Area Variations in the Prevalence of Substance Use and Gambling Behaviours and Problems in Quebec: A Multilevel Analysis

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Objectives: This study aimed to examine whether variations among regions in Quebec existed after we controlled for individual characteristics in the prevalence of 1) alcohol, cannabis, and gambling behaviours and 2) substance-related disorders and pathological gambling.

Methods: Using data derived from the Canadian Community Health Survey: Mental Health and Well-Being (CCHS 1.2), we nested 5332 respondents from the province of Quebec within 374 regions equivalent to census subdivisions (CSDs). Outcome variables included 1) drinking status (past 12 months), alcohol consumption (last week), and 12-month diagnosis of alcohol dependence; 2) cannabis use (past 12 months and lifetime) and diagnosis of illicit drug dependence; and 3) gambling status, severity of gambling problems, and number of reported gambling activities (past 12 months). Multilevel regression models with individuals (Level 1) nested in regions (CSDs, Level 2) assessed the variations among regions in the prevalence of various outcomes and disorders when individual characteristics were controlled for.

Results: Variance component models revealed that all alcohol-related variables, the prevalence of cannabis use (12 months), and problem gambling did not vary among areas. Gambling rates and the average number of reported gambling activities varied among areas, even when individual-level variables were accounted for in the models, whereas for lifetime cannabis use, variations among areas became nonsignificant.

Conclusion: Intervention programs may need to address the environment as a relevant determinant of health-related behaviours and lifestyles.

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Clinical Implications

- The presence of contextual differences above and beyond compositional factors suggests that intervention programs and strategies, as well as policies, may need to address the environment as a relevant determinant of behaviours and behavioural change.
- Our results point to the need to contextualize individual risk factors within the physical and social environment.

Limitations

- CSDs remain a proxy for the social and physical environment, and the choice of such units of analysis remains debatable.
- The sampling design of the CCHS was not primarily based on any geographical unit smaller than the province, which may limit the representativeness of the CSD samples.
- This paper's results remain a starting point for future research to analytically explore explanatory contextual factors.

Key Words: *substance use, substance dependence, pathological gambling, area variations, multilevel analysis, Canadian Community Health Survey: Mental Health and Well-Being*

Over the last decade or so, many areas of the social sciences have witnessed the expansion of a multilevel conceptualization of determinants of health (1,2). A large body of research in Europe and North America (3–7) has revealed that differences in health-related behaviours exist among areas of different size, ranging from regions to neighbourhoods. Spaces and places ought therefore to be considered as potential factors underpinning variations and disparities in health and disease; geography then becomes both a crucial component to understanding the processes that shape individual and population health and a locus for intervention to improve health. Although studies have examined area effects on many health behaviours and states, we limit our review to alcohol, cannabis, and gambling.

Why Do Area Variations Exist? Compositional and Contextual Effects

Two main alternative interpretations—the compositional and the contextual—have been proposed to understand area variations and patterning in health behaviours and outcomes (8–10). To give an example, the compositional explanation for observed area variations in drinking behaviour refers to the premise that the rate of alcohol consumption will be higher in some areas because people whose personal and household characteristics are associated with drinking tend to live in certain areas or neighbourhoods. Thus the observed variability among areas is mostly due to the concentration in these areas of people whose personal characteristics make them more likely to exhibit a given behaviour. In this respect, the individuals who make up a place, rather than the place itself, are relevant. Conversely, according to a contextual explanation, features of the social, economic, and cultural or physical environment affect drinking rates. Contextual factors may refer to the proximity and concentration of liquor outlets or to an area's reputation. Contextual factors influence all those living in the same area equally or, alternatively, may influence particular groups more significantly.

