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Risk factors for falling among community-dwelling seniors using home-care services: An extended hazards model with time-dependent covariates and multiple events

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Abstract

The identification of risk factors for falls in longitudinal studies becomes difficult because of exposures that change during the follow-up and also because individual subjects may experience an event more than once. These issues have been neglected and improper statistical techniques have been used. The typical approaches have been to report the proportion of fallers or the time to first fall. Both avoid the underlying assumption of independence between events and discard pertinent data. We review the existing methods and propose a Cox hazards extension. We exemplify it in the study of potential risk factors associated with all falls in 959 seniors. Finally, we compare the results of the proposed Wei, Lin, & Weissfeld (WLW) method with those of several other techniques. Stable exposure variables measured at baseline and updated time-varying exposures include socio-demographic characteristics, BMI, nutritional risk, alcohol consumption, home hazards, gait and balance, and medications. Results demonstrate that the usual methods of analyzing risk factors for falling are inappropriate, as they produce considerable biases relative to the WLW model using time-dependent covariates. Results also show that modeling for first events may be inefficient, given that the risk of occurrence varies between falls.

Key words: *Accidental falls, Cox model, elderly, environmental hazards, negative binomial distribution, hazards model, regression analysis, survival analysis, logistic models*

Introduction

Falls are common, recurrent problems with serious consequences for elderly people and the health care system.[1] Evidence of fall-risk factors has generally been identified by prospective observational designs. These studies may suffer from problems similar to those found in cohort studies of other issues, such as loss to follow-up and variable follow-up time. The identification of fall-risk factors deals with additional problems such as exposure changes during follow-up and recurrent events in the same person. These issues have been neglected and inefficient statistical techniques have been used. As a result, this may have distorted the magnitude in estimates of particular predictors or produced misleading results. Moreover, this may have missed questions of great clinical relevance.[2-5]

More than 15 years ago, Cumming, Kelsey, and Nevitt[6] advised that more attention be paid to repeated measures regarding both risk factors and rates for all falls. Despite this, few researchers have challenged the design of their studies and the analysis of their data. Rather, they seem to have been adversely affected, circumventing the methodological complications by discarding much relevant information.

The aim of the present paper is to raise the awareness of researchers about some epidemiological and statistical considerations. We review the statistical background of methods of fall studies, introduce the philosophical issues of time-dependent covariates and multiple events, and discuss the existing statistical techniques which deal with them. We propose an extension of the Cox proportional hazards traditional model and use it in the identification of potential risk factors associated with all falls in elderly people living at home. Finally, we compare the different results obtained by various statistical methods.

Statistical background of methods of fall studies

A variety of strategies has been used to study the risk factors for recurrent falls. Their analysis is complicated by the within-subject correlation. In other words, the occurrence of an event acts on the risk of the next one. Failure to account for dependence in the data leads to the usual estimator of variance being underestimated. This produces confidence

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intervals that are too narrow and a test of significance too liberal (i.e. rejects the null hypothesis too often).[3,5,7]

A summary of some of the discussed methods is provided in Figure 1. A simplistic approach to such problems involves reporting the proportion of fallers (subjects who fall at least once over an arbitrarily defined period) or the time to a first fall.[8] Both possibilities avoid the underlying assumption of independent association between multiple events. However, the use of all available data for each individual could be more efficient.[4,8,9] The author of a key paper has argued that the incidence rate for falls was a public health priority[6], particularly for less robust elderly people.[10] The challenge in analysing all falls arises because some elderly are more prone to recurrences than others; hence, they run a higher risk of fall-related injury as opposed to those who fall only once. The choice of outcome, according to whether the focus is on fallers or on the rate of falls, could also affect the conclusion; i.e., knowing whether a particular exposure constitutes a risk factor. Stable over-time factors are more likely to be related to the state of "being a faller" than exposures that vary over time.[6]

Alternatives have been proposed for dealing with multiple events. Among these are the negative binomial regression, some extensions to the Cox proportional hazards model, and a modified logistic regression. The dependent variable in the negative binomial regression is the individual event rate adjusted for the follow-up time i.e., the number of falls for a person divided by their specific follow-up time (Figure 1).[4,11] Since the negative binomial distribution has one more parameter than the Poisson, it naturally accommodates for over-dispersion (i.e., the variance typically exceeds the mean).[8] Therefore, this approach is robust for dependent structure data, and suitable for frequent and recurrent events.

