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ORIGINAL PAPER

Predictors of Quality of Life in Montreal, Canada: A Longitudinal Study

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Abstract
This study sought to assess factors associated with quality of life (QoL), and predictive of improvements in QoL over time, in a population-based cohort study. A 4-year longitudinal survey was administered to 2433 individuals at the study baseline; of these, 1828 individuals participated in Wave 2, and 1303 participated in Wave 3. QoL was measured by the Satisfaction with Life Domains Scale. Thirty-two variables were correlated with baseline QoL and together explained 58.2% of the variance. Eleven variables were independent predictors of improvement in QoL over time. Among these variables, social support and stress/coping showed the strongest association with QoL, and neighbourhood characteristics had an additional influence. Multidimensional modelling of a broad spectrum of the factors related to QoL enabled situating mental health and well-being in an ecological system with attendant implications for public health and social policy intervention to facilitate improvement of QoL in the population.

Keywords Quality of life · Life satisfaction · Stress and coping · Social support · Neighbourhood · Longitudinal study

Quality of life (QoL) and well-being are considered positive indicators of mental health (Keyes 2006). However, there is no standard definition or indicators of QoL, as the term covers different conceptualisations. Ferrans (1996) developed taxonomy of these conceptualisations, grouping them into six categories: normal life, social utility, happiness/affect, satisfaction with life, achievement of personal goals, and natural capacities. Moons et al. (2006) after examining these different conceptualisations and the problems related to them, conclude that satisfaction with life seems to overcome most of the problems and seem to be the most suitable conceptualisation of QoL.

The present study is based on satisfaction with life domains that have an objective and a subjective dimension. The subjective dimension refers to the respondent's perceptions of well-being, life satisfaction or happiness and while the objective component hinges on aspects of social functioning and environment (Bigelow et al. 1991).

For nearly 30 years, cross-sectional studies have sought to better understand the various conceptualisations of QoL by identifying its various correlates. A lesser number of longitudinal studies have identified predictors of time trends in QoL. The following summarises what is known about the factors related to or predicting QoL using various conceptualisations and different instruments, presents a critique and conclusions about previous research and describes the theoretical model used for framing QoL in this study.

There is no clear relationship between gender and QoL. Some research (Andrews and Withey 1976; Mercier et al. 1998) have observed no connection between gender and QoL, others report higher QoL in women than in men (Atkinson et al. 1997; Carpinielo et al. 1997; Koivumma-Honkanen et al. 1996; Röder-Wanner et al. 1997), and some have found interactions between age, gender and life domains (Lehman et al. 1992, 1995; Caron et al. 2005b; Vandiver 1998). For some QoL domains and age categories,

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women score higher than men but other studies indicate the reverse. Most empirical studies indicate that married people have a higher QoL [for a comprehensive review, see Dinner et al. (2000)].

Most studies to date have consistently indicated that satisfaction with life is positively related to increasing age (Caron et al. 2005a, b, c; Darbonne et al. 2003; Hansen et al. 2008), higher levels of education (Caron et al. 2005a; Stephens et al. 2000; Wallace et al. 2007; Caron 2012; Ritsner et al. 2003) and more positive working situations (Caron et al. 2005a, b, c; Murphy and Athanasou 1999; Wallace et al. 2007). Studies in several countries consistently report lower QoL for individuals in lower socio-economic status (SES) conditions (Caron et al. 1998; Defrances 1996; Park et al. 2002; Pappa et al. 2006; Cummins 2000, 2002; Gonçalves et al. 2010; Cattell 2010; Ghate and Hazel 2002; Krueger and Chang 2010; Turner and Turner 2005; Caron and Liu 2010).

Stressful events are linked to lower QoL (Caron et al. 2005a, b, c; Caron 2012) and the reduction of stressors has been shown longitudinally to improve QoL (Ritsner et al. 2003). Many studies have found greater QoL in individuals with better coping abilities (Caron et al. 1998, 2005a, b, c; Ritsner et al. 2003). Several cross-sectional and longitudinal studies have identified social support as one of the strongest factors associated with QoL (Koivumma-Honkanen et al. 1996; Caron et al. 2005c; Defrances 1996; Baker et al. 1992; Cohen et al. 2000; Katschnig et al. 1997).

With respect to clinical variables, most research has shown that high psychological distress and depression are associated with lower QoL (Atkinson et al. 1997; Carpinielo et al. 1997; Koivumma-Honkanen et al. 1996; Röder-Wanner et al. 1997; Pukrop et al. 2003). A longitudinal study (Lam and Rosenheck 2000) also demonstrated that a reduction in substance abuse improves QoL.

Neighbourhood socio-economic deprivation is well established as associated with ill health and lower QoL having deleterious effects for individuals both poor and better off who reside in lower SES areas (Jia et al. 2004; Drukker et al. 2004; Leventhal and Brooks-Gunn 2003; Dalgard and Tambs 1997; Sloggett and Joshi 1994; Diez Roux et al. 2011; Bernard et al. 2007; Moore et al. 2010; Daniel et al. 2008). Other features of residential neighbourhoods, perceived and objectively assessed, also appear to influence QoL (Kobetz et al. 2003; Guite et al. 2006; Bond et al. 2012; Paquet et al. 2010). Such factors include: perceiving the area as having a good internal reputation; being satisfied with house and landlord, and feeling that home and neighbourhood contribute to a sense of doing well; living in a house; having a home in good repair; living in an area perceived as having attractive buildings; and living in an attractive, quiet and peaceful environment. All these factors are associated with QoL. Conversely, negative physical environmental qualities of neighbourhoods (e.g. derelict buildings, lack of green space etc.), dwelling density, perceived neighbourhood problems, and limited opportunities for social participation have all been associated with lower QOL.

