



Health in Hamilton neighbourhoods: Exploring the determinants of health at the local level

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ABSTRACT

The population health perspective recognizes a broad range of characteristics that are thought to be important determinants of health. In Canada, 12 such determinants of health are recognized, which range from lifestyle practices and the use of health care services to social and physical environments. While the list of social determinants is quite exhaustive, few studies have examined the relative importance of these determinants. The intent of this paper is to examine the relative importance of a range of social determinants of health in predicting four health outcomes of interest using data from a neighbourhood-level cross-sectional health survey conducted in Hamilton, Ontario. The results show that key social determinants of health vary by health outcome. The significance of the findings is discussed in terms of policy relevance and future research.

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Introduction

A great deal of research has explored the extent to which health is influenced by the characteristics of individuals and/or their social and physical environments. The social (or non-medical) determinants of health (SDOH) have further become an important dimension of policy discourse, although which ones can be influenced and in which ways remains a matter of debate (Wilkinson and Marmot, 2003; Irwin et al., 2006; Collins et al., 2007; Frankish et al., 2007). But much policy discourse has in fact continued to add determinants to the list of characteristics seen as important to shaping health. In Canada the first listing of determinants came from the 1974 Lalonde report entitled *New Perspective on the Health of Canadians*, which identified human biology, environment, life style, and health systems (Lalonde, 1974). The Canadian Institute of Advanced Research expanded those to include different types of behaviour (e.g., smoking, work relationships) and environment (physical and social) as well as individual sociodemographic characteristics and responses to illness episodes (Mustard and Frank, 2004). These ideas have now been formally taken up and further developed by national agencies so that there now exists a 12 item list of health determinants, established by the Public Health Agency of Canada,

which inform the development of healthy public policy (Canada, 2003). These are income and social status, social support networks, education and literacy, employment/working conditions, social environments, physical environments, personal health practices and coping skills, healthy child development, biology and genetic endowment, health services, gender, and culture. While this represents a comprehensive list, research has yet to explore the relative importance of these determinants in the context of different health outcomes. Such an exploration is likely to be useful for the development of healthy public policy and health promotion strategies. Thus, in this paper we seek to examine the relationships between these factors with respect to different health outcomes. We do this using data from a neighbourhood-level cross-sectional health survey as the significance of the local for health status is now well established.

There has been much research activity focused on some but not all of the characteristics that shape the health of populations variously defined. For example, one of the earliest factors associated with health status was access to and utilization of health care services (Roos and Mustard, 1997). Research has also identified some of the other key associations between health and its determinants, such as the relationship between poor health and low income, low levels of education, employment status and conditions, poor social environments, and various sociodemographic characteristics (age, gender; Adams et al., 1998; Blakely et al., 2002; Macintyre et al., 2003; Malmstrom et al., 1999; Manderbacka et al., 1999). In addition, it has been noted that

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health status varies by culture and/or ethnicity (Newbold and Danforth, 2003; Yu et al., 2004). Social support has long been recognized as an important determinant of health (Kamrul Islam et al., 2006, see also Warr, 2006). In terms of personal health practices and coping skills, many studies have demonstrated links between poor health, smoking, and physical inactivity. Recent interest has focused on physical inactivity as part of the obesity epidemic. This epidemic has been linked, along with other factors such as genetics and diet, to suburban design and its role in supporting physical activity (Frank et al., 2005; Frumkin, 2002). Research has shown that a lack of physical activity is associated with sprawl and linked to respiratory and cardiovascular diseases (Frumkin, 2002) as well as obesity (Andersen et al., 2002; Frank et al., 2005; Hoehner et al., 2005; Kelly-Schwartz et al., 2004; Lopez, 2004; Saelens et al., 2003). Poor health is also seen as being associated with poor physical environments such as housing quality and toxic environments (Clapp et al., 2006; Dunn, 2002; Elliott et al., 1999; Macintyre et al., 2003).