One problem using event rates is that the likelihood of event occurrence must be assumed to be constant through time within one participant. A critical example could be to consider the equivalent event rates for three

participants, each of whom is observed over three years and suffers three falls. One has fallen once each year, another three times in the first year, and the last three times in the third year. The outcome variable ignores the time of occurrence of these events.[8] Thus, a negative binomial modeling event rates may not be the method of choice when the value of important covariates or the likelihood of event occurrence changes with the passing of time.[3] Greater efficiency and accuracy can be obtained by modelling the lengths of inter-episode intervals via time-to-event techniques.[9] Rather than focusing on the numbers of cases, the time-to-event approach considers the time between falls. If the incidence rate is high, the intervals between events will be short, and vice versa.[3]

In addition, measured risk factors of which we want to evaluate the effects are usually only fixed variables, defined at the initial examination.[2] They refer to the intrinsic characteristics of the subjects (e.g., the sex), the past exposures (e.g., prior falls) or exposures present at baseline (e.g., use of medication). Exposures that occur after the starting point or vary over time for an individual are not taken into account. Examples, which can potentially cause falls through short-term exposure preceding the event, include environmental hazards, alcohol consumption, and use of medication. A great advantage of the time-to-event approach is its ability to handle time-dependent covariates.[3]

The hazards models include the counting process of Andersen & Gill[16] (hereafter referred to as AG), the conditional model of Prentice, Williams, & Peterson[17] (PWP), and the marginal model of Wei, Lin, & Weissfeld[18] (WLW). None of these approaches explicitly models the dependence structure between failure times. Instead, robust estimates of variance are used to account for correlated observations within subjects; i.e., the so-called «variance-corrected» hazards models.[12-15]

The distinction of the hazards methods can be seen in terms of who is in the risk-set at each failure.[15,19] The AG rests on the strong assumption that the risk of an event for a given subject is unaffected by any earlier

events, unless a term that captures such dependence (i.e., number of previous falls) is included as a time-dependent covariate.[3,7] In other words, the data for each subject with multiple events could be described as data for multiple subjects, where each has delayed entry and is followed until the next event (Figure 1). This model ignores the order of the events; i.e., all falls are indistinguishable, leaving each subject to be "at risk" for an event as long as the subject is still under observation at the time the event occurs.[3,7,8,13-15,19]

The PWP is based on the idea that a subject is not technically at risk for a later event until all previous events have been experienced. This is accomplished by stratifying data by event order. Accordingly, the risk-set at time t for the kth event is limited to those subjects under study at t who have already experienced k-1 events (not exemplified in Figure 1).[13-15,19] However, Robertson[20] has argued that the conditional assumption of the order of events does not hold for falls. As an illustration of her argument (personal communication), let us speculate that a person has slipped on water on the kitchen floor without injury and, at another time, has fallen on the pavement outside. This has resulted in a hip fracture. The person is at risk for both these falls from the beginning of the study period; i.e., the time at risk for the second fall on the pavement does not start only after the first fall in the kitchen has occurred.

The risk-set of the WLW marginal approach includes all patients under observation who have not yet experienced the kth event. The time for each event starts at the beginning of follow-up time for each subject. Furthermore, each subject is considered to be at risk for all events, regardless of how many events each subject has actually experienced. The WLW does not impose any dependence structure among the related failure times. Thus, it ignores the ordering of events but takes into account previous events by situating each failure in an independent stratum (Figure 1).[4,7,8,13-15,19]

The logistic regression analysis is the most commonly used method in epidemiological

research. D'Agostino et al.[21] showed that a so-called pooled logistic regression is identical to the time-dependent covariate Cox regression. This is what makes the technique attractive to evaluate the relationship of risk factors to disease development. O'Loughlin[22] applied such an approach to the study of falls. The theoretical basis for the use of this logistic regression variant is well established when the intervals between measurements of risk factors are short, the probability of an event within an interval small, and the intercept for the pooled logistic constant across intervals.[21] The underlying statistical requirements and the data setup for the pooled logistic regression are very close to those defined for the AG. Each of the follow-up intervals for a single subject is assumed to represent intervals from different subjects. The method pools the subjects at risk and the events developed in each interval. The follow-up interview number is included as a categorical variable to test this assumption. Similarly, the dependence between multiple falls within the same individual is accounted for by considering the occurrence of previous falls as a predictor variable.[23]

