



Weighing the importance of neighbourhood: A multilevel exploration of the determinants of overweight and obesity

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ABSTRACT

Overweight and obesity have reached epidemic proportions in many countries, including Canada. In addition to becoming critical public health challenges in and of themselves, they represent major risk factors for chronic disease and disability (e.g. cardiovascular disease, diabetes). The various symptoms and co-morbidities associated with these chronic conditions place tremendous stress on the Canadian health care system, generating economic concern. This research takes a population health approach to the study of obesity, examining the complex relationships between individual demographics and behaviours, and aspects of the local social and physical environments. A subset of a nationally representative survey was linked to neighbourhood-level data from the 1991 Canadian Census, and analysed from a multilevel perspective. This study found substantial area-level variation in body mass index and waist circumference, and discovered an important role for neighbourhood-level characteristics independent of individual-level characteristics. These findings provide evidence that the underlying mechanisms driving the increasing prevalence of overweight and obesity may be so called obesogenic environments that encourage physical inactivity and unhealthy eating. An effective policy response must address environmental conditions in order to curb current obesity trends.

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Introduction

On a global scale, the increasing prevalence of obesity has reached epidemic proportions, and is a major contributing factor to dramatic increases in the rates of various chronic diseases and disabilities. Worldwide, approximately 1 billion adults are overweight (body mass index [BMI] ≥ 25 kg/m²) and at least 300 million of these individuals can be classified as obese (BMI ≥ 30 kg/m²) as defined by the World Health Organization standards (WHO, 2006). Likewise, in Canada obesity has emerged as a critical public health issue over the last several decades. The 2004 Canadian Community Health Survey found that approximately 36% of Canadian adults were overweight, and almost 23% could be classified as obese (Canadian Institute for Health Information [CIHI], 2004).

Overweight and obesity have been linked to numerous adverse health outcomes such as type II diabetes mellitus (WHO, 2006), various cancers (World Cancer Research Fund/American Institute for Cancer Research, 2007), and adverse psychosocial outcomes such as depression (Kim, Meade, & Haines, 2006). Additionally, it is now clear that overweight and obesity are important risk factors for

cardiovascular disease, currently the leading cause of mortality in Canada and much of the western industrialized world (Health Canada, 2006). In 2001, national medical costs attributable to adult overweight and obesity were estimated at \$4.3 billion (CAD), or 2.2% of total health care expenditure (Katzmarzyk & Janssen, 2004).

At the physiological level, overweight and obesity are caused by an energy imbalance whereby caloric intake (diet) exceeds expenditure (physical activity) (Black & Macinko, 2008). Despite this relatively simple equation, obesity is a complex, multifactorial disease (Huot, Paradis, & Ledoux, 2004). Evidence has consistently shown variation in obesity rates between individuals to be associated with genetic, psychological, socioeconomic, and behavioural factors, all of which are thought to play a substantial role in onset (Poortinga, 2006). Until recently, obesity research has focused on exploring and identifying these potentially modifiable individual risk factors. While these strategies have had some success in developing intervention approaches for obesity, they have failed to effectively slow or reverse current obesity trends at the population-level, which indicate increasing prevalence across individuals of all ages, genders, socioeconomic groups, educational levels, and geographic regions (McLaren, 2007).

Within more recent obesity research, there is a growing consensus that individual characteristics and behaviours, and in particular dietary and physical activity patterns, are influenced by aspects of the broader socioeconomic, cultural, and environmental

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contexts in which people live (Moon, Quarendon, Barnard, Twigg, & Blyth, 2007; Ross et al., 2007). Following arguments developed by Rose (1985), population-level interventions have the power to shift the obesity distribution curve in a direction that would benefit the entire population by removing or modifying these underlying forces. Indeed, major gains in altering other health behaviours, such as reducing smoking-related inequalities in health, have been realized by developing interventions focused on modifying population-level determinants in combination with individual-level interventions (Thomas, Fayter, & Misso, et al., 2008).

A more ecologically informed approach to the obesity problem has the potential to identify, and help us understand the so called *obesogenic* environments which foster high energy diets and sedentary lifestyles, and develop an appropriate 'upstream' preventive response (Black & Macinko, 2008). It is these environmental factors that are explored in this paper. Overweight and obesity are framed as being functions of individual characteristics (e.g. age, sex, education, socioeconomic status, physical activity behaviours, dietary patterns), operating within a local neighbourhood context characterized by various socioeconomic, cultural, and physical characteristics.

