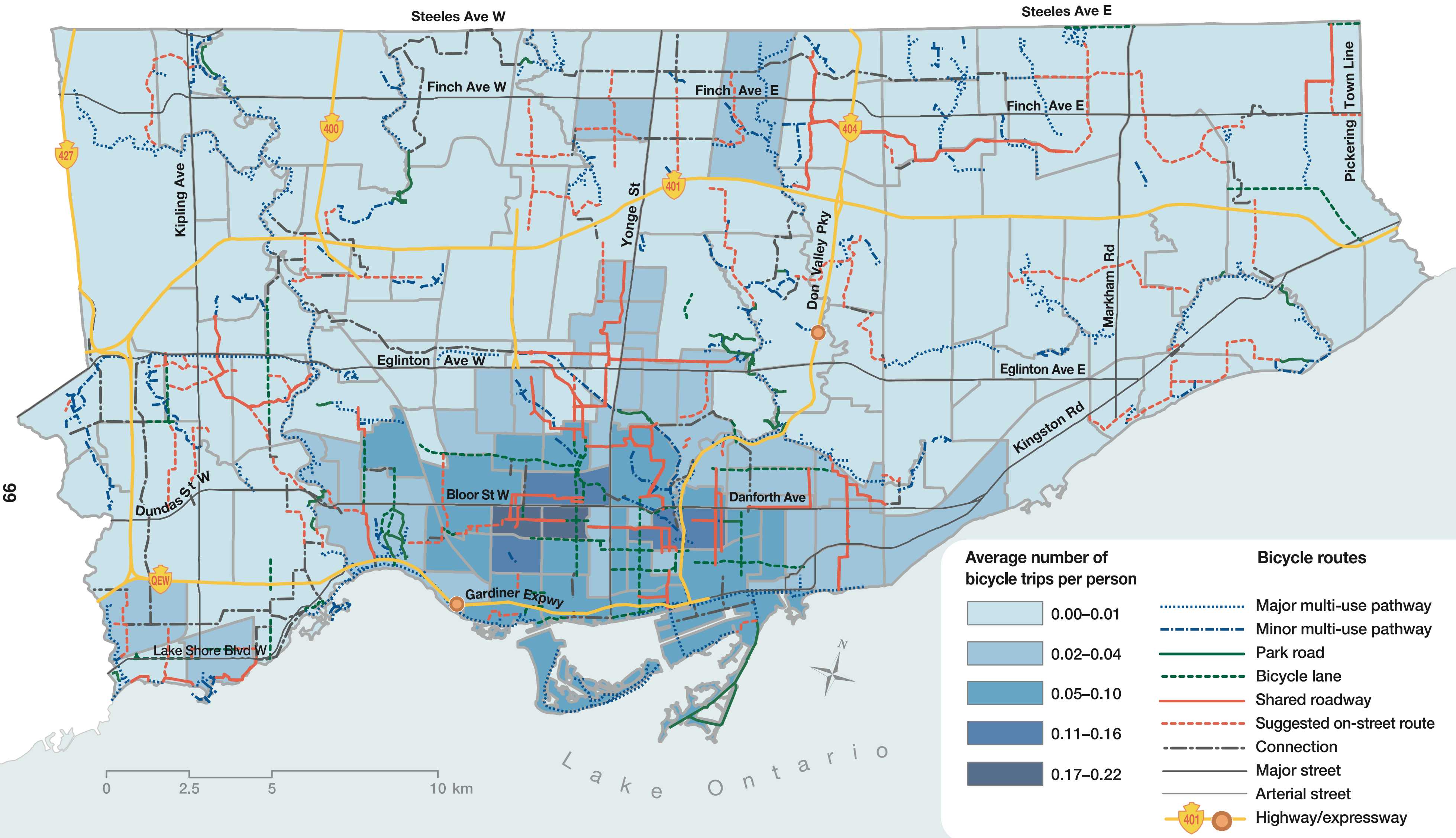
Exhibit 5.7 Average number of daily bicycle trips per person, by neighbourhood of residence, in Toronto, 2001



Findings

- In 2001, the highest number of daily bicycling trips per person occurred among residents living in Toronto's downtown area and its immediate surroundings. The fewest number of trips per person occurred in scattered locations across the rest of the city.
- There was at least a 40-fold variation among different neighbourhoods in the number of daily bicycling trips per person.

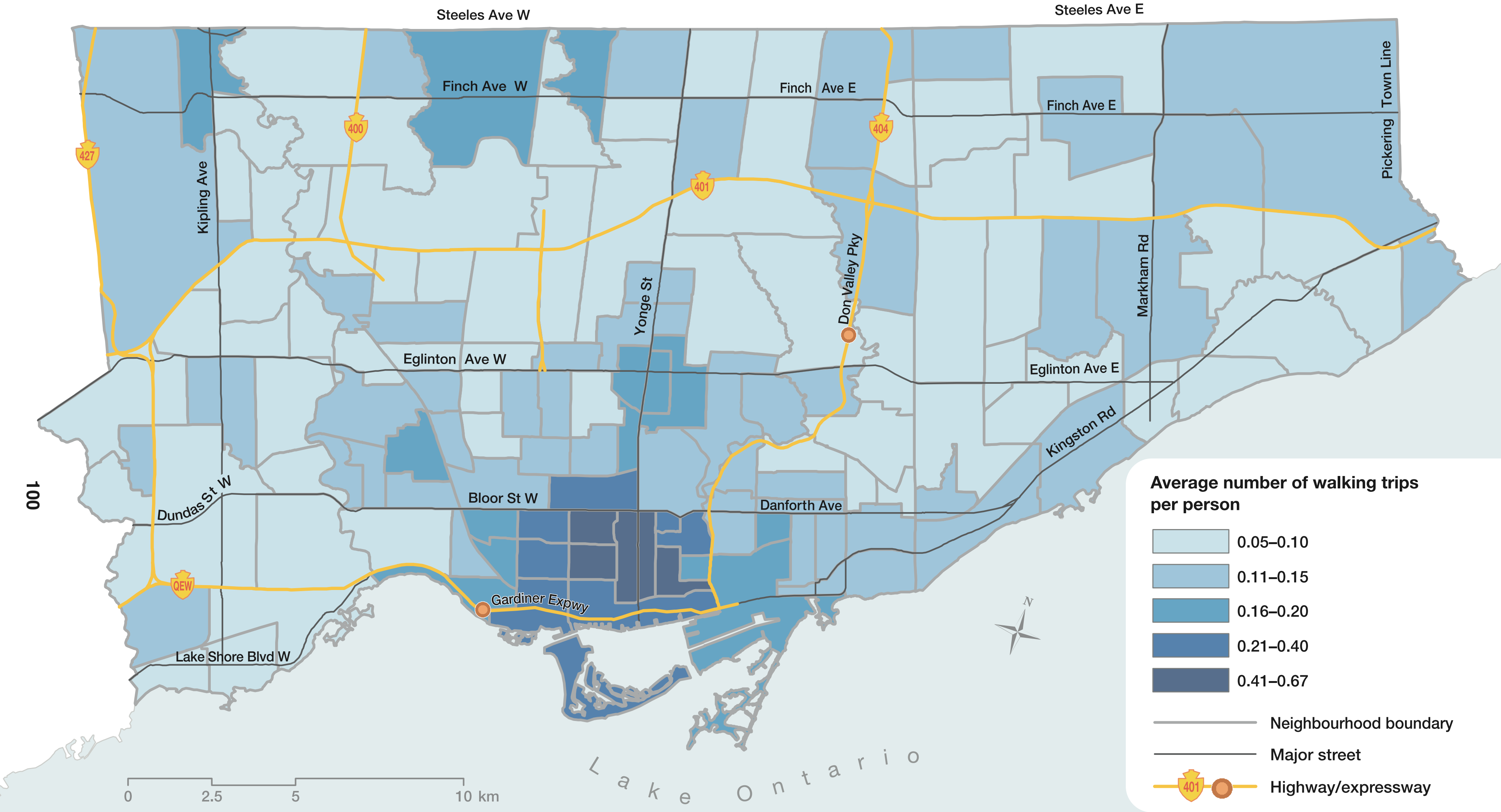
Exhibit 5.8 Average number of daily bicycle trips per person by neighbourhood of residence, and bicycle routes, in Toronto, 2001



Findings

- In 2001, residents in the downtown core of Toronto had the highest number of daily bicycle trips, corresponding to the area with the most bicycle lanes.
- Other areas with high numbers of daily bicycle trips corresponded to the presence of multi-use pathways.

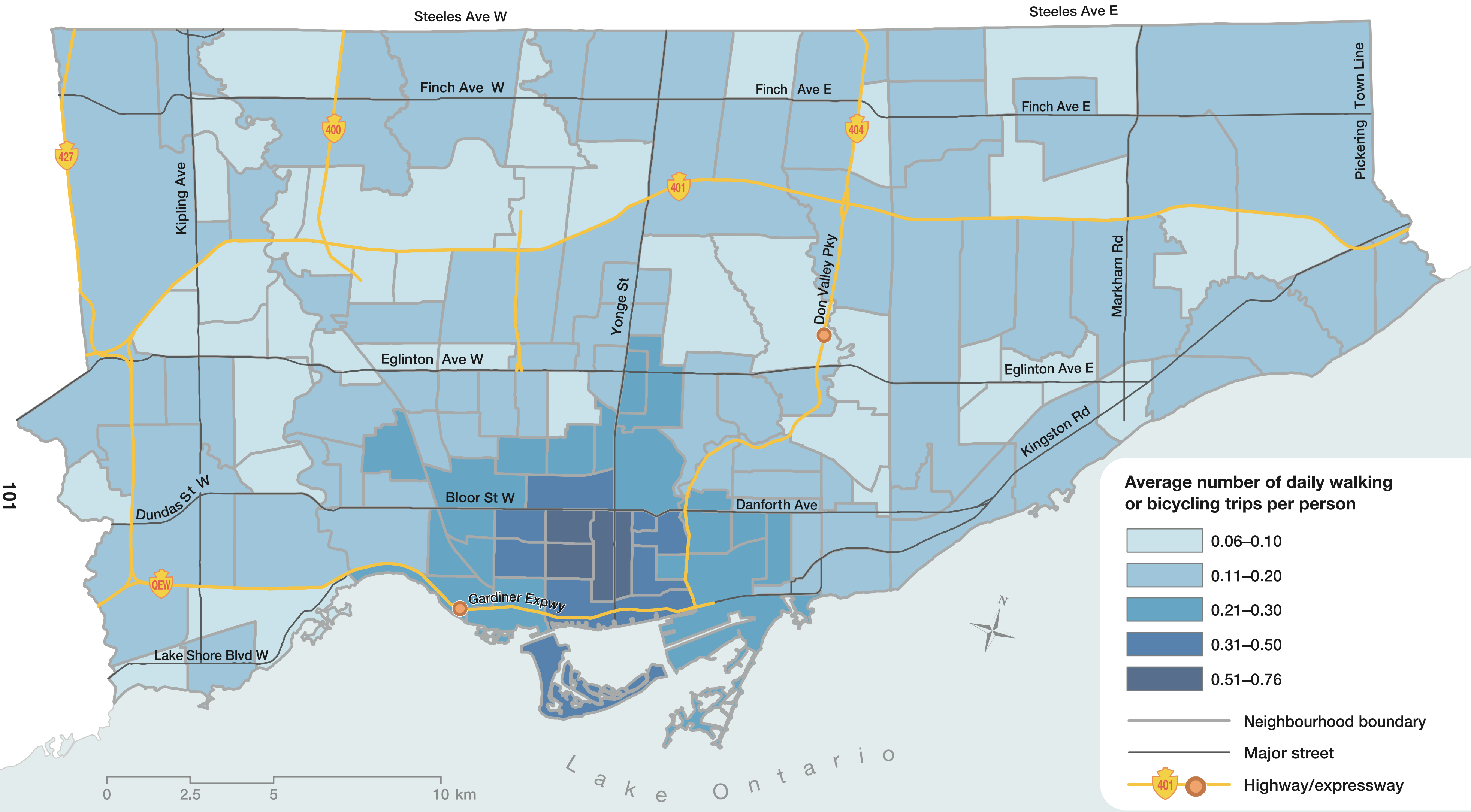
Exhibit 5.9 Average number of daily walking trips per person, by neighbourhood of residence, in Toronto, 2001



Findings

- In 2001, residents in the south central downtown area of Toronto had the highest number of daily walking trips.
- Residents living in a broad band of neighbourhoods, stretching from the southwest and across northern Toronto to the east had the lowest number of daily walking trips.
- There was approximately a 10-fold variation among neighbourhoods of residence in the number of daily walking trips per person.

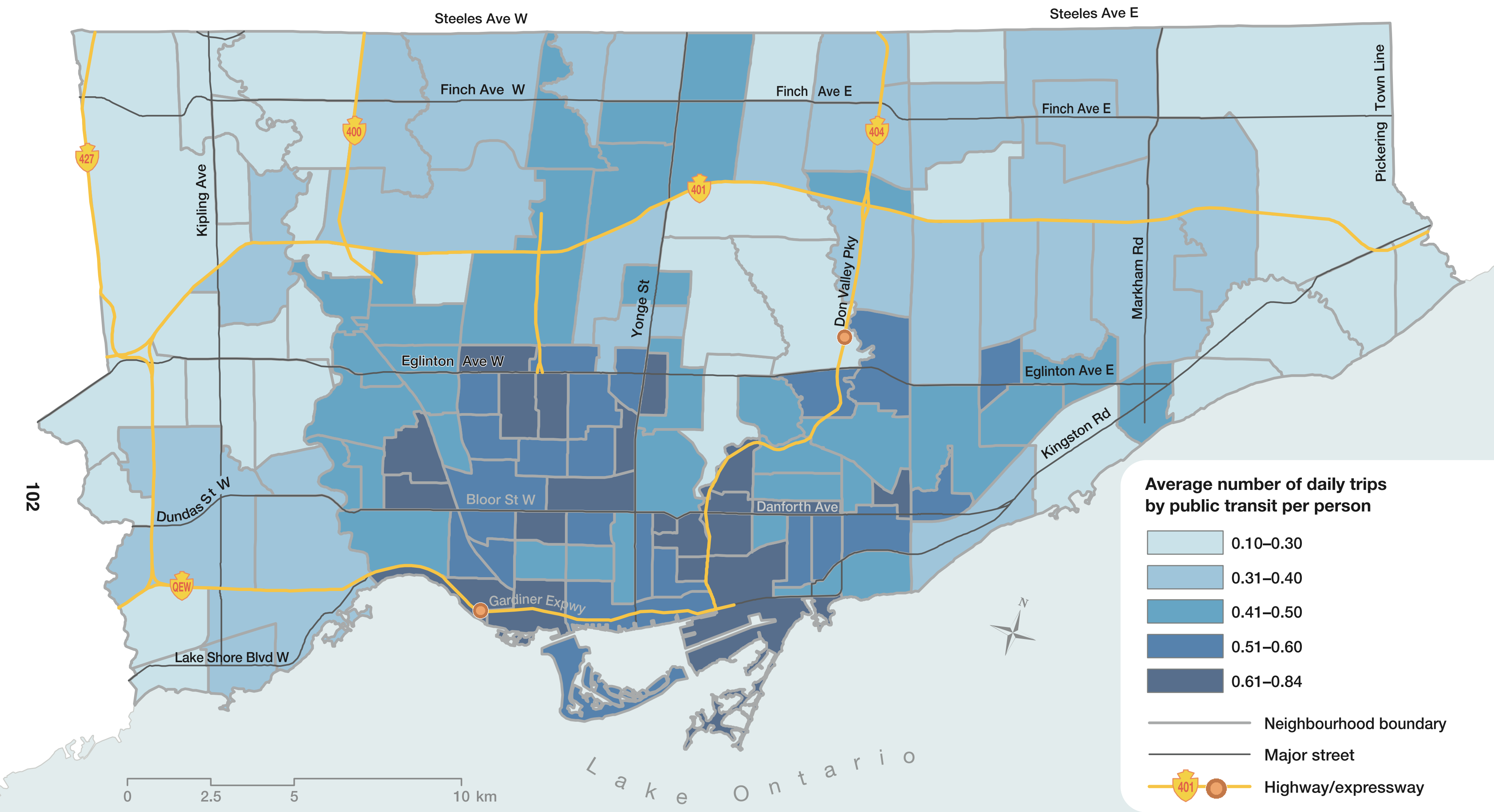
Exhibit 5.10 Average number of daily walking or bicycling trips per person, by neighbourhood of residence, in Toronto, 2001



Findings

- In 2001, the pattern of daily walking or bicycling trips closely resembled that of daily walking trips (Exhibit 5.9), with a concentration of more daily trips among residents in the south central downtown area.

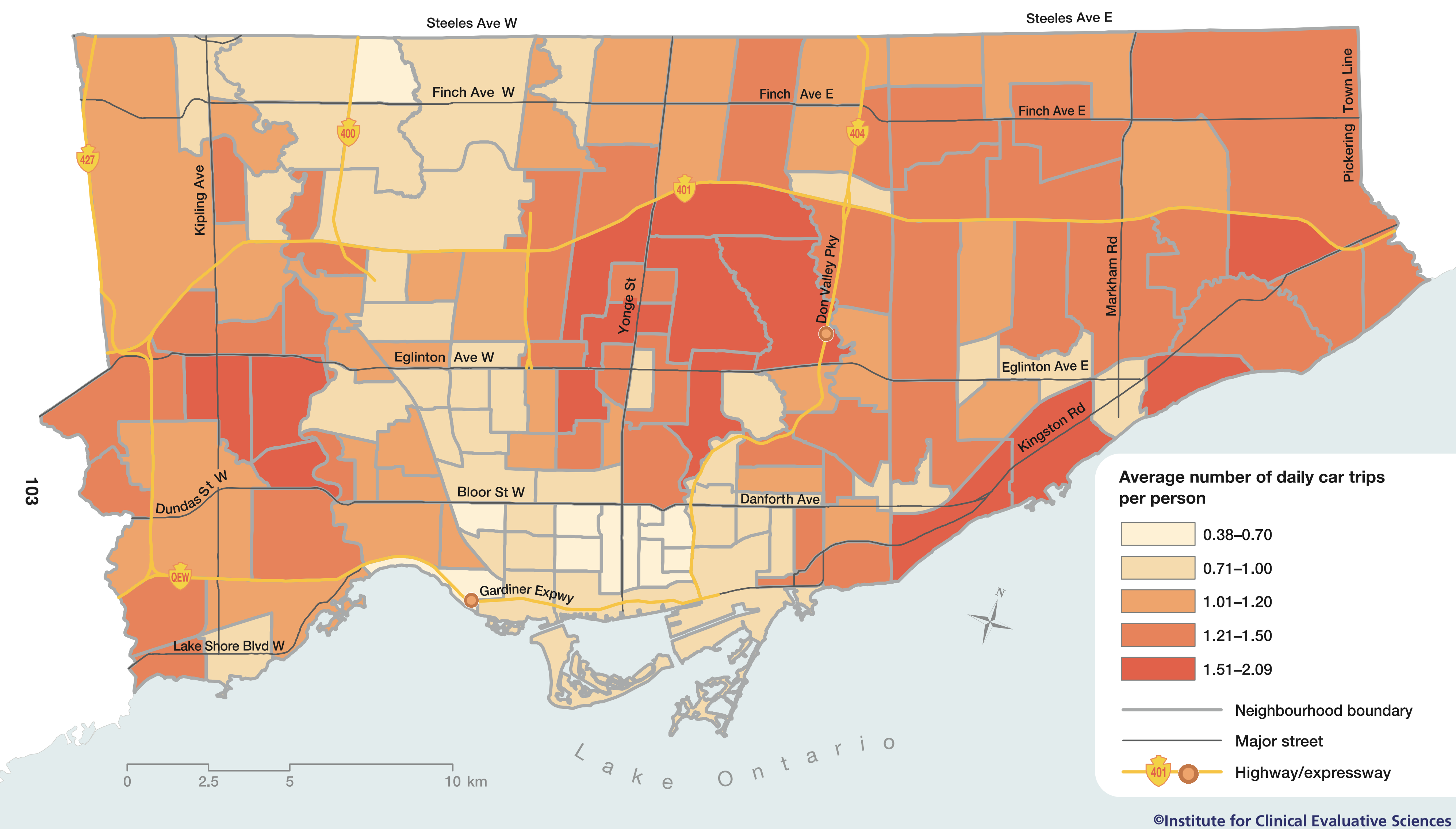
Exhibit 5.11 Average number of daily public transit trips per person, by neighbourhood of residence, in Toronto, 2001



Findings

- In 2001, the number of daily transit trips was highest among residents in a large area of south central Toronto, with some extension into northern areas. Higher transit use was found among residents in the low-income, doughnut-shaped area surrounding central Toronto (Chapter 3).
- Residents living in parts of central Toronto, along with those from areas in the far west and far east of the city, had the lowest number of daily transit trips. Residents in these areas had relatively high income levels (see Chapter 3).
- There was approximately an eight-fold variation among neighbourhoods of residence in the number of transit trips per day.

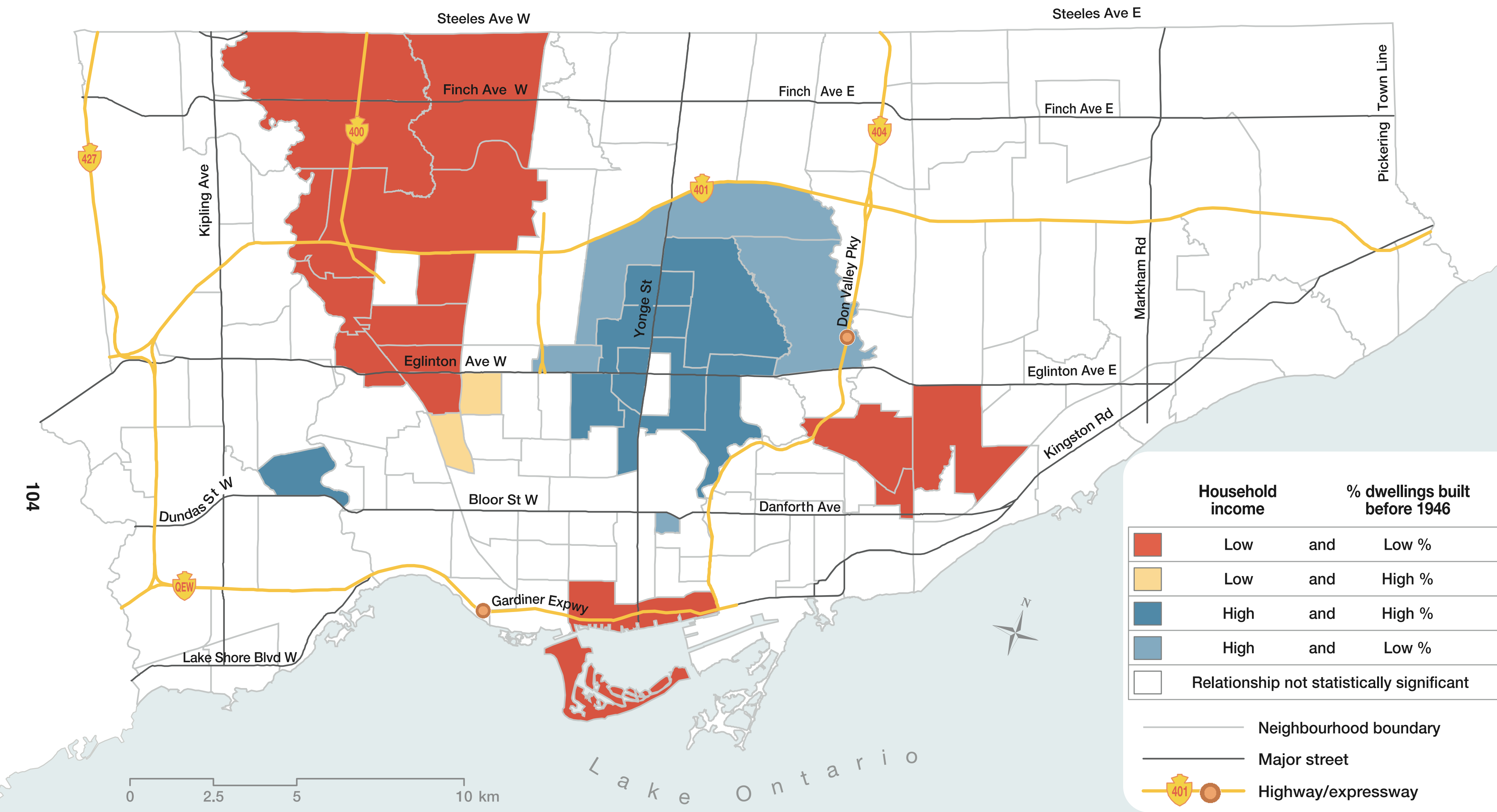
Exhibit 5.12 Average number of daily car trips per person, by neighbourhood of residence, in Toronto, 2001



Findings

- In 2001, the number of daily car trips per person was, to some extent, the reverse of the public transit trips pattern: the lowest levels of car use per person were found among residents in the downtown area and in neighbourhoods to its northwest.
- Neighbourhoods in the far west, as well as those across eastern and central Toronto, had the highest number of daily car trips per person.
- There was approximately a five-fold variation among neighbourhoods of residence in the number of daily car trips per person.
- Residents living in areas with higher levels of car use had relatively higher incomes (Chapter 3).

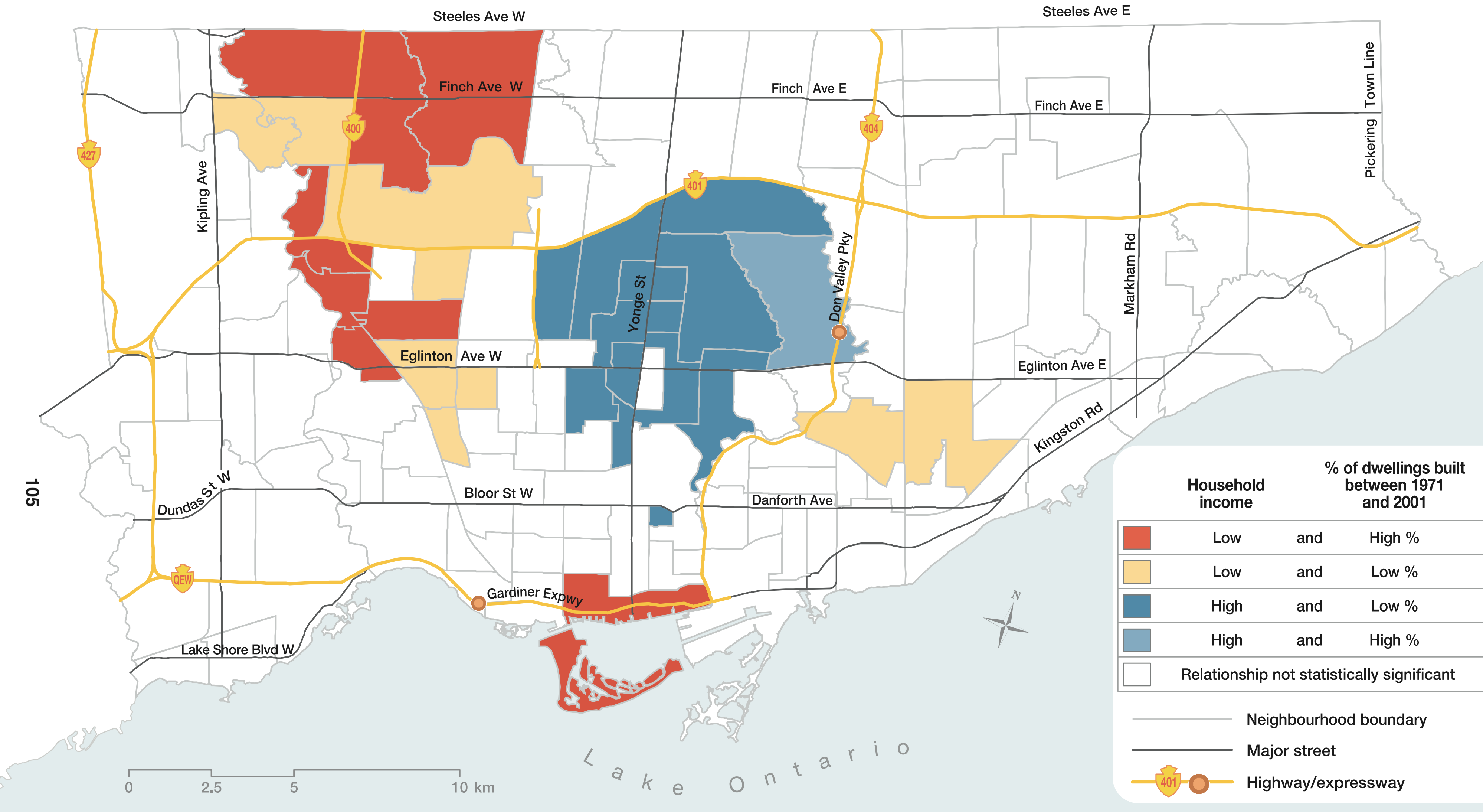
Exhibit 5.13 Spatial relationship between average annual household income (high or low) and percent of dwellings built before 1946 (high or low), by neighbourhood, in Toronto, 2001



Findings

- In 2001, areas in the northwest and east of the city had both lower income neighbourhoods and a lower proportion of housing built before 1946. Many of these same neighbourhoods were shown to have higher rates of diabetes (Chapter 2).
- Low-income areas in the northwest also had a higher proportion of relatively new housing construction (built between 1971 and 2001).
- This exhibit identifies central Toronto as an area with older residential neighbourhoods coinciding with higher household incomes.

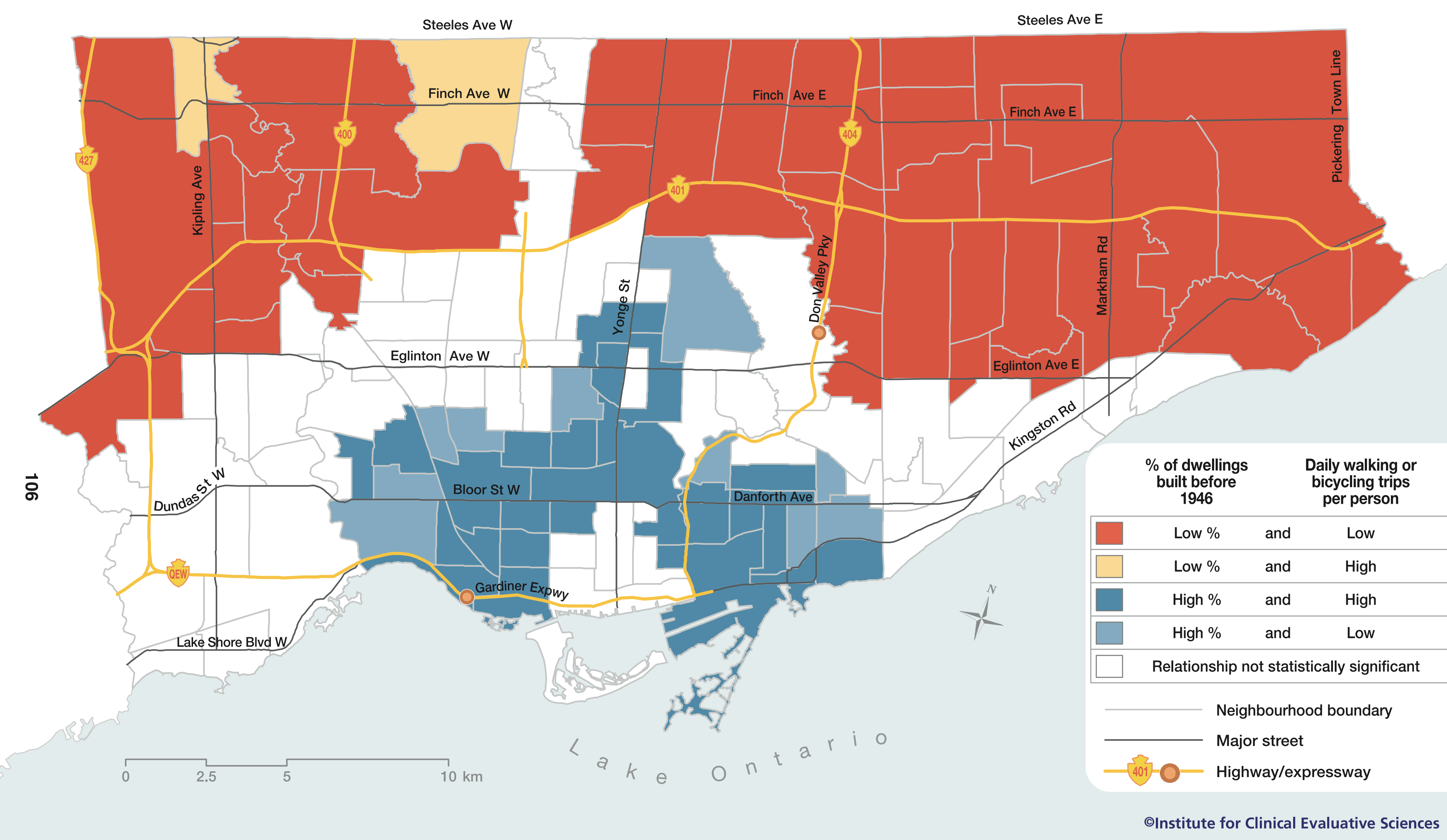
Exhibit 5.14 Spatial relationship between average annual household income (high or low) and percent of dwellings built between 1971 and 2001 (high or low), by neighbourhood, in Toronto, 2001



Findings

- Portions of northwest Toronto had both low income and a high proportion of dwellings built between 1971 and 2001.
- Most of central Toronto had both high income and a low proportion of dwellings built between 1971 and 2001.

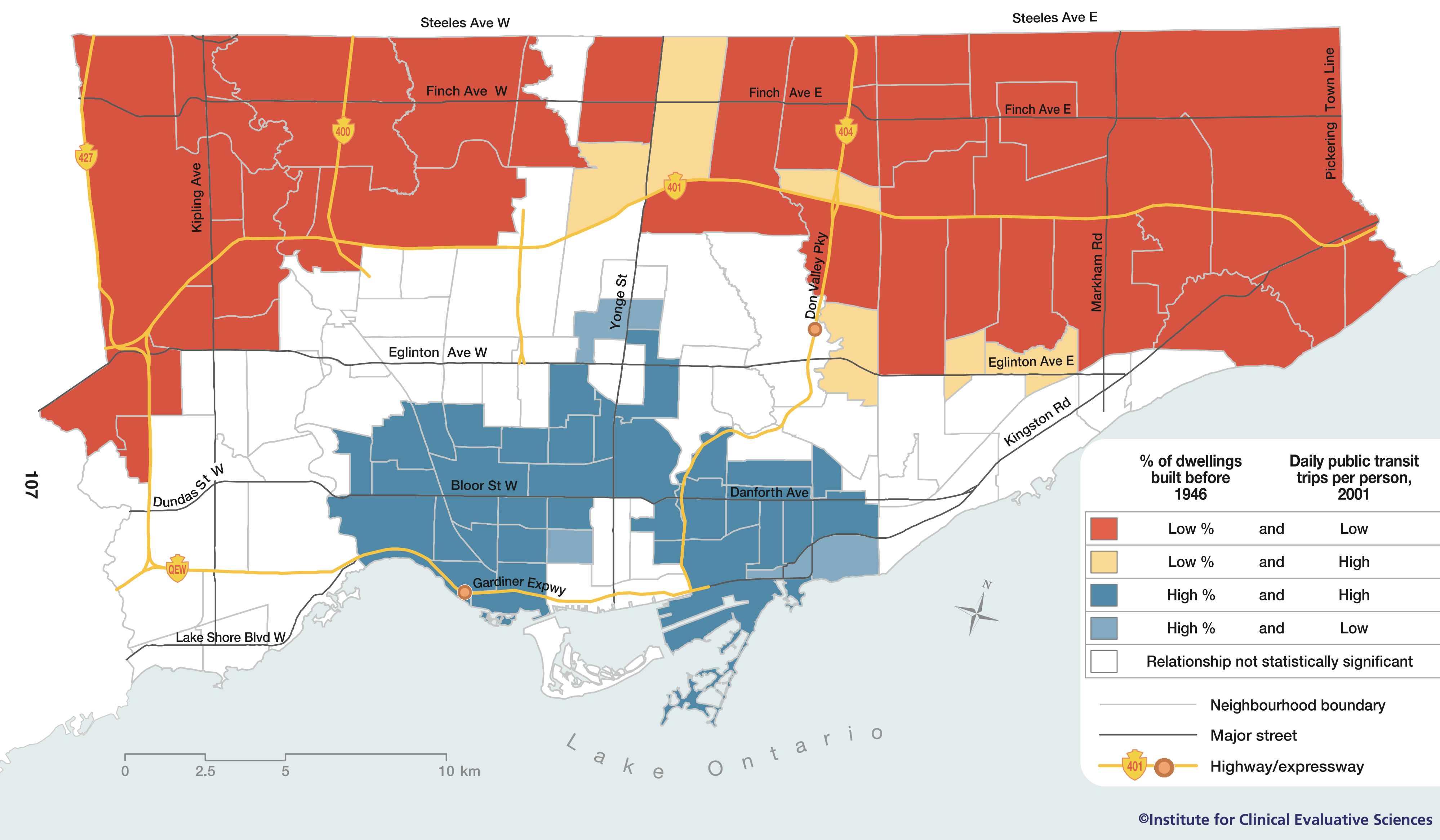
Exhibit 5.15 Spatial relationship between dwellings built before 1946 (high or low) and daily walking or bicycling trips per person (high or low), by neighbourhood, in Toronto, 2001



Findings

- In 2001, in a large band of neighbourhoods across northern portions of the city, there were relatively low rates of walking or bicycling trips per person.
- In contrast, south central Toronto had higher rates of walking or bicycling trips and a higher proportion of dwellings built before 1946.

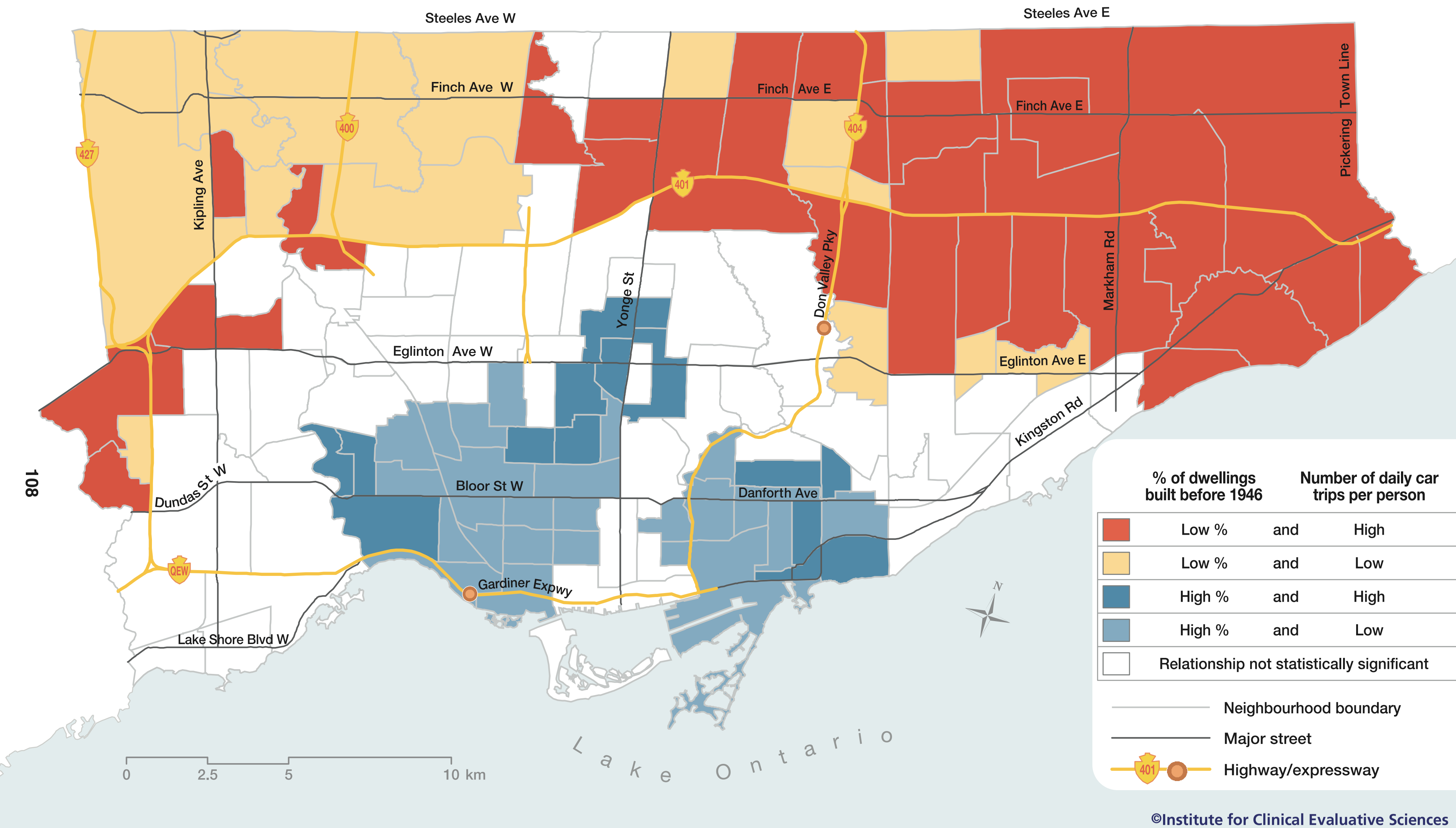
Exhibit 5.16 Spatial relationship between percent of dwellings built before 1946 (high or low) and daily public transit trips per person (high or low), by neighbourhood, in Toronto, 2001



Findings

- Based on 2001 data, the pattern of daily public transit trips and dwellings built before 1946 is very similar to the pattern seen for walking trips (Exhibit 5.15).

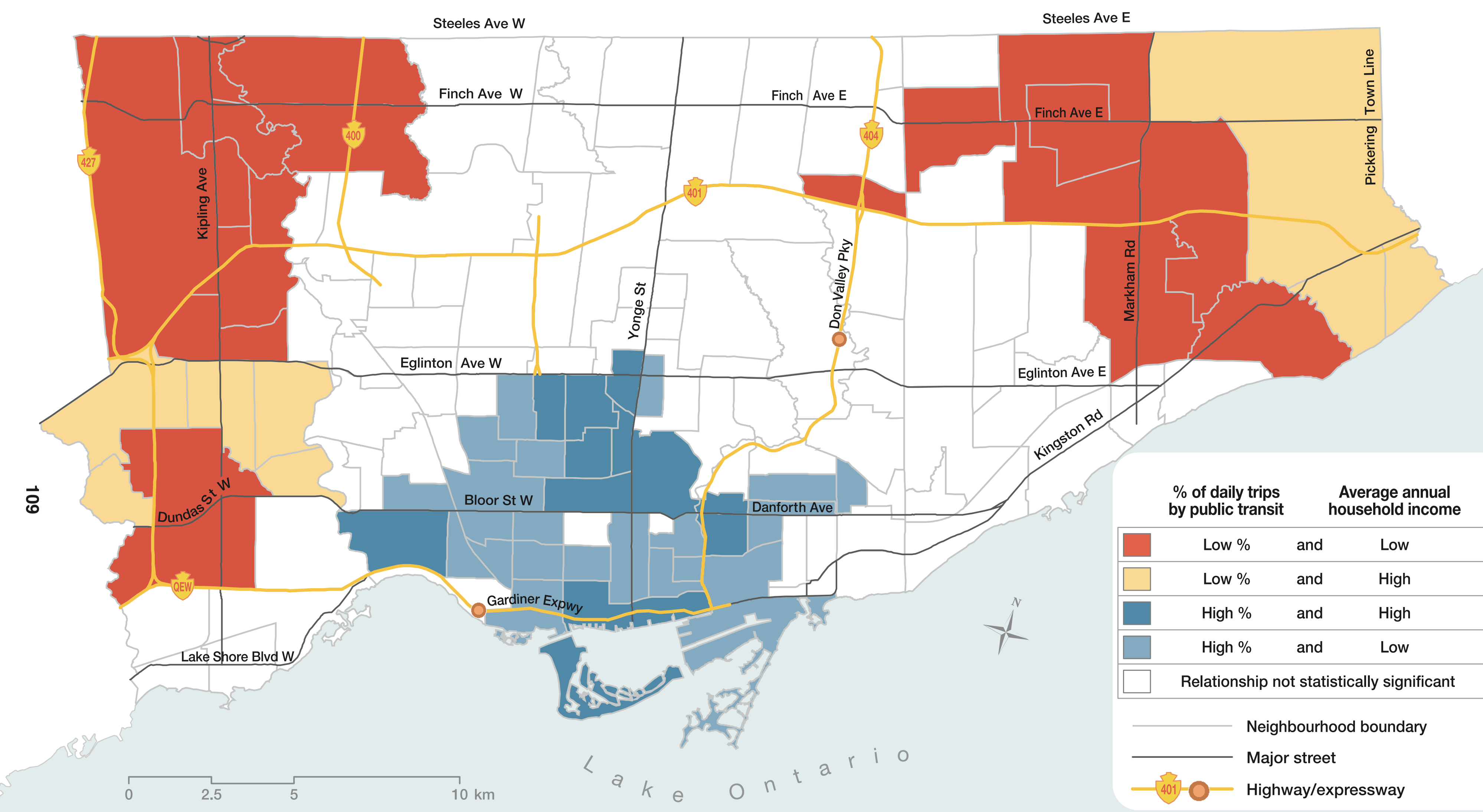
Exhibit 5.17 **Spatial relationship between percent of dwellings built before 1946 (high or low) and daily car trips per person (high or low), by neighbourhood, in Toronto, 2001**



Findings

- In 2001, the number of daily car trips per person was relatively high in eastern and northeastern Toronto, both areas with a low proportion of dwellings built before 1946.
- Northwestern Toronto also had a low proportion of dwellings built before 1946, but the number of daily car trips per person was relatively low.

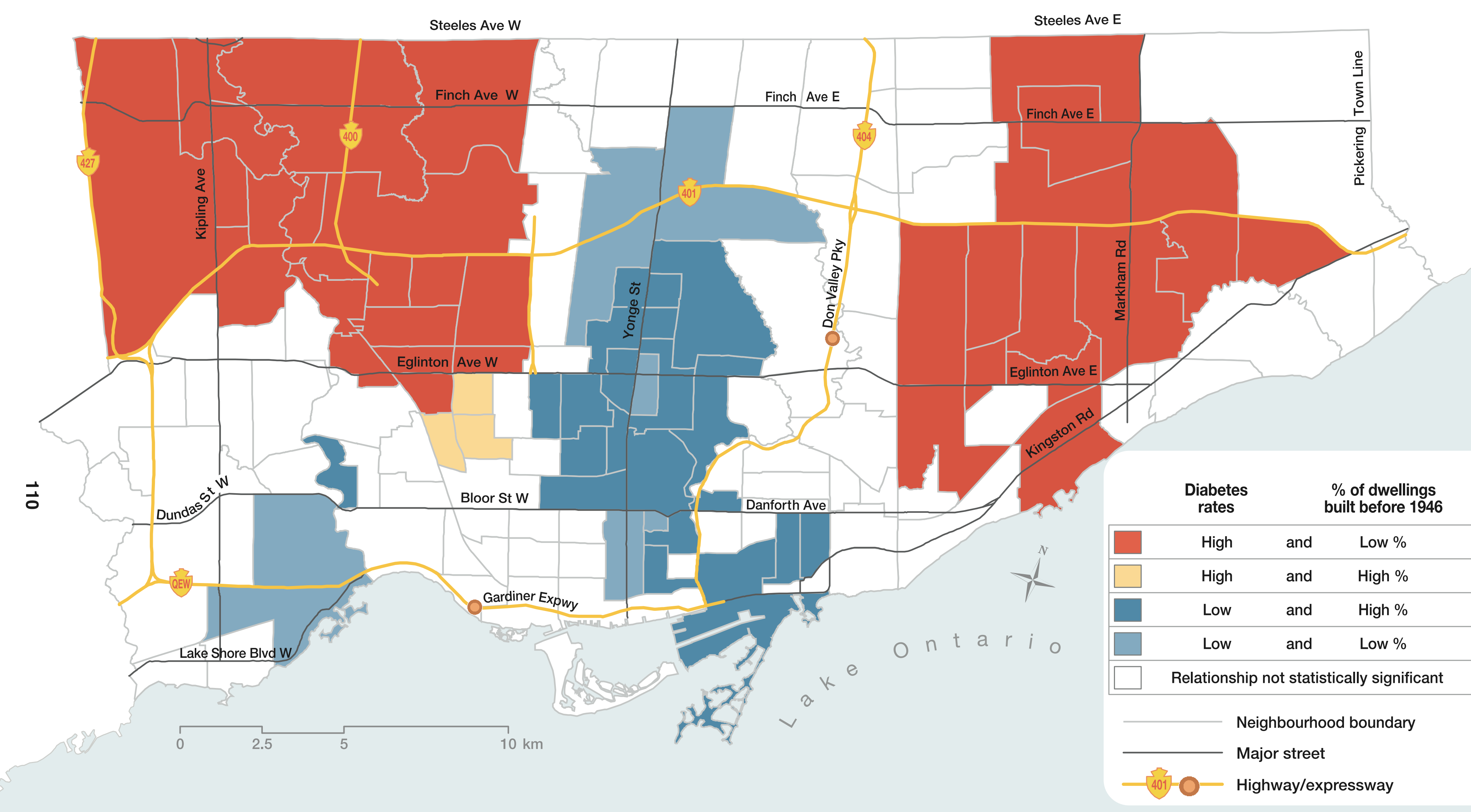
Exhibit 5.18 **Spatial relationship between average number of daily public transit trips per person (high or low) and average annual household income (high or low), by neighbourhood, in Toronto, 2001**



Findings

- In 2001, the far eastern and far western areas of Toronto had a relatively low number of daily public transit trips in areas that had both high and low average annual household income.
- South central Toronto had a relatively high number of daily public transit trips in areas that had both high and low household income.

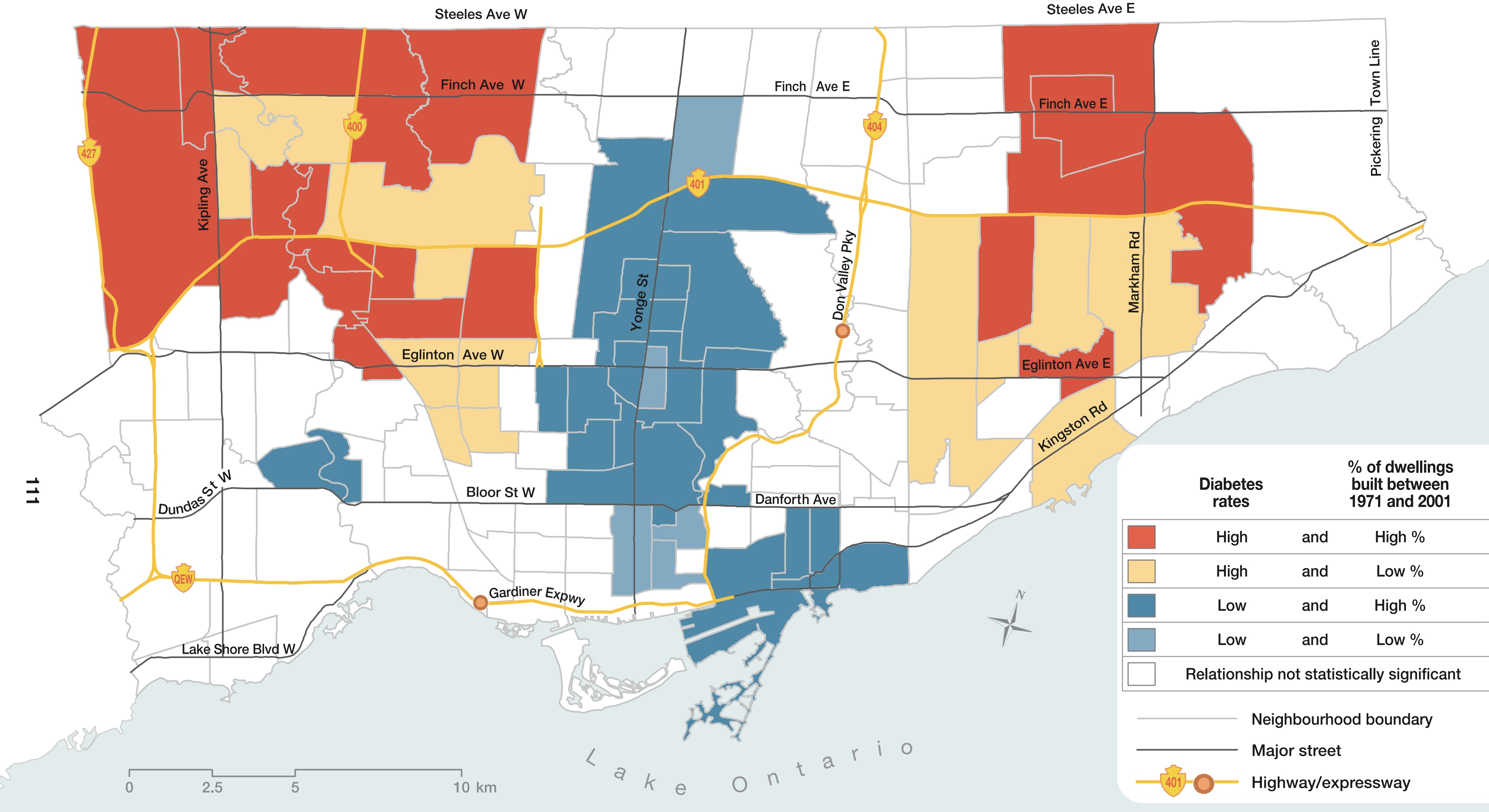
Exhibit 5.19 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of dwellings built before 1946 [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, high diabetes rates were found among residents living in large areas in the northwest and east of Toronto where the proportion of dwellings built before 1946 was low.
- Low diabetes rates were found among residents living in central Toronto and some parts of downtown. In these areas, the proportion of dwellings built before 1946 was high.

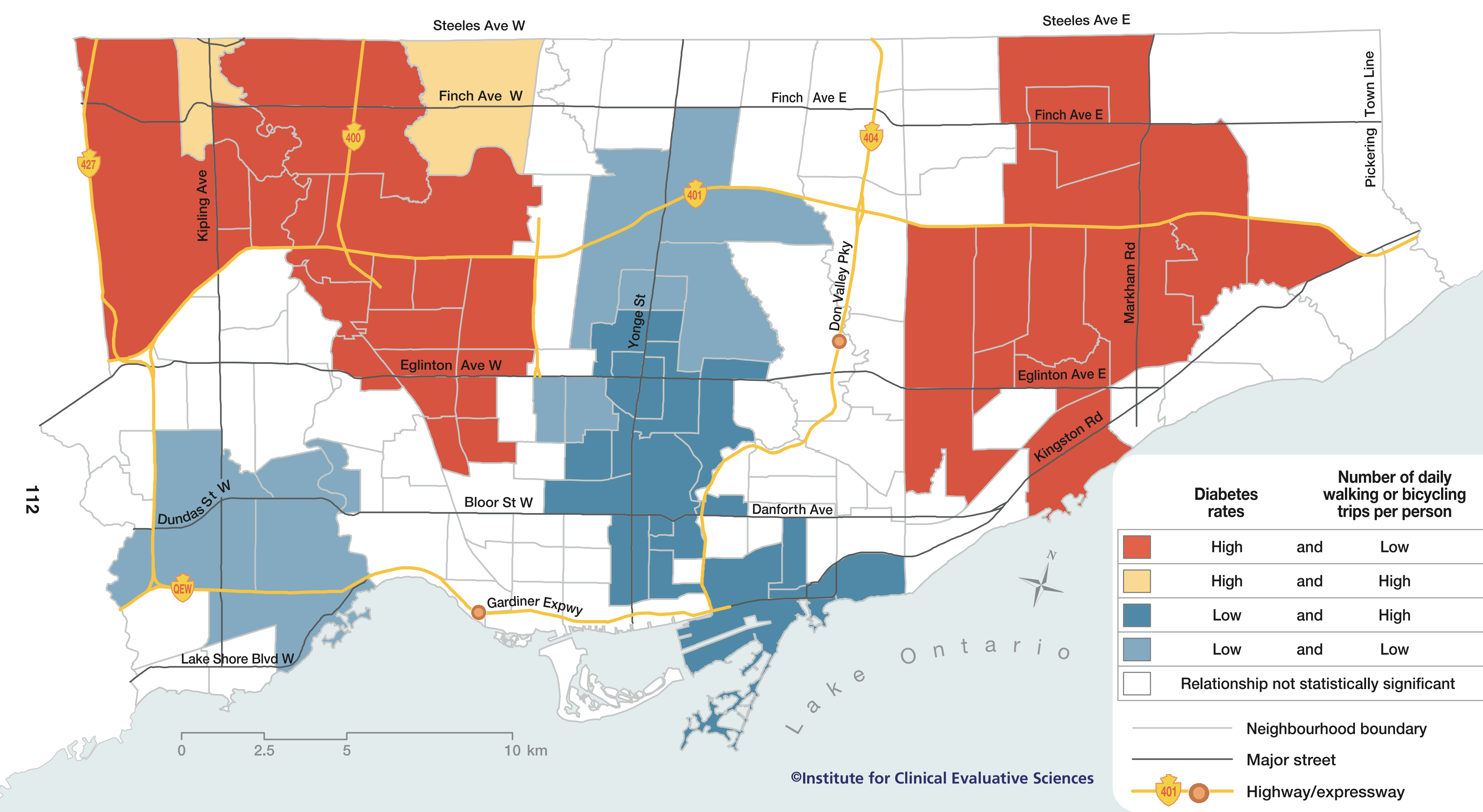
Exhibit 5.20 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and percent of dwellings built between 1971 and 2001 [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, neighbourhoods in the northwest and east of the city with high diabetes rates had both low and high proportions of dwellings built between 1971 and 2001.
- Central Toronto had low diabetes rates and a low proportion of dwellings built between 1971 and 2001.

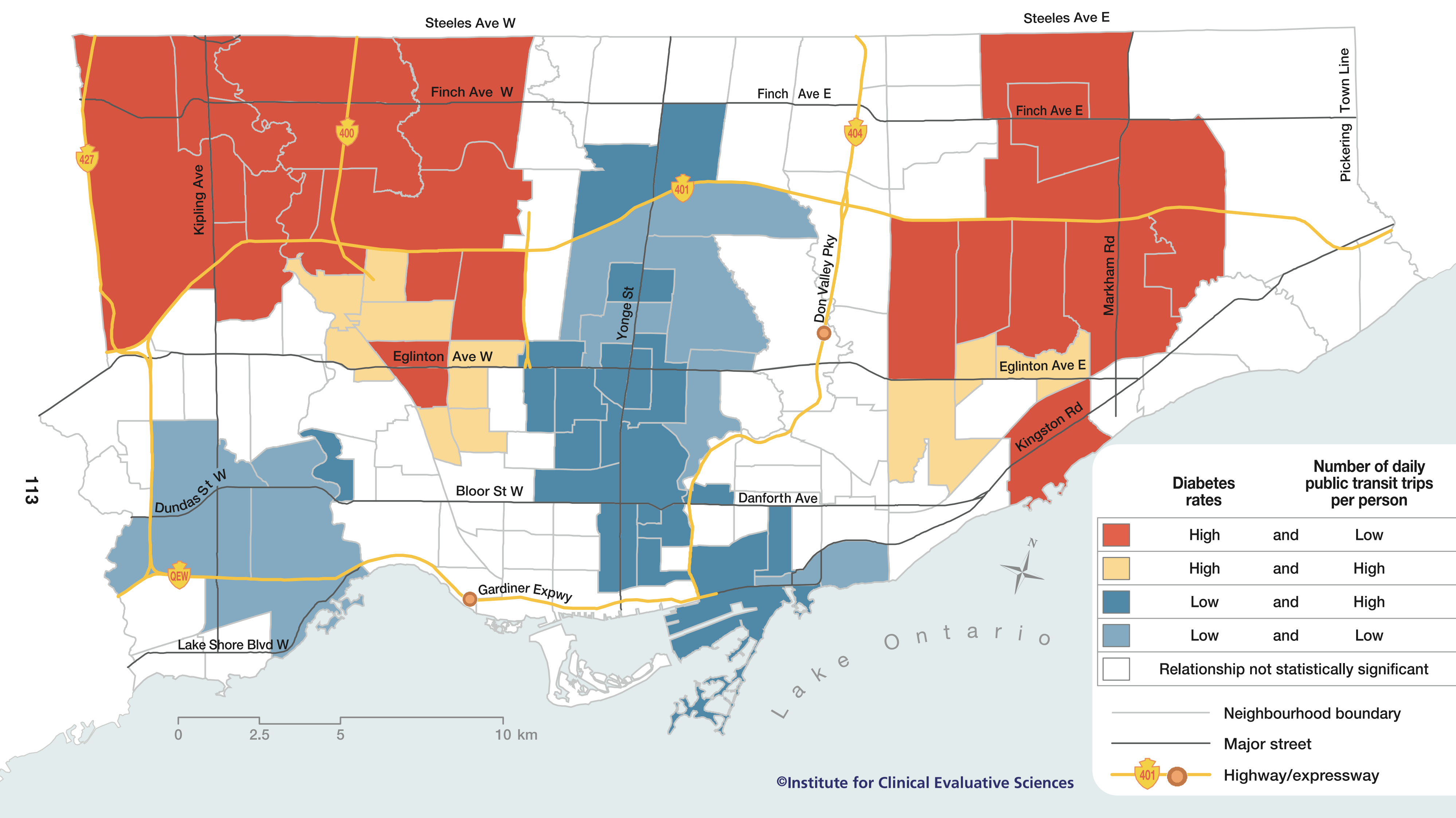
Exhibit 5.21 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and average number of daily walking or bicycling trips per person [2001] (high or low), by neighbourhood of residence, in Toronto



Findings

- In 2001, residents living in large areas in the northwest and east of Toronto with high diabetes rates had a relatively low number of daily walking or bicycling trips.
- South central Toronto had low diabetes rates and a relatively high number of daily walking or bicycling trips.

Exhibit 5.22 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and average number of daily public transit trips per person [2001] (high or low), by neighbourhood of residence, in Toronto



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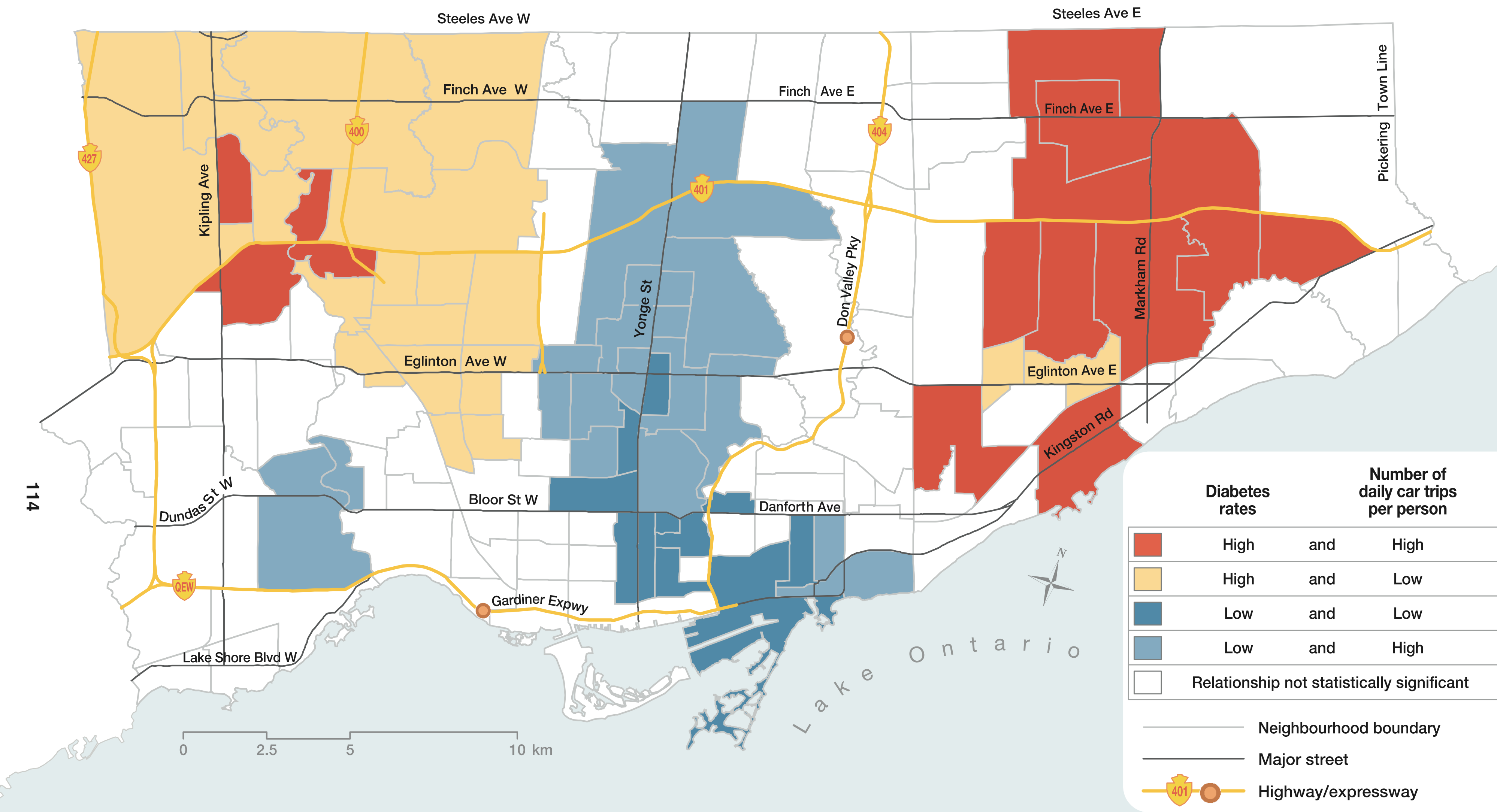
Findings

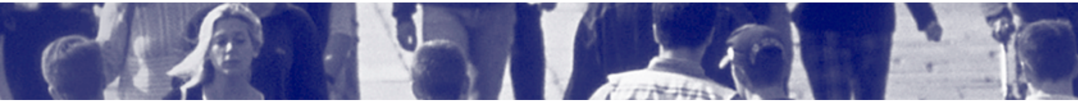
- The pattern for daily public transit trips in 2001 is very similar to that found for walking or bicycling trips (Exhibit 5.21).

Exhibit 5.23 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and average number of daily car trips per person [2001] (high or low), by neighbourhood of residence, in Toronto



Findings

- In 2001, residents living in a large area in the east of Toronto with high diabetes rates had a high daily number of car trips, while those from a large area in the northwest with high diabetes rates had a relatively low number of daily car trips.
- Central Toronto had low diabetes rates despite having a relatively high number of car trips, while some parts of downtown had low diabetes rates and a relatively low number of daily car trips.



Discussion

The findings presented in this chapter are consistent with emerging evidence that links the physical characteristics of neighbourhoods to the propensity for daily activity among residents. The amount of daily physical activity is, in turn, linked to obesity and its health consequences, such as diabetes. Neighbourhood characteristics can serve to increase these risks (e.g., when car travel is the only accessible method of transportation), or can contribute to reducing health risks (e.g., when walking, bicycling and public transit are convenient and practical).

The spatial patterns found in Toronto neighbourhoods were strong and consistent. Downtown and south central Toronto are older areas featuring high road network density and highly mixed land use. The road network was dense in these neighbourhoods, bicycle lanes were more common, and the public transit network was both dense and frequently served. In keeping with these physical characteristics, daily walking, bicycling and public transit use were much higher in downtown and south central Toronto than elsewhere in the city, and the number of car trips was much lower. The number of daily car trips was highest among residents living in the more affluent areas of central and southwest Toronto, as well as among those from the lower-income eastern part of the city.

High diabetes rates predominated in the northwest and east ends of the city—areas with lower socioeconomic status and higher numbers of visible minority* residents (Chapters 3 and 4). Compared with the downtown, these neighbourhoods had newer housing, a less dense road network, and longer walks to public transit routes with less frequent service. Consistent with these characteristics, these areas had relatively low levels of daily walking, bicycling and transit use.

The maps in this chapter show high diabetes prevalence rates in neighbourhoods with newer housing and lower numbers of daily walking, bicycling and transit trips per person. Diabetes clusters were visible in areas with a high number of daily car trips in the east but not in the northwest areas of the city (where the number of car trips was lower). Central Toronto appeared to be an anomaly, with low diabetes rates despite low rates of daily walking, bicycling and transit trips and a high number of daily car trips. It is a highly affluent area where our analyses may not have captured physical activities such as gym workouts, gardening, golfing, skiing or cottage activities.

*The proportion of visible minorities living in each neighbourhood was derived from the 2001 Census of Canada, which uses the following definition based on the Employment Equity Act: visible minorities are "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour."

While many of the neighbourhood characteristics examined in this chapter (e.g., age of housing construction) might be viewed as fixed, most are modifiable over time. Numerous high-rise condominiums are currently being built throughout the city. This is occurring in neighbourhoods identified as having high rates of diabetes. When enough newer high-rise construction takes place, population density increases, resulting in a need for more convenient and frequent public transit routes. Zoning bylaws and construction approval processes are modifiable, as are incentives, so that higher-density developments can be directed to specific areas.

Public transit routes and schedules can also change over time. There are current proposals for dedicated routes and lanes for public transit throughout Toronto. Targeting some of these routes to higher-diabetes prevalence areas could enhance transit use and increase levels of physical activity in those areas.

Toronto's network of bicycle pathways, lanes and roadways are interconnected only along major river systems and along the shore of Lake Ontario. Most other bicycling routes are short, disconnected and unsuitable for commuting or longer trips. There are virtually no north-south bicycle routes that connect residential areas with the downtown core and few east-west routes connecting residential areas with one another.

Building additional, accessible bicycle pathways, lanes and roadways in high-diabetes prevalence areas could increase residents' access to services, recreation and commuting options. These changes have the potential to enhance levels of physical activity in these areas and thereby improve residents' health.

Conclusions and Next Steps

Toronto has an older, dense downtown area that features good access to public transit, high levels of daily physical activity among residents and low diabetes rates. It also has newer, less dense areas in the northwest and east with relatively poorer transit access, much lower levels of daily physical activity and high diabetes rates.

The chain of disease causation may follow from neighbourhood physical characteristics (e.g., poor access to transit), to lower levels of physical activity, to the development of obesity, and finally to outcomes such as diabetes. While this pathway is plausible and perhaps likely, obesity and diabetes have multiple and complex causes which combine genetic predisposition with a much broader array of environmental factors than can be considered here.

There are some limitations to our study. For example, we realize that cross-sectional analyses undertaken at a single point in time cannot be used to prove causation. Nor can we rely solely on ecological analyses such as this one which examined neigbourhoods rather than individuals. Finally, experimental evidence is lacking to demonstrate that health can be improved by modifying neighbourhood physical characteristics.

However, despite these limitations, the spatial associations examined in this chapter are strong, consistent and fit with a growing body of research that points to neighbourhood physical characteristics as important causes of obesity and its consequences, including diabetes.

Many neighbourhood characteristics have not been examined in this chapter, even though they might be linked with diabetes. For example, dense neighbourhoods that are well served by transit could be unsafe for walking, or there may be fewer services that would stimulate residents to walk as a daily activity. Access to parks, school yards and recreation centres may be important determinants of physical activity. Access to sources of healthy and unhealthy foods and also to health care services are some additional relevant neighbourhood characteristics. A group of neighbourhood characteristics thought to be associated with daily activity are considered in Chapter 6 of this Atlas, and access to healthy resources is examined in Chapters 7 through 12.

Appendix 5.A—How the Research was Done

Data sources

Details about land use in Toronto were obtained from City of Toronto Land Information Services. Neighbourhoods were categorized as: residential; park or recreational area; industrial, commercial or utilities area; or "other"' (agricultural, church/cemetery, multi-functional, parking or vacant). Year of dwelling construction was obtained from the 2001 Census of Canada and was categorized as *before 1946, 1946–1970* or *1971–2001.* These eras follow the patterns of housing construction that have been shown to be important in other studies.[8]

Data from Land Information Toronto and the Toronto Transit Commission were used to provide details on Toronto's road and transit networks, respectively. Data regarding trips made by car, transit, walking or bicycling, and the average number of daily trips per person, were obtained from the Transportation Tomorrow Survey (TTS). The TTS was conducted in 2001 by Greater Toronto Area (GTA) municipalities and public transit organizations. Data on average annual household income were obtained from the 2001 Canadian census. Information about public transit routes was obtained from the Toronto Transit Commission,[9] and information about bicycling routes came from the City of Toronto.[10]

Age-and sex-adjusted diabetes rates were calculated using the Ontario Diabetes Database and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES).

Analysis

Land uses were combined into major groups, as shown in Exhibit 5.1. Period of construction was calculated based on the majority of dwellings within a neighbourhood being built during a certain period. Older areas of downtown Toronto were largely rebuilt post-war. In order for those areas to qualify as being built before 1946, a criterion was imposed whereby 10 percent or more of occupied private dwellings had to have been constructed before 1946. Daily trips by different modes of transportation were calculated based on the number of trips made per person, by each mode of travel.

The pair-wise spatial relationships between year of housing construction, household income, trips made by different modes of transportation, and diabetes rates were evaluated using *Local Indicator of Spatial Association (LISA)* maps.

More detailed information about data sources, rate calculations and analyses is available in "Appendix B: Technical Notes" at the end of this Atlas.

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INSIDE

6
Chapter

Neighbourhood Infrastructure and Health

Gillian L. Booth, MD, MSc, Maria I. Creatore, MSc, PhD (candidate), Peter Gozdyra, MA, Kelly Ross, BSc, MSA, Jonathan Weyman, BSc (candidate), and Richard H. Glazier, MD, MPH

Executive Summary

Issue

Physical activity is an essential part of lifestyle programs aimed at preventing or controlling type 2 diabetes. Community design can either promote or discourage local residents from walking or using a bicycle for transportation, or from participating in other types of activities. This chapter explores the relationship between environmental factors thought to influence physical activity and levels of walking or bicycling, and diabetes within City of Toronto neighbourhoods.

Study

An Activity-Friendly Index (AFI) was created for each City of Toronto neighbourhood using the following variables: population density (derived from the 2001 Census of Canada); density of and access to retail services (using data from the City of Toronto's 2004 Employment Survey); car ownership rates (based on the 2001 Transportation Tomorrow Survey); and rates of drug-related and violent crime (from the 2001 Toronto Police Services Statistical Report). Age- and sex-standardized diabetes prevalence rates were derived from the Ontario Diabetes Database. Maps depicting each of these variables were generated, as well as bivariate *Local Indicator of Spatial Association (LISA)* maps that illustrated the spatial clustering of diabetes rates, along with neighbourhood AFI values and individual subcomponents of the AFI. We also looked at the relationship between neighbourhood AFI and how often residents walked and/or bicycled each day.

Key Findings

- Older neighbourhoods within and around downtown (south central) Toronto had a high population density, mixed residential and commercial land use, and lower rates of car ownership compared to more outlying areas.
- Neighbourhoods in the outlying areas of the city had a relatively low population density, less access to retail services, and higher rates of car ownership compared to more central areas.
- People living in neighbourhoods that were more activity-friendly reported more walking or bicycling trips per day. Activity-friendliness was associated with lower diabetes rates, especially in high-risk areas characterized by lower income levels and higher proportions of visible minority residents.
- High-income areas appeared to be protected against diabetes, even in parts of the city that were not activity-friendly.

Implications

- **The "activity-friendliness" of a neighbourhood may be modifiable through a variety of means, such as changes in planning, development and zoning practices that reduce urban sprawl, increase residential density and promote mixed land use.**
- **The creation of neighbourhood environments that encourage walking and other physical activities and decrease dependency on cars for travel may help to offset the rise in obesity and in turn, decrease rates of diabetes.**

Introduction

Physical activity is a key component of lifestyle interventions that have been shown to delay or prevent the onset of type 2 diabetes.[1,2] Moderate-intensity activities such as brisk walking have been associated with significant health benefits, including lower rates of cardiovascular disease and overall mortality.[3-5] However, finding opportunities to incorporate physical activity into a daily routine may be difficult. Studies suggest that the amount of time North Americans spend in sedentary activities, such as television viewing or sitting in a car, is increasing, while levels of physical activity during work hours are decreasing.[6,7]

How a community is designed may influence certain lifestyle choices among local residents. As shown in Chapter 5, residents living in older areas of Toronto (e.g., the south central portion of the city) reported higher rates of walking, bicycling and taking public transit as a means of travel compared to people who lived in newer, more outlying areas of the city. They were also less likely to report using cars for transportation.

There is evidence that older neighbourhoods tend to be more densely populated, to have smaller block sizes, more street connections and sidewalks, and to provide easier access to local amenities. These features are all recognized as making a neighbourhood more "walkable."[8-11]

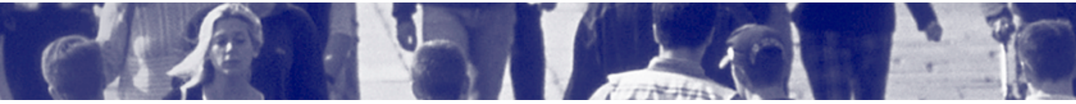
However, trends in zoning and urban development over the past 30 years have created residential communities that are less conducive to walking and other physical activities. Modern suburbs often lack sidewalks and have fewer connections between streets. Instead, streets often end in cul-de-sacs, thus increasing the distance residents must travel to access neighbourhood resources. Moreover, newer housing developments are typically zoned for residential purposes only, further increasing residents' dependency on automobiles in order to access local stores and other services.

Land use greatly influences the method people choose for travelling from one place to another.[12] For example, the coexistence of commercial and residential areas in the same neighbourhood gives local residents easier access to services and amenities. American and Australian data suggest that residents are more likely to walk to a store if it can be reached within five to 10 minutes.[13,14] Another study by Frank et al., found an inverse relationship between the degree of land use mix in certain neighbourhoods in the United States and the level of obesity among local residents.[15] Furthermore, individuals who spent more minutes per day traveling in a car had a greater likelihood of being obese.

This chapter focuses on selected environmental factors that are thought to promote or discourage walking and other activities at the neighbourhood level. These factors include: population density, the availability of and access to retail services, the level of car ownership, and local crime rates.

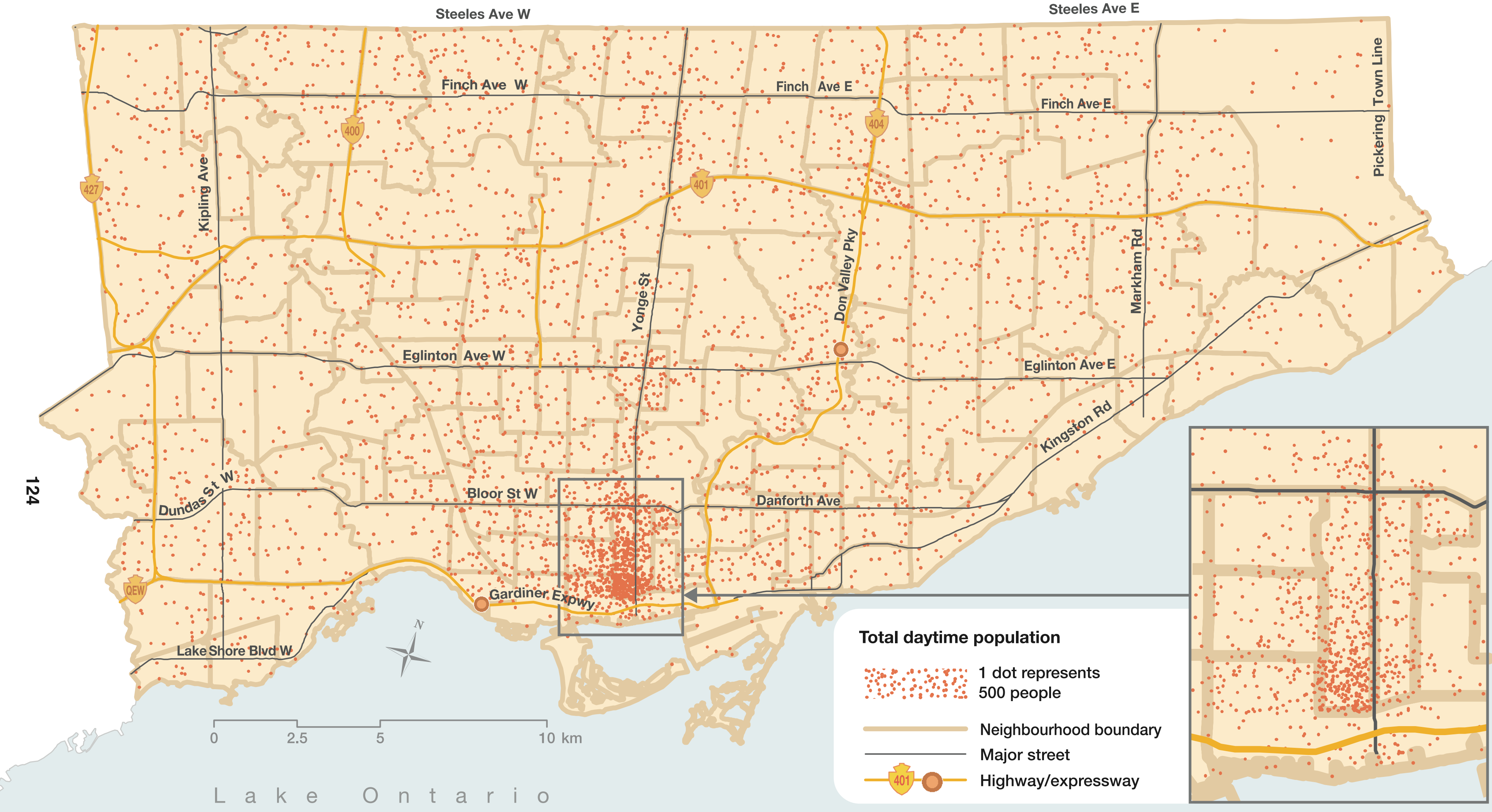
Based on these factors, we developed an Activity-Friendly Index (AFI) for Toronto. We then used this tool to examine the relationship between neighbourhood infrastructure and patterns of daily walking, bicycling and transit use, and also between residents' activity levels and the prevalence of diabetes within specific neighbourhoods.

Chapter 6—List of Exhibits



Exhibits and Findings

Exhibit 6.1 Daytime population, in Toronto, 2001



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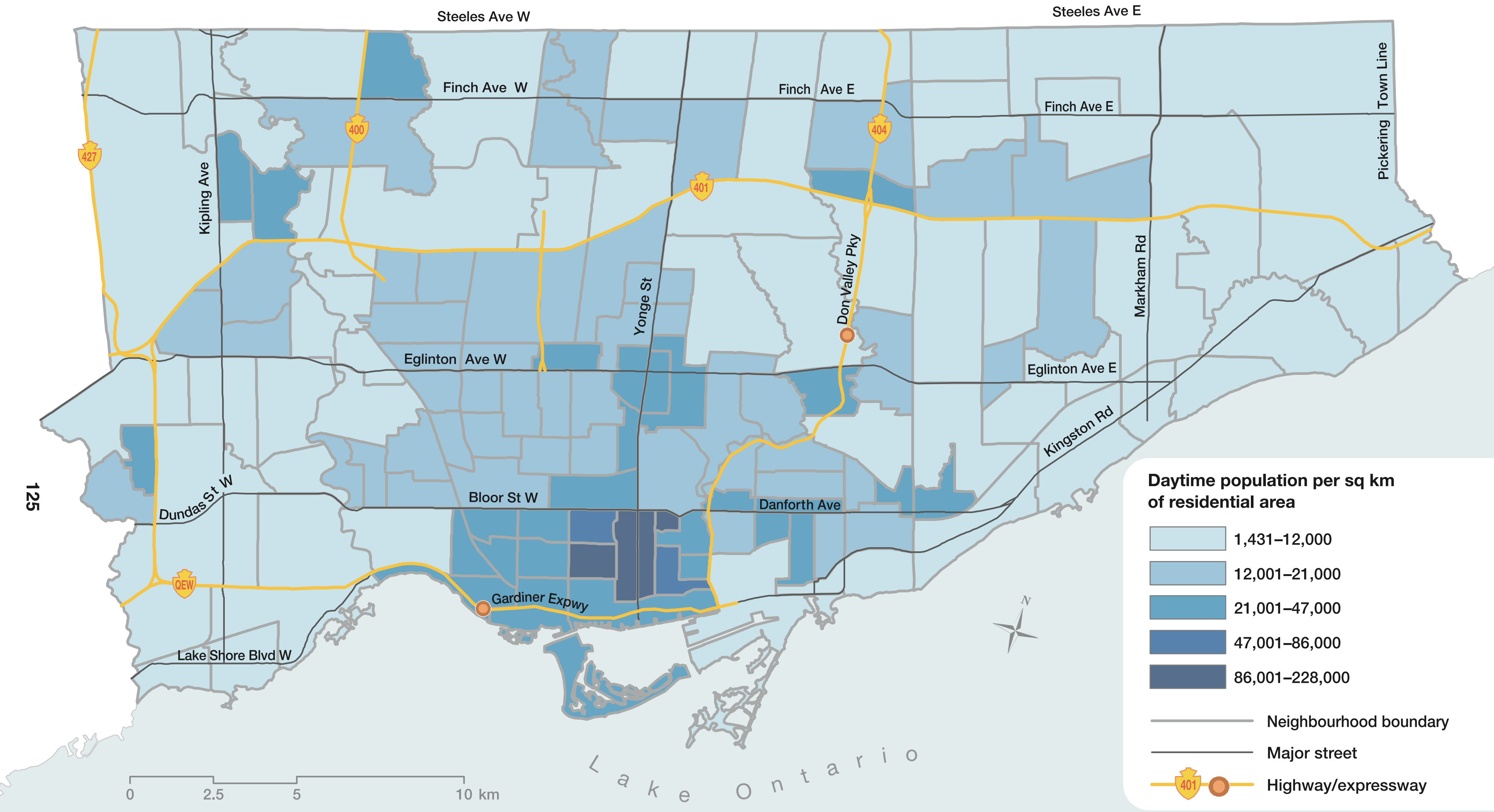
Findings

- In 2001, Toronto's daytime population was greatest in the downtown (south central) core of the city (see also Exhibit 6.2).

