

Measuring and Mapping Disparities in Access to Fresh Fruits and Vegetables in Montréal

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ABSTRACT

Objective: This study was conducted to evaluate disparities in access to healthy food in Montréal, focusing on the availability of fresh fruits and vegetables (F/V) as an indicator.

Method: F/V selling area was measured in all food retail stores and public markets offering more than 75 square feet of fresh fruits and vegetables. An accessibility index was elaborated, taking into account motorization rates and the total surface of these fresh foods for sale within an easily accessible zone. The extent of that zone was determined differently for motorized (3 km) and non-motorized (500 m) consumers. Measures were calculated and georeferenced at the level of "Dissemination Areas" according to the 2001 Census.

Results: In general, access to healthy foods is quite good for consumers who shop by car. But 40% of the population have poor access to fruits and vegetables within a walkable distance from home. No relationship is observed between median income in dissemination areas and food supply.

Conclusion: Improved access to healthy food by non-motorized consumers is needed in many areas of Montréal. Implications of differential access to fresh fruits and vegetables for health and environmental sustainability are discussed.

Key words: Accessibility; healthy food; inequalities; mapping; Canada

La traduction du résumé se trouve à la fin de l'article.

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In recent years, inequalities in access to food have been addressed among important factors of health inequalities.¹⁻⁴ In Montréal, as in many cities in North America and Europe (particularly the UK), it has long been contended that socio-economically deprived areas were less well served in terms of price, quality and variety of food than better-off districts,⁵⁻⁸ corner stores are over-represented in underprivileged areas, although there are exceptions in poor multiethnic sectors where specialty food stores are the most abundant.^{9,10} In the US, studies have reported "grocery gaps" to describe the withdrawal of large food retail chains from inner cities where high concentrations of poor are left with an inadequate food supply and higher prices.¹¹⁻¹⁵ In the UK, the term "food deserts" was introduced in government reports to promote policy recommendations for improvement of retail provision of food in poor neighbourhoods.¹⁶⁻¹⁸ Extensive literature has been produced around this concept, referring to urban areas where people experience physical and economic barriers to accessing healthy food.¹⁹⁻²⁸ Notably, most of the studies, especially the American ones, focus quasi-exclusively on supermarkets, as if they were the only pathway to healthy food provision.^{4,12,14,15,23,24,29}

However, the notion that access to a quality food supply, be it in terms of proximity or affordability, is inversely related to neighbourhood socio-economic status has recently been challenged by some researchers.^{7,21,25,30,31} These observations have raised questions on equity of access to healthy food in a mixed food-cultured city like Montréal, where the poverty rate is 29%.³² Proximity was the first criterion mentioned by Québec consumers to determine where they shop for food.³³ Previous observations in the US reported that most consumers tend to shop for food within 3 kilometres from home;^{34,35} we can suppose that the same holds true for Montréal. Means of transportation is then a factor to consider. Indeed, food shopping trips account for a significant proportion of local car trips (23% in San Francisco).³⁶ In the UK, Caraher reports that 95% of superstore customers go by car; this observation has emerged as an environmental issue among several actors, along with food production practices and long-distance transportation from the field to the

store.³⁷⁻⁴³ Access to healthy food in urban settings thus needs to be assessed with respect to sustainable development.

To measure *healthy food* access, researchers have mostly focused on either a specific food category or grocery list.^{4,21,30,44} Numerous studies have established the protective effects of fruits and vegetables against cancer, obesity and cardiovascular diseases.⁴⁵⁻⁴⁸ The Canadian Community Health Survey reports correlations between the frequency of fruit and vegetable consumption and other health behaviours such as physical activity and not smoking.⁴⁹ Although recommended in food guides for years, fruit and vegetable consumption is now the central recommendation in nutrition-based disease prevention and health promotion programs.⁵⁰⁻⁵⁴ Considering the nutritional value a diversity of fruits and vegetables brings to a person's diet, the availability of these foods in urban settings can be seen as a quality indicator of the food environment.

The goal of this study was to evaluate disparities in access to healthy food among Montréal neighbourhoods.

METHOD

Fresh fruit and vegetable supply was chosen as the healthy food indicator. Health benefits, reported above, and practicality strengthened this option. The provision of fruits and vegetables can indeed be readily estimated by measuring the selling area devoted to produce in all retail stores. The data collected, expressed in one simple unit (square feet), can then be easily aggregated over any territorial area.