Several limitations characterize many of these studies. Besides the problem of different definitions and indicators that limit our understanding of QoL, most previous studies have important additional limitations. On the one hand, correlates identified in cross-sectional studies do not allow for determining the temporal basis of relationships between the identified variables and QoL. Longitudinal studies, on the other hand, do enable the identification of factors that predict, or seem to shape, time trends in QoL. Most such longitudinal research has sought to analyse QoL in terms of the impact of few independent variables without controlling the impact of other predictors or covariates. Determinants of QoL are likely, however, to be multidimensional in collectively shaping QoL. Hence, analyses evaluating the impact of a small number of independent predictors within key domains can introduce bias, as relevant confounders are not accounted for in other domains. Further, some cross-sectional or longitudinal studies have focused on populations with specific characteristics (e.g. clinical patients, the disadvantaged, or ethnic sub-groups, etc.). While important for understanding QoL for these groups, such studies do not lend themselves to straightforward comparisons of either QoL or the factors related to QoL between different groups, nor can their results be generalised to the larger population.

In conclusion, non-representative samples in some cross-sectional studies for which associations were identified could be misleading in their conclusions if the results were generalized to the overall population. The absence for controlling confounders in many studies, could also lead to misleading conclusions. There is also a need to reach beyond cross-sectional associations to better understand the factors that predict change over time in QoL and to determine which variables that are cross-sectionally associated with QoL do not predict change over time in QoL.

The first objective of the study was to assess, in the general population, the correlates of QoL. As pointed out by Carr et al. (2001). "Perception of QoL is a dynamic phenomenon. Individuals may appraise their QoL differently over time due to ever-changing life events, progress of illness, coping abilities, or cultural changes." From that perspective, the second objective of the study was to identify predictors of QoL change over time using a multidimensional model including most of the variables recognized through a literature review associated with QoL.

Figure 1 presents variables known to be related to QoL, conceptually grouped in sets by which to assess their association and predictive value for QoL in the current study: socio-demographics, stress, coping abilities/spirituality, social support and social stigma, economic factors, mental

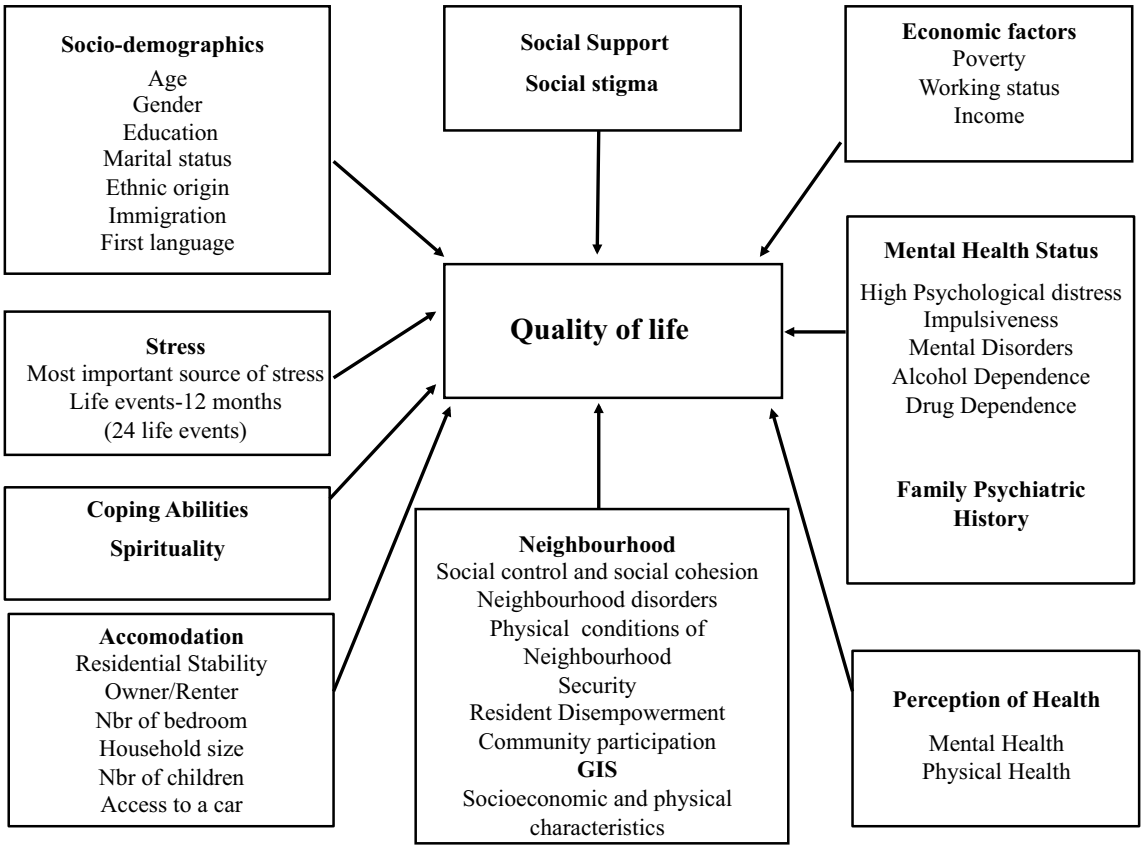

Fig. 1 Theoretical model illustrating variables and categories of variables evaluated in relation to quality of life. The direction of the arrows does not indicate causality and several variables within each block are interrelated and could interact with each other

health status/family psychiatric history, perception of health, accommodation/perception of neighbourhood, and objective characteristics of the neighbourhood.