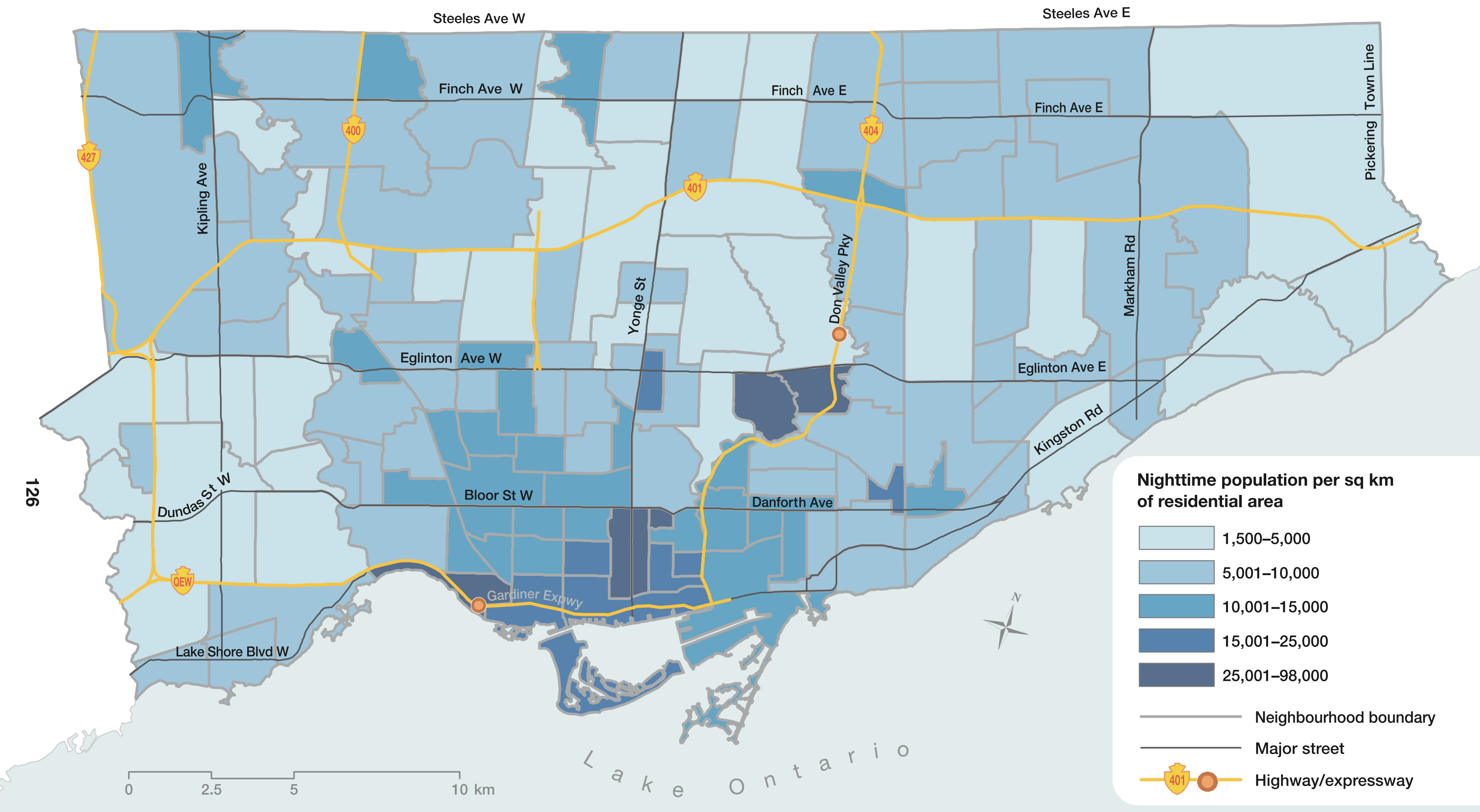
Exhibit 6.2 **Daytime population per square kilometre (sq km), by neighbourhood, in Toronto, 2001**



Findings

- In 2001, daytime population densities were highest in Toronto's downtown core and surrounding communities with additional areas of increased density in the central and western portions of the city (see also Exhibit 6.1).
- Large sections of the outlying areas of the city had relatively low levels of daytime population density.

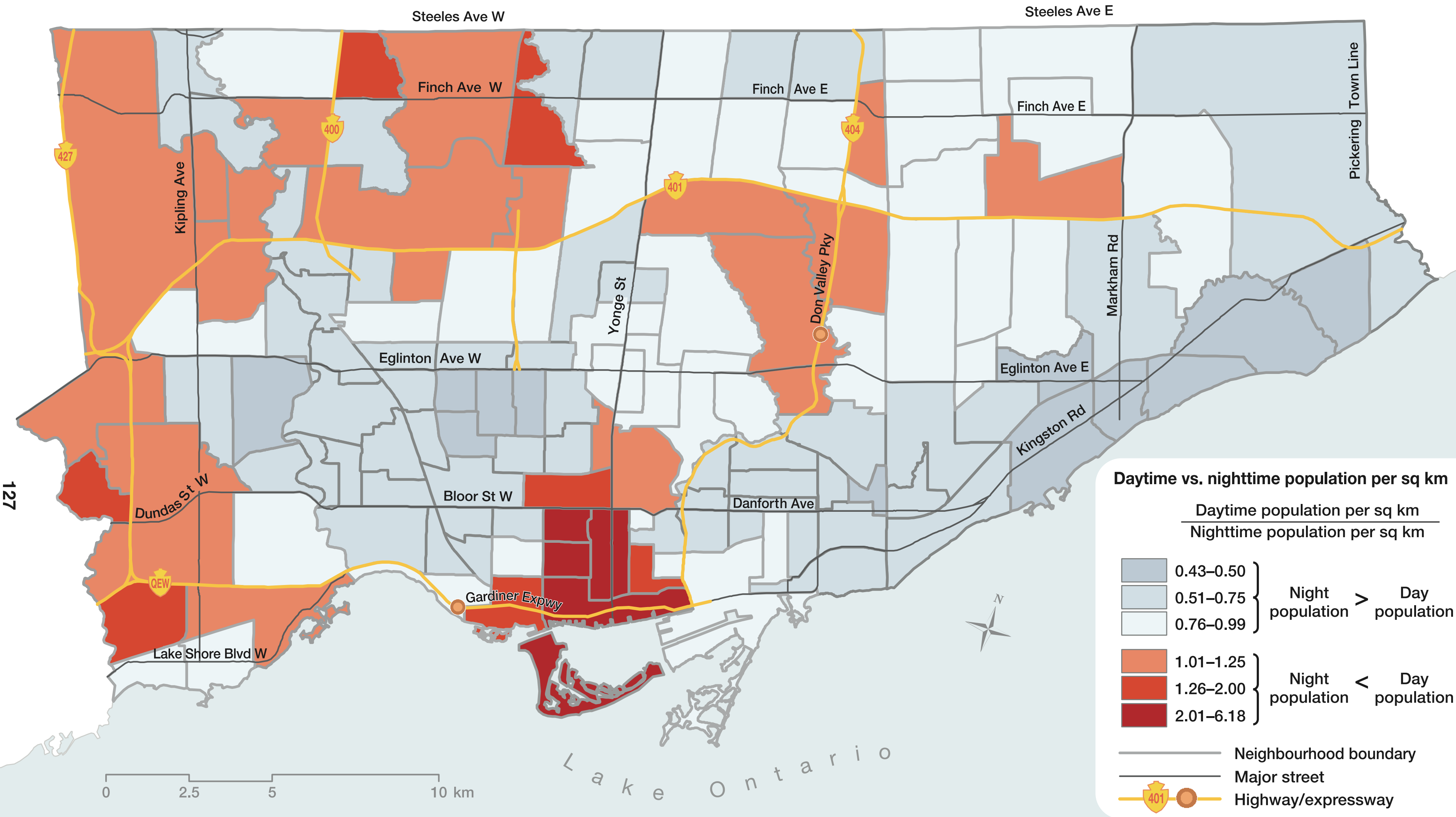
Exhibit 6.3 Nighttime population per square kilometre (sq km) of residential area, by neighbourhood, in Toronto, 2001



Findings

- In 2001, nighttime population density in Toronto followed a similar pattern to the daytime distribution shown in Exhibits 6.1 and 6.2.
- The nighttime population density in Toronto differed by as much as 65-fold between the highest density areas (located in south central Toronto) and the lowest density areas (located in the west, central north and east ends of the city).

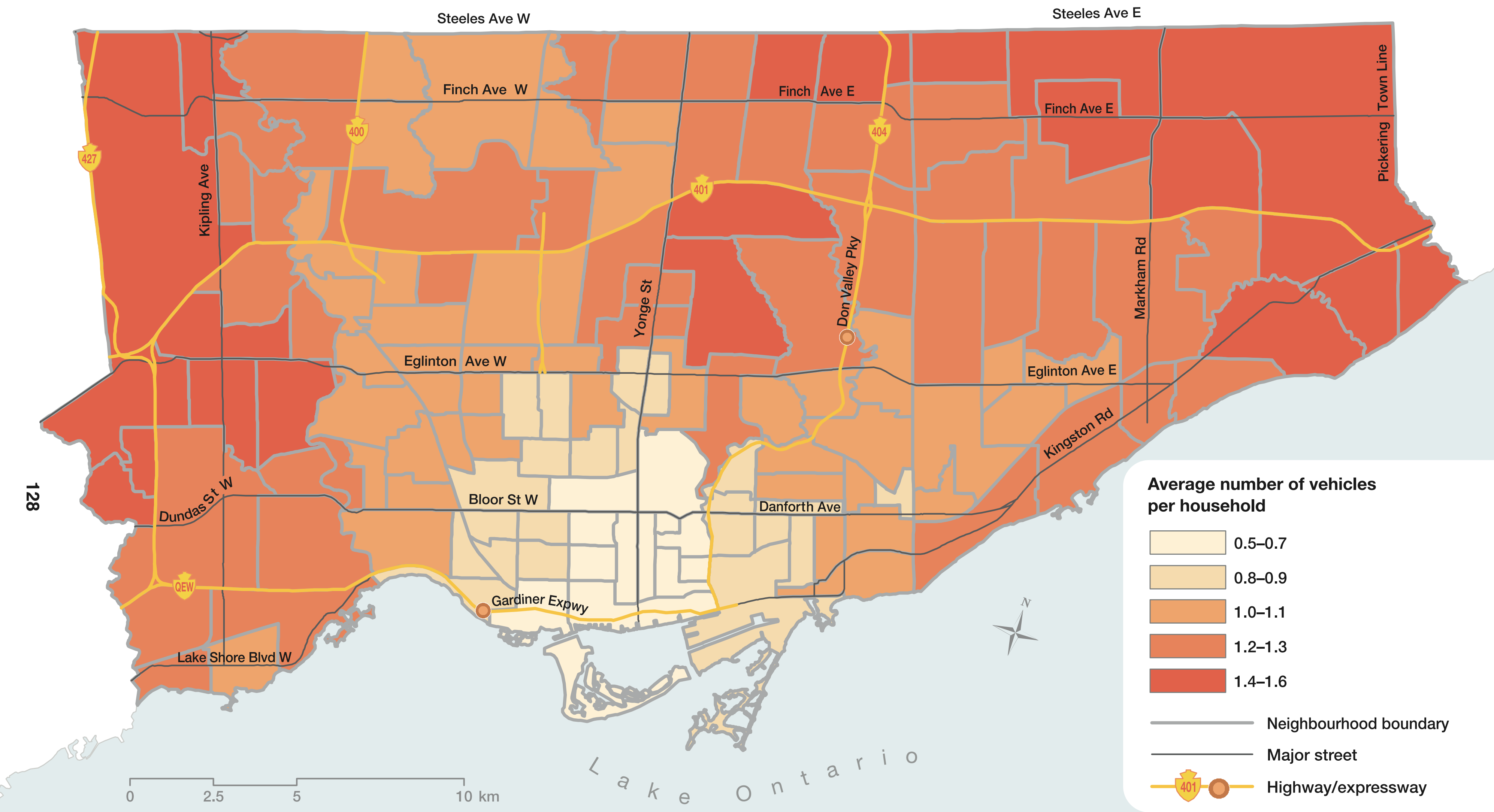
Exhibit 6.4 Daytime versus nighttime population per square kilometre (sq km), by neighbourhood, in Toronto, 2001



Findings

- In 2001, downtown (south central) Toronto and, to a lesser extent, small areas in the southwest and northwest, were the main destinations for the daily influx of people coming from outlying areas. A larger percentage of individuals living in the central west and eastern portions of the city travelled outside their neighbourhoods of residence during daytime hours.

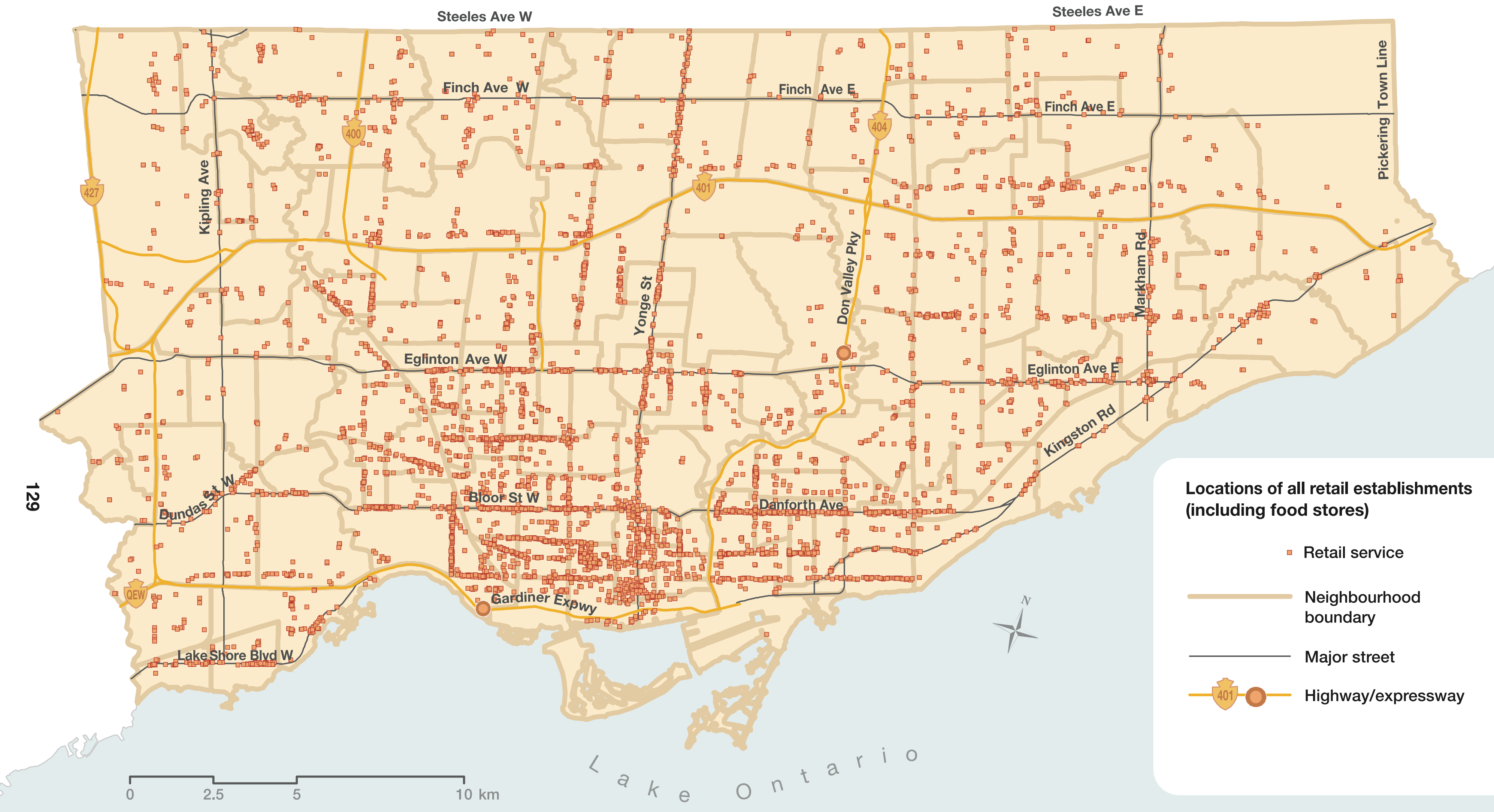
Exhibit 6.5 Average number of vehicles per household, by neighbourhood, in Toronto, 2001



Findings

- In 2001, people living in Toronto's downtown core and its surrounding areas were less likely to own cars.
- Car ownership rates were highest among residents in the outer regions of the city, particularly in the northwest and northeast, and also among those living in centrally-located, wealthier neighbourhoods.

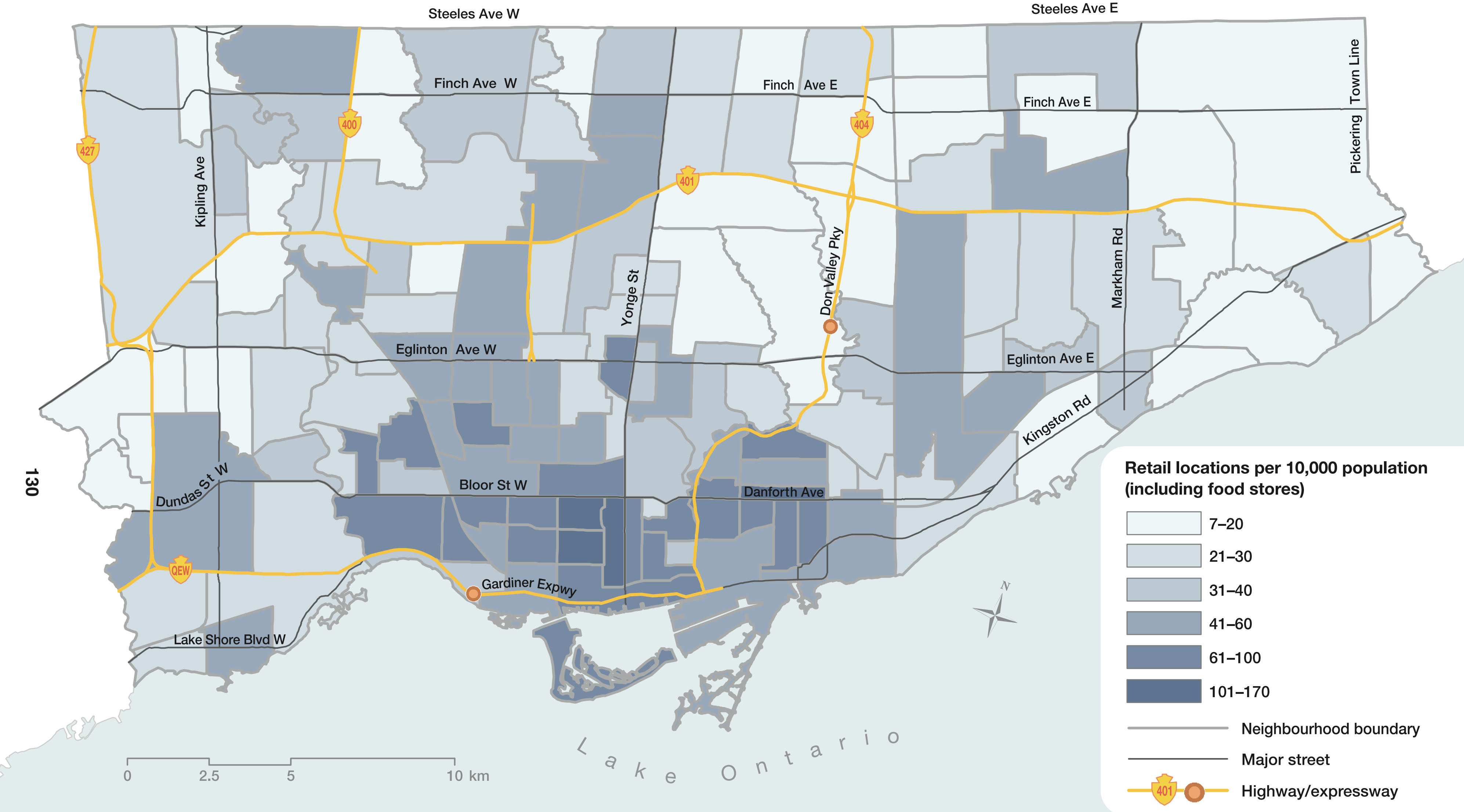
Exhibit 6.6 Locations of retail establishments, in Toronto, 2004



Findings

- In 2004, retail services (including food stores) were most highly concentrated in the downtown and southern portions of Toronto.

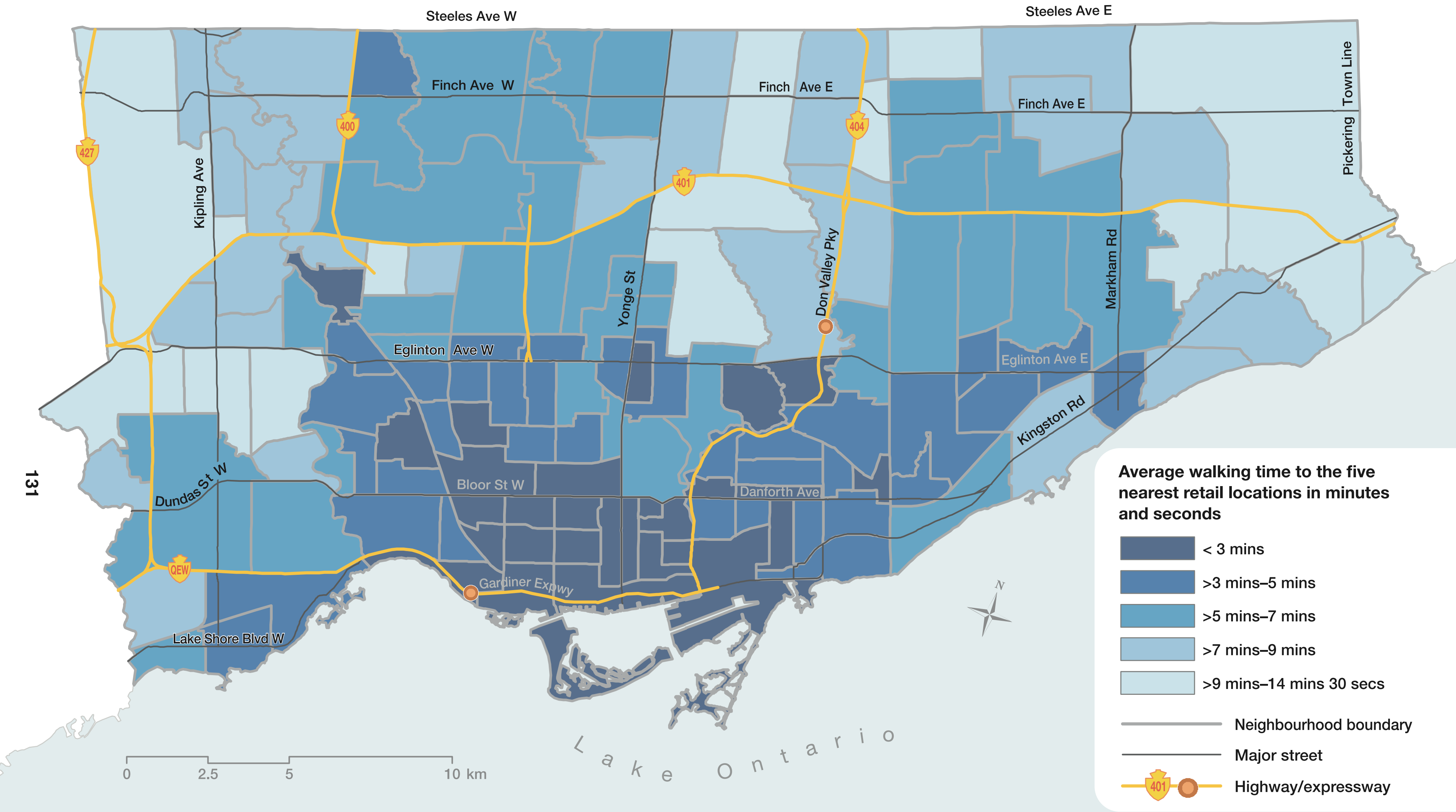
Exhibit 6.7 Total number of retail locations per 10,000 population [2001], by neighbourhood, in Toronto, 2004



Findings

- In 2004, the concentration of retail services (including food stores) varied by as much as 23-fold among different areas. The greatest service density was in the south central portion of the city; the lowest service density was in the north central, northwest and eastern areas.

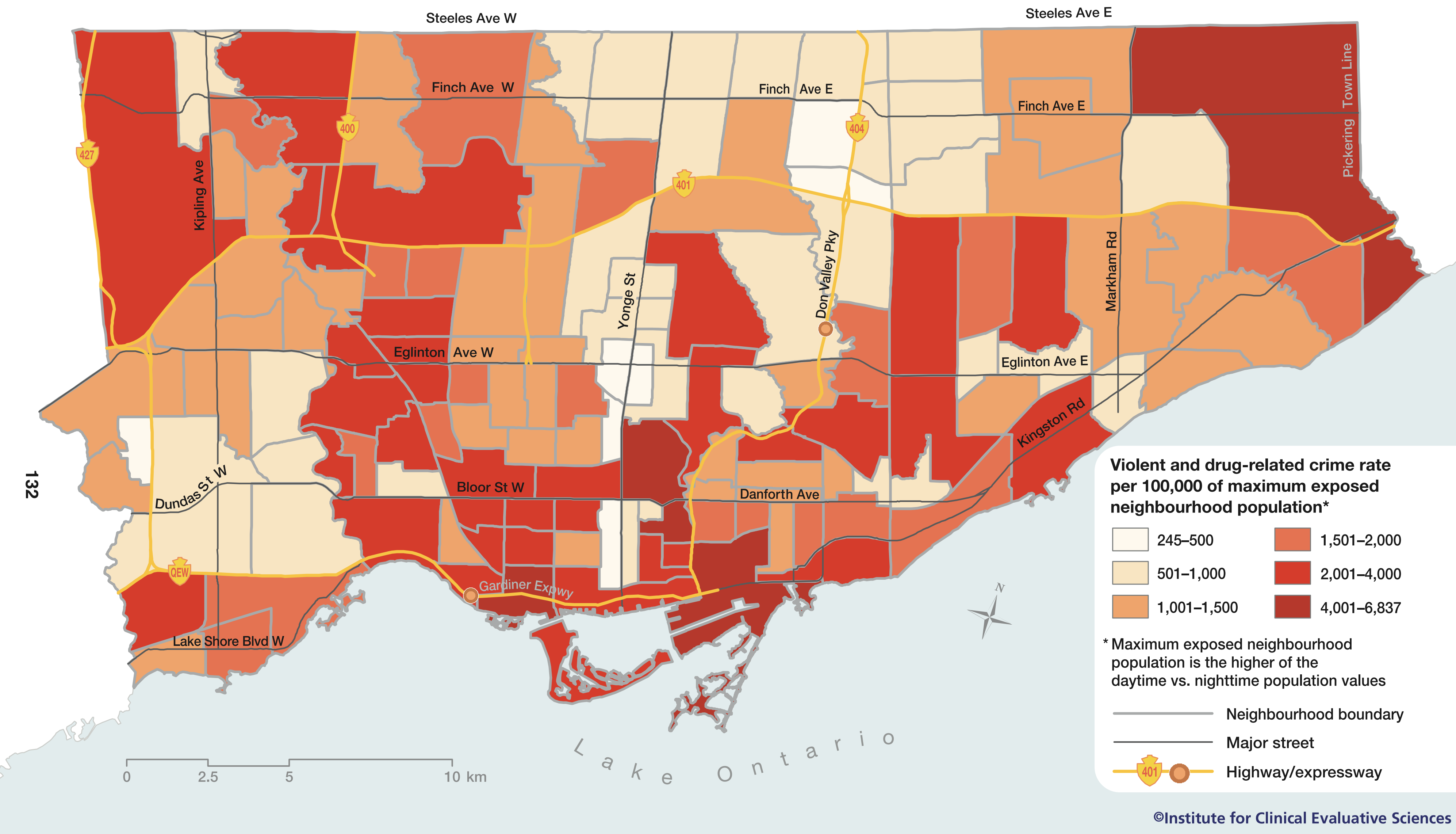
Exhibit 6.8 Average walking time to the five nearest retail locations, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- In 2001, access to retail services by walking was best in the south central portion of Toronto and poorest in neighbourhoods in the north central, northwest and eastern portions of the city.
- However, retail services were available within a 15-minute walk for residents in all areas of the city, including those living in neighbourhoods with the poorest access to such services.

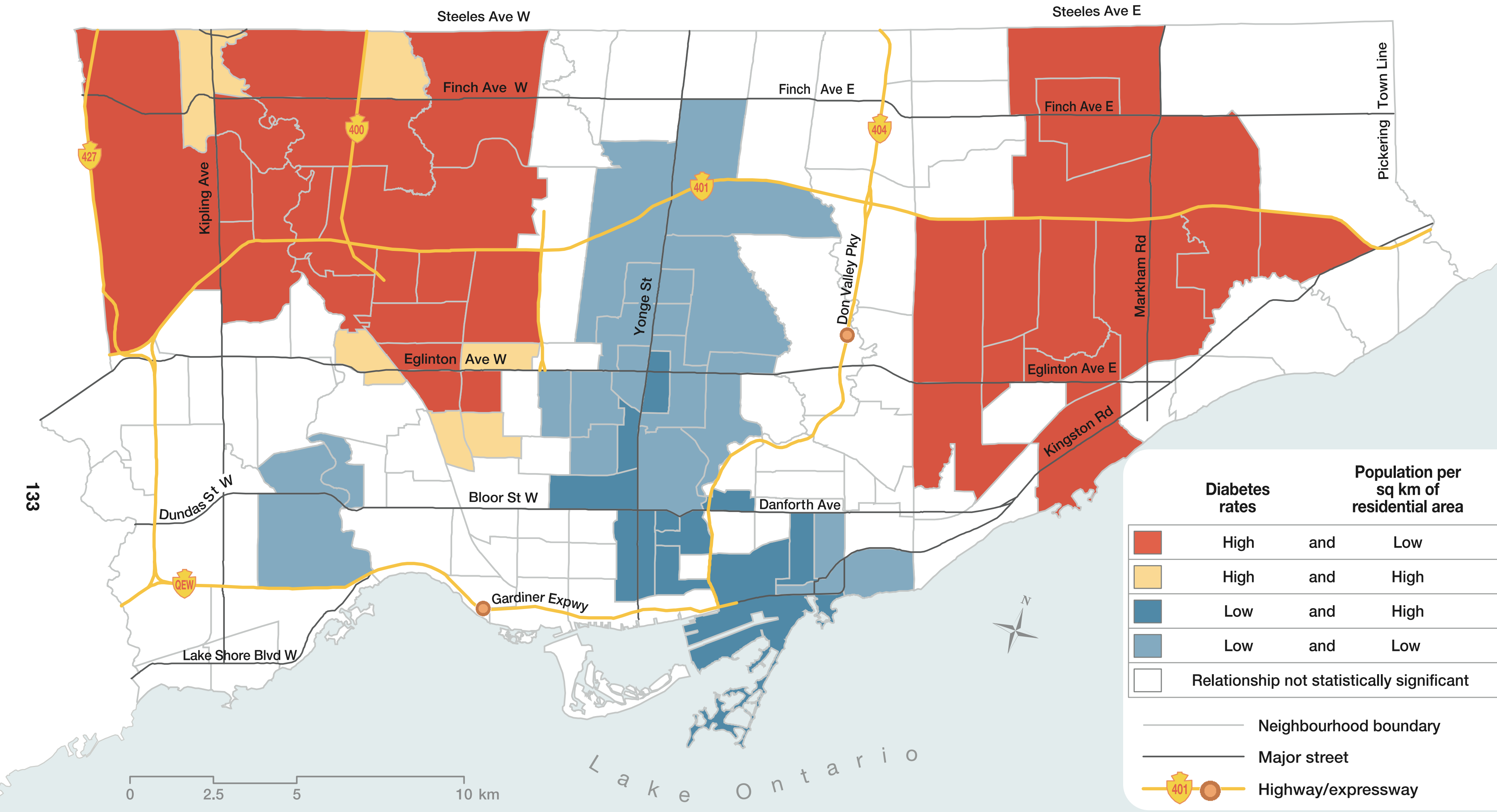
Exhibit 6.9 Violent and drug-related crime rate per 100,000 maximum exposed population, by neighbourhood, in Toronto, 2001



Findings

- Neighbourhoods with the highest rates of violent and drug-related crime in 2001 were located in the downtown (south central) part of Toronto and in the east end of Toronto.
- Several other neighbourhoods with higher crime rates were located in the northwest and central areas of the city.

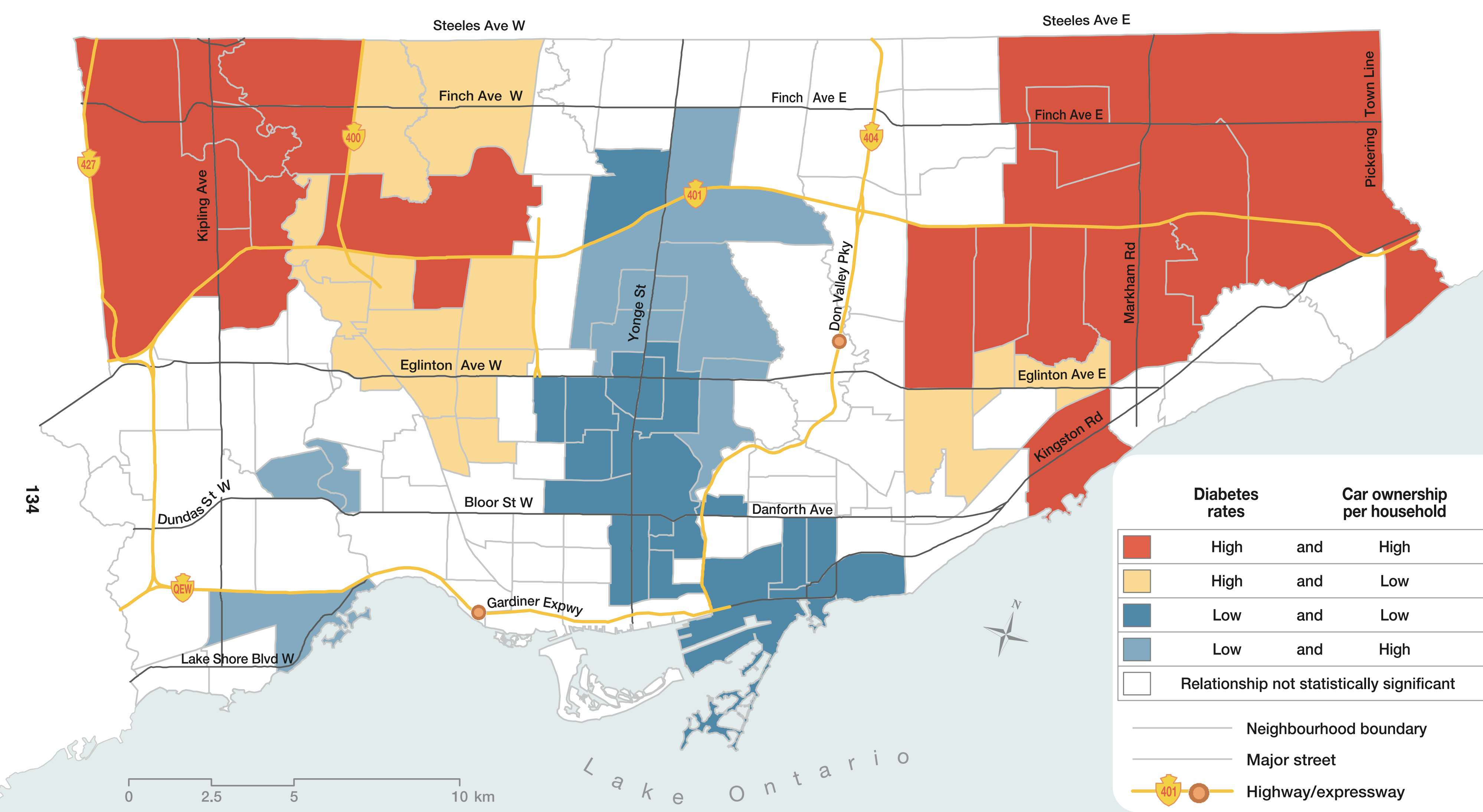
Exhibit 6.10 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and population per square kilometre (sq km) of residential area [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, areas in the northwest and eastern parts of Toronto had both lower population density and high rates of diabetes among local residents.
- In contrast, the downtown core and some surrounding areas of south central Toronto had both high population density and low diabetes rates.

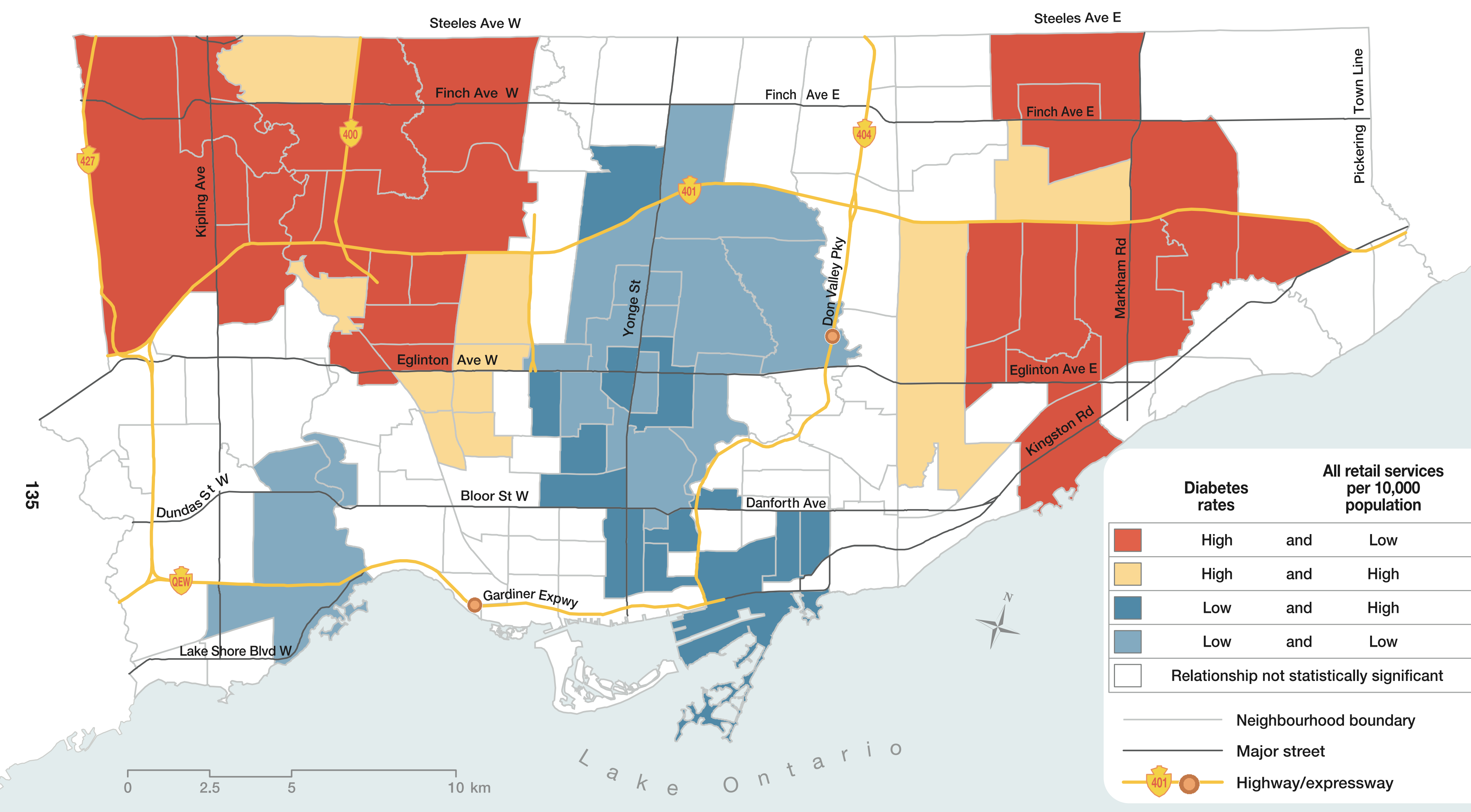
Exhibit 6.11 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and car ownership per household [2001] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, areas in the northwest and eastern parts of Toronto had both high rates of car ownership and high rates of diabetes among local residents.
- Portions of south central and central Toronto had both low rates of car ownership and low diabetes rates.

Exhibit 6.12 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and the total number of retail services per 10,000 population [2004] (high or low), by neighbourhood, in Toronto



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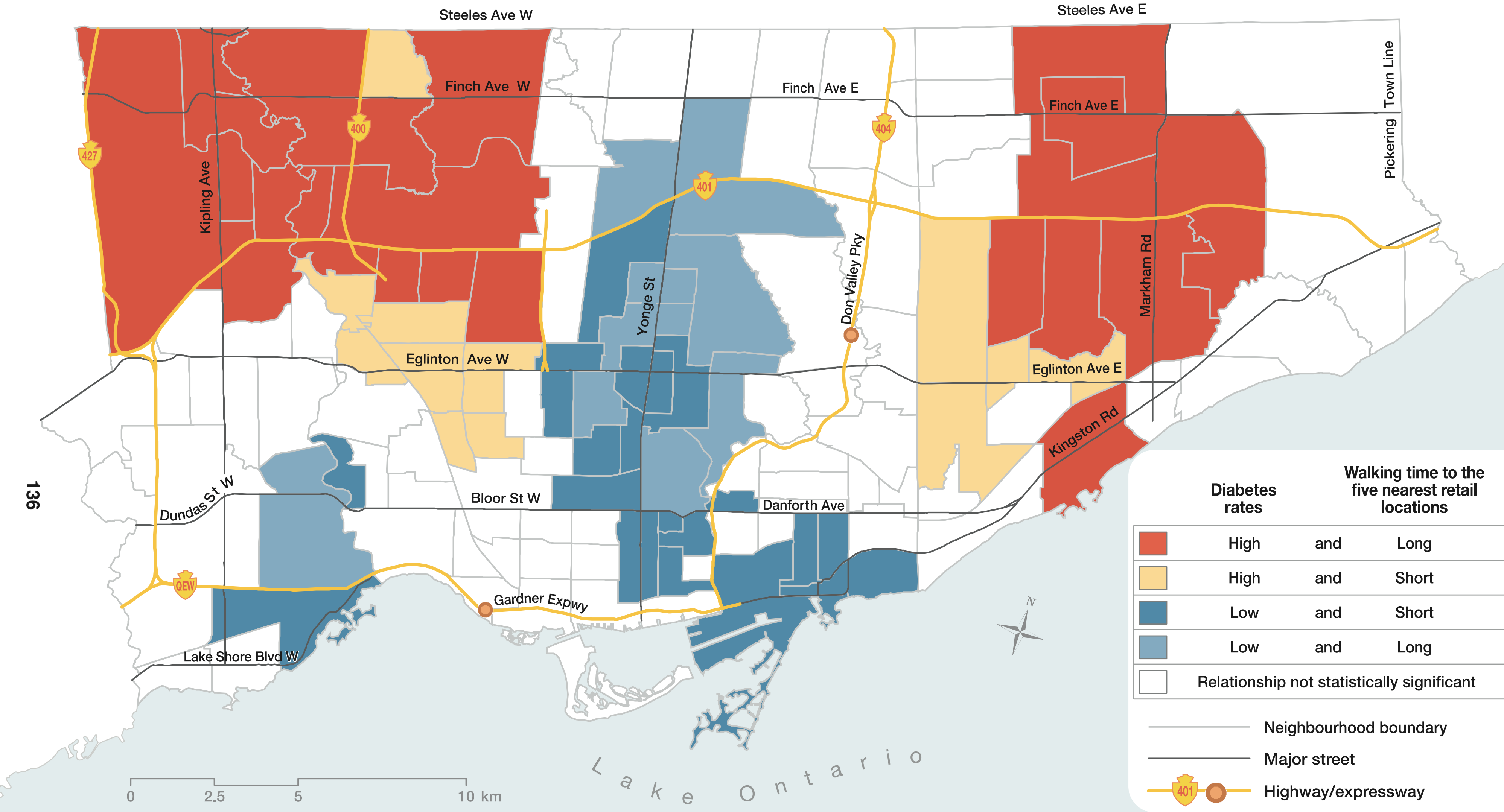
Findings

- In 2001, areas in the northwest and eastern parts of Toronto had both a low density of retail services and high rates of diabetes among local residents.
- An opposite pattern (i.e., a high density of retail services/low rates of diabetes) was observed in the downtown core and in several other central areas of the city.

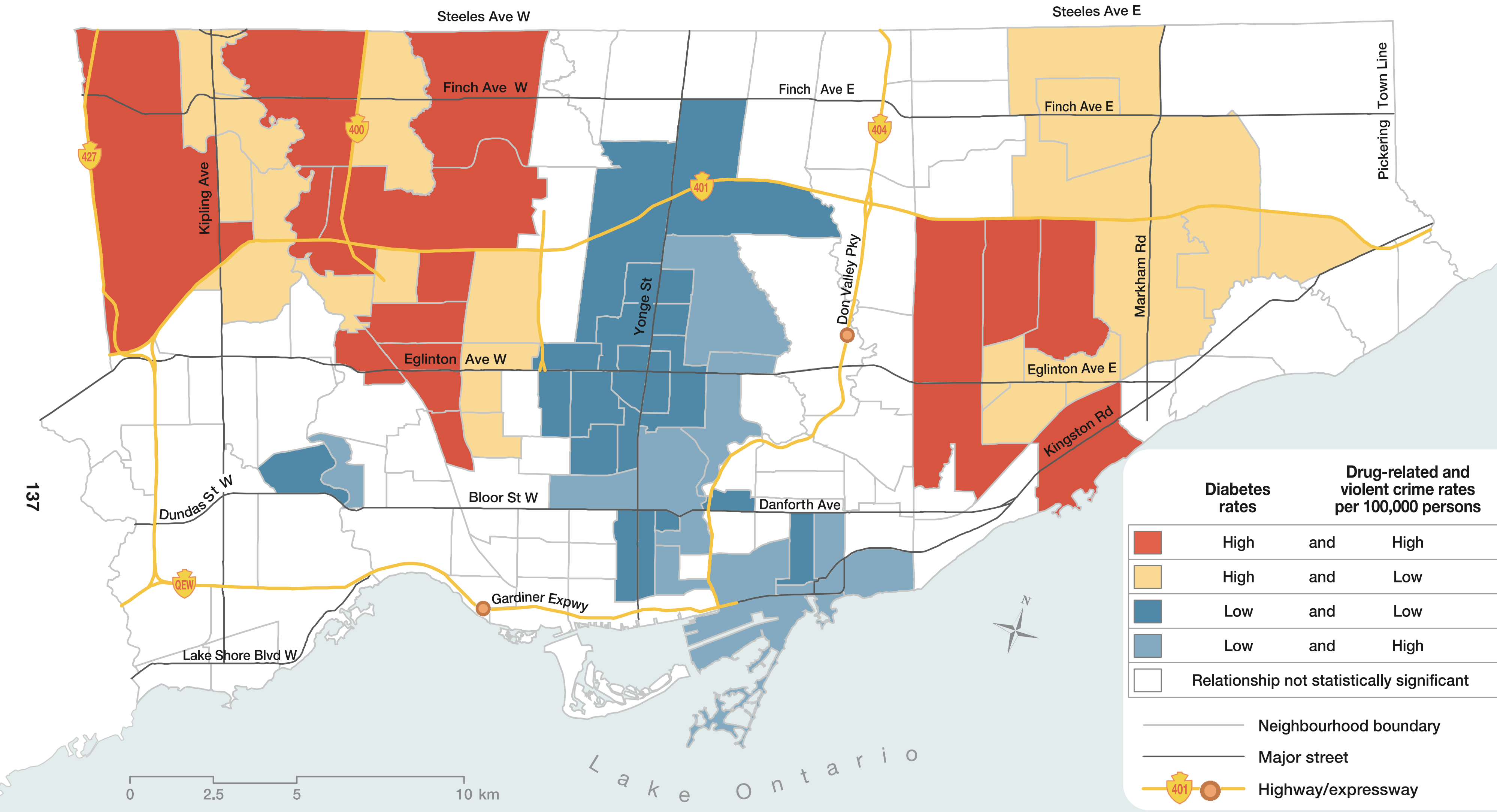
Exhibit 6.13 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and average walking time to the nearest five retail locations [2004] (long or short), by neighbourhood of residence, in Toronto



Findings

- In 2001, the pattern of spatial association between access to retail services and diabetes rates among local residents was similar to that depicted in Exhibit 6.12.
- Areas in the northwest and eastern parts of the city had both longer walking times to retail services and high rates of diabetes; neighbourhoods in the downtown core and some other central areas had both shorter walking times to retail services and low diabetes rates.

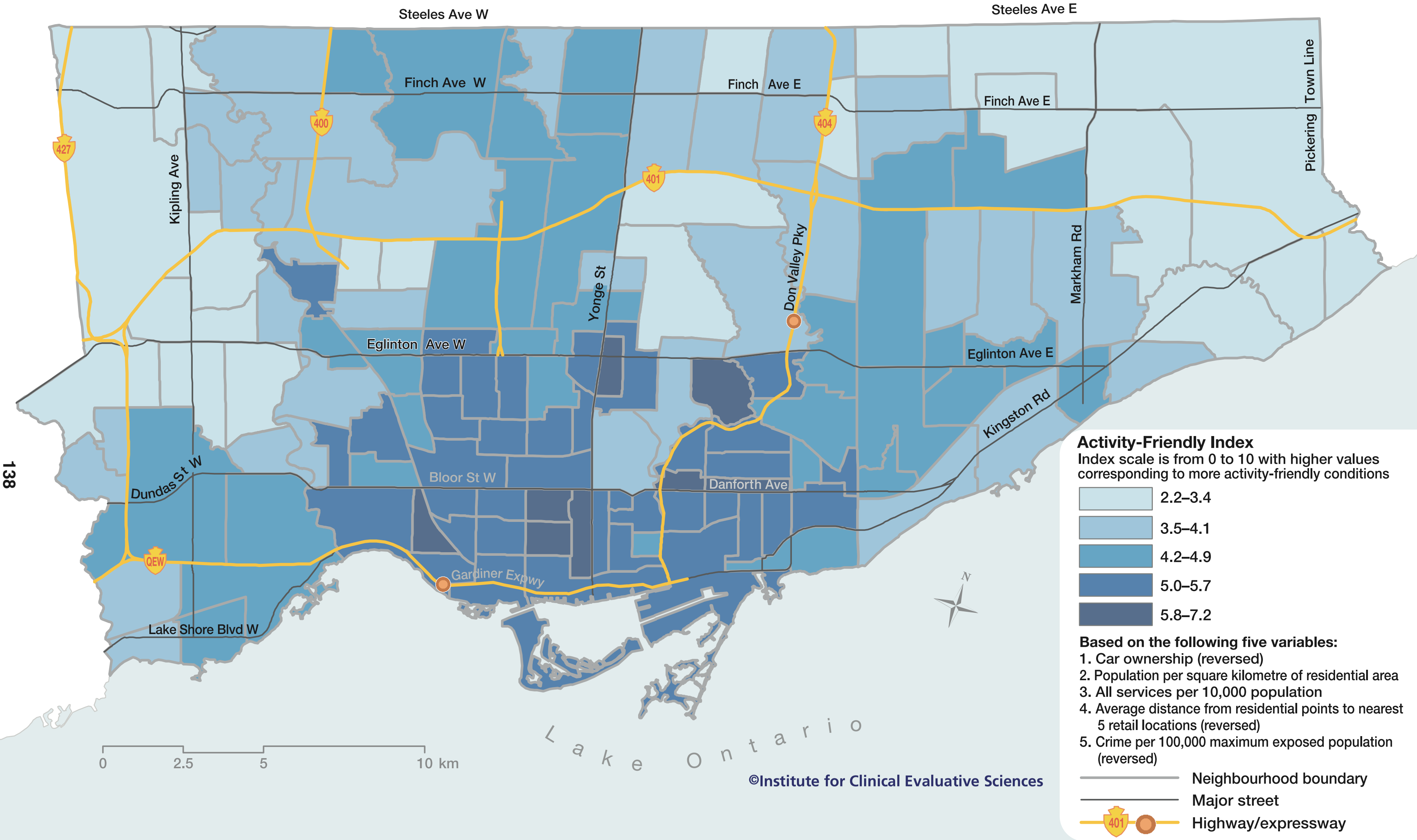
Exhibit 6.14 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and drug-related and violent crime rates per 100,000 population [2001] (high or low), by neighbourhood, in Toronto



Findings

- Some areas in the northwest and eastern parts of Toronto with higher rates of drug-related and violent crime in 2001 also had high rates of diabetes among local residents.
- An opposite pattern was seen in the centre of the city (i.e., lower rates of crime and lower diabetes rates among local residents).

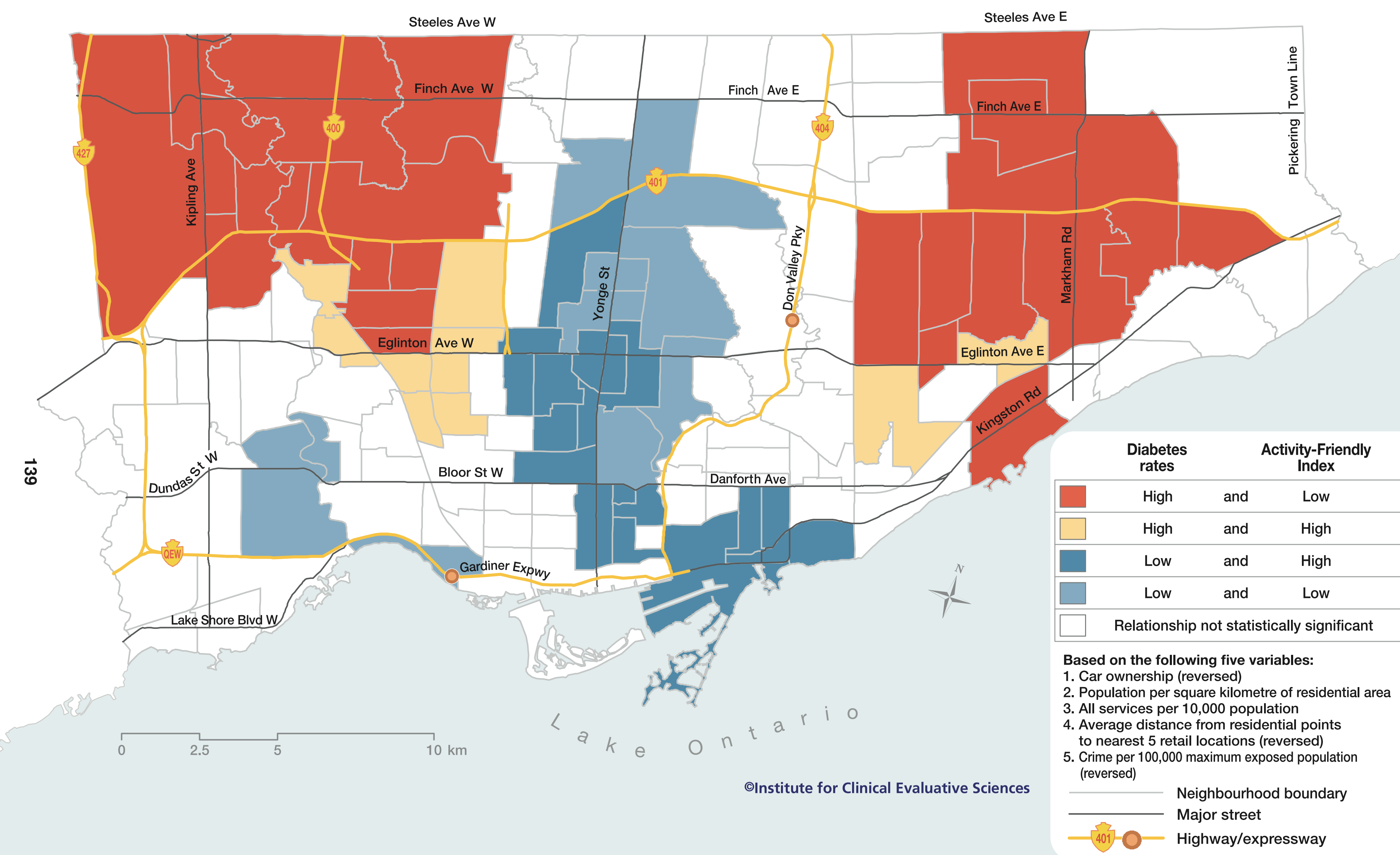
Exhibit 6.15 Activity-Friendly Index (AFI) values, by neighbourhood, in Toronto, 2001–2004



Findings

- In 2001, neighbourhoods within and around downtown (south central) Toronto were the most activity-friendly.
- In general, "activity friendliness" decreased in neighbourhoods that were farther away from downtown Toronto.
- Large areas in the northwest and the east ends of the city were among the least activity-friendly. These same areas were found to be more socioeconomically disadvantaged, to have a higher proportion of visible minority residents, higher levels of recent immigration and higher rates of diabetes (Chapters 2, 3 and 4.) (For a definition of "visible minority," see section 6.A at the end of this chapter.)

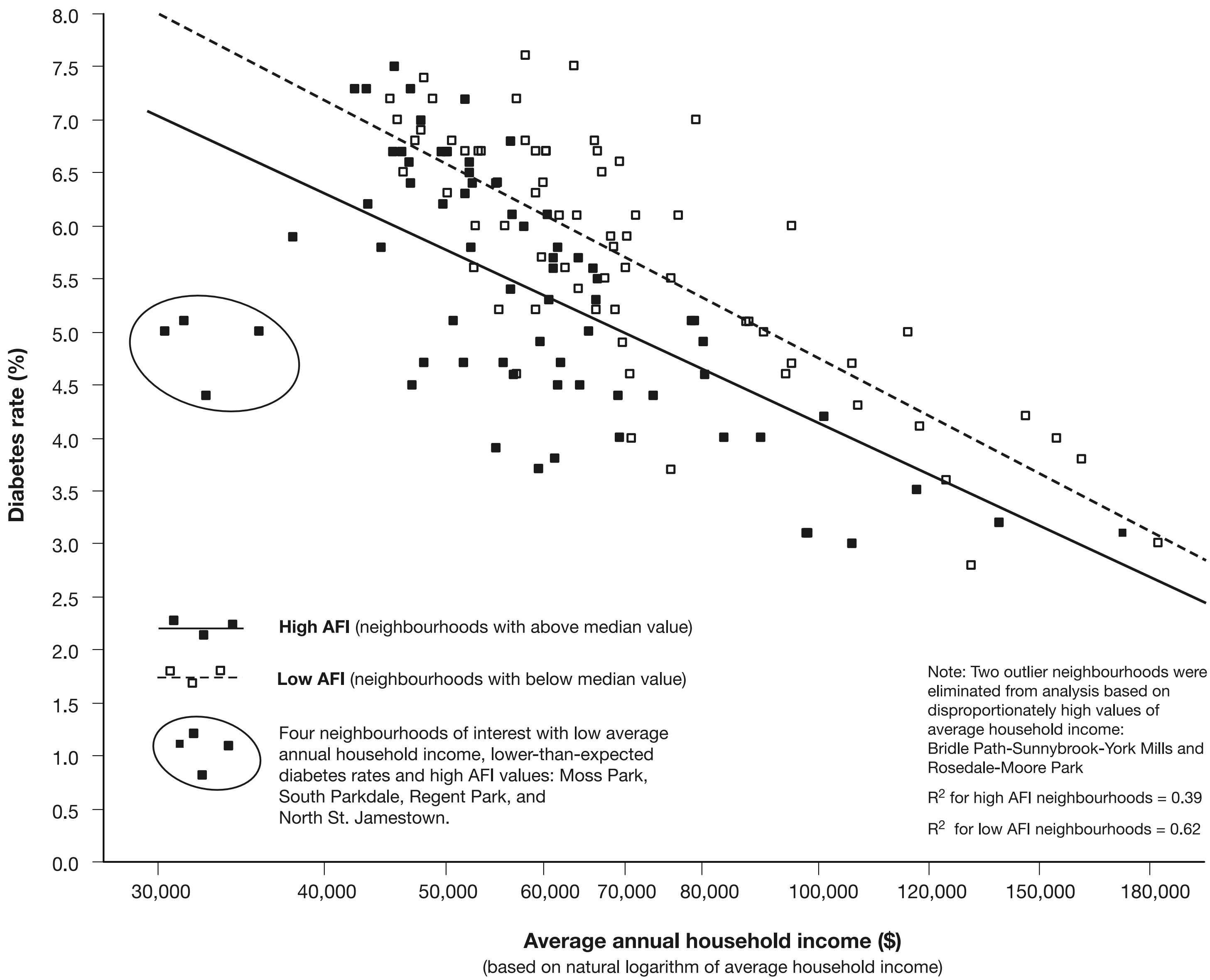
Exhibit 6.16 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and Activity-Friendly Index (AFI) values [2001–2004] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, areas in the northwest and eastern parts of Toronto had both high diabetes rates and low scores on the Activity-Friendly Index (AFI).
- A number of neighbourhoods in downtown (south central) and central Toronto had both low diabetes rates and high AFI scores.

Exhibit 6.17 **Diabetes prevalence rates [2001/02] and average annual household income [2000] in Toronto neighbourhoods, by Activity-Friendly Index (AFI) values [2001–2004] (above and below median)**

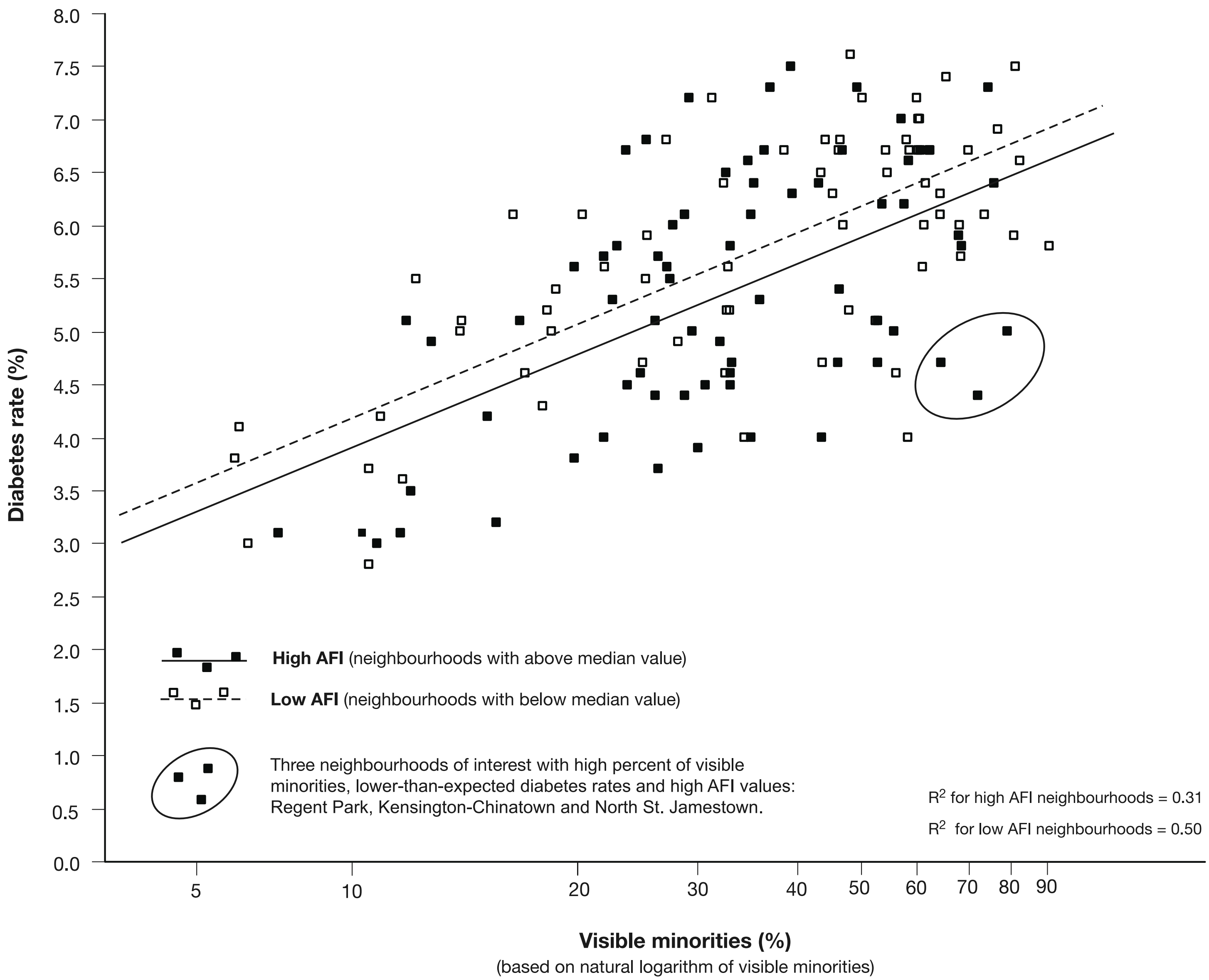


Findings

- Data from 2001 show that, as residents' average annual household income increased, neighbourhood rates of diabetes decreased.
- Diabetes rates were consistently higher for neighbourhoods that scored lower using the Activity-Friendly Index (AFI) compared to those with higher AFI scores. However the difference between these two categories was less pronounced in high-income areas.
- We noted four *"outlier"** neighbourhoods with high AFI scores that had lower-than-expected diabetes rates, despite the fact that these areas tended to be socioeconomically disadvantaged.

* In research, an "outlier" is an observation that lies outside the range of most of the observations within a particular distribution of data.

Exhibit 6.18 **Diabetes prevalence rates [2001/02] and percent visible minority residents [2001] in Toronto neighbourhoods, by Activity-Friendly Index (AFI) values [2001–2004] (above and below median)**



Findings

- In 2001, as the proportion of visible minorities living in a neighbourhood increased, diabetes rates also went up. However, diabetes rates were consistently lower in neighbourhoods with higher scores on the Activity-Friendly Index (AFI).
- Three outlier neighbourhoods had high AFI scores and lower-than-expected diabetes rates, despite the fact that a high percentage of residents in these areas were from a visible minority group.

Exhibit 6.19 Correlation between the Activity-Friendly Index (AFI) and its elements [2001–2004], and neighbourhood rates of walking/bicycling [2001], and diabetes prevalence rates [2001/02], in Toronto

	Spearman Rank Correlation with Diabetes Rates	Spearman Rank Correlation with Mean Number of Walking/Bicycling Trips per Person
Population per square kilometre (sq km) of residential area	0.053	0.607**
Car ownership	0.205	-0.604**
All retail services per 10,000 population	-0.192	0.461**
Average distance from residential points to the nearest five retail services	0.141	-0.604**
Crime rate per 100,000 population	0.270*	0.353**
Activity Friendly Index¥	**-0.235***	**0.597****

* P-value <0.01

** P-value <0.001

¥ AFI is composed of: population per sq km of residential area; cars per household; retail services per 10,000 population; average distance to nearest five retail services; and crime rate per 100,000 population.

Findings

- Overall, in 2001, people living in neighbourhoods that were more activity-friendly reported significantly more walking or bicycling trips per person. They also experienced significantly lower rates of diabetes.
- Individual elements of the Activity-Friendly Index (AFI) were significantly related to the mean number of walking or bicycling trips per person. Residents of neighbourhoods that had a higher population density, greater availability and access to retail services and lower rates of car ownership also walked or bicycled more frequently than those living in areas with opposite characteristics. Surprisingly, areas that had higher crime rates had higher reported rates of walking or bicycling per capita.
- Residents of neighbourhoods with greater availability of and access to retail services and lower rates of car ownership had lower rates of diabetes (compared to those living in areas with opposite characteristics). However, these differences were not statistically significant.
- Neighbourhoods that had higher crime rates also had higher rates of diabetes.

Exhibit 6.20 **Median Activity-Friendly Index (AFI) values for neighbourhoods and correlations with diabetes rates and walking/bicycling trips by income, visible minority population and neighbourhood risk level, in Toronto, 2001**

Sociodemographic groups	Median AFI¥	Spearman Rank Correlation between AFI¥ and Diabetes Rates	Spearman Rank Correlation between AFI and Mean Number of Walking/Bicycling Trips per Person
Overall (N=140)	**4.4**	**-0.235***	**0.595****
High Income (N=70)	4.1	-0.372*	0.639**
Low Income (N=70)	4.5	-0.475**	0.586**
High Visible Minority (N=70)	4.2	-0.247	0.427**
Low Visible Minority (N=70)	4.5	-0.051	0.696**
† High Risk (N=50)	**4.4**	**-0.540****	**0.480****
† Low Risk (N=50)	**4.4**	**-0.148**	**0.686****

* P-value <0.01

** P-value <0.001

¥ AFI is composed of: population per sq km of residential area; cars per household; retail services per 10,000 population; average distance to nearest five retail services; and crime rate per 100,000 population.

† High-risk neighbourhoods were defined as falling below the Toronto median annual household income and above the median level of visible minority residents for city neighbourhoods. Low-risk neighbourhoods were defined as falling above the Toronto median annual household income and below the median level of visible minority residents for city neighbourhoods.

Findings

- In 2001, neighbourhoods that were more activity-friendly had lower overall rates of diabetes. This association was stronger in low-income areas and also in "high-risk" neighbourhoods, which were characterized by both lower income and a higher percentage of residents from a visible minority group.
- People living in neighbourhoods that were more activity-friendly were more likely to walk or bicycle for transportation. This association was consistently strong, regardless of area income or ethnicity.

Discussion

Our research shows that in 2001, older neighbourhoods in south central Toronto, particularly those in the downtown core built prior to 1946, were more activity-friendly than communities outside the city centre that were built after the Second World War.

As shown in Chapter 5, there was a striking concordance between historical patterns of residential development in Toronto and residents' preferences for various modes of travel. We found that residents of neighbourhoods which scored higher on the Activity-Friendly Index (AFI) were also more likely to report walking or bicycling on a regular basis and to have lower rates of diabetes.

Older styles of urban design include many features that make communities more "walkable." For example, zoning for mixed land use (i.e., both commercial and residential) was a more common practice in pre-war neighbourhoods. We found access to retail services was greatest in the older neighbourhoods of south central Toronto—an element that could encourage residents to walk as a means of transportation. Denser urban areas also tend to have more sidewalks, smaller block sizes, and greater street connectivity (features that we were unable to measure for the purpose of this study).

In contrast, modern suburbs are characterized by urban sprawl and the planned separation of residential and non-residential lands. Neighbourhoods in the outlying areas of Toronto had a much lower population density, particularly during the daytime, which suggests that residents in these areas relied heavily on commuting to work. We found that access to local retail services was relatively poorer in these areas. While we estimated that most services could be reached within a 15-minute walk, other data suggest that a person's propensity to walk to local amenities may wane when travel time to and from the destination exceeds five to 10 minutes.[13,14] Longer distances between blocks, fewer sidewalks and connections between streets, wider roads and other barriers to walking may further deter residents from walking to their destinations.

As shown in Chapter 5, the outlying areas of Toronto also had poorer access to public transit. Together all of these features render communities more dependent on cars. Our data support this notion: we found that levels of car ownership were greater in the outlying neighbourhoods of Toronto compared to older sections of the city.

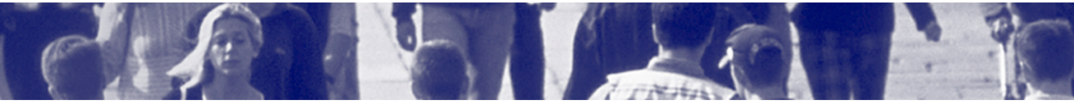
We identified areas in the northwest and eastern parts of the city that had particularly high diabetes rates. These high rates coincided with environments that appeared to be unfavourable for physical activity. These communities had lower AFI scores and lower reported rates of walking or bicycling as a means of travel. As shown in previous chapters, residents in these communities also had lower average annual household incomes and lower education levels; they were also more likely to have immigrated to Canada or to belong to ethnoracial groups known to be at high risk for diabetes.

Since diabetes prevalence is higher among people with low socioeconomic status and among members of visible minorities, these neighbourhood characteristics alone could explain a significant proportion of the excess diabetes found in these communities. However, apart from socioeconomic and ethnoracial factors, our findings suggest that living in a less activity-friendly neighbourhood may be an additional risk factor for diabetes; in fact, the strength of the association between AFI scores and diabetes rates was strongest in high-risk areas of the city (i.e., those characterized by lower income levels and a greater proportion of visible minority residents).

Interestingly, several neighbourhoods in south central Toronto with low socioeconomic status among residents and high rates of immigration had lower-than-expected rates of diabetes. These findings could be due to a high level of activity-friendliness in these areas which created more opportunities for daily physical activity. However, these areas had a higher level of transience, meaning residents moved in and out of the area more frequently (Chapter 3). This means there would likely be a smaller window of opportunity for them to be diagnosed with diabetes before they relocated to another part of the city. It is also possible that the most recent—and therefore the healthiest—immigrants were temporarily residing in these areas.

More affluent neighbourhoods showed a mixed pattern: those in south central Toronto and surrounding areas had high AFI scores, while others located north of the downtown had relatively low scores. Furthermore, our Activity-Friendly Index proved to be less strongly related to diabetes rates in high-income areas. One possible explanation is that wealthier individuals may have more opportunities to be physically active simply because they can afford memberships in health clubs, sports equipment, personal trainers, and may have access to weekend or vacation properties outside the city. In contrast, members of low-income groups are likely to be more dependent on less expensive or free opportunities for physical activity within their own neighbourhoods.

Due to the cross-sectional and ecological nature of the analyses, these patterns do not prove that certain neighbourhood features either cause diabetes or protect against it. Such patterns do, however, demonstrate associations that could be causal and that warrant further investigation. They are also consistent with a growing body of evidence showing that environmental features are important for physical activity and for negative health consequences including obesity.[15-19]



We believe the patterns observed here also demonstrate two possible protective effects for diabetes. First, we noted that people with high socioeconomic status had low rates of diabetes, even if they lived in a less activity-friendly neighbourhood. Second, we observed that people with low socioeconomic status who lived in areas that were activity-friendly had lower-than-expected rates of diabetes. These potential protective effects merit further investigation.

Conclusions and Next Steps

An Activity-Friendly Index (AFI) was developed for Toronto in order to identify parts of the city with potentially modifiable features that might stimulate or enhance daily physical activities among residents. The AFI combines neighbourhood population density, density and dispersion of commercial services, car ownership and crime rates.

Based on 2001 data, we found that Toronto neighbourhoods with the highest levels of activity-friendliness were located mainly in the downtown area; those with lower AFI values were predominantly in the suburbanized, outer areas of the city. Diabetes prevalence rates were highest in neighbourhoods that were the least activity-friendly. This inverse relationship between diabetes and the AFI was particularly strong in lower-income areas of the city.

Our findings raise policy concerns about the health impacts of social disadvantage in suburbanized communities. In particular, we identified low-income areas in the northwest and eastern sections of the city whose populations were at high risk for poor health outcomes, based on their high existing rates of diabetes and other underlying characteristics. These communities would benefit most from diabetes prevention strategies. However, residents living in these areas of the city face a number of challenges that make it more difficult to incorporate physical activity into daily life. Our findings suggest that newer urban developments create a less conducive environment for walking and bicycling, low-cost activities that could be performed as part of a daily routine.

Some neighbourhood characteristics are more modifiable than others. Street connectivity, for example, is modifiable only through major redevelopment projects, and for that reason we did not include it within our Activity-Friendly Index.

Toronto is currently undergoing a major construction boom involving condominium buildings, which is adding considerable density to many neighbourhoods. Commercial/retail services often develop in conjunction with increased population density —in this case, either within the condominiums themselves or on nearby streets. These effects may serve to increase both the daily physical activity and the health of local residents. Increasing the number of local services and enhancing public transit could also reduce people's dependence on cars; bylaw and regulation changes which reduce the number of required parking spaces in new residential developments might further decrease car ownership and encourage local residents to walk and/or bicycle.

The social environment in which people live also needs to be considered when governments and communities plan strategies to promote physical activity within a given area. For instance, inadequate street lighting may deter residents—particularly those living in areas high in crime—from walking to their destinations. Individuals from different backgrounds and cultures may also vary in their perceptions of neighbourhood walkability and in their attitudes and beliefs about physical activity. A multifaceted approach focusing on both social and environmental barriers to walking is likely needed in order to create more opportunities for physical activity and widespread changes in lifestyle among high-risk urban populations.

Appendix 6.A—How the Research was Done

Data Sources

Toronto's daytime population, neighbourhood average annual household income and proportion of visible minority residents were obtained from the 2001 Canadian census. Daytime population was defined as the sum of: 1) total population by place of work status; 2) total unemployed population; and 3) total population not in the labour force. The nighttime population was considered equivalent to the total residential population in a neighbourhood.

Data on vehicles per household were obtained from the 2001 Transportation Tomorrow Survey (TTS) conducted in census years by Greater Toronto Area (GTA) municipalities and public transit organizations.

Data on retail services were obtained from the 2004 Employment Survey (conducted by the City of Toronto Planning Department) and from the Ontario Food Terminal database (Canadian Urban Institute). This dataset contains retail categories that include food stores. Locations of these stores were used to calculate their density within neighbourhoods per 10,000 residents; they were also used to calculate the average walking time in each neighbourhood from residential areas to the nearest five stores.

Crime data were compiled from the 2001 Toronto Police Services Statistical Report.

Age- and sex-adjusted diabetes prevalence rates were derived from the Ontario Diabetes Database and other administrative data sources held at the Institute of Clinical Evaluative Sciences (ICES).

The 2001 Census of Canada was used to obtain social characteristics of each neighbourhood, including the average annual household income level and the percentage of residents who identified themselves as belonging to a visible minority group. Visible minorities are defined by the Employment Equity Act as "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour." Visible miniority status was self-reported.

Data on walking/bicycling trips per person were obtained from the 2001 Transportation Tomorrow Survey (TTS). Many of these trips (45 percent) were defined as "to work" or "to school," but other destination types such as "to daycare" and "to marketing/shopping" were also included.

Analysis

Population density was calculated per square kilometre of residential area; availability of services was calculated as the number of services per 10,000 residents. Both these measures were calculated at the neighbourhood level.

The ratio between nighttime and daytime populations was calculated by dividing their density values for each neighbourhood. Car ownership was based on the average number of vehicles per household in each neighbourhood.

The average walking time to the nearest five retail locations was calculated based on the average of this measure from all major residential locations within a neighbourhood. The retail destination locations did not need to be located within the same neighbourhood. This average travel time was acquired using a network analysis.

Data on drug-related and violent crime rates were available at the level of Toronto's 16 police divisions and were divided among smaller neighbourhoods proportional to the area of each neighbourhood in a given police division. Crime rates were calculated by dividing the sum of violent and drug-related crimes by the larger of two denominators at a neighbourhood level—nighttime and daytime population. This way the rate was standardized by the maximum population exposed to drug-related and violent crime within a neighbourhood.

The bivariate *Local Indicator of Spatial Association (LISA)* approach was used to measure spatial relationships between neighbourhood infrastructure elements and diabetes rates.

The Activity-Friendly Index (AFI) was calculated for each neighbourhood using the following variables:

- car ownership per household (values reversed)
- population density per square kilometre of residential area
- number of all retail services per 10,000 population
- average distance from residential points to the nearest five retail locations (values reversed)
- drug-related and violent crime rate per 100,000 of maximum exposed population (values reversed)

While walkability indices have been created for other jurisdictions using different elements than those chosen for our AFI, many of these alternative measures were not available in our data sources.[12,19] The five chosen variables were standardized and equally weighted, creating an index with a scale from 0 to 10, with zero representing the least, and 10 representing the most activity-friendly conditions within a neighbourhood. The AFI for Toronto neighbourhoods had a range of 2.2 to 7.2, a mean and median of 4.4, and a standard deviation of 0.9.

Choropleth (shaded) maps were used to depict different levels of the AFI. Bivariate *LISA* maps were used to demonstrate the relationship between values of age-sex adjusted diabetes rates, and values of AFI and its components at the neighbourhood level. Spearman rank correlations were used to analyze the relationship between age-sex adjusted diabetes rates, mean number of walking/bicycling trip per person, as well as scores on the AFI (and its components). These correlations were also obtained for groups of neighbourhoods with different socioeconomic characteristics.

More detailed information about data sources, rate calculations and analyses is available in "Appendix B: Technical Notes" at the end of this Atlas.

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INSIDE

7

Chapter

Physical Activity and Diabetes

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Executive Summary

Issue

Lack of adequate physical activity is a major contributor to obesity, which in turn increases the risk of developing diabetes. Increased rates of obesity are contributing to higher rates of diabetes in Canada and most developed countries. Promotion of physical activity at the societal level and advice about increasing activity levels in clinical settings have been taking place for a long time in Canada, yet rates of activity remain low. To date, little attention has been directed at the role that neighbourhoods play in encouraging physical activity. Neighbourhood resources that may enhance activity include the local availability of parks, schoolyards and recreational facilities. The presence of these resources does not ensure their use, as acceptability factors and individual choice are also important, but absence of these resources poses barriers to physical activity.

Study

The distribution and accessibility of parks, schoolyards and recreation facilities were examined for neighbourhoods throughout the city. Information on the location of parks was obtained from the City of Toronto and from DMTI Spatial Parks for 2004. Small parkettes were excluded. School locations for 2005 were obtained from the Ontario Ministry of Education. Locations of recreation facilities for 2004 were obtained from the City of Toronto Parks, Forestry and Recreation. These included community centres, indoor and outdoor pools, arenas, artificial ice rinks, gymnasiums, baseball and softball diamonds, soccer fields and tennis courts. Network analysis was used to estimate walking, public transit and driving times to these facilities. The relationship between diabetes rates and these measures of availability and accessibility was evaluated using bivariate *Local Indicator of Spatial Association (LISA)* maps. The 2000–2001 Canadian Community Health Survey (CCHS) was used to determine rates of self-reported physical activity in Toronto by area of residence.

Key Findings

- Parks, schoolyards and public recreation facilities were generally well-distributed throughout the city. Despite this, several neighbourhoods had substantially fewer of these facilities available compared to others.
- Walking and transit times to parks and schoolyards were as long as 20 minutes each way in many areas of the city. Walking and transit times to recreation facilities were as long as 40 minutes and 20 minutes each way, respectively.
- Several neighbourhoods in the northwest and east of the city had high diabetes rates and long travel times to parks, schoolyards and recreation facilities. A few neighbourhoods with high diabetes rates had long travel times to all of these facilities.
- Levels of self-reported physical activity were highest among residents living in the south central and central west of the city; they were lowest among those living in the east and northeast. The areas of lowest physical activity had high diabetes rates, and many of the areas with higher physical activity had low diabetes rates.

Implications

- Some Toronto neighbourhoods had limited availability of, and access to, parks, schoolyards and recreation facilities; many of these neighbourhoods had high diabetes rates.
- Policies that identify neighbourhoods for attention and investment should take into account the health needs of the local population and the existing availability of resources that promote an active lifestyle.

Introduction

Physical Activity and Health

According to a report from Ontario's Ministry of Health and Long-Term Care, in 2003 almost half of Ontario adults were considered overweight or obese.[1]

The two principal ways to control body weight are through diet and exercise. However, most adults in industrialized countries do not meet the physical activity guidelines required for a healthy lifestyle.[2–5] Canada's Physical Activity Guide to Healthy Active Living recommends 30 to 60 minutes of physical activity daily for adults to maintain or improve health.[6] Although the proportion of Ontario adults achieving recommended physical activity levels has increased by 16 percent since 1990,[1] 55 percent of adults are still not reaching these targets.[7] There is growing concern that 57 percent of Ontario youth aged 12–19 years[8] and half of children in Canada aged five to 12 years do not meet Canadian recommended physical activity guidelines.[5]

Levels of physical activity in Toronto appear to be lower than the provincial average: a recent survey found that just 33 percent of Torontonians reported themselves to be physically active.[9] As worrisome as these figures seem, Torontonians are still marginally more active than their American counterparts. In the United States (US), 25–30 percent of Americans reported 30 minutes of physical activity five days a week, while 30–40 percent reported no physical activity outside of work.[10]

Physical activity has been shown to have a favourable effect on the risk of cardiovascular disease, hypertension, and diabetes.[11,12] Research has shown that physically inactive Canadians are 90 percent more likely to develop coronary artery disease and 40 percent more likely to experience a stroke, hypertension, colon cancer or type 2 diabetes.[13]

When it comes to diabetes, inadequate levels of physical activity reduce insulin sensitivity and decrease glucose tolerance, both factors in the development and control of this disease.[14] The relationship between physical activity and the risk of diabetes persists even after controlling for Body Mass Index (BMI)*,[15] Furthermore, the amount of time devoted to sedentary behaviours such as television viewing or sitting at a desk has been directly linked to the risk of obesity and type 2 diabetes.[16] In Canada, an estimated 2.5 percent of total direct health costs ($2.1 billion) and 21,000 premature deaths were attributed to physical inactivity in 1999.[17]

Lifestyle changes that promote physical activity and weight loss have proved to be effective in decreasing the risk of diabetes.[18,19] In two randomized controlled trials conducted in the US and Finland, intensive lifestyle changes resulted in a 58 percent lower incidence of diabetes among groups at high risk for developing this disease. In both studies, lifestyle changes focused on reducing calories and fat intake and on participating in regular physical activity, roughly equivalent to 30 minutes of brisk walking five days a week. On average, the net weight loss resulting from these efforts was less than 10 pounds (4.54 kg).