Although much of the research on the SDOH has focused on national and international levels, there is growing interest in looking at health at the local level. For example, research has looked at the impact of disadvantaged neighbourhoods on health (Cummins et al., 2005; Pampalon et al., 2007), although this notion has been challenged in studies by Pearce et al. (2007) in New Zealand and van Hooijdonk et al. (2007) in the Netherlands. Links have also been made between local-area variations and different measures of health status (Sooman and Macintyre, 1995). Pampalon et al. (2007) have examined the relationships between neighbourhood perceptions and self-assessed health status, mastery, and control in Quebec City. Mental health outcomes (Fone et al., 2007), heart disease (Cubbin and Winkleby, 2005; Diez Roux et al., 2004), and chronic conditions (Janghorbani et al., 2007) have all been associated with varying neighbourhood characteristics. Significant relationships have also been identified between neighbourhood problems (traffic density, pollution, dirt, noise, absence of amenities, threats to self and property) and impaired physical function, self-rated health, and psychological distress. Deteriorated neighbourhood environments have also been linked to increased stress and depression (Campbell, 1983; Evans, 2003; Latkin and Curry, 2003). In fact this linkage between psychological process, neighbourhood, and health has been seen as key in recent research (Warr et al., 2007; Poetz et al., 2007). Furthermore, it has been suggested that neighbourhood has a multidimensional impact on health (see Parkes and Kearns, 2006). But these conclusions come primarily from studies that examine specific determinants of health for discrete health outcomes. Therefore in this paper we examine the relative importance of the determinants for different health outcomes for the same population living in four neighbourhoods in Hamilton, Ontario. In doing so, we therefore seek to examine the importance of neighbourhood as a social determinant of various health outcomes.

Methods

Research setting

This study took place in four distinct neighbourhoods in Hamilton, Ontario, an industrial city in Canada, located on the western tip of Lake Ontario, about 60 km southwest of Toronto (population at the time of the study ~490,000 (Statistics Canada, 2007)) Data came from a cross-sectional survey, designed to assess determinants of health at the local-level. In brief, neighbourhoods were selected through a combination of statistical methods that utilized socioeconomic and demographic data extracted at the census tract level from the 1996 Census of Canada (data were

taken from this year as the 2001 census data had not been released at the time of our study) in conjunction with smoking data from a random survey of Canadian adults, including Hamilton (see Manfreda et al., 2001). Principal Component Analysis (PCA), local indicators of spatial association (LISA), and geographical information systems (GIS) were used to identify neighbourhoods representing clusters of 17 socioeconomic and demographic determinants of health and related risk factors (see Luginaah et al., 2001 for a full discussion of neighbourhood selection criteria). This analysis was coupled with qualitative interviews with prominent local decision makers and key informants, which identified similar boundaries for the study neighbourhoods. The selected neighbourhoods displayed various combinations of economic wealth and social diversity, including high versus low socioeconomic status (SES; e.g., income, education, housing tenure) as well as high versus low social and demographic diversity (e.g., percent married, average age, lack or presence of recent immigrants, visible minorities, etc.). The neighbourhoods selected are referred to as: the Downtown Core, Chedoke-Kirkendall, Northeast Industrial, and the Southwest Mountain.

The Downtown Core is characterized by high diversity, a high proportion of rental apartments, and low SES. The Northeast Industrial neighbourhood is close to two highly visible steel industries and is characterized by low SES and low diversity. Chedoke-Kirkendall is a high-SES and high-diversity neighbourhood and the Southwest Mountain is a relatively new residential area, elevated above the central city by the Niagara escarpment and has low diversity and high SES.

Study design

The sampling frame for the telephone survey was obtained from tax assessment records provided by City of Hamilton officials. This database provided the names and addresses of potential respondents, and telephone numbers were then sought using the Canada 411 Internet locator service. Prior to data collection, ethics approval from the University Research Board was obtained. An introductory letter from the research team was sent to approximately 2500 potential respondents, informing households about the study. Between November 2001 and April 2002, a telephone survey was administered to approximately 300 individuals living in randomly selected households, aged 18 years and older, from each neighbourhood. Only one survey was completed per household. Individuals with the most recent birthday were selected to complete the survey. All telephone numbers received a minimum of 12 call attempts and, to maximise the likelihood of finding respondents at home, calls were scheduled during the day, evening, and weekend hours. The final response rate was approximately 61 percent. The survey contained a range of questions designed to measure health status along with various SDOH. As is common with telephone surveys, our sample has higher levels of SES (i.e., household income, education, housing tenure) than the general population (Grube, 1997; Purdiel et al., 2002).