Testing this comprehensive multidimensional model with a representative sample of the population can allow for clarifying the association between many domains of variables and QoL, while controlling for many confounders; and using a longitudinal design is further useful for identifying actual predictors of QoL *over time*.

Given the literature to date, we anticipated that most of the domains included in the model should contribute to QoL and QoL change, and that the stress/coping and social support variables should have the strongest contribution according to a previous study testing a multidimensional model (Caron 2012).

Method

Setting and Study Design

A longitudinal population-based mental health and well-being survey targeting adults aged 15–65 years was conducted in an epidemiological catchment area across four neighbourhoods (Saint-Henri/Pointe St-Charles, Lachine/Dorval, LaSalle, and Verdun) together accounting for 269,720 residents in south-western Montreal, Quebec, Canada. There were three waves of data collection starting in 2007, each wave separated by 2 years such that Wave 3 occurred 4 years following the baseline survey.

Sample

The objective was to obtain a representative sample of the target population, accounting for geographical location, population density, and SES. Of those 269,720 residents of the catchment area, 198,585 individuals were between the ages of 15 and 65 years. A random sample of 3408 households was selected for the catchment area of four neighbourhoods, using the 2004 property value register from the City of Montreal. For more detailed information on the sampling procedure see Caron et al. (2012).

At baseline, 2433 individuals aged 15–65 years were recruited and participated in the data collection. The study sample overrepresented women (61.6%) compared to the reference population (51.7%); men under the age of 45 were

underrepresented. To obtain the precise prevalence of mental illness in the population, we weighted the data for sex and age. The co-operation rate was 48.7% and is superior to the median rates reported in epidemiological studies of populations conducted post year 2000 (Morton et al. 2010). The attrition rate at Wave 2 was 25.1% (n = 610), and 28.2% ($n = 516$) between Wave 2 and 3 (Fig. 2 illustrates the causes of attrition between waves). Attrition was greatest among individuals who were younger, single, less educated, low-income, and substance dependent. The attrition rate was lower than in the USA Epidemiological Catchment Area survey (Eaton et al. 1992) and the predictors of attrition were similar (Buchloz et al. 1996). Of these 2, 433 individuals, 1828 participated in Wave 2, and of those participating in Wave 2, 1312 participated in Wave 3.

Measures

Quality of life was measured with the Satisfaction with Life Domains Scale (SLDS) (Baker and Intaglia 1982; Caron et al. 1997). It covers 20 items, including one item on overall life satisfaction, each measured with a 7-point Likert scale, grouped into five sub-scales: daily life and social relations, living environment, autonomy, relationships, and leisure activities. The internal consistency is excellent; alpha = 0.92 for the overall scale, and the range of the alphas varies across domains from 0.72 to 0.84.

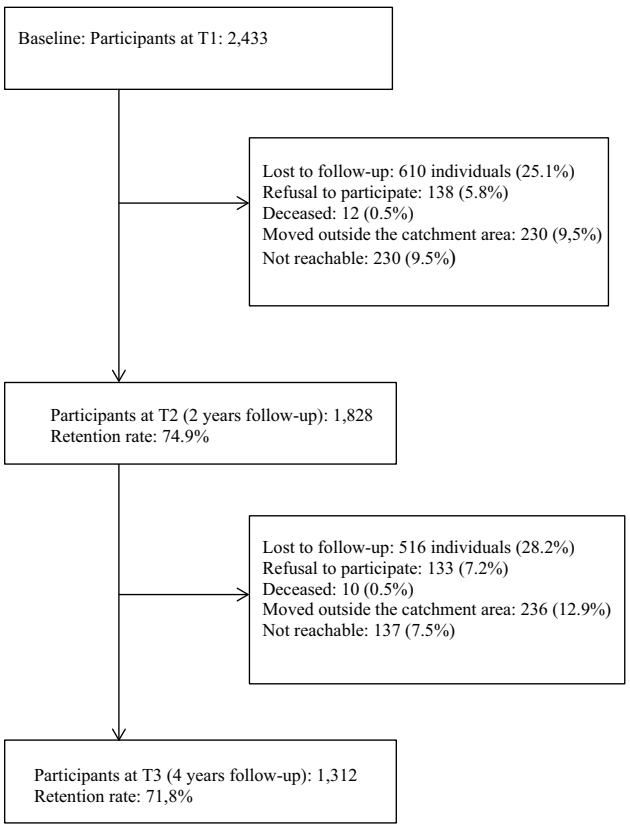

Fig. 2 Recruitment flow-chart from Wave 1 to Wave 3 in the south-west Montreal Catchment area

Socio-demographic and economic data were collected using the Canadian Community Health Survey (CCHS 1.2) questionnaire from Statistics Canada (2002). *Psychological distress* was measured using the K-10 scale; Its internal consistency was alpha = 0.93 (Kessler et al. 2005). *Mental disorders* were identified with the CCHS 1.2 version of the Composite International Diagnostic Interview (Kessler et al. 1998), including mood disorders (major depression, and mania), some anxiety disorders (panic attacks, social phobia, agoraphobia) and alcohol and drug dependence. *Psychiatric family history* was measured using the Parental Psychiatric History (Driessen et al. 1998). *Impulsivity* was measured using the Barratt Impulsivity Scale (version 11a) (Barratt 1994), comprised of 30 units graded on a four-point scale, alpha = 0.82. The *mental health services* questionnaire was adapted from the CCHS 1.2 (Statistics Canada 2002). It measures need for care and the type and frequency of service use as well as consultation with most type of mental health professionals.

