



Cohort Profile

Cohort Profile: The Interdisciplinary Study of Inequalities in Smoking (ISIS)

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Abstract

The Interdisciplinary Study of Inequalities in Smoking (ISIS) is a cohort study investigating the joint effects of residents' socio-demographic characteristics and neighbourhood attributes on the social distribution of smoking in a young adult population. Smoking is a behaviour with an increasingly steep social class gradient; smoking prevalence among young adults is no longer declining at the same rate as among the rest of the population, and there is evidence of growing place-based disparities in smoking. ISIS was established to examine these pressing concerns. The ISIS sample comprises non-institutionalized individuals aged 18–25 years, who are proficient in English and/or French and who had been living at their current address in Montréal, Canada, for at least 1 year at time of first contact. Two waves of data have been collected: baseline data were collected November 2011–September 2012 ($n=2093$), and a second wave of data was collected January–June 2014 ($n=1457$). Data were collected from respondents using a self-administered questionnaire, developed by the research team based on sociological theory, which includes questions concerning social, economic, cultural and biological capital, and activity space as well as smoking behaviour. Data are available upon request from [katherine.frohlich@umontreal.ca].

Key Messages

- The unique combination of individual resident characteristics and street-section attributes in ISIS will allow examination of their interaction over time along with their joint effects on social inequalities in smoking.
- At wave 1 there was a non-random social distribution of smoking outcomes according to residential-level material deprivation.
- Where young adults live and conduct daily activities (i.e. their activity spaces) are socially graded; less educated respondents live and conduct activities in areas of higher deprivation than their more educated counterparts.
- Poor mental health was associated with having fewer commercial and recreational resources in one's activity space whereas the number of resources available in one's residential neighbourhood was not.

Why was the Interdisciplinary Study of Inequalities in Smoking (ISIS) cohort set up?

Although the overall population prevalence of cigarette smoking in North America is at an all-time low, smoking rates are increasingly socially stratified.^{1–5} Smoking prevalence is consistently higher among young people in their early twenties compared with any other age group.⁶ As well, proportionally more people from lower socioeconomic status (SES) groups smoke for more years and experience less success in quitting than higher SES smokers.^{7,8} Lower SES smokers suffer a higher burden of illness associated with smoking and their children are more likely to initiate smoking than higher SES youth.^{9–12}

Growing evidence of place-based disparities in smoking^{10,13–26} has created an area of enquiry which posits that general social inequalities in smoking may also be related to neighbourhood inequalities in smoking. The overarching aim of the ISIS study is thus to understand: (i) why do lower SES smokers not follow the secular trend in smoking reduction at the same rate as the rest of society; and (ii) what attributes of neighbourhoods are associated with social inequalities in smoking.

The ISIS project grapples with an unanswered question in place and health inequalities research: Can we better understand how shared characteristics of neighbourhood residents (for example, their education level), also called 'compositional factors', interact with neighbourhood-level characteristics or 'contextual factors' (for example, availability of green space) in shaping inequalities in health? The ISIS project was specifically designed to capture the complexity of this interaction using a theoretical model developed by our research team^{27–29} (Figure 1). ISIS characterizes neighbourhoods as unique configurations of five domains in which health-related resources can be accessed: the economic, institutional, community organization, local sociability and physical domains. With regard to compositional factors, we view them conceptualized as capitals, including economic, cultural,³⁰ social^{31,32} and biological capital.^{33,34} We posit that neighbourhood resources made