However, the way in which the interval observations are set up, as well as the outcome variable of interest, differs in both methods. The AG builds the intervals according to the precise dates of events. For example, the first interval will cover the time span from entry into the study until the time of the event, and the following interval spans the time from the first event to the next one, and so on (Figure 1).[15] In contrast, the logistic regression uses stable time points fixed by the researcher. For example, an exam could be performed at the same date each month to up-date risk factors and to gather information on falls that occurred in the interval of observation (not exemplified in Figure 1).[22,23] The analysis above is, in essence, an investigation of fallers versus non-fallers in successive short intervals.[22] Even if, taken as a whole, the analysis allows for more than one outcome to occur per subject, less appreciated is the fact that it

FIGURE 1
Schematic representation of statistical models for the study of risk factors for falls
(Modified from a figure published by Robertson, Campbell and Herbison[8])

Hypothetical subject with follow-up of 12 days, falls on day 5 and 8. Let (0) represent no fall and (1) a fall, x_i a risk factor of subject i measured at time t, and k_i its number of falls. Then the baseline hazard is illustrated by $\lambda_0(t)$, the hazard for a fall for the ith subject by λ_i and the hazard of the kth fall for this subject by λ_{ik}. Person-time, pt_i is length of time at risk for subject i, $\beta'x$ denotes the effect size of factor x, p is the probability of event in exposed, e, and unexposed, u, subjects.

Standard Cox regression. One data record covers entry until the 1st fall and discards any information past that point. Total follow-up time is assigned to individual that never fell. The dependent variable is time to first fall.

$$\log\left(\frac{\lambda_i(t)}{\lambda_0(t)}\right) = \beta'x_i(t)$$

Andersen-Gill Cox regression. Three records cover entry until the 1st fall, from the 1st until 2nd fall, from the last fall to the end of follow-up, the latter period being fall-free. The dependent variable is time to each fall.
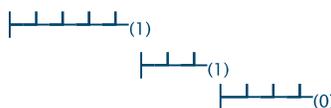
$$\log\left(\frac{\lambda_i(t \mid x_i(t))}{\lambda_0(t)}\right) = \beta'x_i(t)$$

Marginal Wei, Lin & Weissfeld regression. Three records. Each fall as well as the final fall-free period are treated in an independent stratum and time measured from entry. The dependent variable is time to each fall.
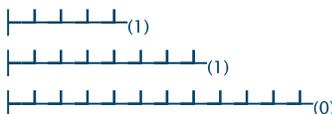
$$\log\left(\frac{\lambda_{ik}(t \mid x_{ik}(t))}{\lambda_{0k}(t)}\right) = \beta_k x_{ik}(t)$$

Negative binomial regression. One record covers entry until the end of follow-up and includes simply the total number of falls and follow-up time per subject. The dependent variable is number of falls.

$$\log\left(\frac{k_i}{pt_i}\right) = \beta_0 + \beta'x_i$$

Logistic regression. One data record, which does not account for follow-up time and ignores multiple falls by subject. The binary dependent variable is status of faller.

$$\log\left(\frac{\dfrac{p_e}{1-p_e}}{\dfrac{p_u}{1-p_u}}\right) = \beta'x_i$$

drops all additional falls that may occur in each particular interval. It seems obvious that if three falls per month are considered equivalent to one fall for the same period, the information translating the intensity of short-term phenomena is lost.

The choice of one of these models must be made starting from *a priori* ideas on the types of relationships which exist between the covariates and the risk of falling. In negative binomial regression, AG, and pooled logistic regression, no distinction is made between the various events that succeed one another. This restricts the baseline hazard and the regression coefficients do not vary according to the rank of recurrence. A history of previous falls is strongly recognized as a predictor of subsequent falls.[10,23] Intuitively, we would expect a first fall to differ from the aetiology of the subsequent falls. The predictors for one fall that can occur by accident might be different from those for recurrent falls that can be associated with one's health condition.[24,25] Hence, researchers and practitioners may be interested in knowing not only the overall covariate effects on the risk of all failures, but also the specific effects of independent variables for the first, second, or subsequent events. The binomial regression, AG, and pooled logistic regression, contrary to the WLW, provide no insights to answer such questions. In accordance with the structure of the data to be analyzed and the research question to be answered, the WLW is expected to be a naturally more appropriate method for studying the risk factors of falls.