Stress and stress management strategies were evaluated using the CCHS 1.2 coping module (Statistics Canada 2002), it is divided into three sections: ability to manage stress, the main source of stress, and the frequency of the use of coping strategies. *Stressful events* were measured with the *Questionnaire sur les événements de vie* (Laurin 1998) that includes 25 items grouped under five domains: events related to income, love, links with family and friends, housing and experiences of aggression. *Components of social support* were measured using the Social Provisions Scale (SPS) (Cutrona and Russell 1987; Caron 1996). It measures six functions of social relationships with 24 items on a 4-point likert scale: *attachment, social integration, reassurance of worth, reliable alliance, guidance*, and *opportunity for nurturance*. Internal consistencies ranged from 0.85 to 0.92. *Social stigma* was measured with The Devaluation-Discrimination Scale (12 items; alpha = 0.76) (Link 1989), which measures the extent to which individuals believe that "most people" will devalue and discriminate against the mentally ill.

Residents 'perceptions of their neighbourhood were measured using several instruments. The *sense of belonging to a community* was measured using the eight-item (alpha = 0.74) *Sense of Community Index* (Long and Perkins 2003). *Community participation* was measured using the *Community Involvement Scale* (Ziersch et al. 2005) which includes six items (alpha = 0.82) and measures the degree of involvement in neighbourhood organization. *Perceived ability to act on one's neighbourhood* was measured using the *Resident Disempowerment Scale* (Nario-Redmond and Coulton 2000) consisting of three units. *Social cohesion*

and informal social control were measured using the *Sense of Collective Efficacy* (alpha = 0.91) (Sampson et al. 1997). *Disruptive elements in the neighbourhood* were measured using the *neighbourhood disorder* (Coulton et al. 1996) comprising nine units (alpha = 0.84) in which the resident reports on neighbourhood problems. *Physical aspects of the neighbourhood* were measured using the *Neighbourhood Physical Conditions Scale* (Friedli 2000) comprising 7 units (alpha = 0.87) in which people evaluate the physical appearance of the neighbourhood, and the condition of dwellings and other buildings.

A geographic information system (*GIS*) (Daniel and Kestens 2007) was used to characterise and measure neighbourhood environmental contexts for 500 m buffer zones constructed for each participant.

Procedure

The Douglas Mental Health University Institute Ethics Committee, in accordance with the Canadian Tri-Council Guidelines, approved the project. The interviewers contacted the residents who had agreed to participate in the study by phone within a week of recruitment, to schedule a face-to-face meeting either at the participant's home or in an office designated for that purpose at the Douglas research Institute; however, most interviews were conducted at home. The face-to-face interview was conducted once the consent form was signed and lasted approximately 1.5–3 h, depending on whether a mental disorder was detected.

Statistical Analyses

Descriptive statistics, including proportions, means and standard deviations (SD), were used to characterize the study population at each wave.

To identify the correlates of the global score of QoL, hierarchical linear regression was used to model QoL at Wave 1 (Tabachnick and Fidell 2001). A total of 73 potential correlates of QoL were grouped into nine sets (Fig. 1): (1) socio-demographics; (2) work and income; (3) stress; (4) coping with stress; (5) social support and social stigma; (6) mental health status; (7) perception of physical and mental health; (8) perceptions of neighbourhood and accommodation; and (9) objectively-assessed GIS variables. To avoid model overfitting given the number of potential correlates, model selection procedures were used to obtain a parsimonious model retaining only statistically significant correlates.

The first analytic step was to sequentially enter the nine sets of variables into the model, using a forward selection procedure to retain sets that had statistically significant associations with QoL. The second analytic step saw all sets retained entered into the model, and used a forward selection and backward deletion procedure to identify statistically significant correlates.

The longitudinal nature of the study provided the opportunity of identifying significant predictors of QoL change over time. To this end, we employed a mixed linear model (Raudenbush and Bryk 2007) to analyse QoL scores across Waves 1, 2 and 3. Per this approach the mixed linear model included the Wave 2 and 3 QoL scores as dependent observations with the Wave 1 score as a covariate and Wave 1 variables as independent predictors (Everitt 1995). A compound symmetry covariance structure was specified. We did not account for clustering of participants by area as only four neighbourhoods were represented and any administrative differentiations of these few adjoining areas is artificial; further, ICCs for observations of individuals within residential areas typically range from 0.005 to 0.01. Lastly, statistically accounting for a small number of neighbourhood clusters would generate undue, inappropriate inefficiency in calculating and applying an ICC as a design effect (Korn and Graubard 1991). All analyses were done with SAS version 9.4 (SAS Institute; Cary, NC).