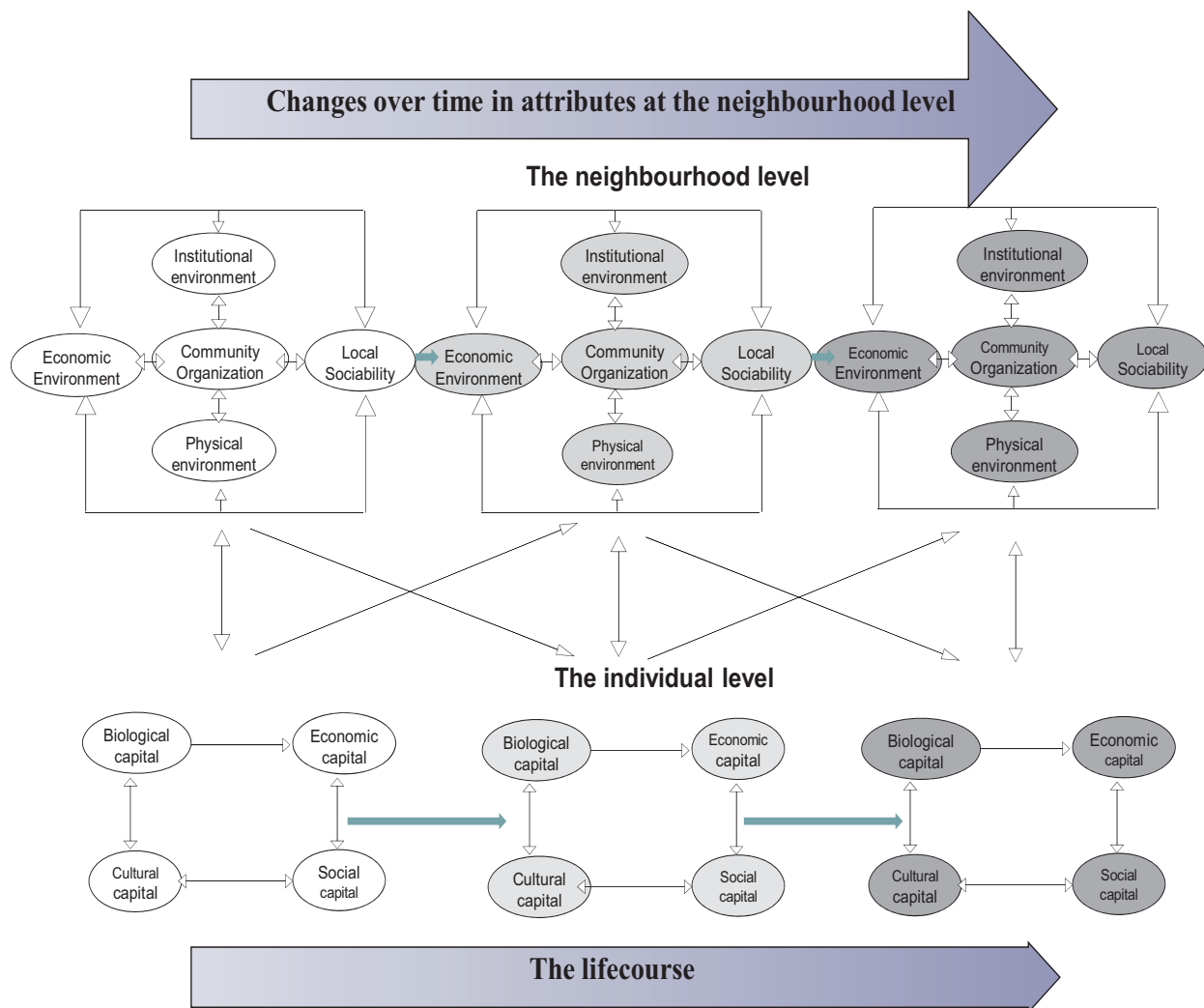
available (or not) through the five domains are shaped by residents' capital levels over time, and hence the need for longitudinal data.

ISIS takes place in Montréal, Canada, at the École de Santé Publique de l'Université de Montréal (ESPUM) and the Institut de recherche en santé publique de l'Université de Montréal (IRSPUM). The project received pilot funding from the Canadian Tobacco Control Research Initiative (2008) and the Public Health Agency of Canada (2011) to develop a questionnaire and a neighbourhood observation grid, as well as 4-year funding (2011–15) in an operating grant from the Canadian Institutes of Health Research (CIHR) for the first two waves of data collection. Our multidisciplinary team includes 12 researchers with diverse expertise, graduate students, post-doctoral fellows, staff, visiting scholars and an advisory board composed of governmental partners [www.isis-montreal.ca].

Who is in the ISIS cohort?

ISIS is a cross-lag panel study of individuals embedded in their residential neighbourhood. Our study population is a sample of non-institutionalized young adults aged 18–25, proficient in English and/or French, who have resided at their current address for at least 1 year at time of first contact. We requested that the Régie de l'Assurance Maladie du Québec (RAMQ), the publicly funded health insurance programme in Quebec, draw an equal-size simple random sample of 172 individuals between the ages of 18 and 25 years from each of the 35 Centres Locaux de Santé Communautaire (CLSC) territories on the Island of Montreal ($n=6020$). CLSCs were used as the primary sampling units since they are related to postal code area and variability in area-level deprivation has been documented.³⁵

Given that smoking rates vary by sex,^{36,37} we also ensured that each CLSC sample was divided into equal numbers of males and females. The RAMQ provided the names, mailing addresses, sex, preferred language of



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Figure 1. The ISIS theoretical framework © Les Presses de l'Université de Montréal.

correspondence and date of birth of each potential respondent. Given the decreasing number of young adults who use landlines,³⁸ the strengths of nominalized address-based sampling frames and the dramatically declining rates of success for studies attempting to recruit by telephone using polling firms,³⁹ we chose to contact potential respondents via mail. Four response options for questionnaire completion (online, by mail, by phone or in person) were offered. Respondents gave informed consent before completing their questionnaire.

Recruitment was undertaken in two phases for logistical reasons (Figure 2). In the first phase, 50% of the initial sample ($n = 6020$) was randomly selected taking into account respondent sex, CLSC territory and the deprivation level of the dissemination area (DA) in which they lived.

DAs are small, geographical units composed of one or more adjacent dissemination blocks with a population of 400–700 persons.⁴⁰ Deprivation was measured using the material dimension of the Pampalon Index which combines education, employment and income indicators.⁴¹ DAs were divided into quartiles based on their deprivation scores. This allowed the research team to track participation according to residential deprivation, adjust recall strategies and ensure that the final sample would be as representative as possible of the entire range of deprivation levels in Montréal. On 23 November 2011, letters were sent to the first group ($n = 3010$) inviting them to become part of the ISIS project. Three weeks after the initial mail-out, a reminder letter was sent to non-respondents and telephone calls were made to individuals whose phone