The initial list of food stores to be measured was compiled with information gathered from the ministère de l'Agriculture, des Pêcheries et de l'Alimentation. We updated this list using previous mapping works and field observations.⁹ Pre-tests showed that stores carrying less than 75 sq. ft. of produce are a negligible and unstable source of fruits and vegetables. Details of the methodology are described in a research report.⁵⁵

In this study, neighbourhood refers to dissemination area (DA), the smallest territorial unit for which Statistics Canada provides census information. The island of Montréal (483 km², 1,800,000 inhabitants), the territory covered in the present research, is divided into 3,237 dissemina-

TABLE 1

Montréal and the West Island – Two Worlds

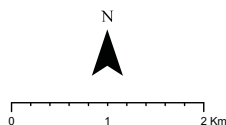
	West Island	Montréal without West Island
Population	222,550	1,589,400
Surface area	155 km ²	328 km ²
Land occupation density	1,436 inhabitants/km ²	4,848 inhabitants/km ²
Average income per household	\$78,839	\$47,887
Cars per capita	0.49	0.34

Retail Stores (fruit and vegetable)

Area (sq. ft.)

- 75 to 200
- 201 to 500
- 501 to 1000
- 1001 to 6500
- Over 5000 sq. ft.

— Streets



Sources: DSP-Montréal-Centre; Agence métropolitaine de transport; Société d'assurance automobile du Québec; Statistiques Canada
Mapping: P. Pitre, Centre Léa-Roback, March 2007; M.-S. Cloutier, 2004.
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Figure 1. Example of a local fruit and vegetable retailing environment in a dissemination area

tion areas. We excluded 79 DAs because they were uninhabited or composed mostly of elderly populations living in institutions, or because of missing data. Our survey thus covers 98.5% of Montréal's population, living in 3,158 dissemination areas.

An "easy access zone" (EAZ) was determined for DA residents. For car-owning households, the relevant EAZ was defined as a circle with a buffer zone of a 3 km radius from the centroid of each dissemination area. For non-motorized households, a 0.5 km radius determined the EAZ which can reasonably be walked while carrying grocery bags. Figure 1 shows a DA with its access zones.

Analysis

We characterized healthy food accessibility in each dissemination area with a single value. An index (I_{FV}) was designed by integrating preceding variables.

For the i -th DA, I_{FV_i} is defined as:

$$I_{FV_i} = (1 - m_i) A_{0.5i} + m_i A_{3i}$$

Where

m_i = motorization rate (or % of households owning at least one car) in the i -th dissemination area

$A_{0.5i}$ = total selling area of F/V in all stores located within a radius of 0.5 km from the centroid of the i -th dissemination area

A_{3i} = total selling area of F/V in all stores located within a radius of 3 km from the centroid of the i -th dissemination area

In addition to the index, we focused on absolute surfaces of F/V supply measured within a 500 m walking distance. The objective was to uncover discrepancies among neighbourhoods in regard to F/V accessibility without motorized transport.

These data were calculated and mapped using a Geographic Information System.^{56,57}

We hypothesized a relationship between F/V availability (estimated by I_{FV_i} or by $A_{0.5i}$) and socio-economic status of dissemination area (estimated by median income). We examined this relationship by means of linear regression.

RESULTS

Our field investigation led to an inventory of 501 food stores where produce-selling areas were greater than 75 sq. ft.

Figure 2 shows the distribution of the Index of fruit and vegetable availability per population quintile throughout the region. White areas indicate sectors with the lowest I_{FV} . These appear to be mainly concentrated in the western part of Montréal, where most DAs seem poorly supplied. In fact, a typical suburban pattern differentiates the West Island from the urban core of Montréal. Table I underlines the specificity of both subregions for density, income and car ownership. Although more than 85% of West Island households are motorized and the index takes into account F/V availability over a 3 km radius, I_{FV} is less than 6,749 for 50% of the West Island population compared with the median value of 27,699 for the urban subregion.