Physical Activity and the Environment

Physical activity levels depend not only on the individual's propensity to exercise, but also on the physical environment.[20] Compared to compact cities, areas of urban sprawl have been associated with greater reliance on cars and also with higher levels of overweight populations.[21–23]

In Canada, urban environments seem more conducive to physical activity than rural areas.[24] A Canadian survey by the Heart and Stroke Foundation found that respondents in urban areas were more likely than those in rural areas to report the following: they felt their community was convenient for walking or bicycling; they walked or bicycled to do daily chores; they walked, bicycled or used public transit to go to work; and they were currently at a healthy weight.[24] Canadians living in moderate-to-high density neighbourhoods with community and commercial services within walking distance were 2.4 times more likely to meet the 30 minutes per day minimum physical activity recommendation.[24]

Access to parks and recreation centres, the existence of sidewalks, and neighbourhood safety all play a key role in determining the duration and frequency of physical activity.[25–27] Data from Australia and the US suggest that residents are more likely to walk to a local shop or another facility if they can do so within five to 10 minutes.[10,28]

The term "walkability" is commonly used to describe the potential which individual neighbourhoods offer for walking and other physical activities.[29] Research shows that people are more likely to have a sedentary lifestyle if they live in a neighbourhood lacking in sidewalks, bicycle paths and parkland.[30–33] In contrast, residents in neighbourhoods that are deemed "walkable" spend more time each day being physically active, and they experience lower rates of obesity.[34] An Australian study found a positive association between access to and use of outdoor facilities such as beaches and other "attractive public open spaces."[25] Similarly, children's activity levels appear to be strongly related to the number of play spaces (such as parks) near their homes and the amount of time spent using these spaces.[35]

In contrast to the research on neighbourhood design and green spaces, there is very little objective evidence that access to indoor exercise facilities has an impact on physical activity levels. In the US, 51 percent of adults who took part in a survey reported that they would be more active if exercise facilities were more available to them.[36] However, since this was a hypothetical situation presented in a survey, it is impossible to say whether physical activity levels would actually increase if access to facilities improved.

Another US study found that individuals living in neighbourhoods with a higher density of private exercise facilities were more likely to exercise than those who lived in areas with lower densities.[26,37] However, the same relationship was not observed in an Australian study,[25] nor has it been found by researchers studying public (free) exercise facilities.[38–40]

Income appears to play a role in physical inactivity. For example, research from Canada and elsewhere indicates that physical inactivity rates were up to one-third higher among people in lower socioeconomic groups compared to those from wealthier segments of the population.[7,33] Individuals living in low-income areas seemed to walk more often for transportation but less often for recreation.

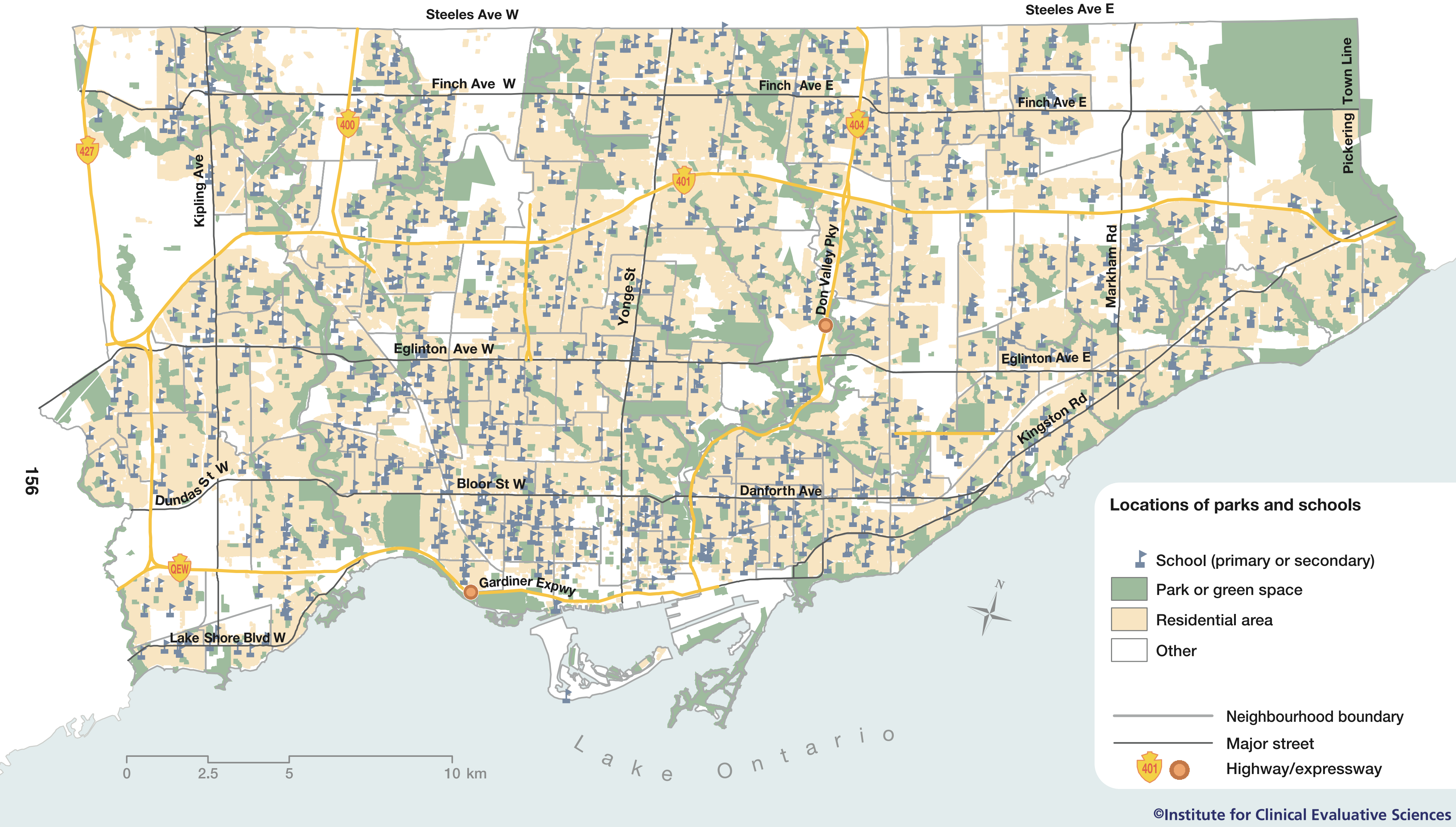
One study found that 75 percent of Canadian children from high-income families participated in weekly organized sports activities compared with only 25 percent of children from low-income families.[41] In addition, youth in families with higher incomes were more active than youth in families with lower incomes.[41] The same economic trend has been seen in adults; the proportion of individuals who were physically active increased as levels of income and education increased.[1]

How might this be explained? There may be direct economic barriers to participating in physical activity such as registration fees and equipment costs. There may also be indirect barriers, such as living in neighbourhoods with fewer parks and recreation facilities. The perception of safety in lower-income neighbourhoods may also be a factor: twice as many low-income as moderate-income respondents said concerns about safety in their neighbourhood were an obstacle to physical activity.[33,42] Where there is good access to parks and recreational facilities, focus must be placed on promoting their availability and on overcoming social, environmental and cultural impediments to their use.[33]

* BMI is a ratio of weight to height and can be calculated according to the equation: $BMI = weight(kg)/height(m)^2$

Chapter 7—List of Exhibits

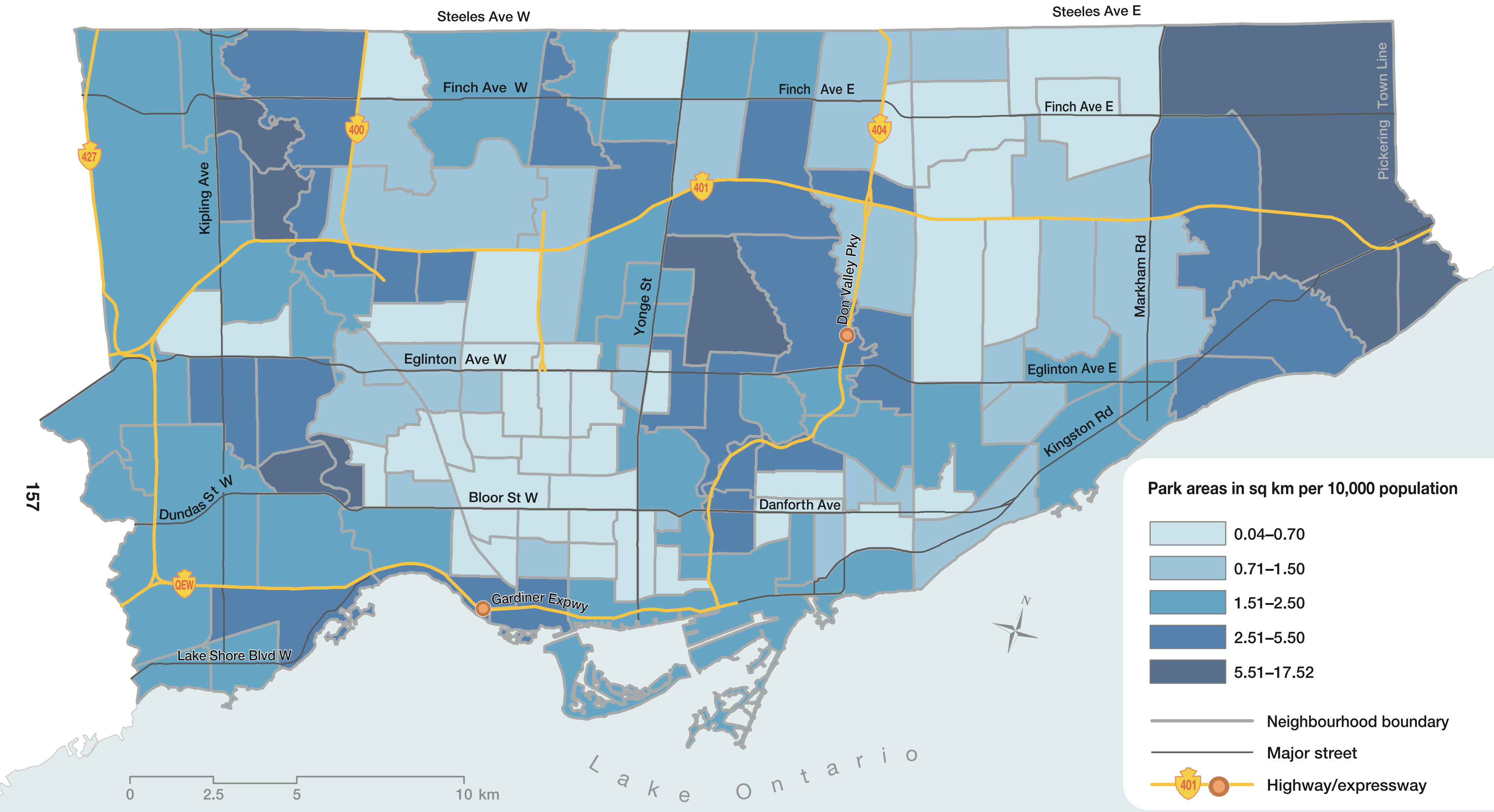
Exhibit 7.1 Locations of parks (2002) and schools (2005) in Toronto



Findings

- In 2005, schoolyards were generally well-distributed across Toronto with only small pockets of limited availability found across the city.
- In 2002, large park systems were concentrated in the west, east and central parts of Toronto with smaller parks scattered throughout the city.

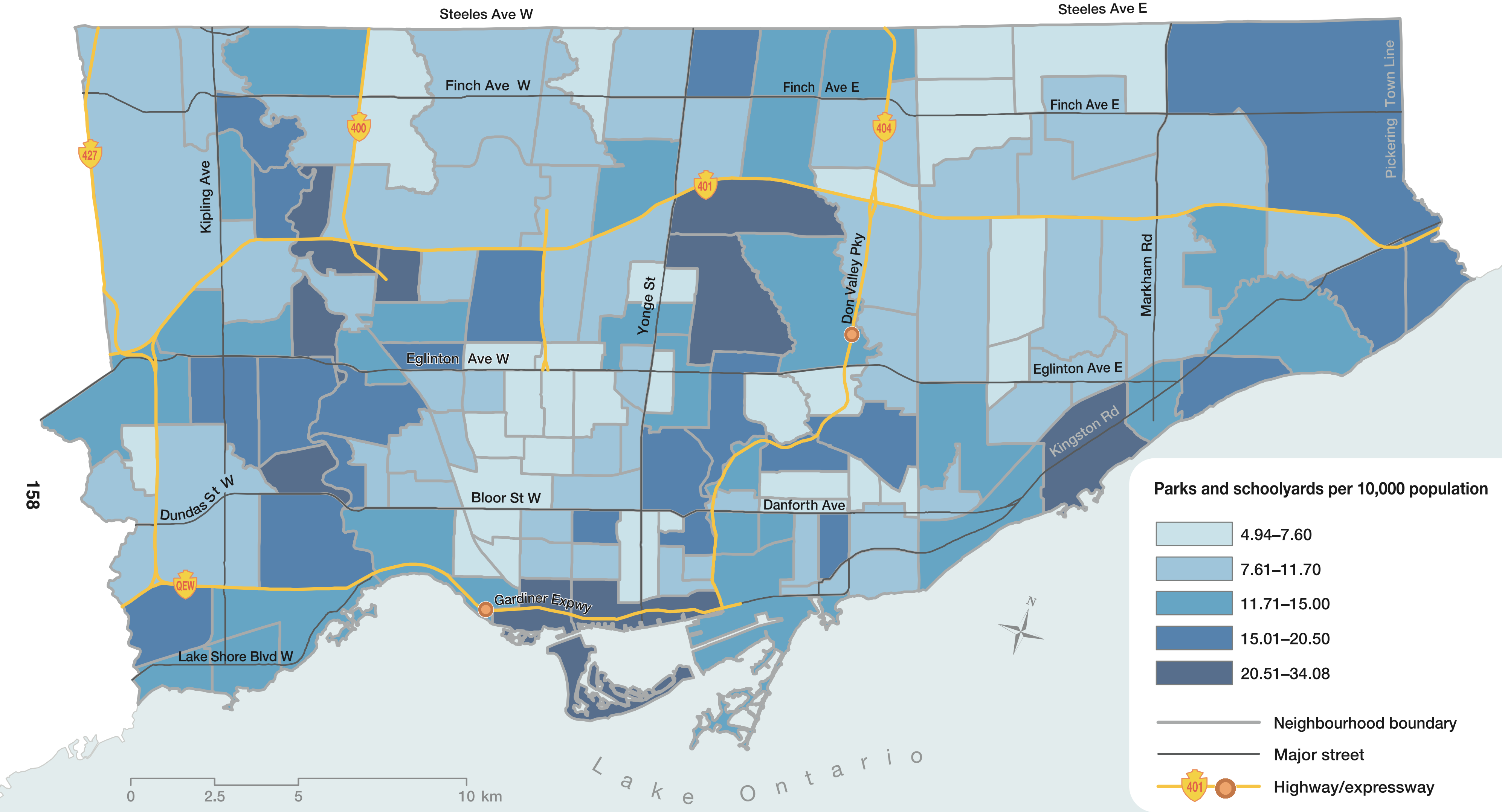
Exhibit 7.2 Parks area in square kilometres (sq km) per 10,000 population [2001], by neighbourhood, in Toronto, 2002



Findings

- In 2001, part of the downtown (south central Toronto) and central west region of the city had relatively little park area per capita.
- There was also a large area in the east/northeast region of the city with very low availability of parks per capita.

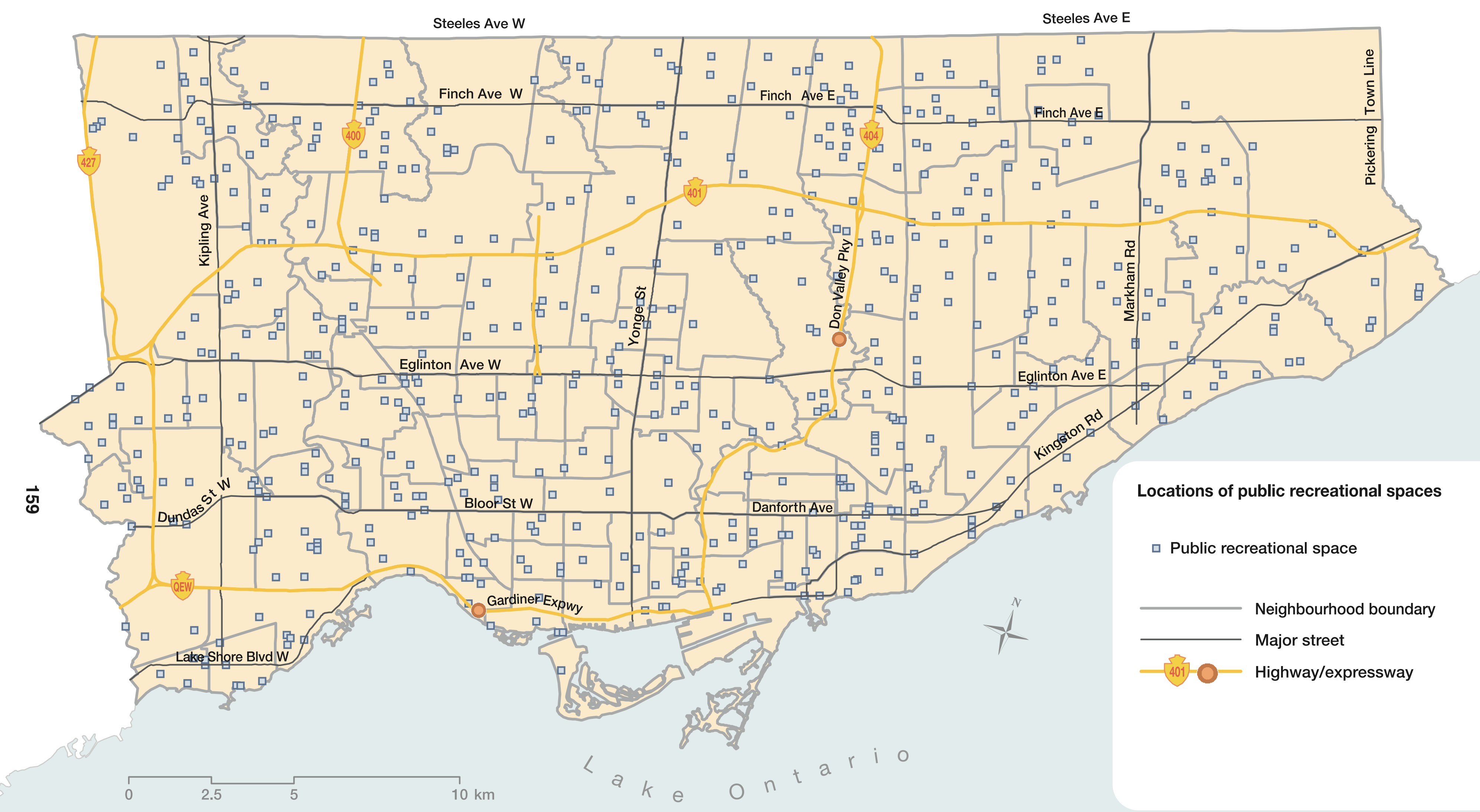
Exhibit 7.3 Parks and schoolyards per 10,000 population [2001], by neighbourhood, in Toronto, 2002–2005



Findings

- In 2001, several neighbourhoods in the northwest, central west and east of the city lacked park spaces and had a low density of schoolyards and playgrounds, suggesting a true lack of public outdoor spaces in these areas.

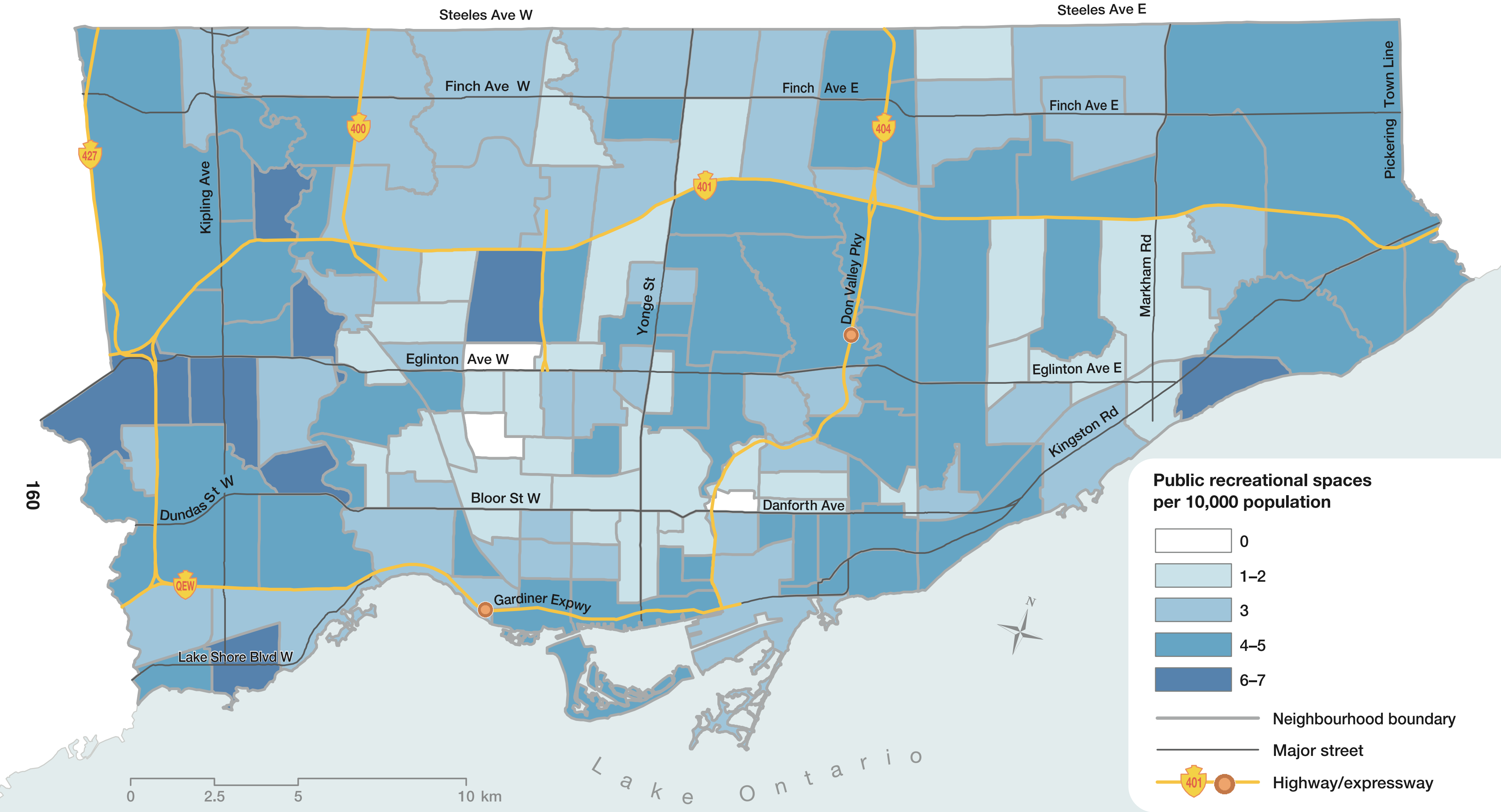
Exhibit 7.4 Locations of public recreational spaces, in Toronto, 2004



Findings

- Although widely distributed across the city, public recreational spaces, which include a diversity of categories ranging from soccer fields in a park to community centres, tended to be concentrated along major streets in 2004.

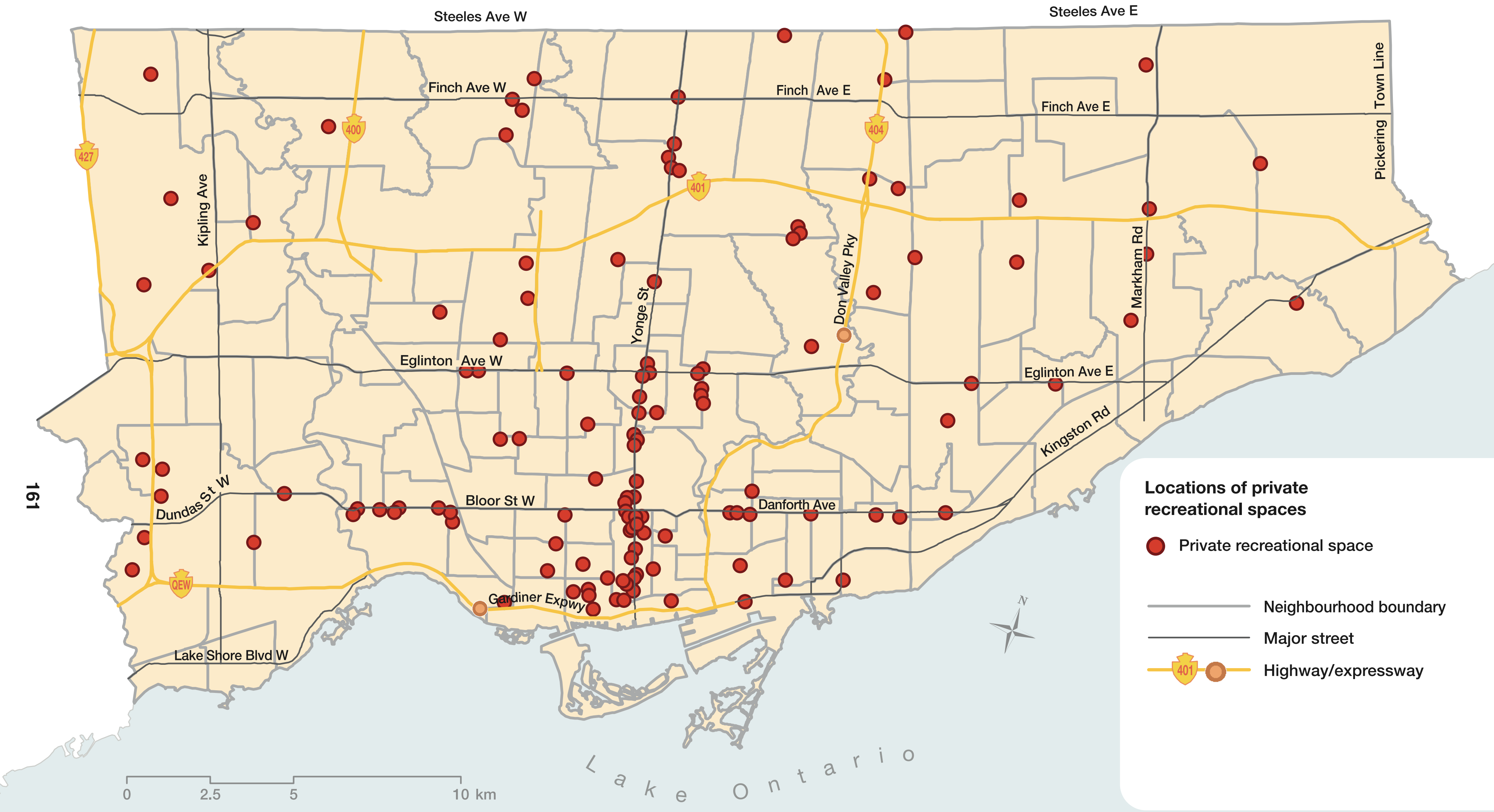
Exhibit 7.5 Public recreational spaces per 10,000 population [2001], by neighbourhood, in Toronto, 2004



Findings

- In 2001, certain neighbourhoods in the west end had the highest density of recreational facilities. Neighbourhoods in the western half of the downtown, the north central region and in the east end had the lowest density of recreational facilities.
- There was a very low density of parks and schoolyards in several of the neighbourhoods with the lowest density of public recreational spaces, particularly in the downtown (south central) area and just west of downtown (Exhibit 7.3).

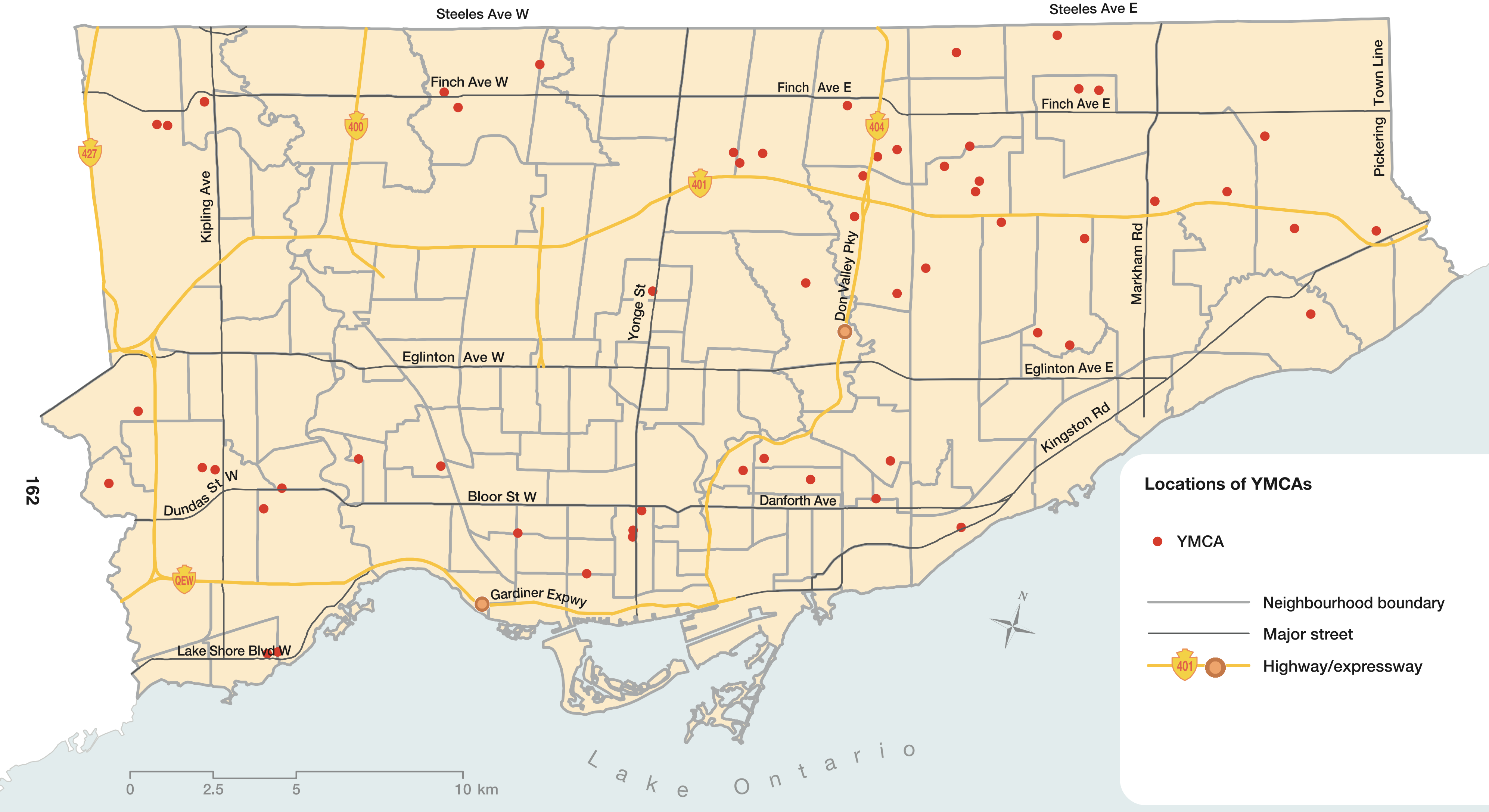
Exhibit 7.6 Locations of private recreational spaces, in Toronto, 2004



Findings

- In 2004, private recreational spaces clustered strongly in the downtown core and in high-income areas of western and north central Toronto.
- Very few such private facilities were found in lower-income regions of the northwest and eastern parts of Toronto.

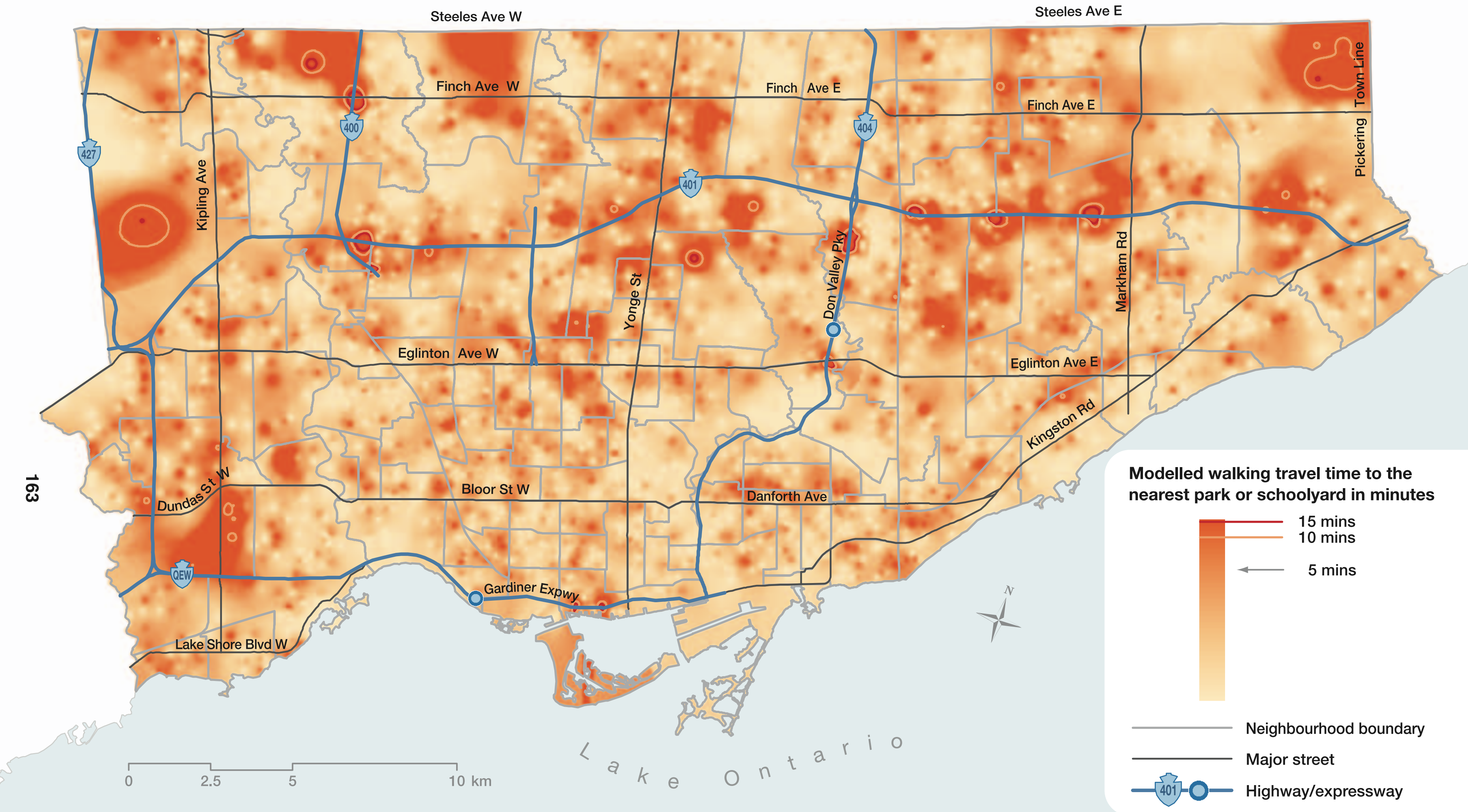
Exhibit 7.7 Locations of YMCAs, in Toronto, 2004



Findings

- In 2004, YMCAs were located in the downtown (south central) area, in the southwest and central north areas and east of Toronto (Exhibit 7.7).
- Large areas in central and central west Toronto had no YMCAs.

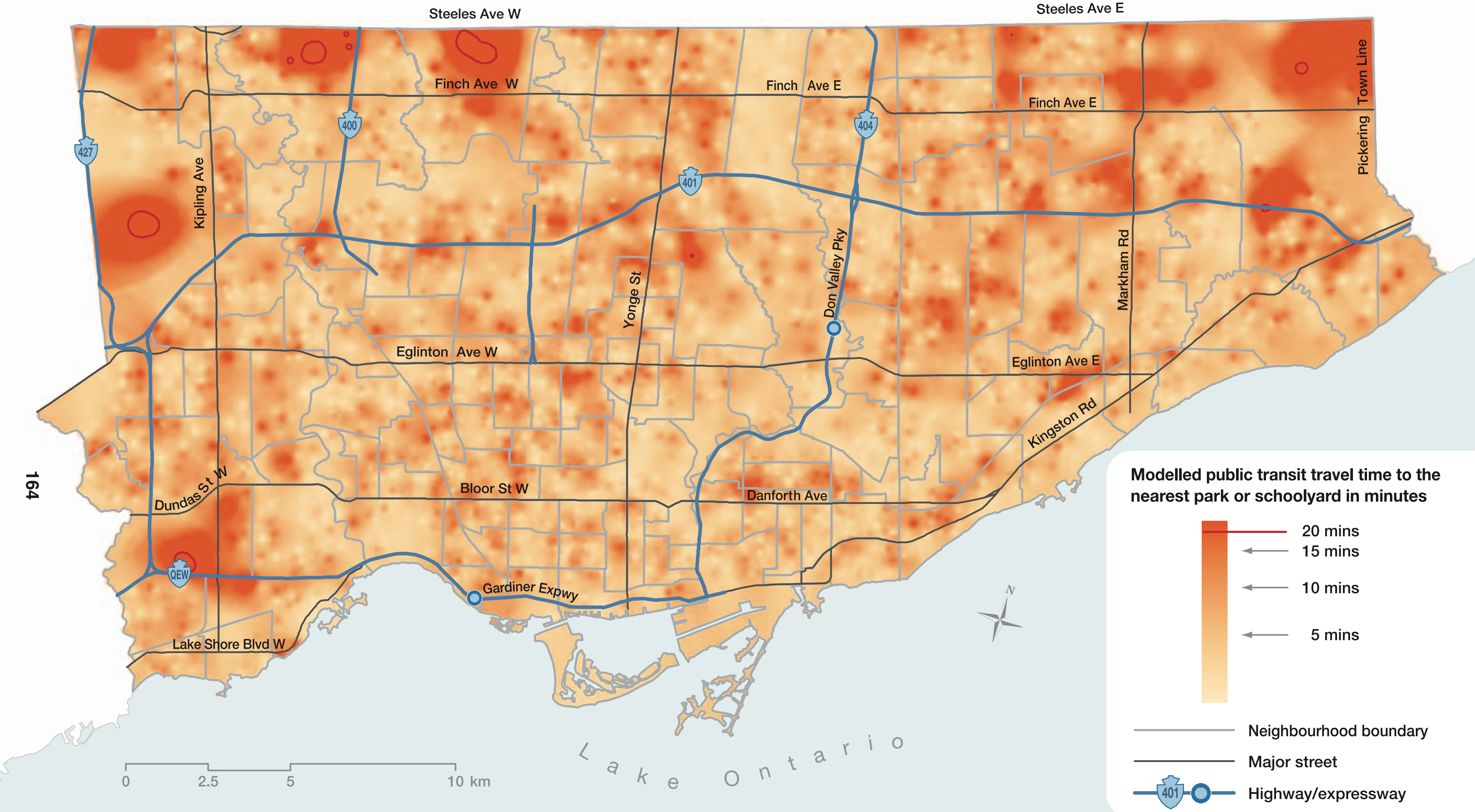
Exhibit 7.8 Modelled travel time by walking to the nearest park or schoolyard, in minutes, by neighbourhood of residence, in Toronto, 2002–2005



Findings

- Based on 2001 data, we noted pockets in the northwest, southwest, central and eastern parts of Toronto where parks or schoolyards could not be accessed in less than 20 minutes by walking.

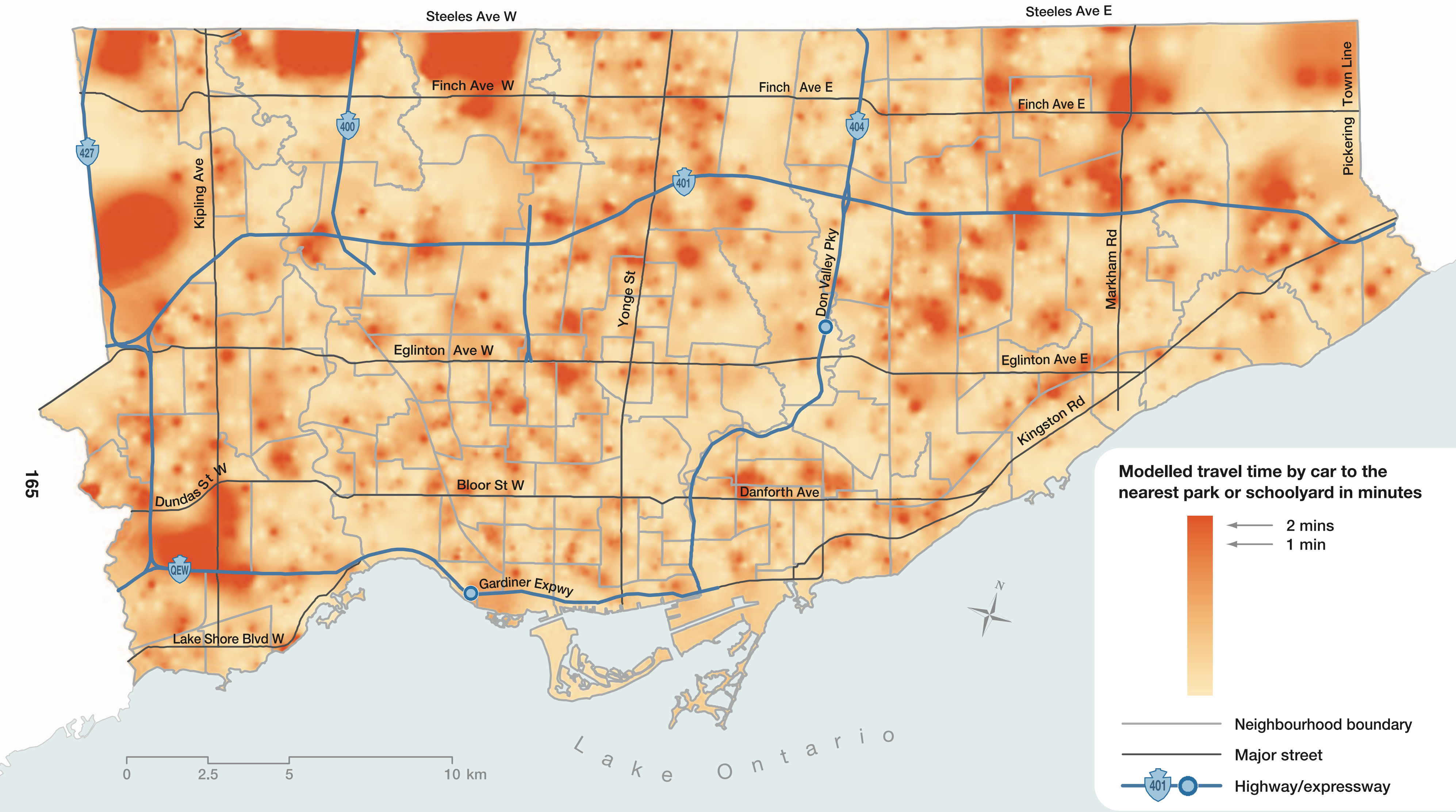
Exhibit 7.9 Modelled travel time by public transit to the nearest park or schoolyard, in minutes, by neighbourhood of residence, in Toronto, 2002–2005



Findings

- In 2001, parks or schoolyards could not be accessed in less than 20 minutes by public transit in pockets in the northwest, southwest, central and eastern parts of Toronto.

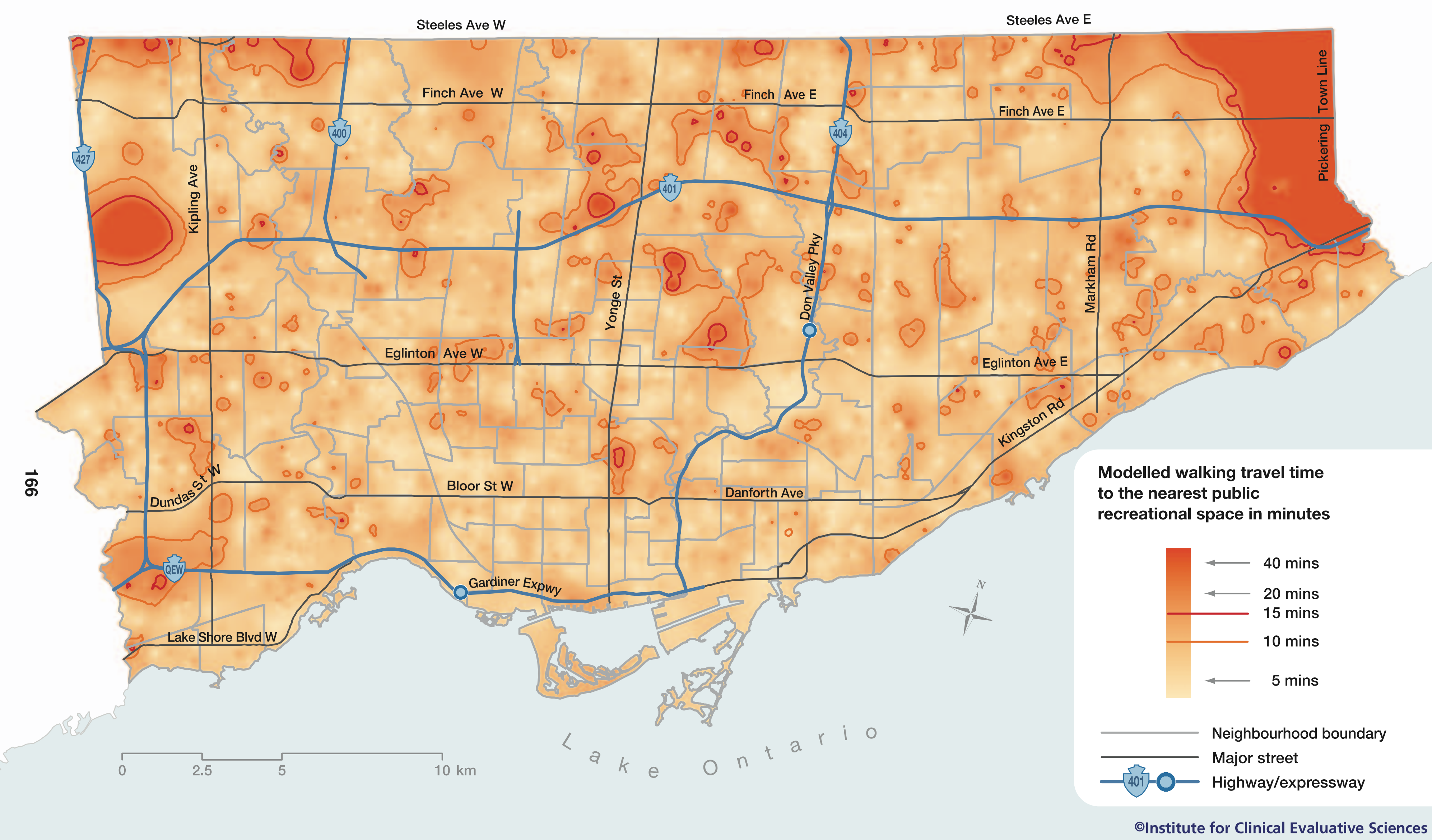
Exhibit 7.10 Modelled travel time by car to the nearest park or schoolyard, in minutes, by neighbourhood of residence, in Toronto, 2002–2005



Findings

- In 2001, travel time by car to parks or schoolyards was uniformly short in Toronto neighbourhoods.

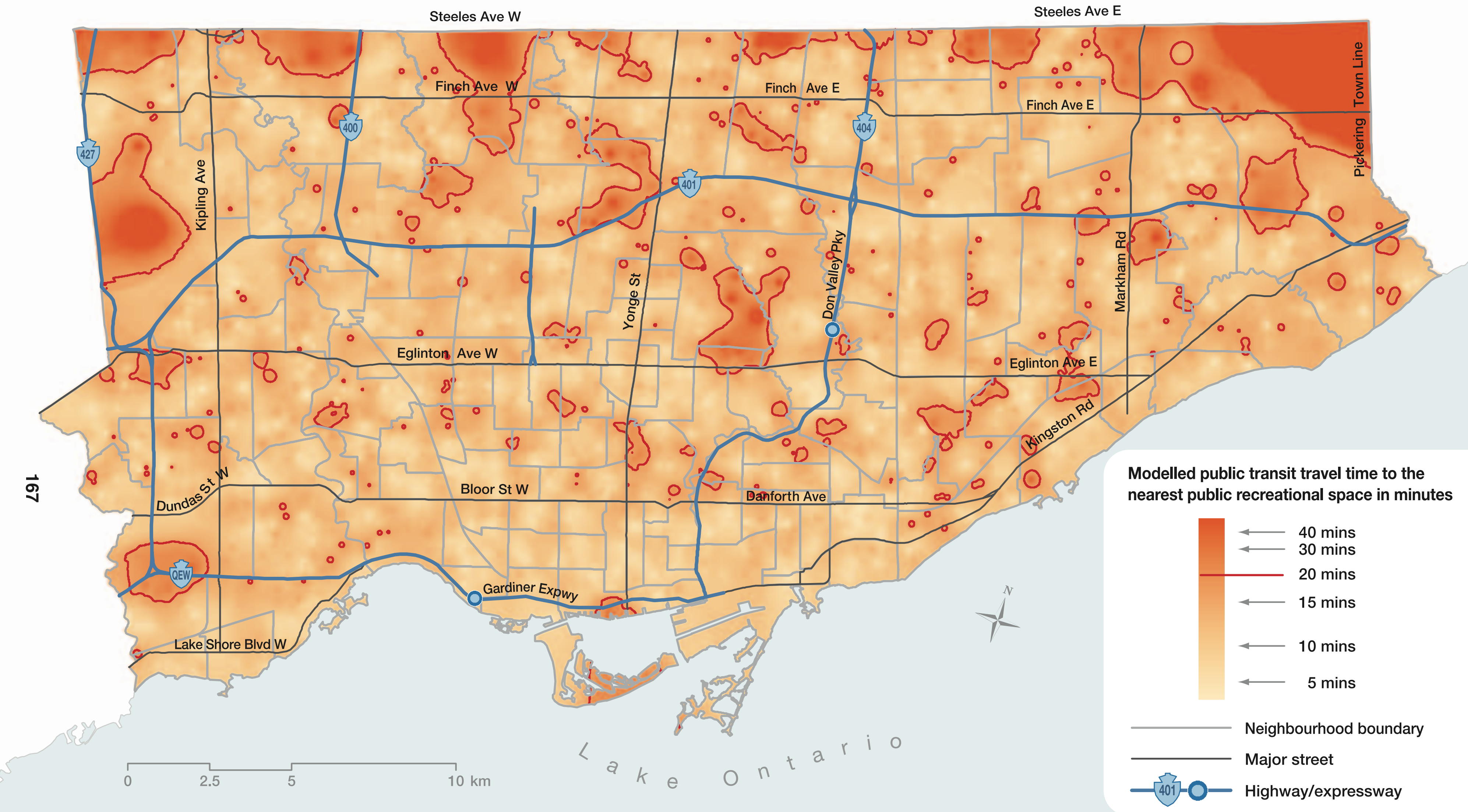
Exhibit 7.11 Modelled travel time by walking to the nearest public recreational space, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- In 2001, there were some areas scattered throughout the city where accessing a recreational space took at least 40 minutes by walking. Many of these neighbourhoods were located in the northwest, northeast, central and eastern regions of the city. Some of these areas match those which had limited access to parks and schoolyards.

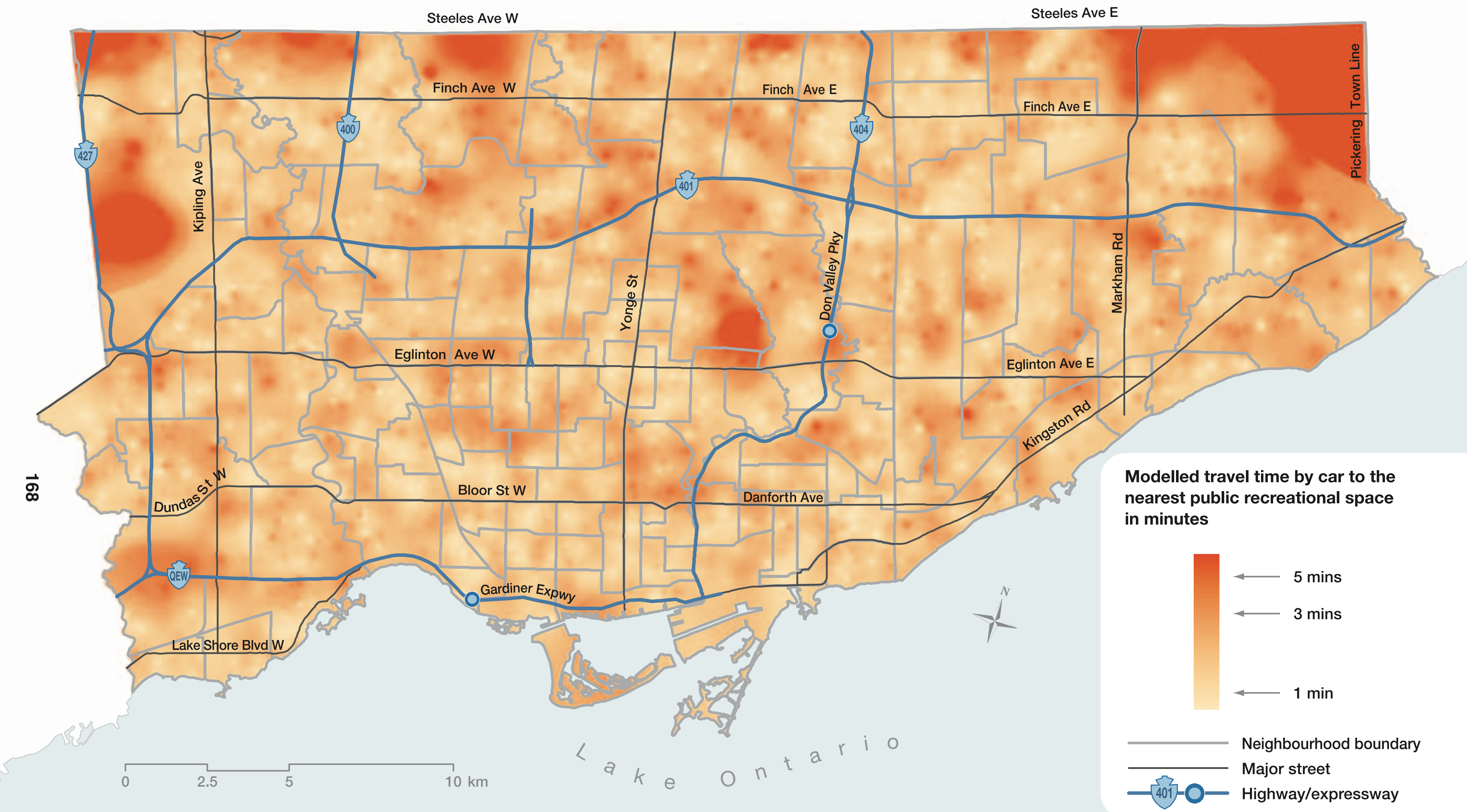
Exhibit 7.12 Modelled travel time by public transit to the nearest public recreational space, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- In 2001, accessing a public recreational space took at least 20 minutes by public transit in areas in the northwest, northeast, central and eastern regions of the city.

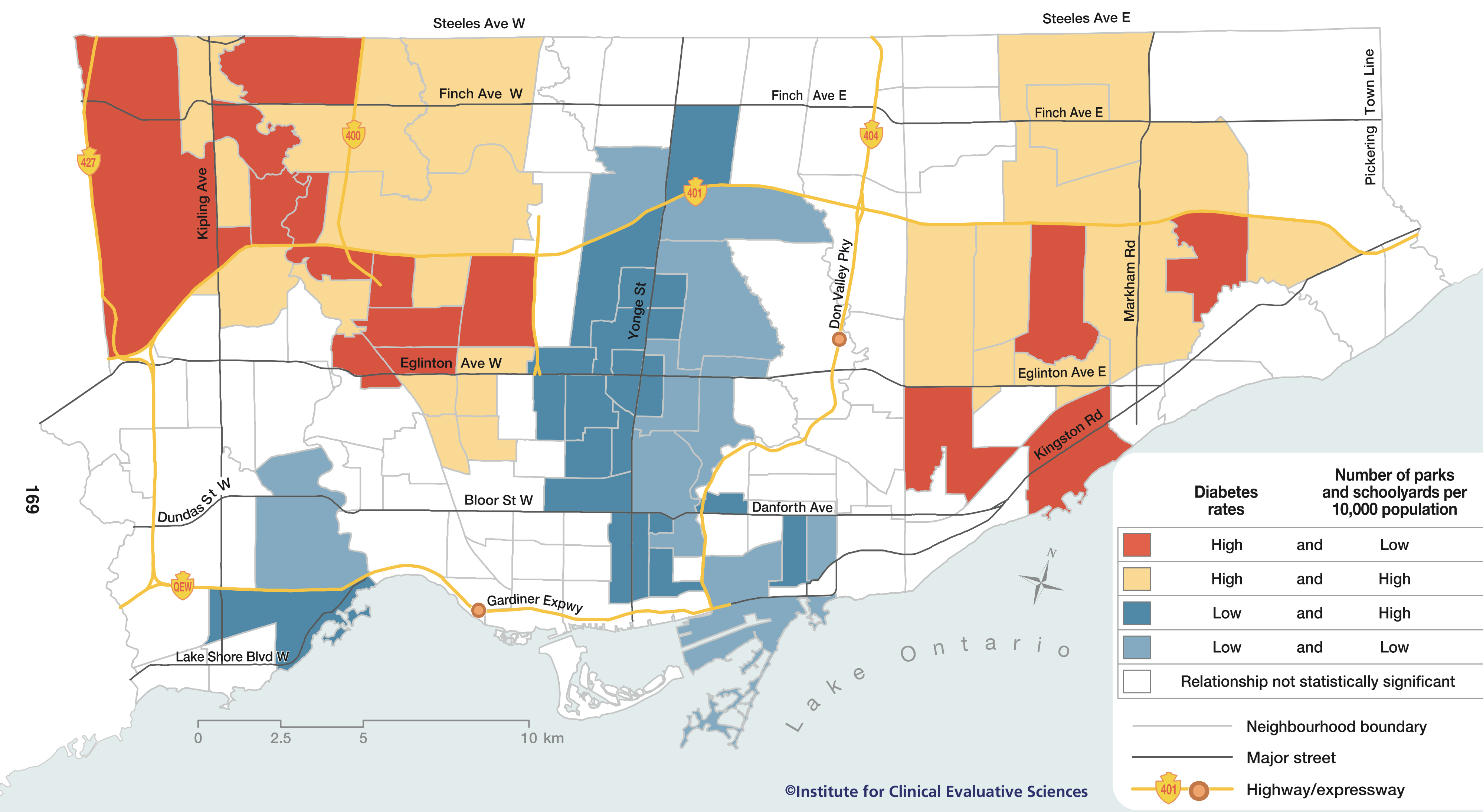
Exhibit 7.13 Modelled travel time by car to the nearest public recreational space, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- In 2001, public recreational spaces were readily accessible by car throughout Toronto neighbourhoods.

Exhibit 7.14 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and number of parks and schoolyards per 10,000 population [2002–2005] (high or low), by neighbourhood, in Toronto



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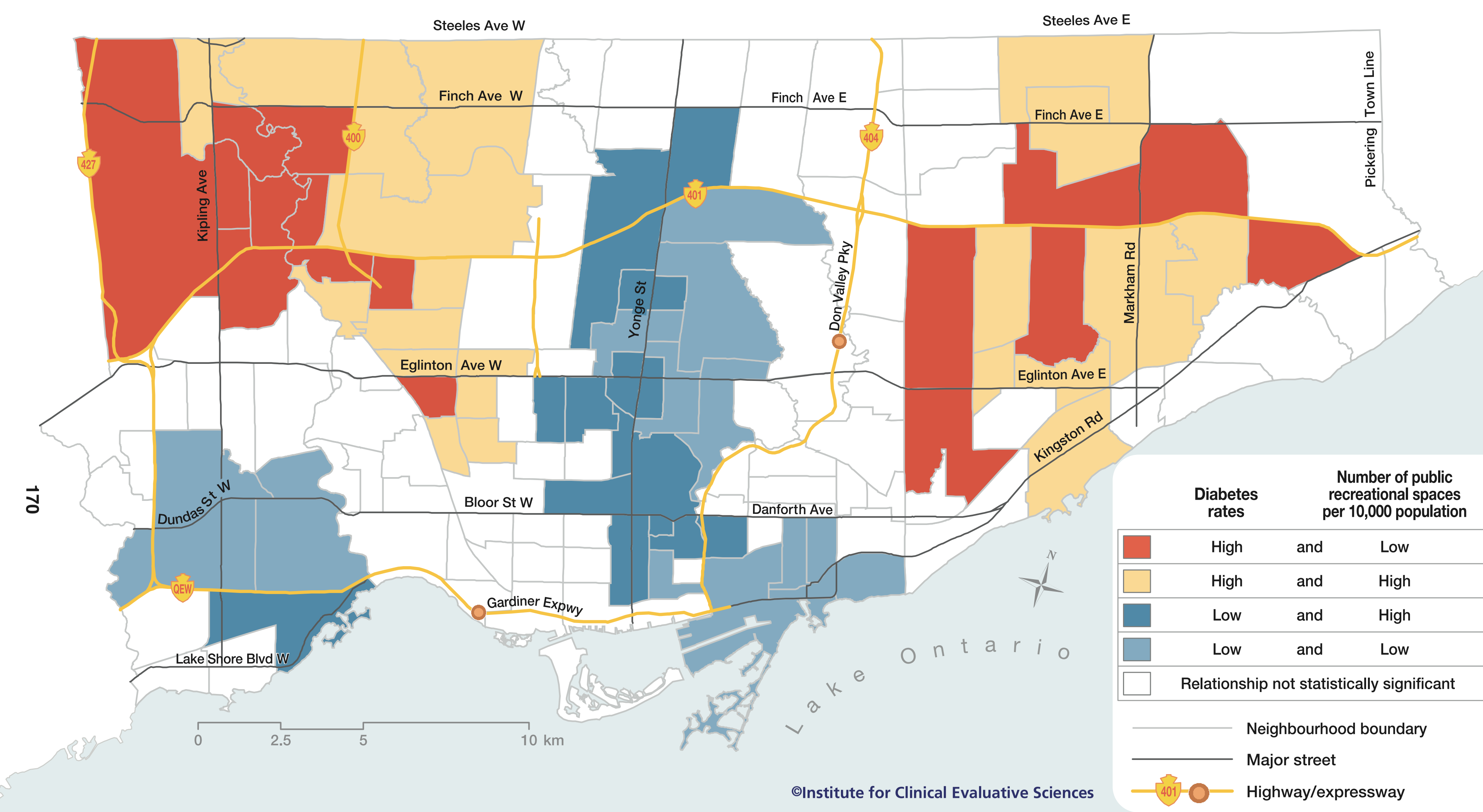
Findings

- In 2001, several neighbourhoods in the northwest and eastern areas of Toronto demonstrated a pattern of high diabetes rates accompanied by a low density of parks and schoolyards per capita.
- In contrast, there were high-diabetes neighbourhoods in the northwest and east that had relatively good access to parks and schoolyards.
- Many neighbourhoods in the south central (downtown) area and also the central and north central areas of the city had a lower density of parks and schoolyards yet had low rates of diabetes.

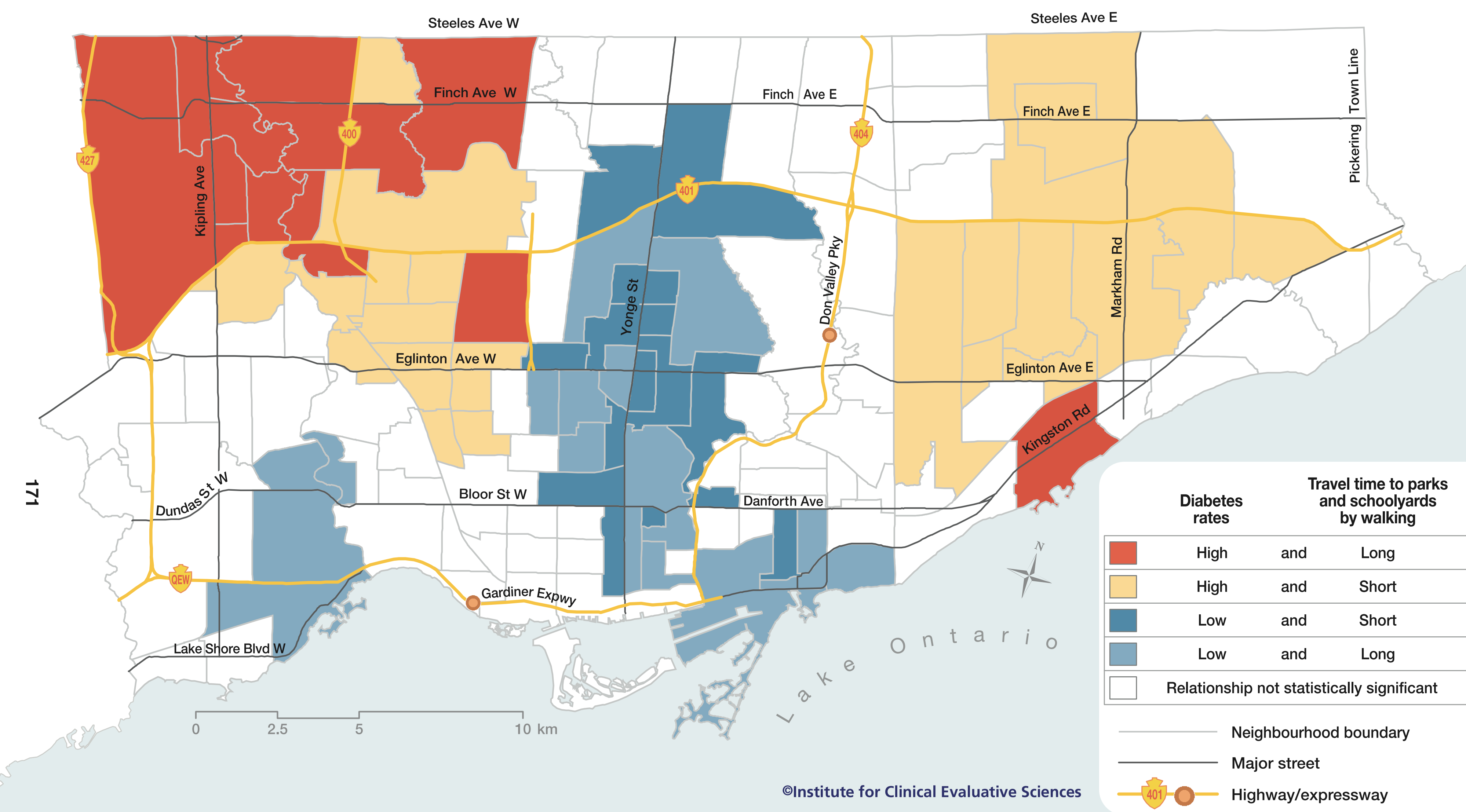
Exhibit 7.15 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and number of public recreational spaces per 10,000 population [2004] (high or low), by neighbourhood, in Toronto



Findings

- In 2001, high diabetes rates and a lower density of recreational spaces were found in the northwest and eastern areas of Toronto.
- Many of the neighbourhoods with lower densities of recreational space also had a lower density of parks and schoolyards (Exhibit 7.14). This suggests a potential lack of resources needed to promote physical activity in these neighbourhoods.
- High-income areas in the downtown (south central) area, and also in the central, central north, and southwest parts of the city, had low rates of diabetes and varied densities of recreational spaces.

Exhibit 7.16 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and travel time to parks and schoolyards by walking [2002–2005] (long or short), by neighbourhood of residence, in Toronto

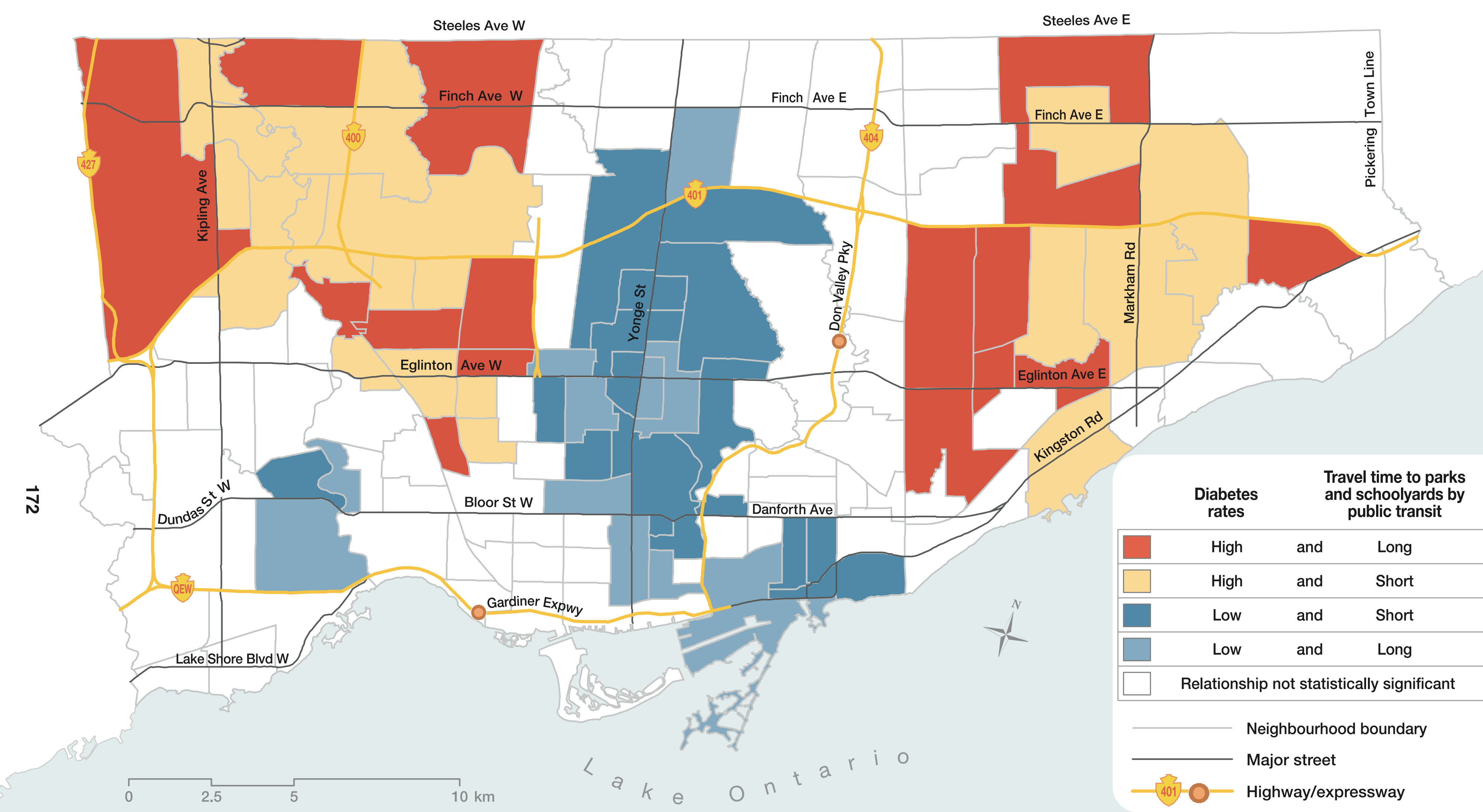


Findings

- In 2001, neighbourhoods that had both high diabetes prevalence and longer walking times to parks and schoolyards were spatially clustered in the northwest and east end of Toronto. Several other high-diabetes neighbourhoods had relatively shorter travel times to these resources.
- Residents of the downtown (south central) area had low rates of diabetes and shorter walking times to parks and schoolyards.
- The central and southwest sections of the city had low rates of diabetes and mixed access times to parks and schoolyards.

Exhibit 7.17

Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and travel time to parks and schoolyards by public transit [2002–2005] (long or short), by neighbourhood of residence, in Toronto



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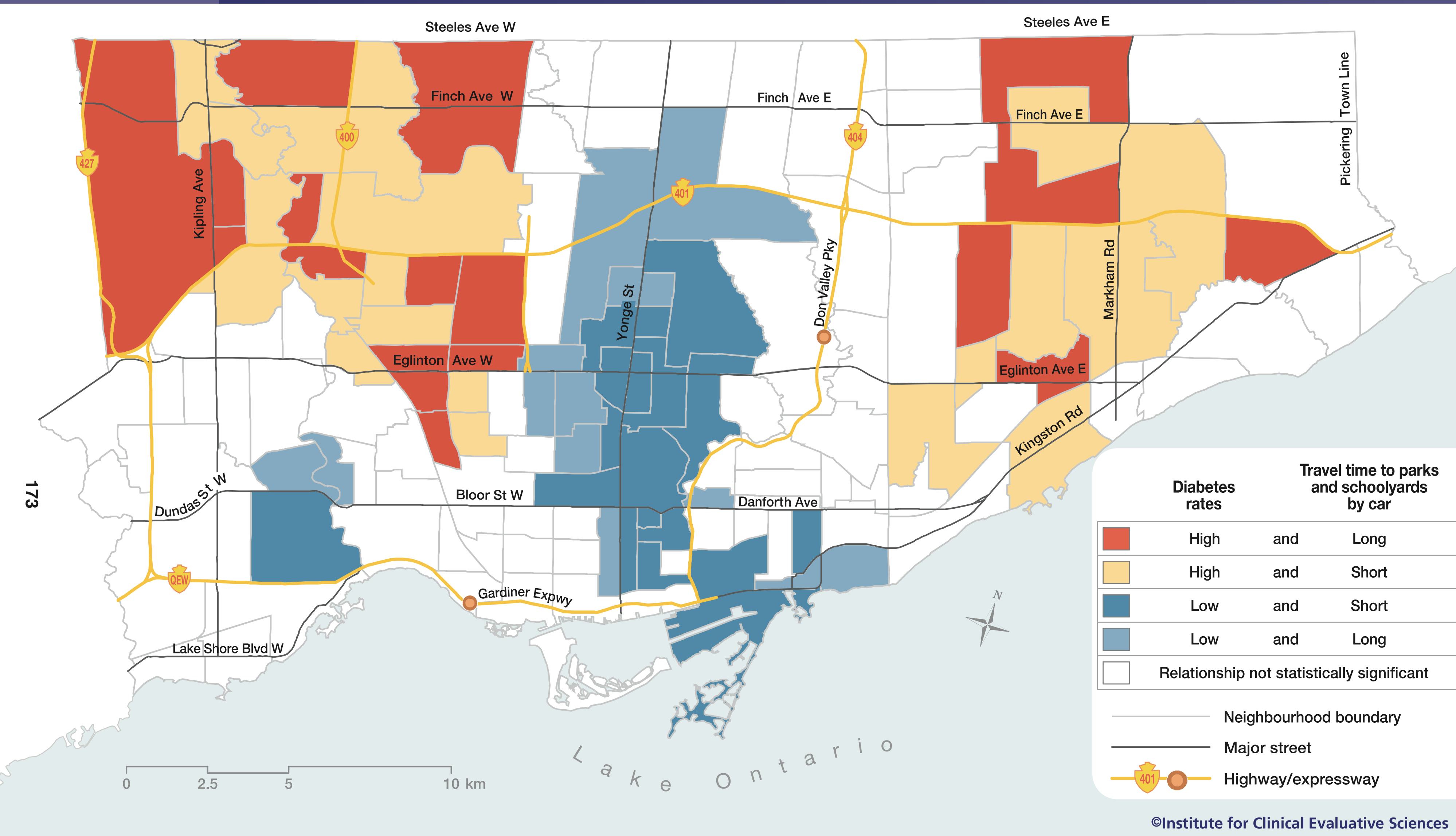
Findings

- In 2001, neighbourhoods in the northwest and east end of Toronto had both high diabetes prevalence and longer travel times by public transit to parks and schoolyards. The downtown (south central) area had low rates of diabetes and shorter travel times by public transit to parks and schoolyards.

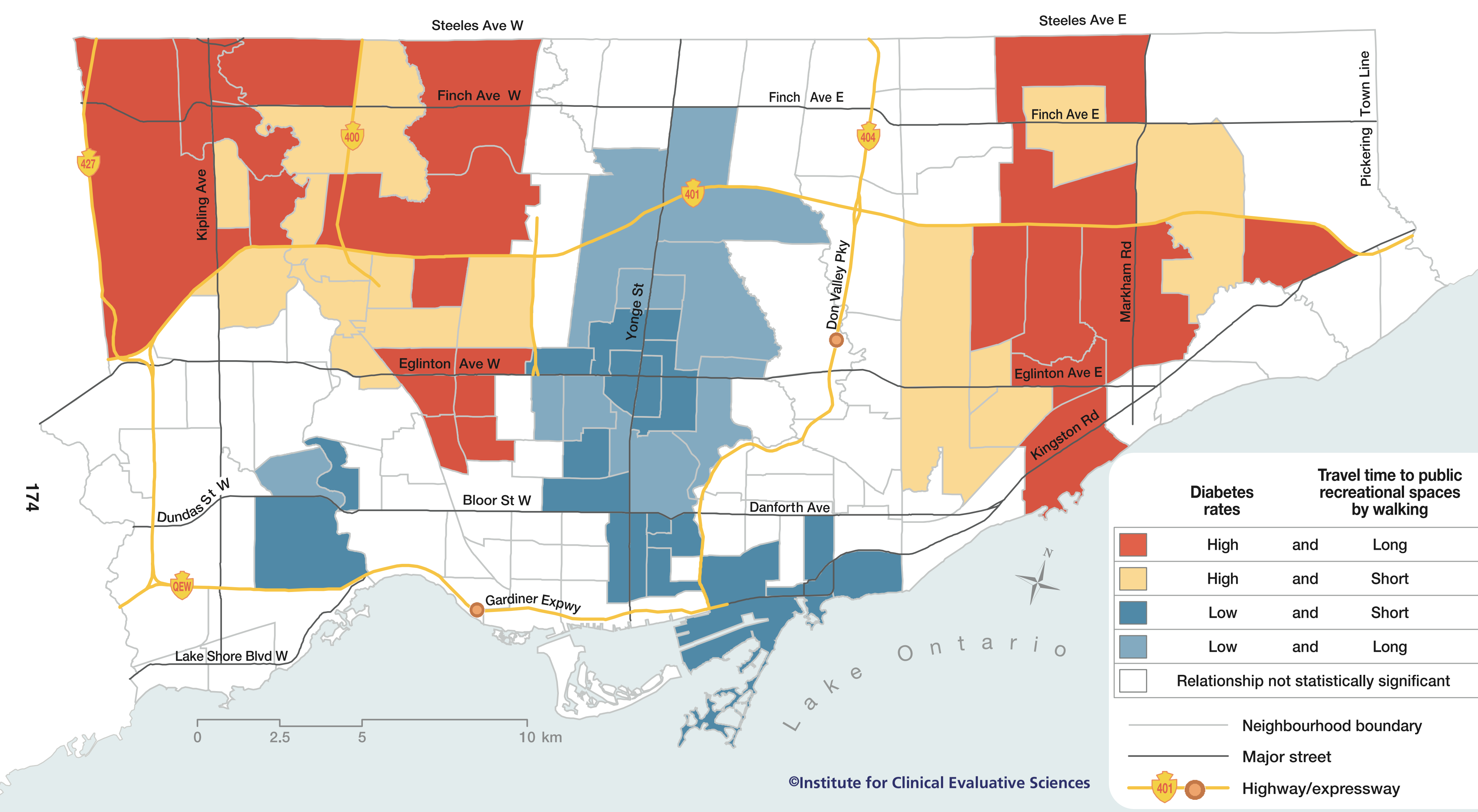
Exhibit 7.18 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and travel time to parks and schoolyards by car [2002–2005] (long or short), by neighbourhood of residence, in Toronto



Findings

- In 2001, access to parks and school yards by car was very good. However areas in the northwest and east end of Toronto had both high diabetes rates and longer travel times by car to parks and schoolyards. This pattern is similar to findings about walking and public transit.

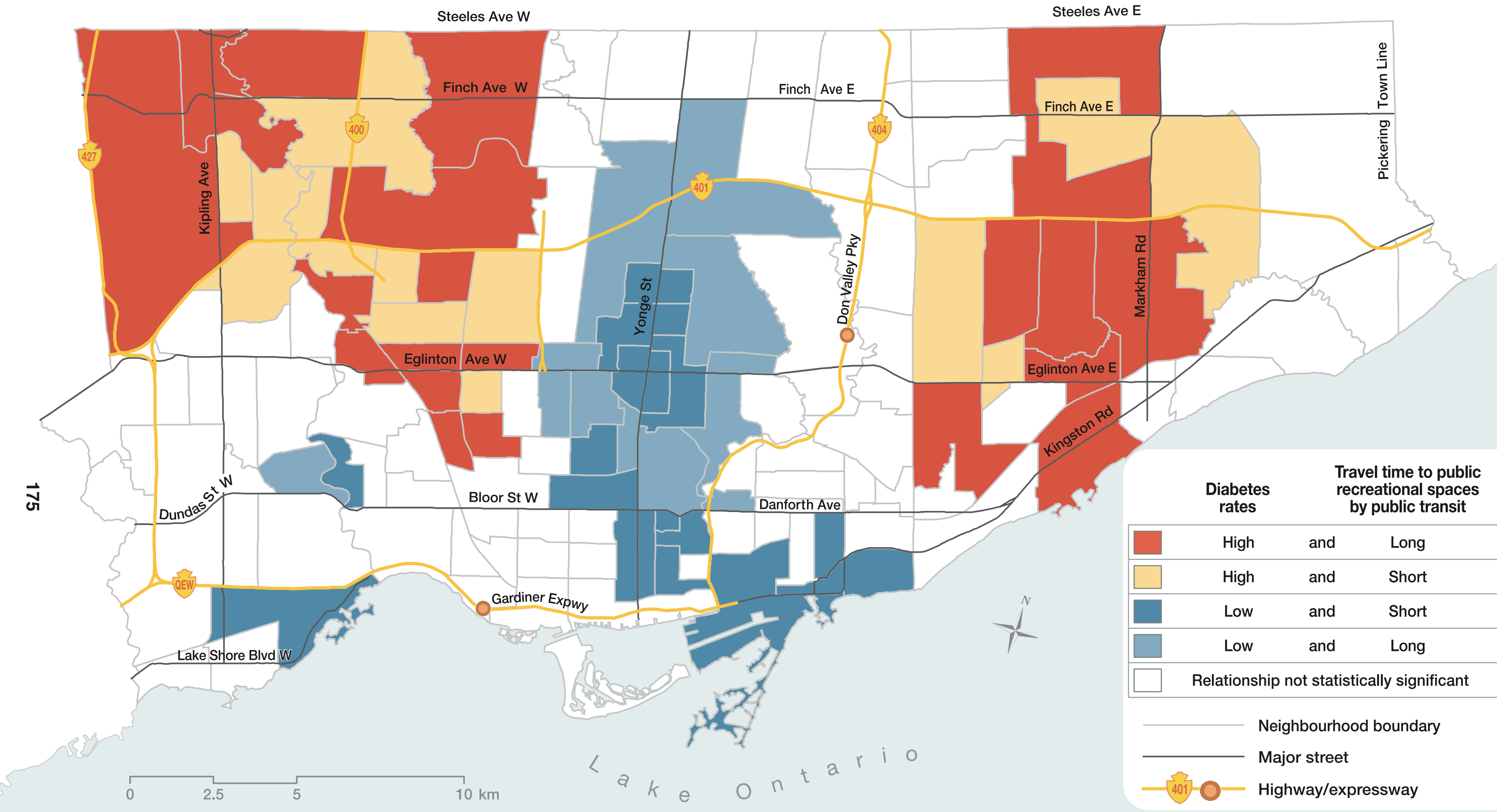
Exhibit 7.19 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and travel time to public recreational spaces by walking [2004] (long or short), by neighbourhood of residence, in Toronto



Findings

- In 2001, the northwest and east end of Toronto had clusters of neighbourhoods where high diabetes rates were associated with longer walking times to recreational spaces.
- Similar to the pattern seen with parks and schoolyards, downtown (south central) areas and southwest parts of the city had low diabetes rates and shorter walking times to recreational spaces.
- The central and north central areas of the city had low rates of diabetes and mixed access times to recreational space.