Measuring the social determinants of health

In our analysis, we have selected 11 of the 12 SDOH identified by the Public Health Agency of Canada, the exception being early childhood development (which we were unable to measure in our adult population survey; see Table 1). In the following discussion we reference the importance of these determinants in the Canadian context. *Income/social status* (see Raphael, 2004) is represented by household income and is divided into four

Table 1
Distribution of variables representing the social determinants of health

Variables	Classification	%
<i>Income/social status</i>		
Household income	< \$30,000	28
	\$30,000–\$49,999	24
	\$50,000–\$79,999	25
	\$80,000+	22
Housing tenure	Own	77
	Rent	23
<i>Education/literacy</i>		
Highest level of schooling	High school	79
	Less than high school	21
<i>Employment</i>		
Employment	Employed	33
	Not employed	67
<i>Social support</i>		
Marital status	Married	62
	Not married	38
Number of people in dwelling	Mean number	3.0
Number of friends	Mean number	8.5
<i>Social/physical environments</i>		
Neighbourhood of residence	Mountain	27
	Chedoke-Kirkendall	24
	Downtown	22
	Northeast industrial	27
Neighbourhood likes	None	10
	Social like	48
	Physical like	42
Neighbourhood dislikes	None	34
	Social dislike	22
	Physical dislike	44
	Length of residence	Mean number (years)
Social involvement	Any involvement	33
	No involvement	67
Housing conditions	Major repairs required	17
	No repairs required	83
<i>Personal health practices/coping</i>		
Smoking status	Non-smoker	29
	Smoker	71
Exercise	No exercise	10
	Exercise	90
Coping	Excellent to good coping	89
	Fair to poor coping	11
Health services use	Use	30
	No use	70
<i>Biology and gender</i>		
Age	18–24	12
	25–44	40
	45–64	34
	65+	15
Gender	Female	53
	Male	47
<i>Culture</i>		
Ethnicity	Canadian	24
	Other than Canadian	76

categories—< \$30,000, \$30,000–\$49,999, \$50,000–\$79,999, and \$80,000 and greater. *Education/literacy* (FPT, 1999) is measured by an individual's highest level of schooling categorized as a binary variable with those not completing high school forming one category and those earning a high school diploma or more forming the other. *Employment* (Lavis et al., 1998) is a binary variable represented by those unemployed/not in the work force and the employed. *Social support networks* (Raphael, 2004) are represented by marital status, number of people in the dwelling, and number of friends an individual has in their neighbourhood. Marital status was dichotomized: married/living with partner and

not married (single/separated/widowed/divorced). Number of people in the household and the number of friends an individual has in their neighbourhood are retained as continuous variables. *Social and physical environments* (see Hancock et al., 1999) are measured by six variables, five of which examine one of our main foci, namely the role of neighbourhood environments as a social determinant of health: neighbourhood of residence, perceived neighbourhood likes and dislikes, length of time in the neighbourhood, social involvement in the neighbourhood, and housing conditions. Neighbourhood of residence was included in the models with the 'Mountain' neighbourhood as the reference group. Neighbourhood perceptions were also obtained. Individuals were first asked to report what they disliked most about their neighbourhood. This was followed by a question asking respondents to report what they liked about living in their neighbourhood. Only the first mention was recorded. The most commonly reported physical dislikes were related to traffic (i.e., pollution from exhaust, noise, speed) and the most commonly reported social dislikes were social issues and problems such as crime, homelessness, and prostitution. We followed the method used by Ellaway et al. (2001) of classifying responses obtained for these two open-ended questions into categories that were either 'social' (e.g., lack of safety, friendliness of neighbours) or 'physical' (e.g., green space, pollution). Reliability in coding was ensured by dual coding of the responses by more than one researcher. Participants were also asked how long they had lived in their current neighbourhood. Length of time living in their present neighbourhood was measured in years and retained as a continuous variable. Respondents were also asked about the number and type of informal/formal community groups they were involved in (e.g., faith, self-help, voluntary, sport organizations). Based on the distribution of responses, community involvement was coded as any involvement versus no involvement. Respondents were also asked if their dwelling was currently in need of major repairs. Responses were dichotomized as yes or no. We use smoking, physical activity, and coping to proxy *personal health practices and coping skills* (Birch et al., 2005; de Wolff, 2008). Smoking was measured by asking participants if they smoked daily, occasionally, or not at all. This represents a binary variable with daily/occasional smokers forming one category and non-smokers forming the other category. Physical activity was determined by asking about frequency of physical exercise or activities (such as fitness training or walking) in the past 3 months. The variable was dichotomized into any exercise versus none in the past 3 months. Coping was measured using a question that measured an individual's ability to cope with day-to-day daily demands: "How would you rate your ability to handle the day-to-day demands in your life, like work or school or family responsibilities?" Participants were asked to rate their coping ability using a five-point scale ranging from excellent to poor. Fair or poor responses defined those with coping problems and the remainder (excellent, very good, good) formed the reference group. *Health services* (Stabile and Ward, 2006) are measured by whether or not an individual visited a family physician visit in the past 2 weeks or used hospital or home care services in the past 12 months defined health service use. Any use formed one category and no use of health services formed the other category. In our analysis we use age to proxy *biological* (see FPT, 1999) determinants of health. The age variable is represented by four categories: 18–24, 25–44, 45–64, and 65 years and older. *Gender* (see Clark, 2000; Denton and Walters, 1997) is also included in all models. Finally *culture* (see PHAC, 2007) is represented by ethnicity with individuals being asked to identify to which ethnic group they belong. This approach is taken from the Census of Canada and relies on self-report. Thus it may be open to multiple interpretations by respondents. It is important to note that there is much