These observations led us to exclude the West Island from the analysis of food supply over a walking distance, and we focused on the truly urban sector. Figure 3 shows the distribution of F/V surfaces within a 500 m radius. It reveals that a large number of urban DAs are clearly underserved; 40% of Montrealers have access to less than 640 sq. ft. of produce. In fact, 28% of the population cannot buy any fresh fruit and vegetables within 500 m of their home. This finding bears no relationship to income. The same is true of I_{FV} . Indeed, regression of I_{FV} and $A_{0.5}$ on income yielded r^2 values of 0.05 and 0.009, respectively. Absence of an association between income and I_{FV} is shown in Figure 4, where box plot graphs illustrate the distribution of I_{FV} (4a) and $A_{0.5}$ (4b) by income quintiles.

DISCUSSION

This study reveals different patterns of access to healthy food among Montréal neighbourhoods, and results may be somewhat surprising. First, even with a high motorization rate, West Island sectors show the poorest index of fruit and vegetable availability. It would however be incongruous to characterize the West Island as a classic case of “food desert”, since it is one of the wealthiest areas of the country; as in other typical suburbs where food chains establish their largest stores, people must drive long distances. Second, even if F/V availability looks better in more urban sectors, 40% of their population have no access or less than 640 sq. ft.

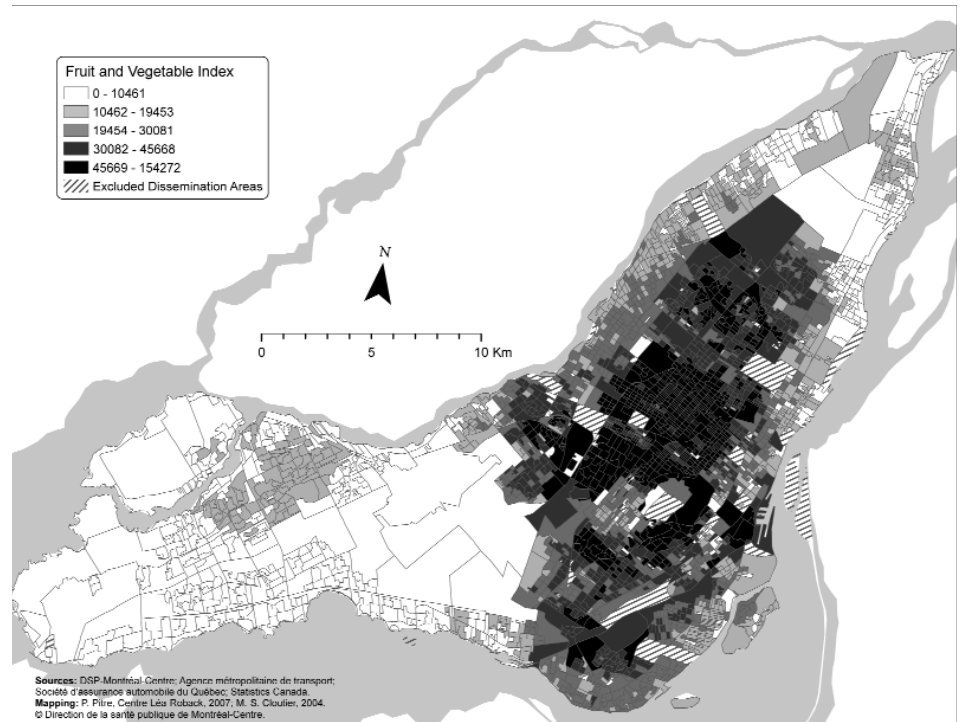


Figure 2. Distribution of the Fruit and Vegetable Index (I_{FV}) by population quintiles, Island of Montréal (population: 1,787,925)