Existing literature on area variations in health behaviours suggests a contextual effect of area on behaviours above and beyond a compositional effect. However, conclusions remain equivocal as to the magnitude of the effect, depending on the variable under study, the area unit of analysis, the sample characteristics, and the method of analysis. To our knowledge, most of the studies have reported on area variations in drinking, with few, if any, reporting on gambling and drug use. Regional differences in drinking were reported in Britain after socioeconomic and age variables were controlled for (11). Although differential relations between social class and drinking were observed in various types of areas (3), these regional differences tended to decrease to an estimated 10% when various individual characteristics were controlled for and adequate multilevel techniques were used (4). However, Rice and others estimated that only 2% of the variation in reported last-week alcohol consumption is attributable to area variations, whereas 58% and 40% of the variations are situated in individuals and households, respectively (12). More generally, in Quebec, Pampalon and others showed significant local area variations in health perception, above and beyond variations attributable to individuals and households (7).

Objectives

The CCHS 1.2 (see www.statcan.ca/english/concepts/health/cycle1_2/) provides the first opportunity in Canada to examine the spatial patterning of a wide variety of substance-related and gambling behaviours and problems. The linkage in the dataset of respondents to geographical areas, based mainly on 2001 Census data (see www12.statcan.ca/english/census01/home/index.cfm), makes it possible to investigate area variations in gambling and substance use and dependence. Using multilevel models and controlling for major individual demographic characteristics, we primarily investigated the area effect on health-related behaviours by examining area variations within Quebec in behaviours related to alcohol and drug use and dependence, as well as variations in gambling behaviours and problems. We addressed the following questions:

- Do these behaviours vary among areas in Quebec?
- Do these behaviours vary among areas in Quebec after we control for personal characteristics (the compositional explanation)?

Abbreviations used in this article

CCHS 1.2	Canadian Community Health Survey: Mental Health and Well-Being
CI	confidence interval
CPGI	Canadian Pathological Gambling Index
CSD	census subdivision
IGLS	iterative generalized least squared method
PQL	predictive quasi-likelihood
SE	standard error

Table 1 Descriptive statistics for major study variables for the province of Quebec and across CSDs

Variables	Quebec		Distribution across CSDs[a]	
	%	95%CI	Lowest %	Highest %
Lifetime cannabis use (excluding once)	33.1	31.79–34.41	0	100
Cannabis use (12 months, excluding once)	12.1	11.20–13.00	0	100
Illicit drug dependence (12 months)	0.9	0.64–1.16	0	25
Reported gambling (12 months)	80.5	79.41–81.59	0	100
Problem and pathological gambling	1.7	1.35–2.05	0	33.3
Drinking status (12 months)	82.9	81.56–83.94	0	100
Alcohol dependence (12 months)	1.9	1.52–2.29	0	50
	Mean	95%CI	Minimum	Maximum
Number of gambling activities (12 months)	1.70	1.66–1.74	0	5
Quantity of alcohol consumption (last week)	4.61	4.39–4.83	0	58

[a] Additional descriptive statistics were not disclosed to respect confidentiality of data.

Method

Sample

Data were derived from the CCHS 1.2, which has a total sample size of 36 984 respondents representative of the Canadian population aged 15 years and over and living in private dwellings in 10 provinces (13). In this paper, we carried out the analyses exclusively with the subsample ($n = 5332$) representative of the province of Quebec. We nested each respondent within a CSD according to his or her place of residence, generating a total of 374 CSDs across the province. A CSD is a municipality or an area that is deemed to be equivalent to a municipality for statistical reporting purposes. A listwise deletion of missing cases resulted in a subsample varying between 3977 and 4918 respondents across 363 to 373 CSDs, depending on the outcome.

Measures

Using short screening scales (14), we examined 9 outcome variables related to alcohol use and dependence, cannabis use and illicit drug dependence, and gambling behaviours and problems.

Alcohol-Related Variables. Three outcome variables assessed drinking status, that is, whether respondents reported drinking or not in the last 12 months; quantity of alcohol consumption during the week preceding the survey; and diagnosis of alcohol dependence in the past 12 months.