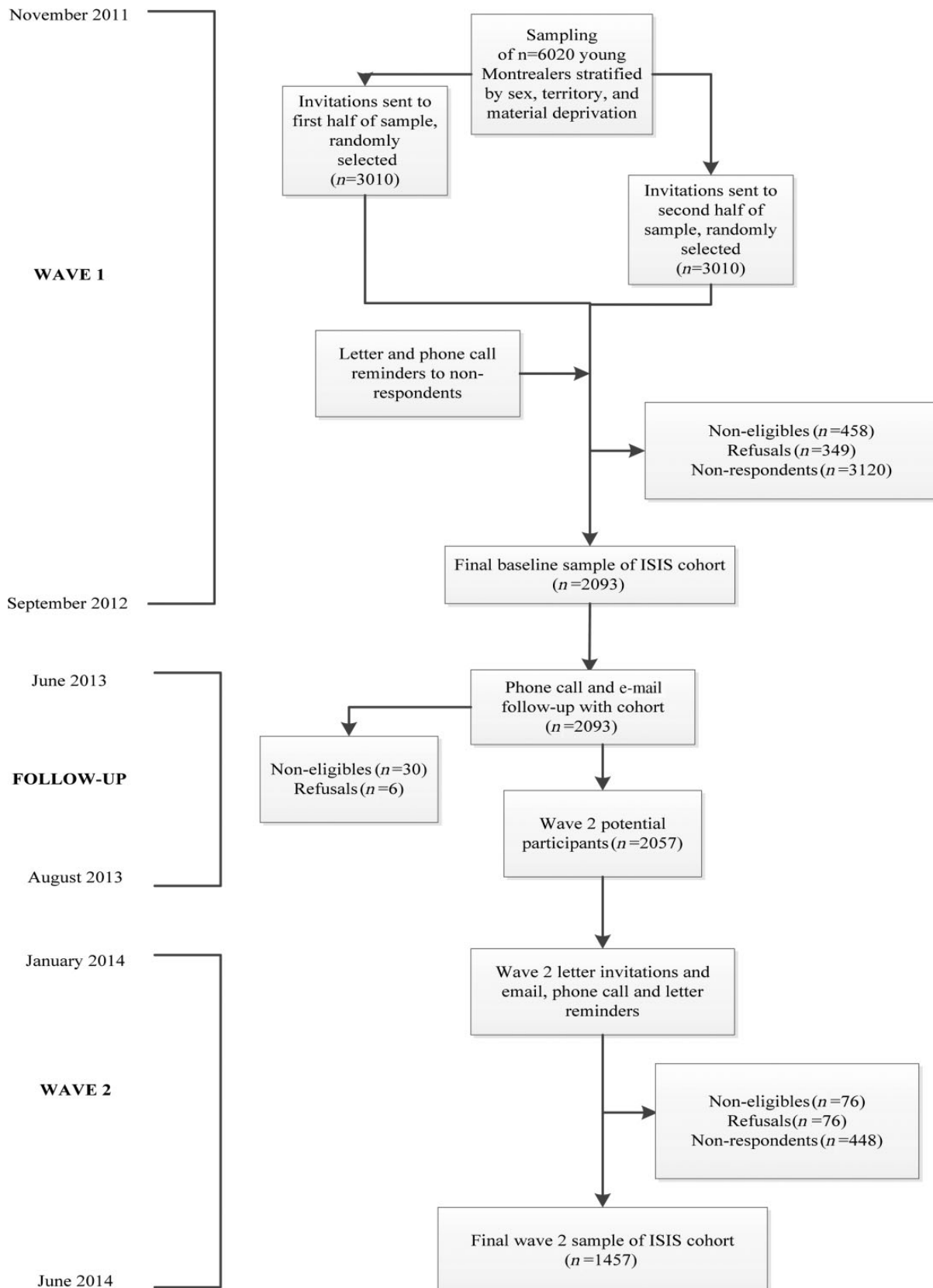


Figure 2. Recruitment, follow-up and participation in the ISIS study waves one and two.

number was listed in the online telephone registry (approximately 60% of the sample) to encourage participation. In January 2012 the second phase of recruitment began with invitation letters sent to the remaining 3010 potential participants. The same follow-up procedure was used for this group as with the first.

For both groups, direct contact with potential respondents (or other residents at their address) in the telephone follow-ups permitted ascertainment of unanticipated ineligibility factors such as temporary or permanent moves outside Montréal, physical or mental disability impeding autonomous completion of the questionnaire, and death. In total, three reminders were sent to non-respondents and as many as 10 phone calls per non-respondent were made. Baseline data collection ended on 4 September 2012. The final sample at baseline is 2093. Of these respondents, 90% completed their questionnaire online. Non-eligible individuals ($n=458$) were removed from the denominator for the computation of the response proportion. There were 349 individuals who explicitly refused to take part in the study, whereas 3111 others simply did not respond to our invitation, making for a final response proportion of 37.6%. The response proportion, while relatively low, is not uncommon in observational studies and could be attributed to unreported moves, inaccurate mailing addresses or a lack of interest in the study.

Respondents were well distributed across habitable areas on the Island of Montréal (Figure 3). Table 1 offers a description of the characteristics of ISIS respondents at baseline compared with those of a representative sample of Montréal residents aged 18–24 pooled from five consecutive waves of the Canadian Community Health Survey (CCHS) for the years 2007–12. CCHS is an annual health survey of the Canadian population and is designed to provide reliable estimates at the health region level.⁴² The baseline ISIS sample was similar to CCHS respondents in age and sex although proportionally the former tended to be more educated and reported poorer physical and/or mental health. This unusual combination has been found elsewhere (France and the USA) with individuals of higher SES frequently reporting poorer health when they have the same objective health status as those with lower SES.^{43–45} The baseline ISIS sample also had a lower percentage of daily smokers and a higher percentage of non-smokers than the CCHS (Table 1).