Results

Sample Characteristics

At baseline/Wave 1, the mean age of participants was 41.4 (SD = 13.3). Of the sample, 62% were men, 46% were married or in a common law relationship, 73% had a high school diploma, 77% had been employed within the 12 months preceding the survey, 25% were immigrants, and 81% were Caucasian. French was the primary language spoken for 54% of respondents, 22% spoke English and 24% spoke neither English nor French as a primary language. Mean personal income was CAD $32,534 (SD = $31,200) and mean family income was CAD $57,683 (SD = $49,718). Twenty-three percent of participants had a low income per Statistics Canada criteria. Sample characteristics at Waves 2 and 3 participants differed little from Wave 1 (Table 1). It is not surprising to find that the participants differed from wave 1 to 2, and 3 that they became older, completed more years of education, more likely to own the dwelling, having a job, and have more family members. Distribution on gender, marital status, immigrant status stayed the same across the three waves. Although there were significant differences in primary language and Caucasian, it is most likely due to the big sample size. The magnitude of differences was small.

Correlates of QoL

The mean and standard deviation of the QoL scores were 108.5 and 16.6 at Wave 1 (n = 2398), 108.9; 15.3 at Wave 2

Table 1 Socio-demographic characteristics of the study sample

	Wave 1 (n = 2433)	Wave 2 (n = 1823)	Wave 3 (n = 1305)	p Value
Gender (n, %)				0.31
Female	1503 (61.78%)	1147 (62.92%)	839 (64.29%)	
Male	930 (38.22%)	676 (37.08%)	466 (35.71%)	
Age (mean, SD)	41.39, 13.34	44.38, 13.17	48.11, 12.77	< 0.0001
Age (%)				< 0.0001
15–24	292 (12.00%)	146 (8.01%)	62 (4.75%)	
25–34	525 (21.58%)	330 (18.10%)	154 (11.80%)	
35–44	574 (23.59%)	395 (21.67%)	276 (21.15%)	
45–54	546 (22.44%)	473 (25.95%)	349 (26.74%)	
55 +	496 (20.39%)	479 (26.28%)	464 (35.56%)	
Marital status (%)				0.12
Single	886 (36.48%)	620 (34.05%)	401 (30.73%)	
Married	724 (29.81%)	574 (31.52%)	431 (33.03%)	
Separated	74 (3.05%)	55 (3.02%)	43 (3.30%)	
Common-law	384 (15.81%)	284 (15.60%)	202 (15.48%)	
Divorced	319 (13.13%)	250 (13.73%)	198 (15.17%)	
Widowed	42 (1.73%)	38 (2.09%)	30 (2.30%)	
Education (%)				< 0.0001
Less than high school	372 (15.30%)	241 (13.23%)	130 (9.98%)	
High school graduation	280 (11.51%)	213 (11.70%)	123 (9.44%)	
Post-high school	1780 (73.19%)	1367 (75.07%)	1050 (80.58%)	
Immigrant (%)				0.071
No	1811 (75.02%)	1379 (75.77%)	1021 (78.36%)	
Yes	603 (24.98%)	441 (24.23%)	282 (21.64%)	
Primary language (%)				< 0.0001
English	528 (21.90%)	416 (22.87%)	284 (21.80%)	
French	1308 (54.25%)	1031 (56.68%)	770 (59.09%)	
English + French	159 (6.59%)	56 (3.08%)	41 (3.15%)	
Neither English nor French	416 (17.25%)	316 (17.37%)	208 (15.96%)	
Caucasian (%)				0.047
No	450 (18.69%)	313 (17.19%)	202 (15.49%)	
Yes	1958 (81.31%)	1508 (82.81%)	1102 (84.51%)	
Dwelling owned by a household member (%)				< 0.0001
No	1484 (61.47%)	1022 (56.15%)	644 (49.42%)	
Yes	930 (38.53%)	798 (43.85%)	659 (50.58%)	
Held a job in past 12 months (%)				0.031
No	545 (22.60%)	464 (25.49%)	337 (25.88%)	
Yes	1866 (77.40%)	1356 (74.51%)	965 (74.12%)	
Household size (mean, SD)	2.50, 1.39	2.60, 1.45	2.61, 1.52	0.028
Household income (mean, SD)	$57,683, $49,718	$64,360, $54,294	$68,515, $55,577	< 0.0001
Personal income (mean, SD)	$32,534, $31,200	$35,724, $29,313	$39,839, $36,846	< 0.0001

(n = 1816); and 109.2 and 15.2 at Wave 3 (n = 1274). Given that 25% of the sample was lost to follow-up at Wave 2 and another 21% was a lost at Wave 3, we conducted analyses to test whether attrition was related to QoL scores. Specifically, we tested whether subjects who were lost to follow-up at Wave 2 had significantly lower Wave 1 QoL scores than those who stayed in the study at Wave 2. The results indicate a borderline non-significant lower mean QoL score among those lost to follow-up (p = 0.06). However, the difference in the QoL mean score between the two groups has no clinical meaning. Specifically, the mean value of Wave 1 QoL scores among those lost to follow-up at Wave 2 was

107.3 (SD = 17.7), only 1 unit lower than that of participants who continued in the study through Wave 2 (mean = 108.9, SD = 16.2).

Among the nine sets of potential correlates, eight sets of variables were statistically significantly associated with QoL and explained nearly 56% of the variance (Table 2). Work and income was the sole set not related to QoL. The set of social support and stigma variables was the strongest correlate of QoL, accounting for 13.9% of the variance. Stress variables were the second strongest set of correlates of QoL, accounting for 11.4% of the variance, followed by coping with stress (9.8%), socio-demographics (7.0%), mental health status (5.1%), perception of neighbourhood and accommodation (4.3%), perception of health (3.7%), and GIS-based environmental variables (0.6%).