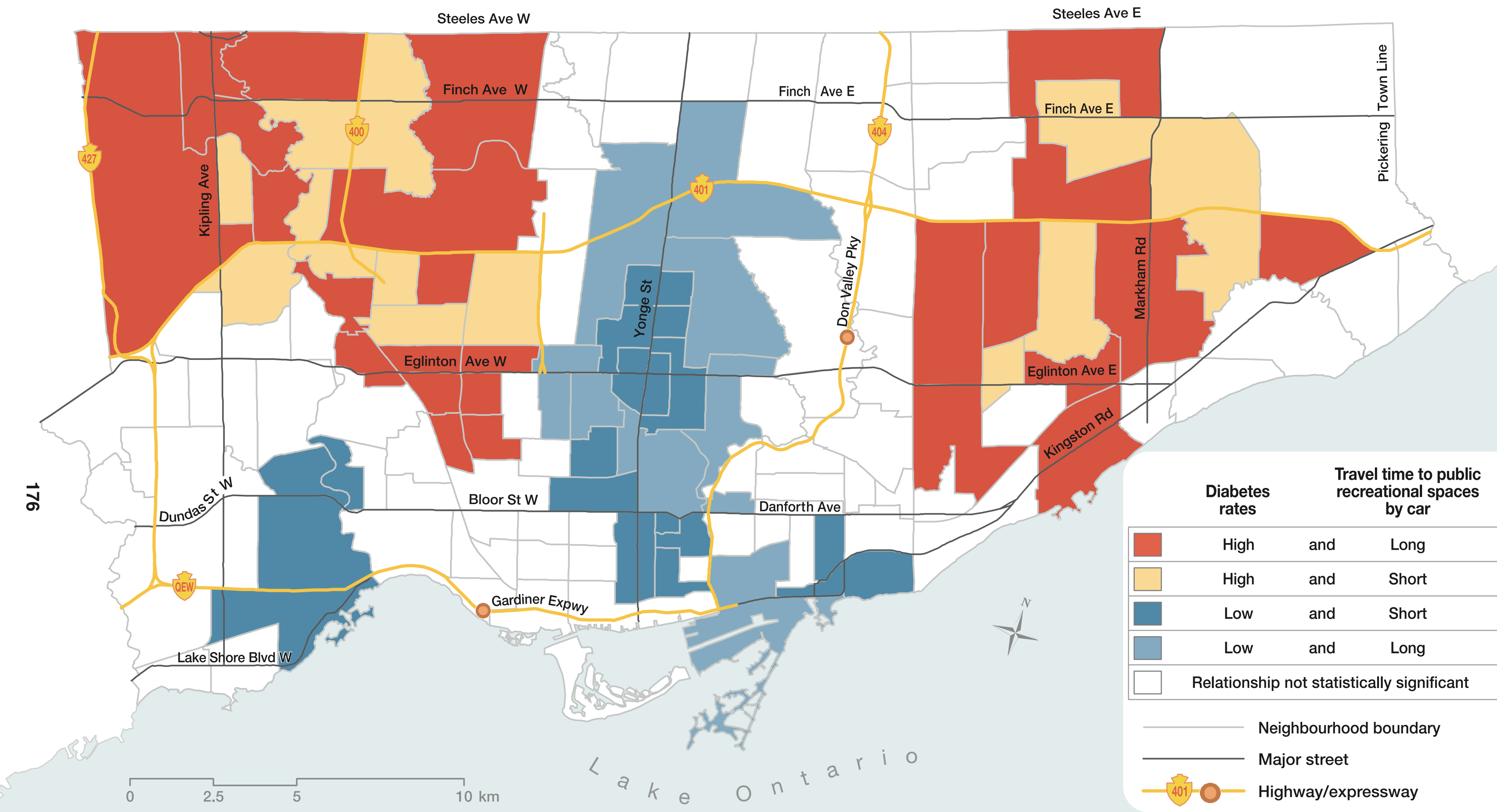
Exhibit 7.20 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and travel time to public recreational spaces by public transit [2004] (long or short), by neighbourhood of residence, in Toronto



Findings

- In 2001, the northwest and east end of Toronto were characterized by high diabetes rates and longer travel times to public recreational spaces by public transit.
- Downtown (south central) areas and southwest parts of the city had low diabetes rates and shorter travel times to recreational spaces by public transit.

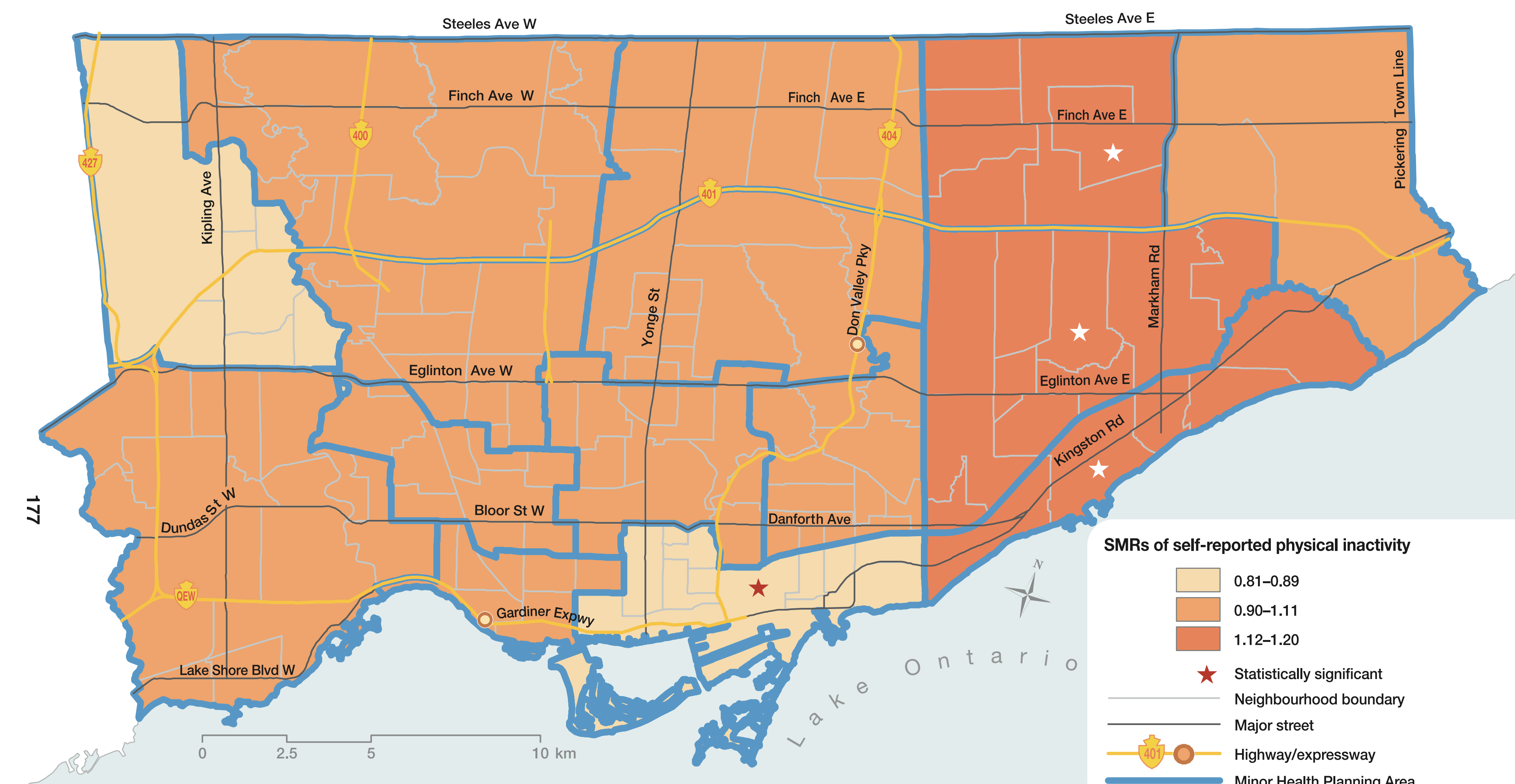
Exhibit 7.21 Spatial relationship between age- and sex-adjusted diabetes prevalence rates [2001/02] (high or low) and travel time to public recreational spaces by car [2004] (long or short), by neighbourhood of residence, in Toronto



Findings

- In 2001, areas in the northwest and east end of Toronto had high diabetes rates and longer travel time to public recreational spaces by car.

Exhibit 7.22 Standardized morbidity ratios (SMRs*) of self-reported physical inactivity among persons aged 12 years and older [2000/01 and 2003], by Minor Health Planning Area, in Toronto



* SMR is a ratio of the number of people reporting themselves to be physically inactive in each neighbourhood compared to the number that might be expected, based on the overall age-specific rates of physical inactivity across the city.

Findings

- In 2001–2003, self-reported levels of physical inactivity were significantly higher among residents living in the east end of the city than the Toronto average (which was 56 percent). These areas corresponded to neighbourhoods with high rates of diabetes.
- Access to parks, schoolyards and other recreational spaces was limited in many neighbourhoods in the eastern part of the city.
- Levels of self-reported inactivity were lower in south central Toronto compared to the average (i.e., residents said they were more physically active). This part of the city also had lower rates of diabetes, a higher density of recreational spaces, and good access to parks, schoolyards and other recreational spaces by walking and public transit.

Discussion

Availability of Parks, Schoolyards and Recreational Spaces

Parks

Park systems are popular recreation destinations for people living throughout the Toronto area, meaning they serve people who live outside the neighbourhood where they are located. Large park systems often serve a different purpose from local, small green spaces located within communities. Large parks are frequently the location for community-based fairs, picnics, walks, bicycle routes and sporting events. Smaller green spaces are more typically used as children's playgrounds, and also for dog-walking as well as other kinds of recreational walking.

In our analyses, we noted that part of the downtown (south central Toronto) and central west regions of the city had relatively little park area per capita. This is an important finding, since people living in more densely populated downtown neighbourhoods with little or no personal green space (such as backyards and gardens) theoretically would depend more on neighbourhood parks for exercise and outdoor activity. There was also a large area in the east/northeast region of the city with very low availability of parks per capita. It is interesting to note that many of the neighbourhoods lacking parks also had a low density of schoolyards and playgrounds, suggesting a true lack of public outdoor spaces in these areas.

Schoolyards

Since most schools in the city have yards or playgrounds that are accessible to the general public, they can serve as places for residents to engage in light or intense physical activity. Our data suggest that Toronto schools are spread out fairly evenly throughout the city, although residents living in parts of the west, north and east had poorer access to a schoolyard or playground. Most schools were located inside residential zones, but several areas with smaller subdivisions along the north edge of the city did not have any schools within their boundaries.

Public recreational spaces

Public recreational spaces play an important and distinct role in encouraging physical activity. They provide locations for people to participate in organized sports; in the case of indoor facilities, they provide opportunities for people to exercise comfortably during the winter months.

The widespread distribution of these facilities likely reflects the diversity of locations that are included in this category; for example, a soccer field in a park, an indoor community centre and a swimming pool located in a public school would all be considered public recreational spaces. Thus in the downtown part of Toronto, the symbols on the map are more likely to represent indoor facilities, community centres, school fields and pools, while in the outskirts they are more likely to represent fields and pools located in large parks. Since public recreational facilities include areas such as baseball diamonds, soccer fields and tennis courts (which are often found in parks), there is some overlap in the locations of recreation centres and parks.

Neighbourhoods in the west half of the downtown, the north central region and in the east end had the lowest density of recreational facilities. Several of the neighbourhoods with the lowest density of public recreational spaces also had a very low density of parks. In particular, certain neighbourhoods in the downtown (south central) and just west of downtown had low density of both parks and public recreational facilities, although some of these neighbourhoods had a higher density of schoolyards.

During the course of our analyses, we also mapped the locations of private facilities, as well as the locations of neighbourhood YMCAs. This was done to compare the distribution of public and private recreational facilities and to determine whether they were accessible to different populations. YMCAs were found in the downtown (south central), southwest and eastern parts of Toronto.

No further analysis was conducted regarding private facilities due to their relatively sparse numbers and their limited accessibility to the general public. We found that private recreational spaces were clustered mainly in the downtown core and in high-income areas of western and north central Toronto. Very few private athletic facilities were found in lower income regions of the northwest and eastern parts of Toronto.

Geographic Access to Parks, Schoolyards and Recreational Spaces

Public access to parks and schoolyards in Toronto varied considerably. There were pockets in the northwest, southwest, central and eastern parts of the city where residents could not access green space in less than 20 minutes by walking, or in 20 minutes by public transportation. This is an interesting finding since neighbourhoods in the northwest, southwest and in the east had a high density of parks and/or schoolyards per capita.

It may be that the large park areas in the west and east were easily accessible to people living in neighbourhoods directly adjacent to the parks, but less accessible to people located in the same neighbourhoods who lived somewhat farther away from the parks.

We found that many areas had limited access by public transit; this was likely due to longer indirect routes and waiting times for public transit connections in some communities. Limited access by both walking and public transit in more recently developed suburbs might also be due to urban plans designed around car travel. Many of these latter areas consist of cul-de-sacs and crescents and likely have fewer direct routes for residents to access local resources, including green space.

These areas were also characterized by a relatively sparse residential distribution, which produces longer travel distances to any neighbourhood resource. In contrast, residential areas with many small parks interspersed throughout the neighbourhood may allow access for a larger fraction of the population despite having a lower density of parkland overall.

Access to public recreational spaces in Toronto appeared to follow a similar pattern. There were some areas scattered throughout the city where a recreational space could not be accessed within a 40-minute walk or in 20 minutes by public transit; many of these neighbourhoods were located in the northwest, northeast, central and eastern regions of the city. Many of these same areas were identified as having limited access to parks and schoolyards.

Diabetes Rates and Availability of Parks, Schoolyards and Recreational Spaces

In previous chapters we showed that large areas in the northwest and east of the city had high rates of diabetes among their residents. Many of these neighbourhoods were also shown to have high proportions of low-income and immigrant residents (Chapters 3 and 4), populations that typically have higher rates of diabetes (Chapter 2).

We noted high rates of diabetes and a lower density of parks and schoolyards per capita in the northwest and eastern parts of Toronto. Similarly, we observed high diabetes rates and a lower density of recreational spaces in pockets of the northwest and east.

Neighbourhoods in the south central (downtown) area, central north and southwest areas of the city showed mixed densities of parks, schoolyards and recreational spaces; yet, for the most part, residents in these areas had low diabetes rates. These areas generally are composed of high-income populations that may not be as dependent on local facilities for opportunities to be physically active.

Diabetes Rates and Geographic Access to Parks, Schoolyards and Recreational Spaces

Some neighbourhoods with both high diabetes prevalence and longer travel times to parks, schoolyards and recreational spaces were spatially clustered in the northwest and east end of the city. However, several other high diabetes neighbourhoods in these areas had relatively shorter travel times to these resources.

We noted a particularly large cluster of neighbourhoods in the east end of the city with high diabetes rates and longer travel times—by public transit—to parks and schoolyards. Residents of the downtown (south central) area had low levels of diabetes and shorter travel times to parks, schoolyards and recreational spaces by all modes of travel. The central, north central and southwest sections of the city had low diabetes rates and mixed access times to parks, schoolyards and recreational space.

Physical Inactivity

Self-reported levels of physical inactivity were significantly higher among residents living in the east end of the city compared to the average self-report for all of Toronto. Residents in these neighbourhoods also experienced limited access to parks, schoolyards and recreational spaces. The highest levels of inactivity were reported by residents living in the northeast. These areas were also shown to have high rates of diabetes.

Residents in south central Toronto reported lower inactivity levels (i.e., they were more physically active) compared to the Toronto average; these neighbourhoods also had a high density of recreational spaces and good access by walking or public transit to parks, schoolyards and recreational spaces, as well as low diabetes rates.

Thus it seems that in the areas where people were less active (compared to the Toronto average), diabetes rates were higher; where people were more active, diabetes rates were lower. We noted that many neighbourhoods in the high-diabetes, low physical activity area had limited access to opportunities for exercise; the reverse was true in the low-diabetes, high physical activity areas.

Unfortunately, due to the size and sampling of the Canadian Community Health Survey, physical activity levels could not be reported by neighbourhood. More detailed information about physical activity at the neighbourhood level is needed.

Conclusions and Next Steps

Canadian research suggests that residents of urban areas are more likely to walk, bicycle and use public transit than those living outside cities. Yet a recent survey found that just one-third of Torontonians reported being physically active.[7]

Toronto has a rich physical activity infrastructure. In 2004, this included approximately 200 municipal or community-operated recreational centres, 140 public swimming pools, 100 public skating arenas/rinks and 1,500 parks.[7] But despite these considerable resources, several neighbourhoods were found to have low availability of and access to parks, schoolyards and recreational spaces. Residents living in some of these same neighbourhoods also had high rates of diabetes.

Spatial clustering of high diabetes rates and low density or limited access to parks, schoolyards and recreational spaces was evident in parts of the northwest and east of the city. In these neighbourhoods, community programs and resources aimed at encouraging people to be more physically active may not be sufficient if residents cannot access places where they can exercise. In these parts of the city, the creation of additional recreational spaces may be recommended.

We realize that the existence of recreational resources in a neighbourhood does not necessarily ensure that these resources will be used by neighbourhood residents. It is not simply the availability of parks and recreational facilities that encourages use, but also the aesthetics, design and safety of recreational spaces, as well as social and personal factors unique to each individual.[43,44]

An important consideration is that many neighbourhoods in the northwest and east end of the city had high proportions of low-income and immigrant populations (Chapters 3 and 4) who typically experience higher rates of diabetes than the general population. In these areas, exercise preferences may be influenced by ethnocultural norms. The ability to participate in some sports may also be constrained by financial realities. Community-based programs to promote physical activity in these areas should take this into consideration.

Land use patterns in Toronto are responsible for some of the relationships found for parks, school yards and recreational spaces. For instance, large park systems were more common outside the central core of the city, whereas schools and recreational centres tended to be less common in these areas. Many communities in Toronto still do not have easy access to public transportation, making their residents more dependent on cars.

Limited access by both walking and public transit in more recently developed suburbs may also be due to their design around car travel. Many of these suburban areas consist of crescents and cul-de-sacs. This means there are fewer direct routes that would allow residents to access local resources, including green space. These newer suburban areas of the city are also characterized by a relatively sparse residential distribution, which produces longer travel distances to any neighbourhood resource. We believe more research is needed to better understand the environmental correlates of physical activity for Toronto residents.

Appendix 7.A—How the Research was Done

Data sources

In order to find the area and number of parks, we consulted the City of Toronto 2004 Land Use File and DMTI Spatial Parks layer. Park size was limited to a minimum of 2,500 square metres to exclude small parkettes. This excluded approximately 30 percent of the parks in the city, but the total park area lost was minimal due to the small sizes of the excluded parks. Golf courses and the Metro Toronto Zoo (located on the outskirts of the city) were also excluded, while large cemeteries were included as a possible location for active walking and bicycling. In total, 1,089 parks were included in the analysis. The Ontario Ministry of Education supplied the locations of schools for 2005, which totalled 918.*

The City of Toronto Parks, Forestry and Recreation (formerly the Economic Development, Culture and Tourism, Research and Grants Department) supplied the 2004 recreation facility data. These facilities included: community centres, indoor and outdoor pools, arenas, artificial ice rinks, gymnasiums, baseball and softball diamonds, soccer fields and tennis courts.

These files were geocoded and provided to us in a Geographic Information System (GIS) file format. A total of 1,436 public spaces of recreation, corresponding to 752 unique locations, were mapped. There was some overlap between places of recreation and parks, since many soccer fields and baseball diamonds were located within city parks. Only public recreational spaces were included in the principal analysis since, by definition, these are accessible at no cost or at low cost to all residents. Thus, access to these spaces should not be highly dependent on socioeconomic status, unlike access to private gyms and clubs.

Although private gyms and clubs as well as some programs in YMCAs are not universally accessible, it could be important to understand where they are located. It is possible that they serve to fill in gaps in public services, especially in higher-income neighbourhoods. For that reason, maps locating these facilities were included in this chapter. The locations of 129 private gyms and clubs were obtained from the 2004 City of Toronto Employment Survey data; the locations of 68 YMCA facilities were identified using the 2005 211 FindHelp Information Services database.

Age- and sex-adjusted diabetes rates were calculated using the Ontario Diabetes Database and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES).

The 2000–2001 Canadian Community Health Survey (CCHS) was used to determine rates of self-reported physical activity in Toronto by area of residence.

Analysis

We examined the availability and accessibility of parks, schoolyards and recreational facilities for neighbourhoods throughout the city. The relationship between diabetes rates and these measures of accessibility was evaluated using bivariate *Local Indicator of Spatial Association (LISA)* maps.

"Availability" is depicted in two ways on maps included in this chapter:

- The first method uses symbols to show the locations of the resource (i.e., recreational spaces across the city). This method allows us to determine where services were located and whether certain resources existed in specific neighbourhoods.
- The second method uses colour or shading to show the density of the resource in an area, taking population into account (i.e., the number of recreational spaces per 10,000 population). This method tells us where resources were located in relation to where people lived, and which neighbourhoods had more resources per capita than others.

"Access" or "accessibility" as shown on the accessibility maps is defined as the travel time in minutes from a point of residence to a resource location (e.g., along the network of streets, public transit routes and highways leading to a recreation centre).

More detailed information about data sources, rate calculations and analyses is available in "Appendix B: Technical Notes" at the end of this Atlas.

* Ministry of Education disclaimer: "The information is provided for informational purposes only. Although the Ministry endeavours to keep the information accurate and current, it cannot be held responsible for any damage resulting from its use."

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INSIDE

8
Chapter

Healthy Food and Diabetes

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Executive Summary

Issue

It has been argued that food quality is the most critical factor that promotes health in urban environments. Diets rich in fruits, vegetables and whole grains have been associated with lower rates of insulin resistance and type 2 diabetes. The availability of affordable, nutritious food in local stores may influence the food choices and eating habits of area residents.

Study

The locations of grocery stores were obtained from the City of Toronto's 2004 Employment Survey (conducted by the Planning Division). The locations of additional vendors selling fruits and vegetables were identified using the Ontario Food Terminal Database. Locations of City of Toronto programs that offered meals to homeless or underhoused populations were obtained from the Social Policy Analysis and Research Unit of the City's Social Development Finance and Administration Division. Geographic accessibility to food stores was calculated using network analysis and is shown on maps that modelled travel times. The travel time in minutes was measured from a point of residence to the nearest food store located along the network of streets, public transit routes and highways. The relationship between diabetes rates and these measures of accessibility was evaluated using bivariate *Local Indicator of Spatial Association (LISA)* maps.

Key Findings

- Large sections of the city had limited access to grocery stores and fruit and vegetable stands, particularly north of the downtown core.
- The northwest and east ends of the city contained many neighbourhoods that experienced high diabetes rates, along with limited availability of and access to stores selling fruits and vegetables.
- Many of the neighbourhoods identified as having high diabetes rates and limited access to stores selling fresh fruits and vegetables were characterized by low annual household income levels, a high rate of immigration and poorer access to public transportation.

Implications

- **Limited access to stores selling foods that are affordable and nutritious may lead to unhealthy eating behaviours.**
- **Given the ongoing epidemic of obesity in North America and many western nations, public health measures to encourage and enhance healthy eating must be considered a major priority.**
- **Access to healthy foods may be modifiable through improved public transit and through changes in neighbourhood planning, and zoning. Other measures could also be taken that encourage grocery stores to move into high-need communities.**

Introduction

Today's parallel epidemics of obesity and diabetes are the result of a number of contributing factors. The typical North American or "western" diet is not only high in calories, but also rich in saturated fat and sugar, factors that individually have been linked to an increased risk of insulin resistance and type 2 diabetes.[1] In contrast, diets high in fruits, vegetables, fibre, and polyunsaturated or monounsaturated fat may protect against these conditions.[2-5]

Despite increasing levels of obesity and type 2 diabetes, Canadians are actually eating more fruits and vegetables now than they were two decades ago. Since the early 1990s fruit consumption has risen by 19 percent, and the intake of vegetables has increased by three percent.[6] However, these encouraging trends are not necessarily translating into better eating habits. The consumption of less nutritious foods, and of total calories in general, also appears to be increasing. Furthermore, the relatively higher cost (actual or perceived) of nutritious foods and the abundance of low-cost unhealthy food options may mean some Canadians are eating more poorly today than they were two decades ago.

The types of food available in local stores could influence the eating habits of area residents. Larger supermarkets and grocery stores, in particular, may provide more nutritious options for local consumers. For example, a study from the United States (US) found that supermarkets had four times the average inventory of healthy foods compared to convenience stores.[7] Furthermore, dietary choices can be influenced by the availability of food stores and services: another American study found that pregnant women living more than four miles from a supermarket were 2.5 times more likely to have a poor quality diet than those living closer to a supermarket, even after researchers controlled for factors such as age, race, income and education.[8] Finally, a third study showed a direct correlation between the availability of grocery stores and the likelihood that local residents met their recommended dietary intake of fruits, vegetables, fat and cholesterol.[9]

Research also suggests that many people with low or fixed incomes simply cannot afford to buy healthier foods. A Canadian study found that low-income households purchased fewer servings of milk products, fruits and vegetables.[10]

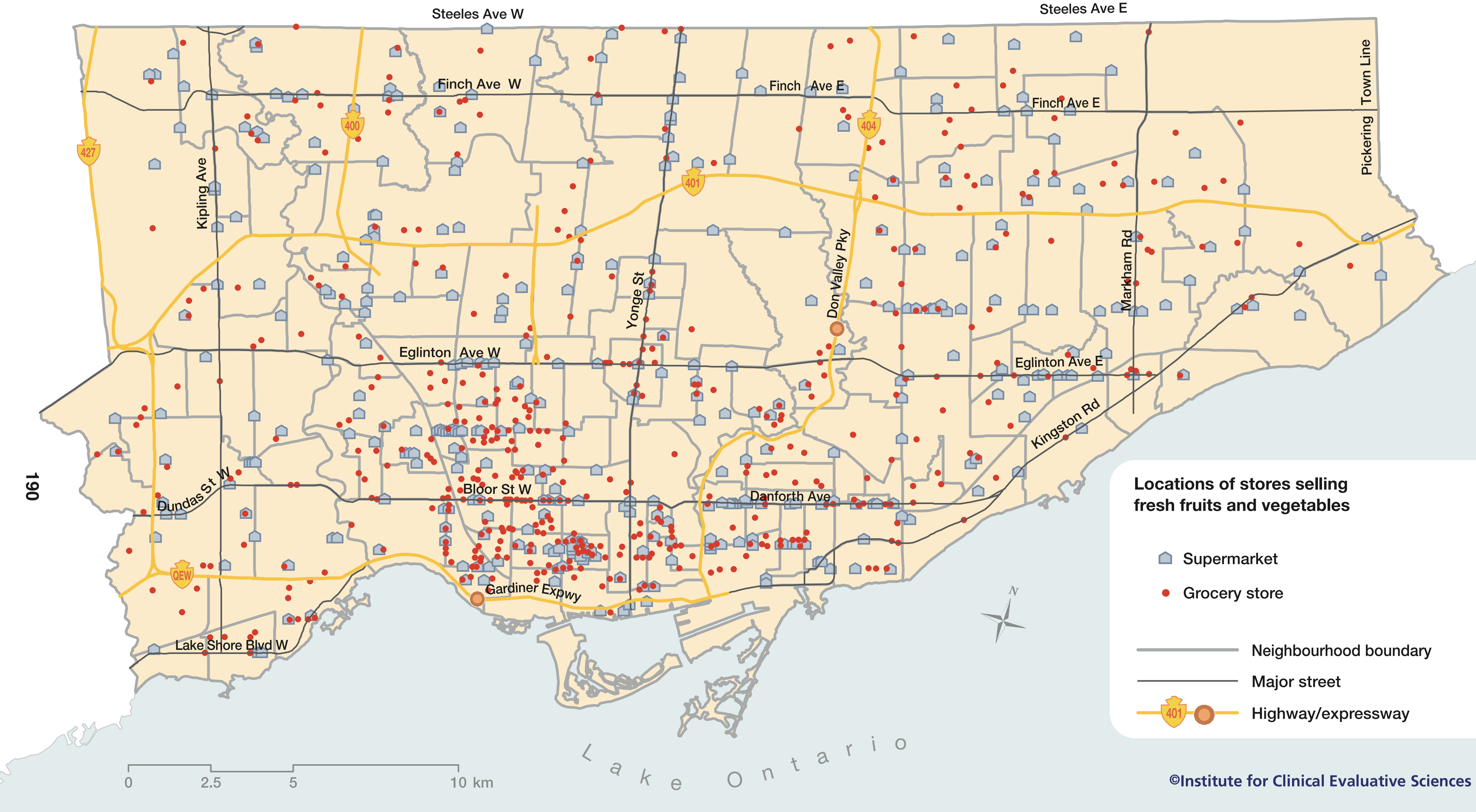
In the US, poverty has been associated with lower consumption of fruits and vegetables, lower-quality diets, and a higher likelihood of obesity.[11,12] In addition to direct financial barriers, low-income neighbourhoods in the US have fewer supermarkets than wealthier neighbourhoods, creating an additional barrier to accessing healthy food for low-income families.[7,13]

There could be a socioeconomic explanation for some of these findings. For example, foods which are high in fat and sugar may be less expensive than fresh fruits and vegetables.[12] Low-income families often have limited weekly budgets and may be less able to pay more up front in order to buy food in bulk, which is a less expensive alternative to buying small quantities of groceries.[7] In Canada, the high cost of fresh produce during the winter months, when these items must be imported from warmer climates, could make many fruit and vegetable choices less affordable.

Chapter 8—List of Exhibits

Exhibits and Findings

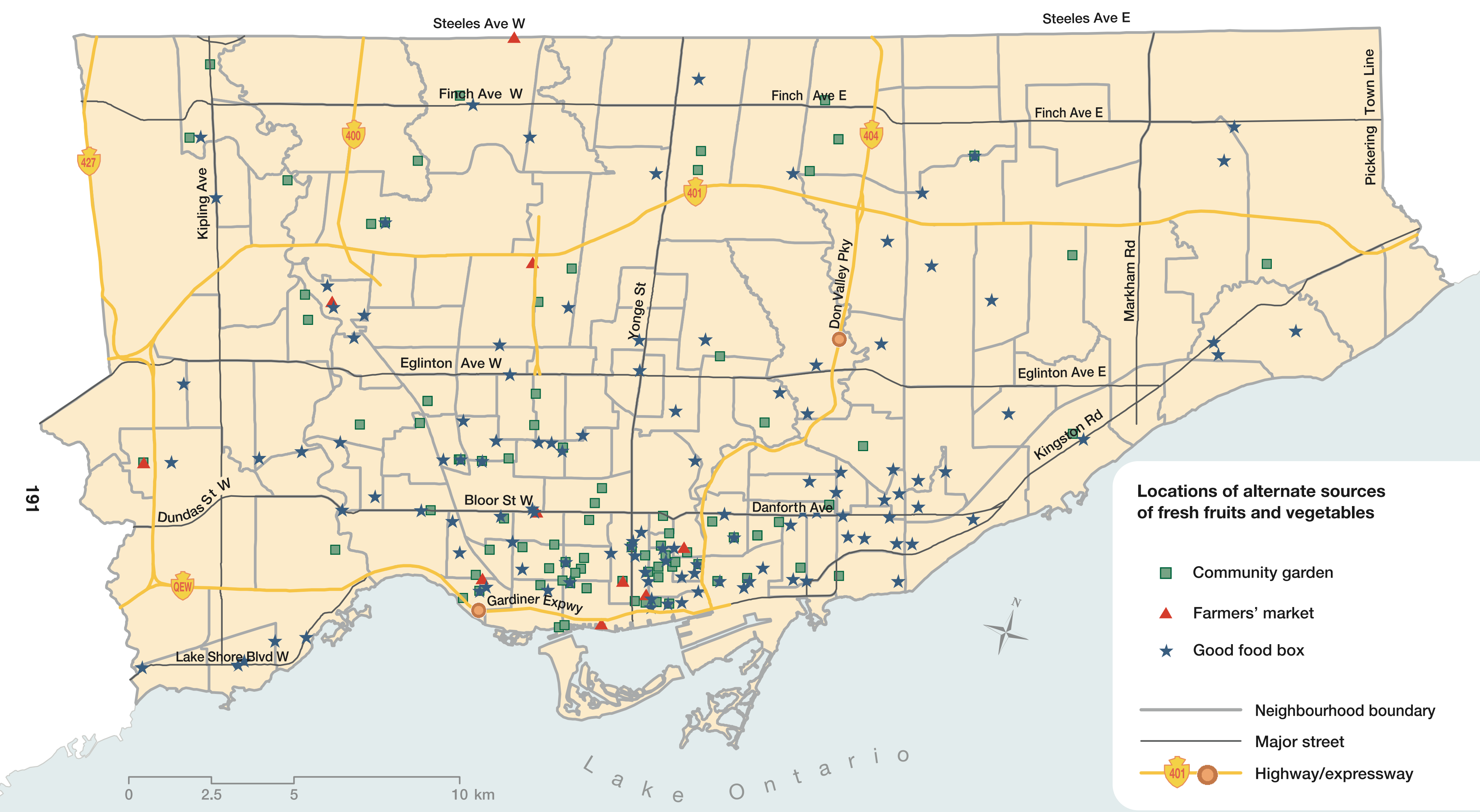
Exhibit 8.1 Locations of stores selling fresh fruits and vegetables, in Toronto, 2004



Findings

- In 2004, the highest concentration of stores selling fresh fruits and vegetables was in the south central region of Toronto and along major roadways.
- The availability of stores selling fresh fruits and vegetables decreased substantially north of the downtown, in the north central region of the city, and in the northeast and northwest, particularly in neighbourhoods that were far from a major roadway.

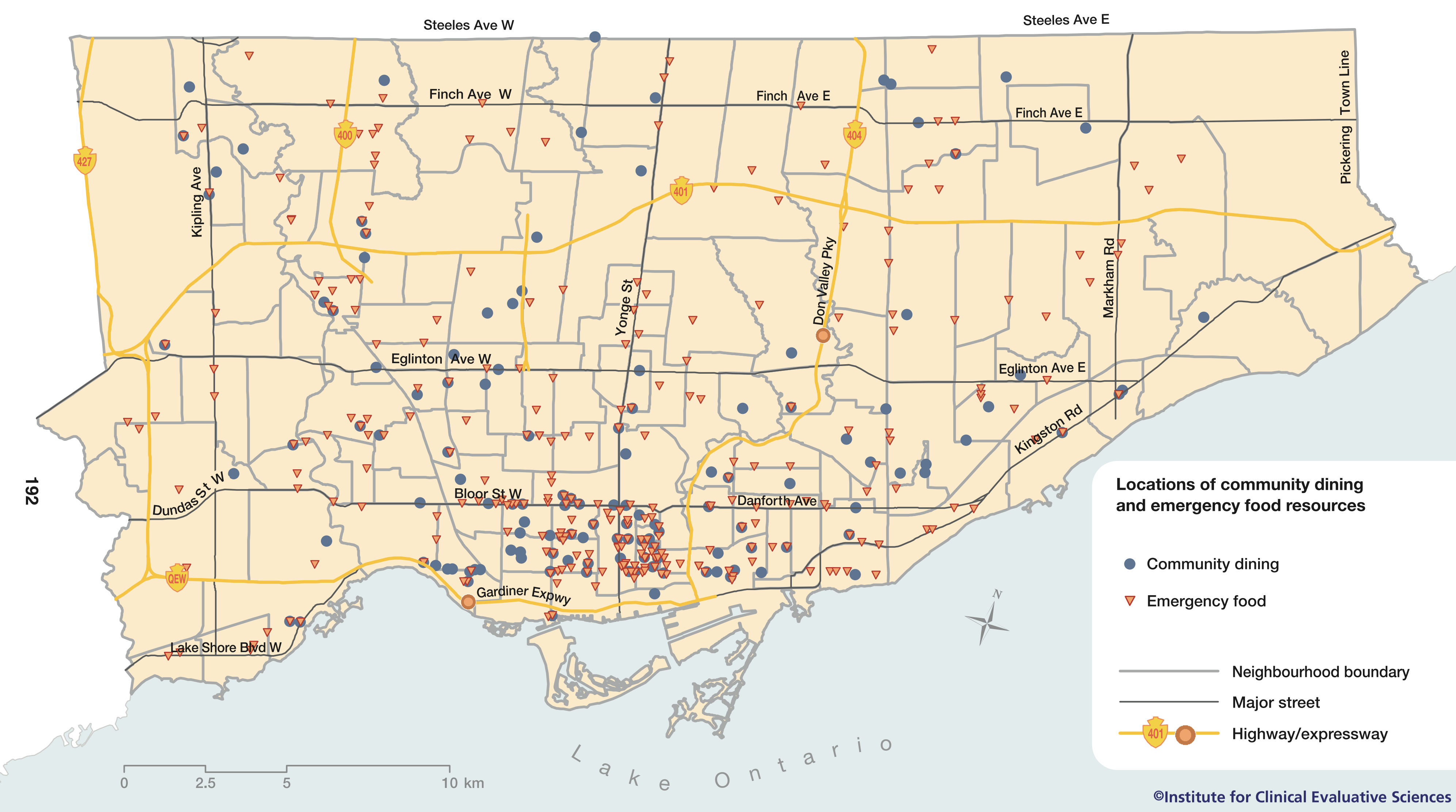
Exhibit 8.2 Locations of alternate sources of fresh fruits and vegetables, in Toronto, 2005



Findings

- In 2005, alternate sources of fresh fruits and vegetables (i.e., community gardens, farmers' markets and a good food box program were concentrated in the downtown core of the city, with a few locations scattered throughout the rest of the city. (Good food boxes were provided via a program that sold fresh produce at cost and delivered it to neighborhood drop-offs.)
- With few exceptions outside of the downtown, these alternate sources of fresh produce were located in lower-income communities.

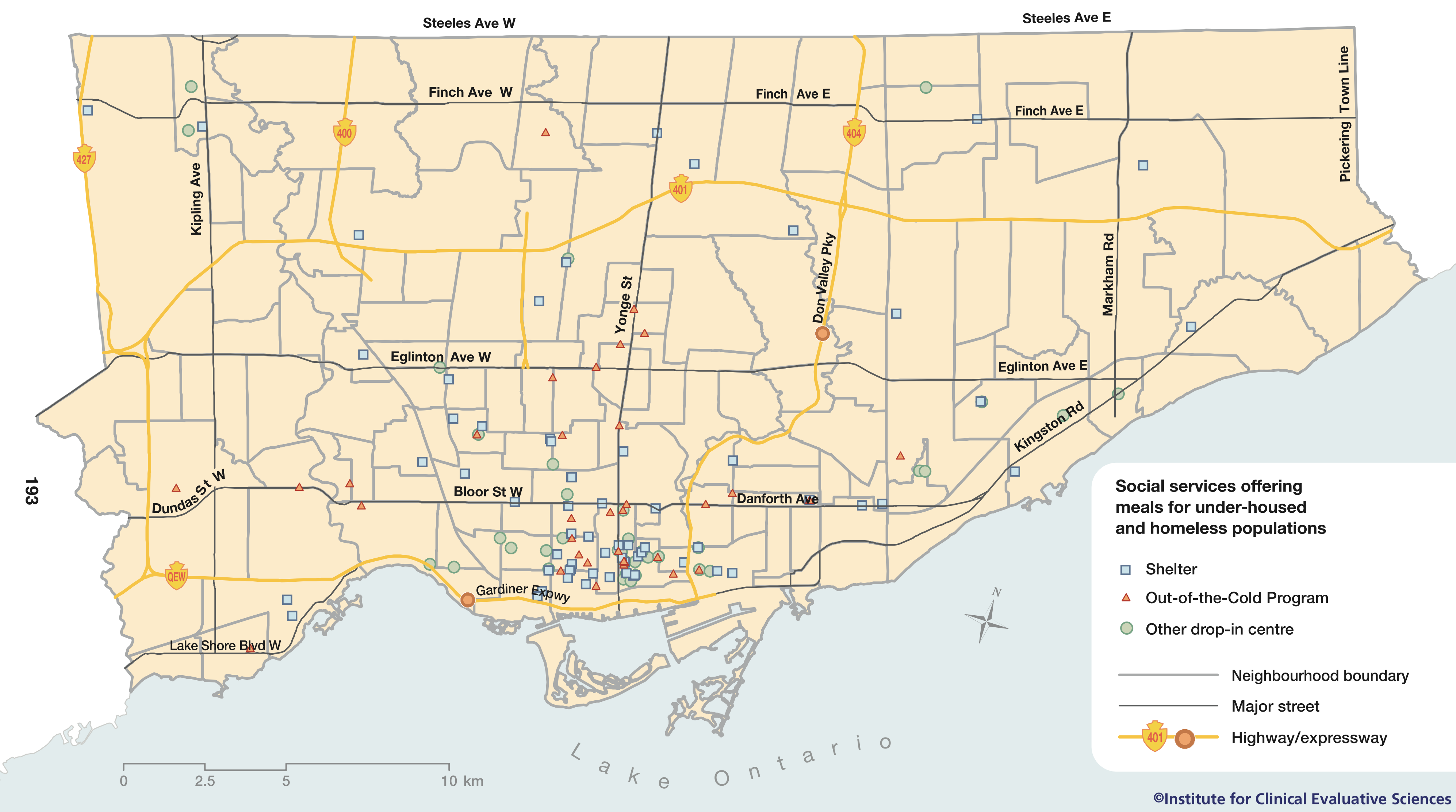
Exhibit 8.3 Locations of community dining and emergency food resources, in Toronto, 2005



Findings

- In 2005, emergency food resources and community dining were concentrated in downtown Toronto as well as in or near low-income neighbourhoods. This is similar to the pattern seen for alternate sources of fresh fruits and vegetables (Exhibit 8.2).

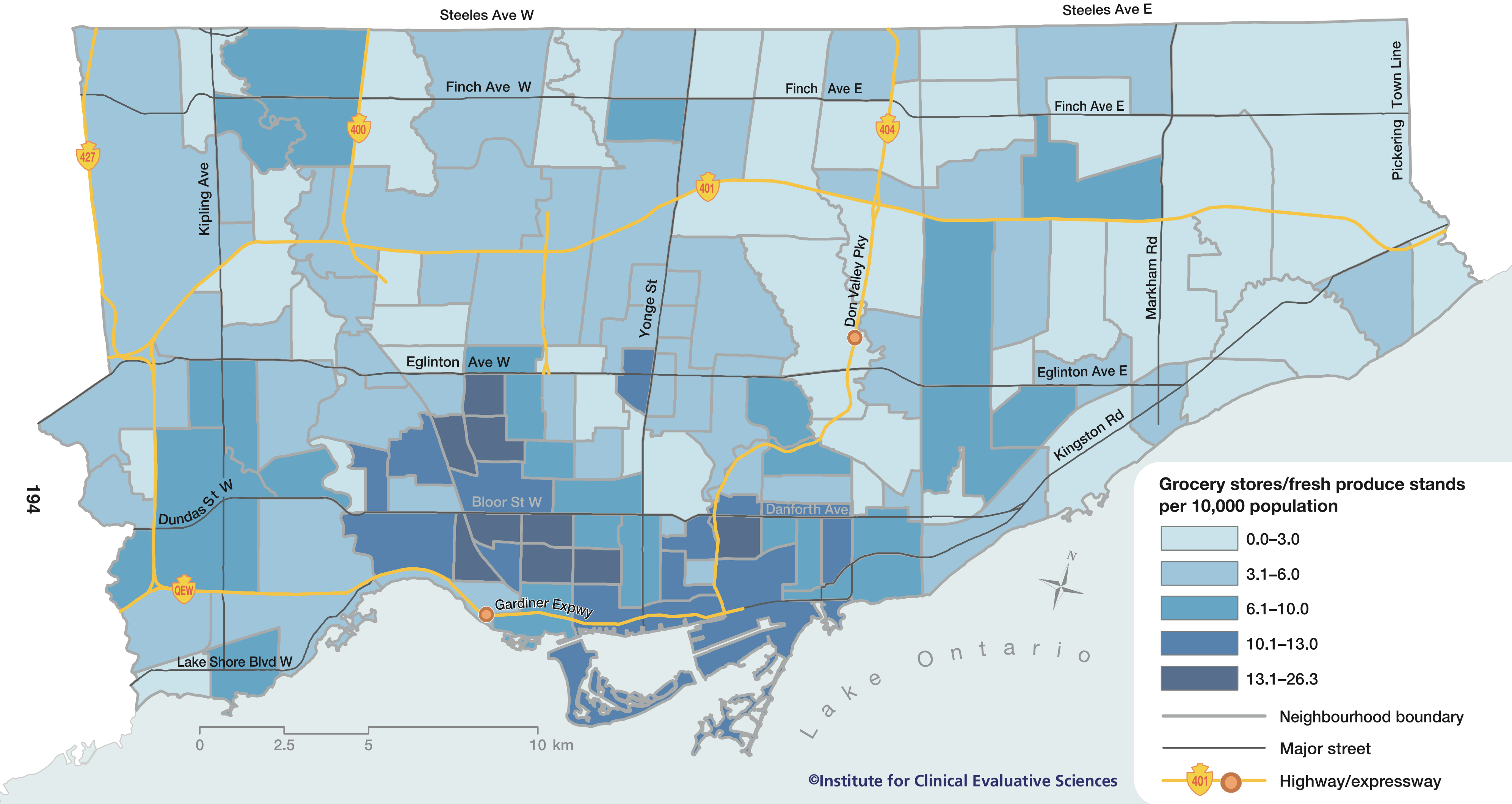
Exhibit 8.4 Locations of social service organizations offering meals for under-housed and homeless populations, in Toronto, 2005



Findings

- In 2005, food provided by social service agencies for under-housed and homeless residents followed a similar pattern to that seen in Exhibits 8.2 and 8.3. These food sources were located largely in the downtown core and, to a lesser extent, in lower-income communities outside the downtown.

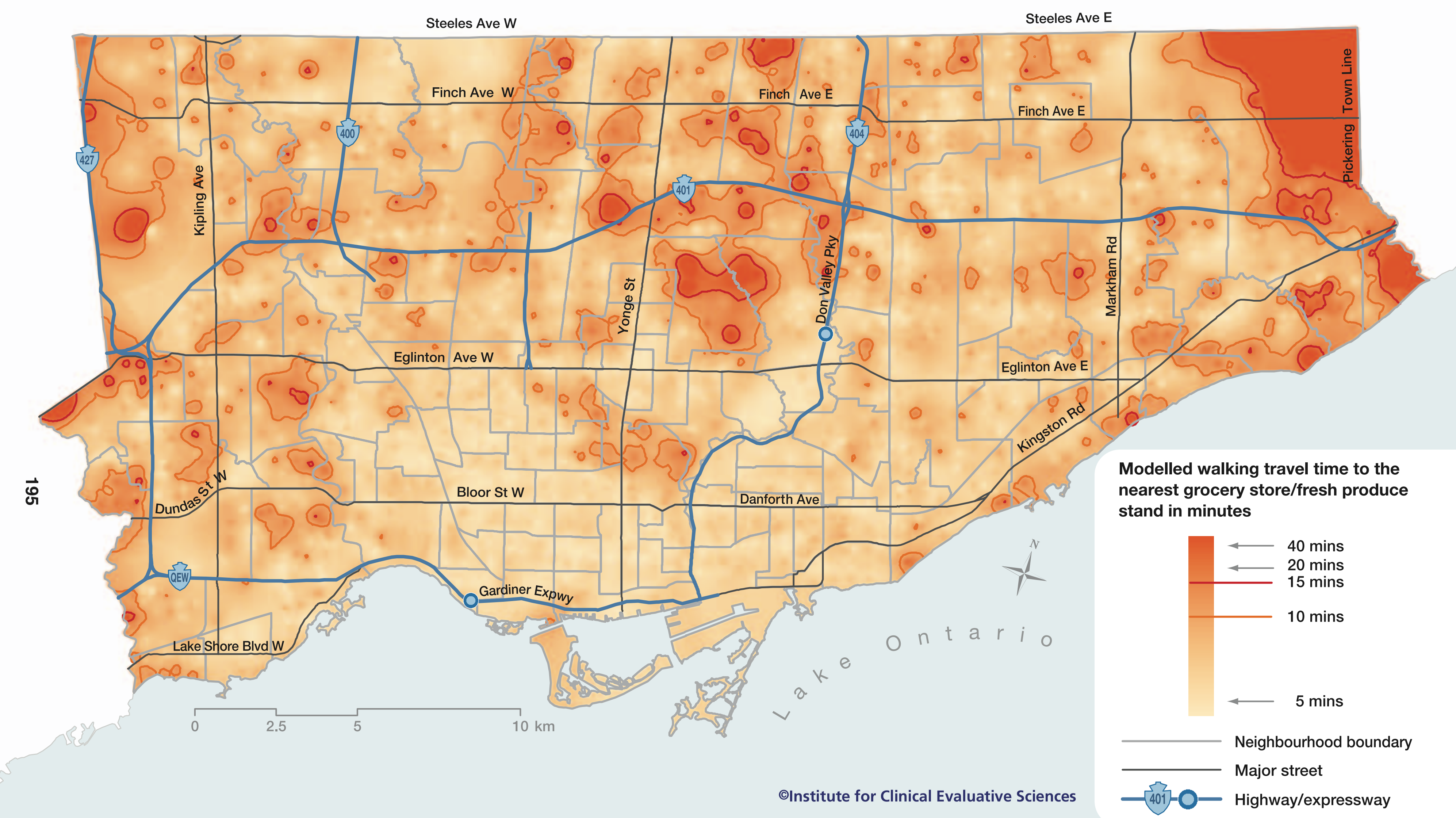
Exhibit 8.5 Number of grocery stores/fruit and vegetable stands per 10,000 population [2001], by neighbourhood, in Toronto, 2004



Findings

- In 2004, the number of stores/stands per capita selling fresh fruits and vegetables varied by as much as 10-fold between neighbourhoods. Availability was greatest in south central Toronto and poorest in the north and east ends of the city.
- Neighbourhoods in downtown Toronto with fewer stores/stands per capita selling fresh fruits and vegetables had among the lowest average annual income levels in the city (Chapter 3). They also had higher proportions of residents belonging to a visible minority group (Chapters 3 and 4). (The proportion of visible minorities living in each neighbourhood was derived from the 2001 Census of Canada, which uses the following definition based on the Employment Equity Act: visible minorities are “persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour.”)

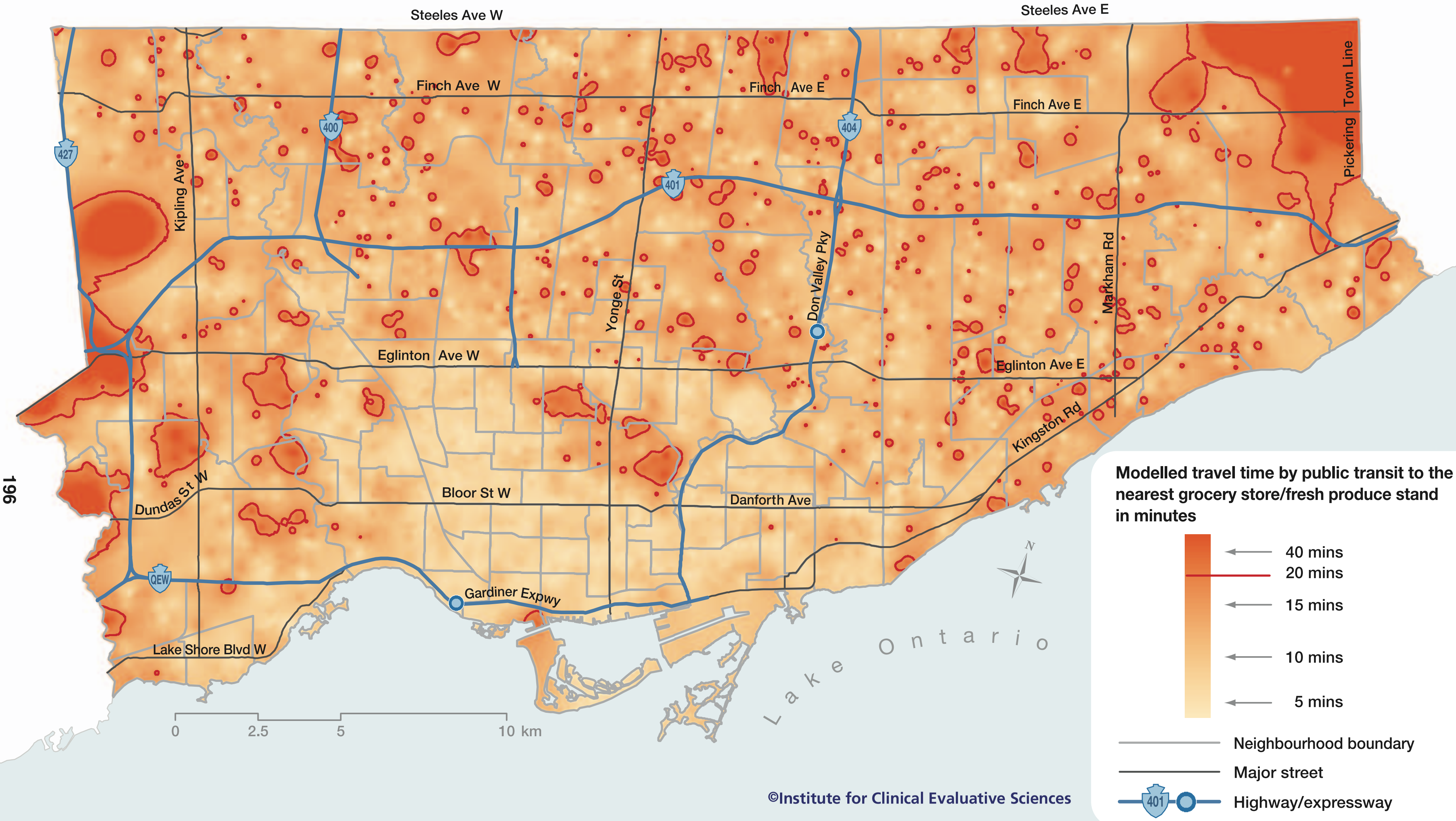
Exhibit 8.6 **Modelled travel time by walking to the nearest grocery store/fruit and vegetable stand, in minutes, by neighbourhood of residence, in Toronto, 2004**



Findings

- In 2004, throughout most of Toronto, stores selling fresh fruits and vegetables could be accessed within a 10-minute walk.
- More limited access to stores selling fresh fruits and vegetables was seen in the northern part of the city, particularly in the north central region. Access was also limited in the west and east ends, where walking times to a store selling fresh produce ranged between 20 and 40 minutes.
- Many communities with reduced access to stores selling fresh produce were located within newer residential subdivisions. These same areas had lower access to all retail services compared to older, more established neighbourhoods (Chapter 6).

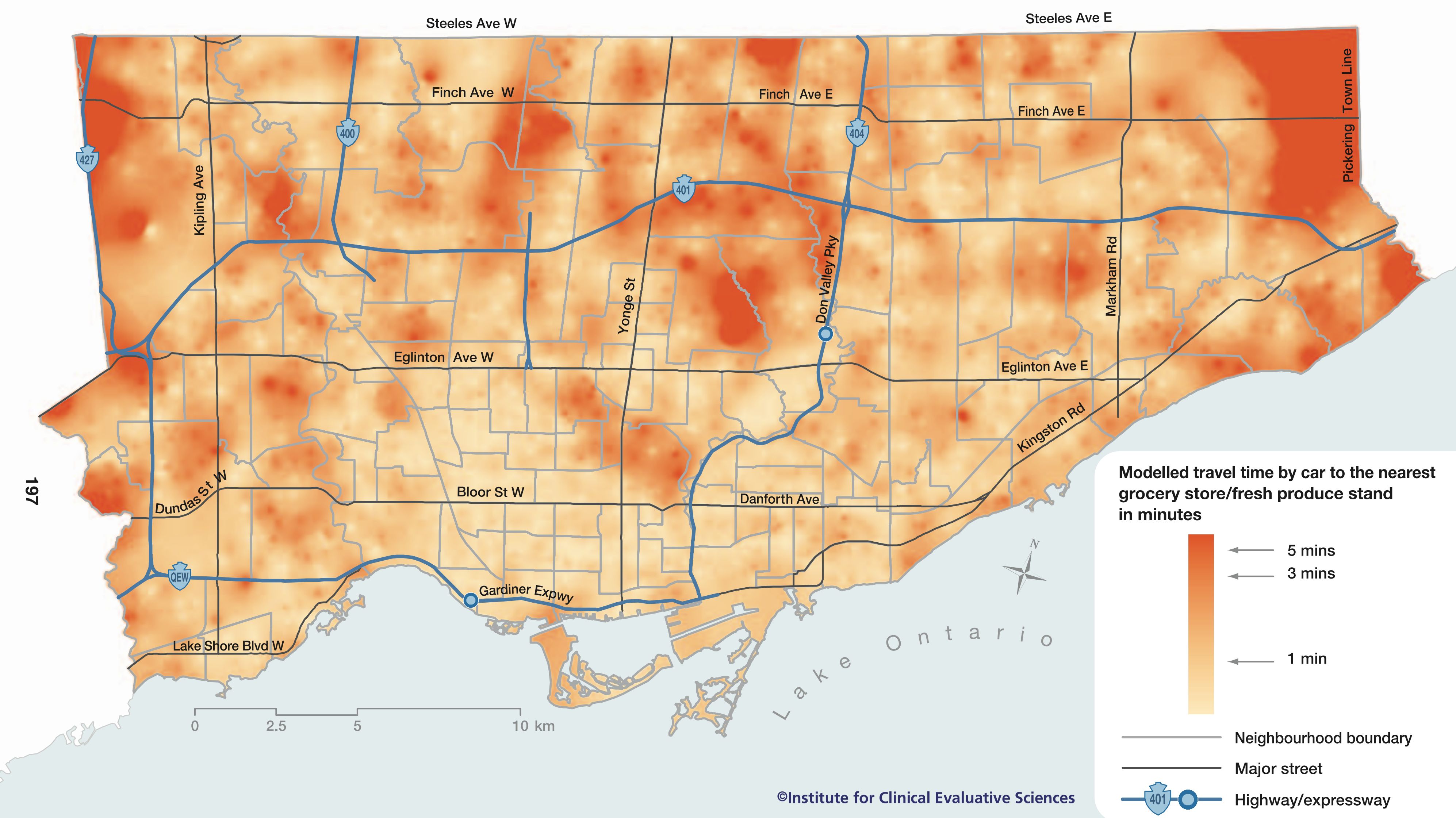
Exhibit 8.7 Modelled travel time by public transit to the nearest grocery store/fruit and vegetable stand, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- In 2004, throughout most of Toronto, stores selling fresh fruits and vegetables could be accessed within a 20-minute trip via public transit.
- Several areas identified as having longer walking times to stores selling fresh produce also had longer travel times by public transit.
- Access was also limited in many small pockets scattered outside the downtown core, where travel time via public transit to a store selling fresh produce ranged between 20 and 40 minutes.

Exhibit 8.8 Modelled travel time by car to the nearest grocery store/fruit and vegetable stand, in minutes, by neighbourhood of residence, in Toronto, 2004



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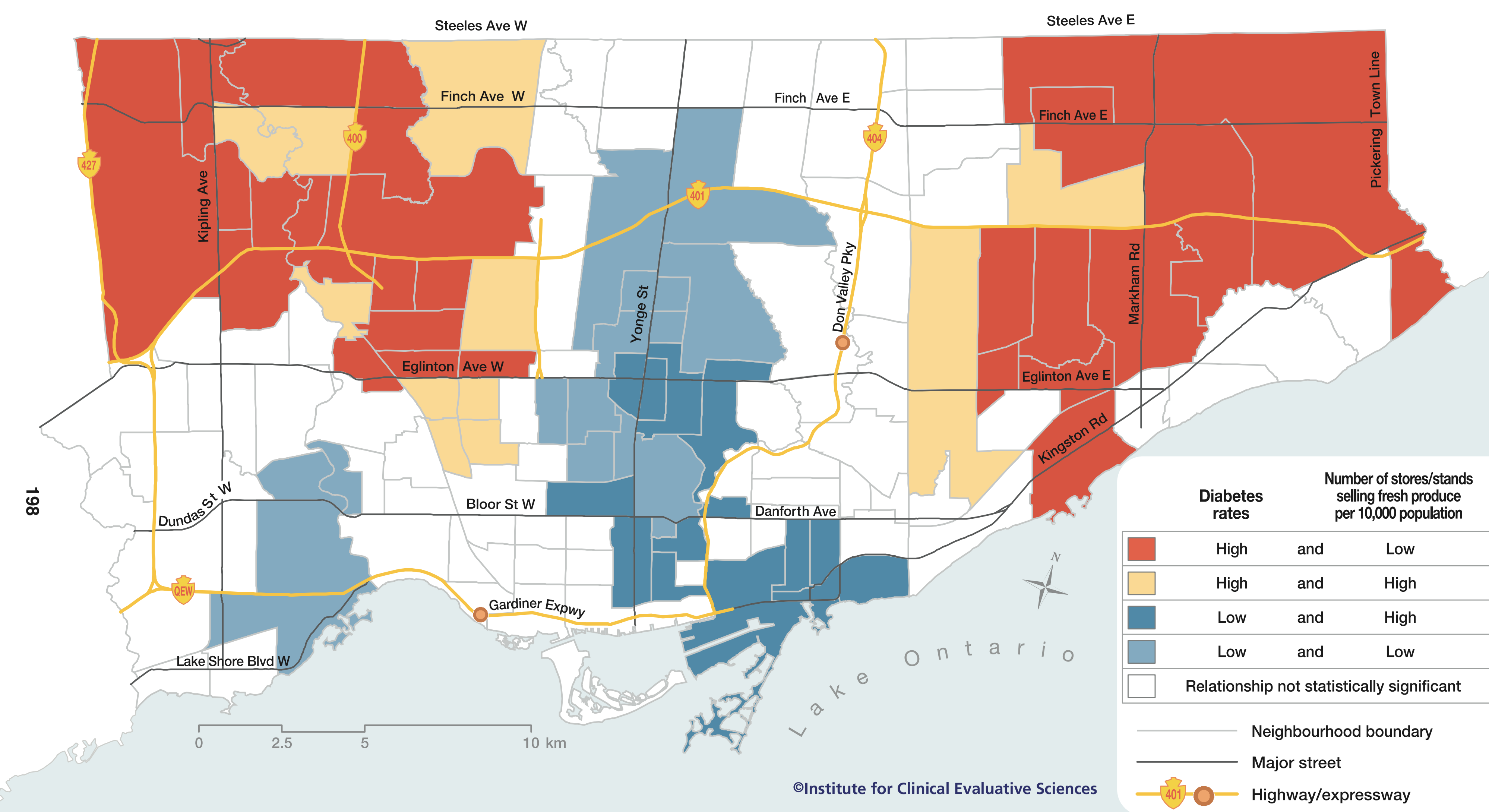
Findings

- In 2004, most Toronto residents could access a store/stand selling fresh fruits and vegetables by car within a few (one to three) minutes.
- Similar to findings regarding walking and public transit times (Exhibits 8.6 and 8.7), the neighbourhoods with relatively poorer access by car to stores selling fresh fruits and vegetables were in the east, west and north central Toronto.
- Some of the areas farthest away from fresh produce outlets were home to residents with higher incomes who could probably afford to own private vehicles or use taxis for food shopping (Chapter 6).

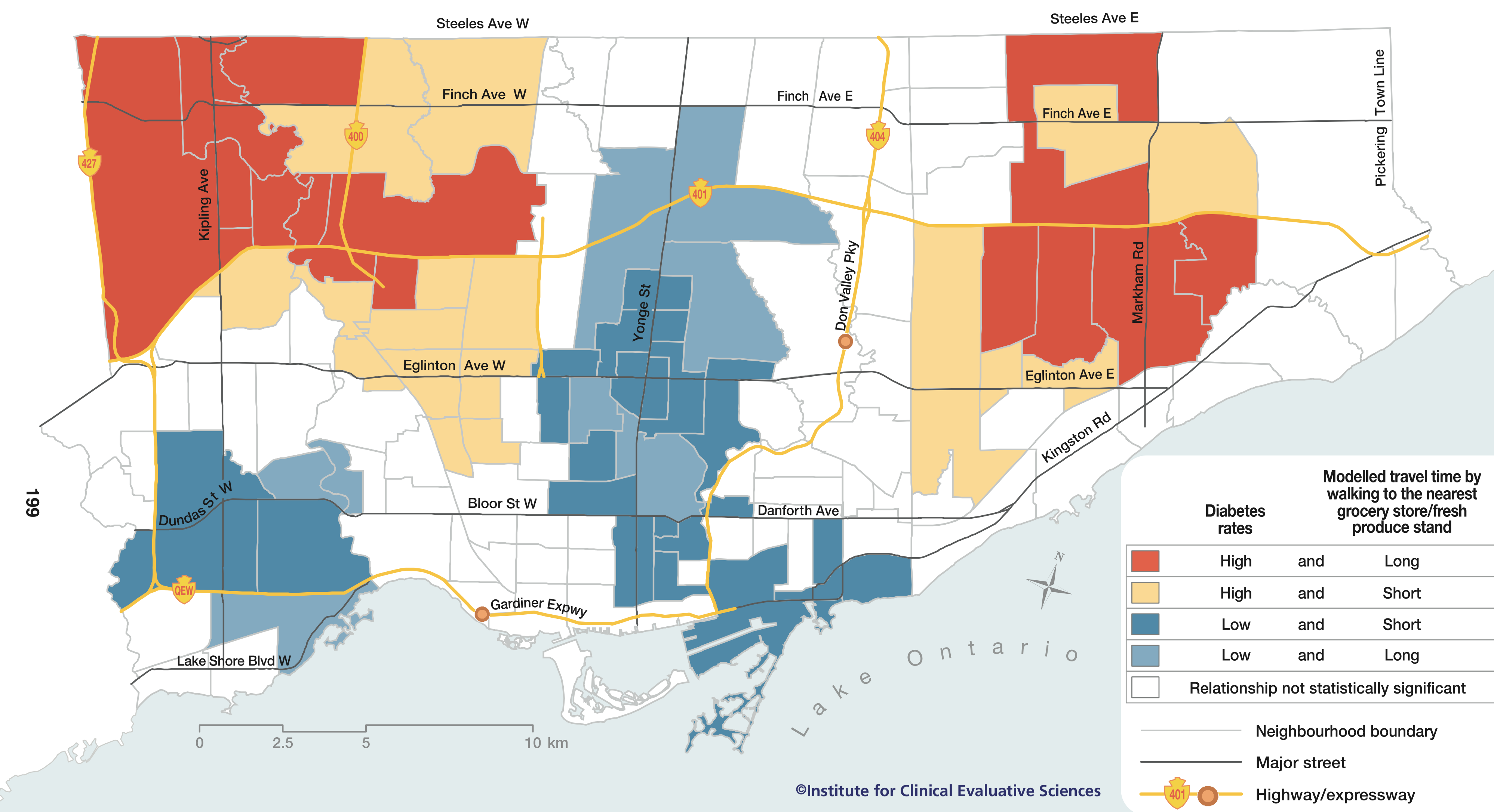
Exhibit 8.9 **Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and number of grocery stores/fruit and vegetable stands per 10,000 population [2004] (high or low), by neighbourhood, in Toronto**



Findings

- In 2004, residents living in the northwest and east ends of Toronto had both limited availability of stores/stands selling fresh produce and high rates of diabetes. These areas also tended to have low-income levels and high rates of immigration (Chapters 3 and 4).
- The downtown (south central) part of the city had low diabetes rates and a high availability of stores selling fresh produce.
- An exception to the low-diabetes/high-availability pattern emerged in the more affluent neighbourhoods in the central core (north of downtown Toronto). We noted a low availability of stores selling fresh fruits and vegetables along with low rates of diabetes. This pattern was also seen in the southwest portion of the city.

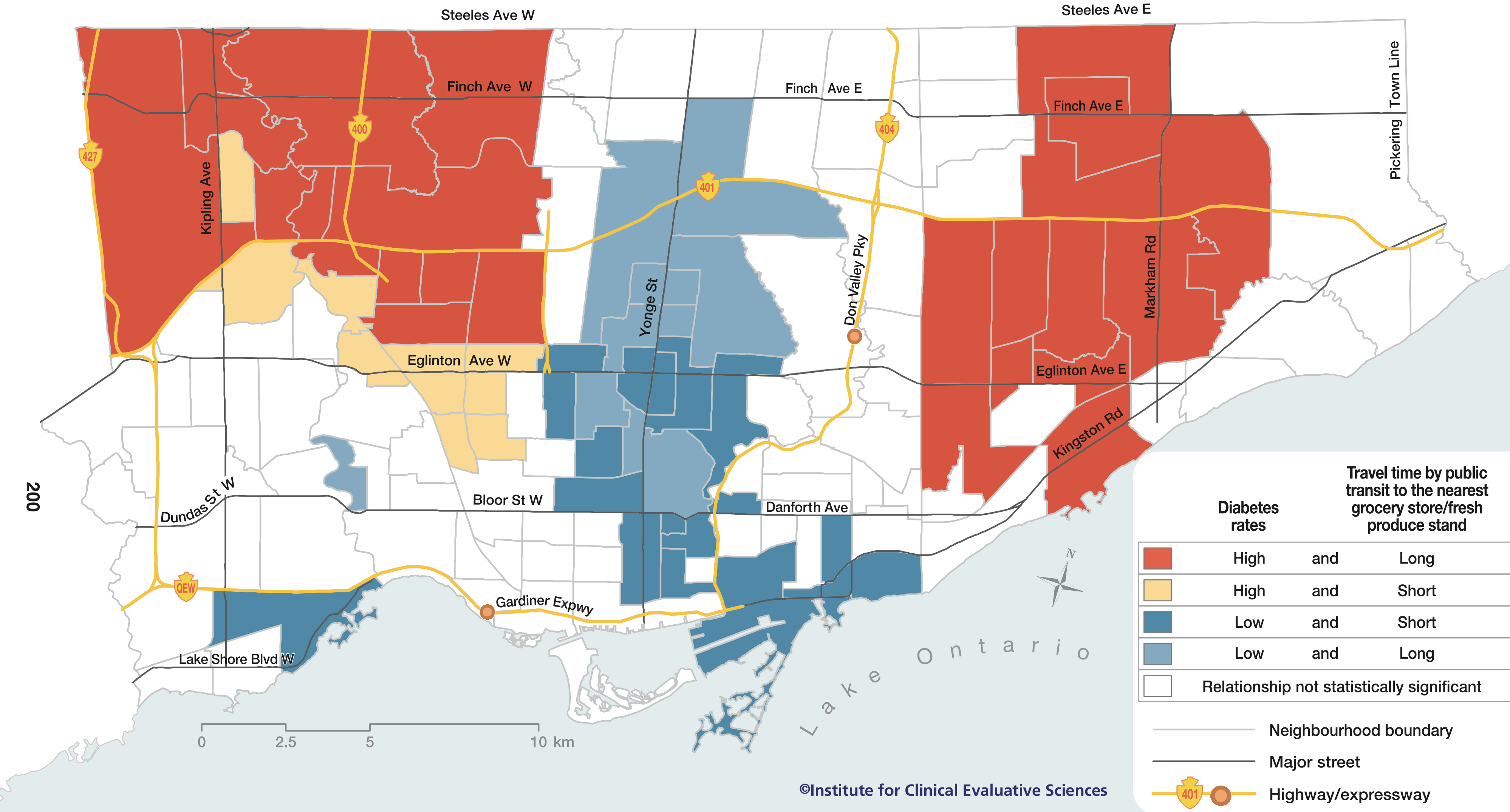
Exhibit 8.10 **Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to the nearest grocery store/fruit and vegetable stand by walking [2004] (long or short), by neighbourhood of residence, in Toronto**



Findings

- In 2004, several neighbourhoods in the northwest and east of the city had poor access (by walking) to stores and stands selling fresh produce and also a high prevalence of diabetes.
- Residents in downtown (south central) Toronto had both low diabetes rates and good access by walking to stores offering fresh produce.
- An exception to the low-diabetes/good-access-by-walking pattern emerged in the wealthier central and southwest regions of the city. We noted low diabetes rates and relatively poor access (by walking) to stores selling fresh produce.

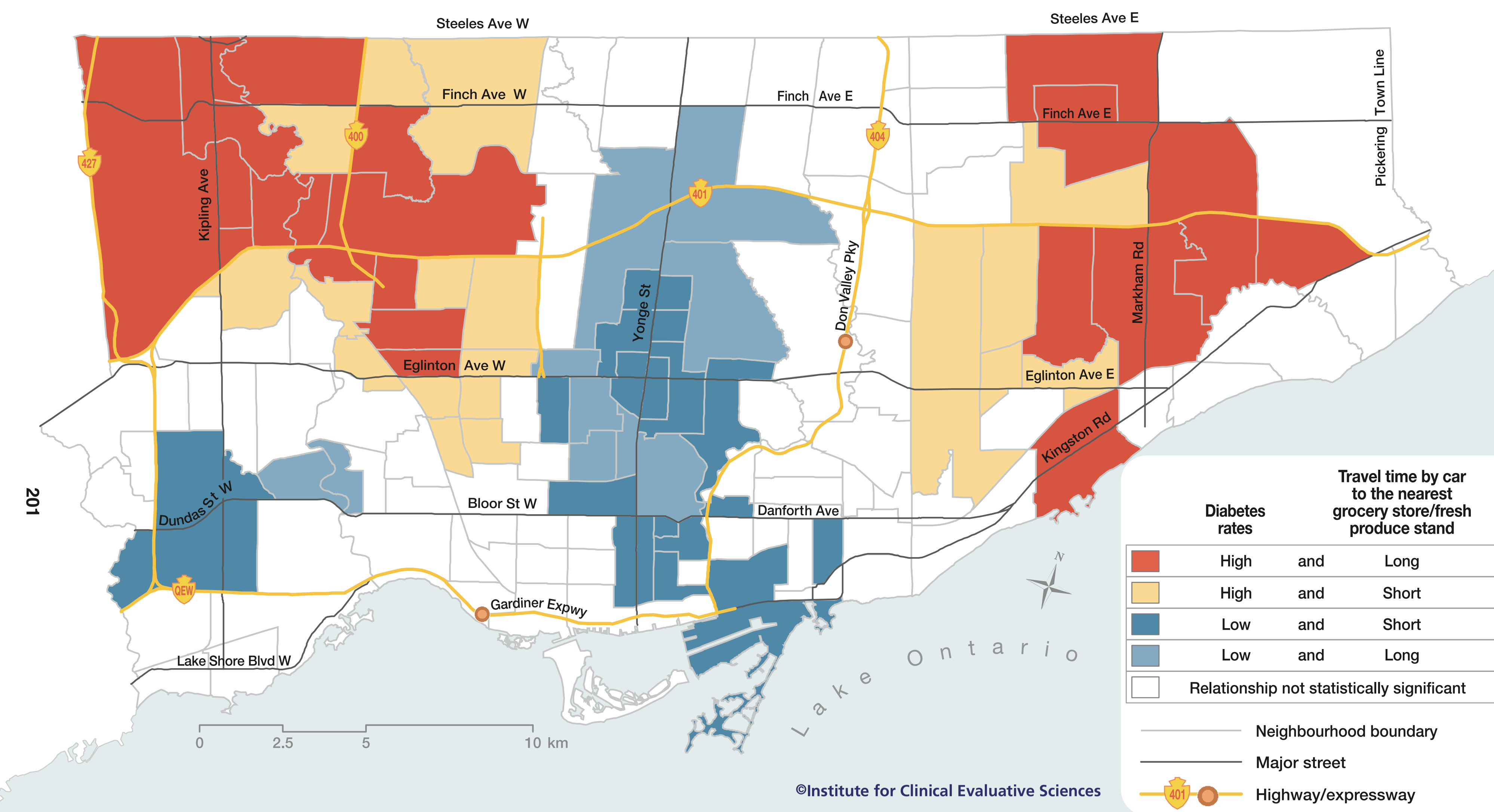
Exhibit 8.11 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to the nearest grocery store/fruit and vegetable stand by public transit [2004] (long or short), by neighbourhood of residence, in Toronto



Findings

- In 2004, large areas in the northwest and east ends of the city had both high rates of diabetes and longer travel times by public transit to stores/stands selling fresh fruits and vegetables.
- Residents in downtown and southwest areas of Toronto had both low diabetes rates and good access by public transit to stores offering fresh produce.
- An exception to the low-diabetes/good-access-by-public-transit pattern emerged in the wealthier central core of the city. We noted low diabetes rates and relatively poor access (by public transit) to stores selling fresh produce. This is similar to the pattern seen for walking (Exhibit 8.10).

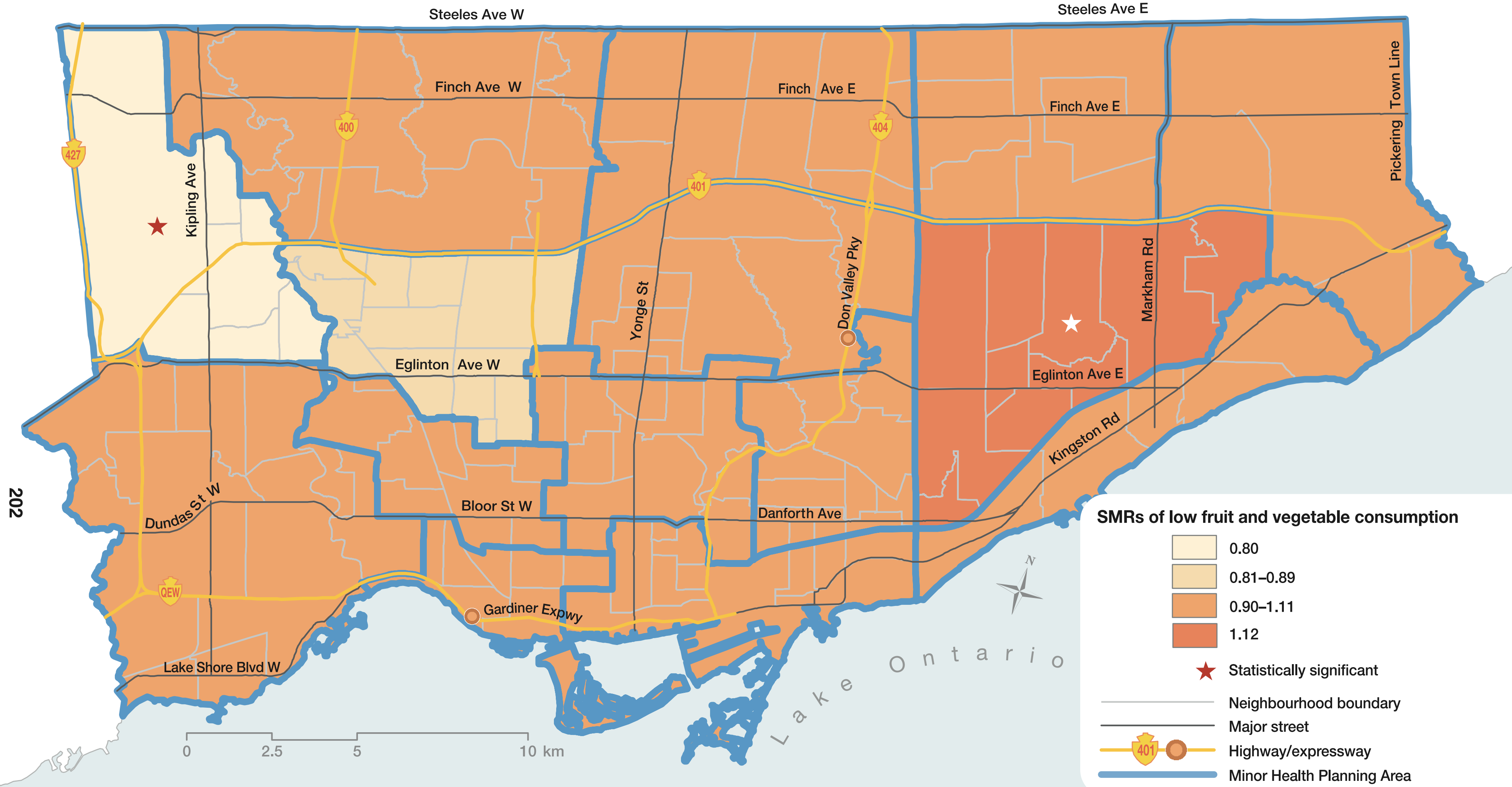
Exhibit 8.12 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to the nearest grocery store/fruit and vegetable stand by car [2004] (long or short), by neighbourhood of residence, in Toronto



Findings

- In 2004, areas in the northwest corner and east end of the city had high diabetes rates and also longer travel times by car to stores/stands selling fresh fruits and vegetables. This is similar to the findings shown in Exhibits 8.10 and 8.11.
- A large proportion of neighbourhoods in the centre of the city, as well as nearly all neighbourhoods in the downtown and southwest, had lower diabetes rates and shorter travel time by car to stores offering fresh produce.

Exhibit 8.13 **Standardized morbidity ratios (SMRs*) of low fruit and vegetable consumption among people age 12 years and older [2000/01 and 2003], by Minor Health Planning Area, in Toronto**



* SMR is a ratio of the number of people reporting low fruit and vegetable consumption in each neighbourhood compared to the number that might be expected, based on the overall age-specific rates of consumption across the city.

Findings

- Data from 2000 to 2003 show residents in eastern Toronto were less likely to meet current Canada's Food Guide recommendations for fruit and vegetable consumption (fresh and/or processed). At the time, the recommended daily intake for adults was five to 10 servings. (The current recommendation is seven to 10 servings.)
- Areas in the east with low rates of fruit and vegetable consumption corresponded with neighbourhoods that had high diabetes rates and limited availability of and access to stores selling fresh produce. These areas also had lower income levels and more immigrants and visible minority residents (Chapters 3 and 4).
- Unexpectedly, an area in the northwest with higher consumption of fruits and vegetables corresponded with neighbourhoods that had high diabetes rates and lower availability of and access to stores selling fresh fruits and vegetables.

Discussion

Despite the fact that grocery stores are needed wherever residential populations exist, our analyses found a clustering and higher density of such stores in downtown (south central) Toronto. By contrast, we noted several areas in the northwest, north central and east ends of the city that had far fewer grocery stores per capita.

This pattern of development likely reflects zoning initiatives that took place in newly developed subdivisions outside the old city of Toronto after the Second World War. Newer urban developments tended to separate retail and other non-residential lands from residential areas. This practice resulted in a high concentration of commercial buildings, including grocery stores, in strip malls and shopping centres outside of the main residential areas.[14]

Large food stores, known as "supermarkets," were first introduced in the 1950s. A grouping of stores or "shopping centre" was traditionally focused around a supermarket. These malls soon became a fixture in developing suburban areas. Between 1950 and 1960, supermarkets became the dominant form of retail food sales, expanding from 35 percent to 70 percent of the market share.[13]

Obstacles to developing the new, larger-format supermarkets exist in the urban environment due to the sheer size of the lots required and the high cost of land in densely developed areas.[13] It is much easier to build supermarkets in the suburban outskirts of the city where land is less expensive and where the majority of new housing is being built. Closing down a supermarket indicates a disinvestment in a community which can lead to further disinvestment. However, building a new supermarket in a neighbourhood can have positive effects, including even greater community development.[13]

Areas of particular concern in Toronto are the low-income, high-immigration neighbourhoods in the east and northwest parts of the city. These areas were found to have both high diabetes rates and longer travel times to stores selling fresh produce.

While residents in these areas faced longer travel times by all modes of transportation, access by public transit to stores selling fresh fruits and vegetables seemed to be the most problematic. (In fact, walking may be less relevant to any discussion of travelling to and from a grocery store, since people are limited to buying only what they can carry back home.)

People living in areas underserved by public transit may have more difficulty accessing grocery stores, and therefore, they have poorer access to healthy foods. This could be of particular concern in communities with specific kinds of residents (e.g., a disproportionately older population, those who are socially and/or economically disadvantaged, and those who rely more heavily on public transit). These same areas also appear to be less "activity-friendly," which creates a further barrier to achieving a healthy lifestyle (Chapter 6).

The high density of grocery stores in south central Toronto parallels the high overall concentration of retail services in these areas. However, stores selling fresh fruits and vegetables tended to be less common in downtown communities that had lower income levels and higher proportions of visible minority residents. We found that alternative and social support-related food sources (such as community gardens, farmers' markets, "good food boxes," and meals provided in drop-in centres and "out-of-the-cold" programs) were more concentrated in these parts of the city. One explanation for this could be that such sources were filling a gap caused by the scarcity of big supermarkets and grocery stores in these areas. Alternative and emergency sources of food primarily serve people who are homeless and under-housed—groups that are clustered in downtown Toronto.[15]

In contrast, many high-income neighbourhoods in the centre of the city had lower availability of and more limited access to grocery stores than other areas. Yet residents in these neighbourhoods experienced low rates of diabetes. One explanation may be that wealthier individuals have access to other means of transportation for food shopping, including cars and taxis. Even neighbourhoods that rated low on "activity-friendliness" still had low rates of diabetes if they were affluent (Chapter 6). Individuals who have higher incomes may have more opportunities to achieve a healthier lifestyle, and this may protect them against developing diabetes.

We identified a significant degree of variation in fruit and vegetable intake across the city of Toronto. Some regions that reported lower rates of consumption had higher rates of diabetes. Our source for this data was the Canadian Community Health Survey (CCHS), and the numbers of respondents living in given areas were relatively low. This hindered our ability to assess dietary patterns at the neighbourhood level.

However, the data that were available generally supported the assumption that areas with limited access to healthy food also had lower intakes of fruits and vegetables. Areas with the lowest intake were those in the east end of the city that also had higher proportions of visible minority residents. Cultural norms of vegetable consumption may vary, and this may not be adequately reflected in standard survey questions. Therefore, areas with a high concentration of certain ethnic groups may seem to have higher or lower vegetable consumption than the city average.

There are additional limitations to our analysis that merit discussion. First, we assumed that individuals shop at stores nearest to their homes. In reality, people who work downtown but live elsewhere may shop at downtown grocery stores at lunch hour or on their way home. Moreover, access to healthy foods may not be sufficient to influence individual eating habits; however, we believe it is a necessary step to ensuring good nutrition.

Conclusions and Next Steps

A healthy diet is essential to both the prevention and control of type 2 diabetes and is a key component to maintaining a healthy body weight.

We identified large sections of the city with lower access to stores selling fresh fruits and vegetables, which are an essential part of a healthy diet. These areas tended to be located north of the downtown core. We found that such neighbourhoods in the northwest and east had both high rates of diabetes and poorer access to stores selling fresh produce. We believe these neighbourhoods represent high-risk communities that should be targeted for diabetes prevention strategies.

Preventing the ongoing rise in obesity levels requires a multi-faceted approach, including strategies to improve healthy eating patterns among the population. Reducing the risk of diabetes in low-income neighbourhoods may be particularly challenging, given the relatively higher costs (or perceived higher costs) of purchasing fresh produce compared to the costs of higher calorie, pre-made or convenience foods. Limited access to stores selling foods that are affordable and nutritious may lead to unhealthy eating behaviours.

We found that residents living in low-income communities outside the city centre also had poorer access to public transportation. This would seem to create yet another barrier to shopping for fresh produce. A lack of public transit may, in turn, signal a lack of public services in a neighbourhood. This relationship needs to be further explored.

Suburban communities in the outer regions of Toronto are more sparsely populated and have reduced access in general to retail services. Promoting the location of grocery stores and other services into these areas is a significant challenge because of the inherent economic barriers faced by local businesses. Changes in zoning practices and other regulations, as well as incentives for developers to create retail spaces within new suburban developments, could help to encourage the location of services in areas of reduced access.

The revitalization of Regent Park, a lower-income neighbourhood in downtown Toronto, is a good example of how such measures could be undertaken. This project, which will be implemented over a 12-year period, involves (among other "healthier community" measures) the creation of new streets to physically reconnect the community to surrounding neighbourhoods, along with strategies to bring new stores and other services to the area. (See Chapter 14 on policy implications for details on this kind of revitalization project). In addition, the introduction of a community garden in this neighbourhood has provided a new source of fresh produce for local residents. The presence of a community garden also provides an opportunity for people to share information on healthy eating habits and is a mechanism for enhancing social cohesion within a neighbourhood.