How often have they been followed up?

Two waves of data have been collected to date (Figure 2). To encourage retention between waves, birthday cards and a newsletter were sent to respondents. At each wave, ISIS respondents were given a \$10 gift certificate for their

involvement in the study. The ISIS website is also updated regularly with news, information and publications. In the summer of 2013, an intensive follow-up was undertaken by sending e-mails and calling respondents to update contact information and inform them of the upcoming second wave of data collection. Following this, 2057 respondents were identified as being potentially eligible to take part in the second wave of the project. We sent this sample up to two letters and three mass e-mails and called those who had provided a valid phone number up to 10 times.

After the second wave of data collection, which took place between 3 January and 1 June 2014, there were 1457 respondents, making for a 73.3% retention rate. Ineligibility criteria at wave two included death ($n=1$) or having moved outside the Greater Montréal Region ($n=75$). Attrition was due to explicit refusal to take part in the study ($n=82$) and non-response ($n=448$). Table 2 provides a description of loss to follow-up by comparing wave two respondents and non-respondents on selected baseline individual- and area-level characteristics. Wave two respondents and non-respondents were similar on many of our socio-demographic capital indicators including age, physical health and neighbourhood deprivation level. Compared with respondents, non-respondents were more likely to be men, in lower educational categories and to smoke. They were also more likely to report excellent or fair/poor self-rated mental health.

What has been measured?

Individual-level data

Table 3 offers a summary of individual-level data available in the ISIS study. Respondents' characteristics have been operationalized as capitals.^{31,46} We collected capital data as well as several indicators of smoking in a 98-variable closed questionnaire. Examples of capitals include employment status, crowding within the home, home ownership (economic capital), satisfaction with relationships with friends, number of friends who smoke (social capital), highest level of education attained by respondents and their parents (cultural capital) and self-perceived health and ability to do various physical activities (biological capital). Outcome variables of interest include: smoking status, defined as being a daily, occasional, never or ex-smoker; age at initiation, defined as age when first whole cigarette smoked; age of initiation to daily smoking, defined as age started smoking cigarettes daily; and number of cigarettes smoked daily. Smoking cessation outcomes include: intention to quit; smoking abstinence; quit attempts; and time since last smoked a cigarette or smoked daily. The questions used to assess smoking status were