Illicit Drug–Related Variables. Three variables assessed cannabis use, excluding 1-time use, for the past 12 months; lifetime cannabis use; and diagnosis of drug dependence in the past 12 months.

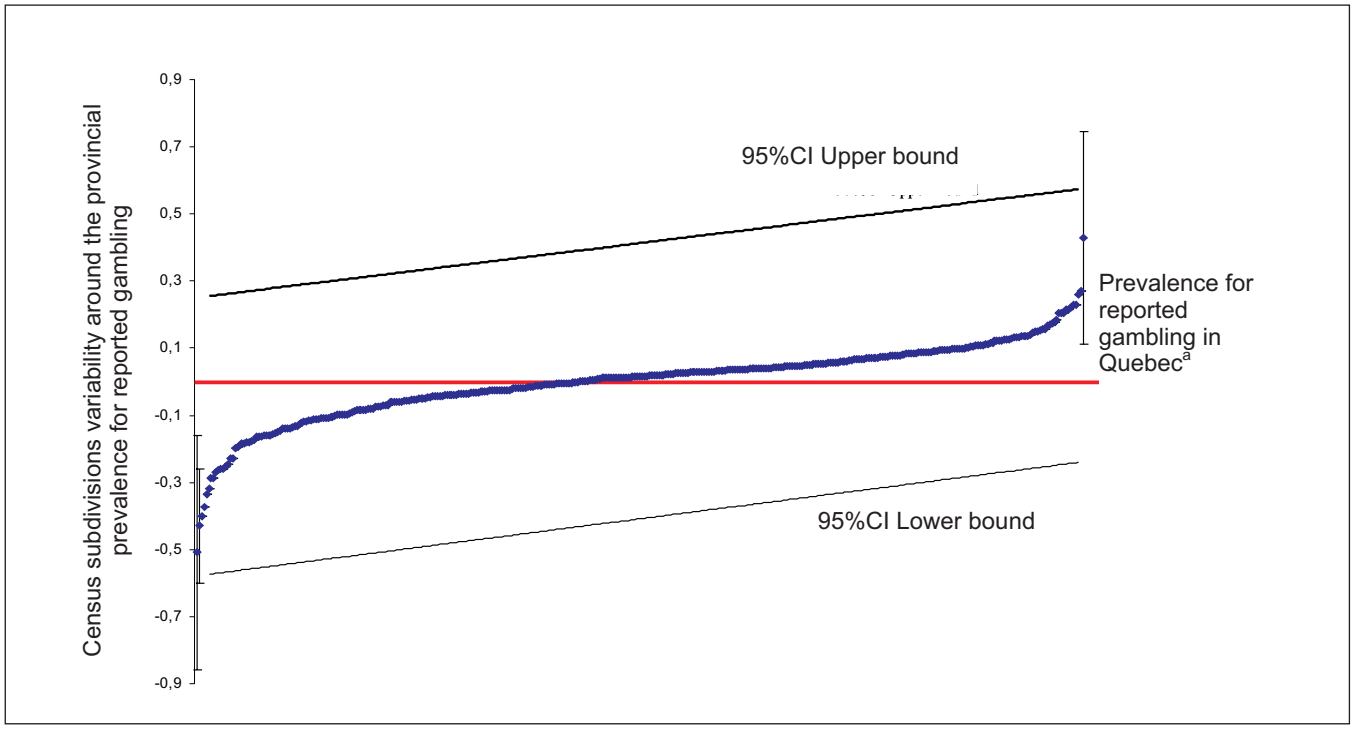
Gambling Variables. Three gambling variables were also included in the analyses. These were prevalence rate of gamblers, or whether respondents reported at least one gambling activity over the last 12 months; number of gambling activities reported in the last 12 months, for a total of 13 activities; and type of gambler, defined according to the CPGI (15), that is, nongambler or nonproblem gambler (score 0), low risk gambler (scores 1,2), moderate risk gambler (scores 3 to 7), and problem gambler (scores 8 and above). Given the low rates of pathological gambling and to ensure statistical power of the analysis, we decided to dichotomize the variable, combining moderate risk gamblers and problem gamblers on the one hand and nongamblers, nonproblem gamblers, and low-risk gamblers on the other hand.