debate but little consensus on the measurement of ethnic group identification (see Goldscheider, 2002; Robbin, 1999; Sheldon and Parker, 1992). Based on the distribution of responses the variable is categorized as 'Canadian' versus other ethnicities.

Health outcome measures

Given that a key goal of our research is to examine if the SDOH vary for different health outcomes, we include four measures of health in the analysis that follows (see Table 2). *Physiological health* was measured using self-rated health status (McDowell and Newell, 1996) reported on a five-point scale: 'excellent', 'very good', 'good', 'fair', or 'poor'. This variable was dichotomized to 'excellent', 'very good', 'good' and those reporting 'fair' or 'poor'. Respondents were also asked about the presence or absence of 13 diagnosed chronic conditions (such as diabetes, cancer, asthma, arthritis; Manuel et al., 2002). This variable was recoded into two or more chronic conditions versus one/none. *Psychosocial health* was measured using the 20-item version of the General Health Questionnaire (GHQ), a validated measure of emotional well-being (Goldberg, 1972). For each GHQ item, the participants first indicated if they had felt a certain way in the past 2 weeks (e.g., able to concentrate, reasonably happy, feeling nervous and tense). Second, they indicated how usual it was for them to have felt that way. Summing across all 20 items, the cut-off point for emotional distress in adults is a score of 4. Therefore, those who scored 4 or more were classified as meeting the criterion for emotional distress and those scoring less than 4 formed the reference group. *Body Mass Index (BMI)* was derived from measures of height and weight (weight (kg)/height (m²)). A BMI of 25 or more was regarded as overweight (Health Canada, 2003).

Statistical analyses

Given the dichotomous nature of the dependent variables (0, 1), a series of logistic regression models were run in order to examine the relative contribution of the 11 categories of the SDOH with respect to the four health outcomes. Coefficients are estimated using the maximum likelihood method (MLM) of estimation (Aldrich and Nelson, 1984). As described above, all but three of the independent variables are categorical and were recoded into categorical indicator variables. One value of each variable is chosen to be the reference category. For all variables, the value chosen to be the reference category is the one hypothesized to be least likely associated with the dependent variables. For example, we assume that younger individuals (18–24 years) and the employed would be the least likely to report fair/poor health, have two or more chronic conditions, score above 4 on the GHQ, and be overweight (see Table 2). For ease of interpretation, the results are discussed in terms of the odds ratios. The odds ratio is a measure that approximates how much more likely (or unlikely) it is for the outcome (e.g., fair/poor self-rated health) to be present among those with a given

attribute relative to the reference category while controlling for all other attributes. Regression analyses were performed using SPSS statistical software (Norusis, 1990). While others have investigated the neighbourhood level through multi-level modeling (MLM) techniques to assess the relative roles of individual versus area effects on health (for a review see Pickett and Pearl, 2000), in this analysis we are examining the SDOH in neighbourhoods at the individual level. Thus, MLM techniques are not appropriate as they are designed to address a different set of research questions.

Results

In the first model we examine self-assessed health (Table 3). In predicting fair/poor health age, household income, exercise, health services use, neighbourhood of residence, neighbourhood dislikes, and coping were all statistically significant. In particular, those 45–64 years of age, those with low income (<\$30,000), those living in the Northeast neighbourhood, and those reporting social dislikes were twice as likely to be in fair poor health than the respective reference categories. Individuals who had not exercised in the past 3 months were 1.8 times more likely to report fair/poor health than those who had. Those who used health services in the past 12 months were more than 50 percent less likely to be in fair/poor health than those who sought care. Finally, those with poor coping skills were almost six times more likely to report fair/poor health than those with good to excellent coping skills. Supplementary analysis of the data reveals a link between poor coping skills and lower levels of education.