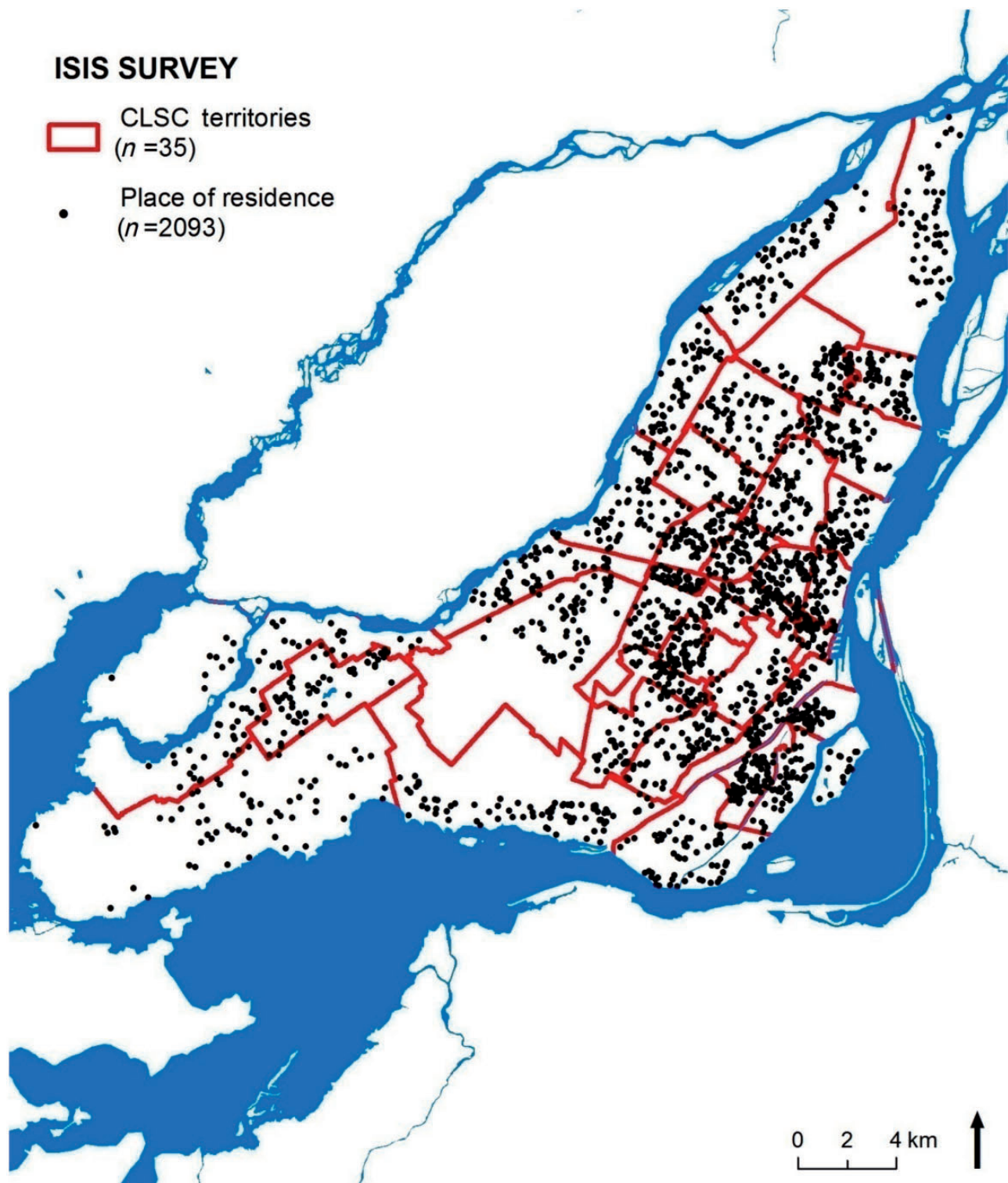


Figure 3. ISIS respondents at baseline ($n = 2093$) as distributed across CLSC territories.

taken from the validated and widely used Canadian Community Health Survey questionnaire.

Our questionnaire also included a list of questions with regard to respondents' activity space, i.e. the locations where they regularly: study; work; shop for groceries;

practise sports or physical activity and leisure activity; up to two other unspecified activities (waves one and two); and health service provider location (wave two). At wave one, respondents were invited to provide information on the location where the activity usually took place (name,

Table 1. Comparison of ISIS respondents at baseline with a representative sample of Montréal young adults (pooled CCHS data 2007–12)

Variable	ISIS wave 1 (<i>n</i> = 2093)	CCHS (2007–12) Montreal (<i>n</i> = 779)	<i>P</i> -value (significance)
Age	2093	779	0.059 ^a
18–19 years, (%)	547 (26.1)	231 (29.7)	
20–25 years, (%)	1546 (73.9)	548 (70.3) ^b	
Sex	2093	779	0.286 ^a
Women, (%)	1183 (56.5)	423 (54.3)	
Men, (%)	910 (43.5)	356 (45.7)	
Highest level of education attained	2083	760	*0.003 ^a
Less than secondary school, (%)	150 (7.2)	59 (7.8)	
Secondary school, n (%)	663 (31.8)	291 (38.3)	
Post-secondary education, n (%)	1270 (61.0)	410 (53.9)	
Physical health	2082	775	*0.000 ^a
Excellent or very good, n (%)	1026 (49.3)	543 (70.1)	
Pretty good, n (%)	724 (34.8)	201 (25.9)	
Fair or poor, n (%)	332 (15.9)	31 (4.0)	
Mental health	2076	772	*0.000 ^a
Excellent, n (%)	600 (28.9)	281 (36.4)	
Very good, n (%)	858 (41.3)	306 (39.6)	
Pretty good, n (%)	429 (20.7)	155 (20.1)	
Fair or poor, n (%)	189 (9.1)	30 (3.9)	
Smoked 100 cigarettes or more	2085	778	*0.002 ^a
Yes, n (%)	532 (25.5)	224 (31.4)	
No, n (%)	1553 (74.5)	534 (68.6)	
Age of first smoked cigarette	942	386	0.078 ^a
5 – 11 years, n (%)	37 (3.8)	17 (4.4)	
12 – 14 years, n (%)	243 (25.8)	116 (30.1)	
15 – 17 years, n (%)	425 (45.2)	179 (46.4)	
18 – 19 years, n (%)	164 (17.4)	58 (15.0)	
20 – 24 years, n (%)	73 (7.8)	16 (4.1)	
Smoking status	2083	777	*0.000 ^a
Daily smokers, n (%)	207 (9.9)	129 (16.6)	
Occasional smokers, n (%)	270 (13.0)	106 (13.6)	
Non-smokers, n (%)	1606 (77.1)	542 (69.8)	
Age when started smoking daily	207	129	0.860 ^a
11 years or less, n (%)	1 (0.5%)	N.A.	
12 – 14 years, n (%)	35 (16.9)	25 (19.4)	
15 – 17 years, n (%)	102 (49.3)	65 (50.4)	
18 – 19 years, n (%)	47 (22.7)	28 (21.7)	
20 – 24 years, n (%)	22 (10.6)	11 (8.5)	
Number of cigarettes smoked per day (daily smokers only)	207	129	0.383 ^c
Per cigarette, mean (SD)	11.1 (6.9)	12.1 (7.2)	

^aChi-square test.^bCCHS sample only includes ages 20–24 years.^ct-test.**P*-value < 0.05.

address, street, closest intersection or landmark, city).⁴⁷ Respondents' activity locations were then precisely geolocated with x,y coordinates with an online geocoder which uses the GoogleMaps application programming interface (API).⁴⁸ At wave two, we relied on a novel web-mapping application, VERITAS (Visualization and

Evaluation of Route Itineraries, Travel Destinations and Activity Spaces), to collect activity space data and perceived neighborhood delimitation.⁴⁹ Respondents could directly search for, and situate on a map, their activity locations which were automatically geocoded with the GoogleMaps API.