Neighbourhood context and obesity

A number of environmental factors have been identified in the literature as potential determinants of overweight and obesity at the neighbourhood-level (Black & Macinko, 2008). In terms of the physical environment, access to opportunities for healthy eating and physical activity has been the main focus, including access to walking paths, trails, quality sidewalks, and recreation facilities (Boehmer, Hoehner, Deshpande, Brennan Ramirez, & Brownson, 2007; Giles-Corti & Donovan, 2002). These and other characteristics, such as street connectivity, have been combined to develop a *walkability index* for neighbourhoods that have been found to be positively correlated with recommended daily physical activity levels and thus, reduced rates of overweight (Frank, Saelens, Powell, & Chapman, 2007). Additional correlates of obesity at the local community level include: access to local shops, health related stores, supermarkets, and fast-food restaurants (Reidpath, Burns, Garrard, Mahoney, & Townsend, 2002; Stafford et al., 2008). Higher rates of obesity prevalence have also been reported in rural populations of Canadian youth (Oliver & Hayes, 2008), and adults (CIHI, 2006; Huot et al., 2004).

The remaining variation in weight status at the neighbourhood-level points to social and economic factors as likely contributors (Cohen, Finch, Bower, & Sastry, 2006).

The relationship between individual-level socioeconomic status (SES) and obesity has been relatively well-established, and in most developed countries, there exist inverse gradients between SES and adult overweight and obesity regardless of the indicator of SES used (McLaren, 2007). In addition to individual-level SES being a strong predictor of obesity, there is a growing consensus that neighbourhood-level socioeconomic disadvantage may also play an important role in understanding the epidemiology of obesity. Among this literature, findings generally indicate a negative association between obesity and area-level SES, independent of individual-level SES (Janssen, Boyce, Simpson, & Pickett, 2006). For example, multilevel studies in Australia (King, Kavanagh, Jolley, Turrell, & Crawford, 2006), Scotland (Ellaway, Anderson, & Macintyre, 1997), the United Kingdom (Moon et al., 2007), Sweden (Sundquist, Malmström, & Johansson, 1999), France (Chaix & Chauvin, 2003) and the United States (Diez-Roux, Link, & Northridge, 2000; Robert & Reither, 2004) have all reported that neighbourhood socioeconomic deprivation significantly predicted adult obesity prevalence, independent of individual demographic and socioeconomic characteristics. Further, multilevel studies of adolescents (Janssen et al.,

2006) and youth (Oliver & Hayes, 2008) conducted in Canada, reported significant associations between obesity and neighbourhood SES after adjustment for parents' socioeconomic positions.

There is also strong evidence in the literature that social factors are contributors to population-level obesity rates. In a neighbourhood setting, these sociocultural influences combine to create a group's attitudes and perceptions toward obesity, physical activity, and food (Swinburn, Egger, & Raza, 1999). Measures of social capital, social cohesion, and collective efficacy – the willingness of a community to look after its members – have each been found to be positively associated with weight status (Cohen, et al., 2006; Poortinga, 2006) and physical activity (Wendel-Vos, Droomers, Kremers, Brug, & van Lenthe, 2007). Alternative indicators of the social environment including perceived physical dereliction or disorder, perceived unpleasant community, perceived community aesthetics, policing levels and recorded violent crime, and unemployment levels have also been found to have significant neighbourhood-level effects on obesity rates (Boehmer et al., 2007; Ellaway, Macintyre, & Bonnefoy, 2005; Farley, Meriwether, & Baker, et al., 2007; Robert & Reither, 2004; Stafford et al., 2008).

What is apparent is that the geography of obesity and overweight is complex, with numerous interrelated factors at the individual- and contextual-levels (Moon et al., 2007). While the volume of literature exploring the relationships between neighbourhood measures and weight status is expanding, the field still offers important opportunities for new study. This research will contribute to the literature by using the most recently collected clinically measured obesity outcomes in Canada, building upon the relatively small class of multilevel obesity studies of neighbourhood determinants of obesity in Canada, and by applying the analysis grid for environments linked to obesity (ANGELO) framework, to an empirical exploration of the individual- and neighbourhood-level determinants of obesity.

The ANGELO framework

The ANGELO framework was developed by Swinburn et al. (1999) as a conceptual tool for identifying and dissecting elements of obesogenic environments. The ANGELO grid is divided by two axes: one comprising two sizes of environment (macro and micro), and the other characterizing four types of environment (physical, sociocultural, economic, and political, Table 1 – with examples). Micro-environments are defined as settings that influence where and how groups of people interact, including schools, homes, and neighbourhoods. These micro-environments are influenced by the broader macro-environments, or sectors, such as the health system, or the food industry (Swinburn et al., 1999).

Table 1
The ANGELO framework (adapted from Swinburn et al., 1999).

	Physical environment	Sociocultural environment	Economic environment	Political environment
Micro (settings)				
Neighbourhood	Recreational facilities		Affordable opportunities for healthy eating	
Schools		Teachers as role models		Policies on physical education
Macro (sectors)				
Regional planning				Prioritizing physical activity
Media		Perception of obesity in the general population		

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