Similar strategies in other low-income areas of Toronto, particularly those in the outer areas of the city where the rate of diabetes is high, could result in greater opportunities for healthy eating and reduced rates of obesity.

Appendix 8.A—How the Research was Done

Data sources

The locations of grocery stores in Toronto were geocoded based on data collected by the City of Toronto's 2004 Employment Survey (conducted by the Planning Division). We identified additional vendors selling fresh fruits and vegetables from information on retailers who purchase produce from the Ontario Food Terminal. (These data were provided by the Canadian Urban Institute.) The resulting file included major chain grocery stores, smaller independent grocers, and fruit and vegetable stands, amounting to a total of 912 stores.

The locations of other fresh produce sources were obtained from the City of Toronto's Social Development Finance and Administration Division, Social Policy Analysis and Research Unit.[16] These alternate sources for fresh fruits and vegetables included: community gardens; farmers' markets; good food boxes (provided via a program that sold fresh produce at cost and delivered it to neighbourhood drop-offs); community dining facilities; and emergency food centres such as food banks. Locations of social services providing food for under-housed and homeless groups were obtained from the "211 Toronto" database.[17]

Data from the 2000/2001 and 2003 Canadian Community Health Surveys (CCHSs) were used to determine rates of self-reported fruit and vegetable consumption in Toronto by area of residence.

Age- and sex-adjusted diabetes rates were calculated using data from the Ontario Diabetes Database and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES).

Analysis

We examined the distribution and accessibility of grocery stores for neighbourhoods throughout the City of Toronto. Geographic access was calculated using network analysis and shown on maps that modelled travel times. The travel time in minutes was measured from a point of residence to a resource location (e.g., a grocery store) along the network of streets, public transit routes and highways. The relationship between diabetes rates and measures of accessibility were calculated using bivariate *Local Indicator of Spatial Association (LISA)* maps.

Daily fruit and vegetable consumption patterns were expressed as a rate ratio, based on the rate of consuming fewer than five servings per day of fruits and vegetables (fresh and/or processed) in a given area divided by the same rate in Toronto as a whole. (This was the recommended lowest daily consumption of fruits and vegetables for adults in 2003.) The numbers of CCHS respondents living in given City of Toronto neighbourhoods were too few to allow us to calculate consumption rates based on these small areas. Instead, these rates were calculated and depicted at the level of Toronto's Minor Health Planning Areas.

More detailed information about data sources, rate calculations and analyses is available in "Appendix B: Technical Notes" at the end of this Atlas.

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INSIDE

9 Chapter

Fast Food and Diabetes

Maria I. Creatore, MSc, PhD (candidate), Kelly Ross, BSc, MSA, Peter Gozdyra, MA, Gillian L. Booth, MD, MSc, Anne-Marie Tynan, BA, MA (candidate), and Richard H. Glazier, MD, MPH

Executive Summary

Issue

Fast food has been implicated as a contributor to the current and growing levels of obesity in western societies. Soft drinks, fried foods and other high-calorie/high-fat foods are being consumed more frequently over time, and portion sizes have grown considerably in the past few years. Previous research in Ontario has linked the availability of fast food chains in a community with increased rates of heart disease; however, no study has yet tried to establish a similar association with diabetes. Not all communities have the same exposure to fast food. In some other settings, fast food has been found to be much more available in low-income vs. high-income areas, but it is not known whether this same pattern exists in Ontario. Fast food is not always obtained close to home. However, proximity of fast food outlets to residential areas may increase people's exposure to these foods and increase the likelihood that they will consume these products.

Study

Fast food establishments were identified based on commercial activity codes used in the City of Toronto's 2004 Employment Survey (conducted by the Planning Division). Based on this approach, 2,818 fast food outlets were identified and have been included in this analysis. Geographic accessibility was calculated using network analysis and illustrated on travel time maps. The travel time in minutes was measured from a point of residence to the nearest fast food outlet along the network of streets, public transit routes and highways. The relationship between diabetes rates and these measures of accessibility was evaluated using bivariate *Local Indicator of Spatial Association (LISA)* maps.

Key Findings

- In 2004, fast food was readily available and easily accessible in almost all areas of the city. Fast food outlets were concentrated in the downtown core, with the greatest density in or near major retail and business districts.
- In general, higher rates of diabetes in Toronto neighbourhoods were not correlated with either the availability of fast food outlets or with how easy (or difficult) it was for residents to access these places.
- Areas that experienced both high diabetes rates and easier access to fast food tended to be those with higher levels of immigration, lower average incomes and higher proportions of residents belonging to visible minority groups. (For a definition of "visible minority," see section 9.A at the end of this chapter.)

Implications

- **Based on 2004 data, we found a high availability of fast food in Toronto. This is cause for concern, as are the short travel times to fast food outlets we observed in most residential areas of the city.**
- **Limiting the consumption of high-calorie/high-fat fast foods is important for the prevention of obesity and its consequences, which include diabetes. Given the ubiquity and popularity of these outlets, policies that promote healthier food choices among consumers and that encourage fast food outlets to devise healthier menus should be pursued.**
- **High exposure to fast food among people who work, shop and go to school in downtown Toronto is a potential health risk that requires further investigation.**

Introduction

The past decade has seen a marked proliferation of fast food outlets and the so-called "supersizing" of food portions. Both these environmental factors expose the population to excess calories and an increased risk of obesity.

In the United States (US), portion sizes in restaurants have increased substantially since the 1980s in parallel with increasing body weights.[1] Similar trends are now being observed in Canada. According to Statistics Canada, total calories consumed by Canadians, which was fairly stable between 1971 and 1991, increased by 17 percent between 1991 and 2001.[2] Food sources are significantly related to Body Mass Index* (BMI), even when other factors are taken into consideration.[3] For instance, men and women who consumed fast food more frequently appeared to have higher BMIs than those who did not.[3,4] In turn, high BMIs and obesity have been associated with numerous health conditions, including diabetes.[5]

Fast food tends to be high in saturated fat, trans fat, sugar and salt. These individual components are associated with negative health outcomes, including obesity, hypertension (high blood pressure), type 2 diabetes, elevated cholesterol and cardiovascular disease.[4,6–12] A recent study showed that among 380 regions throughout Ontario, cardiac mortality and hospitalization were higher in areas with relatively larger numbers of fast food chains.[13] These findings persisted after the researchers accounted for population differences in age, sex and socioeconomic status. Similar research has not been conducted on fast food availability and rates of diabetes within specific regions.

North Americans are working more hours per week and have less time for food preparation than ever before. This may explain the higher rates of food consumption away from home observed in recent years.[4] Between 1980 and 1990, the percentage of all food dollars spent away from home in the US increased from 26 to 37 percent.[4] By 2001, these figures had risen to 42 percent.[14] The locations where food was most frequently consumed away from home were full-service restaurants and fast food outlets.[15]

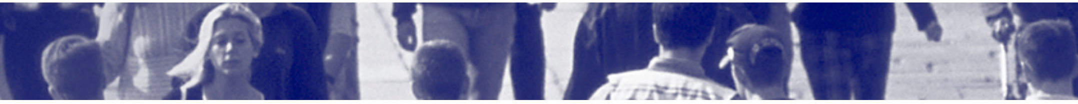
Greater consumption of fast food is associated with less healthy eating choices and activity levels and is also related to more hours spent watching TV.[4,14–16] Fast food consumption is more common in suburban areas and among young adults. A recent study suggested that individuals aged 20–29 were four times more likely than those aged 55 and over to eat fast food.[4] In a survey conducted by the US Department of Agriculture between 1989 and 1991, one in six adults reported eating fast food on the survey day. That ratio increased to one in four when the 1994–1996 survey was conducted.[4]

The availability of fast-food outlets may also vary depending on a neighbourhood's socioeconomic status. Research conducted in Melbourne, Australia, on the density of fast food outlets found that individuals living in low-income areas had 2.5 times more exposure to fast food compared to those living in more affluent areas.[17] Although this study did reveal some interesting patterns, it is not clear whether differential exposure to fast food has contributed to higher rates of obesity in low- versus high-income areas.[18]

In contrast, a Canadian study exploring the density of fast food outlets in certain parts of Ontario and residents' socioeconomic status did not find a significant relationship between the density of such outlets and median household income.[13]

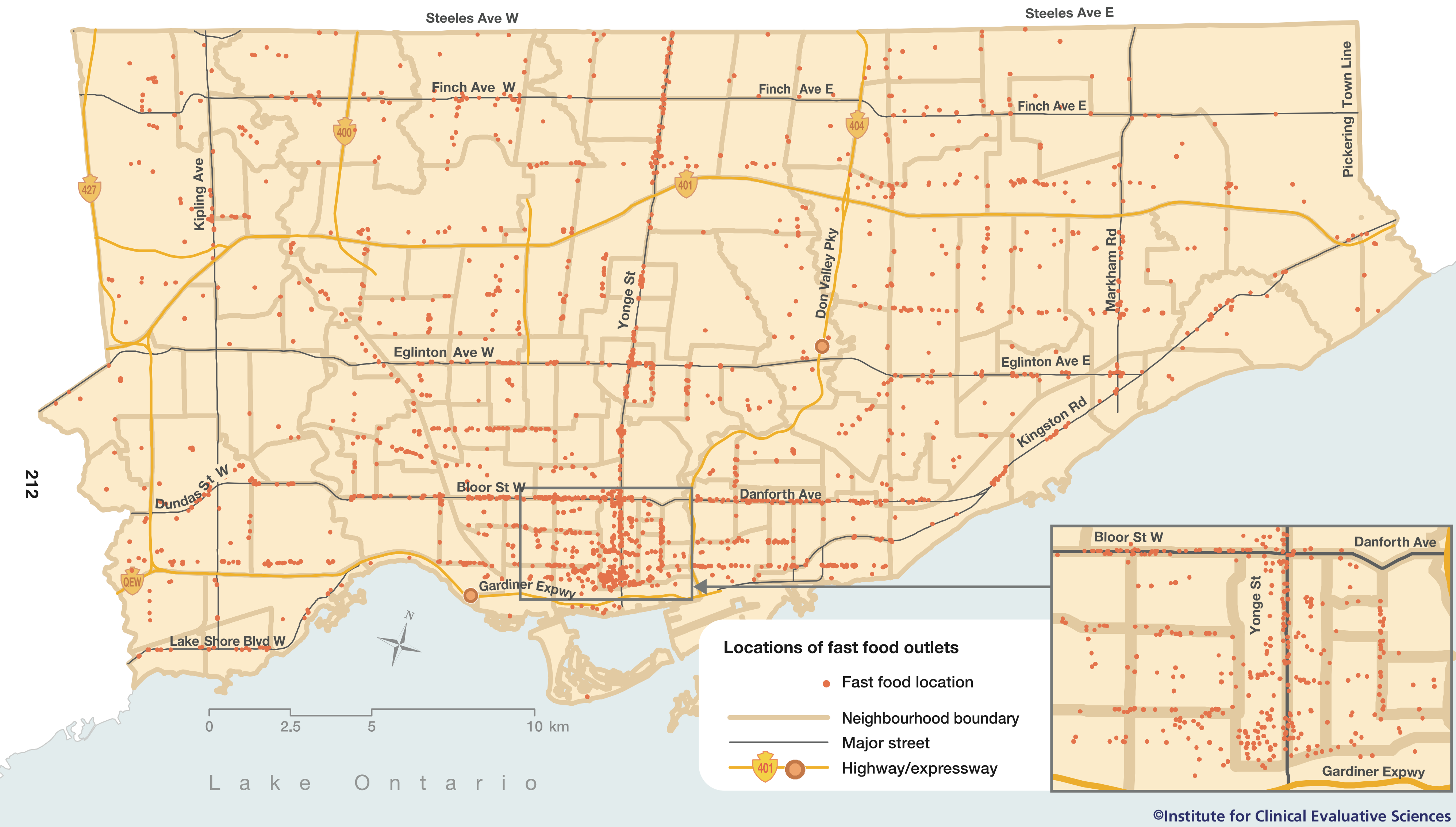
* BMI is a ratio of weight to height and can be calculated according to the equation: $BMI=weight(kg)/height(m)^2$

Chapter 9—List of Exhibits



Exhibits and Findings

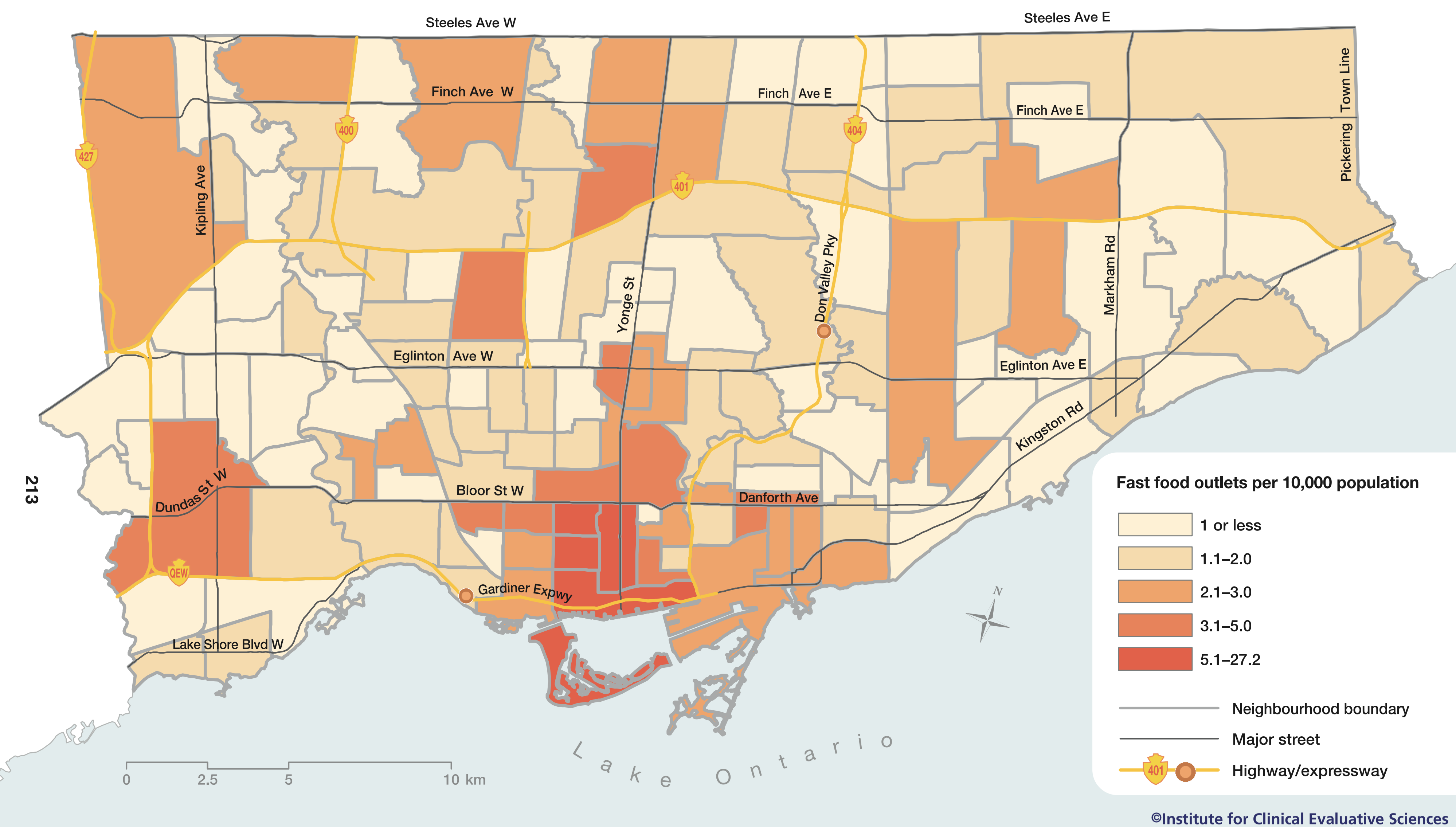
Exhibit 9.1 Locations of fast food outlets, in Toronto, 2004



Findings

- In 2004, the majority of fast food outlets were concentrated in the downtown core, with the highest density located close to major retail and business districts.
- Throughout the city, areas with greater availability of fast food tended to cluster along major traffic routes.

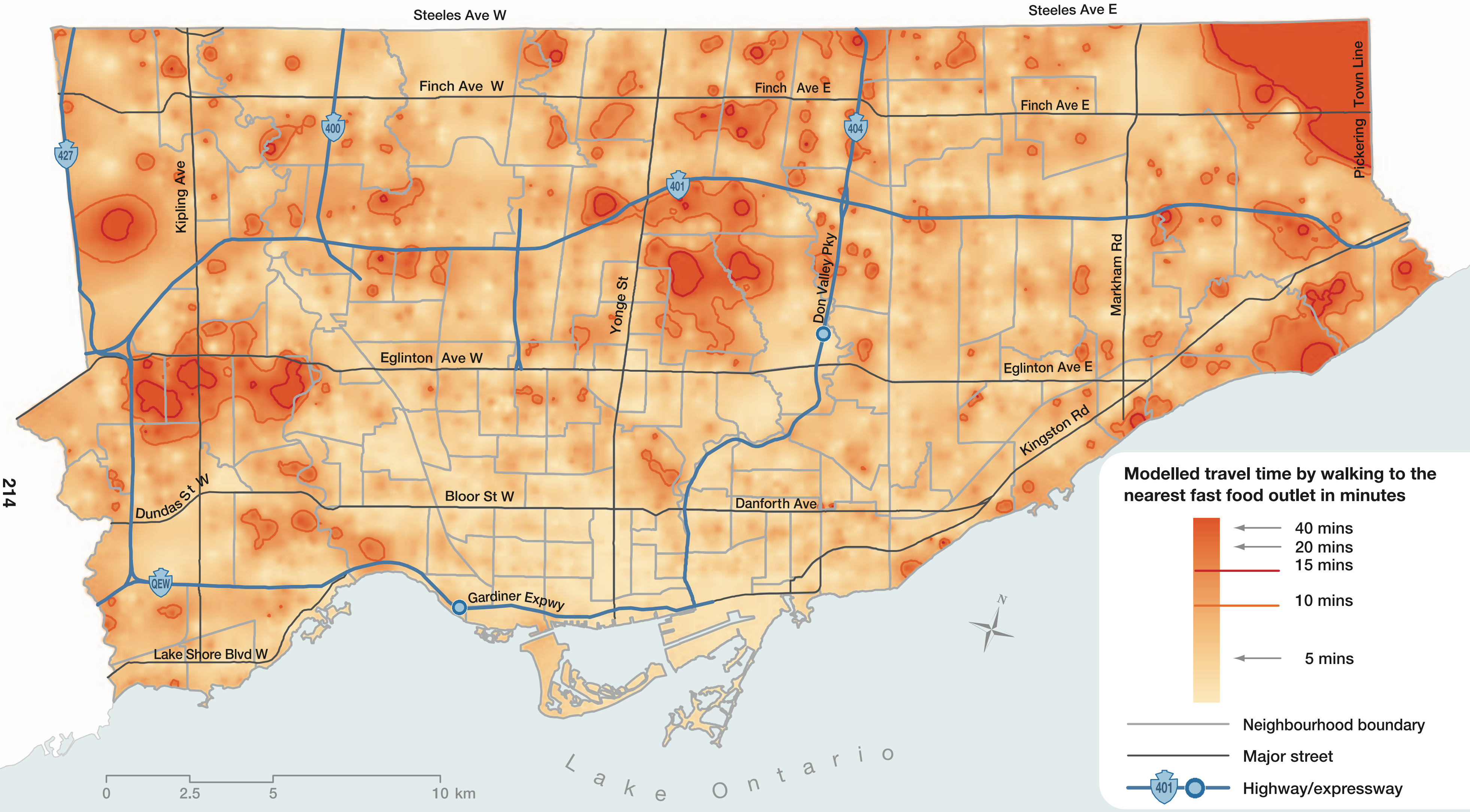
Exhibit 9.2 Number of fast food outlets per 10,000 population [2001], by neighbourhood, in Toronto, 2004



Findings

- In 2004, downtown (south central) Toronto had the highest proportion of fast food outlets, reaching a maximum of just over 27 outlets per 10,000 residents. Scattered areas outside the downtown core in the southwest and north also had greater numbers of these outlets.

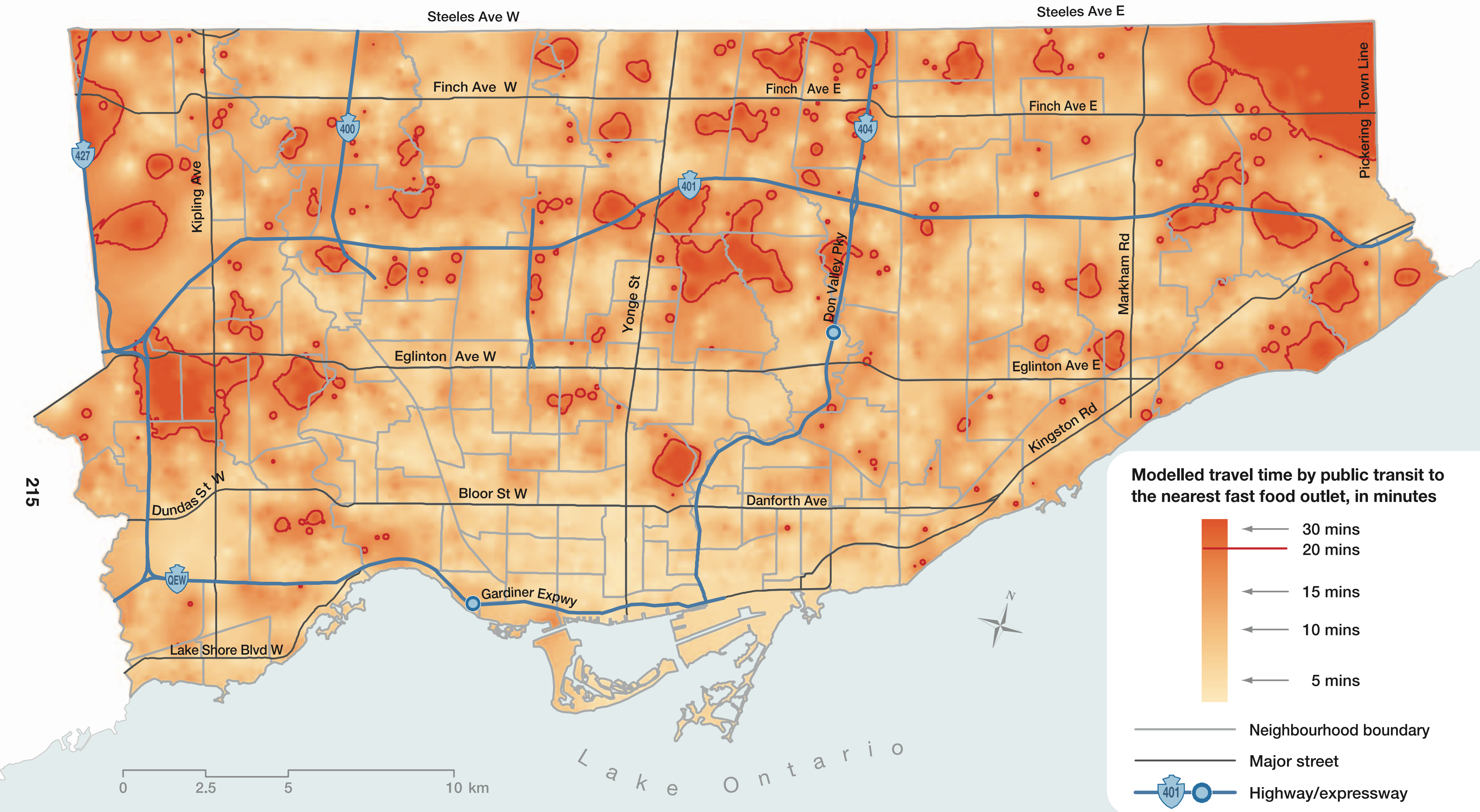
Exhibit 9.3 Modelled travel time by walking to the nearest fast food outlet, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- In 2004, fast food was generally accessible to people throughout Toronto within a five- to 10-minute walk from their area of residence.
- Most of the neighbourhoods where people had to walk for 15 minutes or longer to access fast food were high-income areas in the central, southwest and southeast parts of the city.

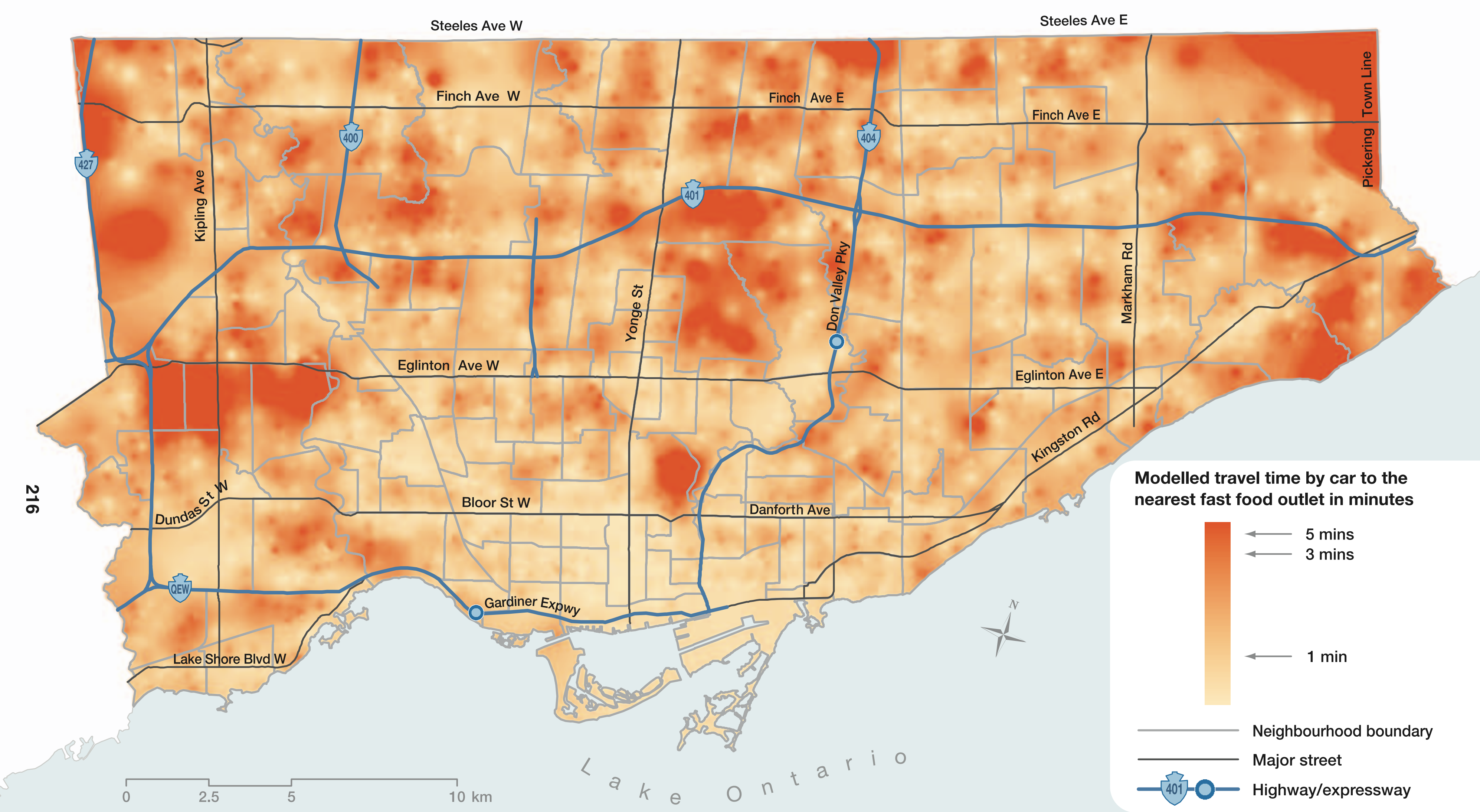
Exhibit 9.4 Modelled travel time by public transit to the nearest fast food outlet, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- In 2004, most people living in Toronto could access fast food within 20 minutes by public transit from their area of residence. This was true except for those living in a few neighbourhoods located in the central, west and east areas of the city. This pattern is similar to that seen in Exhibit 9.3.

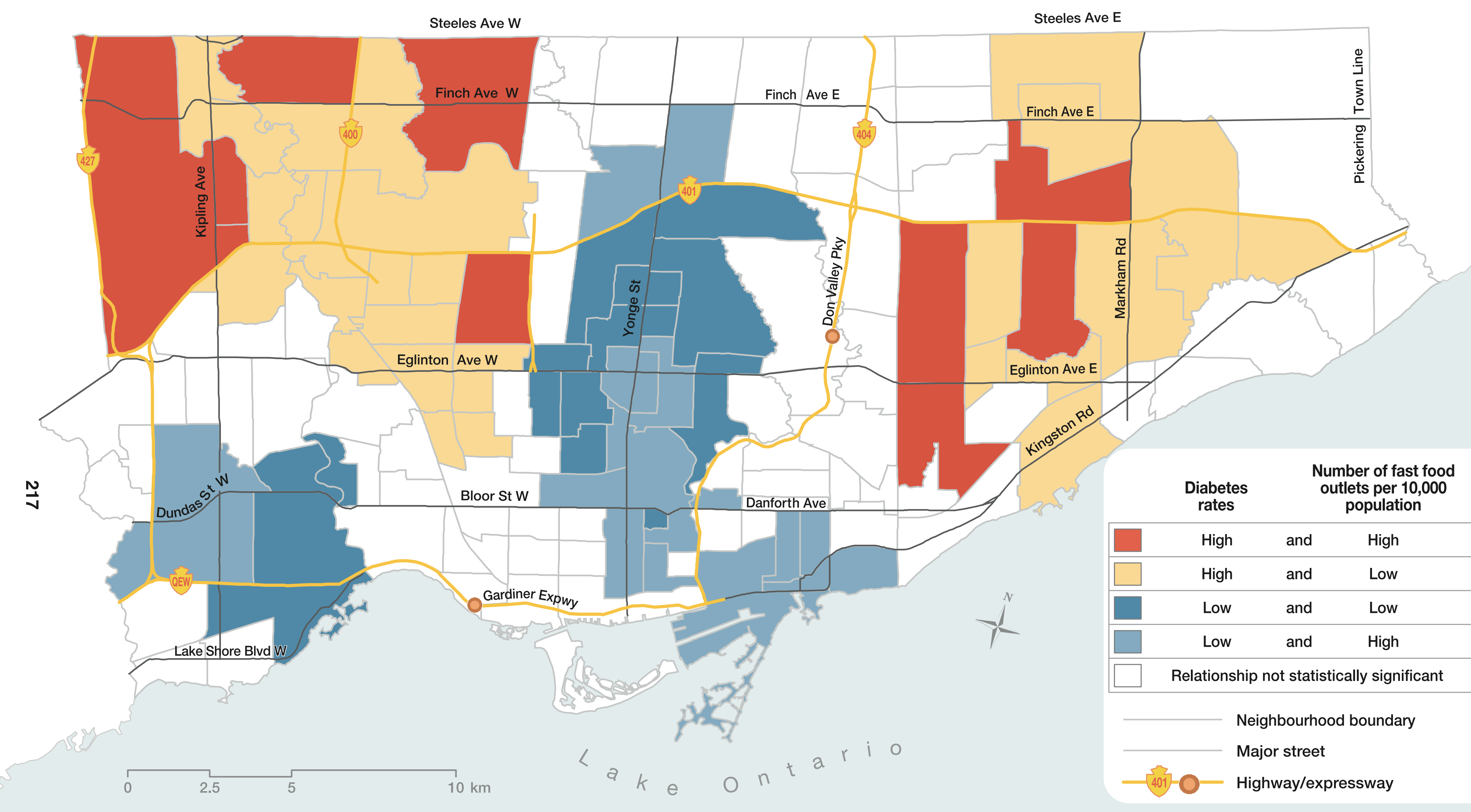
Exhibit 9.5 Modelled travel time by car to the nearest fast food outlet, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- In 2004, fast food was very accessible by car from most Toronto neighbourhoods—no more than a one- to three-minute drive.
- Parts of the city that had the least access to fast food included some of the wealthier, more residential neighbourhoods in the central core, in the west and in the east end. This finding is similar to the patterns seen for walking and public transit (Exhibits 9.3 and 9.4).

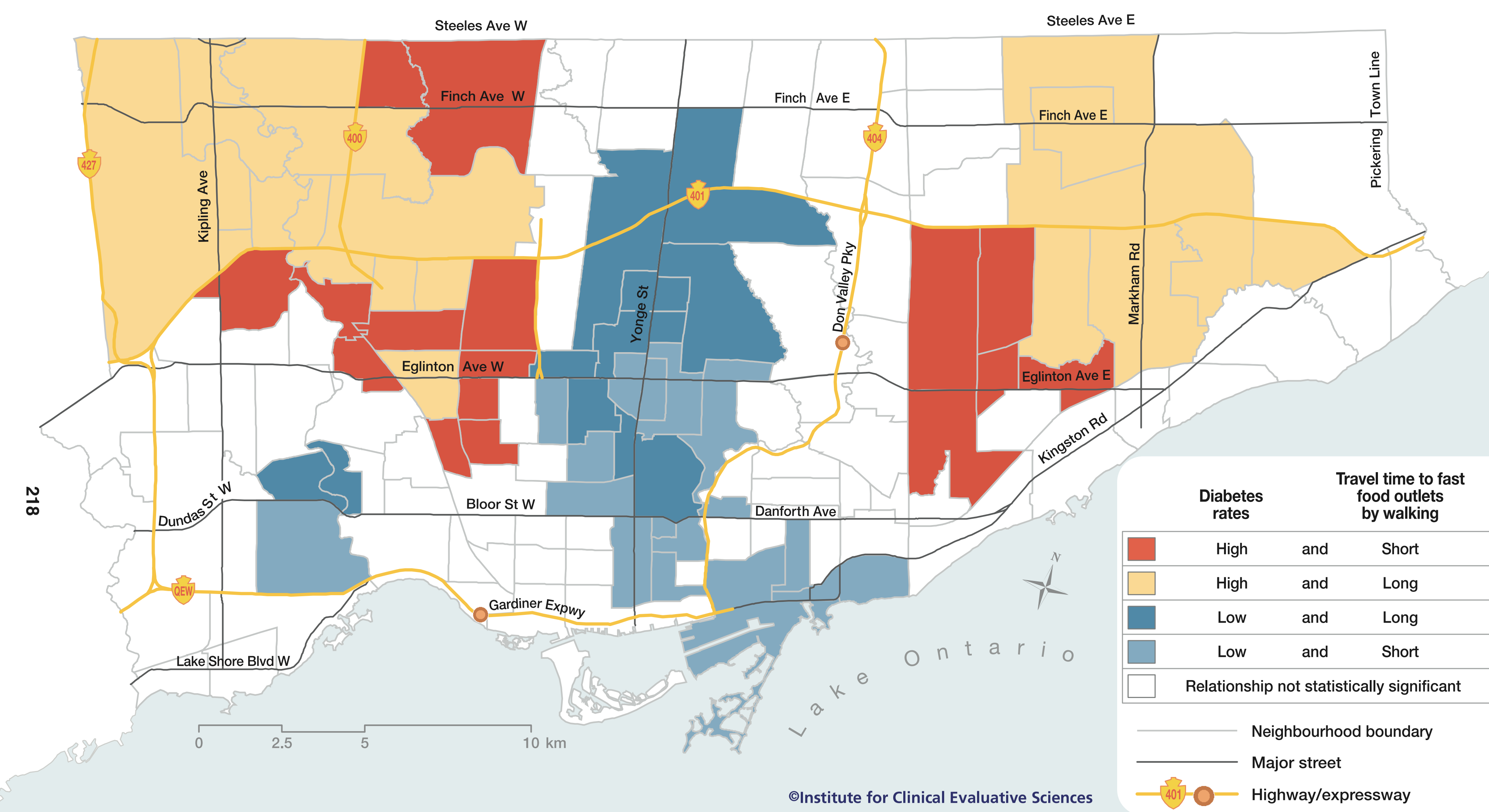
Exhibit 9.6 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and number of fast food outlets per 10,000 population [2004] (high or low), by neighbourhood, in Toronto



Findings

- Data from 2001/02 and 2004 suggest that some neighbourhoods in the northwest and east of the city had both high diabetes rates and high availability of fast food.
- Central Toronto had both low diabetes rates and low availability of fast food.
- Rates of diabetes among residents living in the downtown core were low despite the high availability of fast food in that part of the city.

Exhibit 9.7 **Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to fast food outlets by walking [2004] (long or short), by neighbourhood of residence, in Toronto**



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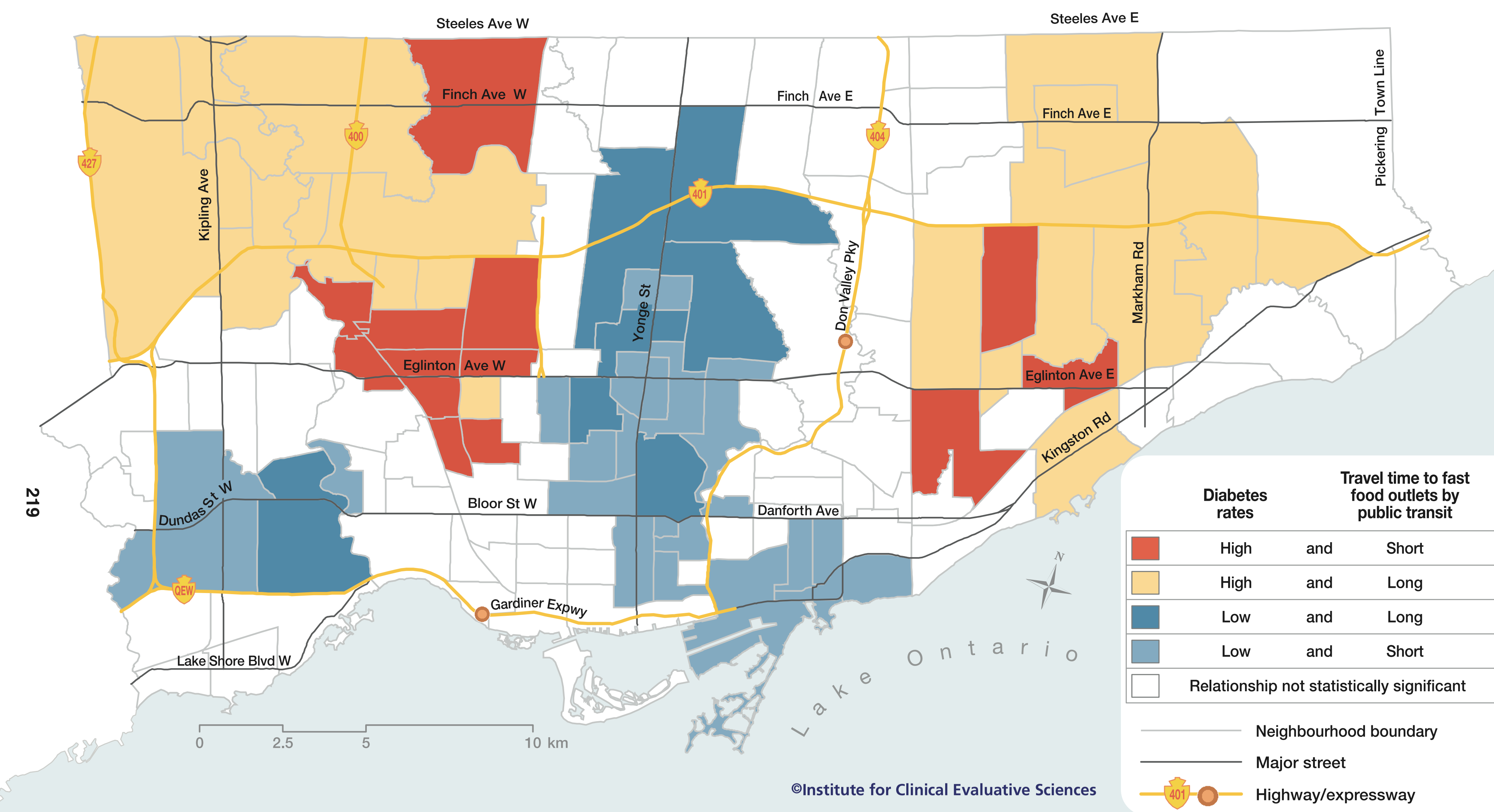
Findings

- Data from 2001/02 and 2004 suggest neighbourhoods with high diabetes rates and shorter walking times to fast food outlets were located in the lower-income central west and central east ends of the city.
- Wealthier neighbourhoods in central Toronto had low diabetes rates and both shorter and longer walking times to fast food, depending on the area.
- The downtown (south central) area had short walking times to fast food, yet rates of diabetes were low (similar to the pattern in Exhibit 9.6).
- Many neighbourhoods, mainly in the northwest and northeast, had high diabetes rates, even though residents' access to fast food was lower.

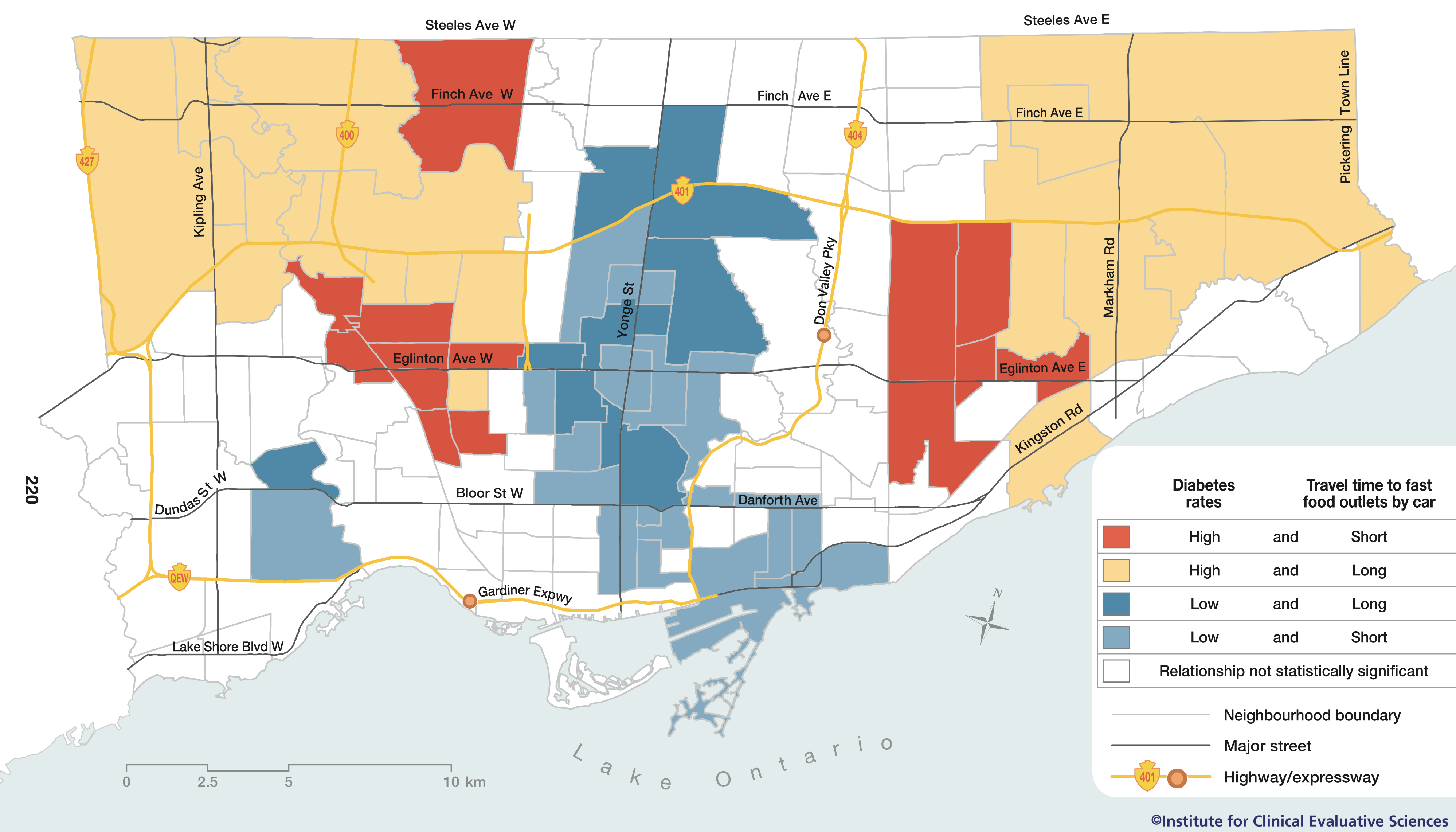
Exhibit 9.8 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to fast food outlets by public transit [2004] (long or short), by neighbourhood of residence, in Toronto



Findings

- The spatial relationship found between travel times to fast food outlets by public transit and rates of diabetes was very similar to the relationship observed between travel times to fast food outlets by walking (Exhibit 9.7).

Exhibit 9.9 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to fast food outlets by car [2004] (long or short), by neighbourhood of residence, in Toronto



Findings

- The spatial relationship found between travel times to fast food outlets by car and rates of diabetes was very similar to the relationship observed between travel times to fast food outlets by walking and public transit (Exhibits 9.7 and 9.8).

Discussion

Availability of Fast Food

The location and availability of fast food outlets in Toronto between 2001 and 2004 varied across the city, with some neighbourhoods having much higher availability than others. In general, fast food outlets were concentrated in the downtown core, with the highest number located near major retail and business districts. This pattern may be due to the low number of residential units in the central core of the city (since availability is measured as the number of fast food outlets per residential population). Another contributor is that many retail and business complexes in that area likely featured large food courts which typically offer a variety of fast foods. It is also likely that a large percentage of the daytime population who patronized these fast food eateries worked downtown but lived in other parts of the city and surrounding areas. Areas with greater availability of fast food also tended to fall along major routes.

Geographic Access to Fast Food

Based on data from 2001 and 2004, access to fast food was easy in Toronto, whether people walked, drove or used public transit to reach their fast food outlet of choice. In most neighbourhoods, residents lived within a five-minute walk or transit ride, or within a one- to three-minute drive to the nearest fast food outlet. The areas of the city where accessibility to fast food was lower included some neighbourhoods in the central core, in the west end, and a few neighbourhoods in the east end. Residents in these neighbourhoods also had a higher average annual household income level, compared to those living in places where fast food could be accessed within one minute by car or within five minutes by transit and walking (Chapter 3).

These findings suggest a socioeconomic pattern: we noted that certain residential, high-income neighbourhoods had the longest travel times to fast food. A similar pattern was noted in Australia where fast food restaurants were found to be more prevalent in low-income neighbourhoods.[17]

Our analysis highlights the relatively shorter travel time to fast food outlets via transit routes for residents of downtown neighbourhoods as compared to people living in the outer regions of the city.

Diabetes Rates and Availability of and Access to Fast Food Outlets

We noted some Toronto neighbourhoods where the local prevalence of diabetes and exposure to fast food were inversely related. That is, in some areas there was a low prevalence of diabetes yet a high density of fast food outlets (this pattern was most evident in the downtown core). In other neighbourhoods, there was a high prevalence of diabetes yet a low density of fast food outlets. These counterintuitive findings may be related to the fact that the areas in the downtown core with the highest concentration of fast food had sparse residential populations. Therefore, it is likely that the people eating in these restaurants were those who worked, shopped and/or studied downtown, yet who lived somewhere else.

Whether people who had relatively quick access to fast food during working hours (i.e., away from their place of residence) also had a greater risk of diabetes cannot be determined from this study. We noted several areas with low diabetes rates where fast food outlets were relatively scarce. However, those areas tended to be wealthier and located outside the downtown business core. We also noted high diabetes rates and high availability of fast food outlets in the northeast and northwest parts of the city and also in the east end. Interestingly, these diabetes/fast food "hotspots" correlated closely with areas characterized by a concentration of recent immigrants and high proportions of visible minority residents and low-income households (Chapters 3 and 4).

Conclusions and Next Steps

Based on data from 2001 and 2004, we found that access to fast food was high throughout Toronto. We noted that fast food outlets were concentrated in the downtown core. The proliferation of fast food outlets in the downtown area is likely due to the fact that the principal financial, business and shopping districts—and also some university and college campuses—were and still are located downtown, ensuring steady breakfast and lunch-time traffic for fast food outlets located in this area.

Parts of Toronto with both low diabetes rates and limited access to fast food tended to be the wealthier neighbourhoods in the centre and southwest portions of the city. Areas where we noted both high diabetes rates and shorter travel times to fast food tended to be the low-income, high-immigration neighbourhoods in the northwest and east ends of the city.

However, it is important to note that the majority of neighbourhoods with high diabetes rates were not located in the downtown core and appeared to have less access to fast food outlets. It remains unclear whether residential proximity to a fast food establishment is actually related to the consumption of fast food. A recent US study showed no relationship between the density of fast food outlets within a two-mile (3.2 km) radius of a person's home or workplace and how often he or she consumed fast food.[19] Eating fast food away from home and ordering fast food such as pizza by phone may explain the lack of a strong association between the local availability and consumption of fast food.

The high availability of fast food in Toronto is of concern, as are the short travel times to fast food outlets from most residential areas of the city. Limiting consumption of high-fat/high-calorie fast food is important for the prevention of obesity and its consequences, which include diabetes. Given the ubiquity and popularity of fast food outlets, policies that promote healthier food choices among consumers and which encourage fast food outlets to devise healthier menus should be pursued.

Appendix 9.A—How the Research was Done

Data sources

The definition of a "fast food outlet" likely varies from place to place. For the purpose of this Atlas, we relied on the definition used by the City of Toronto which describes them as "those establishments that sell prepared food in a self-serve, take-away setting." Eateries that offer both full-service seating and take-out service would not be classified as "fast food" outlets, since to fit the definition, take-away service must be their primary function.

Fast food establishments were identified based on commercial activity codes used in the City of Toronto's 2004 Employment Survey (conducted by the Planning Division). A total of 2,818 fast food outlets were identified and included in this analysis.

Age- and sex-adjusted diabetes rates were calculated using the Ontario Diabetes Database and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES).

Neighbourhood population estimates were abstracted from the 2001 Canadian census.

*The proportion of visible minorities living in each neighbourhood was derived from the 2001 Census of Canada, which uses the following definition based on the Employment Equity Act: visible minorities are "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour."

Analysis

We examined the distribution and accessibility of fast food outlets for neighbourhoods throughout Toronto. The relationship between diabetes rates and these measures of accessibility was evaluated using bivariate *Local Indicator of Spatial Association (LISA)* maps.

Geographic availability was examined using symbols to show the locations of fast food outlets and choropleth (shaded) maps to show the density of fast food outlets in an area, taking residential population into account (i.e., the number of fast food outlets per 10,000 population). Accessibility was calculated using network analysis and illustrated using travel time maps. The travel time to a fast food outlet in minutes was measured from a point of residence to a location, along the network of streets, public transit routes and highways.

More detailed information about data sources, rate calculations and analyses is available in "Appendix B: Technical Notes" at the end of this Atlas.

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INSIDE

10
Chapter

Convenience Stores and Diabetes

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Executive Summary

Issue

Access to convenience stores could have a positive or negative effect on lifestyle choices among residents in a particular neighbourhood. Convenience stores traditionally offer a wide array of high-calorie foods and beverages that have limited nutritional value; however, many such outlets are increasingly offering healthier food options. Furthermore, residents who live close to their local convenience store will likely walk there rather than drive; thus the presence of these stores in a neighbourhood could stimulate physical activity.

Study

The locations of convenience stores were obtained from the City of Toronto's 2004 Employment Survey (conducted by the Planning Division). Geographic accessibility was calculated using network analysis and is shown on maps that modelled travel times. The travel time in minutes was measured from a point of residence to the nearest store along the network of streets, public transit routes and highways. The relationship between diabetes rates and these measures of accessibility was evaluated using bivariate *Local Indicator of Spatial Association (LISA)* maps.

Key Findings

- In 2004, downtown Toronto had the highest number of convenience stores per capita. The lowest numbers were found north of the downtown and in the east and west ends of the city.
- Although convenience stores were generally very accessible throughout Toronto, the time required to reach the nearest one (within a specific area) increased as one moved farther away from the downtown core. This reflects urban development patterns and the post-war emergence of suburban neighbourhoods with little or no commercial zoning.
- Areas in the northwest and in the east end of the city had high diabetes rates as well as a low availability of and poor access to convenience stores.

Implications

- **Changes in planning, development and zoning practices that reduce urban sprawl, increase residential density, and promote mixed land use could make suburban communities more walkable for local residents.**
- **Further research is needed to understand the impact of convenience stores on the eating patterns of local residents.**

Introduction

Over the past 30 years, there has been an increasing trend toward eating food that has been prepared outside the home. In 1970, foods eaten away from home (including foods found in convenience stores) comprised 25 percent of total American food spending. By 2001, this figure had risen to 42 percent.[1,2]

According to the National Association of Convenience Stores, a convenience store is "a retail business with primary emphasis placed on providing the public a convenient location to quickly purchase from a wide array of consumable products (predominantly food…)."[3]

Traditionally, a disproportionate percentage of consumables sold in convenience stores are high-calorie foods and beverages that have limited nutritional value, such as potato chips, soft drinks and candy. However, for residents in certain neighbourhoods, these stores may be their most accessible source for basic food staples such as milk and bread.

Being able to walk to a convenience store could provide a health benefit if the mere presence of such a store stimulated local residents to be more physically active. In fact, a previous study by researchers in the United States (US) showed that proximity to a corner store was one of the most important factors in determining the degree to which Americans walked each day.[4]

The literature is sparse when it comes to research on the health impact of convenience stores. Indeed, we were unable to find any previous research looking at the association between access to convenience stores and the prevalence of diabetes. However, other studies have suggested both positive and negative relationships between convenience stores and health in general:

- In one American study looking at diet quality during pregnancy, proximity to convenience stores was significantly associated with a higher-quality diet. This was independent of individual-level characteristics such as age, race, income, education and marital status.[5]

- However, in a different study, also carried out in the US, the prevalence of overweight and obesity was higher in areas where convenience stores were located and lower in areas that had a supermarket.[6]

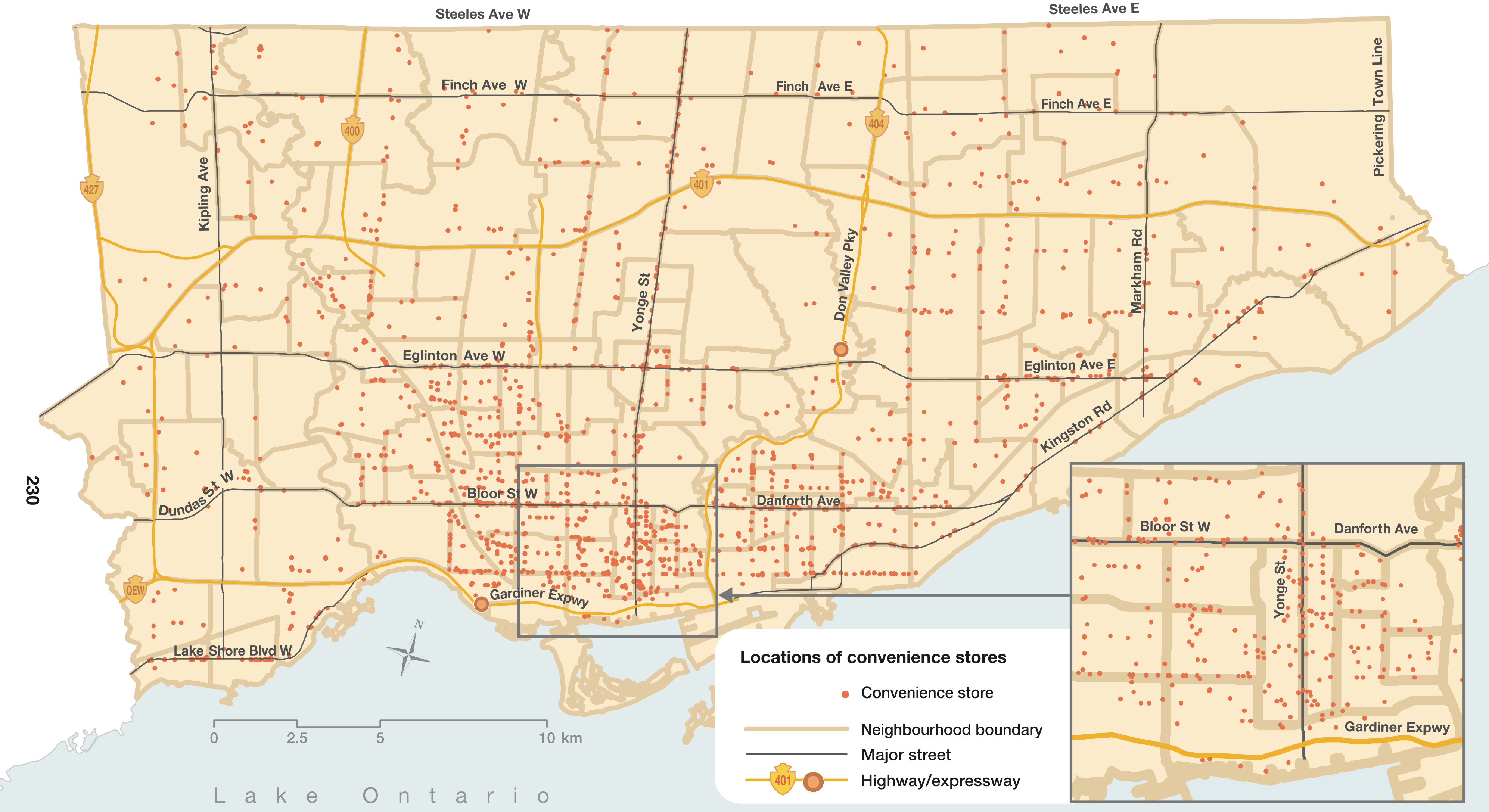
- Another American study used access to convenience stores as a proxy for access to cigarettes. It found that neighbourhoods with more convenience stores had higher rates of smoking, thus suggesting a negative association with health.[7] This same study found that low-income neighbourhoods had significantly higher concentrations of convenience stores.

It is possible that the health impacts of convenience stores depend on the presence of other food retailers in an area and also on residents' personal preferences for healthy or unhealthy foods.

Chapter 10—List of Exhibits

Exhibits and Findings

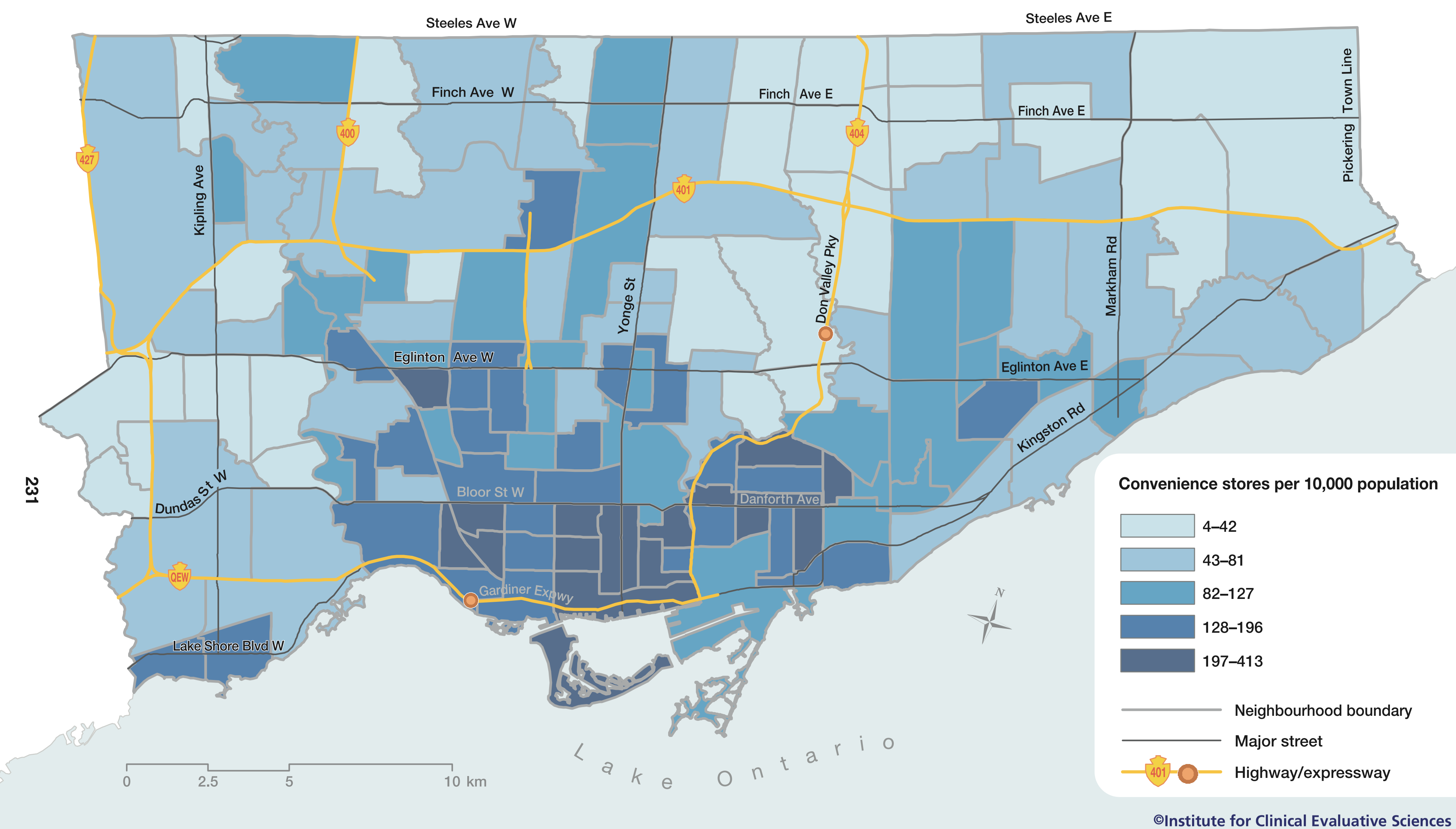
Exhibit 10.1 Locations of convenience stores, in Toronto, 2004



Findings

- In 2004, convenience stores were concentrated in the downtown (south central) core of the city and along major streets, with a more scattered pattern in communities outside of the downtown.

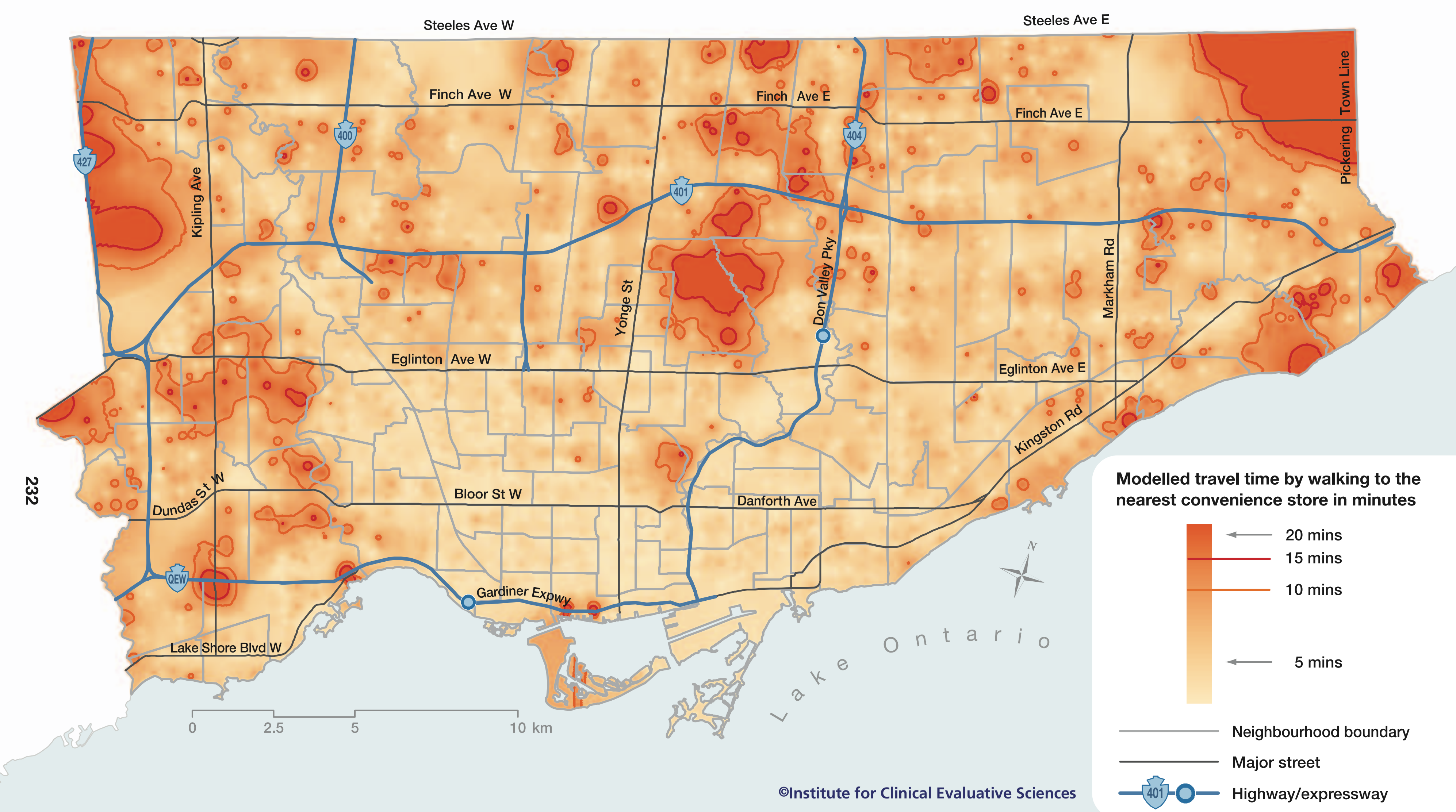
Exhibit 10.2 Number of convenience stores per 10,000 population [2001], by neighbourhood, in Toronto, 2004



Findings

- In 2004, the downtown (south central) area had the highest number of convenience stores per capita.
- The lowest number of convenience stores per capita was seen north of the downtown and in the east and west ends of the city.

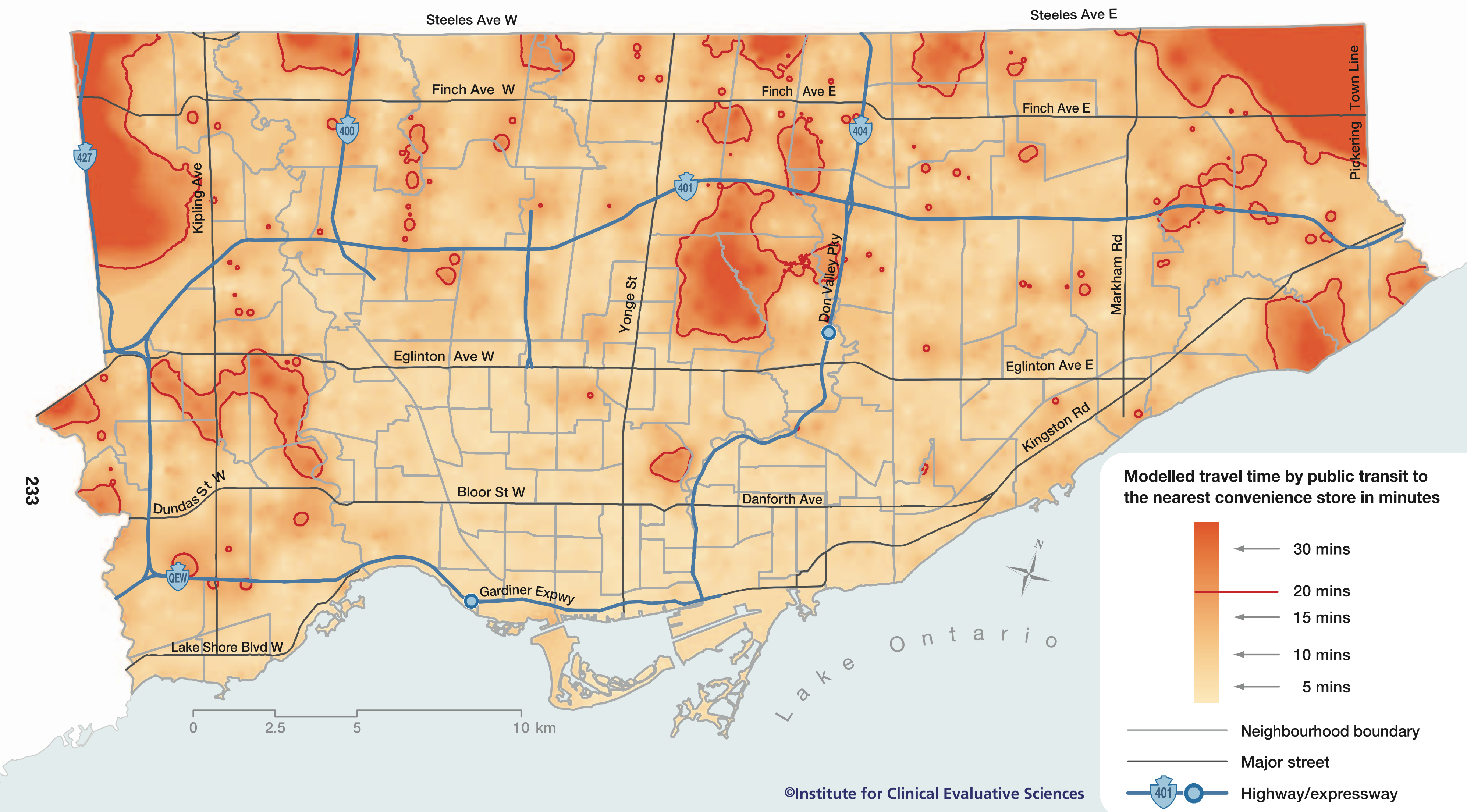
Exhibit 10.3 Modelled travel time by walking to the nearest convenience store, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- In 2004, convenience stores were accessible within a 15-minute walk for residents in most Toronto neighbourhoods.
- Relatively poorer access was found in a few areas in the east, centre and northwest of the city where residents would be unable to walk to a convenience store in less than 20 minutes.

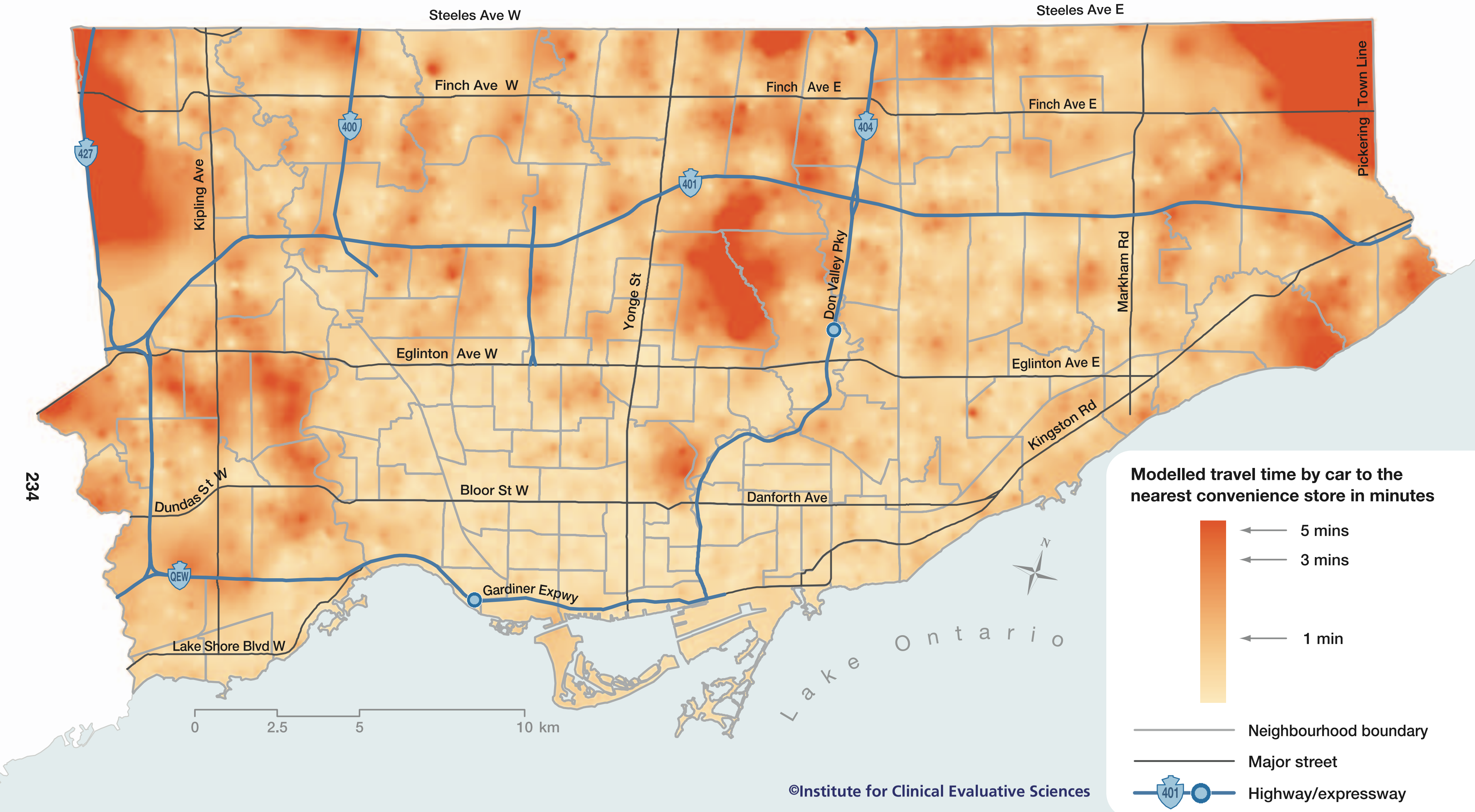
Exhibit 10.4 Modelled travel time by public transit to the nearest convenience store, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- Although most Toronto neighbourhoods had good access to convenience stores in 2004, there were a few neighbourhoods where a convenience store could not be accessed in less than 20 minutes by public transit. These were generally the same neighbourhoods where convenience stores could not be easily accessed by walking (Exhibit 10.3).
- Access to convenience stores in some neighbourhoods in central Toronto was faster by walking than by public transit (Exhibit 10.3). This could be due to a combination of factors including: relatively close proximity of convenience stores to residential areas; long walking distances to transit routes; or infrequent transit service.

Exhibit 10.5 Modelled travel time by car to the nearest convenience store, in minutes, by neighbourhood of residence, in Toronto, 2004



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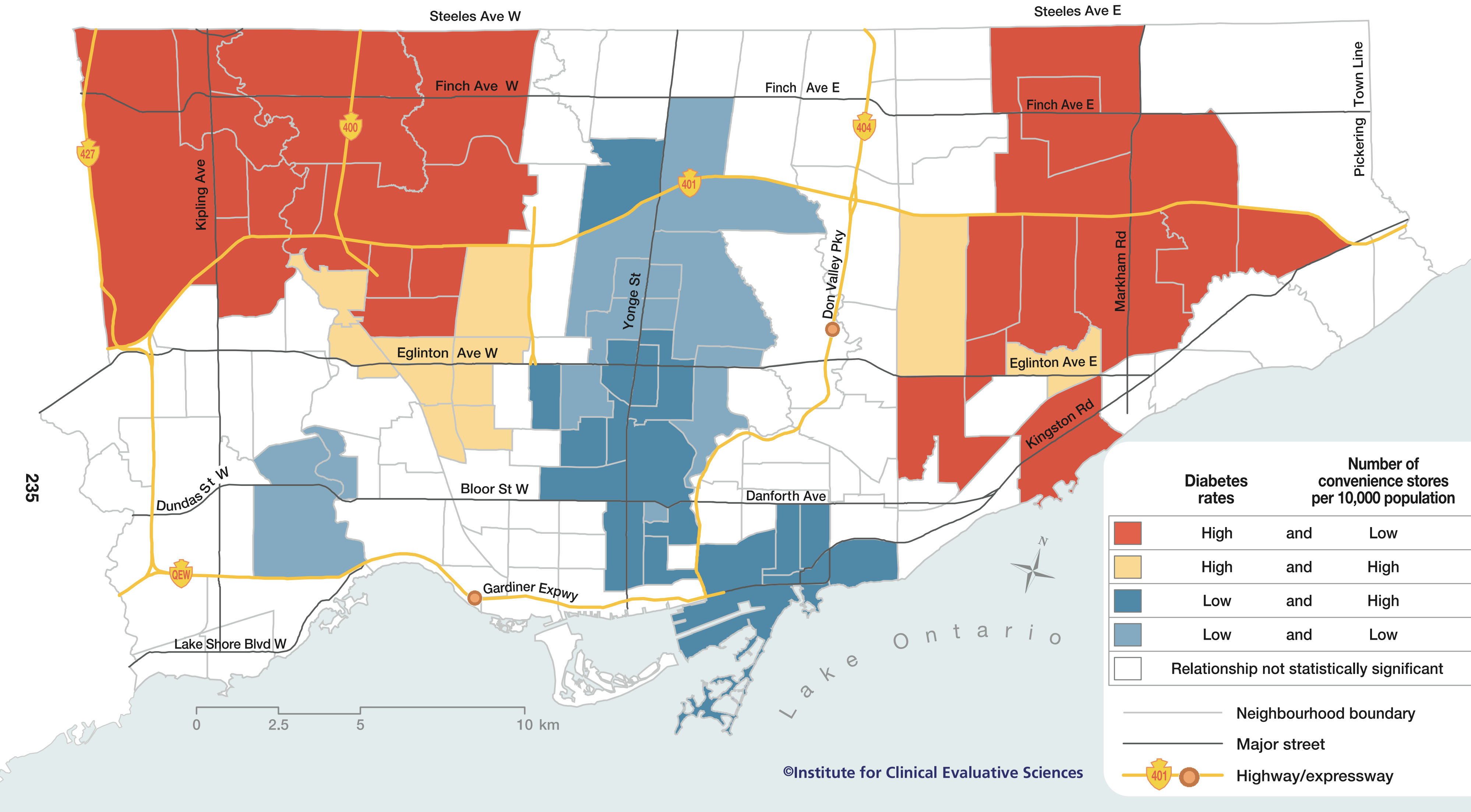
Findings

- In 2004, residents in most Toronto neighbourhoods could access a convenience store by car within three minutes or less. The pattern of accessiblity is similar to that seen for walking and public transit (Exhibits 10.3 and 10.4).
- Areas of the city where convenience stores were least accessible by car were in the north, northwest and east ends of Toronto. Accessibility by car was also more difficult in highly residential, wealthier neighbourhoods in the central and southwest areas of the city.

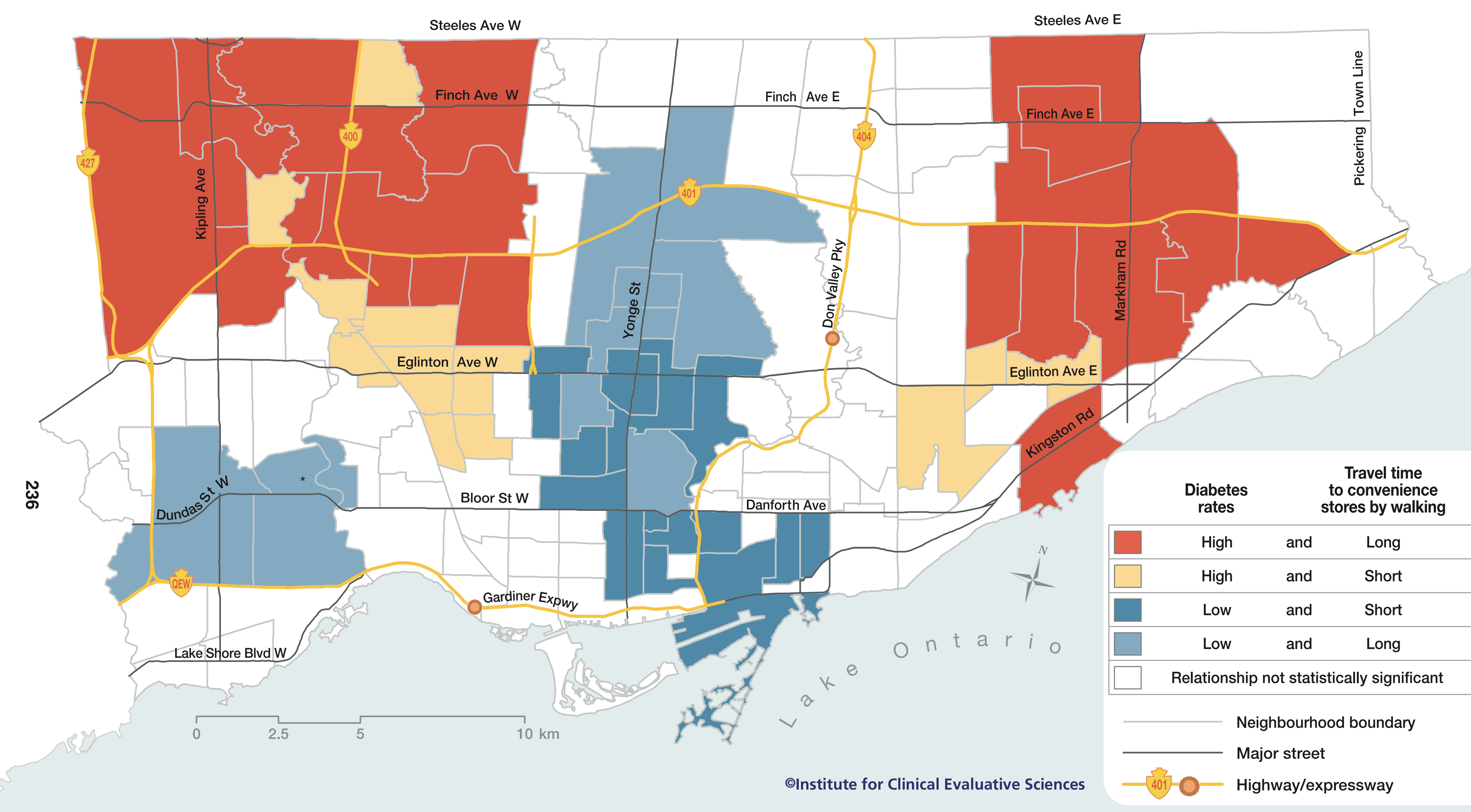
Exhibit 10.6 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and number of convenience stores per 10,000 population [2004] (high or low), by neighbourhood, in Toronto



Findings

- Based on 2001/02 and 2004 data, areas with both high diabetes rates and a low availability of convenience stores were located mainly in the northwest and eastern ends of the city. It has already been shown that these areas were home to more low-income, visible minority residents (Chapters 3 and 4). (For a definition of "visible minority" see section 10.A at the end of this chapter.)
- The wealthy neighbourhoods in central and southwest Toronto had low diabetes rates and mixed availability of convenience stores.
- Downtown (south central) Toronto experienced low diabetes rates and a high availability of convenience stores.

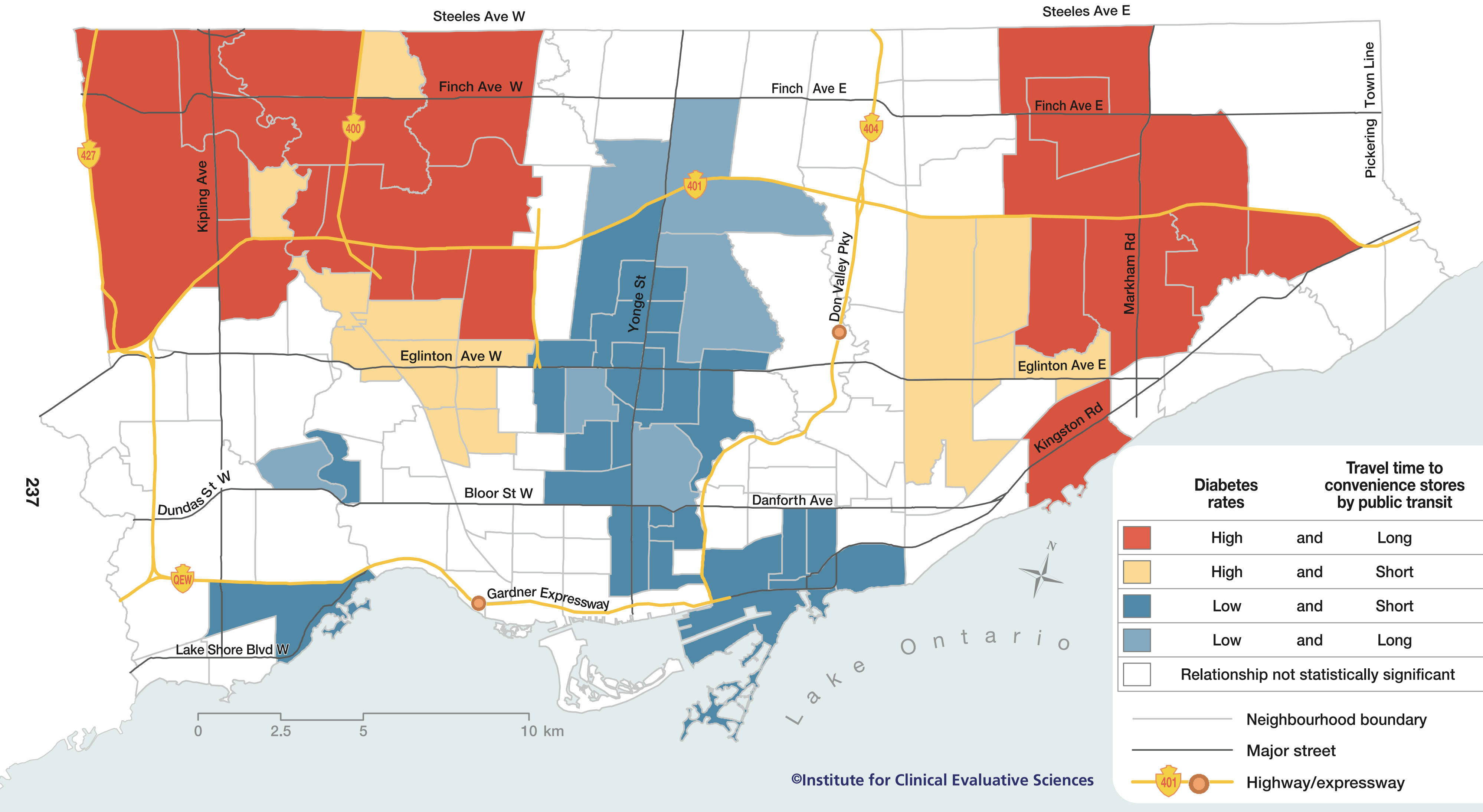
Exhibit 10.7 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to convenience stores by walking [2004] (long or short), by neighbourhood of residence, in Toronto



Findings

- Neighbourhoods where high diabetes rates were spatially associated with longer walking times to convenience stores were located in the northwest and east ends of Toronto. It has already been shown that these areas were home to more low-income, visible minority residents (Chapters 3 and 4).
- The downtown (south central) core and central region of the city had low diabetes rates and generally shorter travel times to convenience stores by walking.
- Both the north central and southwest parts of the city had low diabetes rates and more limited access to convenience stores by walking.