Table 2. Loss-to-follow up: comparison of ISIS wave 2 respondents and non-respondents on selected baseline characteristics

	Variable	ISIS wave 2 Respondents (n = 1457)	ISIS wave 2 Non-respondents (n = 636)	P-value (significance) ^a
Socio-demographic characteristics	Age	1457	636	0.763
	18–19 years, (%)	378 (25.9)	169 (26.6)	
	20–25 years, (%)	1079 (74.1)	467 (73.4)	
	Sex			*0.003
	Women, (%)	854 (58.6)	329 (51.7)	
	Men, (%)	603 (41.4)	307 (48.3)	
Cultural capital	Highest level of education attained	1453	630	*0.000
	Less than secondary school, (%)	84 (5.8)	66 (10.5)	
	Secondary school, (%)	460 (31.7)	203 (32.2)	
	Post-secondary school, (%)	909 (62.6)	361 (57.3)	
	Number of books in childhood household	1404	597	0.807
	Less than 10, (%)	89 (6.3)	45 (7.5)	
	10 to 49, (%)	442 (31.5)	188 (31.5)	
	50 to 199, (%)	496 (35.3)	215 (36.0)	
	200 to 399, (%)	233 (16.6)	90 (15.1)	
	400 or more, (%)	144 (10.3)	59 (9.9)	
Biological capital	Physical health	1452	630	0.056
	Excellent or very good, (%)	693 (47.7)	333 (52.9)	
	Pretty good, (%)	513 (35.3)	211 (33.5)	
	Fair or poor, (%)	246 (16.9)	86 (13.7)	
	Mental Health	1444	632	*0.042
	Excellent, (%)	409 (28.3)	191 (30.2)	
	Very good, (%)	625 (43.3)	233 (36.9)	
	Pretty good, (%)	282 (19.5)	147 (23.3)	
	Fair or poor, (%)	128 (8.9)	61 (9.7)	
Social capital	Satisfaction with friend relationships	1452	630	0.133
	Very satisfied, (%)	619 (42.6)	291 (46.2)	
	Other, (%)	833 (57.4)	339 (53.8)	
	Number of friends who smoke	1430	621	*0.004
	None, (%)	232 (16.2)	93 (15.0)	
	One or a few (%)	800 (55.9)	307 (49.4)	
	About half, (%)	224 (15.7)	117 (18.8)	
Most or all, n(%)	174 (12.2)	104 (16.7)		
	Number of family members who smoke	1446	629	0.215
	None, (%)	643 (44.5)	262 (41.7)	
	One or a few (%)	635 (43.9)	278 (44.2)	
	About half or more, (%)	168 (11.6)	89 (14.1)	
Economic capital	Home ownership	n = 1449	630	*0.045
	Owner, (%)	830 (57.3)	331 (52.5)	
	Renter, (%)	619 (42.7)	299 (47.5)	
	Enough money to pay for rent or mortgage	1363	585	0.369
	Yes, (%)	1210 (88.8)	511 (87.4)	
	No, (%)	153 (11.2)	74 (12.6)	
Smoking	Smoked 100 cigarettes or more	1453	632	*0.000
	Yes, (%)	334 (23.0)	198 (31.3)	
	No, (%)	1119 (77.0)	434 (68.7)	
	Smoking status	1451	632	*0.000
	Smoker, (%)	299 (20.6)	178 (28.2)	
	Non-smoker, (%)	1152 (79.4)	454 (71.8)	
	Smoking status (nuanced)	1451	632	*0.000
Daily smokers, (%)	124 (8.5)	83 (13.1)		
Occasional smokers, (%)	175 (12.1)	95 (15.0)		
	Non-smokers, (%)	1152 (79.4)	454 (71.8)	
Neighbourhood deprivation	Neighbourhood deprivation level	1407	613	0.062
	Q ₁ (least deprived), (%)	360 (25.6)	172 (28.1)	
	Q ₂ , (%)	378 (26.9)	130 (21.2)	
	Q ₃ , (%)	327 (23.2)	151 (24.6)	
	Q ₄ (most deprived), (%)	342 (24.3)	160 (26.1)	

^aChi-square test.

*P-value < 0.05.

Table 3. Summary of data collected from individuals at waves 1 and 2 of ISIS

Construct	Variable	Wave 1	Wave 2
Economic capital	Number of people residing in home	X	X
	Household composition	X	X
	Home ownership	X	X
	Number of rooms in home	X	X
	Lacked money to pay rent or mortgage	X	X
	Lacked money to pay for electricity, hot water or heating	X	X
	Lacked money to pay for food	X	X
	Possibility of urgently borrowing \$500 from mother, father, partner/spouse, sibling, grandparent, friend, co-worker and/or other	X	X
	Personal income, before tax deductions	X	X
	Financial investments	X	
Cultural capital	Received social assistance	X	X
	Highest level of education completed	X	X
	Current education status	X	X
	Paternal education		X
	Maternal education		X
	People consulted for health information	X	
	Parental value of healthy lifestyle	X	
	Place of birth	X	
	Age of immigration to Canada	X	
	Parents' country of birth	X	
	Languages spoken at home	X	X
	Number of books in childhood home	X	
	Identification to a religion	X	X
	Importance of religion	X	X
	Frequency of participation to religious activities, services or meetings	X	X
Social capital	Possibility for employment improvement through family contacts	X	X
	Employment status	X	X
	Satisfaction with friendships	X	X
	Presence and number of people within social circle to confide in	X	
	Presence and number of people within social circle to help with a problem	X	
	Presence and number of people within social circle to be affectionate with and considered close	X	
	Number of friends who smoke	X	X
	Number of family members who smoke	X	X
	Marital status	X	X
	Self-rated physical health	X	X
Biological capital	Self-rated mental health	X	X
	Ability to do selected physical activities	X	X
	Date of birth	X	
Smoking	Suffer from chronic bronchitis, persistent cough or asthma	X	X
	Status: daily, occasional, ex- or never smoker	X	X
	Number of cigarettes smoked daily or occasionally	X	X
	Number of days smoked in past month	X	X
	Ever smoked 100 cigarettes or more	X	X
	Ever smoked an entire cigarette	X	X
	Age of first entire cigarette smoked	X	X
	Age started to smoke daily	X	X
	Past 30-day smoking (yes/no and number of days)		X
	Smoked cigarettes daily in the past	X	X
	Time when stopped smoking cigarettes daily	X	X
	Time last smoked a cigarette	X	X
	Intention to quit smoking in next 30 days		X
24-h smoking abstinence in past 12 months (yes/no and number of times)		X	
Cigarettes bought where and in what format		X	