Thirty-two variables were statistically significantly associated with QoL. Specifically, subjects being married and with lower education had higher QoL. Compared to Francophones, QoL was higher among bilinguals but lower among Anglophones. Subjects who reported having been stressed by their work or financial situation had lower QoL. The number of stressful events within the 12 months preceding the survey was inversely associated with QoL.

Some coping strategies were associated with higher QoL, including ability to handle unexpected and difficult problems, personal ability to deal with the main source of stress, and spiritual values helping to provide meaning in life. Most social support variables were positively related with QoL, except for two: nurturance (feeling useful and necessary), and tangible and material support.

Regarding mental health variables, family psychiatric history; high psychological distress; higher impulsiveness total score; social phobia and drug dependence were negatively related to QOL Good rating in self-rated physical health and mental health was associated with greater QoL. Greater number of bedrooms in the accommodation dwelling and larger household size were positively associated with QoL. However, controlling for household size, greater number of children in the family was inversely associated with QoL. Physical conditions of neighbourhood, and social control and social cohesion were positively associated with QoL but neighbourhood disorder was negatively related. Four GIS-based environmental variables were negatively associated: proportion of female population, proportion of 4–5 person households, proportion of residents who moved from another country within the previous 5 years, and rate of crime against the person.

Predictors of QoL Change

Among the 73 potential predictors, 11 were found to be independent and statistically significant predictors of QoL improvement, including: better QoL score at time 1, being married, having worked in the past 12 months, higher score in the social support variable reassurance of worth, lower score for impulsiveness assessment, not having major depression, not having alcohol dependence, a good rating in self-rated physical health, higher score in perception of physical conditions of the neighbourhood and its level of social control and social cohesion, and lower proportion of households below the low income cut off (Table 3).

Discussion

This population-based study explains a substantial percentage of the total variance in QoL and social support variables were most strongly correlated with QoL. These results are consistent with previous multidimensional analyses indicating that social support is one of the strongest factors associated with or predicting QoL (Koivumma-Honkanen et al. 1996; Caron et al. 1998, 2005; Katschnig et al. 1997). Five dimensions of support were identified: emotional, reassurance of worth, social integration, tangible help, and nurturance. Two of these dimensions, namely emotional support and support providing reassurance of worth, have been consistently identified as excellent predictors of QoL in the general population, low-income populations, people with a diagnosis of schizophrenia, and families of people with serious mental health problems (Caron et al. 1998, 2005a, b, c). These results suggest that the availability of close personal relationships that enable emotional integration or provide positive feedback regarding abilities and competencies, are key contributors to the perception of QoL. Social integration was also positively related to QoL, an association also reported by other studies (Caron et al. 2000, 2005a, b, c). Tangible assistance, associated with higher QoL in some previous studies (Caron et al. 2005a, b, c; Newsom and Schulz 1996), and opportunity for nurturance were counter-intuitively negatively related to QoL in the current study. Within the set of social support variables only reassurance of worth was a predictor of improvement in QoL over time.

The results are consistent with Transactional theories of coping (Lazarus and Folkman 1984); the stress set of variables ranked second in extent of association with QoL, followed by the coping-with-stress set of variables, and together they accounted for almost 36% of the variance in QoL. The main source of stress related either to work situation or financial difficulties, and decreased QoL as did the total score of life events. Two aspects of coping ability have been identified as predicting increased QoL over time: good ability to handle unexpected and difficult problems, and having the personal ability to deal with the main source of stress (Caron et al. 2005a, b, c; Ritsner 2009). Many aspects of spirituality can be a way of coping with stressful situations, giving a sense to what is happening in life and indicating that