We also had 5 independent individual variables: sex, age, marital status, household income, and highest level of education. Household income is a composite, 4-category, derived variable (1 = lowest, 2 = average low, 3 = average high, and 4 = highest). The highest school level was recoded into 4 categories (1 = secondary or less, 2 = postsecondary but not university, 3 = university undergraduate, and 4 = university graduate).

Analyses

The goal of our analyses—to decompose the effect of individual characteristics and areas on predicting alcohol use, illicit drugs use, and gambling behaviours and problems—required

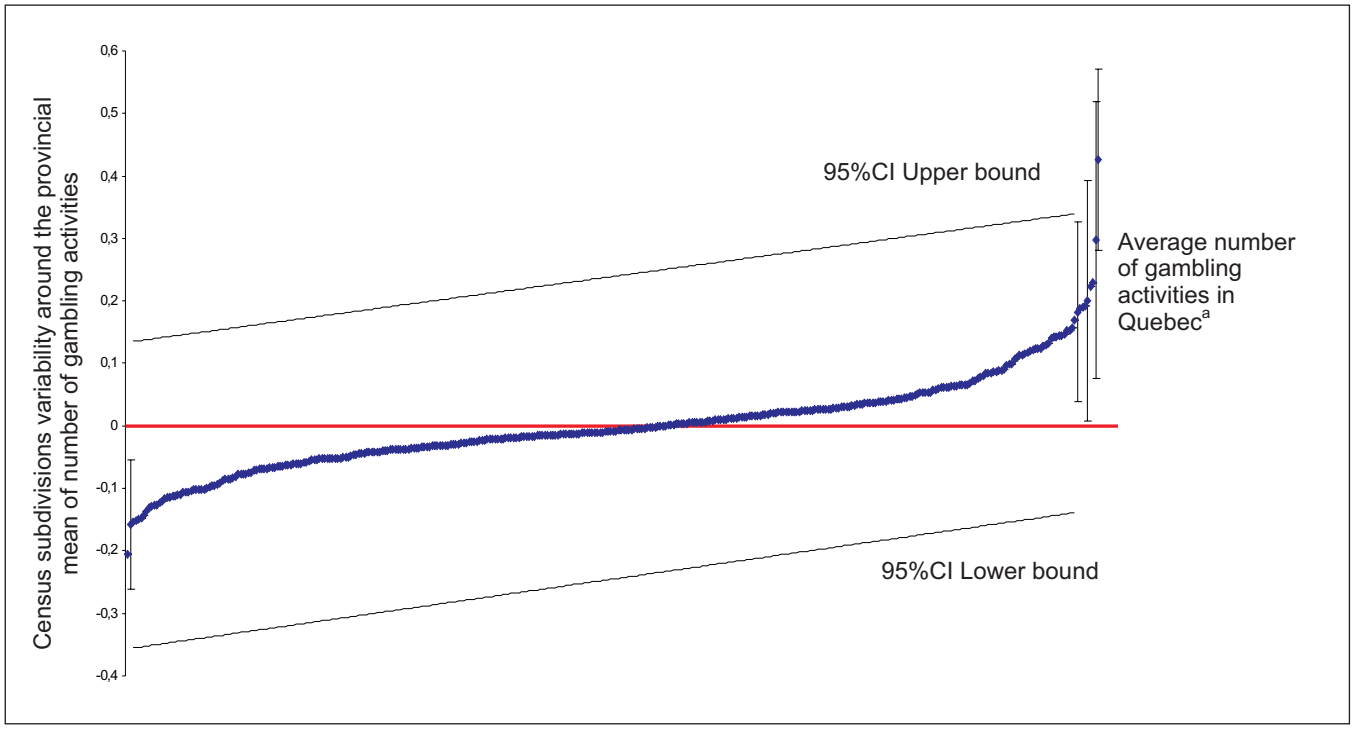
Figure 1 Variation in prevalence of reported gambling across the CSDs, individual-level characteristics controlled for



[a]Prevalence for reported gambling in Quebec (12 months) 80.5 was standardized in the plot.