(continued)

Table 3. Continued

Construct	Variable	Wave 1	Wave 2
Local sociability domain	Mutual aid between neighbours	X	X
	Trust neighbours	X	X
	Feel safe going out at night alone in neighbourhood	X	X
Residential neighbourhood	Perceived neighbourhood boundaries	X	X
	Perceived service availability		X
	Time lived at current address	X	X
Activity space	Name and address of educational establishment	X	X
	Geographical location of place of study		X
	Hours per week spent at educational establishment	X	X
	Perceived availability of services around educational establishment		X
	Workplace name and address (multiple workplaces may apply)	X	X
	Main location of employment (office, home, on the road)	X	
	Geographical location of workplace		X
	Hours per week spent at workplace	X	X
	Perceived availability of services around workplace		X
	Person in household responsible for groceries	X	X
	Name and address of up to two grocery stores most often visited	X	
	Geographical location of up to two grocery stores most often visited		X
	Number of groceries store visits in a month	X	X
	Regularly engage in physical activity or sport	X	X
	Name and address of place where regularly engage in physical activity or sport	X	
	Geographical location of place where engage in physical activity		X
	Hours per week spent at physical activity place	X	X
	Regularly engage in leisure activities	X	X
	Name and address of place where regularly engage in leisure activities	X	
	Geographical location of place where engage in leisure activity		X
	Hours per week spent at leisure activity place	X	X
	Other places for other types of activities	X	X
	Name and address of up to two places where regularly spend time	X	
Geographical location of other activity place		X	
Hours per week spent at other activity place	X	X	
Has regular medical doctor			X
Type, name and geographical location of place where receive medical services			X
Type of activity		X	X
Has driver's licence		X	X
Owns/has access to a car		X	X
Has monthly public transit pass		X	X
Capability	Satisfaction with life		X
	Perceived life possibilities		X
Family's socio-demographics	Mother's age		X
	Father's age		X

Area-level data

Concerning contextual factors, ISIS relies on a combination of two data collection tools to measure area-level attributes of the five domains (economic, institutional, local sociability, community organization and physical domains²⁷). First, secondary data are available through the MEGAPHONE⁵⁰ geographical information system (GIS) for characterizing the social and physical environment in the Greater Montréal Metropolitan Region.

MEGAPHONE includes a large selection of databases containing land use information, satellite images, transportation data, the location of institutions, services and businesses and crime data, as well as National Census data, which can be aggregated at various spatial scales and which are frequently updated.

Second, area-level data have been collected using an observation grid developed and validated by the ISIS team.⁵¹ We randomly selected one street section within each of the

Table 4. Variability in smoking behaviours across neighbourhood deprivation quartiles

Variable	Total	Q ₁ (Least deprived)	Q ₂	Q ₃	Q ₄ (Most deprived)	P-value	Trend test P-value ^z
Wave 1 (n = 2020)							
Smoked 100 cigarettes or more	2012	532	508	473	499	*0.031 ^x	*0.007
Yes, (%)	508 (25.2)	121 (22.7)	113 (22.2)	130 (27.5)	144 (28.9)		
No, (%)	1504 (74.8)	411 (77.3)	395 (77.8)	343 (72.5)	355 (71.1)		
Smoking status	2010	531	508	472	499	*0.048 ^x	*0.012
Smoker, (%)	455 (22.6)	105 (19.8)	104 (20.5)	121 (25.6)	125 (25.1)		
Non-smoker, (%)	1555 (77.4)	426 (80.2)	404 (79.5)	351 (74.4)	374 (74.9)		
Smoking status (nuanced)	2010	531	508	472	499	*0.041 ^x	NA
Daily smokers, (%)	197 (9.8)	35 (6.6)	47 (9.3)	57 (12.1)	58 (11.6)		
Occasional smokers, (%)	258 (12.8)	70 (13.2)	57 (11.2)	64 (13.6)	67 (13.4)		
Non-smokers, (%)	1555 (77.4)	426 (80.2)	404 (79.5)	351 (74.4)	374 (74.9)		
Number of cigarettes smoked per day (daily smokers only)	197	35	47	57	58	0.416 ^y	NA
Per cigarette, mean (SD)	11.0 (6.9)	9.5 (4.8)	11.7 (8.8)	11.8 (6.8)	10.7 (6.2)		
Wave 2 (n = 1401)							
Smoked 100 cigarettes or more	1396	352	319	320	405	0.751 ^x	0.329
Yes, (%)	346 (24.8)	84 (23.9)	75 (23.5)	79 (24.7)	108 (26.7)		
No, (%)	1050 (75.2)	268 (76.1)	244 (76.5)	241 (75.3)	297 (73.3)		
Smoking status	1397	352	320	320	405	0.598 ^x	0.474
Smoker, (%)	283 (20.3)	65 (18.5)	70 (21.9)	61 (19.1)	87 (21.5)		
Non-smoker, (%)	1114 (79.7)	287 (81.5)	250 (78.1)	259 (80.9)	318 (78.5)		
Smoking status (nuanced)	1397	352	320	320	405	0.566 ^x	NA
Daily smokers, (%)	122 (8.7)	23 (6.5)	30 (9.4)	26 (8.1)	43 (10.6)		
Occasional smokers, (%)	161 (11.5)	42 (11.9)	40 (12.5)	35 (10.9)	44 (10.9)		
Non-smokers, (%)	1114 (79.7)	287 (81.5)	250 (78.1)	259 (80.9)	318 (78.5)		
Number of cigarettes smoked per day (daily smokers only)	121	23	30	26	42	0.773 ^y	NA
Per cigarette, mean (SD)	10.6 (7.6)	9.7 (6.0)	11.6 (9.2)	9.8 (6.6)	10.8 (7.7)		