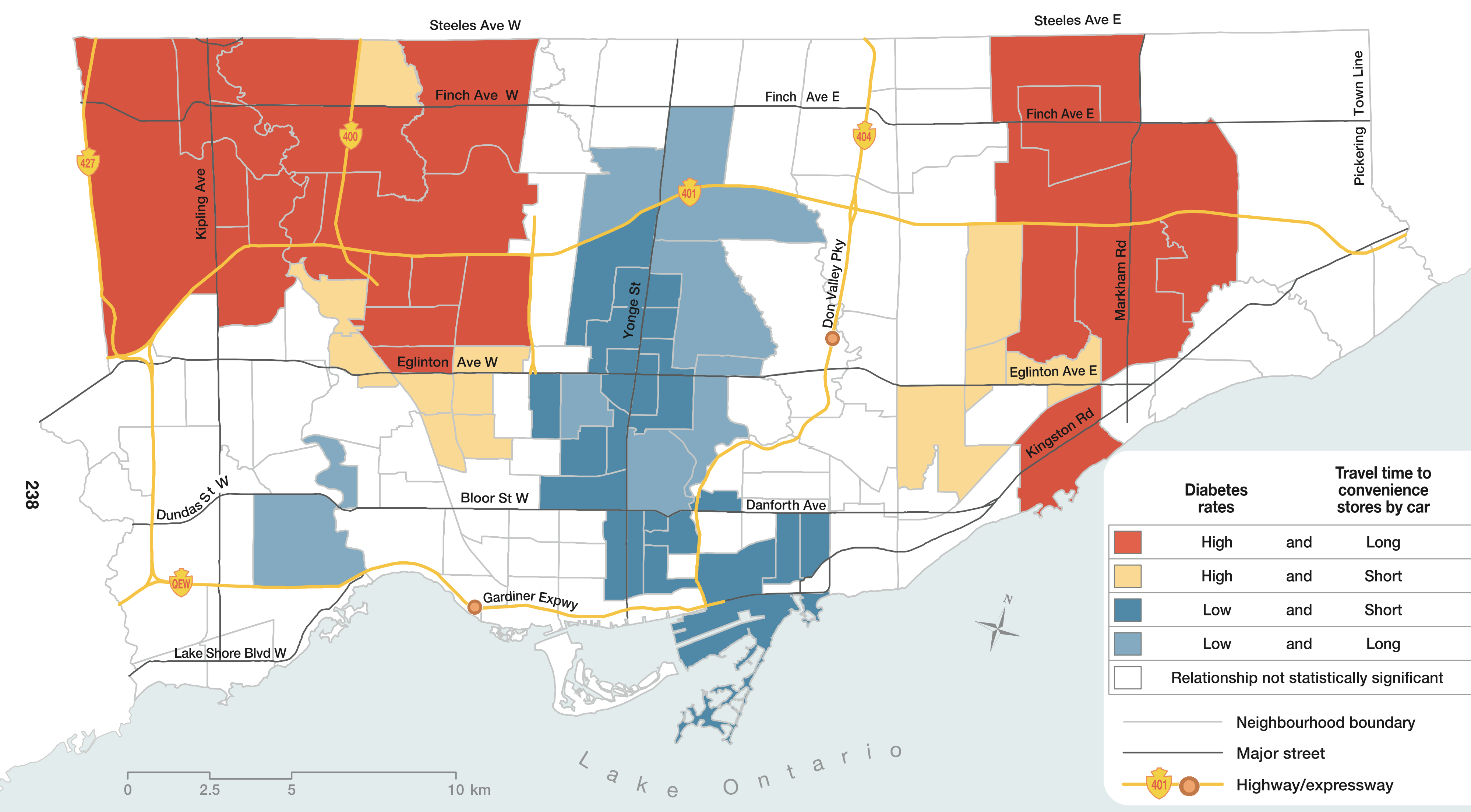
Exhibit 10.8 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to convenience stores by public transit [2004] (long or short), by neighbourhood of residence, in Toronto



Findings

- Based on data from 2001/02 and 2004, the spatial relationship between diabetes and access to convenience stores by public transit was quite similar to that for walking (Exhibit 10.7).
- Access to convenience stores by public transit was better than access by walking in some wealthy neighbourhoods in the southwest and north central Toronto where diabetes rates were low.

Exhibit 10.9 **Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to convenience stores by car [2004] (long or short), by neighbourhood of residence, in Toronto**



Findings

- Based on data from 2001/02 and 2004, the spatial relationship between diabetes and access to convenience stores by car was very similar to that for walking and public transit (Exhibits 10.7 and 10.8).

Discussion

In 2004, convenience stores were most highly concentrated in the downtown core of Toronto and along major streets, with much lower concentrations in the outlying and suburban areas. This pattern of availability corresponds well to the general pattern of retail services resulting from inherent differences in land usage across the city (Chapters 5 and 6).

In the downtown core, retail businesses were (and still are) located along major street fronts within residential areas, facilitating pedestrian access. In contrast, businesses in the suburban and more newly developed areas of the city tend to be clustered in shopping centres within non-residential areas, which discourages walking and encourages the use of cars.

This urban development pattern reflects changes in zoning that occurred after the Second World War. During this period, a primary objective of suburban development was to create "car-friendly" neighbourhoods where residential activities were separated from commercial zones. To this end, the building of stores, including convenience stores, was restricted in these newly-built, residential areas outside the central core.[8]

As a result of historical zoning patterns, the presence of a neighbourhood convenience store may simply reflect the underlying infrastructure of a neighbourhood. Neighbourhoods that have mixed (commercial and residential) land use are more activity-friendly (Chapter 6) and encourage residents to walk to local services and amenities. In addition, people living in these areas may walk to their neighbourhood corner store to buy items that they might otherwise drive to purchase, including dietary staples such as milk and bread.

Studies from the US suggest that lower-income neighbourhoods have more convenience stores than higher-income areas.[7] In contrast, we found that low-income areas in the northwest and east ends of Toronto had longer travel times to convenience stores by walking, public transit and car; some of the wealthier areas in the centre of the city had generally shorter travel times to convenience stores. Again, differences in zoning patterns and population density may explain the disparity in travel times between high- and low-income communities.

The demand for convenience foods has driven snack food sales in both Canada and the US. In 2004, the marketing company ACNielsen reported that sales of snack foods at major retail outlets in Canada totalled $981.4 million.[9] Increasing consumption of convenience foods that are high in calories, fat and sugar is thought to be one of the main factors fuelling the current obesity epidemic.

Data from the US suggest that the availability of convenience stores may be associated with obesity in areas that lack a supermarket.[5] In Toronto, however, we found that residents who lived in neighbourhoods with the highest prevalence of diabetes (mainly in the northwest and east ends of the city) had more limited access to convenience stores. By comparison, neighbourhoods in south central Toronto that had low rates of diabetes had much greater access to convenience stores. These findings suggest that access to convenience stores may not necessarily be associated with adverse health outcomes.

It is not only the presence of a convenience store in a neighbourhood that is likely to impact the health of residents, but also the types of foods that can be purchased there. In response to the demand for healthy food options, some convenience stores have started offering healthier, on-the-go food items as well as fresh produce. In addition, some local stores may carry specialty food items particular to certain ethnic groups. Therefore, for a variety of reasons, shopping at a convenience store will not necessarily lead to poorer eating habits.

Indeed, if these trends continue, convenience stores could fill a gap left in areas with poor access to supermarkets or other grocery stores. However, our research identified several areas in the northwest and east end of Toronto that had poorer access to both grocery stores (Chapter 8) and convenience stores, suggesting that these convenience stores are not necessarily fulfilling a need for healthy food in this city.

Conclusions and Next Steps

Travel time to convenience stores is a factor that could reinforce both positive and negative health behaviours. In the absence of previous work in this area, it is unclear whether convenience stores are more likely to encourage unhealthy food habits, such as consumption of soft drinks and candy bars, or to provide quick access to healthy food staples, such as milk and bread. On the other hand, the very presence of a convenience store in a neighbourhood could promote physical activity among local residents, regardless of their food choices.

While it seems intuitive that people would be more likely to walk to a store if it is nearby, there is some evidence from previous research that people living in neighbourhoods with easily-accessed stores are more likely to walk in general.[3,10–12] These findings relate to a body of research around the "walkability" of a neighbourhood, including our own findings (Chapter 6).

We have already shown that in 2001/02 high diabetes rates occurred mainly in the low-income, high-immigration neighbourhoods outside the central core of the city (Chapters 3 and 4). These areas were developed during the post-war era at a time when commercial building was intentionally restricted by zoning regulations. As a result, convenience stores, as well as many other businesses, were much less common in these areas. In this case, the lack of a convenience store may signal a general lack of commercial resources in these neighbourhoods. This could lead local residents to become more reliant on automobiles which in turn may result in lower levels of physical activity in these areas.[13] Furthermore, these more recently developed areas tend to be less dense and more spread out, another factor that could discourage walking within communities.

Changes in planning, development and zoning practices that reduce urban sprawl, increase residential density, and promote mixed land use could make suburban communities more walkable for local residents. However, further research is needed to understand the impact of convenience stores on the eating patterns of residents living in different parts of the city.

Appendix 10.A—How the Research was Done

Data sources

The City of Toronto's 2004 Employment Survey (conducted by the Planning Division) was used to identify the location of convenience stores. Retail businesses were selected based on their activity code.[14] Using this definition of convenience stores, 1,585 locations were identified, geocoded and are included in the analysis.

Age- and sex-standardized diabetes rates (2001/02) were derived from the Ontario Diabetes Database and other administrative data sources housed at the Institute for Clinical Evaluative Sciences (ICES).

Other population denominators were abstracted from the 2001 Canadian census.

Analysis

Geographic availability was analyzed using dot density maps to depict the locations of convenience stores, and choropleth (shaded) maps were used to depict the concentration of convenience stores per 10,000 residential population. Accessibility was calculated using network analysis and shown on travel time maps. The travel time in minutes was modelled from residential areas to convenience stores along the network of streets, public transit routes and highways.

The relationship between diabetes rates and measures of availability and accessibility was evaluated using bivariate *Local Indicator of Spatial Association) (LISA)* maps.

More detailed information about data sources and analyses is available in "Appendix B: Technical Notes" at the end of this Atlas.

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INSIDE

11 Chapter

Community-Based Health Services and Diabetes

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Executive Summary

Issue

Access to and use of appropriate health services is essential for improving the diagnosis and control of diabetes and diabetes-related conditions. The health care system plays a variety of roles in diabetes management. First, it plays an important role in promoting healthy diets and activity levels. This may help prevent or delay the onset of diabetes and help people with the disease achieve better control of their blood sugar levels. Second, it screens people for diabetes and also for other risk factors such as obesity, smoking, high blood pressure and elevated cholesterol levels which, along with diabetes, raise the risk of cardiovascular disease. Finally, health services are essential for the treatment of diabetes.

Studies show that both lifestyle modification and medications may reduce a person's chance of developing diabetes. Such interventions can also reduce the risk of serious diabetic complications such as blindness, kidney disease, nerve damage and heart disease. Unfortunately, many people with diabetes remain unaware of their condition or do not take full advantage of treatment and lifestyle approaches aimed at maximizing health (i.e., their blood sugar and other risk factors are not well-controlled).

Study

We mapped the geographical locations of health service providers in Toronto who are involved in caring for people with diabetes. These included: family physicians/general practitioners; diabetes specialists (endocrinologists, ophthalmologists and optometrists); and hospital- and community-based diabetes education centres. The concentration of these services per capita was calculated for each neighbourhood. Network analysis was used to model travel time to these locations by public transit and by car. Bivariate *Local Indicator of Spatial Association (LISA)* maps were used to examine spatial clustering of these measures and determine associations with age- and sex-adjusted diabetes rates (derived from the Ontario Diabetes Database).

Key Findings

- Based on different sets of data collected between 2001 and 2004, the availability of health services for people with diabetes was relatively low in large parts of Toronto, especially areas outside the downtown core.
- Diabetes rates were high in the northwest and east ends of the city where availability of and access to health services was low. Conversely, diabetes rates were low in central and south central Toronto where availability of and access to health services were high.
- Neighbourhoods with higher diabetes rates tended to have high proportions of immigrants and low-income residents. Many of these areas also had poorer access to diabetes health services.

Implications

- **We noted a striking mismatch between parts of the city where diabetes health services were most needed and where they were located.**
- **Health services planning and integration should be based on population needs and should strive to locate new services in relatively underserved areas.**
- **Improving public transit to areas of Toronto with high diabetes rates would help to increase residents' access to the health services aimed at preventing and treating diabetes and associated conditions.**

Introduction

Health Services and Diabetes

Diabetes is one of the most commonly encountered conditions in primary care practice,[1] accounting for nearly seven million annual visits to family physicians in Ontario alone.[2] In total, approximately five percent of the Canadian population has diabetes.[3] Yet it is estimated that as many as one-third of all people with diabetes are undiagnosed.[1]

There is strong scientific evidence that the long-term complications of diabetes (including cardiovascular disease, kidney disease, eye disease, and nerve damage which may result in limb amputation) can be delayed or prevented through specific interventions. These include achieving optimal control of blood sugar levels, cholesterol and blood pressure;[4–8] in one trial, targeting these factors simultaneously and adopting other strategies to protect against heart disease resulted in a 50 percent reduction in cardiovascular events.[8]

Because of its complexity, successful diabetes management requires focused resources and regular access to health care services. A variety of health personnel are involved in the management, prevention and treatment of diabetes. These include family physicians and general practitioners (FPs/GPs), other medical specialists, diabetes educators, optometrists and dietitians.[2]

This chapter examines the availability and accessibility of diabetes care providers in Toronto. We focused on the services provided by primary care practitioners (FPs/GPs), specialists (endocrinologists, ophthalmologists, and optometrists) and community and hospital-based diabetes education programs.

Family physicians/General practitioners (FPs/GPs)

Primary care providers are central to the prevention, identification and treatment of diabetes. They are usually the first (and often the main) medical contact for persons with this disease.[9] A large proportion of the responsibility for diabetes management in Ontario falls to FPs/GPs, with three-quarters of patients receiving diabetes care from their FP/GP only. Furthermore, Ontarians with diabetes visit physicians twice as often as members of the general population.[2] Primary care providers such as FPs/GPs are mainly responsible for screening otherwise healthy people for diabetes. This includes screening designed to detect undiagnosed diabetes, and also screening aimed at identifying people with "prediabetes" who would benefit from diabetes prevention strategies.[9]

In one study of patients over age 40 who were visiting their family physicians, diabetes screening strategies—when applied consistently—proved to be effective. They allowed physicians to identify a substantial group of people with undiagnosed diabetes and an even larger group with glucose intolerance (prediabetes).[1]

The continuity of care provided by family physicians is an important predictor of diabetes complications. In a recent Ontario study, failure to see a primary care physician during the previous year was associated with a two-fold higher risk that patients would be hospitalized or seen in an emergency department for uncontrolled diabetes (i.e., their blood sugar levels were either too high or too low).[10] In contrast, having a regular care provider and visiting a physician more frequently appeared to be protective against these episodes. Regular access to care may play a role in whether patients develop chronic complications. In a related study, persons with diabetes who saw their FP/GP at least three times a year were one-third less likely to require a diabetes-related amputation over the next five years compared to those with fewer annual visits.[11]

Specialists (endocrinologists, ophthalmologists and optometrists)

Referral to a diabetes specialist is one of a number of measures available to primary care providers to aid patients who are not meeting therapeutic targets.

Most endocrinologists provide specialized care for diabetes; they also have expertise in managing complex diabetes regimens. However, other types of physicians, including specialists in general internal medicine, may also specialize in diabetes management. Endocrinologists may work in either hospital- or community-based settings, often in close proximity to centres offering diabetes education programs.

Although many patients with diabetes will not need specialist care in order to achieve treatment targets, these services should be available to those who do. Earlier research suggests that accessibility and use of diabetes specialists varies more than 10-fold across Ontario counties.[2] However, research exploring access to these physicians on a neighbourhood level is lacking.

Eye problems are a common complication of diabetes that can lead to serious loss of vision and blindness. Fortunately, vision loss related to diabetes may be averted by prevention strategies, early detection and treatment. Based on this evidence, Canadian guidelines recommend that all patients with diabetes undergo periodic retinal screening examinations by a trained eye care specialist. Therefore, access to an ophthalmologist or optometrist with experience in detecting diabetic eye disease (retinopathy) is essential.

Diabetes education programs

Diabetes education programs also provide essential services to people with diabetes. These facilities deliver basic education about diabetes to patients and their families, including strategies to control blood sugar levels and reduce the risk of complications. Such strategies aimed at improving diabetes control and overall health for patients include: learning to track blood sugar levels on a day-to-day basis using home monitors; learning to recognize hypoglycemic (low blood sugar) reactions and how to treat them appropriately; optimizing diet; and encouraging appropriate levels of physical activity. Most centres also provide advanced training in insulin administration and dose adjustment.

Individuals with diabetes play a key role in managing their disease,[9] and the educational opportunities available to them through diabetes education programs are central to encouraging effective self-care. Research shows that an effective education program for people with diabetes accomplishes four goals: it reduces acute complications; decreases foot problems (common in people with poorly controlled diabetes); shortens or eliminates the need for hospitalizations; and improves long-term blood sugar control.[1,10,11]

Geographic Access to Health Services

Geographic access to primary health care is recognized as an important facilitator of overall population health.[12] Despite the ideal of equal access to health care services for those in equal need,[13] access to health care is not spatially uniform, and access problems are particularly prominent in both rural and very low-income urban communities.[14]

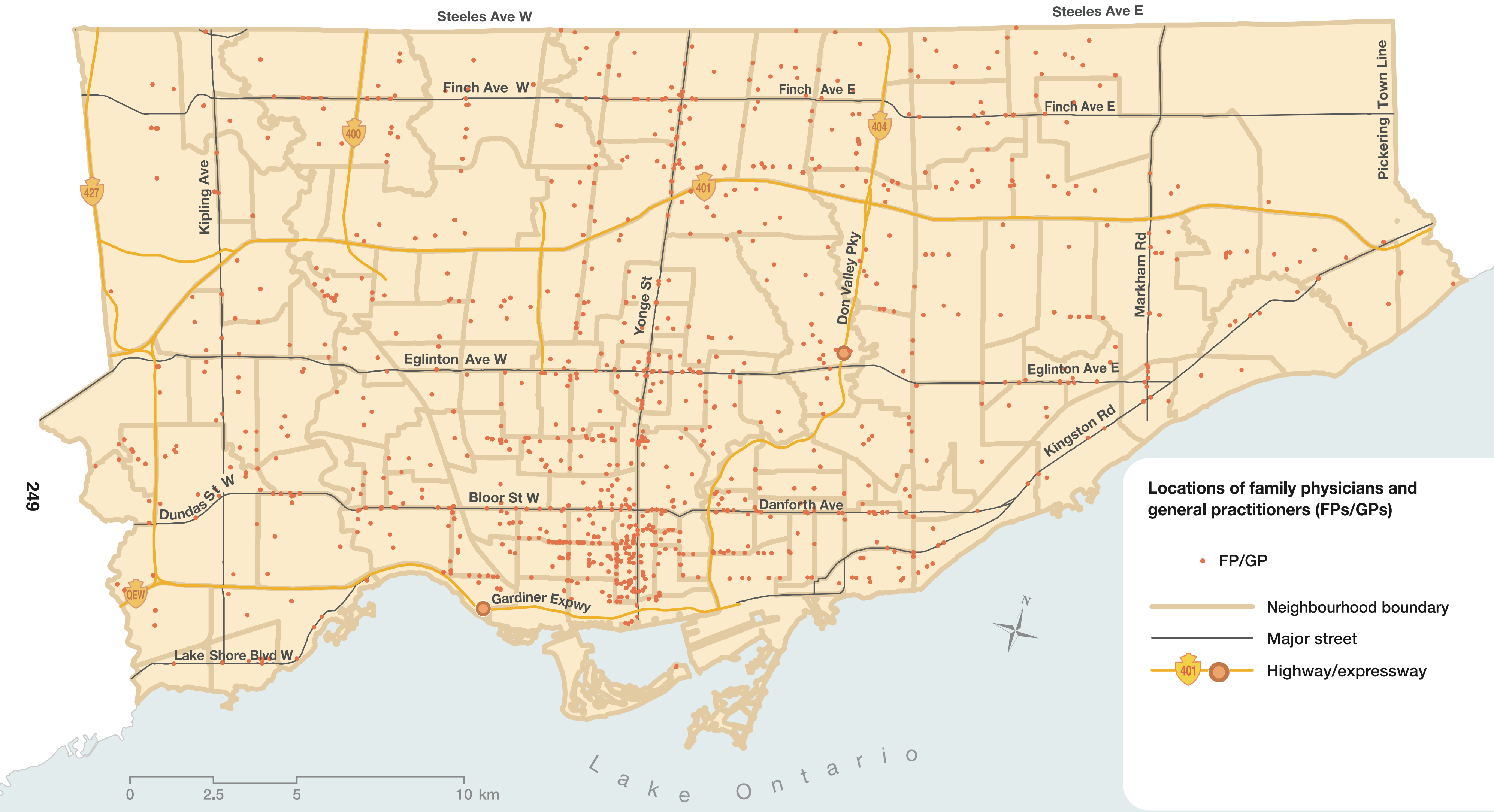
Access to various health services such as primary care in rural areas is well documented,[13–15] but only recently has the research focus shifted to urban regions.[12,16] A recent study involving a major American city found racial and social inequalities in spatial access to primary care for children.[16] This suggests that difficulties in using services may arise from both cultural and social factors and also from the need to overcome the physical distance to the service provider.[13]

While many studies have focused on sociocultural factors in service utilization, few have examined geographic barriers to accessing health services in the urban context. Fewer still have used Geographic Information Systems (GIS) to do so.[17] In this chapter, we explore geographic access (represented by travel time to diabetes care providers and diabetes education programs) in relation to the local prevalence of diabetes in Toronto neighbourhoods.

Chapter 11—List of Exhibits

Exhibits and Findings

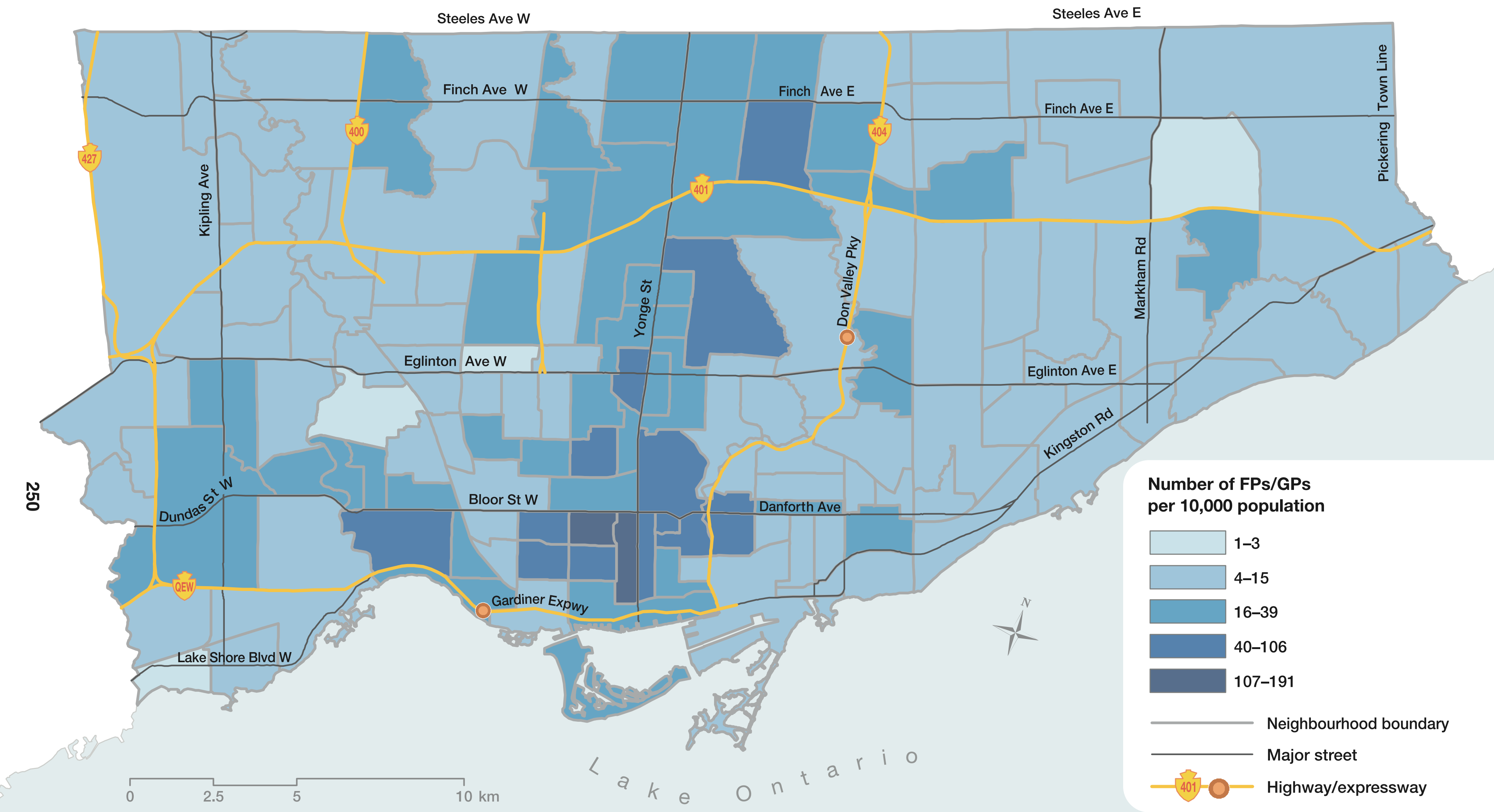
Exhibit 11.1 Locations of family physicians and general practitioners (FPs/GPs), in Toronto, 2002



Findings

- In 2002, there was a high concentration of family physicians/general practitioners (FPs/GPs) in the downtown (south central) core of Toronto, a finding that may be influenced by the large number of hospitals concentrated in this area.
- Throughout the rest of the city, FPs/GPs were fairly evenly distributed, largely along major roadways.

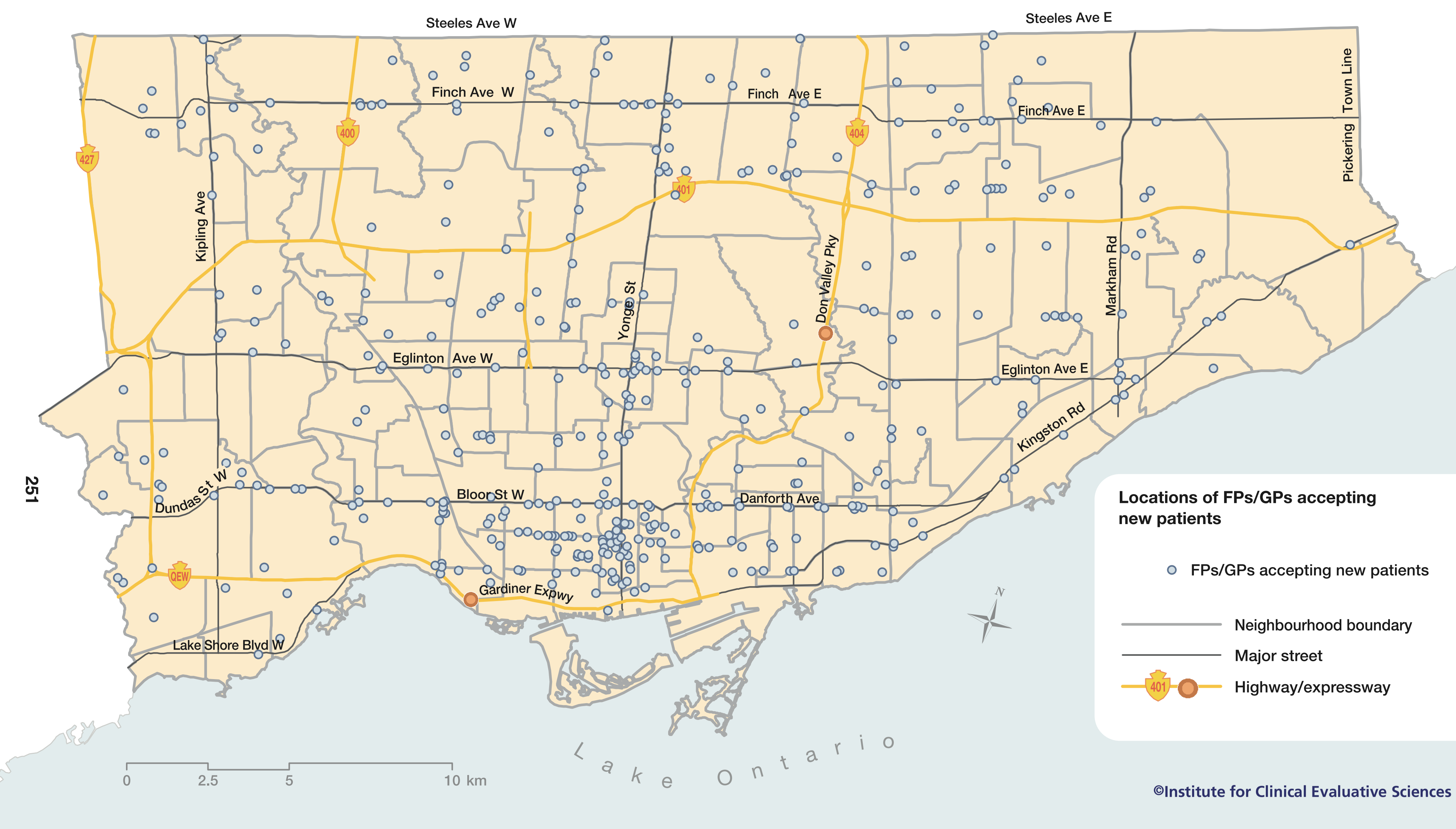
Exhibit 11.2 Number of family physicians and general practitioners (FPs/GPs) per 10,000 population [2001], by neighbourhood, in Toronto, 2002



Findings

- In general, the number of family physicians/general practitioners (FPs/GPs) per capita in 2002 was lowest in the northwest and eastern regions of Toronto, areas previously shown to have among the highest rates of diabetes in the city (Chapter 2).

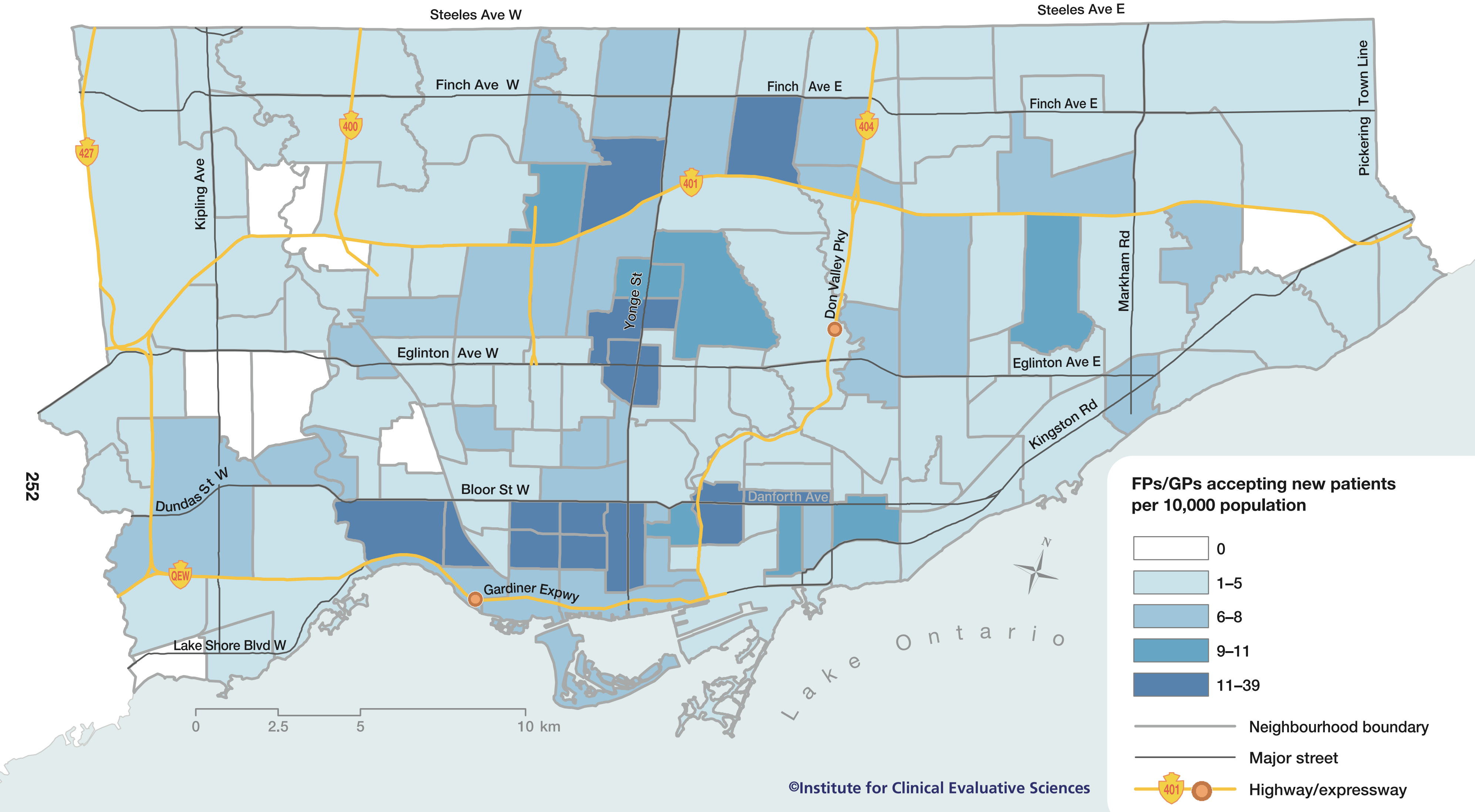
Exhibit 11.3 Locations of family physicians and general practitioners (FPs/GPs) accepting new patients in Toronto, 2002



Findings

- The highest concentration of family physicians/general practitioners (FPs/GPs) accepting new patients in 2002 was in the downtown (south central) core of the city and in the wealthy central and north central regions, as well as along some major roadways.

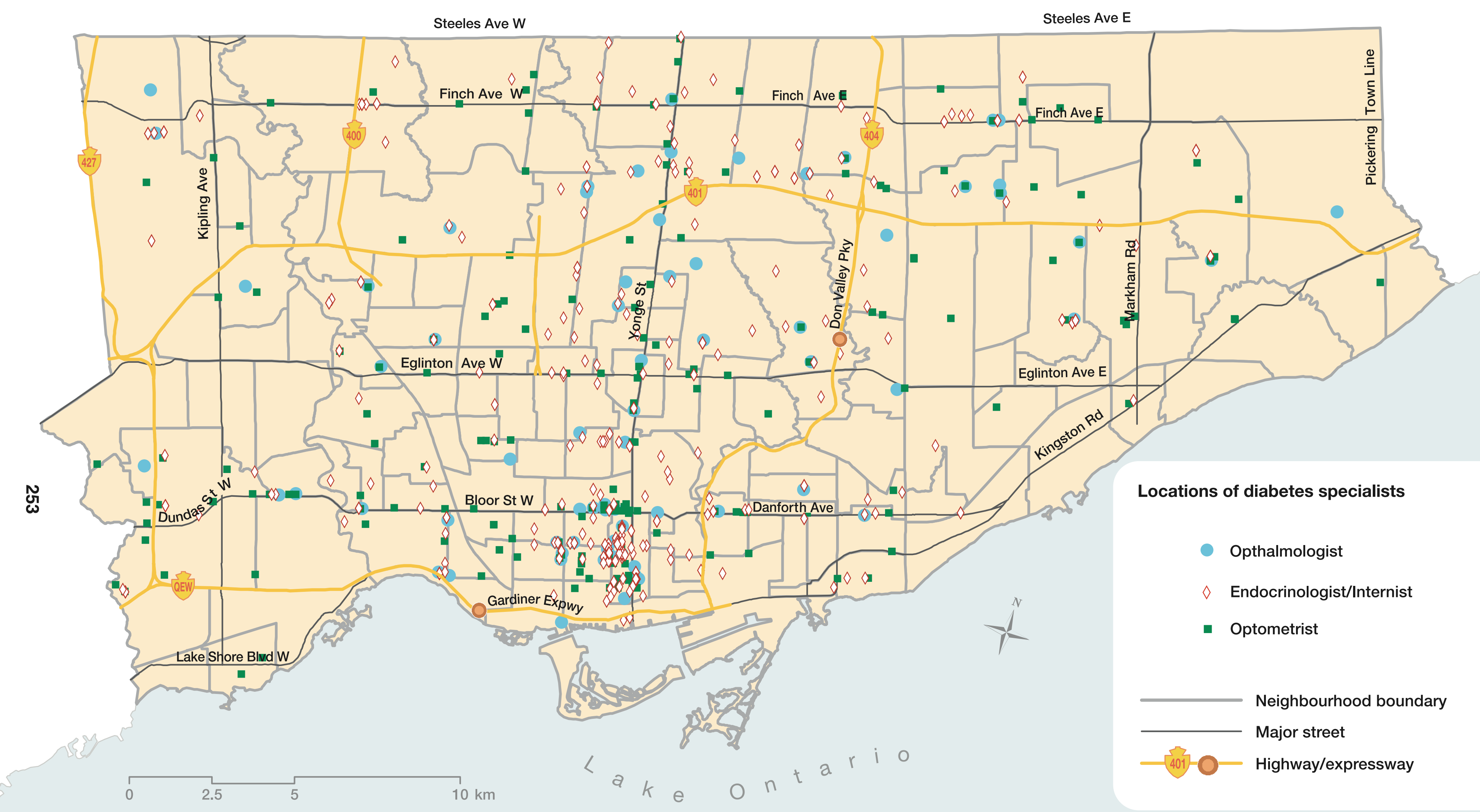
Exhibit 11.4 Family physicians and general practitioners (FPs/GPs) accepting new patients per 10,000 population [2001], by neighbourhood, in Toronto, 2002



Findings

- The number of family physicians/general practitioners (FPs/GPs) accepting new patients per capita in 2002 was highest in the downtown (south central) core of the city and in the central and north central regions. This is similar to the pattern seen in Exhibit 11.3.
- Although parts of eastern and central Toronto had limited access to FPs/GPs, neighbourhoods in the northwest and central west were the most underserviced. These areas were previously shown to have a high prevalence of diabetes (Chapter 2).

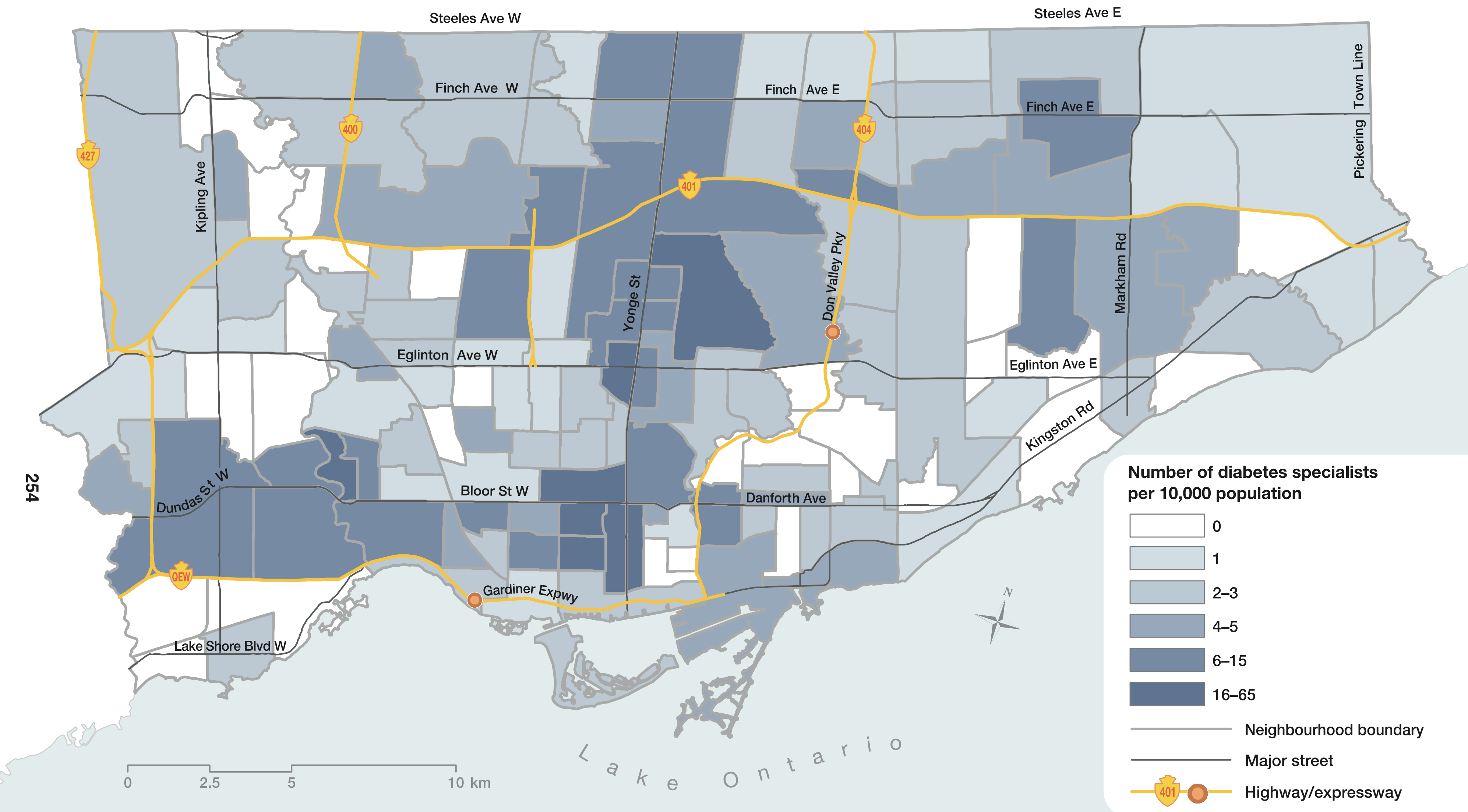
Exhibit 11.5 Locations of diabetes specialists, in Toronto, 2002



Findings

- In 2002, the majority of endocrinologists, ophthalmologists and optometrists were located in downtown (south central) Toronto and along major traffic routes.

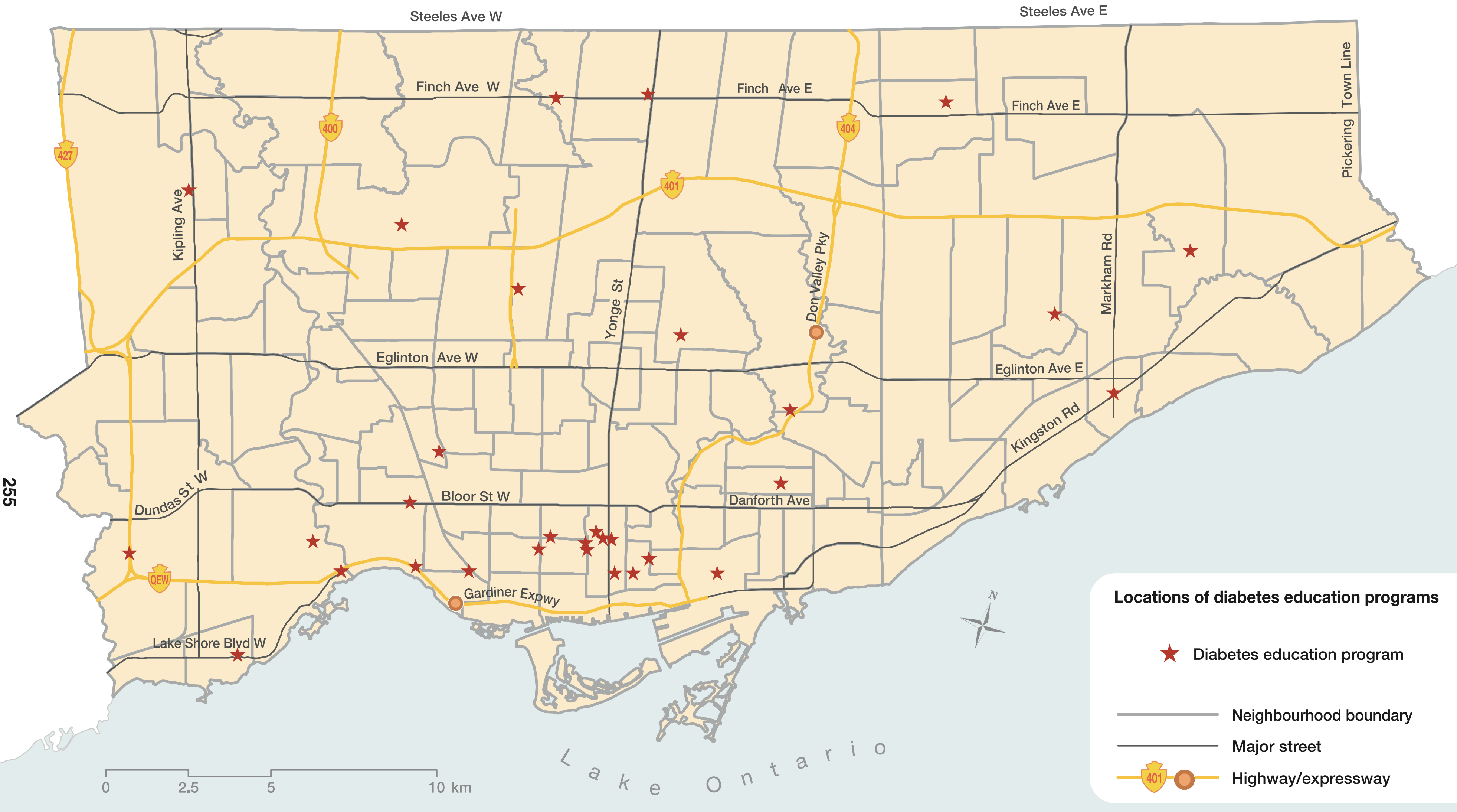
Exhibit 11.6 Number of diabetes specialists per 10,000 population [2001], by neighbourhood, in Toronto, 2002



Findings

- In 2002, the highest numbers of diabetes specialists per capita were in the downtown (south central) core, the southwest, central and north central areas of Toronto. There was also a concentration of specialists in a few central east neighbourhoods.
- The availability of diabetes specialists was much lower in many neighbourhoods in the northwest and east ends of the city where diabetes rates were previously shown to be highest (Chapter 2).

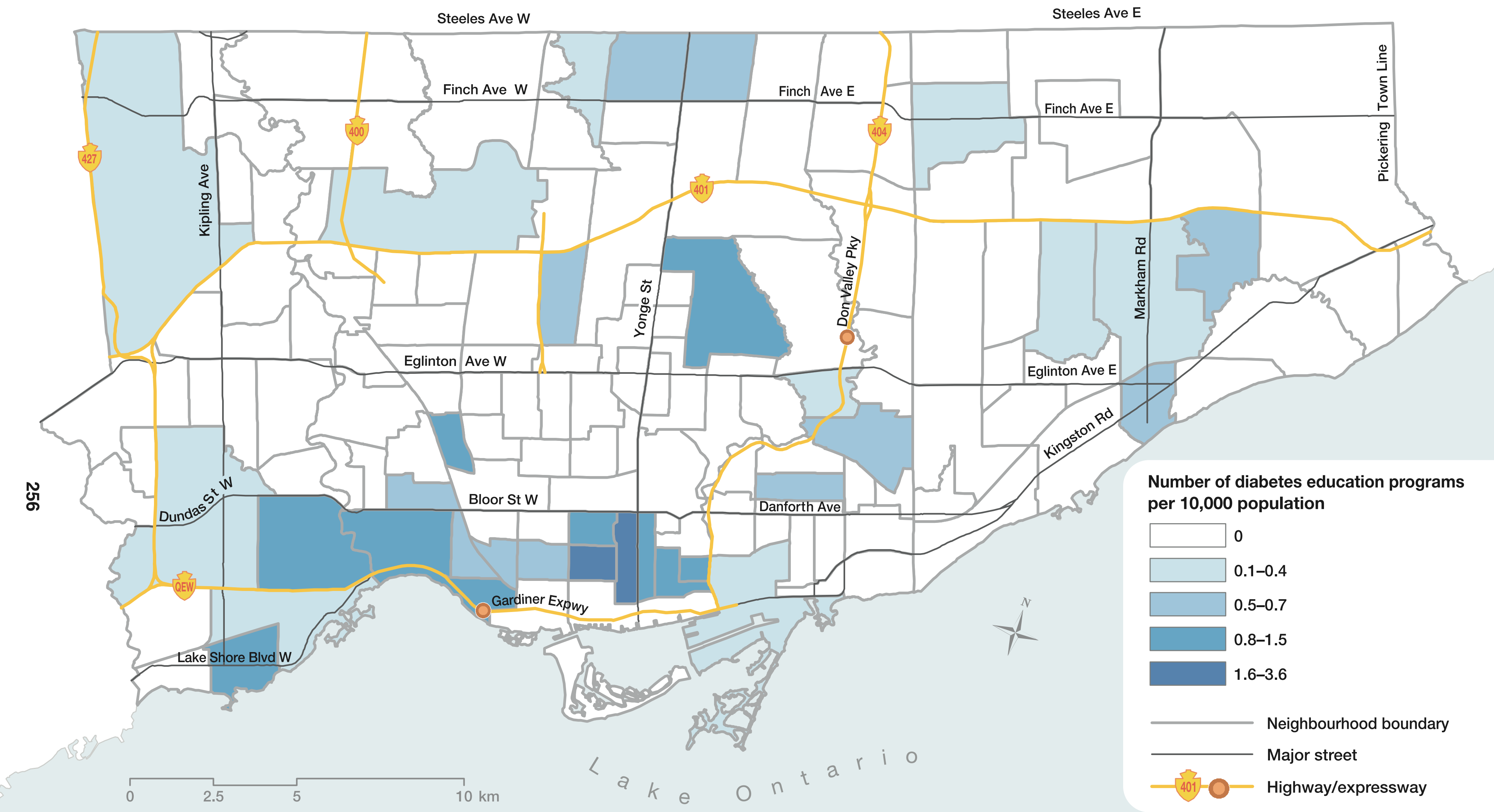
Exhibit 11.7 Locations of diabetes education programs, in Toronto, 2004



Findings

- In 2004, the majority of community- and hospital-based diabetes education programs were located in downtown Toronto and in the area directly west of the downtown core. This is likely due to a clustering of hospitals in this part of the city.
- There was a relatively sparse distribution of such programs in other areas of the city.

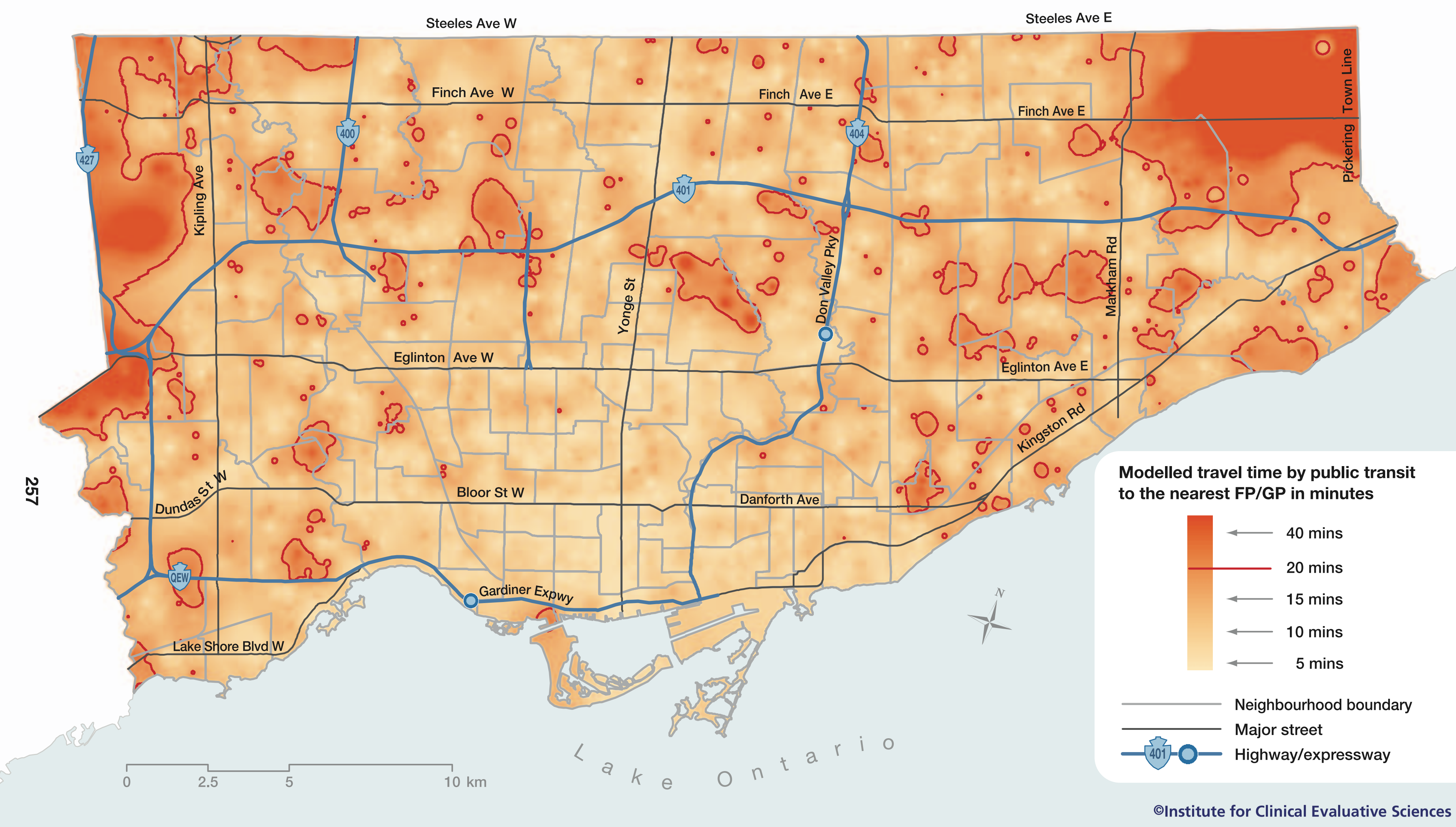
Exhibit 11.8 Number of diabetes education programs per 10,000 population [2001], by neighbourhood, in Toronto, 2004



Findings

- In 2004, the highest availability of community- and hospital-based diabetes education programs per capita was in the downtown (south central) and just west of the downtown. This followed a similar pattern to that seen in Exhibit 11.5 (locations of diabetes specialists).
- Many communities that lacked diabetes education programs were those previously shown to experience high diabetes rates (Chapter 2).

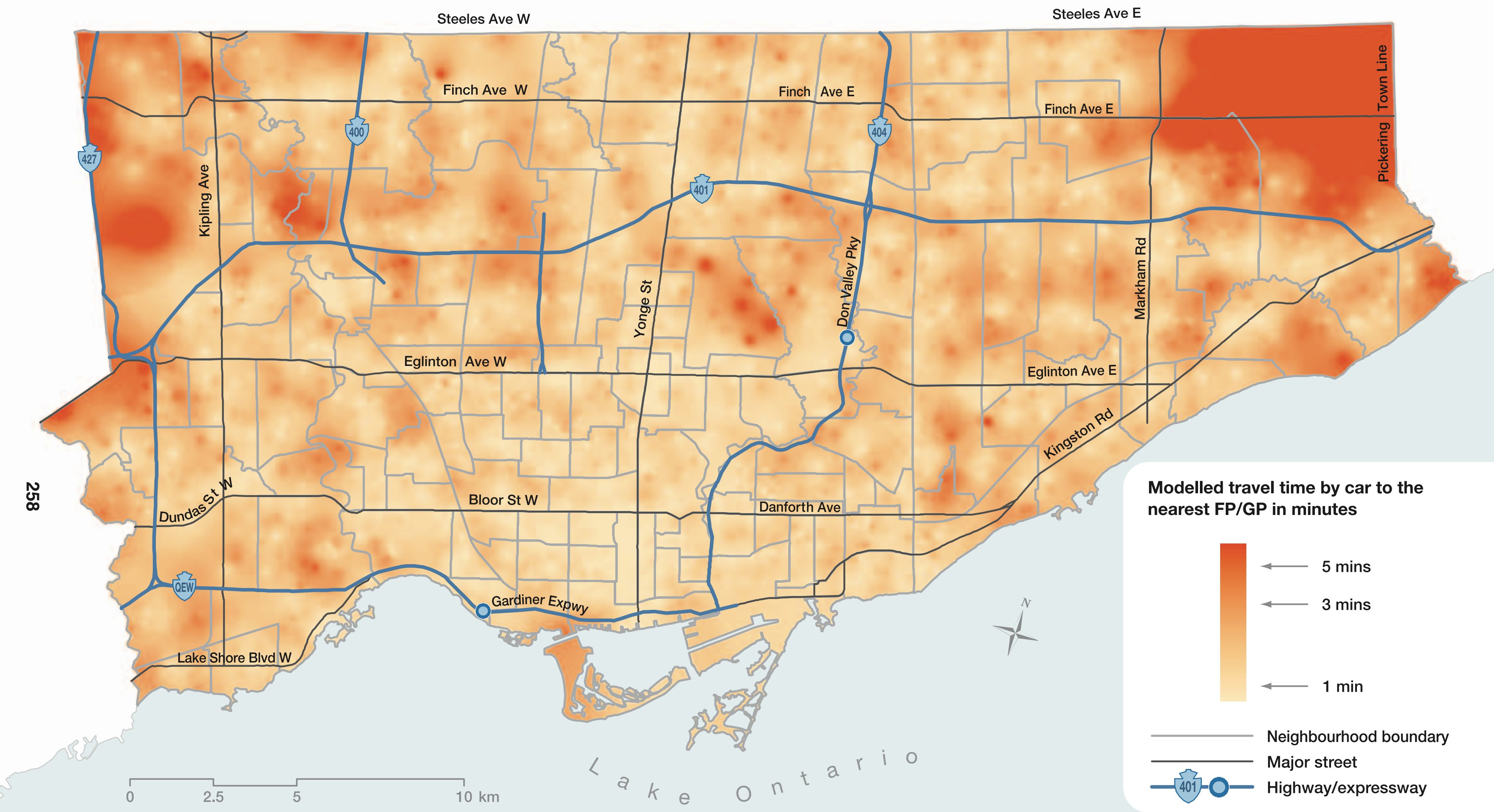
Exhibit 11.9 **Modelled travel time by public transit to the nearest family physician/general practitioner (FP/GP), in minutes, by neighbourhood of residence, in Toronto, 2002**



Findings

- In 2002, residents of most Toronto neighbourhoods were able to access family physicians/general practitioners (FPs/GPs) in less than 20 minutes each way by public transit.
- In large areas of the northwest and east end of the city, where diabetes rates were shown to be highest, travel times to the nearest FP/GP increased to 20 minutes or more in each direction.

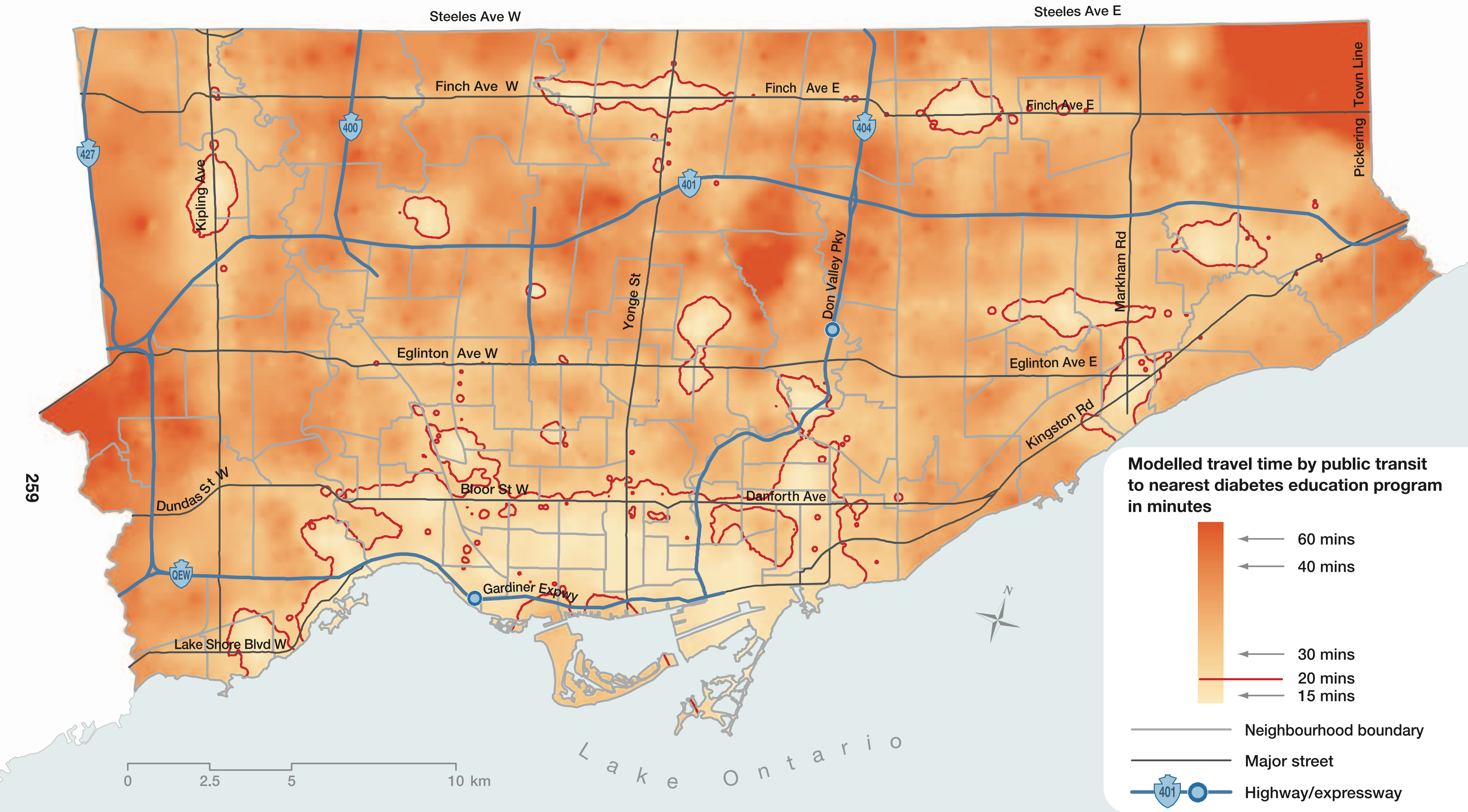
Exhibit 11.10 **Modelled travel time by car to the nearest family physician/general practitioner (FP/GP), in minutes, by neighbourhood of residence, in Toronto, 2002**



Findings

- In 2002, travel times to family physicians/general practitioners (FPs/GPs) by car followed a similar pattern to Exhibit 11.9 (travel times by public transit), although trips by car were uniformly shorter than trips by transit.
- Residents living in the majority of Toronto neighbourhoods were within a five-minute drive to an FP/GP.

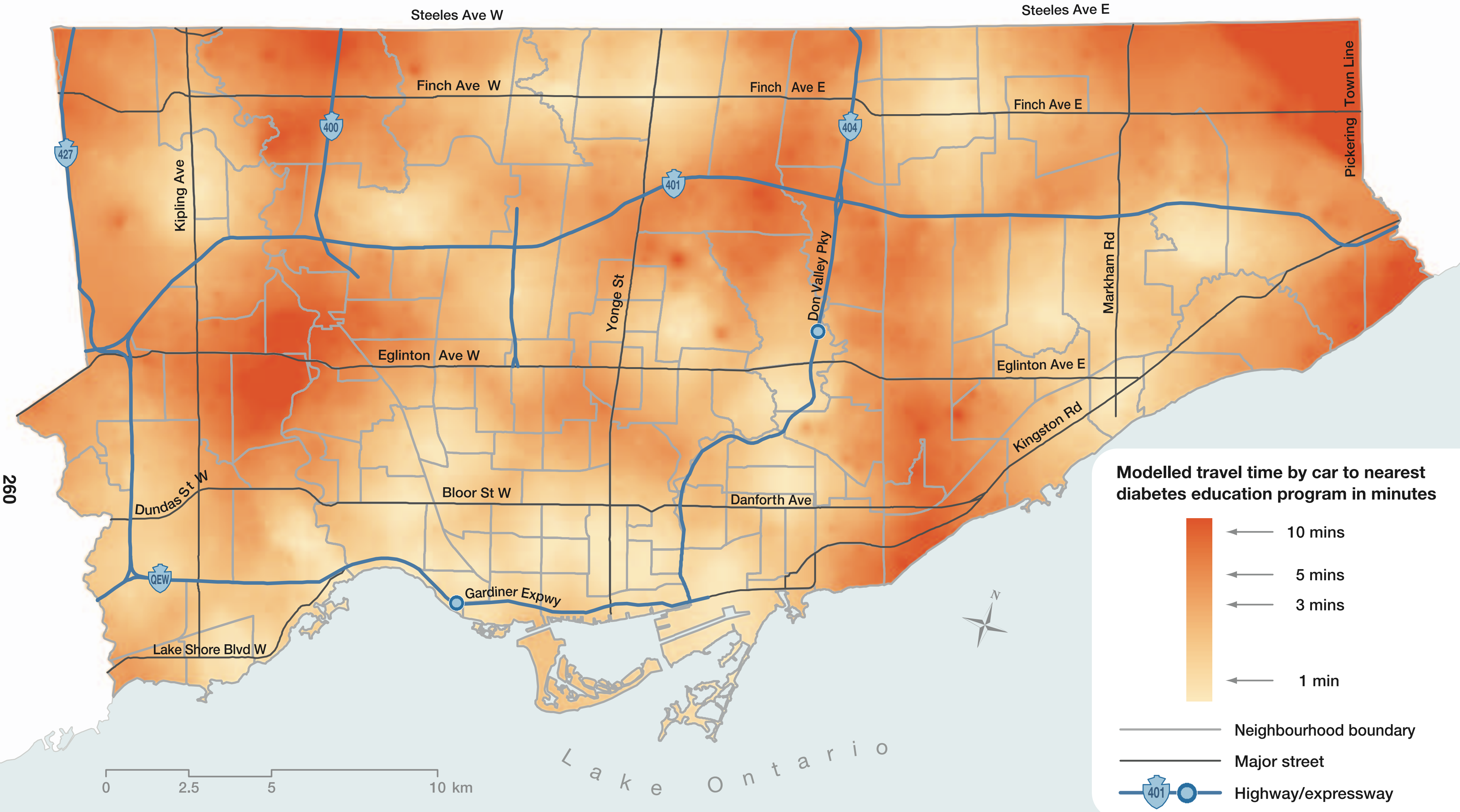
Exhibit 11.11 Modelled travel time by public transit to the nearest diabetes education program, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- In 2004, residents living in most downtown (south central) neighbourhoods could access a community- or hospital-based diabetes education program within 20 minutes by public transit. Very few people living in communities outside the downtown could access a diabetes program within this time using public transit.
- Access to diabetes education programs was particularly limited in the east, north central and west ends of the city.

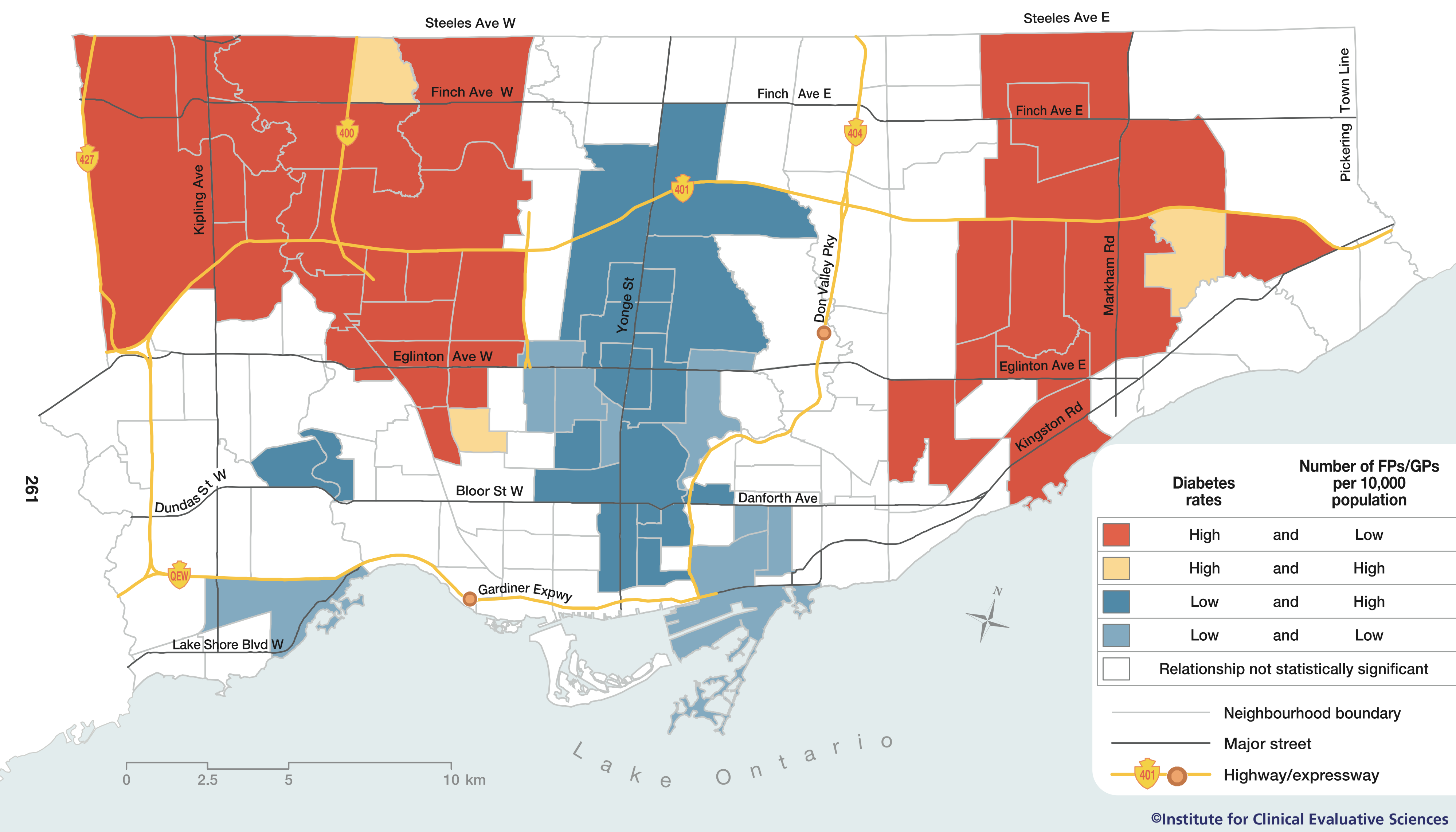
Exhibit 11.12 Modelled travel time by car to the nearest diabetes education program, in minutes, by neighbourhood of residence, in Toronto, 2004



Findings

- In 2002, the pattern for accessing community- and hospital-based diabetes education programs by car was similar to that for public transit (Exhibit 11.11).
- Although residents living in many neighbourhoods could access such a diabetes education program within five minutes by car, there were several areas where drive times went beyond 10 minutes. These longer drive times could be expected by those living in the east, central east and north, and also in some parts of west Toronto.

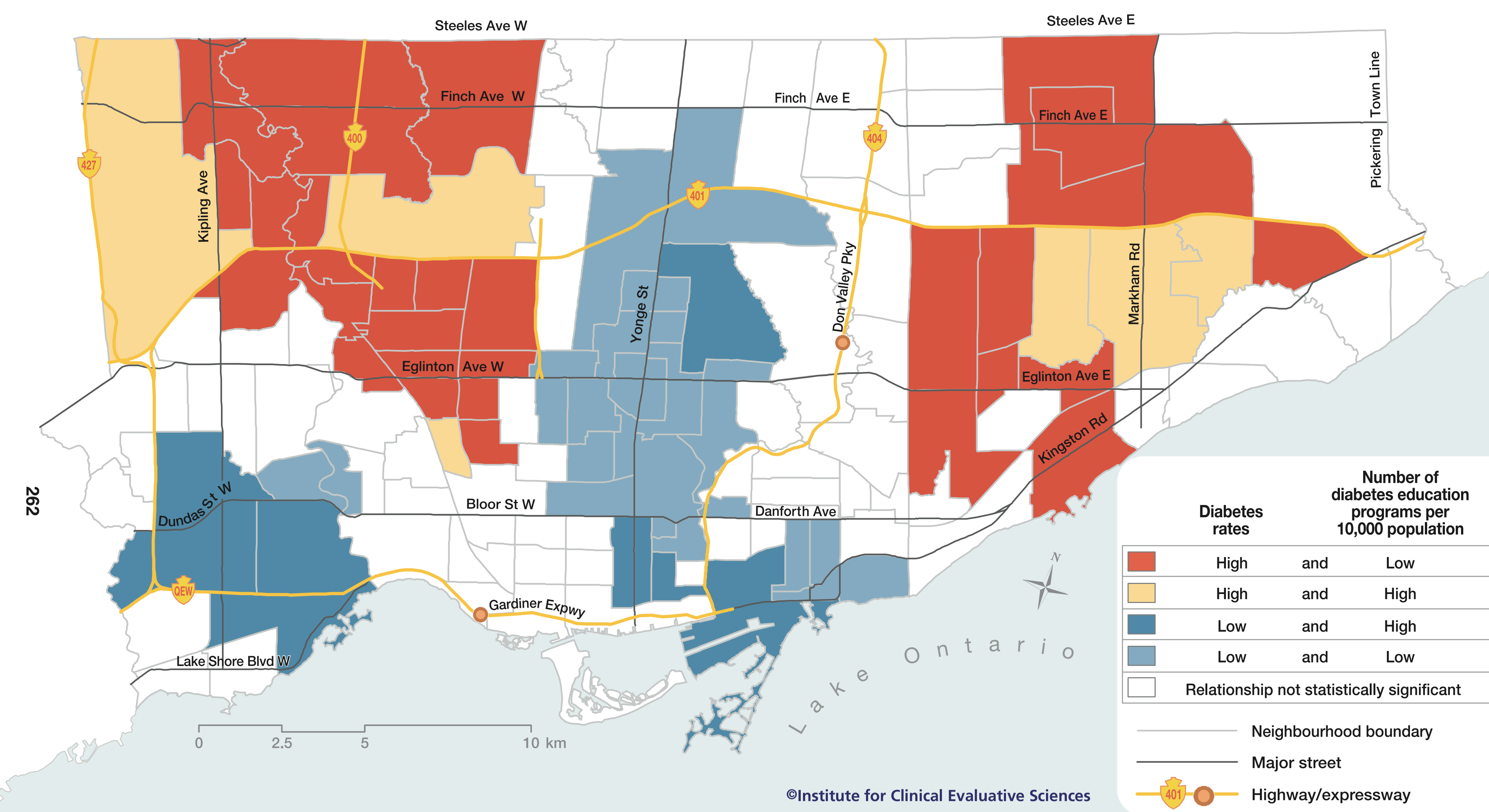
Exhibit 11.13 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and number of family physicians/general practitioners (FPs/GPs) perr 10,000 population [2002] (high or low), by neighbourhood, in Toronto



Findings

- Neighbourhoods where high diabetes rates (in 2001/02) were spatially associated with a low availability of family physicians/general practitioners (FPs/GPs) in 2002 were located in the northwest and eastern regions of Toronto.
- Relationships between diabetes rates and the availability of FPs/GPs was mixed in the downtown, north central and southwest parts of the city. These areas had low diabetes rates throughout and (in the majority of neighbourhoods) a high availability of FPs/GPs.

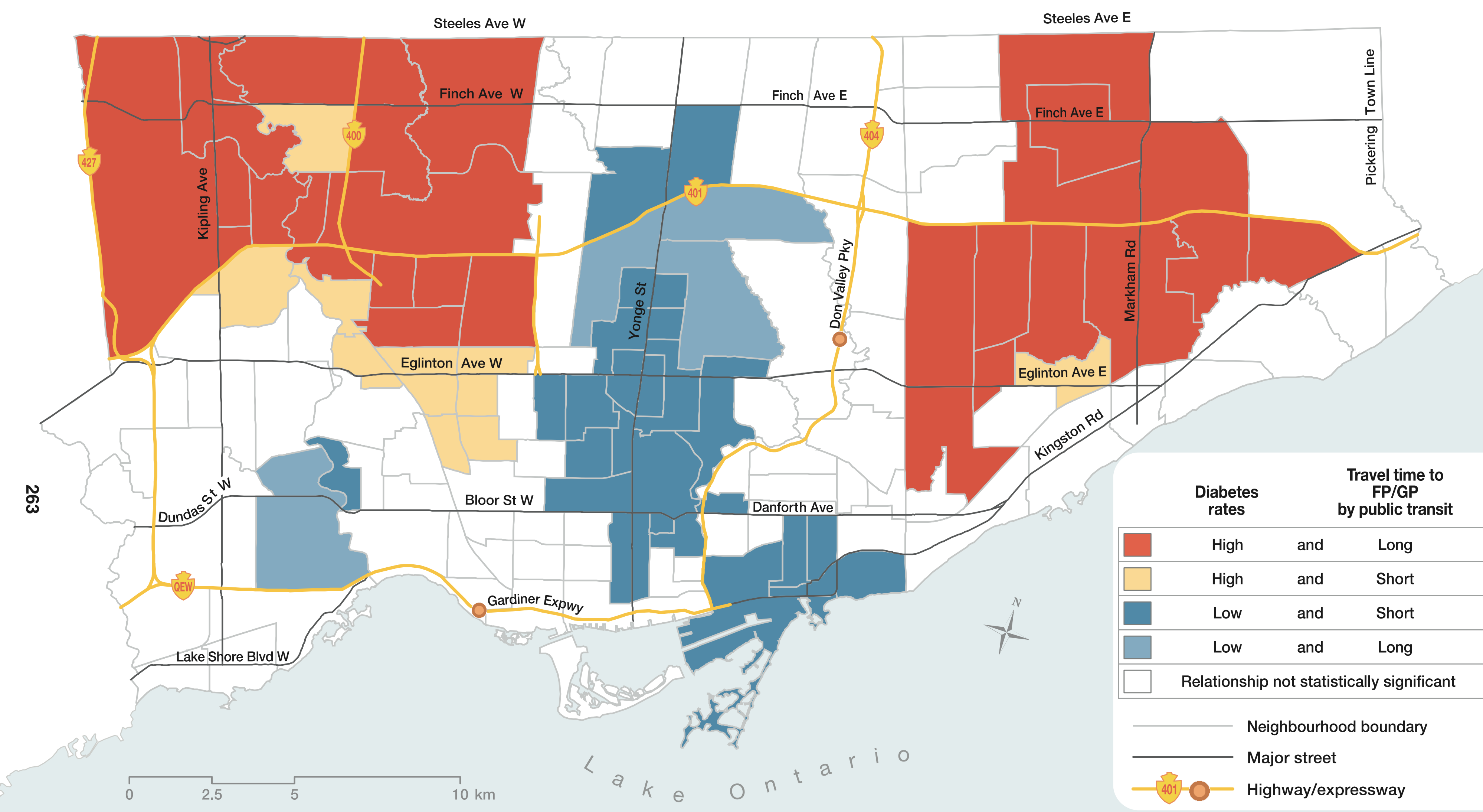
Exhibit 11.14 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and number of diabetes education programs per 10,000 population [2004] (high or low), by neighbourhood, in Toronto



Findings

- Despite high rates of diabetes (in 2001/02), many neighbourhoods in the northwest and eastern areas of Toronto had a low availability of diabetes education programs (in 2004).
- Many neighbourhoods in central Toronto were characterized by lower diabetes rates and a lower availability of diabetes education programs.
- Neighbourhoods where the opposite pattern was apparent (lower diabetes rates and higher availability of diabetes programs) were found in downtown Toronto, the southwest, and in a small area in the centre of the city. This pattern may be due in part to the locations of Toronto's major hospitals, many of which offer diabetes education programs.

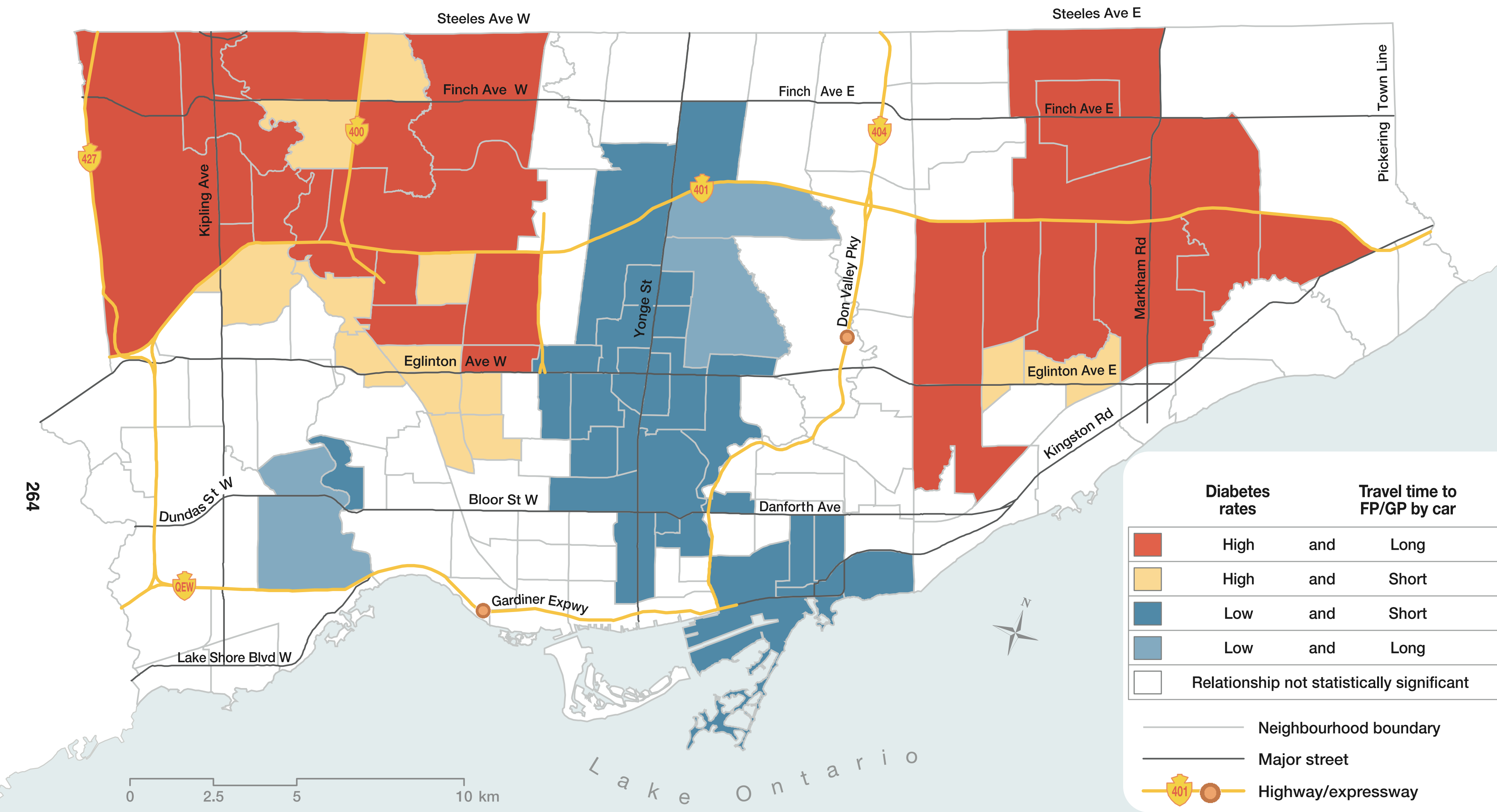
Exhibit 11.15 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to the nearest family physician/general practitioner (GP/FP) by public transit [2002] (long or short), by neighbourhood of residence, in Toronto



Findings

- Large portions of the northwest and east ends of the city which had higher diabetes rates (in 2001/02) were spatially associated with longer travel times to family physicians/general practitioners (FPs/GPs) by public transit (in 2002).
- Residents of downtown (south central) and central Toronto had lower diabetes rates and shorter travel times to FPs/GPs by public transit.
- In parts of north central Toronto, lower diabetes rates were found to be spatially clustered with more limited access to FPs/GPs.