♦Census subdivision units

Figure 2 Variability in the average number of gambling activities across the CSDs, individual characteristics controlled for



[a]Prevalence for reported gambling in Quebec (M = 1.7) was standardized in the plot.

♦Census subdivision units

a multilevel analysis that considered the hierarchical data structure of CSDs (Level 2) and nested individuals (Level 1).

For binary dependent variables, we employed 2-level hierarchical logistic regressions. Parameter estimation was done using the PQL method with second-order Taylor expansion (16) provided by MlwiN software (17). For continuous dependent variables, we used multilevel linear regression models in which the parameter estimation method was the IGLS (16,18). All fixed coefficients were tested with normal deviate 2-tailed significance reported at $P < 0.05$. For variance parameters, Wald tests were applied with halved P values ($P < 0.05$ reported) (19). Since the CCHS has a sampling complex design, all estimated SEs were adjusted for design effects (20,21).

Results

Table 1 presents the overall prevalence in Quebec of alcohol use and dependence, cannabis use and illicit drugs dependence, and gambling behaviours and problems. Inspection of the lowest and highest prevalence rates across the CSDs reveals that rates vary largely among the areas and differ from overall provincial rates. For instance, the provincial rate of past-12-month drinkers is estimated at 82.9% and ranges from 0% to 100% across the CSDs, whereas rates for past-12-month cannabis use and past-12-month gambling are estimated at 12.1% and 80.5%, respectively (both ranging from 0% to 100% across the areas). However, these figures should be interpreted with caution because sampling probability was not ensured according to geography. Instead, because areas were rebuilt a posteriori, samples across the units may not be representative of their respective areas.

The first step in the multilevel regression models was to estimate the variability among the CSDs for each outcome separately, without taking further explanatory variables into account (the null model). The analyses revealed that the 3 alcohol-related variables did not vary significantly among areas: 1) the prevalence of drinkers or those who reported drinking in the last 12 months, with area variation ($\sigma_\mu^2 = 0.049$, $P = 0.115$); 2) the typical quantity consumed during the week preceding the survey, with area variation ($\sigma_\mu^2 = 0.087$, $P = 0.706$); and 3) the 12-month alcohol-dependence diagnosis, with area variation ($\sigma_\mu^2 = 0$, $P = 1.0$). Moreover, areas did not vary significantly in prevalence of past-year cannabis use ($\sigma_\mu^2 = 0.085$, $P = 0.07$), diagnosis of illicit drug dependence ($\sigma_\mu^2 = 0.044$, $P = 0.876$), and prevalence of problem gambling, with moderate risk gamblers and problem gamblers combined ($\sigma_\mu^2 = 0.165$, $P = 0.43$). Table 2 reports only variables varying significantly among areas.

As shown in Table 2, Model 1 revealed that CSDs differed in 1) the prevalence of lifetime cannabis use ($\sigma_\mu^2 = 0.047$, $P < 0.06$), with 1.4% of the variation attributed to area differences; 2) the prevalence of gambling ($\sigma_\mu^2 = 0.133$, $P < 0.001$), with 3.9% of the variation due to differences between areas; and 3) the number of gambling activities during the past 12 months ($\sigma_\mu^2 = 0.038$, $P < 0.05$), with 1.1% of the variation situated between areas.