Although waves 1 and 2 samples included 2093 and 1457 respondents, respectively, these analyses were based on a maximum of 2020 and 1401 respondents, respectively, due to missing material deprivation scores.

NA, not applicable.

^xChi-square test.

^yANOVA.

^zCochran-Armitage Exact Trend test.

* P-value < 0.05.

dissemination areas in which at least one of our respondents lived at baseline. From June to September 2012, five trained observers evaluated the quality of 1399 street sections with the observation grid which comprised 86 indicators⁵¹ (see Appendix 1 for a detailed list of characteristics measured with the observation grid, available as [Supplementary data](#) at *IJE* online). Since ISIS aims to follow both individuals and their neighbourhood longitudinally, a second round of street section observations will be undertaken in 2016.

What has ISIS found?

Table 4 demonstrates the non-random social distribution of selected smoking outcomes for respondents in wave one according to residential-level material deprivation quartile. We tested for trend across deprivation levels using the Cochran-Armitage Trend Test,⁵² which assesses the presence of an ordering when analysing categorical data. At wave one, there was a marked social gradient across deprivation levels for the variables 'smoked 100 cigarettes or more in one's life' and 'smoking status', with Quartile 1 representing the most well-off areas and Quartile 4 the most deprived. Less variation was found, however, for the number of cigarettes smoked per day among smokers. At wave two, there was some variation in smoking behaviours across neighbourhood deprivation levels although trends were less strong across the four neighbourhood deprivation quartiles. However, proportionately more people living in the most deprived areas smoked and were daily smokers than people living in more advantaged neighbourhoods.

A complete list of ISIS publications, as well as the two questionnaires, can be found on the study website: [www.isis-montreal.ca]. Papers have been published describing our theoretical framework,^{27,28} as well as reporting on the development and validation of our neighbourhood observation grid⁵¹ and activity space questionnaire.⁴⁷ A noteworthy result from the baseline data collection was the large number of respondents who chose to complete the questionnaire online. In a pilot study which sought to determine whether including a paper version of the questionnaire with our mailed invitation affected response, we found that almost half of the individuals who were sent a paper copy chose to complete the questionnaire online.⁵³ This is an important finding given that web-completion reduces mailing and administration costs.

Two papers have also been published describing baseline activity space. In a paper by Shareck *et al.*,⁵⁴ the authors found that where young adults lived and conducted activities of daily life is socially graded: less educated respondents tended to live, but also to conduct activities, in areas of higher deprivation than their more educated

counterparts. In another paper, Vallée *et al.*⁵⁵ showed that whereas mental health was not associated with number of commercial and recreational resources available in one's residential neighbourhood, having fewer resources in one's activity space was associated with poorer mental health.

What are the main strengths and weaknesses?

The first strength of the ISIS study is the relationship between our theoretical model and data collection instruments. A second strength pertains to our interdisciplinary research team which addresses the research and questions from the perspectives of epidemiology, geography, biostatistics and sociology. Thirdly, loss to follow-up was low. We were able to retain as much as 73.3% of the initial sample, after accounting for residential moves outside the Greater Montréal Region. Lastly, the fact that we have respondents' residential addresses enables us to be more precise about residential contextual exposures and to explore different neighbourhood units without a priori assuming which one is best.⁵⁶

A limitation of ISIS is that the overall response rate was low at baseline (37.6%). This response rate is, however, a conservative estimate as we do not know how many of the non-respondents were actually eligible. Moreover, we failed to reach the tail end of the social distribution at wave one or lost it to follow-up. These concerns, along with the specific profile of non-respondents at wave two, may somewhat limit the generalizability of our findings and the statistical power to detect associations with smoking outcomes. These observations, which are rather common in social epidemiological studies, will be studied further in the ISIS project. For instance, we will undertake sensitivity analyses to explore whether the lack of a gradient in smoking across deprivation levels arises from the way we geographically defined neighbourhood.

Can I get hold of the data? Where can I find out more?

Enquiries related to the use of ISIS data are welcome and will be reviewed with interest. More information on the ISIS study is provided at: [www.isis-montreal.ca]. Requests to use data may be forwarded to the project's principal investigator [katherine.frohlich@umontreal.ca].

Supplementary Data

[Supplementary data](#) are available at *IJE* online.

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