Table 2 Significant correlates of QoL at Wave 1

Variable	Parameter estimate	95% CI		p Value	R^2 (%)
		Lower limit	Upper limit		
Block 1: Socio-demographics					7.04
Marital status					
Married (ref)					
Single	−2.90	−4.26	−1.54	<0.0001	
Common-law	−1.65	−3.20	−0.09	0.0379	
Separated or widowed or divorced	−2.01	−3.62	−0.41	0.0141	
Highest education level					
Less than high school (referent)					
High school graduation	−3.30	−5.23	−1.37	0.0008	
Post-secondary school	−4.78	−6.28	−3.27	<0.0001	
Conversation language					
French					
English	−1.00	−2.31	0.31	0.1337	
English + French	2.46	0.36	4.56	0.0216	
Neither English nor French	−0.41	−1.85	1.03	0.5747	
Block 2: Stress					11.37
Source of stress: work situation	−2.21	−3.54	−0.89	0.001	
Source of stress: financial situation	−1.46	−2.84	−0.07	0.039	
Total score of stressful events	−0.59	−0.82	−0.36	<0.0001	
Block 3: Coping with stress					9.77
Ability to handle unexpected and difficult problems: good vs. not good	3.57	1.86	5.27	<0.0001	
Have the personal ability to deal with the main source of stress	2.03	0.08	3.99	0.0416	
Spirit. Values/finding meaning in life	2.16	1.03	3.29	0.0002	
Block 4: Social support and social stigma					13.91
Can count on people to help me cope with my main source of stress	2.28	0.79	3.77	0.0027	
Opportunity for nurturance	−0.29	−0.57	−0.01	0.0451	
Reassurance of worth	0.64	0.27	1.01	0.0007	
Social integration	0.58	0.22	0.95	0.0018	
Attachment	1.48	1.12	1.85	<0.0001	
Tangible help	−0.48	−0.87	−0.09	0.016	
Block 5: Mental health status					5.11
Having at least one immediate family member who has seen a psychiatrist, a psychologist, a social worker or other health professional for a psychological or emotional problem	−1.56	−3.01	−0.11	0.0351	
High psychological distress	−3.73	−4.93	−2.52	<0.0001	
Impulsiveness total score	−0.16	−0.22	−0.11	<0.0001	
Past 12 months social phobia	−3.04	−5.82	−0.25	0.0324	
Past 12 months drug dependence	−4.83	−7.99	−1.66	0.0028	
Block 6: Perception of health					3.72
Perception of physical heath (good vs. fair or poor)	4.90	3.45	6.35	<0.0001	
Perception of mental health (good vs. fair or poor)	7.65	5.79	9.51	<0.0001	
Block 7: Perception of neighbourhood and dwelling accommodation					4.31
Number of bedrooms in the dwelling	1.08	0.45	1.70	0.0007	
Household size	1.49	0.77	2.21	<0.0001	
Number of children	−1.27	−2.04	−0.51	0.0012	
Physical conditions of neighbourhood	0.29	0.23	0.34	<0.0001	
Neighbourhood disorder	−0.08	0.05	0.11	<0.0001	
Social control and social cohesion	0.17	0.08	0.25	<0.0001	

Table 2 (continued)

Variable	Parameter estimate	95% CI		p Value	R^2 (%)
		Lower limit	Upper limit		
Block 8: Objectively-assessed environmental measures (from GIS)					0.59
Proportion women within 500 m buffer zone	−0.35	−0.68	−0.02	0.0352	
Proportion of 4–5 person households within 500 m buffer zone	−0.23	−0.35	−0.10	0.0006	
Proportion of population within 500 m buffer zone having relocated from other country in last 5 years	−0.19	−0.28	−0.11	< 0.0001	
Crime rate: crimes against the person within 500 m buffer zone	−0.32	−0.60	−0.03	0.0297	
Total variance					55.82

Table 3 Significant predictors of change in QoL score over time

Wave 1 variable	Parameter estimate	95% CI		p Value
		Lower limit	Upper limit	
Block 1: Quality of life score	0.51	0.48	0.55	< 0.0001
Block 2: Socio-demographics				
Marital status				
Married (ref)				
Single	−2.67	−3.84	−1.51	< 0.0001
Common-law	−1.76	−3.16	−0.36	0.014
Separated or widowed or divorced	−2.78	−4.15	−1.41	< 0.0001
Block 3: Work and income				
Worked in the past 12 months	1.17	0.01	2.33	0.0483
Block 4: Social support and social stigma				
Reassurance of worth	0.51	0.24	0.78	0.0002
Block 5: Mental health status				
Impulsiveness total score	−0.08	−0.13	−0.03	0.0008
Major depression within last 12 months	−2.57	−4.32	−0.82	0.0041
Alcohol dependence within last 12 months	−4.88	−7.81	−1.94	0.0011
Block 6: Perception of health				
Perception of physical heath (good vs. fair or poor)	2.58	1.25	3.91	0.0001
Block 7: Perception of neighbourhood and dwelling accommodation				
Physical conditions of neighbourhood	0.06	0.02	0.11	0.0073
Social control and social cohesion	0.10	0.03	0.18	0.006
Block 8: Objectively-assessed environmental measures (from GIS)				
Proportion of households below low income cut off	−0.05	−0.09	0.003	0.0648

spiritual values help to find meaning in life was positively associated to QoL. Recent research has uncovered links between spiritual values and health and well-being (Caron 2012; Friedli 2000; Dyson et al. 1997).

The set of socio-demographic variables was the fourth strongest contributor to QoL. As anticipated, being married was positively related to QoL at baseline, consistent with most previous studies (Dienner et al. 2000) and was also identified as a predictor of improvement in QoL over time.

Contrary to many studies (Vandiver 1998; Caron et al. 2005a, b, c; Stephens et al. 2000), education was inversely associated with QoL. Caron (2012) reported an inverse relationship between education and QoL in a low-income population residing in two of the four neighbourhoods characterised in the present study. While these two neighbourhoods are among the poorest in Montreal, sections of the two others could be viewed as socioeconomically deprived. As noted already, neighbourhood deprivation affects QoL for both poor and rich individuals (Leventhal and Brooks-Gunn 2003; Dalgard and Tambs 1997). When people evaluate an element or aspect of their life, they cognitively compare their current situation to what they could aspire to, given their situation and status. The higher their expectations and the more that people feel their situation deviates from these expectations, the lower their opinion of their QoL. Thus, better educated people having a low income or living in

a socioeconomically deprived neighbourhood could have higher expectations than less educated individuals, leading them to negatively evaluate their current living conditions. Compared to Francophones and Anglophones, QoL scores were higher among bilinguals; even though French is the official language in the Province of Quebec, a large proportion of the population of Montreal, speaks both French and English (40%). Speaking both languages could provide greater opportunity for work and social relationships and thus explain the higher QoL.