The model for chronic conditions identifies again age, household income, neighbourhood dislikes, and coping skills as statistically significant variables (Table 3). In addition, smoking status and length of residence in the neighbourhood are significant predictors of chronic conditions. Specifically, individuals aged 45–65 and 65 years and older are more than six times more likely to report two or more chronic conditions as compared to those aged 18–24 years. Those with poor coping skills are almost two times, those reporting social dislikes about their neighbourhood are 20 percent, and those with household income below \$50,000 are also, more likely to suffer from two or more chronic conditions than those in the reference categories. Finally, smokers are less likely to report two or more chronic conditions than non-smokers.

The model for emotional distress again revealed age, income, and coping skills as significant determinants of health (Table 4). In addition, education, smoking status, neighbourhood likes, and housing conditions are significantly associated with emotional distress. We note that individuals earning less than \$50,000 are almost three times, those with poor coping skills are more than five times, those living in houses in need of major repairs are 2.5 times, as likely and those who smoke are two times as likely to score above the cut-point, indicating emotional distress than the respective reference categories. Furthermore, those aged 45 years and over along with those expressing physical likes in their neighbourhood are less likely to score above the cut-point.

The final model explores BMI (Table 4). Of the four health outcomes, the model for BMI is weakest in terms of explanation (i.e., much lower rho-square value). Again age, income, and smoking status are significant predictors of health. In addition, gender and highest level of education are also revealed as statistically significant. Those between 25 and 44 years of age, those with less than high school education, and those with household incomes of \$50,000–79,999 are all more likely to be overweight. In contrast, women and smokers are less likely to be overweight than men and non-smokers.

Table 2
Distribution of health outcomes

Variables	Classification	%
Self-assessed health	Fair/poor	15
	Excellent/very good/good	85
Chronic conditions	Two or more conditions	22
	One or no conditions	78
Emotional distress	GHQ score 4 or higher	11
	GHQ < 4	89
Body mass index	BMI 25 or higher	35
	BMI < 25	65

Table 3
Social determinants of health as predictors of self-rated health and chronic conditions

Social determinants of health (ref.)	Classification	Self-rated health (fair/poor)		Chronic conditions (2 or more)	
		OR	(95% CI)	OR	(95% CI)
<i>Income/social status</i>					
Household income (\$80,000+)	<\$30,000	2.01*	(1.03, 3.93)	2.50**	(1.33, 4.70)
	\$30,000–\$49,999	0.99	(0.52, 1.92)	1.89*	(1.05, 3.40)
	\$50,000–\$79,999	0.98	(0.52, 1.86)	1.25	(0.70, 2.26)
Housing tenure (own)	Rent	1.55	(0.92, 2.62)	1.22	(0.75, 2.01)
<i>Education/literacy</i>					
Highest level of schooling (high school or more)	Less than high school	1.25	(0.79, 2.00)	1.47	(0.96, 2.25)
<i>Employment</i>					
Employment (employed)	Not employed	1.29	(0.80, 2.08)	1.47	(0.95, 2.28)
<i>Social support networks</i>					
Marital status (married)	Not married	1.07	(0.69, 1.65)	0.78	(0.51, 1.22)
Number of people in dwelling		1.02	(0.96, 1.09)	0.89	(0.76, 1.05)
Number of friends		1.00	(0.98, 1.02)	1.01	(0.99, 1.02)
<i>Social/physical environments</i>					
Neighbourhood of residence (mountain)	Chedoke-Kirkendall	1.05	(0.56, 1.98)	0.80	(0.48, 1.34)
	Downtown	0.84	(0.43, 1.62)	0.65	(0.35, 1.19)
	Northeast Industrial	2.10*	(1.17, 3.77)	0.76	(0.45, 1.30)
Neighbourhood likes (none)	Social like	0.73	(0.37, 1.44)	2.05	(0.98, 4.31)
	Physical like	0.75	(0.38, 1.46)	1.83	(0.87, 3.84)
Neighbourhood dislikes (none)	Social dislike	2.19**	(1.27, 3.76)	1.96**	(1.19, 3.21)
	Physical dislike	1.44	(0.89, 2.44)	1.34	(0.89, 2.04)
Length of residence		1.01	(0.99, 1.02)	1.02**	(1.00, 1.03)
Social involvement (involved)	No involvement	0.87	(0.57, 1.33)	1.19	(0.82, 1.74)
Housing conditions (no repairs required)	Needs major repairs	1.59	(0.99, 2.54)	1.28	(0.81, 2.03)
<i>Personal health practices/coping skills</i>					
Smoking status (non-smoker)	Smoker	1.05	(0.68, 1.61)	0.65*	(0.43, 0.97)
Exercise (exercised in past 3 months)	No exercise	1.88*	(1.07, 3.31)	0.69	(0.38, 1.27)
Coping (excellent to good coping skills)	Fair to poor coping	5.98***	(3.72, 9.60)	3.29***	(1.98, 5.47)
Health services (use)	No use	0.43***	(0.29, 0.64)	0.71	(0.49, 1.03)
<i>Biology and gender</i>					
Age (18–24 years)	25–44	1.14	(0.54, 2.38)	1.82	(0.68, 4.89)
	45–64	2.19*	(1.05, 4.56)	7.70***	(2.90, 20.4)
	65+	0.93	(0.37, 2.30)	6.58***	(2.31, 18.8)
Gender (male)	Female	0.77	(0.51, 1.15)	0.79	(0.55, 1.14)
<i>Culture</i>					
Ethnicity (Canadian)	Other than Canadian	1.13	(0.71, 1.81)	0.83	(0.55, 1.24)
Specificity (%)		78		76	
Sensitivity (%)		66		76	
Rho squared		0.28		0.33	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Discussion and conclusions