Methods

Subjects and procedures

Subjects were volunteers recruited bet-ween March 2002 and July 2005 to form an open cohort that included community-dwelling persons, aged 65 years and over and receiving home-care services. People who could speak neither French nor English, those not able to walk more than six meters, and those with reduced communication and cognition were

excluded. All subjects gave informed consent. The study was approved by the authorities of each participating centre.

This study is a part of a research project on the evaluation of a multifaceted preventive intervention.[26] Participants were visited at home, at entry and every six months, by a trained physical rehabilitation therapist in order to ascertain information about potential risk factors. A fall was defined as an event resulting in the subject inadvertently coming to rest on the ground, floor or other lower level (e.g., stairs). Excluded were sports-related falls.[23] Subjects were asked about falls in the three months preceding the initial interview and were monitored for new falls by use of a daily completed calendar and monthly phone calls.

Material and social forms of an ecological deprivation index were imputed to participants, using postal codes to match geographic areas of residence with Canadian census data.[27,28] Nutritional risk screening was performed on a graded 13-point scale tool.[29-32] Body weight was self-reported and height was measured using standard techniques. Gait, balance, and mobility performance were assessed by the Berg scale[33-36] on a 56-point scale, and by the Timed Up & Go test[37,38] which measures the overall time, in seconds, to complete a series of functional tasks. Subjects' homes were assessed for 37 potential environmental hazards using the Gill's room-by-room assessment form[39,40] Housing types included: single-family house; apartment; row housing or other unique entrance dwelling units; private residential facilities for seniors; other housing, including room in shared accommodation. Data about the use of benzodiazepines (yes/no) and number of daily consumed prescribed drugs were recorded directly from the containers. A detailed history of alcohol consumption was obtained through a questionnaire developed by the Québec Institute of Statistics.[41,42] Responses were categorized for both drinking in the preceding week

(yes/no) and usual drinking during the last 6 months (non-drinker, ≤ 2 times a month, 1-6 times a week, every day). Generally, higher values of the measurements denoted higher risk or impairment, except for the Berg scale where the opposite was true.

Statistical analyses

Descriptive analyses were carried out using SPSS® 13.0; regression analyses using SAS® 9.1. The adjusted effects of subject characteristics on the likelihood of falling were investigated using three survival-analysis techniques (conventional Cox regression, AG extension, and WLW extension), a negative binomial regression, and a logistic regression.[15,43]

The dependent variable in all survival analyses was time to fall for each participant during the follow-up, measured in days. Only cases with at least one month of follow-up fall data were included. Subjects were censored upon reaching 18 months of follow-up (optional voluntary drop out), end of study, or time of withdrawal for any reason. Repeated falls were considered as occurrences of the same type of indistin-guishable events. Survival analyses were performed with all covariates measured on baseline only and with updated covariates. Baseline covariates included age, sex, number of falls in the three months prior to study entry, type of residence, and deprivation index. For the time-varying covariates, including BMI, nutritional risk, alcohol consumption, home environmental hazards, gait and balance, use of benzodiazepines and all medications, the measurement closest to the time preceding the fall was considered.[2] Measurement of exposure to the middle of the follow-up period was used in the case of the people who did not fall. Thus we tested the null hypothesis that the exposure collected during the follow-up was not associated to the risk of falling thereafter.[2] No proportional hazards assumption was required in Cox with time-dependent covariates procedure, since the hazards depended on time.[2,43]

TABLE 1
Adjusted relative risk estimates of factors for falls among the community-dwelling elderly, according to different statistical regression methods