To disentangle the contextual effect of areas from the compositional effect, we undertook a second step, wherein we estimated multilevel regression models including individual demographic characteristics. Model 2 (see Table 2) revealed that area variation becomes nonsignificant for lifetime cannabis use when individual characteristics are controlled for ($\sigma_\mu^2 = 0.040$, $P = 0.14$). However, a comparison of the intraclass correlation between Models 1 and 2 showed that the variation among areas in rates of gambling, which was estimated at 3.9%, decreased to 2.9% when individual-level variables were entered in the equation. Similarly, the variation in the number of reported gambling activities among areas remained stable at 1.1% when individual-level variables were controlled for. As can be seen in Figures 1 and 2, the provincial estimates for the prevalence of gambling (80.5%) and the average number of reported gambling activities (mean 1.7) fall within the upper and lower CIs of most of the CSD estimates. However, few CSDs at the right end and left end of the distribution vary significantly, given that their CIs do not include the provincial estimates.

Concluding Remarks

Using multilevel modelling techniques, we found fairly small but significant variations among areas in the prevalence of lifetime cannabis use (1.4%) and in the average number of reported gambling activities (1.1%); we found a more sizeable variation for 12-month gambling (3.9%). Area variations decreased slightly but remained significant when the model accounted for individual demographic characteristics, namely, for the average number of reported gambling activities (which remained stable at 1.1%) and for 12-month gambling prevalence (which decreased from 3.9% to 2.9%). The stability of these variations suggests that the environment has an independent effect apart from characteristics of the people who live in it.

Our results must be tempered, given our study's limitations. First and foremost, this study focused mainly on estimating area variations within the province of Quebec and did not account for environmental factors that might explain these variations. To be more specific, this type of analysis needs to be pursued to better qualify the observed disparities in the use of and problems related to alcohol, illicit drugs, and gambling. It is also important to consider that existing literature on the geography of health does not provide straightforward definition and measurement of social and physical environments,

Table 2 Linear and logistic hierarchical regression models for prevalence of lifetime cannabis use, reported gambling, and number of reported gambling activities

Variables	Lifetime cannabis use (excluding once)				Reported gambling (12 months)				Number of gambling activities (12 months)			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	Estimate	95%CI	Estimate	95%CI
Fixed effect												
Individual-level variables												
Male sex			1.857****	1.613–2.139			1.137	0.979–1.321			0.062	–0.018 to 0.141
Age (years)			0.944****	0.939–0.950			1.008***	1.003–1.013			–0.007****	–0.010 to 0.004
Marital status												
Single			—	—			—	—			—	—
Married			0.533****	0.437–0.651			1.483****	1.201–1.831			0.002	–0.114 to 0.119
Living common law			1.188	0.979–1.441			2.025****	1.590–2.578			0.199***	0.076 to 0.322
Widowed			0.355****	0.207–0.611			1.161	0.839–1.606			0.142	–0.040 to 0.324
Separated			1.041	0.734–1.475			1.322	0.896–1.951			0.012	–0.205 to 0.228
Divorced			1.018	0.773–1.342			1.734****	1.279–2.352			0.050	–0.111 to 0.211
Household income												
Lowest			—	—			—	—			—	—
Average low			0.789**	0.631–0.988			1.372***	1.113–1.692			0.133**	0.011 to 0.255
Average high			0.816	0.659–1.011			1.740****	1.408–2.151			0.276****	0.155 to 0.396
Highest			0.923	0.719–1.184			2.084****	1.595–2.722			0.411****	0.267 to 0.556
Level of education												
Secondary or less			—	—			—	—			—	—
Postsecondary			1.219**	1.043– 1.426			1.248**	1.051– 1.482			0.009	–0.081 to 0.099
University undergraduate			1.259**	1.008– 1.573			0.919	0.722– 1.168			–0.118	–0.248 to 0.012
University graduate			1.097	0.773– 1.557			0.323****	0.233– 0.447			–0.612****	–0.816 to 0.408