The purpose of this paper was to contribute to our understanding of the determinants of health by examining the links among SDOH and different health outcomes at the local, neighbourhood level. In all models age and income are significantly associated with the health outcome of interest. With the exception of BMI, coping skills and neighbourhood (variously measured) are also significant determinants of health status. This lack of association between obesity and neighbourhood is interesting and seems to challenge recent policy discourse and some research evidence on the relationship between these factors (e.g., Eid et al., 2008; Frank et al., 2005). Smoking status was also significant in three models (BMI, chronic conditions, and emotional distress). The results do show that beyond age, income, coping skills, and neighbourhood, other key determinants of health vary by outcome. That is, other determinants are significant predictors of some, but not all, health outcomes. For example, gender was shown to be a significant predictor only in the BMI model. Similarly, neighbourhood of residence was found

to be an important determinant only for self-assessed health, in which residents in the Industrial neighbourhood were twice as likely to report fair/poor health than those residing in the Mountain neighbourhood. Furthermore, health service use appears only in the self-assessed health model, housing conditions in the model predicting emotional distress, and length of residence in the neighbourhood in the chronic conditions model. But we should expect different variables to be associated with the different health outcomes.

Our research findings reflect the general literature on SDOH. Specifically, it is accepted that as age increases, the probability of being in poor health also increases. Increased length of time residing in the neighbourhood was found to be a significant predictor of increased chronic conditions. In this sense, length of time may be acting as a proxy for age. Income was shown to be a significant predictor for all four health outcomes. This is not surprising given that income, along with other measures of SES, is known to be an important determinant of health (Marmot et al., 1999; Merkin et al., 2007). Use of health services was only significantly associated with one health outcome—self-assessed

Table 4
Social determinants of health as predictors of emotional distress and body mass index