High psychological distress and social phobia were negatively related to QoL. Psychological distress is known to be associated with lower life satisfaction (Atkinson et al. 1997; Koivumma-Honkanen et al. 1996), Higher impulsiveness and drug dependence were also negatively related to QoL aligned with other studies (Riley et al. 2006; Victor et al. 2003). Depression, alcohol dependence and impulsiveness, however, were strong predictors of reduced QoL over time.

Greater self-reported physical and mental health was associated with better QoL is consistent with preceding research (Vaez and Laflamme 2003; Ratcliff and Vernich 2001). Good self-reported physical health was also a predictor of QoL improvement. This result seems to support the "response shift model" which predicts that QOL would change as a function of health state alterations (Sprangers and Schwartz 1999).

Perceptions of neighbourhoods and accommodation explained nearly the same proportion of variance in QoL as did mental health status, and far more than objective GIS-based measures of neighbourhoods. These results imply that QoL could be a function more of positive perceptions than actual environmental context, but it would be premature to suggest that perceptions of places are not to some degree a function of the context in which one lives. Further research is required in this area. Consistent with previous results (Guite et al. 2006), a greater number of bedrooms in the dwelling and larger household size were associated with greater QoL. However, controlling for household size and other variables, a greater number of children in the family was related to lower QoL. Children seem to impact the quality and quantity of investment within many otherwise positive domains of family life (Cáceres-Delpiano 2004). Perception of better physical conditions of neighbourhood, less neighbourhood disorders, and greater social control and social cohesion were associated with higher QoL, in accordance with earlier research (Dalgard and Tambs 1997; Drukker and Van Os 2003; Drukker et al. 2003). A unique finding of the present study was that perception of positive physical conditions and greater social control and cohesion predicted improved QoL over time.

Four GIS variables were negatively associated with higher QoL score: proportion female population, proportion 4–5 person households, proportion of immigrants, and crimes against the person. All such aspects of neighbourhoods link to neighbourhood deprivation, which in turn is negatively related to QoL (Leventhal and Brooks-Gunn 2003; Dalgard and Tambs 1997; Sloggett and Joshi 1994; Diez Roux et al. 2011; Bernard et al. 2007). The effect of neighbourhood deprivation across time was confirmed by the finding that a lower prevalence of low-income families was a positive predictor of QoL improvement.

Contrary to the results of many studies (Cummins 2000, 2002), low SES was not related to QoL nor identified as a predictor of improvement in QoL over time. This might be explained by the fact that low income is a proxy of many variables explicitly measured and analysed in the present survey that might more directly affect QoL. Such variables contain: more stressful events; lower coping abilities and social support; poorer mental health status; lower perception of health; neighbourhood deprivation; and unemployment. Having a job in the past 12 months at the study baseline was a positive predictor of improvement in QoL as found in other studies (Caron et al. 2005a, b, c; Wallace et al. 2007).

This study, despite its key strengths (representative population-based sampling, and longitudinal design), has limitations. Chief considerations are the use of self-reported data for which responses to survey questions could be subject to memory and social desirability bias (Paulhus 1991), and the number of variables modelled which presents the possibility of Type I error. Given attrition at follow-ups, and associations between attrition and participant characteristics, the generalizability of the study findings to the source population could be affected. However, results from a simulation study (Gustavson et al. 2012) on the impacts of attrition in analyses of longitudinal data showed that regression estimates were only weakly affected by attrition rates. In that study, attrition rates of 30%, 50%, and 70% were assumed—all higher than attrition rates observed in our study (25.1% at wave 2 and 21.2% at wave 3). Similar baseline characteristics were reported to be related to attrition in both studies including younger age, living alone, lower education level, etc. We also assessed the potential for multicollinearity in the course of our analyses. Thus, we would assert that our study nevertheless provides viable and internally valid information on predictors of QOL, given attrition. Furthermore, despite having assessed the relationships between QoL and numerous theoretically relevant variables, other variables not included in this study can influence QoL, including self-efficacy, self-esteem and sense of control (Barry 1997; Zissi et al. 1998), reordering goals (Rapkin and Fischer 1992) and reframing expectations (Allison et al. 1997). Although we have identified impulsivity as associated with, and as a predictor of, QoL over time, other aspects of personality could also be involved (Diener and Lucas 1999). We would also note that the low income and urban nature of

our sample may limit the generalizability of the findings to other populations.

Conclusion

The results of this study underscore the importance of testing a multidimensional model; 32 of 73 variables were independently associated with baseline QoL and 11 variables were independent predictors of improvement in QoL over time. Among these, social support and stress/coping variables showed the strongest association with QoL, and neighbourhood characteristics had an additional influence on QoL beyond individual and social variables. One important finding is that low SES was not related to QoL nor identified as a predictor of change in QoL over time, contrary to the results of other studies. This might be explained by the design and the strong methodology used in the present study, specifically its representativeness and inclusion of many variables that probably have a more direct effect than low SES or poverty on QoL. Many individual, social and neighbourhood factors linked to QoL in our study could be targeted by public health interventions to facilitate improved QoL within the general population. Examples of such interventions include programs in schools to learn how to cope with stress, reducing stress in the workplace, development of social support and cohesion in neighbourhoods, urban planning policies for diversity in populations with high and low incomes, housing policies for large families, renovation of buildings in poor condition, and broader social policy to reduce neighbourhood disorder and criminality.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with animals performed by any of the authors. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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