	1 Logistic (fallers[c])	2 Negative binomial (all falls)	3a Standard Cox/WLW (first fall)	4a AG Cox[a] (all falls)	5a WLW (all falls)	3b Standard Cox/WLW (first fall)	4b AG Cox[b] (all falls)	5b WLW (all falls)
Risk factor			with baseline covariates[d]				with time-varying covariates[e]	
Home hazards (nb)	–	–	–	–	–	1.12****	1.08***	1.19****
BMI (kg/m²)	–	–	–	0.98**	–	–	0.98**	0.99*
Berg score	–	0.98**	–	0.98****	0.98***	0.99**	0.98****	0.99****
Time Up & Go score	–	–	–	–	0.99**	–	–	–
Male	1.47*	–	1.25*	–	1.22*	1.34**	–	1.30**
Age (yrs)	–	0.97**	–	0.97**	0.98**	0.98*	0.97**	0.98***
Residential facility housing	–	–	–	–	1.29*	1.45**	–	1.61****
One prior fall[f]	1.95***	1.41*	1.47***	1.40**	1.26*	1.45***	1.37*	1.24*
Two or more prior falls[f]	3.28****	3.15****	2.35****	2.31****	2.12****	2.07****	2.21****	1.86****

Significant (two-tailed): *$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$; ****$p \leq 0.0001$
Included number of previous falls during the follow-up as a time-dependent covariate to account for dependence between falls:
[a] IRR =1.10****; [b] IRR =1.09****.
[c] Subjects monitored less than 12 months who did not declare any falls ($n = 221$) were excluded, given that we could not define the status of faller.
[d] All covariates measured on baseline only; [e] up-dated covariates included home hazards, BMI, Berg and Timed Up & Go scales.
[f] History of falls in 3 months preceding initial interview.

The dependent variable in the logistic regression was the state of being a faller (subjects who fall at least once) over a 12-month period. The negative binomial and logistic regressions were performed with all covariates measured on baseline. The statistical methods are summarized in Figure 1. The linearity assumption of the relationships was checked for continuous predictor variables. All models were fit using a stepwise-like process to retain any variable in the presence of others with a p-value ≤ 0.05. Robust sandwich estimates of variance were used in the survival-analysis, as well as the negative binomial regression techniques, in order to compensate for the lack of independence between multiple falls.

The WLW approach estimated both common and event-specific β for the first five falls of each subject, as well as the common β for all the observed falls. The number of subjects at risk for a given stratum, after the first fall, was made up of all subjects who experienced a fall in the preceding stratum minus those who were lost in the follow-up; n of subjects at risk for a given pooled fall group was made up of all subjects under observation in all considered strata, as if subjects in each stratum represented a different subject. Each model was examined both with and without past fall strata, as it could have masked the effects of other variables of interest.[6,23]

Results

Study subjects

Of the 959 persons who met the study inclusion criteria, agreed to participate, and received a home visit, 22 withdrew without completely filling the baseline assessments or before one month of follow-up. Mean and median follow-up times of the remaining 937 subjects were 488 and 458 days, respectively (range, 27 to 1330 days). Some 549 subjects (57.2%) remained in the study at 12 months and 377 (39.3%) at 18 months. Respondents were mainly women (75.7%). Mean age (standard deviation) was 79.5 (6.7), of which 76.4% were 75 years of age or older.

Thirty-nine percent (39.0%) experienced at least one fall in the three months prior to study entry and 14.9% had two or more.

Comparison of statistical methods

Table 1 summarizes the differences in relative risks for falling obtained through several statistical methods. Firstly, the logistic regression (1) and time-to-first fall using a standard Cox (3a) overlooked the recurrence of falls and identified less significant risk factors than did the negative binomial (2), AG (4a), and WLW (5a), that considered all the available information (number between parentheses refers to the concerned model in Table 1). Although both logistic regression and standard Cox identified the same risk factors, logistic regression ignored the time of occurrence of falling. This led to a conclusion of higher magnitude of the related relative risks, compared to standard Cox. The values obtained by the logistic regression were between 17.6% (1.47 vs 1.25) and 39.6% (3.28 vs 2.35) greater than those of standard Cox.