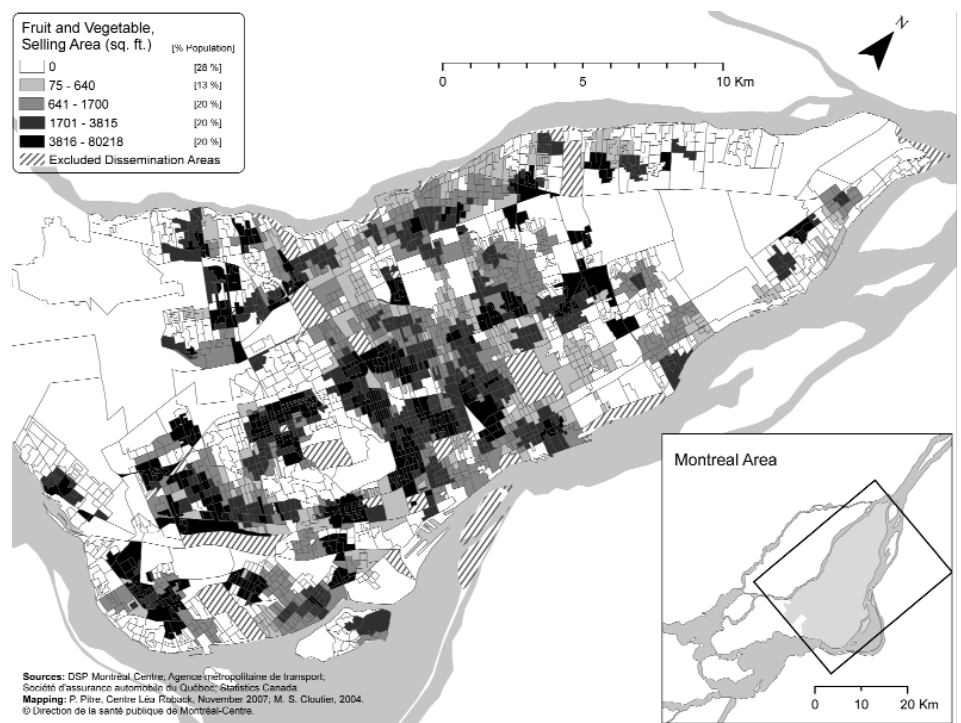


Figure 3. Selling areas of fruits and vegetables in the 500 m easy access zone, Montréal without West Island (population: 1,565,200)

of fruits and vegetables within walking distance (500 m), which is less than what is found in a *single* typical supermarket. This result is far from ideal in the perspective of sustainable urban development, aiming at reducing car use. Admittedly, public trans-

portation is not the most convenient means of transportation when shopping for food.^{13,33} Moreover, if we recognize the value of F/V in the diet, the lack of availability for a high percentage of the population raises the question of daily consumption. Third,

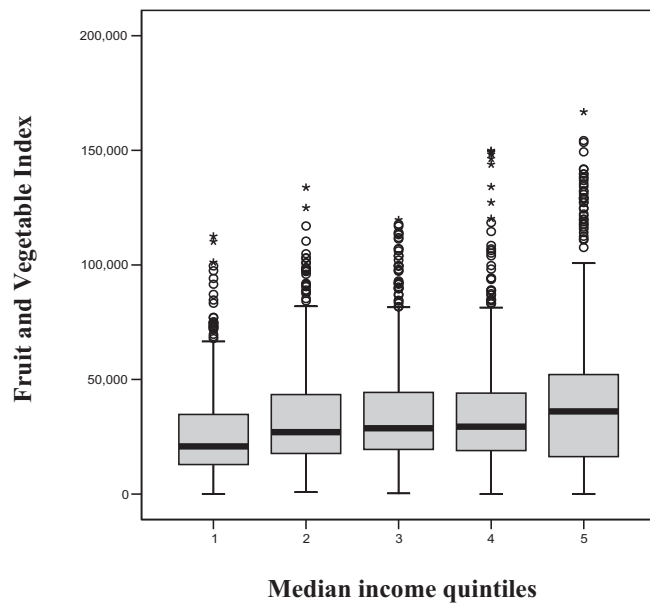


Figure 4a.* Distribution of Fruit and Vegetable Index (I_{FV}) by median income quintile, Montréal without West Island

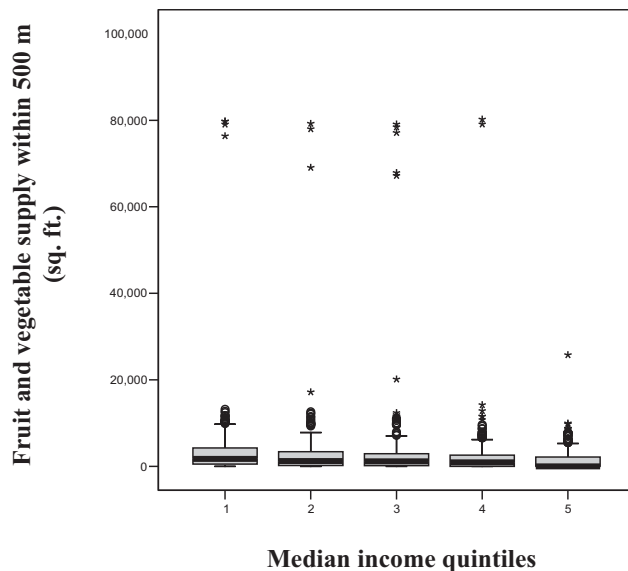


Figure 4b.* Distribution of fruit and vegetable supply within 500 m, by median income quintile, Montréal without West Island