Social determinants of health (ref)	Classification	Emotional distress (GHQ score 4 or higher)		Overweight (BMI 25 or higher)	
		OR	(95% CI)	OR	(95% CI)
<i>Income/social status</i>					
Household income (\$80,000+)	<\$30,000	2.91**	(1.24,6.16)	1.21	(0.75,1.95)
	\$30,000–\$49,999	2.84**	(1.42,5.69)	1.39	(0.91,2.13)
	\$50,000–\$79,999	1.11	(0.53,2.30)	1.56*	(1.06,2.30)
Housing tenure (own)	Rent	1.48	(0.85,2.56)	0.93	(0.63,1.39)
<i>Education/literacy</i>					
Highest level of schooling (high school or more)	Less than high school	0.99**	(0.25,0.83)	1.67**	(1.15,2.43)
<i>Employment</i>					
Employment (employed)	Not employed	1.09	(0.65,1.84)	0.96	(0.67,1.39)
<i>Social support networks</i>					
Marital status (married)	Not married	0.62	(0.38,1.01)	1.09	(0.78,1.52)
Number of people in dwelling		0.91	(0.92,1.07)	0.95	(0.85,1.06)
Number of friends		1.00	(0.98,1.02)	0.99	(0.98,1.01)
<i>Social/physical environments</i>					
Neighbourhood of residence (mountain)	Chedoke-Kirkendall	0.98	(0.50,1.91)	0.69	(0.46,1.02)
	Downtown	0.86	(0.43,1.72)	0.65	(0.41,1.02)
	Northeast Industrial	1.17	(0.62,2.21)	1.16	(0.78,1.71)
Neighbourhood likes (none)	Social like	0.58	(0.29,1.13)	1.01	(0.59,1.71)
	Physical like	0.35**	(0.17,0.71)	1.24	(0.73,2.11)
Neighbourhood dislikes (none)	Social dislike	1.65	(0.91,2.98)	1.24	(0.85,1.82)
	Physical dislike	1.14	(0.68,1.91)	1.06	(0.77,1.47)
Length of residence		1.00	(0.98,1.02)	1.01	(1.00,1.02)
Social involvement (involved)	No involvement	1.11	(0.68,1.83)	1.12	(0.83,1.51)
Housing conditions (no repairs required)	Needs major repairs	2.57***	(1.58,4.16)	1.43	(0.99,2.05)
<i>Personal health practices/coping skills</i>					
Smoking status (non-smoker)	Smoker	2.07***	(1.32,3.24)	0.65**	(0.47,0.89)
Exercise (exercised in past 3 months)	No exercise	1.37	(0.73,2.55)	1.18	(0.74,1.88)
Coping (excellent to good coping skills)	Fair to poor coping	5.14***	(3.04,8.70)	0.97	(0.62,1.53)
Health services (use)	No use	0.64	(0.41,1.01)	0.96	(0.71,1.31)
<i>Biology and gender</i>					
Age (18–24 years)	25–44	0.64	(0.32,1.25)	1.68	(0.97,2.90)
	45–64	0.36**	(0.17,0.76)	2.34**	(1.32,4.15)
	65+	0.18**	(0.60,0.52)	1.07	(0.52,2.17)
Gender (male)	Female	1.49	(0.95,2.33)	0.55***	(0.42,0.73)
<i>Culture</i>					
Ethnicity (Canadian)	Other than Canadian	1.25	(0.75,2.08)	1.05	(0.77,1.45)
Specificity (%)		74		61	
Sensitivity (%)		72		64	
Rho square		0.25		0.11	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

health status—reflecting the broader SDOH literature that recognizes a range of factors, beyond the health care system, that shape health. The education associations, which show that those with low levels of education are more likely to be overweight but less likely to be in emotional distress, are difficult to explain. The difficulty in explaining such effects rests with the uncertainty of knowing what our education variable, derived from the Census of Canada, is actually measuring (Birch et al., 2000). The results also show that smokers are more likely to be in emotional distress but are less likely to have chronic conditions. Research has demonstrated that smokers do not always suffer from the worst health status when compared to non-smokers (Birch et al., 2000). Thus, while smoking is not protective of health status, it may be linked in complex ways to chronic conditions. The results also demonstrated the importance of coping for all health outcomes with the exception of BMI. We note again the strength of the effects of coping skills, as measured by the odds ratios, on health status. It is possible that positive psychological function and good coping abilities act as proxies for well-being itself (see Warr et al., 2007).

Further research is required to tease out the complexities of coping (but see Poetz et al., 2007).

Finally, in terms of neighbourhood variables, the results demonstrate that place of residence, as neighbourhood, has limited importance for determining health but perceptions of neighbourhood environments (i.e., dislikes and to a lesser extent likes) are important for some health outcomes. Specifically, the research revealed that individuals who dislike social aspects of their neighbourhood are more likely to report two or more chronic conditions and fair/poor self-rated health. Interestingly, individuals who report that they like physical aspects of their neighbourhood are less likely to be in emotional distress. This appears to suggest that neighbourhood dislikes detract from health more than neighbourhood likes contribute to health. It may be that low negative perceptions (or stress) about physical surroundings improve sense of well-being more generally and vice versa (Sooman and Macintyre, 1995). Supplementary analysis (not reported) of our data indicates some other health-related associations with neighbourhood dislikes. For example, smokers

are more likely to report social dislikes than non-smokers but further research is required to examine such relationships in greater detail.