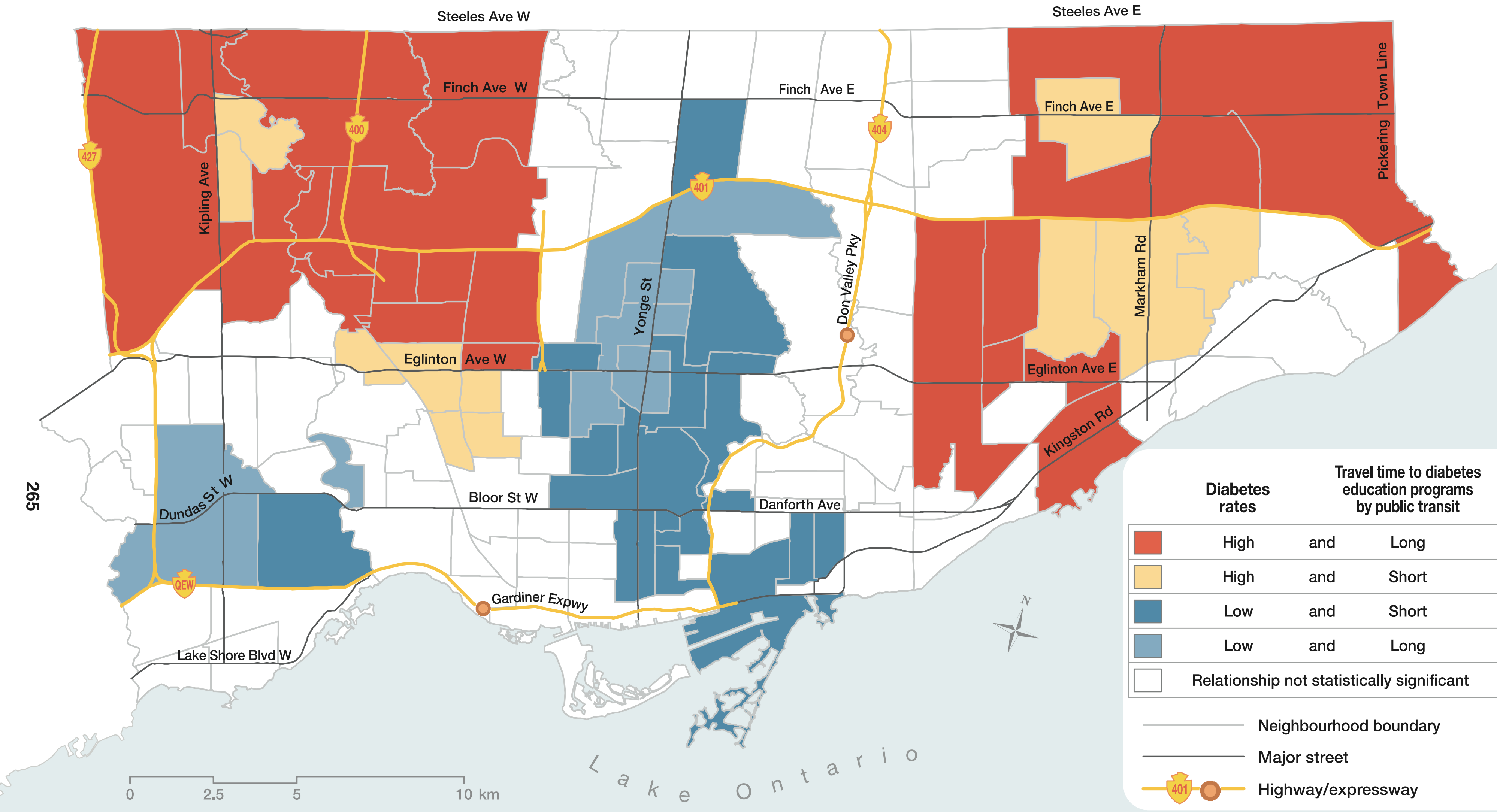
Exhibit 11.16 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to the nearest family physician/general practitioner (FP/GP) by car [2002] (long or short), by neighbourhood of residence, in Toronto



Findings

- Neighbourhoods where high diabetes rates (in 2001/02) were spatially associated with longer travel times to family physicians/general practitioners (FPs/GPs) by car (in 2002) were located in the northwest and in the east end of Toronto. This pattern is similar to the one for travel times for public transit (Exhibit 11.15).
- Most of downtown, central and north central Toronto had low diabetes rates and good access to FPs/GPs by car.

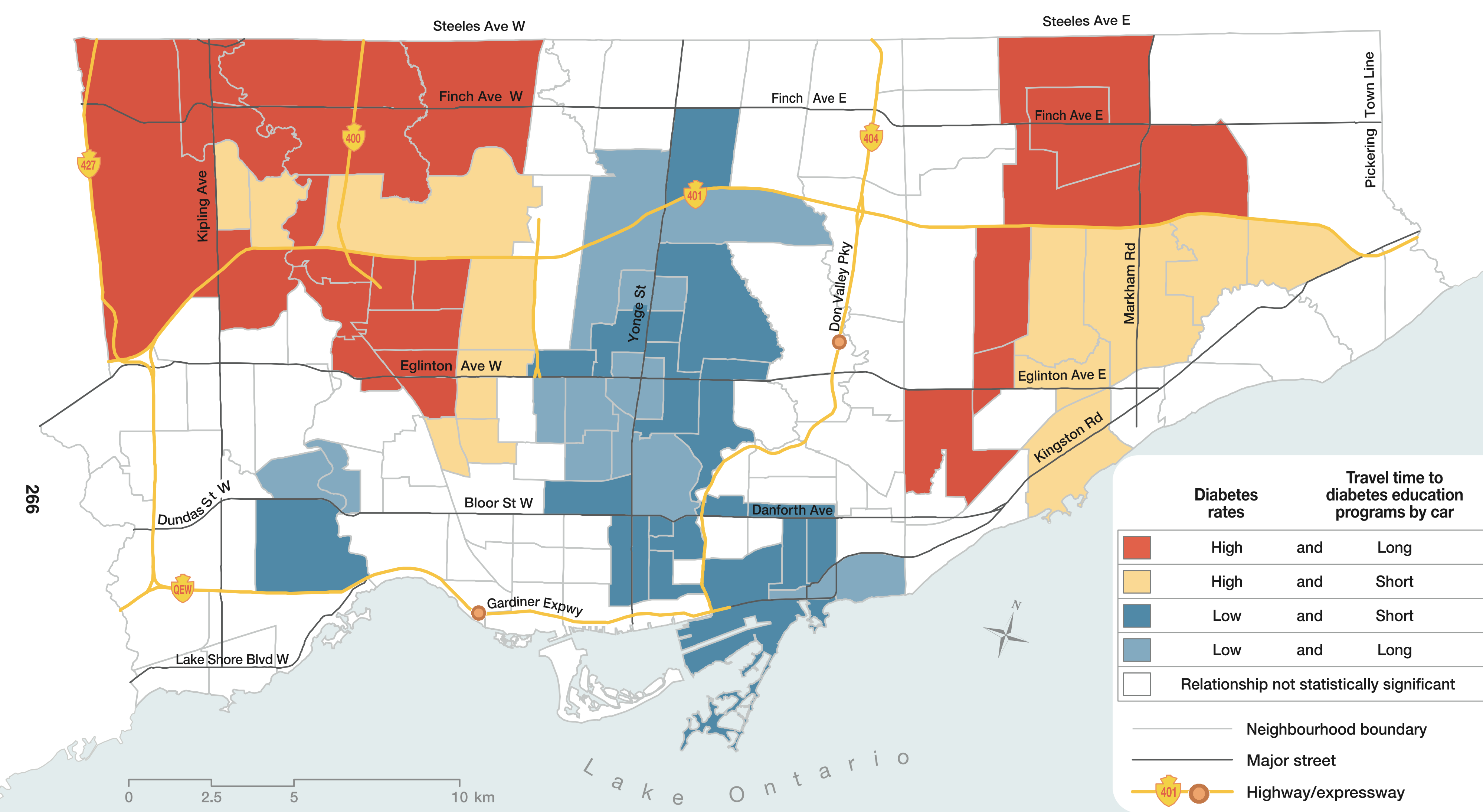
Exhibit 11.17 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to diabetes education programs by public transit [2004] (long or short), by neighbourhood of residence, in Toronto



Findings

- In most of the northwest, and in several neighbourhoods in northeast and central east Toronto, there was significant spatial clustering of higher diabetes rates (in 2001/02) and longer travel times to community- and hospital-based diabetes education programs (in 2004) by public transit.
- Most of central and downtown (south central) Toronto had lower diabetes rates clustered spatially with better access to diabetes education programs.

Exhibit 11.18 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and travel time to diabetes education programs by car [2004] (long or short), by neighbourhood of residence, in Toronto



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Findings

- Neighbourhoods where high diabetes rates (in 2001/02) were spatially associated with longer travel times to diabetes education programs by car (in 2004) were located in the northwest and eastern regions of the city. This pattern is similar to the one for travel times by public transit (Exhibit 11.7).
- Most neighbourhoods in the downtown, central and southwest of Toronto experienced low diabetes rates and good access to diabetes education programs by car.

Discussion

Family Physicians and General Practitioners

We found a high concentration of family physicians and general practitioners (FPs/GPs) in the downtown core of Toronto in 2002, most likely due to the large number of hospitals in this area. Throughout the rest of the city, FPs/GPs were distributed along the north-south axis with relatively fewer FPs/GPs per capita in the northwest and east regions.

Access to FPs/GPs by public transit was relatively good in much of the greater downtown and south central area, with travel time to the nearest primary care physician under 10 to 15 minutes from neighbourhood of residence. Access times increased from relatively moderate to high as one moved farther away from the downtown to the east or north ends of the city. In some pockets in the east and west end, travel time to the nearest FP/GP by public transit was 20 minutes or more in each direction. As we noted in Chapter 2, these latter areas had among the highest rates of diabetes in the city.

Our analyses of bivariate *Local Indicator of Spatial Association (LISA)* maps show that there were large clusters of high-diabetes areas in the northwest and east with relatively low availability of and access to FPs/GPs. In contrast, residents living in low-diabetes areas in the south central part of the city had much better availability/access.

Availability of and access to FPs/GPs accepting new patients followed a similar pattern as the one observed for FPs/GPs in general. However, whether these doctors were accepting new patients at the time (2002) was based on self-report by physicians, and spatial patterns could be subject to change over time.

Specialists (Endocrinologists, Ophthalmologists and Optometrists)

In 2002, the majority of endocrinologists, ophthalmologists and optometrists practiced in downtown (south central) Toronto and along major roadways. The highest density of specialists per capita was in the downtown, the southwest, central and north central areas of the city. In contrast, the availability of diabetes-related specialists was much lower (≤5 specialists per 10,000 people) in virtually all neighbourhoods within the northwest and east ends of the city where diabetes rates were highest.

Modelled travel times to specialists by public transit and car were not analyzed since they would have to relate to three distinct groups of health care providers, each offering specialized services. However, the distribution of specialists was very similar to findings about other health care providers examined in this chapter. We would expect to find similar patterns of lower availability and access in high-diabetes neighbourhoods and higher availability and access in low-diabetes neighbourhoods.

Community- and Hospital-Based Diabetes Education Programs

In 2004, a majority of Toronto's community- and hospital-based diabetes education programs were located in the downtown area and directly west of it, likely because the majority of hospitals were (and still are) clustered in this part of the city. We noted a relatively sparse distribution of programs in other geographical areas—indeed, many communities did not have a local diabetes education centre, including those in the east and west ends of the city with high rates of diabetes.

Access to diabetes education programs by public transit was limited for many communities throughout Toronto, particularly those in the east, north central and west ends of the city where travel time from neighbourhood of residence reached and exceeded 60 minutes in each direction. Although residents in most neighbourhoods could access a diabetes education program within five minutes by car, longer travel times were the rule in the east, as well as in the central, west and northwest areas of Toronto. As with FPs/GPs, many neighbourhoods with high rates of diabetes also had lower availability of and access to diabetes education programs. In contrast residents in areas of central Toronto with low diabetes prevalence had much better availability and access.

Conclusions and Next Steps

Large portions of the northwest and eastern parts of Toronto had relatively higher diabetes rates. They also had a lower density of and geographic access to family physicians/general practitioners (FPs/GPs), along with a lower density of and access to community- and hospital-based diabetes education programs.

It is important to note that many of these neighbourhoods were home to large numbers of low-income and visible minority residents.* It is likely that both these factors contributed to the higher observed rates of diabetes in these communities. These neighbourhoods also tended to be home to recent immigrants who typically encounter barriers in accessing health care[18–20, 22] (Chapter 4).

These high-risk areas of Toronto could benefit from more programs aimed at preventing diabetes (in the community at large) and preventing diabetes complications (in those who have already developed diabetes). Primary care providers play a key role in both aspects of prevention; access to and use of these services are essential to reduce the future burden of diabetes. Likewise, diabetes education and other diabetes services play a critical role in the prevention and treatment of diabetes-related complications. Despite these benefits, we observed a significant disparity between the availability of and access to these services and the underlying need in high-risk communities.

Future plans to expand such services in Toronto should consider both the inherent risk for chronic disease within the local population and residents' ability to access these services by public transit or other means of travel. However, providing additional services in higher-need areas may not fully solve the issue of overall access. Special attention must be paid to overcoming additional barriers to access besides geographic location. These include language and cultural differences, the cost of transportation, and services that may be difficult to comply with or that may be inappropriate in the context of local residents' values and beliefs.

Research has found that such factors play a key role in determining the overall accessibility of a health service.[13] Further study is needed into how such factors—alone or in combination—affect diabetes rates and access to health services in Toronto.

* The proportion of visible minorities living in each neighbourhood was derived from the 2001 Census of Canada, which uses the following definition based on the Employment Equity Act: visible minorities are "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour."

Appendix 11.A—How the Research was Done

Data sources

For the purposes of this Atlas, "health services" consisted of family physicians/general practitioners (FPs/GPs), specialists (endocrinologists, ophthalmologists and optometrists) and community- and hospital-based diabetes education programs.

Locations of FPs/GPs in 2002 were obtained from the MD Select database.[21] The numbers of FPs/GPs accepting new patients in the same year were obtained from the College of Physicians and Surgeons of Ontario website.[23] The postal code of each doctor was abstracted and geocoded. In total, 2,938 doctors in 1,066 unique postal code locations were included in the data set.

The locations of 45 endocrinologists and 145 ophthalmologists were obtained from the MD Select database and geocoded. The locations of optometrists were obtained from the College of Optometrists of Ontario website[24] and geocoded. The data set contained 202 optometrists.

Age- and sex-standardized diabetes rates (2001/02) were derived from the Ontario Diabetes Database, a population-based registry created from physician claims and hospital discharge records and housed at the Institute for Clinical Evaluative Sciences (ICES).

The locations of community- and hospital-based diabetes education programs as of November 2004 were geocoded from data received from the Ministry of Health and Long-Term Care (MOHLTC). These programs are often referred to interchangeably as "diabetes programs," "diabetes education programs," or "diabetes education centres." The data set contained 32 centres.

Analysis

We analyzed travel times to both FPs/GPs and diabetes education programs by neighbourhood of residence. The analysis was conducted for all FPs/GPs and also for those who were accepting new patients at the time. The results of these analyses showed very similar patterns; therefore we chose only to present the results for all FPs/GPs. In addition, it was assumed that the majority of the general population would only be willing to travel by public transit or by car to access either of these services. Therefore, a walking analysis was not conducted for these resources.

We examined the distribution and accessibility of both FPs/GPs and diabetes education programs for neighbourhoods throughout the city. The relationship between diabetes prevalence and both these health services was evaluated using bivariate *LISA* maps.

"Availability" is depicted in two ways on maps. The first method uses symbols to indicate the locations of the resource (i.e., services across the city). This method shows where services were located and whether certain resources existed in specific neighbourhoods. The second method uses colour or shading to show the concentration of the resource in an area taking population into account (i.e., services per 10,000 population). This method tells us whether resources were located where people lived, and which neighbourhoods had more resources per capita than others.

Geographic accessibility was calculated using network analysis and is shown on travel time maps. The travel time in minutes was measured from a point of residence to a resource location (e.g., a doctor's office), along the network of streets, public transit routes and highways.

More detailed information about data sources and analyses is available in "Appendix B: Technical Notes" at the end of this Atlas.

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INSIDE

12
Chapter

Access to Healthy Resources

Richard H. Glazier, MD, MPH, Maria I. Creatore, MSc, PhD (candidate), Peter Gozdyra, MA, Jonathan Weyman, BSc (candidate), and Gillian L. Booth, MD, MSc

Executive Summary

Issue

Access to healthy resources plays a major role in the prevention and treatment of many health conditions including diabetes. Nutritious foods, places to be physically active and health care services are examples of resources necessary for the prevention and control of diabetes. On its own, easy geographic access to resources does not ensure their use; other factors such as the acceptability and affordability of such resources are also important. However, long travel times may serve to discourage people from accessing healthy resources in their communities—even when such opportunities are desired, inexpensive and/or free of charge.

Study

Four factors were equally weighted and combined into a Healthy Resources Index (HRI). These factors were: the average walking time to the nearest store selling fresh fruits and vegetables; the average walking time to the nearest recreational space; the average walking time to the nearest park or schoolyard; and the average travel time by public transit to the nearest family physician/general practitioner (FP/GP).

A shaded (choropleth) map was used to display the distribution of HRI values for Toronto neighbourhoods. A bivariate *Local Indicator of Spatial Association (LISA)* map was used to demonstrate clustering of high or low HRI values with high or low age- and sex-adjusted diabetes prevalence rates. Scatterplots were used for graphing diabetes rates with mean annual household income and also with the proportion of visible minority residents in each neighbourhood, according to high and low HRI levels. Spearman rank correlations were used to examine relationships between HRI values and diabetes rates across neighbourhoods.

Key Findings

- Neighbourhoods with the best access to healthy resources (as defined by the HRI) were found mostly in downtown areas of Toronto. Those with the least access were found in the northwest, the centre of the city and in the east.
- Better access to healthy resources was associated with low diabetes rates in low-income areas and in areas with a combination of low-income and visible minority residents. (For a definition of "visible minority," see section 12.A at the end of this chapter.)
- High-income areas tended to have low diabetes rates, even when these areas also had poorer access to healthy resources.

Implications

- **Geographic access to healthy resources at the neighbourhood level is likely to be important for health and was associated with low diabetes rates in Toronto, especially in low-income areas and in areas with a combination of low-income and visible minority residents.**
- **Healthy resources were mismatched with need as they were most accessible in areas with a low prevalence of diabetes and least accessible in areas that had a high prevalence.**
- **Enhanced public transit has the potential to improve access to healthy resources in areas that have high rates of diabetes.**
- **Zoning regulations and incentives that result in increased population density and new commercial, recreational and health services have the potential to improve health in many areas of Toronto where there is a high prevalence of diabetes and therefore, the need for services is high.**

Introduction

As already discussed in previous chapters of this Atlas, access to healthy resources plays a major role in the prevention and treatment of many health conditions including diabetes. In this chapter we report on the development of and application of a tool (an index) that may help policy makers, community groups and researchers identify relationships between access to healthy resources and diabetes prevalence in Toronto neighbourhoods.

Our purpose was to reflect the overall availability and accessibility of neighbourhood resources for healthy living in relation to both the prevention and treatment of diabetes. So far as we know, this is a unique effort to quantify such resources for this purpose; indeed, we were unable to find similar such indices in the health literature.

Our starting point was to review the resources for healthy living already identified in this Atlas, including those that may influence diet, levels of daily activity and/or use of health services. The Healthy Resources Index (HRI) was calculated for each Toronto neighbourhood using the following variables:

- average walking time to the nearest store selling fresh fruits and vegetables
- average walking time to the nearest recreational space
- average walking time to the nearest park or schoolyard
- average travel time by public transit to the nearest family physician/general practitioner (FP/GP)

The four chosen variables were standardized and equally weighted, creating an index with a scale from 0 to 10, with zero representing the least access and 10 representing the greatest access to healthy resources within a neighbourhood.

Higher HRI values signify greater accessibility of resources for healthy living; lower values signify poorer accessibility. This measure has been developed in the context of diabetes in Toronto and in the context of available data sources; however, some other versions of the tool could be applicable to other health conditions and other settings.

Neighbourhood factors included in the Healthy Resources Index (HRI)

The resources for healthy living considered in this Atlas (Chapters 7–11) included neighbourhood availability of and accessibility to: parks and schoolyards; public and private recreational spaces; stores selling fresh produce; fast food outlets; convenience stores; and community-based diabetes health services.

Our findings suggest that these neighbourhood characteristics may be involved in a complex interplay of risk factors which can influence the development and management of diabetes. For example, a healthy diet and regular physical activity, alone or in combination, have been associated with lower rates of obesity, type 2 diabetes and cardiovascular disease.[1-6] Primary care providers play an essential role in the prevention and treatment of diabetes by offering both medical and non-medical therapies, including lifestyle counselling, and routine screening for diabetes in high-risk groups.[7]

For these reasons, we felt the HRI should include the following factors: geographic access to stores selling fresh fruits and vegetables; access to public recreational spaces; and access to parks and schoolyards where residents could engage in regular physical activity. We believed another key measure should be geographical access to primary care physicians who play a vital role in diabetes screening, prevention and control.

We chose to focus on travel times by walking to grocery stores, recreational spaces and parks/schoolyards. Since most people do not walk to their family doctor's office but travel by car or public transportation, we considered public transit time to be the best measure of accessibility for this resource. Although proximity to a family doctor accepting new patients may be the best marker of access, whether or not a practice is open or closed to new patients can change rapidly. For that reason, in creating the HRI we used access information regarding all family doctors in Toronto.

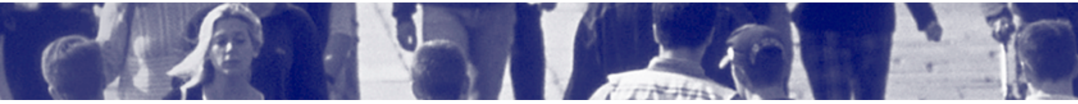
Neighbourhood factors excluded from the Healthy Resources Index (HRI)

As we designed our research, we felt it was important that this Atlas explore the existence and accessibility of fast food outlets and convenience stores in Toronto neighbourhoods. First, there is evidence that consumption of high-fat, high-calorie foods sold in fast food outlets contributes to obesity which in turn increases the risk for type 2 diabetes. Similarly, convenience stores are purveyors of products that contribute to obesity (such as potato chips and soda pop) and of tobacco products which have a variety of adverse health consequences.

However, we noted that fast food outlets and convenience stores were clustered in downtown areas of Toronto, along with other resources that were potentially positive influences on healthy living. Since it would have been difficult for us to "tease out" the positive vs. negative effects, we chose to exclude data on fast food outlets and convenience stores when developing the HRI.

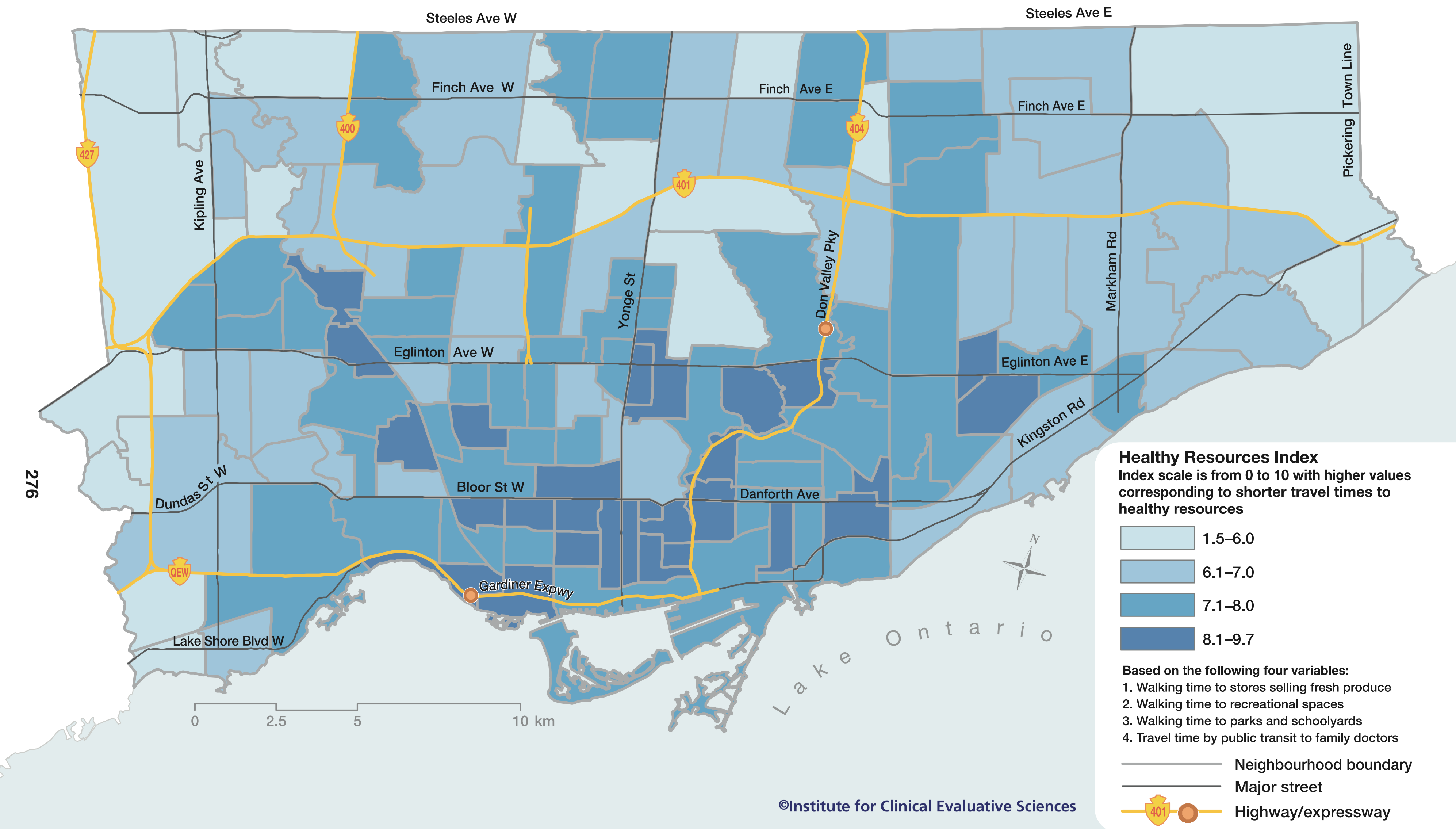
We also chose to exclude neighbourhood access to and availability of community-based diabetes programs. The main reason for this is that such resources are limited and widely dispersed throughout the city. Again, it would have been difficult to accurately factor them into the HRI.

Chapter 12—List of Exhibits



Exhibits and Findings

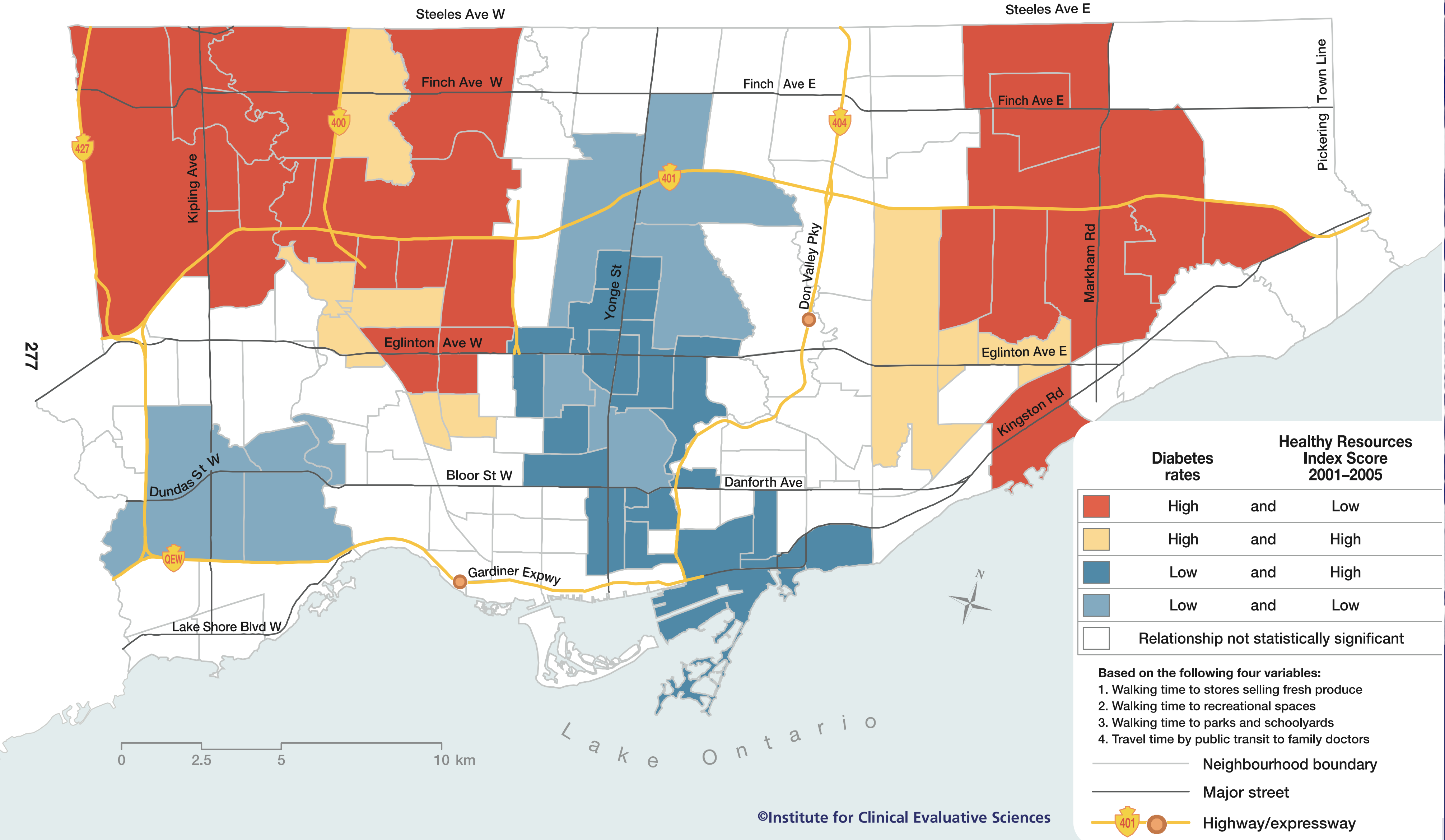
Exhibit 12.1 Healthy Resources Index (HRI) value by neighbourhood, in Toronto, 2001-2005



Findings

- Based on data from 2001–2005, neighbourhoods in the downtown (south central) and immediate surrounding regions of Toronto achieved the highest values using the Healthy Resources Index (HRI).
- HRI values decreased as one moved farther away from the downtown, with the lowest-scoring neighbourhoods located along the western and eastern city boundaries and in a few pockets in north central Toronto.

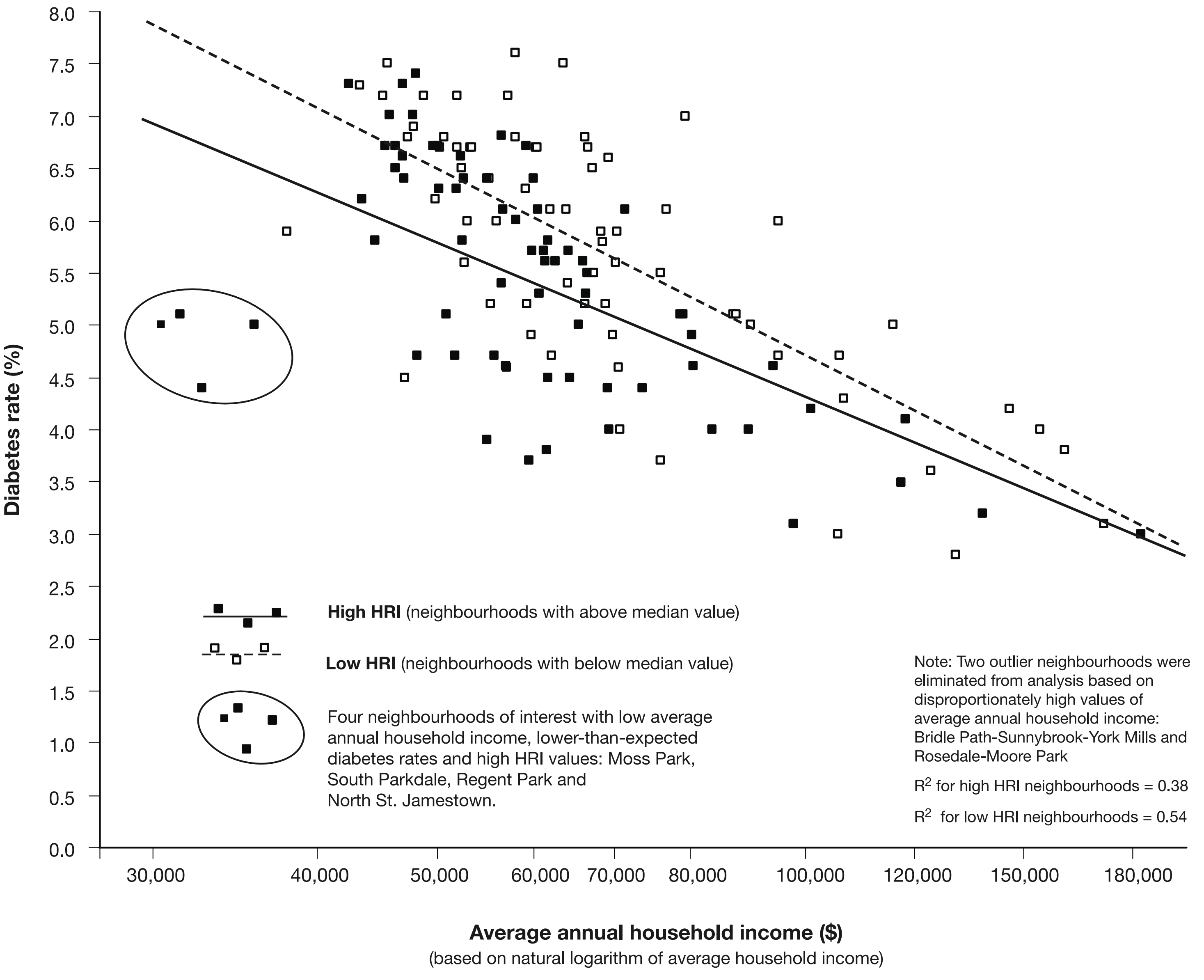
Exhibit 12.2 Spatial relationship between diabetes prevalence rates [2001/02] (high or low) and Healthy Resources Index (HRI) value [2001–2005] (high or low), by neighbourhood, in Toronto



Findings

- Based on data from 2001–2005, high diabetes rates were associated with low Healthy Resources Index (HRI) values (i.e., poor access to healthy resources) in the northwest and eastern parts of Toronto. Many of these neighbourhoods were home to low-income populations and high proportions of visible minorities.
- The downtown (south central) and central regions of Toronto generally had low rates of diabetes along with high values on the HRI.
- North central and southwest Toronto generally had low diabetes rates along with low values on the HRI.

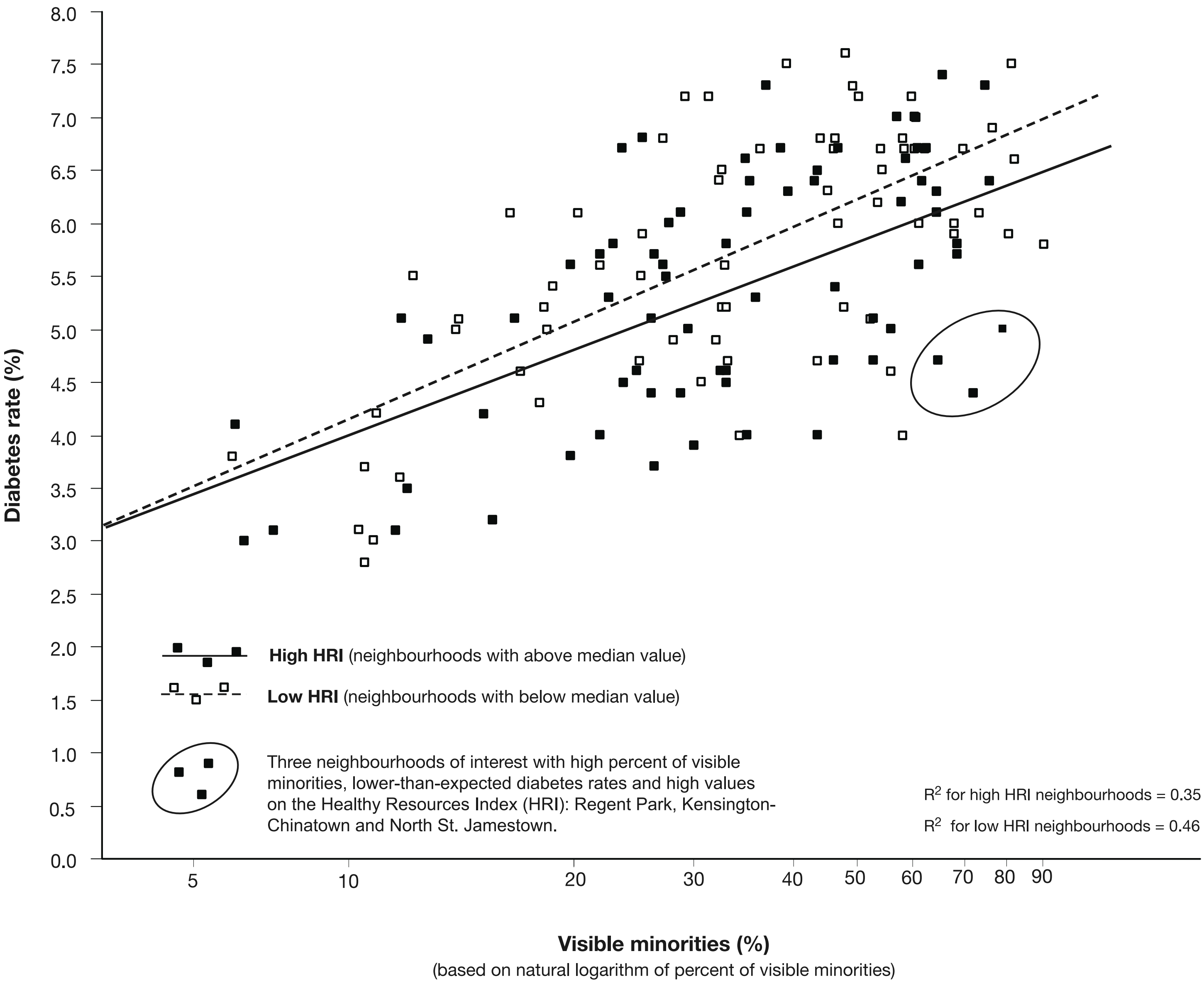
Exhibit 12.3 **Diabetes prevalence rates [2001/02] and average annual household income [2001] in Toronto neighbourhoods by Healthy Resources Index (HRI) value [2001–2005] (above and below median)**



Findings

- Based on data from 2001–2005, as average annual household incomes increased within neighbourhoods, rates of diabetes decreased.
- Neighbourhoods that achieved low values on the Healthy Resources Index (HRI) had higher diabetes rates at all income levels; however, the effect was most pronounced in the lowest-income neighbourhoods.
- We noted four neighbourhoods with high HRI values that had lower-than-expected diabetes rates, despite the fact that many residents were socioeconomically disadvantaged.

Exhibit 12.4 Diabetes prevalence rates [2001/02] and percent of visible minority residents in Toronto neighbourhoods [2001] by Healthy Resources Index (HRI) value [2001–2005] (above and below median)



Findings

- Based on data from 2001-2005, we observed that as the proportion of visible minority residents in a neighbourhood increased, so did rates of diabetes.
- Neighbourhoods that achieved low values on the Healthy Resources Index (HRI) had higher diabetes rates, regardless of what proportion of residents belonged to visible minorities. However, the effect was most pronounced in neighbourhoods with greater numbers of visible minority residents.
- We noted three neighbourhoods which achieved high HRI values that had lower-than-expected diabetes rates, despite the fact that a high proportion of residents in these neighbourhoods belonged to ethnoracial groups known to experience higher rates of diabetes.

Exhibit 12.5 **Correlation between the Healthy Resources Index (HRI) value and its elements [2001–2005] and neighbourhood rates of walking/bicycling [2001] and diabetes prevalence rates [2001/02], in Toronto**

	Spearman Rank Correlation with Diabetes Rates	Spearman Rank Correlation with Mean Number of Walking/Bicycling Trips per Person
Walking time to stores selling fresh produce	-0.001	-0.537**
Walking time to recreational spaces	0.074	-0.370**
Walking time to parks and schoolyards	-0.265*	0.171
Travel time by public transit to family doctors	0.410**	-0.616**
Healthy Resources Index[¥]	**-0.099**	**0.526****

* P-value <0.01

** P-value <0.001

¥ HRI is composed of average walking times to: the nearest store selling fresh produce; the nearest park or schoolyard; and the nearest recreational space; plus average travel time by public transit to the nearest family doctor.

Findings

- Based on data from 2001–2005, we found that the Healthy Resources Index (HRI) was not strongly correlated with diabetes rates in Toronto as a whole. However, neighbourhoods where there was a greater likelihood that people would walk or bicycle on a daily basis were significantly more likely to achieve a high value on the HRI.
- We noted that people were more likely to walk or bicycle in neighbourhoods that had good access to healthy foods, recreational spaces and family doctors.
- Diabetes rates were significantly lower in parts of Toronto with better access to family doctors, but rates of the disease were higher in neighbourhoods with better access to parks and schoolyards.

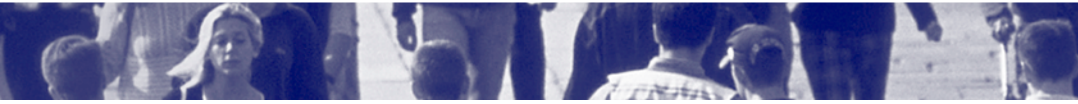


Exhibit 12.6 Median Healthy Resources Index (HRI) value [2001–2005] (high or low) for neighbourhoods and correlations with diabetes rates [2001/02] and walking/bicycling trips [2001] by income, by proportion of visible minority residents and by neighbourhood risk level [2000/01], in Toronto

Sociodemographic groups	Median HRI¥	Spearman Rank Correlation between HRI¥ and Diabetes Rates	Spearman Rank Correlation between HRI and Mean Number of Walking/Bicycling Trips per Person
Overall (N=140)	**7.3**	**-0.099***	**0.526****
High income (N=70)	7.0	-0.193	0.657**
Low income (N=70)	7.5	-0.350*	0.427**
High visible minority (N=70)	7.3	-0.265	0.347*
Low visible minority (N=70)	7.3	0.015	0.713**
† High risk (N=50)	**7.5**	**-0.469****	**0.315**
† Low risk (N=50)	**7.3**	**-0.711**	**0.683****

* P-value <0.01

** P-value <0.001

¥ HRI is composed of average walking times to: the nearest store selling fresh produce; the nearest park or schoolyard; and the nearest recreational space; plus average travel time by public transit to the nearest family physician/general practitioner (FP/GP).

† High-risk neighbourhoods were defined as falling below the Toronto median annual household income and above the median level of visible minority residents for city neighbourhoods. Low-risk neighbourhoods were defined as falling above the Toronto median annual household income and below the median level of visible minority residents for city neighbourhoods.

Findings

- Based on data from 2001–2005, we found that access to healthy resources in Toronto did not vary greatly by area income or by the proportion of visible minorities living within neighbourhoods. In fact, access to these resources was similar in the city's highest risk areas (i.e., low-income/more visible minority residents) and in the city's lowest-risk areas (high-income/ fewer visible minority residents).
- Although the Healthy Resources Index (HRI) was not highly correlated with diabetes in Toronto as a whole, high HRI values were significantly associated with low diabetes rates in low-income and high-risk neighbourhoods.
- We found that residents typically walked and bicycled more in neighbourhoods which achieved high values on the HRI. This effect was was most pronounced in high-risk neighbourhoods; it was not statistically significant in low-risk neighbourhoods.

Discussion

A Healthy Resources Index (HRI) that combines neighbourhood access to healthy foods, recreational spaces, parks and schoolyards and family doctors was developed for Toronto. The goal was to identify parts of the city where residents experienced potentially modifiable problems in accessing resources for healthy living.

Based on data from 2002–2005, neighbourhoods that achieved the highest values on the HRI were located mainly in the downtown area. Those which scored lower values (i.e., where access to healthy resources was more limited) were found mainly in the suburbanized outer areas of the city.

High diabetes rates and low levels of access to healthy resources clustered in the northwest and east ends of the city. Access to healthy resources showed only minor variation by sociodemographic characteristics including income and visible minority status. However, limited access was strongly associated with diabetes in low-income neighbourhoods and in neighbourhoods characterized by both low income and high proportions of visible minority residents.

Due to the cross-sectional design and ecological nature of the analyses, these patterns do not prove that certain neighbourhood features cause diabetes or protect against it. Access to resources for healthy living could, however, play a role in the development and control of diabetes, and so we believe our findings warrant further attention. Even if these relationships are not causal, the lack of access to resources for healthy living in neighbourhoods with a high prevalence of diabetes is cause for concern and should be the basis for advocacy to improve the situation.

The areas with poorer access to resources but low diabetes rates are interesting exceptions. We found these were typically high-income neighbourhoods where it is likely that healthy resources were mainly accessed by car.

Conclusions and Next Steps

The range of HRI values we observed in Toronto neighbourhoods illustrates a serious mismatch between the need for healthy neighbourhood resources and their real-world accessibility. Many of the areas with the greatest need—those with high diabetes rates, low income and high proportions of visible minorities—had the least access to healthy food sources, to facilities and locations that encourage physical activity, and to primary health care providers who play a vital role in screening for, diagnosing and helping people manage diabetes.

According to our findings (which are based on the utilization of our HRI measure), this mismatch appeared most relevant for high-risk neighbourhoods (i.e., low-income/high proportions of visible minority residents). High-risk neighbourhoods with good access to healthy resources had lower-than-expected rates of diabetes and those with poorer access had higher rates.

Access to the services described in this chapter depends on their geographical proximity to residential populations; access is also somewhat dependent on the existing public transit network, especially for people without cars. The location of services can be influenced by zoning regulations, especially those that separate or allow for a mixture of residential and non-residential areas.

As Toronto experiences a boom of new condominium development, it is likely that increased population density, along with regulations, incentives and development practices, will either serve to stimulate or to inhibit such a mixing of services in residential areas. A creative combination of residential, commercial, recreational and health care services should result in better access to these services for local residents.

As we mentioned previously, public transit is also an important determinant of access to services. For the purposes of this chapter, we only measured travel times from neighbourhood of residence to family doctors by public transit. However, good access to public transit has the potential to improve access to all resources for healthy living. Transit routes and frequency of service tend to adapt to changes in residential density, and commercial services and may improve in areas with new development. A review of transit routes and schedules in areas with high diabetes rates and poorer access to services would be valuable to identify opportunities for improving access to healthy resources in these Toronto neighbourhoods.

Appendix 12.A—How the Research was Done

Data sources

The Healthy Resources Index (HRI) was calculated for each neighbourhood using the following variables:

- average walking time to nearest store selling fresh fruits and vegetables
- average walking time to nearest recreational space
- average walking time to nearest park or schoolyard
- average travel time by public transit to the nearest family physician/general practitioner (FP/GP)

The four chosen variables were standardized and equally weighted, creating an index with a scale from 0 to 10, with zero representing the least access and 10 representing the greatest access to healthy resources within a neighbourhood. The HRI values for Toronto neighbourhoods ranged from 1.5 to 9.7; the median value was 7.3; there was a mean of 7.2; and there was a standard deviation of 1.1.

Age- and sex-adjusted diabetes rates were calculated using the Ontario Diabetes Database and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES).

The proportion of visible minorities living in each neighbourhood was derived from the 2001 Census of Canada, which uses the following definition based on the Employment Equity Act: visible minorities are "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour."

Analysis

Mean travel times were calculated based on the results of network analysis from each major residential area within a neighbourhood to the nearest location of a given resource. The variables comprising the HRI were described and mapped individually and in relation to diabetes rates *(Local Indicator of Spatial Association or LISA* maps) in Chapters 7, 8 and 11.

Choropleth (shaded) maps were used to depict different levels of the HRI. Bivariate *LISA* maps were used to demonstrate the relationship between HRI values and age- and sex-adjusted diabetes rates at the neighbourhood level. Scatterplots were used for graphing diabetes rates with mean annual household income and percent visible minorities, according to high and low HRI levels. Spearman rank correlations were used to analyze the relationship between neighbourhood HRI scores and age- and sex- adjusted diabetes rates.

More detailed information about data sources, rate calculations and analyses is available in "Appendix B: Technical Notes" at the end of this Atlas.

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INSIDE

13
Chapter

Neighbourhood Profiles

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Executive Summary

Issue

The authors of this Atlas have developed two original indices which measure key aspects of neighbourhood environments and resources and their potential effects on the health of local residents. This includes their risk for diabetes and their ability to manage the disease if it develops. The Activity-Friendly Index (AFI) indicates whether the local environment encourages daily physical activities such as walking and bicycling. The Healthy Resources Index (HRI) captures local residents' proximity to resources such as healthy foods, places to exercise, and the services of health care providers. In this chapter, we examine these indices in relation to each other and in relation to diabetes. We also present detailed neighbourhood profiles that include diabetes rates, how each neighbourhood scored on both the AFI and the HRI, and other key neighbourhood characteristics. We examine the City of Toronto's 13 "priority neighbourhood areas," including their concordance with diabetes rates and with the high-risk neighbourhoods already identified in this Atlas.

Study

A bivariate *Local Indicator of Spatial Association (LISA)* map was used to demonstrate the spatial relationship between AFI and HRI values in Toronto neighbourhoods. A table was used to present data on each neighbourhood, including: age- and sex-adjusted diabetes prevalence rates; AFI values; HRI values; and other neighbourhood characteristics. Choropleth (shaded) maps were used to depict neighbourhood AFI and HRI values; map overlays of proportional symbols (circles) were used to depict age- and sex-adjusted diabetes rates. Parts of the city which combined low values on the AFI and/or HRI and high diabetes rates would be of most concern. We also used maps showing parts of Toronto previously identified as "priority neighbourhood areas" by the City of Toronto, along with areas that were home to more low-income residents and a higher percentage of visible minority residents. Map overlays of proportional symbols (circles) were used to depict diabetes rates. (For a definition of "visible minority," see Section 13.A at the end of this chapter.)

Key Findings

- Some Toronto neighbourhoods had both lower levels of activity-friendliness and poorer access to healthy resources. In general, these areas had high diabetes rates, although some higher-income neighbourhoods were an exception (i.e., low values on the AFI/HRI indices, but low diabetes rates).
- Neighbourhoods with high levels of activity-friendliness and good access to healthy resources tended to have low diabetes rates, even if a high percentage of residents were low-income and belonged to visible minority groups.
- We noted a strong concordance between activity-friendliness and access to healthy resources. Downtown neighbourhoods tended to have both, along with low diabetes rates; suburbanized areas tended to have neither, along with high diabetes rates.
- The majority of Toronto's priority neighbourhood areas were found to have high diabetes rates. Many high-risk parts of the city (i.e., low-income/high percentage of visible minority residents) also scored lower in activity-friendliness and in access to healthy resources.

Implications

- The profiles derived for each Toronto neighbourhood should serve to help stakeholders (e.g., local residents, relevant agencies and decision-makers) identify factors that need to be addressed.
- Attention must be focused on high-risk parts of the city (i.e., low-income/high percentage of visible minority residents) where diabetes risk is highest and where efforts to increase activity-friendliness and access to healthy resources has the potential to make a difference.
- Improved public transit is one approach that could improve both activity-friendliness and access to healthy resources in high-risk neighbourhoods with a high prevalence of diabetes.
- Other potential interventions for such high-risk neighbourhoods include developing policies, zoning, bylaws and other regulations and incentives to achieve the following: to increase population and service density and mix; to add and/or enhance access to public spaces; to discourage reliance on cars, especially for local travel; to build more and better walking and bicycling paths; to encourage the development of public recreational spaces; to attract retail stores selling healthy foods; to encourage health care providers and services to locate in the neighbourhood; and to design interventions aimed at decreasing crime and/or perception of crime in these parts of the city.
- The current strategy of investment in Toronto's 13 "priority neighbourhood areas" (designated as such in 2005) also has the potential to reduce the risk for and improve the control of diabetes, and thus to enhance overall health in those parts of the city. The neighbourhood profiles found in this chapter can be used to identify additional areas with a high prevalence of diabetes that could benefit from enhanced public transit and infrastructure investment.

Introduction

We have already reported on the development of two original indices which measure key aspects of neighbourhood environments and their potential effects on the health of local residents. This includes their risk for diabetes and their ability to manage the disease if it develops. The Activity-Friendly Index (AFI) indicates whether the local environment encourages daily physical activities such as walking and bicycling (Chapter 6). The Healthy Resources Index (HRI) captures local residents' proximity to resources such as healthy foods, places to exercise and the services of health care providers (Chapter 12).

The maps provided in those sections are designed to help stakeholders (e.g., local residents, agencies and decision-makers) by informing them about local diabetes rates, activity-friendliness and access to healthy resources in their own neighbourhood. The combination of high diabetes rates together with low activity-friendliness and/or poorer access to healthy resources should be cause for concern, and steps to improve the situation should be considered. Even in the absence of high diabetes rates, low AFI or HRI values in a neighbourhood may require attention, since physical activity and access to healthy resources are important for numerous health conditions apart from diabetes.

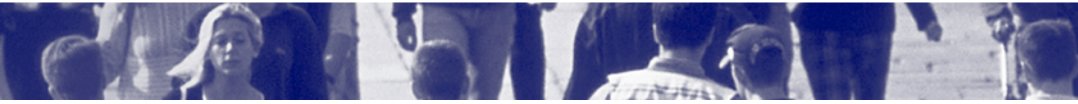
In this chapter, we present data on the spatial relationship between AFI and HRI scores in Toronto neighbourhoods. One goal was to identify areas where there was clustering of similar values of these two measures. Areas of particular concern would be those with both low activity-friendliness and poor access to healthy resources.

We present a table depicting each neighbourhood's rate of diabetes and its scores on both the AFI and HRI. This is intended to further assist local residents, agencies and decision-makers in understanding how these individual factors interact and might affect their area. We also present maps that show the AFI and HRI in relation to diabetes rates, so that their spatial association can be understood. Finally, we include a map that depicts the

13 Toronto neighbourhoods designated by the City for priority infrastructure investment,[1] along with visual data illustrating Toronto's low-income/high visible minority neighbourhoods.

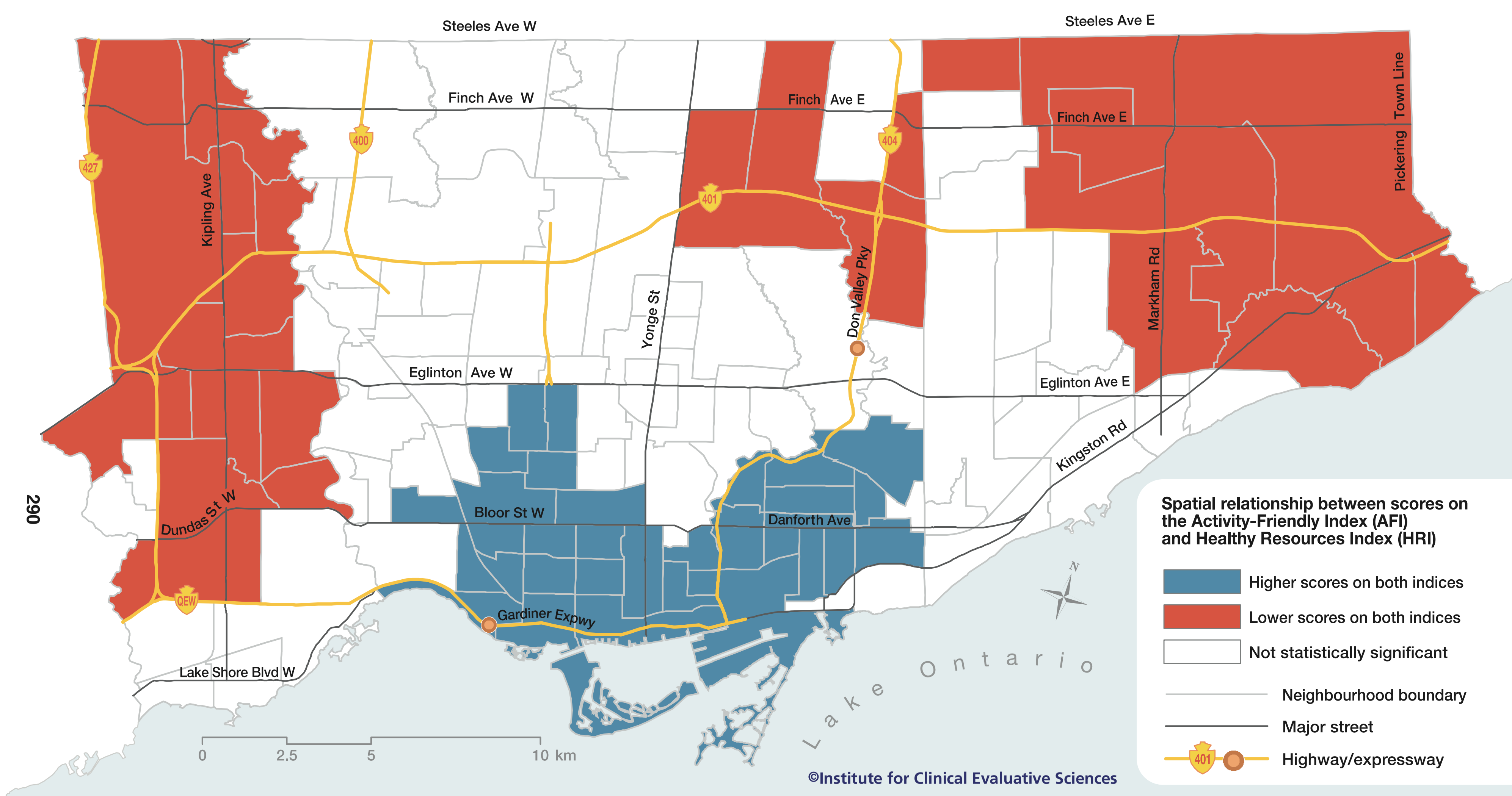
The City of Toronto's process for identifying the 13 priority neighbourhood areas included a different set of considerations than the ones used to produce this Atlas. However, we have chosen to link this data to our own work in order to provide Atlas users with a broader view of health, environment and resources in our city.

Chapter 13—List of Exhibits



Exhibits and Findings

Exhibit 13.1 Spatial relationship between Activity-Friendly Index (AFI) values [2001–2004] and Healthy Resources Index (HRI) values [2001-2005], by neighbourhood, in Toronto



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Findings

- Based on various data sets (2001–2005), areas that had low values on both the Activity-Friendly Index (AFI) and on the Healthy Resources Index (HRI) were located in the west and east ends of Toronto and in the central north of the city.
- These areas may be of special concern because, relative to other parts of Toronto, they lacked both activity-friendliness and access to healthy resources. They also experienced high rates of diabetes.
- Areas that had higher values on both indices (i.e., high levels of activity-friendliness and better access to healthy resources) were located in the downtown (south central) and surrounding neighbourhoods.

Exhibit 13.2a Neighbourhood profiles for age- and sex-adjusted diabetes prevalence rates per 100 persons of all ages [2001/02], activity-friendliness [2001–2004] and access to healthy resources [2001–2005], in Toronto

Definitions:

Diabetes rates (tertiles)**: **High - H ***, **Medium - M**, **Low - L**

A - Cars per household
D - Residential density
S - Service density per 10,000 population
C - Crime per per 100,000 population
5S - Access to nearest 5 retail services
G - Access to grocery stores
P - Access to parks and schoolyards
R - Access to recreational centres
F - Access to family physicians and general practitioners (FPs/GPs)

Neighbourhood name	Neighbourhood ID number+	Diabetes rate*	Neighbourhood ranked by diabetes rate 1=lowest	Diabetes rates tertiles**	Result of *Local Indicator of Spatial Association (LISA)* analysis: High diabetes rate and low AFI	High diabetes rate and low HRI	High diabetes rate and low income	High diabetes rate and high % visible minority residents	Areas for improvement
Agincourt North	129	6.62%	107	H *	✔	✔	✔	✔	A, D, S, 5S, F
Agincourt South-Malvern West	128	6.07%	88	M	✔	✔	✔	✔	A, D, 5S, G, R, F
Alderwood	20	5.51%	65	M					
Annex	95	3.96%	17	L					
Banbury-Don Mills	42	4.61%	34	L					
Bathurst Manor	34	5.41%	63	M					
Bay Street Corridor	76	3.99%	19	L					
Bayview Village	52	4.74%	42	L					
Bayview Woods-Steeles	49	5.12%	55	M					
Bedford Park-Nortown	39	3.56%	10	L					
Beechborough-Greenbrook	112	7.26%	134	H *	✔	✔	✔	✔	D, S, C, R
Bendale	127	6.73%	120	H *	✔	✔	✔	✔	A, D, S, C, 5S, G, R, F
Black Creek	24	7.29%	135	H *	✔		✔	✔	S, F
Blake-Jones	69	5.44%	64	M					
Briar Hill-Belgravia	108	6.70%	116	H *		✔	✔		R
Birchcliffe-Cliffside	122	5.24%	59	M					
Bridle Path-Sunnybrook-York Mills	41	3.56%	11	L					
Broadview North	57	5.09%	53	M					
Brookhaven-Amesbury	30	6.99%	128	H *	✔		✔	✔	D, S, C, F
Cabbagetown-South St.Jamestown	71	4.38%	26	L					
Caledonia-Fairbanks	109	7.22%	131	H *		✔	✔		D, R
Casa Loma	96	3.16%	7	L					
Centennial Scarborough	133	4.73%	40	L					
Church-Yonge Corridor	75	4.63%	36	L					

* **Diabetes rate(s)**: Age- and sex-adjusted diabetes prevalence rates; **AFI** = Activity-Friendly Index; **HRI** = Healthy Resources Index; **Income** = Median annual household income
** **Tertile:** When a continuous variable is sorted from highest to lowest and divided into three equal-sized groups. + See Appendix C for Neighbourhoods, City of Toronto, 2001 map.

Exhibit 13.2.b Neighbourhood profiles for age- and sex-adjusted diabetes prevalence rates per 100 persons of all ages [2001/02], activity-friendliness [2001–2004] and access to healthy resources [2001–2005], in Toronto

Definitions:

Diabetes rates (tertiles**): High - H * ; Medium - M ; Low - L

- **A** - Cars per household
- **D** - Residential density
- **S** - Service density per 10,000 population
- **C** - Crime per per 100,000 population
- **5S** - Access to nearest 5 retail services
- **G** - Access to grocery stores
- **P** - Access to parks and schoolyards
- **R** - Access to recreational centres
- **F** - Access to family physicians and general practitioners (FPs/GPs)

Neighbourhood name	Neighbourhood ID number⁺	Diabetes rate*	Neighbourhood ranked by diabetes rate 1=lowest	Diabetes rates tertiles**	Result of *Local Indicator of Spatial Association (LISA)* analysis				Areas for improvement
					High diabetes rate and low AFI	High diabetes rate and low HRI	High diabetes rate and low income	High diabetes rate and high % visible minority residents	
Clairlea-Birchmount	120	6.41%	101	H *			✔	✔	D, C, F
Clanton Park	33	5.73%	75	M					
Cliffcrest	123	5.88%	81	M	✔	✔	✔		A, D, C, S, 5S, P, R
Corsa Italia-Davenport	92	6.78%	122	H *			✔		R
Crescent Town	61	6.18%	94	H *					
Danforth Village-East York	59	5.60%	70	M					
Danforth Village-Toronto	66	5.55%	67	M					
Don Valley Village	47	5.63%	71	M					
Dorset Park	126	6.69%	113	H *	✔	✔	✔	✔	A, D, S, C, 5S, G, R, F
Dovercourt-Wallace Emerson-Junction	93	6.64%	108	H *					
Downsview-Roding-CFB	26	6.76%	121	H *	✔	✔	✔	✔	A, D, S, C, 5S, G, R, F
Dufferin Grove	83	6.36%	100	H *					
East End-Danforth	62	4.45%	29	L					
Edenbridge-Humber Valley	9	5.02%	48	M					
Eglinton East	138	6.69%	112	H *			✔	✔	D, S, R
Elms-Old Rexdale	5	6.70%	114	H *	✔	✔	✔	✔	A, D, S, 5S, G, P, R, F
Englemount-Lawrence	32	4.91%	44	L					
Eringate-Centennial-West Deane	11	5.52%	66	M					
Etobicoke West Mall	13	5.25%	60	M					
Flemington Park	44	6.36%	98	H *					
Forest Hill North	102	4.16%	23	L					
Forest Hill South	101	3.08%	4	L					
Glenfield-Jane Heights	25	7.39%	137	H *	✔		✔	✔	D, S, 5S, P, F
Greenwood-Coxwell	65	4.69%	38	L					

* **Diabetes rate(s)**: Age- and sex-adjusted diabetes prevalence rates; **AFI** = Activity-Friendly Index; **HRI** = Healthy Resources Index; **Income** = Median annual household income

** **Tertile:** When a continuous variable is sorted from highest to lowest and divided into three equal-sized groups. ⁺ See Appendix C for Neighbourhoods, City of Toronto, 2001 map.

Exhibit 13.2.c Neighbourhood profiles for age- and sex-adjusted diabetes prevalence rates per 100 persons of all ages [2001/02], activity-friendliness [2001–2004] and access to healthy resources [2001–2005], in Toronto

Definitions:

Diabetes rates (tertiles**): High - H*; Medium - M; Low - L

- **A** - Cars per household
- **D** - Residential density
- **S** - Service density per 10,000 population
- **C** - Crime per per 100,000 population
- **5S** - Access to nearest 5 retail services
- **G** - Access to grocery stores
- **P** - Access to parks and schoolyards
- **R** - Access to recreational centres
- **F** - Access to family physicians and general practitioners (FPs/GPs)

Neighbourhood name	Neighbourhood ID number+	Diabetes rate*	Neighbourhood ranked by diabetes rate 1=lowest	Diabetes rates tertiles**	Result of *Local Indicator of Spatial Association (LISA)* analysis				Areas for improvement
					High diabetes rate and low AFI	High diabetes rate and low HRI	High diabetes rate and low income	High diabetes rate and high % visible minority residents	
Guildwood	140	6.07%	87	M					
Henry Farm	53	5.97%	84	M					
High Park North	88	4.93%	45	L					
High Park-Swansea	87	3.80%	15	L					
Highland Creek	134	6.02%	86	M	✔	✔		✔	A, D, S, G, R, F
Hillcrest Village	48	6.12%	90	M					
Humber Heights-Westmount	8	6.11%	89	M					
Humber Summit	21	7.62%	140	H*	✔	✔	✔	✔	A, D, C, 5S, G, P, R, F
Humbermede	22	7.24%	133	H*	✔	✔	✔	✔	A, D, S, C, 5S, P
Humewood-Cedarvale	106	4.42%	28	L					
Ionview	125	6.94%	127	H*	✔		✔	✔	D, S, F
Islington-City Centre West	14	4.86%	43	L					
Junction Area	90	6.12%	91	M					
Keelesdale-Eglinton West	110	7.46%	138	H*		✔	✔	✔	D, C, R
Kennedy Park	124	6.61%	106	H*					
Kensington-Chinatown	78	4.74%	41	L					
Kingsview Village-The Westway	6	6.31%	95	H*	✔	✔	✔	✔	A, D, S, 5S
Kingsway South	15	3.79%	14	L					
Lambton Baby Point	114	5.02%	49	M					
L'Amoureaux	117	5.65%	73	M					
Lansing-Westgate	38	4.34%	25	L					
Lawrence Park North	105	2.85%	1	L					
Lawrence Park South	103	2.97%	2	L					
Leaside-Bennington	56	4.10%	22	L					

* **Diabetes rate(s)**: Age- and sex-adjusted diabetes prevalence rates; **AFI** = Activity-Friendly Index; **HRI** = Healthy Resources Index; **Income** = Median annual household income

** **Tertile:** When a continuous variable is sorted from highest to lowest and divided into three equal-sized groups. + See Appendix C for Neighbourhoods, City of Toronto, 2001 map.

Exhibit 13.2.d Neighbourhood profiles for age- and sex-adjusted diabetes prevalence rates per 100 persons of all ages [2001/02], activity-friendliness [2001–2004] and access to healthy resources [2001–2005], in Toronto

Definitions:

Diabetes rates (tertiles**): High - H*; Medium - M; Low - L

A - Cars per household
D - Residential density
S - Service density per 10,000 population
C - Crime per per 100,000 population
5S - Access to nearest 5 retail services
G - Access to grocery stores
P - Access to parks and schoolyards
R - Access to recreational centres
F - Access to family physicians and general practitioners (FPs/GPs)

Neighbourhood name	Neighbourhood ID number+	Diabetes rate*	Neighbourhood ranked by diabetes rate 1=lowest	Diabetes rates tertiles**	Result of *Local Indicator of Spatial Association (LISA)* analysis: High diabetes rate and low AFI	High diabetes rate and low HRI	High diabetes rate and low income	High diabetes rate and high % visible minority residents	Areas for improvement
Little Portugal	84	6.66%	110	H*					
Long Branch	19	4.61%	32	L					
Malvern	132	7.53%	139	H*	✔	✔	✔	✔	A, D, S, 5S, F
Maple Leaf	29	7.24%	132	H*	✔	✔	✔		A, D, S, C, 5S, R, F
Markland Woods	12	5.08%	51	M					
Milliken	130	5.78%	78	M	✔	✔	✔	✔	A, D, S, 5S, G, R, F
Mimco	17	5.59%	69	M					
Morningside	135	6.67%	111	H*	✔	✔	✔	✔	A, D, S, 5S, G, F
Moss Park	73	5.11%	54	M					
Mount Dennis	115	6.65%	109	H*			✔	✔	S, C
Mount Olive-Silverstone-Jamestown	2	6.89%	126	H*	✔	✔	✔	✔	A, S, 5S, G, P R, F
Mount Pleasant East	99	3.15%	5	L					
Mount Pleasant West	104	3.73%	13	L					
New Toronto	18	4.52%	30	L					
Newtonbrook East	50	4.61%	33	L					
Newtonbrook West	36	5.17%	57	M					
Niagara	82	5.33%	61	M					
North Riverdale	68	4.62%	35	L					
Oakridge	121	5.88%	80	M					
Oakwood-Vaughan	107	6.33%	96	H*					
O'Connor-Parkview	54	6.14%	92	M					
Old East York	58	5.69%	74	M					
Palmerston-Little Italy	80	5.77%	76	M					
Parkwoods-Donalda	45	5.23%	58	M					

* **Diabetes rate(s)**: Age- and sex-adjusted diabetes prevalence rates; **AFI** = Activity-Friendly Index; **HRI** = Healthy Resources Index; **Income** = Median annual household income
** **Tertile:** When a continuous variable is sorted from highest to lowest and divided into three equal-sized groups. + See Appendix C for Neighbourhoods, City of Toronto, 2001 map.

Exhibit 13.2.e Neighbourhood profiles for age- and sex-adjusted diabetes prevalence rates per 100 persons of all ages [2001/02], activity-friendliness [2001–2004] and access to healthy resources [2001–2005], in Toronto

Definitions:

Diabetes rates (tertiles)**: **High - H *** | **Medium - M** | **Low - L**

A - Cars per household
D - Residential density
S - Service density per 10,000 population
C - Crime per per 100,000 population
5S - Access to nearest 5 retail services
G - Access to grocery stores
P - Access to parks and schoolyards
R - Access to recreational centres
F - Access to family physicians and general practitioners (FPs/GPs)

Neighbourhood name	Neighbourhood ID number+	Diabetes rate*	Neighbourhood ranked by diabetes rate 1=lowest	Diabetes rates tertiles**	Result of *Local Indicator of Spatial Association (LISA)* analysis: High diabetes rate and low AFI	High diabetes rate and low HRI	High diabetes rate and low income	High diabetes rate and high % visible minority residents	Areas for improvement
Pelmo Park-Humberlea	23	6.84%	125	H *	✔	✔	✔		D, S, C, 5S, G, P, F
Playter Estates-Danforth	67	5.13%	56	M					
Pleasant View	46	6.50%	103	H *					
Princess-Rosethorn	10	4.23%	24	L					
Regent Park	72	5.05%	50	M					
Rexdale-Kipling	4	6.36%	99	H *	✔	✔	✔		A, D, S, 5S, G, P, F
Rockcliffe-Smythe	111	6.50%	104	H *					
Roncesvalles	86	5.78%	77	M					
Rosedale-Moore Park	98	3.52%	9	L					
Rouge	131	7.01%	129	H *					
Runnymede-Bloor West Village	89	5.08%	52	M					
Rustic	28	7.15%	130	H *	✔	✔	✔	✔	D, S, 5S, G, F
Scarborough Village	139	6.35%	97	H *					
South Parkdale	85	4.95%	46	L					
South Riverdale	70	4.73%	39	L					
St.Andrew-Windfields	40	4.03%	20	L					
St.Jamestown (North)	74	4.39%	27	L					
Steeles	116	5.94%	82	M					
Stonegate-Queensway	16	3.69%	12	L					
Tam O'Shanter-Sullivan	118	6.42%	102	H *					
The Beaches	63	3.15%	6	L					
Thistletown-Beaumond Heights	3	6.83%	124	H *	✔	✔	✔	✔	A, D, S, 5S, G, P, R, F
Thorncliffe Park	55	5.84%	79	M					
Trinity-Bellwoods	81	5.95%	83	M					

* **Diabetes rate(s)**: Age- and sex-adjusted diabetes prevalence rates; **AFI** = Activity-Friendly Index; **HRI** = Healthy Resources Index; **Income** = Median annual household income
** **Tertile:** When a continuous variable is sorted from highest to lowest and divided into three equal-sized groups. + See Appendix C for Neighbourhoods, City of Toronto, 2001 map.

Exhibit 13.2.f Neighbourhood profiles for age- and sex-adjusted diabetes prevalence rates per 100 persons of all ages [2001/02], activity-friendliness [2001–2004] and access to healthy resources [2001–2005], in Toronto

Definitions:

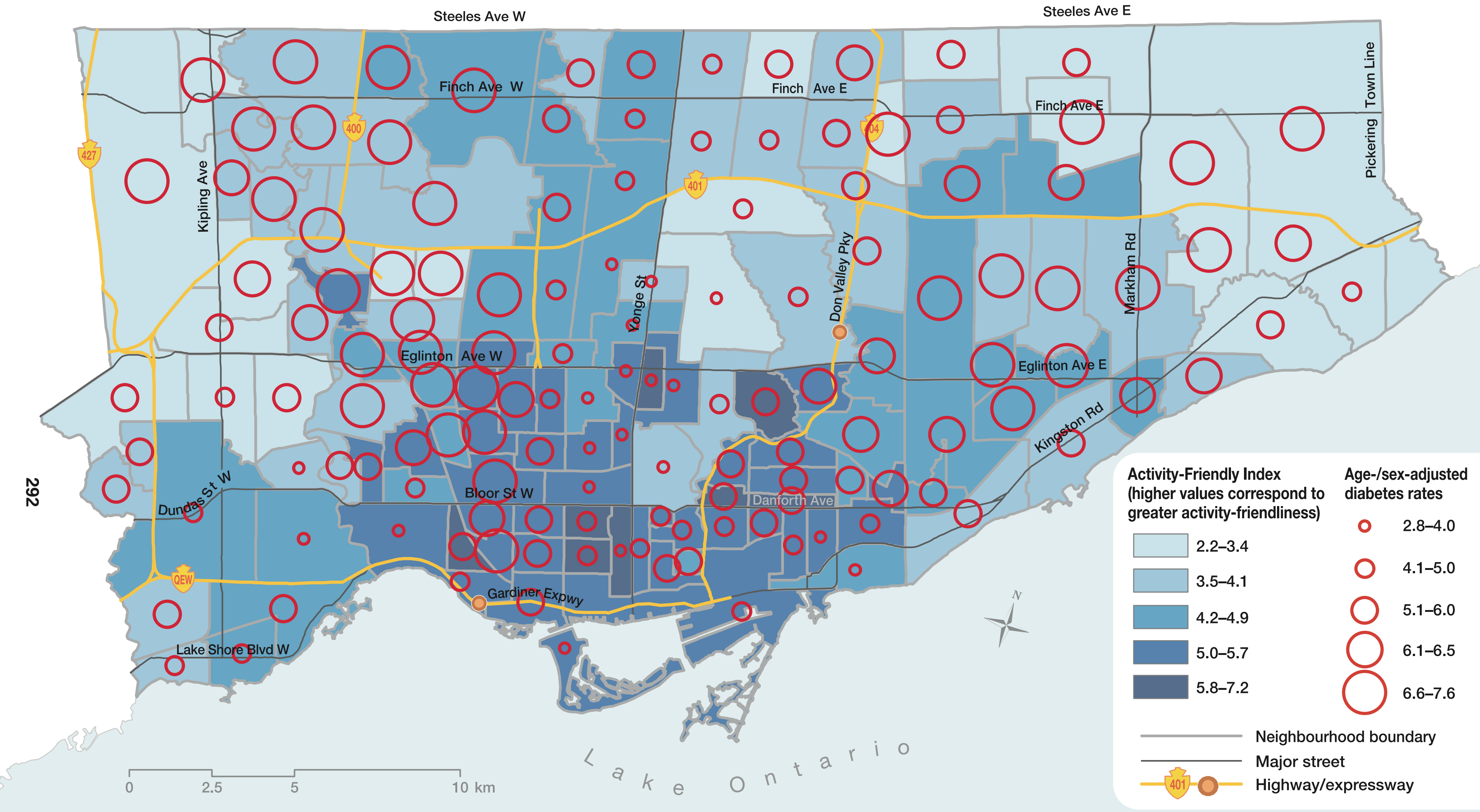
Diabetes rates (tertiles**): High - H*; Medium - M; Low - L

A - Cars per household
D - Residential density
S - Service density per 10,000 population
C - Crime per per 100,000 population
5S - Access to nearest 5 retail services
G - Access to grocery stores
P - Access to parks and schoolyards
R - Access to recreational centres
F - Access to family physicians and general practitioners (FPs/GPs)

Neighbourhood name	Neighbourhood ID number+	Diabetes rate*	Neighbourhood ranked by diabetes rate 1=lowest	Diabetes rates tertiles**	Result of *Local Indicator of Spatial Association (LISA)* analysis: High diabetes rate and low AFI	High diabetes rate and low HRI	High diabetes rate and low income	High diabetes rate and high % visible minority residents	Areas for improvement
University	79	4.54%	31	L					
Victoria Village	43	6.15%	93	M					
Waterfront Communities-The Island	77	3.98%	18	L					
West Hill	136	6.00%	85	M					
West Humber-Clairville	1	6.70%	117	H*	✔	✔	✔	✔	A, D, S, C, 5S, G, P, R, F
Westminster-Branson	35	5.64%	72	M					
Weston	113	6.71%	118	H*			✔	✔	D
Weston-Pellam Park	91	7.30%	136	H*			✔		C, R
Wexford/Maryville	119	6.70%	115	H*	✔		✔	✔	A, D, C, F
Willowdale East	51	4.03%	21	L					
Willowdale West	37	4.66%	37	L					
Willowridge-Martingrove-Richview	7	5.58%	68	M					
Woburn	137	6.73%	119	H*	✔	✔	✔	✔	A, D, S, 5S, G, R, F
Woodbine Corridor	64	3.91%	16	L					
Woodbine-Lumsden	60	5.34%	62	M					
Wychwood	94	5.01%	47	L					
Yonge-Eglinton	100	3.47%	8	L					
Yonge-St.Clair	97	2.97%	3	L					
York University Heights	27	6.82%	123	H*	✔	✔	✔	✔	D, S, C, 5S, P, R, F
Yorkdale-Glen Park	31	6.52%	105	H*		✔	✔		D, 5S, P, F

* **Diabetes rate(s)**: Age- and sex-adjusted diabetes prevalence rates; **AFI** = Activity-Friendly Index; **HRI** = Healthy Resources Index; **Income** = Median annual household income
** **Tertile:** When a continuous variable is sorted from highest to lowest and divided into three equal-sized groups. + See Appendix C for Neighbourhoods, City of Toronto, 2001 map.

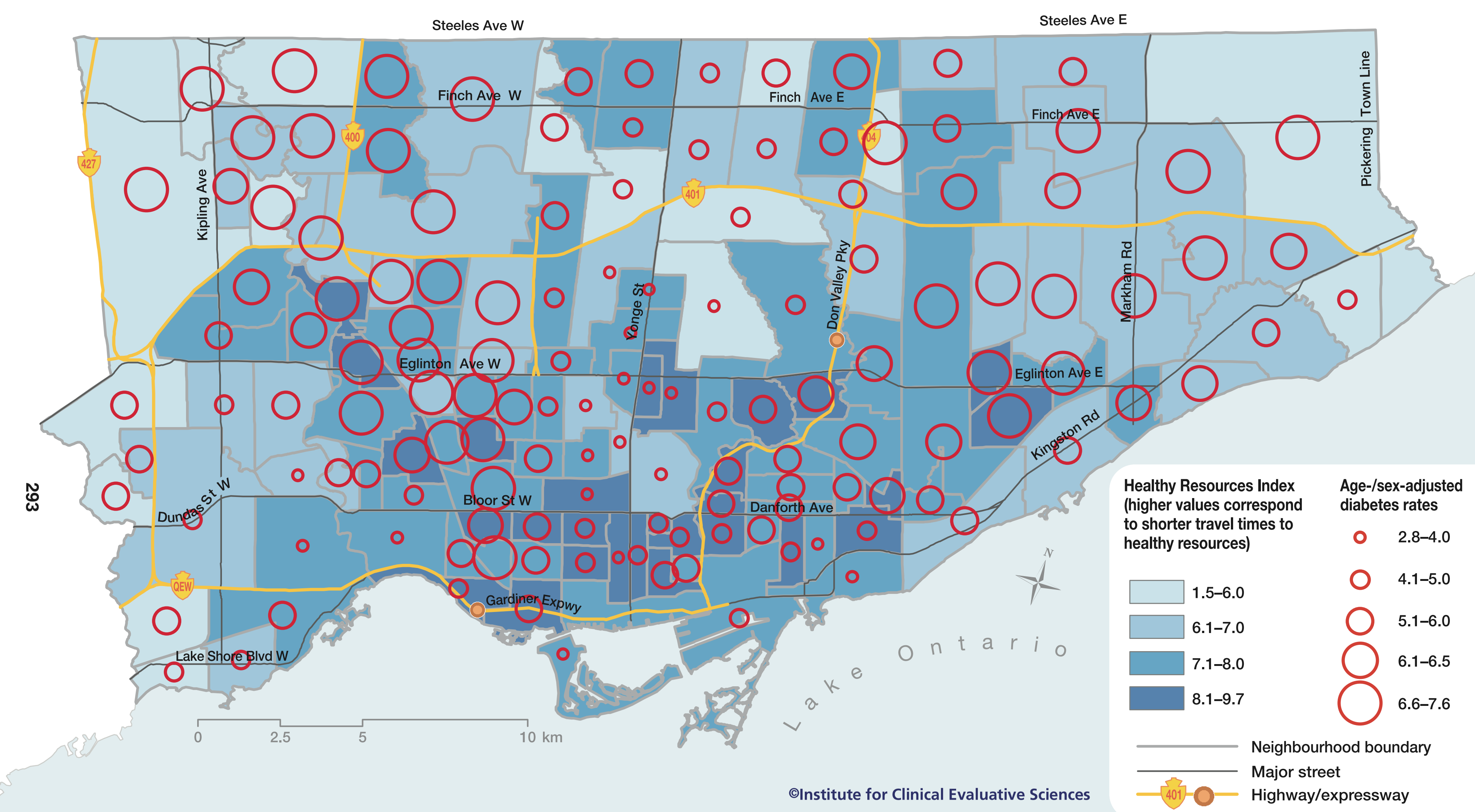
Exhibit 13.3 **Activity-Friendly Index (AFI) values [2001–2004] and age- and sex-adjusted diabetes prevalence rates per 100 persons of all ages [2001/02], by neighbourhood, in Toronto**



Findings

- Based on various data sets (2001–2004), the high diabetes areas in the northwest and east of Toronto were found to be less activity-friendly than the downtown (south central) and central Toronto.
- The few neighbourhoods that had low diabetes rates and lower values on the Activity-Friendly Index (AFI) tended to be located in wealthier areas in the central, north central and southwest regions of the city.

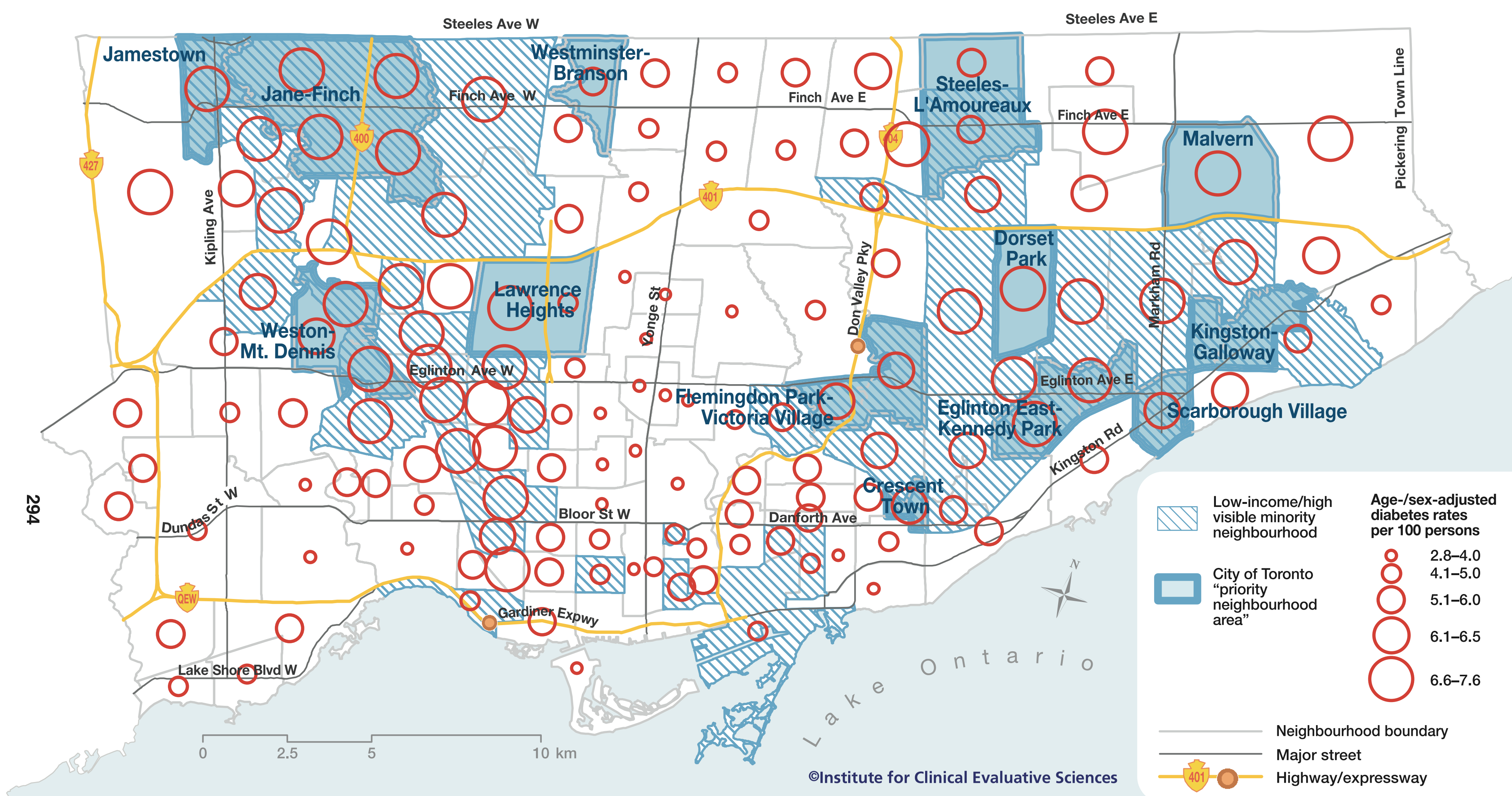
Exhibit 13.4 Healthy Resources Index (HRI) values [2001–2005] and age- and sex-adjusted diabetes prevalence rates per 100 persons of all ages [2001/02], by neighbourhood, in Toronto



Findings

- Neighbourhoods in the northwest and east of Toronto that had high diabetes rates and relatively low scores on activity-friendliness (Exhibit 13.3) also scored lower on the Healthy Resources Index (HRI) compared to downtown (south central) Toronto and surrounding areas.
- As seen in Exhibit 13.3, neighbourhoods with lower rates of diabetes and poorer access to healthy resources tended to be in wealthy areas in the central, north central and southwest regions of the city.