* For each quintile, the lower side of the box indicates the 25th percentile, the upper side indicates the 75th percentile and the bold line in between is the median.

contrary to what is reported in the literature, this study does not show any relationship between healthy food supply and socio-economic status of neighbourhoods. Methodology based on actual measures of a specific food category in all types of commercial outlets, rather than on sole presence of supermarkets, may partly explain this. But some specificities pertaining to Montréal also deserve attention: low-income districts with a strong immigrant population are rather well served by numerous ethnic shops; moreover, a cer-

tain number of DAs belonging to the lowest-income quintiles are adjacent to large public markets where supply of fruits and vegetables is plentiful. However, there remain low-income neighbourhoods (160 DAs; total pop. 93,430) that are poorly supplied (<640 sq. ft.) within 500 m.

Food cost, an important accessibility factor, was left out of our study. We know that prices often differ from one store to another. A recent survey, conducted in various food outlets of Montréal, reported prices per kilo of nine varieties of fruits

and vegetables,⁵⁸ with the highest prices found at a public market (Atwater) and the lowest at another (Jean-Talon). In the middle, green grocers were less costly than grocery stores and supermarkets. This result reinforces the importance of our choice to include all types of stores in our measures, enabling us to cover all price scales.

The question as to what threshold would objectively indicate an “adequate” supply of fruits and vegetables was not addressed. Although floor areas are a common reference in the food retail business, they are not necessarily accurate indicators: smaller shops may be more tightly packed than supermarkets, or have a higher turnover, so that floor area may underestimate the quantity of fruits and vegetables they actually offer. Diversity and quality of products are other components that also qualify supply. These elements depend largely on consumer preferences and should be addressed in future research.

CONCLUSION

In this study, information for small territorial units was processed using geomatics. The application of GIS in public health is recent, but most valuable in terms of its capacity to handle the spatial dimension of information integrating the social, economic and environmental components of health.⁵⁹⁻⁶¹

Local food environments in urban settings are multidimensional and call for multidisciplinary actions. Health, social and private actors, urban planners and the community will improve healthy food access to a greater degree if they work together.

Pothukutchi and Kaufman have made suggestions as to how city planners should integrate food access in their agenda.⁶² Supermarkets are not the only answer where land is scarce, nor do they insure improvement of green spaces, cycling trails or pedestrian streets. Other avenues could be explored: initiatives such as weekly farmers’ markets or conversion of corner stores into specialty stores to address unmet needs in the neighbourhood can improve healthy food access while contributing to a more ecological urban design. From the point of view of public policy, this study may help municipal

decision-makers better identify poorly serviced areas and alleviate inequalities in access to healthy food.

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RÉSUMÉ

Objectif : Cette étude visait à évaluer les disparités dans l'accès à des aliments santé sur l'île de Montréal.

Méthode : En prenant comme indicateur la disponibilité de fruits et légumes frais, nous avons mesuré la surface de vente consacrée à ces aliments pour chacun des commerces montréalais et marchés publics offrant plus de 75 pieds carrés de fruits et légumes frais. Un indice d'accessibilité a été construit en tenant compte du taux de motorisation et de la surface totale de vente des fruits et légumes dans des zones-tampons de 500 m (distance de marche) et de 3 km (personnes motorisées). Ces mesures ont été géoréférencées à l'échelle des aires de diffusion (Recensement 2001).

Résultats : L'accès à des aliments santé apparaît relativement adéquat... à condition de disposer d'une automobile. En effet, 40 % de la population n'a qu'un piètre accès aux fruits et légumes frais à distance de marche du domicile. On ne peut cependant établir de relation entre le revenu moyen dans les aires de diffusion et l'offre alimentaire.

Conclusion : De nombreux secteurs montréalais auraient besoin d'une amélioration de l'offre alimentaire de proximité. Les résultats soulèvent des préoccupations tant du point de vue de la santé que de l'environnement.

Mots clés : accès; aliments santé; inégalités; cartographie; Canada



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