The goal of this paper was to examine the relative importance of the SDOH for different health outcomes for the same population living in four distinct neighbourhoods. In doing so, we also sought to examine the importance of neighbourhood as a social determinant of health. It is surprising that place (i.e., neighbourhood of residence) did not figure more significantly in the analyses. In fact, neighbourhood of residence was significantly related to only one health outcome (i.e., self-rated health) for one neighbourhood (i.e., Northeast Industrial). This does not necessarily mean that place is not an important determinant of health but, rather, speaks of the need for further investigation. Specifically, crosstabulations of the data (results not shown) reveal that some SDOH vary significantly by neighbourhood (e.g., income, education, neighbourhood likes/dislikes, personal health practices). Given this, it is reasonable to expect that relationships between the SDOH and health outcomes would also vary by neighbourhood. This is an important dimension of the health–place link that requires analyzing differences in the relationship between determinants of health and health outcomes by neighbourhood. The sample size by neighbourhood for this study did not permit extensive analysis of this link. As such, this represents an important area for further investigation. Furthermore we note the importance of perceptions of neighbourhood and neighbourhood quality for health. This idea has begun to be explored conceptually (MacIntyre and Ellaway, 2003) and empirically (Wen et al., 2006). There may be value in pursuing the themes of place meaning, attachment, and well-being emerging from psychological studies of place (e.g. Brown et al., 2003; Manzo, 2005).

In discussing the relative importance of SDOH in Hamilton neighbourhoods, some methodological and interpretive issues need to be addressed. First, the definition of neighbourhoods in our study may limit what we can conclude about the role of neighbourhood contexts in shaping health. In this study, neighbourhood boundaries were delineated by observation of spatial clusterings of demographic and socioeconomic features in conjunction with in-depth interviews conducted with prominent local decision makers and key informants. While this study departed from previous research, which tends to rely solely on administrative boundaries (e.g., census tracts) for defining neighbourhoods, the boundaries identified may not match the perceptions of boundaries of residents (Caughy et al., 2003). However, both the quantitative and qualitative approaches yielded similar local areas of interest for study and the survey sample drawn from each neighbourhood is a close match to the census population. In addition, other Canadian studies that have purposively examined neighbourhood definitions and boundaries have found no health differences between matched administrative boundaries and self-reported boundaries (Ross et al., 2004).

Second, our approach may be limited by the ways in which various SDOH were measured. Biology was simply measured by age and culture by ethnicity. Social support and social environment were also measured in limited ways. There is a large body of literature on measuring social networks and social capital at the local level (Lindstrom et al., 2006; Veenstra et al., 2005). Given that we were trying to measure all SDOH meant that we were restricted in how we could portray social support. A similar argument may also be applied to our measures of the physical environment.

Despite these limitations, there are a number of important implications. First, our results demonstrate that the SDOH do vary by health outcome for the same population. With respect to the 11 determinants of health identified by the Public Health Agency of

Canada, and measured in this study, eight were revealed as significant determinants: namely income, education, social and physical environment, personal health practices (coping skills), gender, age (biology), and health services use. Conversely, culture, employment, and social networks were not statistically significant predictors of health in any of the models. Our research does therefore reinforce the importance of income and age, which have been shown to be significant SDOH in previous research. Although appearing in only three of the four models, coping skills were identified as a powerful relative determinant as demonstrated by the odds ratios. Second, neighbourhoods, as a measure of the social and physical environment in which health is produced, appear as important determinants but in different ways for different health outcomes. Thus, actual neighbourhood of residence is rarely significant but perceptions of neighbourhood are. This may suggest, along with the importance of coping skills, that the relationship between neighbourhood and health is mediated by psychosocial processes (Warr et al., 2007).

Third, in the context of policy discourse, our research points to the challenging complexity surrounding the determinants of health. Thus, in developing healthy public policy or health promotion strategies, there must be awareness of the health outcome of interest and the various ways in which the determinants may be conceived and measured. However, we note the overriding importance of income in shaping all four health outcomes. The policy implications of this importance mean that the interventions suggested in population health promotion (Hamilton and Bhatti, 1996), e.g., to guide the development of community action and healthy public policy, may have limited effectiveness in addressing this social determinant of health, especially as our data suggest that social involvement has a limited effect on health status. More positively, the relative strength of coping skills as a determinant means that some individual- and community-based programs may play significant roles in shaping health through a focus on enhancing coping skills (collective efficacy; community development; PHAC, 2007; Vega et al., 2006). Overall therefore those wishing to develop policy from a population health perspective—a conceptually rich framework—may have to carefully specify both the determinants and the outcomes of interest. A targeted approach in this arena seems to be a necessary condition for successful policy development.

Finally, the research also points to future research directions. There is a need for fuller measures of the social and physical environments in neighbourhoods within a SDOH framework. Qualitative explorations are needed to tease out the relative importance of culture at the local level. There is also a need to examine the relationships between health status, health determinants, and psychological processes at the local level more carefully through a longitudinal design. However, we assert our study contributes a nuanced understanding of the determinants of health at the neighbourhood level for a variety of health outcomes, an important conclusion for research and policy discourse.

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