Exhibit 13.5 City of Toronto “priority neighbourhood areas” [2005], low-income/high percent visible minority neighbourhoods [2000/01], and age- and sex-adjusted diabetes prevalence rates per 100 persons of all ages [2001/02], by neighbourhood, in Toronto



Findings

- In 2005, most of the City of Toronto “priority neighbourhood areas” were located in the northwest and eastern regions of the city.
- Many of these areas were found to have high diabetes rates; many also showed a clustering of high diabetes rates with low scores on activity-friendliness, poorer access to healthy resources, and a greater proportion of low-income residents and residents belonging to visible minorities (Exhibit 13.2).
- We noted that many of the City of Toronto priority neighbourhood areas coincided with the low-income/high-visible-minority neighbourhoods which this Atlas has already described as being at high risk for diabetes.

Discussion

Some Toronto neighbourhoods scored low on activity-friendliness as measured by the Activity-Friendly Index (AFI); many of these same areas, which tended to be in the far west or east of the city or in the north, also had poorer access to healthy resources as determined by the Healthy Resources Index (HRI).

It is worth noting that many of these neighbourhoods were built after 1971 when there was increasing separation of residential areas from commercial services, with crescents and cul-de-sacs as the norm. These areas tended to have relatively fewer public transit routes along with infrequent service and low residential density.

These low-scoring neighbourhoods also had high diabetes rates, except for those in the southwest and north of the city where residents' annual income levels were comparatively higher. Conversely, most areas with high values on both the AFI and HRI had low diabetes rates, including those that were home to greater numbers of low-income and visible minority residents.

It is hoped that the detailed information in this chapter will be used at the neighbourhood level to identify parts of the city where residents are at high risk for diabetes and where modifiable factors may be contributing to this increased risk. We have identified each of the AFI and HRI components that was significantly clustered with high diabetes rates; these are presented in the column at the far right side of the table. We believe these specific factors could be considered as targets for improvement.

Conclusions and Next Steps

People living in Toronto neighbourhoods that were activity-friendly and that provided good access to healthy resources tended to have lower diabetes rates and vice versa. High AFI and/or HRI values may be protective in terms of diabetes, especially among residents living in high-risk neighbourhoods. Low AFI and/or HRI values may confer risk, but high-income neighbourhoods seemed to be somewhat immune to these effects, probably because residents could afford other ways to be physically active and to access healthy resources.

Depending on circumstances within each neighbourhood, we believe certain interventions can influence these factors. These include developing policies, zoning bylaws and other regulations and incentives to achieve the following: to increase population and service density and mix; to add and/or enhance access to public spaces; to discourage reliance on cars, especially for local travel; to build more and better walking and bicycling paths; to encourage the development of public recreational spaces; to attract retail stores selling healthy foods; to encourage health care providers and services to locate in the neighbourhood; and to design interventions aimed at decreasing crime and/or perception of crime in these parts of the city.

The current strategy of investment in Toronto's 13 priority neighbourhood areas has the potential to reduce residents' risk for diabetes, to improve the control of diabetes, and to enhance overall health. The neighbourhood profiles found in this chapter can be used to identify additional high diabetes prevalence areas in Toronto that could benefit from enhanced public transit and infrastructure investments.

Appendix 13.A—How the Research was Done

Data sources

The measures used in this section include those derived and depicted in previous chapters, including Chapter 3 (Socioeconomic Status and Diabetes), Chapter 6 (Neighbourhood Infrastructure and Health) and Chapter 12 (Development of a "Healthy Resources Index").

Toronto's priority neighbourhood areas include seven areas identified in the Community Safety Plan,[2] nine identified by the Strong Neighbourhoods Task Force[3] (with some overlap between both), as well as other underserviced areas.

Neighbourhoods were classified by risk according to whether they were low-income and high visible minority (high-risk), high-income and low visible minority (low-risk) or neither (medium-risk). (This is the same method described in Chapters 6 and12.)

Age- and sex-adjusted diabetes rates were calculated using the Ontario Diabetes Database and other administrative data sources held at the Institute for Clinical Evaluative Sciences (ICES).

Sociodemographic information including information on income and visible minority status was derived from the 2001 Canadian census.

The proportion of visible minorities living in each neighbourhood was obtained from the 2001 Census of Canada, which uses the following definition based on the Employment Equity Act: visible minorities are "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour." Visible minority status was self-reported.

Analysis

A bivariate *Local Indicator of Spatial Association (LISA)* map was used to demonstrate the spatial relationship between values of the Activity-Friendly Index (AFI) and the Healthy Resources Index (HRI). A table was used to present data on each neighbourhood (in rows) along with its values in the following areas: age- and sex-adjusted diabetes rate; ranking in relation to other neighbourhoods' age- and sex-adjusted diabetes rates; high, medium and low diabetes rates by tertile; and the spatial association of age- and sex-adjusted diabetes rates with the AFI, HRI, annual income and visible minority status. We also presented components of the AFI and HRI that might be targets for improvement (in columns).

A red letter "H" was used to visually identify neighbourhoods with higher diabetes rates: red check marks were used to depict neighbourhoods with high diabetes rates and also low activity-friendliness, poor access to healthy resources, and greater numbers of low-income/high-visible-minority residents.

Proportional symbols (circles) were used to depict age- and sex-adjusted diabetes prevalence rates in neighbourhoods. Areas with high diabetes rates and low values on the AFI and/or HRI would be of most concern.

Toronto's 13 priority neighbourhood areas were shown on a map as a choropleth (shaded) layer with an overlay of proportional symbols (circles) to depict high diabetes neighbourhoods and hatches indicating low-income/high visible minority neighbourhoods.

References

1. Corke S. City of Toronto, Toronto Strong Neighbourhoods Strategy. Accessed August 17, 2007 at: http://www.toronto.ca/demographics/sntf/city_sntf_staff_report.pdf

2. City of Toronto, Community Safety Plan. Accessed August 17, 2007 at: http://www.toronto.ca/community_safety/plan.htm

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INSIDE

14

Chapter

Summary and Policy Implications

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Introduction

As in other areas of the world, the past two decades have seen a substantial rise in the prevalence of obesity in Canada. One in two Canadian adults is now overweight, and the prevalence of overweight and obesity among Canadian children has nearly quadrupled since the 1980s.[1,2]

Obesity is one of the most important risk factors for the development of type 2 diabetes. Indeed, the current obesity epidemic has led to a parallel rise in rates of diabetes. In Ontario alone, the prevalence of diabetes rose 69 percent over the past decade.[3] This rate of growth already exceeds the 23 percent rise in diabetes prevalence that the World Health Organization predicted would occur in Canada between 1995 and 2025.

There is compelling scientific evidence that type 2 diabetes can be delayed or prevented in people who have "prediabetes" (a condition preceding diabetes where blood sugar levels are mildly elevated).[4,5] This is best achieved through lifestyle behaviours that promote weight loss, namely physical activity and healthy food consumption.

Achieving broad-scale increases in the uptake of these healthy lifestyle behaviours would likely offset the rise in obesity and type 2 diabetes in the general population. This is particularly challenging, given the many factors within our environment that have contributed to the obesity epidemic. However, if environments can be "obesogenic" (i.e., they promote obesity), it is likely that targeting certain aspects of our environment may serve to reduce obesity.

Halting the obesity epidemic will require a multifaceted approach. For example, a variety of anti-smoking strategies has led to a 43 percent drop in tobacco use among Canadians over the past two decades. These strategies included: clinical interventions (smoking cessation advice and prescription for quitting aids); public education campaigns; policy changes resulting in increased taxing of tobacco products; banning smoking in workplaces, restaurants and other public places; and limiting tobacco advertising, particularly ads which target children and adolescents.

In this case, implementing different but complementary approaches simultaneously resulted in a shift in the public's perception of smoking. As a result of these successful campaigns, smoking—once perceived as a cultural norm—has become a highly stigmatized activity. This is reflected in the dramatic decline of tobacco consumption. The battle against obesity will likely be more challenging, given the overall nature and complexity of this condition.

In this final chapter, we provide a brief summary of our key findings and their relevance. Based on our evidence, we also suggest a number of strategies that could be implemented to offset the obesity and diabetes epidemics. Although a variety of approaches will be required, we focus here on neighbourhood-based interventions that would provide more opportunities for individuals to adopt a healthier lifestyle.

Areas for Intervention

1. Make urban communities more "activity-friendly"

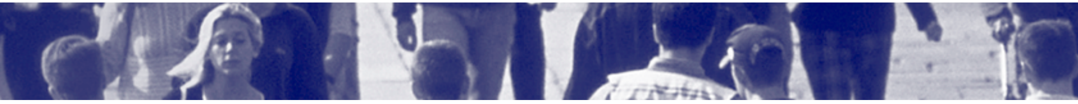
Key Atlas Findings

We found that outlying parts of Toronto (including areas in the northwest and east ends of the city where diabetes rates were highest) were less activity-friendly than more centrally-located areas. Residents living in these less activity-friendly areas took fewer walking or bicycling trips per day and had higher rates of diabetes. The relationship between activity-friendliness and diabetes was strongest in "high-risk" communities (those with higher levels of poverty and a higher percentage of visible minority* residents). Low-income communities that were similarly high-risk but located in downtown Toronto were more activity-friendly and had lower-than-expected rates of diabetes.

Why these findings are relevant

Over the past 30 years, trends in zoning and urban development have created residential communities that are physically separated and far away from retail or commercial services. The term "urban sprawl" captures this landscape well by emphasizing the spread out nature of new residential communities; typically these areas also have fewer sidewalks and fewer connections between streets.

* 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. For this Atlas, ethnic groups were identified according to how respondents described their own ethnic origins.



This development style, which became popular in the 1960s and 1970s, has created large geographical areas of residential housing with a low population density and where there is limited access to services and amenities. This style of urban design increases residents' reliance on automobiles as a means of travel and creates a less conducive environment for walking or other physical activities.

Walking has been associated with improved health outcomes, including lower rates of obesity, type 2 diabetes and cardiovascular disease, even in people who do not participate in more vigorous forms of physical activity.[6,7] Therefore, providing more opportunities for walking or bicycling (activities which can be more easily incorporated into daily life than going to a gym) could help offset the rise in obesity and diabetes. Being able to do grocery shopping or go to the park or take children to school without using a car allows residents to incorporate physical activity into daily life. Local opportunities for physical activity may be even more important for low-income groups, for whom the cost of implementing an exercise program can be prohibitive.

Strategies to increase activity-friendliness of urban communities

- **Alter planning and development practices to reduce urban sprawl and increase residential density.**

- *Create smaller block sizes, add new streets or laneways, and reduce the number of dead-end and unconnected streets.* This will provide more opportunities for residents to meet their neighbours and to access local amenities.

- *Ensure the presence of sidewalks, adequate street lighting and controlled intersections where appropriate.* These features could enhance pedestrians' perceptions of safety and encourage residents to walk more.

- *Designate some streets or parts of streets for pedestrian traffic only.* Such designations may also be used for specific periods of time or on specific days of the week, such as on weekends.

- *Add more "walkable" destinations in residential areas.* These include parks, schools, libraries, day-care centres and retail services.

- **Change zoning bylaws and construction approval processes to enable mixed land use.**

- *Add housing in low population density areas.* This creates greater demand for local services and makes it more economically feasible for businesses to locate within residential areas.

- *Create mixed-income housing.* This increases the average income level of an area, making it more feasible for businesses to succeed there.

- *Provide other financial incentives (e.g., reduced tax rates) to encourage businesses to locate or re-locate in a certain neighbourhood.* These incentives would be aimed at attracting small- to medium-sized retail outlets to move into a high-need community.

- *Impose regulations that require property developers to create retail or commercial spaces.* This could include dedicating space for commercial services in large-scale residential developments and adding commercial or retail spaces to the ground floors of new condominiums.

Achieving the measures outlined above could involve small-scale changes or major redevelopment. For new communities that are not yet built, there is an opportunity to incorporate these elements into the design of the neighbourhood prior to construction. For older communities, these elements can be introduced at the same time as new investments and redevelopment.

There is an absence of data regarding which design elements are more important than others. Attempts have been made to create more "walkable" suburban communities—for example the "new urbanism" movement (also known as "neotraditional"). However, these efforts could fail if planners and developers overlooked key elements—for example, ensuring that walkable destinations actually existed in these communities.

2. Reduce dependence on cars

Key Atlas Findings

Our research showed that residents living in the more suburbanized areas outside of downtown Toronto (where diabetes rates were highest and the activity-friendliness of the neighbourhoods was lowest) had high levels of car ownership and use, combined with low rates of walking and bicycling. In contrast, neighbourhoods in and around south central Toronto had relatively lower levels of car ownership and car use. They also had more bicycle lanes, were more activity-friendly and had higher numbers of daily walking, bicycling and public transit trips per capita. Indeed, bicycle rates were highest in south central Toronto and in areas adjacent to dedicated bicycle lanes or paths. The outlying areas of the city also had less public transit service as evidenced by longer walking times to bus or subway stops and by longer wait times for service.

Why these findings are relevant

Studies suggest that the amount of time spent on sedentary activities, such as television viewing and sitting in a car, has increased over the past two decades.[8,9] At the same time, physical activity conducted during the course of a workday has decreased.[8]

The number of minutes spent behind the wheel of an automobile has been directly correlated to higher rates of obesity.[10] People who sit in traffic for long periods of time may also be less likely to participate in physical activity once they return home. While long commutes may be bad for one's health, using public transit as an alternate mode of transportation would provide some opportunity to walk during the process of getting to work or other places.[11]

Policy makers, planners and the general public are struggling with other issues around the use of cars, including the increasing congestion on our roadways and rising concerns over pollution and gas prices.

Strategies to decrease dependence on cars

- **Enhance public transit.**

- *Add more public transit routes, particularly in parts of the city with a high prevalence of diabetes.* This could serve a number of purposes, including enhancing activity levels and improving access to healthy resources for high-risk populations. Groups such as the elderly, lower-income populations, and others who rely more heavily on public transit in order to get around would benefit most. Increasing the population density within high-risk areas would make this option more feasible by adding more potential transit users to the community.

- *Encourage the development of faster, more convenient transit services operating on more frequent schedules.* This would include building an above-ground rapid transit system using light rail; creating more dedicated routes for buses and streetcars; reducing traffic congestion; and finding economical ways to put more buses, street cars and trains in service.

- **Promote walking as a means of urban travel.**

- *(See "Strategies to increase activity-friendliness of urban communities" on page 301.)*

- **Increase the use of bicycles as a means of urban travel.**

- *Increase connections between existing bicycle routes, including dedicated pathways and lanes on roadways.* This would be of value since the current network is quite disjointed. For example, we found virtually no north-south bicycle routes connecting residential areas with the downtown core of Toronto and few east-west routes connecting residential areas with each other. Such changes would make bicycling more suitable for commuting or longer trips.

- *Build additional and accessible bicycle pathways, lanes and roadways in high diabetes prevalence areas.* This would encourage bicycling both as a recreational activity and as a method for travelling to work, school or local amenities.

- *Introduce features to improve the safety of bicycling and its compatibility with other vehicular traffic on roadways.* This could include adding more dedicated bicycle lanes, dedicating streets to non-motorized vehicle traffic, and/or adding traffic signals for bicycle lanes at controlled intersections.

- *Add dedicated bicycle lanes in public parks.* In order to ensure safety, these dedicated lanes could be specially marked and separate from walking paths.

- *Add more facilities for bicycle storage and lock-up.* These secure spaces could be provided in workplaces and key public areas.

3. Create more opportunities for physical activity

Key Atlas Findings

We noted long travel times (up to 40 minutes by walking or 20 minutes by public transit) to parks, schoolyards and recreational facilities in a number of high-risk neighbourhoods in the northwest and east ends of the city. Recreational facilities did not seem to be filling a gap in parts of Toronto where there was a shortage of parkland and other outdoor recreational spaces (such as tennis courts, baseball diamonds or soccer fields). In fact, we found that areas which lacked one type of facility often lacked other types as well.

Why these findings are relevant

Lack of adequate physical activity is a major contributor to the development of obesity and type 2 diabetes. The cost of purchasing sports equipment and of joining private gyms or sports clubs means it is easier for wealthier individuals to be physically active. Affordable and accessible neighbourhood recreational programs are likely needed to promote physical activity in high-risk neighbourhoods where the average annual household income is typically lower.

However, the mere presence of a park or recreational centre may not be sufficient. In an Australian study, people living in low-income neighbourhoods where access to recreational facilities was good were less likely to use them compared to people living in wealthier areas.[12] One explanation may be that individuals from different backgrounds and cultures vary in what kinds of activities they enjoy, and also in how much social support they need in order to join an exercise program.

A multifaceted approach that reduces both environmental and social barriers to recreation will be needed to increase levels of physical activity among high-risk groups.

Strategies to create more opportunities for physical activity

- Base decisions about where to locate new recreational facilities and recreational spaces on existing resources and on the health and social needs of local residents.
- Add attractive green spaces and parks when redeveloping high-risk communities.
- Add publicly funded recreational facilities to areas currently underserved by existing facilities and/or in areas where physical activity might help improve residents' health.
- Offer culturally appropriate and desirable physical activity programs at local community centres, parks or other recreational spaces.
- Offer free programs in low-income areas (especially for children and youth).

4. Create more opportunities for healthy eating

Key Atlas Findings

We noted that south central Toronto had the highest concentration of grocery stores and stands selling fresh fruits and vegetables; these were more sparse in outlying areas of the city. Of particular concern were low-income, high-immigration neighbourhoods in the northwest and eastern parts of the city that had both high diabetes rates and long travel times to stores selling fresh produce. These same areas also had worse access to convenience stores compared to south central Toronto (where access to all retail outlets was greatest). Alternate sources of fresh fruits and vegetables (community gardens, farmers' markets and the good food box program) were concentrated in downtown Toronto, leaving residents in other lower-income areas without such alternatives. Fast food was readily available and easily accessible throughout Toronto, although the greatest concentration of fast food outlets was found in the downtown core where the daytime population count was high.

Why these findings are relevant

Preventing the ongoing rise in obesity requires a multifaceted approach, including strategies to improve healthy eating patterns in the general population. The consumption of high-calorie convenience and snack foods has increased dramatically over the past two decades. Purchasing fruits, vegetables and other fresh food items may be more costly (or perceived to be more costly) than buying pre-made or convenience foods. Promoting healthy food choices could be particularly challenging in low-income communities, especially where limited access to stores selling affordable and nutritious foods may be contributing to unhealthy eating behaviours.

Strategies to create more opportunities for healthy eating

- Support changes in zoning, bylaws and construction approval processes that promote mixed land use. This would allow stores selling fresh produce to move into high-risk neighbourhoods where current zoning restrictions do not allow residential and commercial land uses to co-exist.
- Provide financial incentives (such as reduced taxes and other incentives) for grocery stores or fruit and vegetable stands to move into high-need areas, and for convenience stores to offer healthier, on-the-go food options and fresh produce.
- Encourage local stores to carry healthy specialty food items that are culturally specific to the ethnic groups living in a particular community.
- Support the creation of community gardens in low-income areas.
- Improve public transit to increase access to healthy foods in high-need communities.
- Develop policies that promote healthier food choices by consumers and healthier menu offerings in fast food outlets.

5. Enhance access to health services in high-need areas

Key Atlas Findings

The downtown core of Toronto contained the highest concentration of family physicians and general practitioners (FPs/GPs) in the city. In contrast, areas in the northwest and east ends of the city (where diabetes rates were highest) had fewer primary care providers per capita, including fewer providers who were accepting new patients. Neighbourhoods with a high prevalence of diabetes also had a lower supply of specialists who treat people with diabetes.

The majority of community and hospital-based diabetes education programs were located in the downtown area of Toronto and directly west of it, likely due to a clustering of hospitals in this part of the city. There was a relatively sparse distribution of such programs in other neighbourhoods. We estimated that it took residents living in the northwest and eastern parts of the city up to 60 minutes each way to travel to the nearest diabetes program by public transit.

Why these findings are relevant

Diabetes is a complicated disease to manage and requires regular visits to health care providers in order to reduce the risk of serious, long-term complications. Three-quarters of the diabetic population in Ontario receives care for their diabetes from an FP/GP alone. These primary care providers also play a key role in health promotion and diabetes prevention: they routinely counsel patients on nutrition and physical activity, and screen for early signs of diabetes and related health problems (e.g., high blood pressure and high cholesterol). Primary care providers also coordinate care by referring their patients with diabetes to other programs and services, including diabetes education centres. We noted a striking mismatch between areas of Toronto where health services were most needed and where they were located.

Strategies to enhance access to health services in high-need areas

- Create incentives for primary care providers to locate in high-risk areas of the city.
- Add new health services (such as satellite community health centres) in relatively underserved areas.
- Develop new diabetes education programs and/or expand existing diabetes education services in high-risk communities.
- Allow the planning and provision of health services to be more locally driven; the existence of Ontario's Local Health Integration Networks (LHINs) provides the opportunity for this to occur.
- Improve public transit in parts of Toronto that have high diabetes rates. This would help increase access to health care services which prevent and treat diabetes and associated conditions.
- Reduce sociocultural barriers to accessing health care services (i.e., ensure that diabetes-related programs are culturally sensitive to local residents).
- Enhance access to non-English speaking residents by offering education and counselling programs in other languages where possible or by providing interpreters; establish and/or enhance existing programs to link new immigrants to health services.

6. Prioritize high-risk neighbourhoods

Key Atlas Findings

Social disadvantage is a risk factor for the development of diabetes. We found that Toronto neighbourhoods with lower levels of average annual household income had a higher prevalence of diabetes, particularly those located in the northwest and eastern parts of the city. These same areas also had higher rates of immigration and unemployment and lower levels of educational attainment. In addition, a greater proportion of their population identified themselves as belonging to a visible minority group. However, we noted that the effect of socioeconomic status and ethnicity was modified by the activity-friendliness of the neighbourhood and also by proximity to healthy resources, such as parks or schoolyards, recreational centres, stores selling fresh fruits and vegetables and primary health care services. In contrast, high income appeared to be protective against diabetes, regardless of whether or not the neighbourhood was activity-friendly or there was good access to healthy resources.

Why these findings are relevant

Rates of type 2 diabetes are increasing in many parts of North America—including the City of Toronto—due to poor quality diets and lack of physical activity, both of which need to be addressed in the general population. Due to the complexity of the interaction between individual health, socioeconomic status and environment, it is vital to focus on the needs of people living in high-risk areas of the city. These neighbourhoods are an ideal target for diabetes prevention programs and related health promotion strategies.

However, public health interventions focused on reducing the risk of diabetes in low-income groups may be more challenging to implement than those undertaken with other high-risk populations. Such measures may require a multifaceted approach by policy makers and politicians to solve the many complex problems which likely contribute to poorer health in these groups.

Culturally appropriate programs and services are likely needed to enhance levels of physical activity level and promote healthier eating patterns. Measures to improve the health of low-income groups and other high-risk populations will also have to address a number of other issues related to poverty and immigration if health promotion and disease prevention programs are to be successful.

Strategies to prioritize high-risk neighbourhooods and improve health

Reduce poverty and its negative impact on health.

- *Develop/encourage policies that provide income support for poor families and individuals.* The amount of money required for housing and other basic necessities often means that people on social assistance simply can't afford to purchase healthy foods and eat a balanced diet, especially given the costly rental market in Toronto.[13] Adjusting social assistance levels to take housing and related costs into account, as well as the additional cost of a healthy diet, is highly desirable.

- *Enhance employment opportunities.* Recent immigrants, youth, older workers and people with low educational attainment are among those who face the greatest difficulty in the job market. Skills upgrading, job retraining and other specific programs aimed at these groups in high-risk neighbourhoods may improve employment chances and thereby reduce dependence on social programs and poverty.

- *Optimize educational attainment.* High school drop-out rates in many of Toronto's high-risk neighbourhoods are cause for concern. Innovative programming in one low-income/high immigration neighbourhood, Regent Park, helped to reduce the drop-out rate from 56 percent to 10 percent. At the same time, post-secondary school attendance increased from 20 percent to 80 percent.[14] Expansion of this and similar programs in Toronto's high-risk neighbourhoods is recommended.

- *Emphasize community development and establish a strong community service network.* This would include funding and support for the development of community programs which would increase the capacity of communities to sustain targeted programs such as those described above.

- *Encourage the development of mixed income communities.* Low-income areas have difficulty attracting retail and commercial services. For that reason, urban redevelopment that creates mixed income, higher-density neighbourhoods is likely to attract more local services (these would in turn serve as walking destinations) and also to create greater demand for public transit.

- *Create more alternate food programs.* Availability and affordability of healthy foods is problematic in many high-risk Toronto neighbourhoods. Creating and expanding innovative projects like the good food box program and community gardens could improve nutrition among community residents and thereby reduce obesity and its consequences, such as diabetes.

- *Focus more attention on the social marketing of healthy food choices.* Fast food and other calorie-dense products such as chips and soda pop are widely available at low cost throughout Toronto. Social marketing that casts these foods in a negative light and boosts the image of healthier foods like fruits, vegetables and dairy products may also be effective in helping people make healthier food choices.

Help new immigrants to Canada maintain and improve their health.

- *Support development and incentives to help new Torontonians maintain food and activity preferences from their home countries.* Immigrants to Canada have generally good levels of health when they first arrive, but their health rapidly declines to the same levels experienced by other Canadians. Settlement services can help immigrants to identify sources of familiar foods and opportunities to maintain an active lifestyle. Food stores can be encouraged to carry foods specific to local ethnic groups.

- *Provide settlement and immigration services to link immigrants and refugees with health services and other programs.* Recent immigrants face barriers in accessing health care services and make less use of preventive health care.[15] Settlement agencies can play a key role in helping immigrants and refugees find family doctors and local services for diabetes prevention and control, such as those in community health centres.

- *Ensure that opportunities to be physically active are culturally appropriate.* For example, it's important to consider the kinds of activities that local groups would like to engage in and how they would prefer these programs be provided.

- *Provide culturally sensitive health services where possible.* This would include offering services in languages other than English and/or providing interpreters.

- *Offer diabetes education and counselling to immigrant populations.* Ideally this would take place at neighbourhood Community Health Centres (CHCs) and/or would involve other local organizations serving large numbers of immigrants and refugees.

Increase networks and interactions that inspire trust within communities.

- *Enhance opportunities for community development and community action at the local level.* This is vital to fully capitalize on potential interventions aimed at improving health in disadvantaged neighbourhoods.

- *Improve the activity-friendliness of a community. (See "Make urban communities more activity-friendly" on page 300.)* This could also serve to promote social cohesion by allowing neighbours to interact on a more regular basis.

- *Support public safety and crime prevention initiatives so people feel it's safe to walk in their community, especially in the evening.* This means ensuring the presence of adequate street lighting, well-kept sidewalks and controlled intersections (where appropriate). High-crime areas will likely need additional and more complex strategies (see below).

- *Provide shared resources.* These include parks, recreational programs, community gardens and neighbourhood walking programs.

Putting it all together: Interventions that target communities in need

We have already suggested a number of strategies aimed at providing more opportunities for Torontonians to be more physically active and to consume a healthy diet. These include: making changes to the physical environment within neighbourhoods (e.g., increasing population density; improving access to local services and amenities; adding sidewalks, bicycle paths and parkland; enhancing access to public transit; and expanding community social service networks and programs, particularly those targeted towards new immigrants and lower-income residents).

Some of these strategies form the basis for several urban redevelopment projects which are currently underway in Toronto.

The Regent Park Revitalization Project

Regent Park is a lower-income neighbourhood located in downtown Toronto.[16] It is home to approximately 7,500 people. The Regent Park revitalization initiative, which will be carried out in several phases over a period of 12 years, involves reconfiguring the area into a more traditional urban neighbourhood. This includes adding new streets to physically reconnect the community to surrounding neighbourhoods; creating new, mixed-income housing; and increasing/enhancing services and amenities (such as banks, stores, health centres, recreational spaces and arts and culture programs) within the community. The plan is to create an urban green community built on environmentally-friendly design principles, along with the addition and expansion of existing parkland and community gardens.

Creating a practical and sustainable redevelopment plan for Regent Park required extensive study, considerable investment from local and provincial governments, and community participation in all aspects of planning and implementation.

Besides improving the physical infrastructure of the neighbourhood, the Regent Park revitalization project is also focused on strengthening the social infrastructure of the community. This includes a comprehensive educational plan for children (the "Pathways to Education" program); skills and vocational training; and employment counselling and coaching. Enhancing community services and support structures is another key element of the redevelopment project that will enable the community to sustain new and existing programs.

Plans also include start-up funds for small businesses, as well as enhanced employment opportunities through local businesses and in the redevelopment and building process itself.

The revitalization project is expected to increase public safety in Regent Park through enhanced surveillance (more "eyes on the street") and by increasing "social capital" (i.e., networks and interactions that inspire trust among citizens) within the community.

Investment in hard infrastructure (streets, buildings, parks, etc.) and in soft infrastructure (community development) will help to promote social cohesion. For example, the ability to perform daily activities without the use of a car (i.e., to go grocery shopping, to walk to a local park, to walk children to school) enables residents in pedestrian-oriented communities to build stronger social ties compared to residents who live in car-dependent areas. The presence of a community garden, parks and other shared resources also provides an opportunity for neighbours to share information on healthy lifestyles and is a further mechanism for enhancing social cohesion within communities. In turn, neighbourhoods with greater social capital have been shown to have lower crime rates and better health.[17]

Improving Toronto's "priority neighbourhood areas"

In 2005, the City of Toronto identified 13 "priority neighbourhood areas" as sites for reinvestment and redevelopment (Chapter 13). Most of these priority areas are located in the northwest and eastern regions of the city, areas identified in this Atlas as having high rates of diabetes. We also identified them as "high-risk" communities, with a greater percentage of low-income residents and residents belonging to visible minority groups.

The 13 neighbourhoods were chosen following recommendations that came out of the Strong Neighbourhoods Task Force. The Task Force report highlighted the increased risk to health and well-being caused by underlying poverty and crime in these communities. Redevelopment of these priority areas will focus on improving public safety and social cohesiveness and increasing residents' access to community services and facilities. The initiative will draw on experience gained from the Regent Park revitalization project.

Investing in these 13 priority neighbourhood areas has the potential to reduce the risk for diabetes, to improve control of the disease, and to enhance the overall health of area residents. Strategies similar to those being implemented in Regent Park could provide more opportunities for residents in these high-risk areas to adopt a healthier lifestyle.

However, as we have already shown in this Atlas, these 13 priority areas are among the least activity-friendly places to live in Toronto. Access to public transit is poor; so is access to healthy resources such as parks, recreational facilities, stores selling fresh produce and health care services. As a consequence, redeveloping these neighbourhoods may prove more challenging and complex than redeveloping Regent Park, which is located downtown; is adjacent to areas that were developed based on older, more traditional urban design principles; and where access to resources already exists.

What about the rest of Toronto?

The neighbourhood profiles we have created (Chapter 13) can be used to identify other parts of the city where diabetes prevalence rates are high. These areas could also benefit from enhancing public transit and infrastructure. Suburban communities outside of Toronto may wish to consider similar strategies. However, the success of any redevelopment project depends on a number of complex factors, including the socioeconomic profile of the neighbourhood and local market conditions. This makes it difficult for planners and policy makers to successfully "borrow" revitalization models from other cities.

However, it is possible for community leaders to learn from the experiences of others. A key first step is to consult with members of a given community. Gaining a better understanding of the specific factors that contribute to poor health and poverty within a neighbourhood will help to focus redevelopment efforts. It is also advisable for everyone to "keep their eyes on the prize": healthier communities that will help to control the worsening epidemics of obesity and type 2 diabetes which threaten the future of ourselves and our children.

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A

Appendix

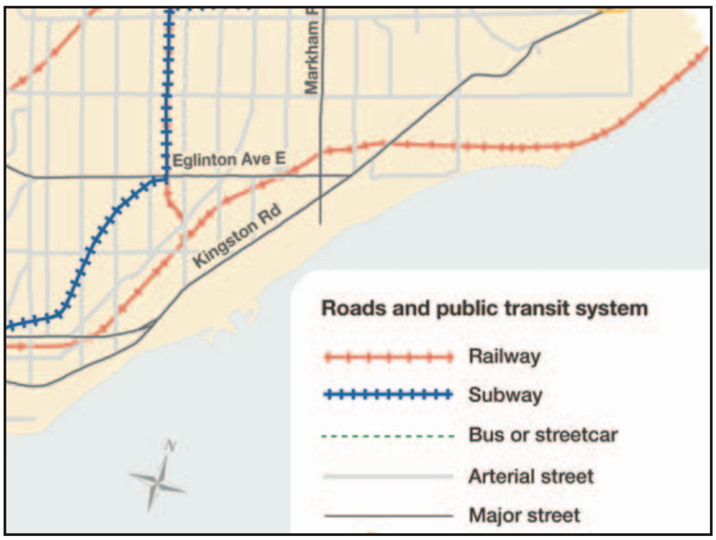
Guide to Atlas Maps

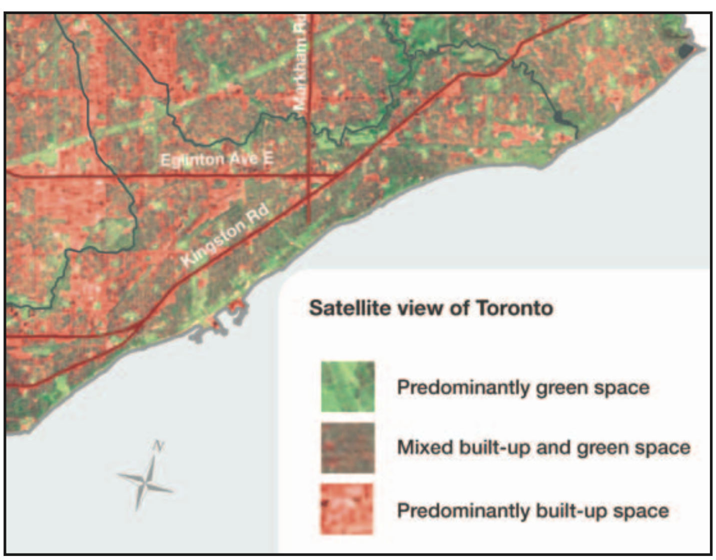
Several types of general reference and thematic maps in this Atlas may require some explanation in order to help readers interpret them correctly.

1. General reference maps

These maps show where various elements are located within the study area (e.g., streets, grocery stores or land cover based on a satellite image). When reading a general reference map, one should keep in mind that symbols are only representing real features on the ground; they may be exaggerated in size or may follow a simplified outline of the real feature, and a single symbol may represent several objects simultaneously.

Examples of general reference maps





2. Thematic (statistical) maps

Thematic maps are the main visual representation of the spatial patterns of variables (e.g., average annual household income, distribution of population). Thematic maps can be used to examine the magnitude of a variable or variables in different geographic locations and to compare spatial patterns of attributes in different areas or at various points in time.

There are four types of thematic map in this Atlas:

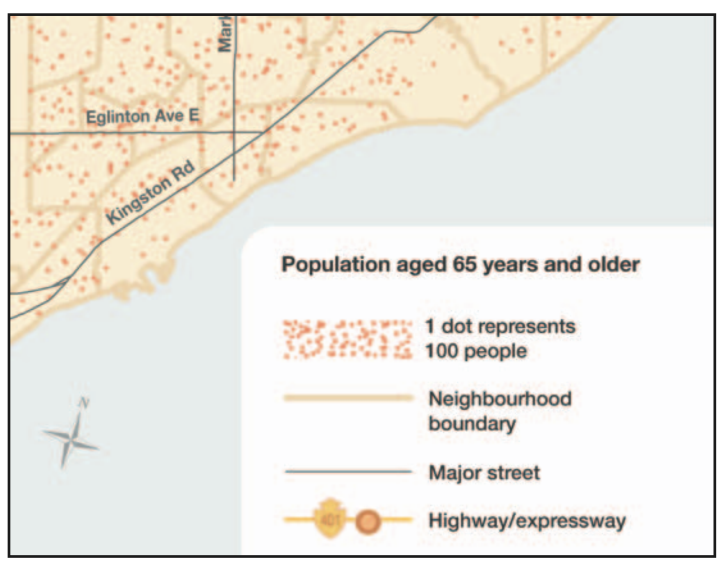
- dot density maps
- choropleth (shaded) maps
- interpolated grid maps
- proportional symbol maps

A short description of each type of thematic map is presented below, along with an example.

Dot density maps

Dot density maps usually display counts with each dot representing a specific value. In the example below, each dot represents 100 people. Dot density maps allow the reader to identify areas with higher or lower concentrations of the depicted variable. In areas with a higher population density, dots are more numerous and appear closer together; lower population density is indicated when dots are less clustered and more spread out. Dot density maps are particularly useful in identifying areas which may be in need of some type of intervention. For example, based on a dot density map showing numbers of people with diabetes in a given area, a health services planner could propose potential locations for new diabetes programs or outreach clinics.

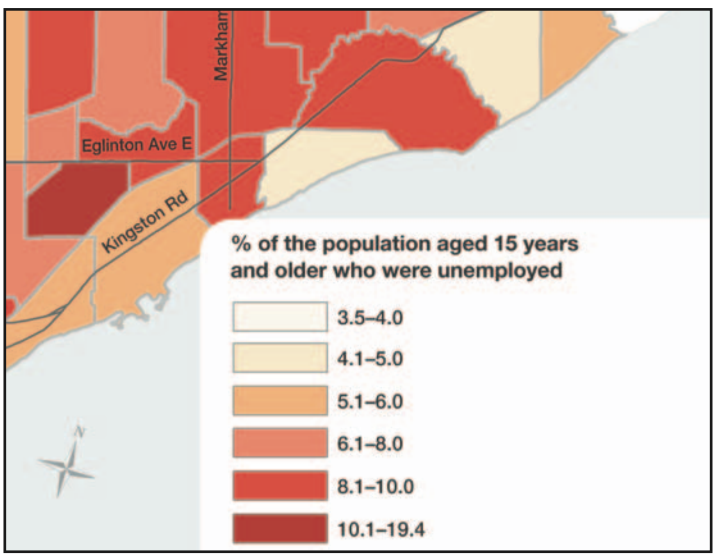
Example of a dot density map



Choropleth (shaded) maps

Choropleth maps (also known as shaded or colour maps) use different shades or colours to classify ranges of values or classes of a given variable. These maps usually represent rate or ratio variables rather than raw counts or amounts; this allows readers to compare values within different geographic areas, taking into account differences in the size of the region or the size of the population living in these different areas. A typical choropleth map assigns darker colours/shades to higher values of the depicted variable. Using shaded maps leads to a uniform standardization of the variable in each defined geographical area. The resulting visual impression is that the attribute's value is the same everywhere within each defined area. It isn't unusual for this value to change (often dramatically) at the border with another area. This simple interpretation can be misleading since few real-life variables meet the criterion of even distribution within an area. Thus, the geographic units used should be as small and uniform as possible (without sacrificing visual clarity). In addition, the reader's visual impression of the overall pattern and values in particular areas on the map may be considerably altered by applying various data classification methods and colour schemes.

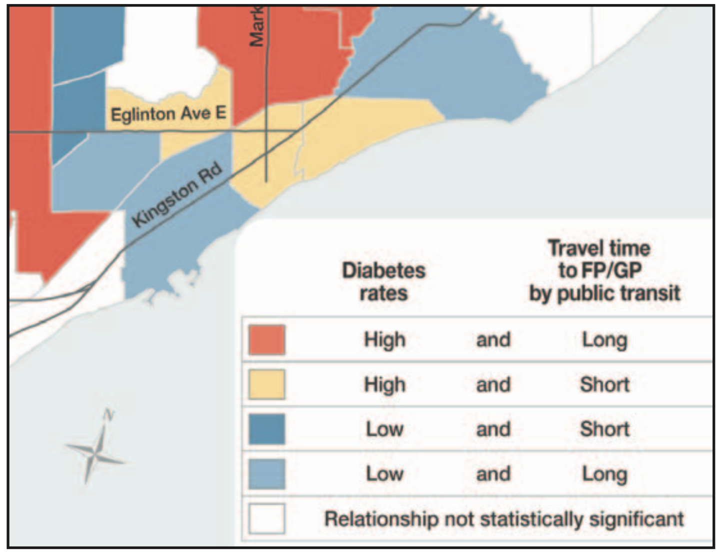
Example of a choropleth (shaded) map



Local Indicator of Spatial Association (LISA) maps

A variation of a choropleth map used in this Atlas is the *Local Indicator of Spatial Association (LISA)* map *(see Appendix B: Technical Notes for more details)*. *LISA* maps depict spatial relationships between values of two variables using several different colours. Each of the colours represents a specific combination of values of the two variables that is statistically significant and is unique to each map; hence *LISA* maps depicting different sets of variables cannot be directly compared with each other but should instead be examined individually.

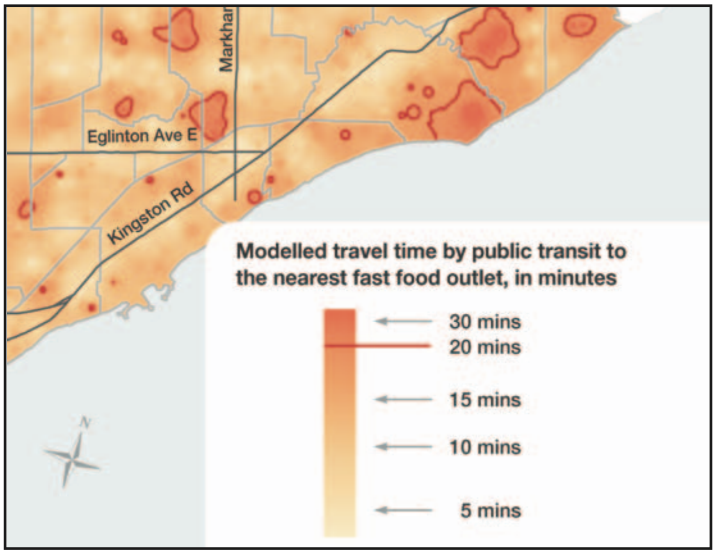
Example of a *LISA* map



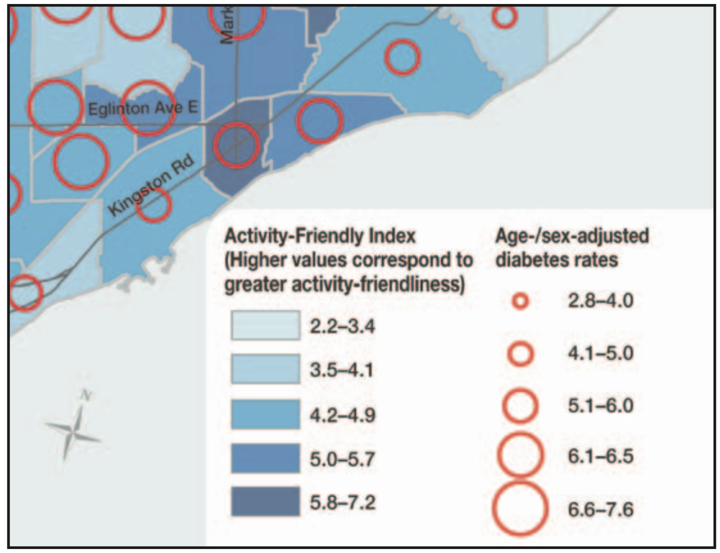
Interpolated grid maps

Interpolated grid maps can depict counts and volumes as well as rates and ratios. Values of the depicted variable in locations where they are not known are interpolated based on known data points from other locations. This can be done using various spatial methods. Inverse distance weighting was the method chosen for this Atlas. Grid maps were created by interpolating travel times by various modes of transit from residential points to various resources across the city *(see Appendix B: Technical Notes for more details)*. Interpolated travel times are presented for the entire city of Toronto, with longer travel times depicted in darker shades and shorter times in lighter shades. Isochrones, which are lines joining points with equal values, were created using interpolated grids in order to depict cut-off values for travel times by walking (greater than 10 or 15 minutes) and for travel times by public transit (greater than 20 minutes). In the example of an interpolated grid map *(see next page)*, isochrones (indicated by red lines) highlight the areas where a family doctor could not be accessed in less than 20 minutes by public transit.

Example of an interpolated grid map



Example of a proportional circle map (map depicts two variables using proportional circles overlaid on a choropleth map)



Proportional symbol maps

Proportional symbol maps can be used to depict various types of attributes including absolute numbers (counts, frequencies) as well as standardized variables (rates, ratios). Various shapes can be used as a symbol, but the most common is a circle, which is used in this Atlas. The size or height of a symbol is usually meant to represent the value of a variable measured for a given geographical unit; the symbol is placed centrally within the relevant area. We used proportional symbols overlaid on top of another thematic layer, allowing depiction of two different variables on one map *(see example above right)*.

3. Transparent maps

The hard copy version of this Atlas contains a selection of detachable, transparent reference and thematic maps. These maps can be overlaid on top of other maps in the Atlas in order to look at multivariate patterns. For example, the *Diabetes Rate* transparent map can be overlaid with the *Unemployment Rate* map in Chapter 3 (Exhibit 3.7) so the reader can observe whether there is a visual correspondence between areas with high diabetes rates and areas with high rates of unemployment.

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B

Appendix

Technical Notes

1. Overview

The methods used to create the ***Diabetes in Toronto*** Atlas can be divided into the following broad groups:

Standard statistics

Standard statistical techniques were used to describe neighbourhood attributes and to examine the relationship between different neighbourhood variables. Standard statistics refer to techniques such as deriving population sums, means, medians and p-values.

Epidemiological analyses

Epidemiological analyses applied in this project included the calculation and comparison of age- and sex-standardized rates of diabetes and related outcomes *(see Section 2.1 of this Appendix for more details)* and measures of correlation between population-based health indicators and outcomes.

Spatial methods

Spatial methods were used to examine the "availability" of various resources—defined as a number of occurrences of a given resource per capita; they were also important in determining "geographic access" to resources—measured in travel time to the nearest location of a given resource *(see Section 3.1 of this Appendix for more details).* The *Local Indicator of Spatial Association (LISA)* method was used to examine the spatial correlations between different variables *(see Section 3.2 of this Appendix for more details)*.

Development of indices

The Activity-Friendly Index (AFI) was developed to measure the "activity-friendliness" of Toronto neighbourhoods; the Healthy Resources Index (HRI) was designed to measure neighbourhood access to specific healthy resources. This helped us gain a better understanding of the types of environments that could strongly influence lifestyle behaviours relevant to the prevention and control of diabetes *(see Section 3.3 of this Appendix for more detail).*

Cartographic design

The cartographic design of this Atlas includes a number of general reference and thematic map types which depict locations, densities, patterns or statistical associations between variables. Examples of thematic maps include: dot maps that depict population densities; shaded (choropleth) maps that illustrate the availability of resources per area or per capita; interpolated grid maps which show travel times to various resources; and *LISA* maps that demonstrate statistical associations between measures *(see Appendix A: How to read the maps for more details).*

2. Data Sources and Measures

A wide and diverse range of data from many different sources was used to produce this Atlas. The data can be grouped into broad conceptual categories that are listed and explained below.

List of Key Variables and Data

Health and Health Behaviours

2.1. Diabetes rates

2.2. Self-reported health and health behaviours

Sociodemographic

2.3. Socioeconomic, ethnoracial and housing characteristics

2.4. Crime statistics

Health Care Resources

2.5. Locations of health care services

Food Resources

2.6. Locations of grocery stores/stands selling fresh fruits and vegetables; fast food outlets; and convenience stores

2.7. Alternative food sources

2.8. Food services for the under-housed and homeless

Physical Activity Resources

2.9. Locations of parks

2.10. Locations of schools and schoolyards

2.11. Locations of recreational spaces and facilities

2.12. Locations of bicycle paths

2.13. Vehicle ownership and daily travel patterns

Urban Characteristics and Infrastructure

2.14. Census dissemination areas and residential points within them

2.15. City of Toronto neighbourhood definitions

2.16. Road networks

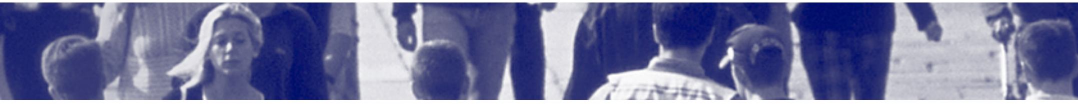
2.17. Land use in Toronto

2.18. Toronto Transit Commission (TTC) routes and service

Other

2.19. City of Toronto "priority neighbourhood areas"

2.20. Satellite image of Toronto area



2.1 Calculation of diabetes prevalence

Diabetes rates were calculated at the Institute for Clinical Evaluative Sciences (ICES) using the Ontario Diabetes Database (ODD) and the Registered Persons Database (RPDB). These data sources are maintained at ICES through a comprehensive research agreement with the Ontario Ministry of Health and Long-Term Care (MOHLTC). All names and other personal identifiers in the analytic files used in this study were removed and replaced by unique internal identifiers. In this process, addresses and postal codes were replaced with 2001 Canadian census dissemination areas and census tracts using Statistics Canada's Postal Code Conversion File Plus (PCCF+).[1]

The Ontario Diabetes Database employs a validated algorithm to identify people with diabetes using data on hospitalizations and physician visits. Hospital discharge abstracts, collected by the Canadian Institute for Health Information (CIHI), were used to identify people who had been hospitalized with a new or pre-existing diagnosis of diabetes, based on a specific code (250.x) in any diagnostic field. Physician claim records held by the Ontario Health Insurance Plan (OHIP) were also used to identify any individuals with visits to a physician for diabetes (diagnostic code 250). Individuals were considered to have diabetes if they had at least one hospitalization or two physician service claims over a two-year period.

This algorithm has been validated and found to have sensitivity and specificity rates for a diabetes diagnosis of 86 percent and 97 percent, respectively[2] (i.e., the algorithm correctly identifies 86 percent of people who have diabetes, and 97 percent of those identified who actually have diabetes, based on data in their health records). Once it has been registered in the ODD, a person's record remains there until death or migration out of the province. For this study, residents within each census tract that had one or more records in the ODD between April 1, 2001 and March 31, 2002 were categorized as having diabetes.

The Registered Persons Database (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, the RPDB was used to create the population denominator for our study. We identified all residents within a census tract between April 1, 2001 and March 31, 2002. While patients' addresses are normally updated at the time of hospitalization, there is no mechanism within the OHIP system to routinely update all addresses. For this reason, RPDB addresses, which are the only ones available for OHIP claims, can be outdated as far back as 1990.

The RPDB may include people who left Ontario but did not inform the MOHLTC; it may also include a few people who died but could not be linked to RPDB files. To exclude these persons, only those individuals who had one or more health claims in the previous three-year period and who possessed a valid Ontario postal code were included in our analyses. Despite potential inaccuracies, the RPDB is still a more appropriate denominator for OHIP-based numerators than census counts, since physician claims from OHIP are derived from the RPDB population; using census counts in the denominator is likely to inflate rates and create estimate bias.

Crude diabetes rates were calculated for three age categories (0–39 years, 40–64 years and 65+ years) and for both sexes for each 2001 Toronto census tract. To adjust for differences in the population's age and sex distribution across neighbourhoods, rates were then age- and sex-adjusted to the overall 2001 Toronto population using direct standardization. For reasons of privacy and confidentiality, rates in areas with five or fewer observed cases of diabetes were suppressed. Rates were generated at the geographic level of census tracts and were then aggregated to neighbourhood levels.

2.2 Self-reported health and health behaviours

Self reported data from two cycles of the Canadian Community Health Survey 2000/01 (CCHS 1.1) and 2003 (CCHS 2.1)[3] were combined to evaluate the following factors: daily consumption of fruits and vegetables; levels of daily physical activity; Body Mass Index (BMI); smoking status; and history of hypertension. These data were originally compiled by Statistics Canada which requires that stringent guidelines be met before any survey data are released. For this reason, even after we combined two cycles of data, the sample size was insufficient to display data at the neighbourhood level; instead, we displayed these data at the level of Toronto's larger Minor Health Planning Areas.

The following are the Statistics Canada definitions of the variables used:

- *Body Mass Index (BMI).* This international standard which relates weight to height is a common method of determining if an individual's weight is in a healthy range based on his or her height. BMI is calculated as follows: weight in kilograms divided by height in metres squared. Health Canada uses the following categories: under 18.5 (underweight), 18.5–24.9 (healthy weight), 25.0–29.9 (overweight) and 30.0 or higher (obese). Because a significant proportion of the adult population has a BMI of 25 or higher, we chose for our analysis to define overweight as a BMI of greater or equal to 27. These data were collected on the total population aged 20 to 64 excluding pregnant women and persons less than 0.914 metres (3 feet) tall or greater than 2.108 metres (6 feet 11 inches) tall.

- *High blood pressure.* Population aged 12 and over who self-reported that they had been diagnosed by a health professional as having high blood pressure prior to the date of the survey.

- *Smoking status.* Based on the population aged 12 and over who reported their smoking status. Current smokers were those who smoked on either a daily or an occasional basis. Daily smoking referred to smoking at least one cigarette per day for each of the 30 days preceding the survey. Occasional smoking referred to smoking at least one cigarette during the 30 days preceding the survey, but not every day. For this analysis, people were classified as smokers if they were in the categories of: daily smoker, occasional smoker (but formerly a daily smoker) or always an occasional smoker.

- *Physical inactivity.* The Physical Activity Index is derived for the total population aged 12 and over. It categorizes individuals as "inactive" based on their total average daily energy expenditure values (kcal/kg/day). These are calculated from the frequency, duration and intensity of their reported participation in leisure-time physical activity in the previous three months.

- *Consumption of fruits and vegetables.* This variable classifies respondents, aged 12 and over, based on the usual number of times per day they consume fruits and vegetables (fresh and processed). Respondents are then grouped into those who (on average) eat fruits and vegetables less than five times per day; between five to 10 times per day; or more than 10 times per day. For this study, people who consumed fewer than five servings of fruits and vegetables per day were considered as not meeting the current daily requirements for fruit and vegetable consumption set by Health Canada. Note that this variable is based on the frequency of fruit and vegetable consumption, not the amount consumed.

2.3 Socioeconomic, ethnoracial and housing characteristics

Sociodemographic variables were based on the 2001 Canadian census. The study area included 477 different census tracts (CTs). Values for each variable were aggregated across all CTs located in a given neighbourhood. CTs contain approximately 4,000 people, with a range of 2,500–8,000 and are thus small enough to be relatively homogeneous in terms of neighbourhood characteristics, such as socioeconomic status and living conditions. The following definitions of variables used in this analysis were derived from the 2001 Census Dictionary.[4]

2.3.1 Demographics and housing variables

- *Total population:* The total population count of the 2001 Canadian census includes the following groups:
  - o Canadian citizens (by birth or naturalization) and landed immigrants with a usual place of residence in Canada
  - o Canadian citizens (by birth or by naturalization) and landed immigrants who were abroad, either on a military base or attached to a diplomatic mission
  - o Canadian citizens and landed immigrants at sea or in port abroad merchant vessels under Canadian registry
  - o Persons with a usual place of residence in Canada who were claiming refugee status and members of their families living with them
  - o Persons with a usual place of residence in Canada who held student authorizations (student visas or student permits) and members of their families living with them
  - o Persons with a usual place of residence in Canada who held employment authorizations (or work permits) and members of their families living with them
  - o Persons with a usual place of residence in Canada who held Minister's permits (including extensions) and members of their families living with them

- *Population 19 and under (%):* Percent of the total population *(see above)* that was aged 19 or under. The age of individuals was based on their age at last birthday as of the census reference date, May 15, 2001.

- *Population 65 and over (%):* Percent of the total population *(see above)* that was aged 65 or older. The age of individuals was based on their age at last birthday as of the census reference date, May 15, 2001.

- *Daytime/nighttime population:* For this study, the nighttime population was considered equivalent to the total residential population in a neighbourhood. Daytime population was defined as the sum of: 1) total population by place of work status; 2) total unemployed population; and 3) total population not in labour force.

- *Population living alone (%):* Percent of the population in private households (excludes collective dwellings) who were living alone.

- *Population living alone/aged 65+ (%):* Percent of the population in private households (excludes collective dwellings) who were aged 65 years and over and living alone.

- *Lone parent families (%):* Percent of census families *(see definition below)* that were composed of a mother or a father, with no spouse or common-law partner present, living in a dwelling with one or more children. "Census family" refers to a married couple (with or without children of either or both spouses), a couple living common-law (with or without children of either or both partners), or a lone parent of any marital status, with at least one child living in the same dwelling. A couple living common-law may be of opposite or same sex. "Children" in a census family include grandchildren living with their grandparent(s) but with no parents present.

- *Period of dwelling construction:* Refers to the period in time during which the building or dwelling was originally constructed. For the purpose of this Atlas, three aggregate time periods were created from the various categories as representing the most relevant urban planning eras: pre-1946, 1946–1970 and 1971–2001.

2.3.2 Mobility and migration variables

- *One-year mobility in population (%):* Percent of the non-institutional population, aged one year or older residing in Canada, who lived at a different address on May 15, 2000, one year prior to (2001) Census Day.

- *Recent immigrants/within five years (%):* Percent of persons, excluding institutional residents, who were first granted the right to live in Canada permanently by immigration authorities within the five years prior to the (2001) census.

- *Recent immigrants/within 10 years (%):* Percent of persons, excluding institutional residents, who were first granted the right to live in Canada permanently by immigration authorities within the 10 years prior to the (2001) census.

- *Immigrants (%):* Percent of persons, excluding institutional residents, who were or had been landed immigrants in Canada. (A landed immigrant is a person who has been granted the right to live in Canada permanently by immigration authorities.)

2.3.3 Socioeconomic variables

- *Average annual household income ($):* The weighted mean total income of households (based on earnings in 2000).

- *Families/incidence of low income (%):* Percent of economic families who spent a higher proportion of their income (20 percent more than average) on food, shelter and clothing. The cut-off is determined using national family expenditure data, last updated in 1992, and adjusted for community size, family size, and yearly changes in the Consumer Price Index.

- *Individuals/incidence of low income (%):* Percent of economic families in private households (combining persons in economic families and unattached individuals 20 years of age and over) who spent 20 percent more than average on food, shelter and clothing. The cut-off is determined using methods similar to those described above and modified to reflect individuals.

- *Less than high school education (%):* Percent of the non-institutional population, aged 20 or over, who did not obtain their secondary school graduation certificate.

- *No knowledge of English/French (%):* Percent of non-institutional population without the ability to conduct a conversation in either English or French.

- *Not in labour force (%):* Percent of non-institutional persons, aged 15 or over who, in the week (Sunday to Saturday) prior to Census Day (May 15, 2001), were neither employed nor unemployed. It included students, homemakers, retired workers, seasonal workers in an "off" season who were not looking for work, and persons who could not work because of a long-term illness or disability.

- *Population with a university degree (%):* Percent of the non-institutional population, aged 15 or over, with a university degree.

- *Rented dwellings (%):* Percent of private households that were rented.

- *Unemployment rate (%):* Percent of the labour force (non-institutional population, aged 15 or over) that was unemployed in the week (Sunday to Saturday) prior to Census Day (May 15, 2001). A person was defined as unemployed if he or she was without paid work or without self-employment work despite being available for work and either 1) had actively looked for paid work in the past four weeks; 2) was on temporary lay-off and expected to return to their job; or 3) had definite arrangements to start a new job in four weeks or less.

2.3.4 Ethnoracial variables

- *Aboriginal (%):* Respondents in the 2001 Canadian census were asked to answer the question: "To which ethnic or cultural group(s) did your ancestors belong?" For the analysis in Chapter 4, the "Aboriginal" population refers to those who reported at least one Aboriginal origin (e.g., North American Indian, Métis, Inuit) in response to this question.

- *Visible minority (%):* Percent of the non-institutional population that identified themselves as non-Caucasian in race or non-white in colour (excluding Aboriginal persons). This definition is derived from the Employment Equity Act. Respondents in the 2001 Canadian census identified themselves as belonging to specified visible minority groups that included: Chinese, South Asian, black, Filipino, Latin American, Southeast Asian, Arab, West Asian, Japanese and Korean, "visible minority not otherwise specified," and "all others." For the purpose of Chapter 4, these responses were aggregated into "ethnoracial groups" including: East Asian, Southeast Asian, South Asian, West Asian, black, Latin American and Aboriginal. The Aboriginal population was derived from the census question described above.

- *Top three countries of origin for people immigrating within last five years:* Refers to the country identified by the individual at the time of the 2001 Canadian census as his/her place of birth. This variable was derived by ranking the countries reported most frequently (by the largest number of people) and reporting the top three ranked countries. This variable excluded institutional populations.

- *Top three home languages for non-English speaking households:* Refers to the language spoken most often or on a regular basis at home, in a non-English speaking household, by the individual at the time of the census. This variable was derived by ranking the languages reported most frequently (by the largest number of people) and reporting the top three ranked languages. This variable excludes institutional populations.

2.4 Crime statistics

Two variables acquired from the Toronto Police 2001 Statistical Report[5] were combined to calculate the crime rates used in this Atlas. They included data on violent crimes and on drug-related offences. These two categories were chosen from a broader list as being most likely to contribute to residents' perceptions about the safety of their neighbourhood. Crime counts at the level of police division (n=16) were divided among Toronto's 140 neighbourhoods based on their area. Denominators for crime rates were calculated using the "maximum exposed population" which was the higher number of two population counts (nighttime and daytime).

2.5 Locations of health care services

Health services data comprised the locations of family physicians/ general practitioners (FPs/GPs); diabetes specialists (endocrinologists, ophthalmologists and optometrists); and diabetes education programs in Toronto. The practice locations of 1,066 unique FPs/GPs were obtained from MD Select, 2002.[6] These were geocoded based on the postal codes of each doctor and with the use of the Statistics Canada Postal Code Conversion File (PCCF)[1], resulting in 925 point locations for FPs/GPs.

In order to determine which FPs/GPs practicing in Toronto were accepting new patients, the name, address, municipality and postal code of each doctor were abstracted and cross-referenced with information provided on the public website of the College of Physicians and Surgeons of Ontario (http://www.cpso.on.ca/). In total, 786 doctors accepting new patients were included in the data set.

The locations of endocrinologists and ophthalmologists practicing in Toronto were obtained from the MD Select database[6] and geocoded. There were 45 and 145 of each, respectively. The locations of Toronto optometrists were obtained from the College of Optometrists of Ontario website (http://www.collegeoptom.on.ca) and geocoded. The data set contained 202 optometrists.

2.6 Locations of stores/stands selling fresh produce, fast food outlets, and convenience stores

Grocery stores, fast food outlets and convenience stores were identified using activity codes from the City of Toronto 2004 Employment Survey (conducted by the Planning Division).[7] A total of 371 grocery stores, 2,818 fast food outlets and 1,585 convenience stores were included in the data set. While the grocery stores included major chain stores as well as smaller independent grocers and fine food retailers, there were no fruit and vegetable stands in the data set. To obtain the locations of additional grocery stores and fruit and vegetable stands, data received from the Canadian Urban Institute[8] listing all Toronto retailers buying fresh produce from the Ontario Food Terminal were geocoded. The data were then queried to obtain the locations of the additional fruit and vegetable stands and small grocers. The data contained only the names of retailers and their postal codes, so the query was based on keywords found in the names of businesses. The following keywords were used: "fruit," "veg," "produce," "grocery," "market," and "mkt." The resulting list of retailers was combined with the data from the City's 2004 employment survey; the final data set included a total of 912 grocery stores and fruit and vegetable stands.

2.7 Alternative food sources

Data showing the locations of alternative food sources were acquired in 2005 from the City of Toronto's Social Development, Finance and Administration Division (Social Policy Analysis and Research Unit). The set included data under the following categories: "Community Gardens" (data compiled by the City's Community Gardens Program which is part of its Parks, Forestry and Recreation Division); "Farmers' Markets;" "Good Food Boxes" (data originally compiled by Food Share); "Community Dining;" and "Emergency Food." (Data on food banks was compiled by Toronto's Daily Bread Food Bank.)

2.8 Food services for the under-housed and homeless

Data on social services offering meals in Toronto shelters were acquired in 2005 from the "211 Toronto" information service; from the city's "Out of the Cold" programs; and from local drop-in centres. The final data set included a total of 135 locations which were identified and mapped.

2.9 Locations of parks

The City of Toronto's 2002 land use spatial data (developed by Land Information Toronto[9]) and the DMTI Spatial 2004[10] parks layer were used to identify city parks and determine their area. The data set was limited to including parks with a minimum size of 2,500 square metres; this was done to exclude from our analyses small parkettes where opportunities for physical activity were likely to be limited or non-existent. A total of 1,312 unique park locations were included our analyses.

2.10 Locations of public schools and schoolyards

Data on the locations of Toronto schools (in 2005) were supplied by the Ontario Ministry of Education in 2006.[11] A total of 918 locations for public primary and secondary schools were included in our analyses. Since most schools have publicly accessible fields, we treated all 918 as potential locations for physical activity. The following disclaimer was provided by the Ministry of Education: "The information is provided for informational purposes only. Although the Ministry endeavours to keep the information accurate and current, it cannot be held responsible for any damage resulting from its use."

2.11 Locations of recreational spaces and facilities

Data on the locations of recreation centres in Toronto (in 2004) were supplied by the City of Toronto's Economic Development Culture and Tourism Division (Research and Grants Department). This included information on community centres, indoor and outdoor pools, arenas, artificial ice rinks, gymnasiums, baseball and softball diamonds, soccer fields and tennis courts. This data set did not include any facilities that were on Toronto District School Board property. There was some overlap between data in this category and the Parks category because many of the soccer fields and baseball diamonds were located in parks. Recreational facilities were limited to public facilities because they were and are relatively accessible to the whole population (more so than private gyms or clubs, for example). A total of 1,436 recreational spaces and facilities were included in our analysis.

2.12 Locations of bicycle paths

Data showing the locations of bicycle paths were acquired in 2007 as an image from the City of Toronto website[12] then digitized and geo-referenced using a geographic information system (GIS).

2.13 Vehicle ownership and daily travel patterns

Data on car ownership by household and daily trip counts by mode of travel were obtained from the Transportation Tomorrow Survey[13] (TTS) which was conducted in 2001 by Greater Toronto Area (GTA) municipalities and public transit organizations. Data sets were supplied by the Joint Program in Transportation, Department of Civil Engineering, at the University of Toronto. Walking trips in the TTS largely reflected trips to work or school.

2.14 Residential points within Census Dissemination Areas (DAs)

Census Dissemination Areas (DAs) were created by Statistics Canada for the 2001 Canadian census[4] and are the smallest census unit for which sociodemographic information is available. The areas of all 3,938 DAs in Toronto were examined using the Toronto land use GIS layer *(see 2.17)*, which led to the identification of 4,343 residential areas within them. The population of each residential area within a given DA was estimated by dividing the total population count from that DA between residential areas based on their relative areal proportion. The residential areas were then converted into points; each area is represented by one centrally-located point called a "centroid." (Centroids are often referred to as "residential points" in this Atlas.)

2.15 City of Toronto neighbourhood definitions

Neighbourhoods were created by the City of Toronto. They consist of several adjacent census tracts demonstrating fairly homogenous socioeconomic and health characteristics. There are 140 such units in Toronto, each containing between 7,000 and 10,000 people.[14]

These neighbourhoods are the basic areal unit for most thematic mapping in this Atlas as well as for the *LISA* analysis and mapping.

2.16 Road networks

Road networks for Toronto were obtained from DMTI Spatial Inc.[15] The DMTI road network used for network analysis included travel speeds for roadways based on signed speed limits and indication of one-way streets. Additional road network files came from Land Information Toronto[9] and the ESRI ArcCanada data set.[16] Geocoded locations of stoplights were received from Land Information Toronto.[9] Turn times at regulated and unregulated intersections were based on a combination of subjective and objective sources.

2.17 Land use in Toronto

Land use data were supplied by Land Information Toronto.[9] The 20 supplied categories were aggregated to five categories for the land use map *(see Chapter 5).*

2.18 Toronto Transit Commission (TTC) routes and service

Digital TTC files were obtained from the Map Library at the University of Toronto;[17] the data included 2004 bus and streetcar routes, subway lines and subway stops. These sets were originally supplied by the TTC. The TTC website was used to find the average speeds for public transit service.[18] The TTC Service Summary 2005 was obtained from the TTC and used to calculate average waiting times for TTC buses and streetcars.[19]

2.19 City of Toronto "priority neighbourhood areas"

These areas were defined based on information in the 2005 Strong Neighbourhoods Task Force Report ("Toronto Strong Neighbourhoods Strategy"[20]) and checked against spatial data files received from the City's Social Policy Analysis and Research Unit in 2007. The Task Force recommended that the 13 identified priority neighbourhood areas be strengthened through targeted investment in services and facilities.

2.20 Satellite image of Toronto area

The satellite image of Toronto and the surrounding area (see Chapter 5) came from LANDSAT-5[21] and was combined from a number of photos taken between 1984 and 1995.

3. Analytic Methods

3.1. Network analysis

3.1.1 Overview of analytic methods

Travel time (in minutes) to various resources shown on maps (Chapters 7 through 11) are the expression of spatial concepts variously referred to as "access," "geographic access" and "accessibility." Travel times were calculated using a set of geographic information system (GIS) methods known as *network analysis.*

Geographic access was calculated from all major residential points within dissemination areas to all analyzed resources along the road and public transit networks for three different modes of travel: 1) walking; 2) walking + public transit; and 3) driving by car. Public transit includes travel by bus, streetcar and/or subway. Travel times were computed on three different networks, each corresponding to one of the modes of travel. For the maps depicting walking and public transit travel times, isochrones (lines joining points with equal values) were presented depicting cut-off values for travel times of greater than 10–15 minutes and greater than 20 minutes, respectively. A cut-off of 10–15 minutes for the walking analysis was based on literature evaluating the propensity of residents to walk to a local store.[22] A cut-off of 20 minutes by transit in each direction was based on the authors' judgment of the travel time that might constitute a barrier to accessing local resources.

Walking can take place on all streets except highways and routes designated for public transit only. The walking and public transit analysis extends the latter analysis to include TTC routes. Additionally, walking is the only mode of travel in the walking and public transit analysis where transit is not available or where walking is the faster of the two modes (for example, for short local trips). Driving can take place along all streets and highways but not on routes that allow only public transit (e.g., along subway lines or designated streets) or on streets closed to traffic.

The calculation of a travel time was based on the most efficient combination of route segments for a given mode of travel. This resulted in the shortest possible travel time from the point of residence to a resource point, using the specified mode of travel. On some occasions, due to a combination of travel characteristics for a given set of points, it was possible to obtain counterintuitive results, where a trip taken using a normally faster mode of travel (e.g., by bus) actually took longer than the same trip using a slower slower travel mode (e.g.,walking). This may be caused by the constraints of one-way streets, delays at stop lights and at turns, wait times for public transit vehicles and other factors.

3.1.2 Data used for network analyses

Network analyses were conducted using ArcGIS Workstation 9.[1–3] (and the following network structure data was utilized):

- *Street network files* (one for each mode of travel): These files contain information about available modes of travel, speed limits, one-way or closed-to-motor traffic limitations, and length of street segments.
- *Turn tables* (one for each mode of travel): These files contain information about delays caused by the need to pass through intersections of the network (e.g., making a left turn at a stop sign while driving a car, going straight ahead at an intersection with traffic lights, or crossing a street on foot). These files also impose impedances for switching between modes of travel and TTC routes for the walking + public transit analysis.
- *Points of origins for trips:* These were created using centroids of residential areas within DAs. There are 4,343 such points in Toronto, each of which was assigned a population value based on the proportion of the total DA residential area it represents.
- *Destination points:* These points represent the services and resources examined in the accessibility analysis (grocery and produce stores, convenience stores, fast food outlets, parks, schoolyards, recreation spaces and health care services).

3.1.3 Network-building methods and assumptions

Walking, public transit and car networks were completed mainly with the use of ArcGIS 9.1 and its module ArcPlot.[23] One aim of this work was to include realistic impedance values for a number of different attributes in the network. This additional modelling allowed for a more accurate measure of accessibility and reduced the overestimation of access that could result from simpler models.

It is important to remember that some of the applied criteria reflect the best case scenario in travelling with a given mode (e.g., walking is always assumed to be conducted at the rate of 1.2 metres per second (m/s), despite the fact that older and less physically able persons may walk at lower speeds). Public transit vehicles are assumed to be moving at average speed for the type of vehicle and the route. Cars are assumed to be travelling at the maximum allowed speed on a given street. However, the last two assumptions do not factor in traffic congestion and other variables which routinely slow the progress of public transit vehicles and cars.

3.1.3.1 Driving Network

A variety of data were required to set up the Driving Network used for calculating travel times to neighbourhood resources. These included specifications of maximum speed, length and one-way restrictions for each road segment. Additionally, it was necessary to account for stoplights and their associated wait times (impedances), as well as the extra time required to make a turn at regulated and unregulated intersections.

Different impedances were put in place for travelling straight through a stoplight and also for turning right and turning left. Impedances were also created for intersections without streetlights, with different times for straight travel and for left and right turns. These values were determined through "assumptions based on personal experience" and varied from five to 20 seconds, depending on the angle and direction of the turn, and whether the intersection had traffic signals. Additionally, no impedance was factored in for having to find parking; the impedance values were based on the assumption that the analysis is examining the "best case scenario" (i.e., not during rush hour traffic, no prohibited turns on streets other than one-ways, no road closures, construction or other obstacles).

3.1.3.2 Transit + Walking Network

In order to create the Transit + Walking Network, data from the TTC (Toronto Transit Commission, 2005) were combined with the road network obtained from DMTI Spatial Inc. (2003). The focus here was on incorporating wait times for buses and streetcars based on TTC schedules, impedances for turns, and travel speeds for individual road and subway segments.

The average wait time for a bus or streetcar was calculated based on an off-peak hours, weekday TTC schedule. Where different transit routes coincided or crossed, the wait time was assumed to be half of the longest of all possible wait times (conservative approach). Information on bus and streetcar stop locations was not available; it was assumed that these vehicles normally stopped every few blocks and at major intersections. Therefore, for simplification, access to a bus or streetcar was set at all intersections.

For the subway system, data on stations and subway lines were available and used in the analysis. To determine travel time along subway segments, the TTC's subway schedule was used. The travel time for each subway segment (i.e., the time to travel between any two stations) was calculated by multiplying the total time required to complete the whole route by the length of each segment expressed as a fraction of the total route's length.

The walking component of the Transit + Walking Network was based on an average walking speed of 1.2 m/s (City of Toronto, 2002).[24] This travel time was incorporated into all the road network segments.

Stoplight and turn impedances were not incorporated into the Transit + Walking Network because these values were already accounted for in the TTC schedules and travel times. However, it was necessary to incorporate waiting times at bus, streetcar and subway stops to simulate transferring from one mode of transit to another. At subway stations, this value was determined to be two (2) minutes, based on the average wait times in TTC schedules. For transfer to a bus or streetcar from either walking or subway, or from another bus or streetcar, the wait time was assessed based on TTC service schedules.

3.1.3.3 Walking Network

The Walking Network was built from the Walking + Transit Network. All non-walkable routes (e.g., highways) were deleted from the system. Turn impedances were also inputted for making a left turn (20 seconds) and walking straight ahead (20 seconds); both these actions require crossing the street. No turn impedance was used for making a right turn (continuing along the same sidewalk without having to cross the street).

3.2. Description of *Local Indicator of Spatial Association (LISA)* mapping

Statistical spatial autocorrelation is a measure of similarity in neighbouring areas based on the values of a variable or two variables and a matrix identifying which areas are considered to be neighbours. The matrix chosen for this analysis to determine neighbouring units uses a first-order weighting,[25] meaning that it considers as neighbours only those areas that share a common boundary.

The spatial autocorrelation method used in this analysis is a relatively new method described by Luc Anselin[26] and available through the GeoDa software.[27] In its basic format, spatial autocorrelation examines values of a single variable across the study area looking for clusters of neighbouring polygons with statistically similar values. The bivariate *Local Indicator of Spatial Association (LISA)* calculates local Moran statistics for two variables. In its basic global form, Moran statistics (Moran's I), defines the level of spatial autocorrelation of a variable, which can be thought of as a clustering of similar values in certain regions of the study area. Moran's I ranges between -1 and +1, where -1 indicates strong negative autocorrelation; 0 indicates random distribution of values; and +1 indicates strong positive autocorrelation. The algorithm identifies spatial clusters of significantly (p-value < 0.05) similar or dissimilar values. The outcome of a bivariate *LISA* classifies study area polygons based on the values of two variables of interest into five categories: *High-High, Low-Low, High-Low, Low-High* and *Not Significant.*

The results are shown on *LISA* maps in numerous chapters of this Atlas. It should be noted that bivariate *LISA* analyses were performed on each set of variables independently so the maps cannot be directly compared between each other but should instead be examined individually.

3.3. Creation of Neighbourhood Indices

The Activity-Friendly Index (AFI) reflects the overall potential of engaging in lighter types of activities suitable for all residents in a neighbourhood (i.e., walking, bicycling or taking part in community gatherings). The AFI is comprised of the following five variables: 1) car ownership per household (values reversed); 2) population density per square kilometre of residential area; 3) density of all retail services per 10,000 population; 4) average distance from residential points to the nearest five retail locations (values reversed); and 5) rates of drug-related and violent crime rate per 100,000 of maximum exposed population (values reversed).

The calculation of the AFI required standardization of the values of each of the five variables to the range of 0 (zero) to 10. The standardized values for the variables (car ownership per household, average distance from residential points to the nearest five retail locations, and drug and violent crime rate per 100,000 population) were reversed by subtracting them from 10. Lastly, standardized values of the five variables were added together (equally weighted) and divided by five. This resulted in the AFI scale ranging (potentially) of 0 (zero) to 10, with zero representing the least and 10 representing the most activity-friendly conditions within a neighbourhood. The AFI and its input variables were described and mapped individually and in relation to diabetes rates *(LISA* maps*)*. *(For more details about the AFI, see Chapter 6.)*

The Healthy Resources Index (HRI) combines measures of geographic access to resources that may contribute to the overall health of residents in each Toronto neighbourhood. The four component variables of the HRI are: 1) average walking time to healthy food retailers, 2) average walking time to public recreational spaces; 3) average walking time to parks and schoolyards; and 4) average travel time by public transit to family physicians/general practitioners (FPs/GPs).

Travel times from each major residential area (represented by a point) within a neighbourhood to the nearest location of each resource were calculated using network analysis. Resources located up to 100 metres outside the boundaries of the neighbourhood for which the calculation was being performed were included in the analysis to account for the possibility of people accessing resources in adjoining neighbourhoods. Travel times to each resource were then population-weighted and averaged based on all residential points within the neighbourhood, and standardized to a scale of 0 (zero) to 10. In the next step, these values were reversed (subtracted from 10), summed and divided by four (4) to create the HRI with a range of 0 (zero) to 10, where zero represents the least desirable conditions (longest travel times to healthy resources) and 10 represents the most desirable conditions (shortest travel times to healthy resources). All variables of the HRI were described and mapped individually and in relation to diabetes rates *(LISA* maps*)* in Chapters 7, 8 and 11. *(For more details about the HRI, see Chapter 12.)*

4. Software

The use of different software products to develop data for this Atlas was based on the unique features of each product.

The main geographic information system (GIS) software used was the ESRI suite of products including ArcGIS Desktop 9.1 and ArcGIS Workstation 9.1.[23] The majority of the network building and all the network analysis was done in ArcGIS Workstation 9.1, with some of the initial testing and minor adjustments done in ArcGIS 9.0/8.3 and MapInfo 7.[28] The density calculations were performed in ArcGIS suite 9.1 and MapInfo 7.

The summarizing of the network results was done in Microsoft Access 4[29] and Microsoft Excel 5[30] along with SPSS 11.[31] All maps were created in ArcGIS Desktop 9.1. Final map edits were performed using Adobe Illustrator CS2.[32]

GeoDa 7,[27] a free shareware application for geographical analysis, was used for bivariate *Local Indicator of Spatial Association (LISA)* analysis. GeoDa 7 uses ESRI shapefiles for map-making purposes.

SAS 8.2[33] was used for calculating correlations between different variables and regression parameters.

Microsoft Excel 5[30] was used for making tables and scatterplots.

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Neighbourhoods,
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C

Appendix

Neighbourhoods, City of Toronto, 2001

Appendix C.1 City of Toronto, neighbourhood boundaries, 2001

Findings

- This map shows the City of Toronto boundaries for its 140 neighbourhoods as they existed in 2001, along with each neighbourhood's ID number.

129	Agincourt North
128	Agincourt South-Malvern West
20	Alderwood
95	Annex
42	Banbury-Don Mills
34	Bathurst Manor
76	Bay Street Corridor
52	Bayview Village
49	Bayview Woods-Steeles
39	Bedford Park-Nortown
112	Beechborough-Greenbrook
127	Bendale
24	Black Creek
69	Blake-Jones
108	Briar Hill-Belgravia
122	Birchcliffe-Cliffside
41	Bridle Path-Sunnybrook-York Mills
57	Broadview North
30	Brookhaven-Amesbury
71	Cabbagetown-South St.Jamestown
109	Caledonia-Fairbanks
96	Casa Loma
133	Centennial Scarborough
75	Church-Yonge Corridor
120	Clairlea-Birchmount
33	Clanton Park
123	Cliffcrest
92	Corsa Italia-Davenport
61	Crescent Town
59	Danforth Village-East York
66	Danforth Village-Toronto
47	Don Valley Village
126	Dorset Park
93	Dovercourt-Wallace Emerson-Junction
26	Downsview-Roding-CFB
83	Dufferin Grove
62	East End-Danforth
9	Edenbridge-Humber Valley
138	Eglinton East
5	Elms-Old Rexdale
32	Englemount-Lawrence
11	Eringate-Centennial-West Deane
13	Etobicoke West Mall
44	Flemingdon Park
102	Forest Hill North
101	Forest Hill South
25	Glenfield-Jane Heights
65	Greenwood-Coxwell
140	Guildwood
53	Henry Farm
88	High Park North
87	High Park-Swansea
134	Highland Creek
48	Hillcrest Village
8	Humber Heights-Westmount
21	Humber Summit
22	Humbermede
106	Humewood-Cedarvale
125	Ionview
14	Islington-City Centre West
90	Junction Area
110	Keelesdale-Eglinton West
124	Kennedy Park
78	Kensington-Chinatown
6	Kingsview Village-The Westway
15	Kingsway South
114	Lambton Baby Point
117	L'Amoureaux
38	Lansing-Westgate
105	Lawrence Park North
103	Lawrence Park South
56	Leaside-Bennington
84	Little Portugal
19	Long Branch
132	Malvern
29	Maple Leaf
12	Markland Woods
130	Milliken
17	Mimco
135	Morningside
73	Moss Park
115	Mount Dennis
2	Mount Olive-Silverstone-Jamestown
99	Mount Pleasant East
104	Mount Pleasant West
18	New Toronto
50	Newtonbrook East
36	Newtonbrook West
82	Niagara
68	North Riverdale
121	Oakridge
107	Oakwood-Vaughan
54	O'Connor-Parkview
58	Old East York
80	Palmerston-Little Italy
45	Parkwoods-Donalda
23	Pelmo Park-Humberlea
67	Playter Estates-Danforth
46	Pleasant View
10	Princess-Rosethorn
72	Regent Park
4	Rexdale-Kipling
111	Rockcliffe-Smythe
86	Roncesvalles
98	Rosedale-Moore Park
131	Rouge
89	Runnymede-Bloor West Village
28	Rustic
139	Scarborough Village
85	South Parkdale
70	South Riverdale
40	St.Andrew-Windfields
74	St.Jamestown (North)
116	Steeles
16	Stonegate-Queensway
118	Tam O'Shanter-Sullivan
63	The Beaches
3	Thistletown-Beaumond Heights
55	Thorncliffe Park
81	Trinity-Bellwoods
79	University
43	Victoria Village
77	Waterfront Communities-The Island
136	West Hill
1	West Humber-Clairville
35	Westminster-Branson
113	Weston
91	Weston-Pellam Park
119	Wexford/Maryville
51	Willowdale East
37	Willowdale West
7	Willowridge-Martingrove-Richview
137	Woburn
64	Woodbine Corridor
60	Woodbine-Lumsden
94	Wychwood
100	Yonge-Eglinton
97	Yonge-St.Clair
27	York University Heights
31	Yorkdale-Glen Park