Table 2 continued

Variables	Lifetime cannabis use (excluding once)				Reported gambling (12 months)				Number of gambling activities (12 months)			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	Estimate	95%CI	Estimate	95%CI
Random effect	Parameter		Parameter		Parameter		Parameter		Parameter		Parameter	
Level 1 = individuals (*n* = 5332)												
$\sigma_e^2 = var(e_{0ij})$	1		1		1		1		1.961***		1.904****	
Level 2[a] = CSDs (*n* = 374)												
$\sigma_\mu^2 = var(u_{0j})$	0.047*		0.040		0.133***		0.100**		0.038**		0.036***	
P	0.052		0.14		0.004		0.015		0.005		0.005	
Intra-CSD correlation (ρ)	0.014		0.012		0.039		0.029		0.011		0.011	

*$P < 0.06$; ** $P < 0.05$; *** $P < 0.01$; **** $P < 0.001$

[a]Level 2 = CSDs are distributed as follows along the rural–urban continuum across the province of Quebec: 1) 193 units are census metropolitan area or census agglomeration, 2) 39 units are strong census metropolitan area and census agglomeration-influenced zones, (3) 99 units are moderate census metropolitan area and census agglomeration-influenced zones, 4) 34 units are weak census metropolitan area and census agglomeration-influenced zones, and 5) 9 units are not census metropolitan area and census agglomeration-influenced zones.

such as areas. Thus the decision made in this study, to examine CSDs as the unit of analysis for areas, encompasses biases of sensitivity and specificity that likely affect the estimation and magnitude of variations among areas.

Despite these limitations, our study has the advantage of replicating to a certain extent existing results on geographical variations in drinking behaviours. Most important, however, our findings contribute significantly by extending these observations to gambling behaviours, a growing issue in our society. Because this statistical technique isolated the specific role of the environment, it speaks in corollary to the need for social policies toward gambling.

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Résumé : Variations régionales de la prévalence de l'utilisation de substances, et des habitudes et problèmes de jeu au Québec : une analyse multiniveau

Objectifs : Cette étude visait à examiner s'il existait des variations entre les régions du Québec, après que nous avons neutralisé les caractéristiques individuelles dans la prévalence 1) de la consommation d'alcool, de cannabis et des habitudes de jeu et 2) des troubles liés à une substance et du jeu pathologique.

Méthodes : À l'aide de données tirées du volet Santé mentale et bien-être de l'Enquête sur la santé dans les collectivités canadiennes (ESCC, Cycle 1.2), nous avons trouvé 5 332 répondants dans la province de Québec, au sein des 374 régions équivalant aux subdivisions de recensement (SDR). Les variables de résultat comprenaient 1) le statut de buveur (les 12 derniers mois), la consommation d'alcool (la semaine précédente), et un diagnostic de dépendance à l'alcool de 12 mois; 2) la consommation de cannabis (les 12 derniers mois et de durée de vie) et un diagnostic de dépendance aux drogues illicites; et 3) le statut de joueur, la gravité des problèmes de jeu, et le nombre déclaré d'activités de jeu (les 12 derniers mois).

Analyses : Des modèles de régression multiniveau sur des personnes (niveau 1) habitant des régions (SDR niveau 2) ont évalué les variations entre les régions dans la prévalence de divers résultats et troubles, lorsque les caractéristiques individuelles ont été neutralisées.

Résultats : Les modèles de composante de variance ont révélé que toutes les variables liées à l'alcool, la prévalence de consommation de cannabis (12 mois), et les problèmes de jeu ne variaient pas entre les régions. Les taux de jeu et le nombre moyen d'activités de jeu déclarées variaient selon les régions, même quand les variables de niveau individuel étaient prises en compte dans les modèles, alors qu'en ce qui concerne la consommation de cannabis à vie, les variations entre régions devenaient non significatives.

Conclusion : Les programmes d'intervention doivent peut-être considérer l'environnement comme étant un déterminant pertinent des comportements et modes de vie liés à la santé.