Secondly, three methods - the negative binomial regression (2), the AG (4a), and WLW (5a) extensions of the Cox model considered follow-up time, rate of all falls, as well as dependence between falls, using robust estimates of variance. WLW revealed more significant fall-risk factors than the other methods and accorded less importance to the history of falls in the three months preceding the initial interview. Notably, the negative binomial regression, in relation to the WLW, exhibited a difference of 48.6% (3.15 vs 2.12) for the variable "two or more prior falls". The different emphasis given by these three approaches to the dependence among multiple event times explains the difference in results. The negative binomial regression does not integrate the length of inter-fall intervals. The AG explicitly models the impact of earlier falls on future events. In this regard, the incidence rate ratio (IRR, virtually equivalent to the so-called hazard ratios) of 1.10 of the time-dependent term "number of previous falls" modelled in the

AG (4a) indicates a 10% increase in hazard for each unit increase in number of prior falls. In contrast, WLW estimates separate relationships for each fall and computes the coefficients and the within-subject correlation more directly than the AG, thus providing efficient weighted average estimates of effect (and variance).

Thirdly, results were compared for the models both with and without time-dependent covariables. The number of home hazards, an exposure particularly likely to vary during the follow-up, was not significantly associated with falls in any of the models that had only baseline covariates (1 to 5a). On the contrary, the variable was always statistically significant in the same models that controlled variation of exposure throughout time (3b to 5b). All survival models with time-varying covariables identified a greater number of fall-risk factors than did the corresponding technique with only baseline covariates (3b vs 3a, 4b vs 4a, and 5b vs 5a), even when estimates were calculated from the robust

variance. A more marked difference was noted between techniques that modeled only time to first fall and those that took into consideration time to each fall. For the marginal WLW model, inattention to time-varying covariables produced bias in various directions. Lastly, results from the usual methods of analysis of risk factors for falling (1 and 3, in Table 1) produced considerable biases relative to the WLW model using time-dependent covariates (5b).

Risk factors for falls

The sample of 937 subjects reported 1,270 falls during a total of 457,283 person-days of observation, given that a same person could report more than one event. Among the subjects, 495 had no falls, 192 experienced one episode, and 250 had more than one. The consideration of the first five falls gathered 90.0% of the 442 fallers and 95.3% of the 937 individuals in the sample. Of all falls for which information on consequences was

TABLE 2
Adjusted and variance-corrected WLW incidence rate ratio by selected risk factors for falls among the community-dwelling elderly, according to the fall rank or pooled fall group

| Risk factor | Fall rank number | | | | | F^{st} 5 falls | All falls |
	1 $n^a = 937$	2 $n = 429$	3 $n = 244$	4 $n = 140$	5 $n = 93$	$n = 1\ 843$	$n = 2\ 169$
Falls (nb)	442	250	144	99	66	1 001	1 270
Home hazards (nb)	1.12****	1.19****	1.20****	1.17***	1.36****	1.16****	1.19****
BMI (kg/m²)	–	–	0.95***	–	–	[0.99*]^b	0.99*
Berg balance score	0.99**	0.98***	0.98**	–	0.97***	0.98****	0.99****
Benzodiazepine use	–	1.37*	–	–	–	[1.22**]	[1.21*]
Alcohol use, past 6 months							
≤ 2 times per month vs. other categories	–	–	1.50*	–	–	[1.20*]	–
Male	1.34**	–	–	–	2.02**	1.28**	1.30**
Age (yrs)	0.98*	–	0.97*	0.96*	–	0.98**	0.98***
Residential facility housing	1.45**	1.70**	–	–	2.52*	1.51***	1.61****
Material deprivation index							
Fourth vs. other quartiles	–	–	–	–	3.81****	–	–
One fall prior initial interview^c	1.45***	–	–	–	–	1.37***	1.24*
≥ 2 falls prior initial interview^c	2.07****	1.65**	2.15****	1.49*	–	1.95****	1.86****

Significant (two-tailed): *$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$; ****$p \leq 0.0001$.
^{a} n of subjects at risk for the considered fall stratum or pooled fall group.
^{b} The brackets show the variables had not reached statistical significance after "previous falls" were introduced.
^{c} History of falls in 3 months preceding initial interview.

available, 44.4% resulted in injuries, 25.2% in activity limitations, 17.1% in a medical consultation, and 5.6% in a hospitalization. Altogether, 82.1% of falls occurred in the subjects' home.

Table 2 displays the adjusted associations between the potential risk factors and the incidence rate for specific and pooled falls. The WLW marginal risk estimates for the first fall stratum in Table 2 are precisely the same as would occur if the analysis were restricted to data on time to first fall using a standard Cox model (column 3b, in Table 1). The only difference is that the *p*-values presented in the former were calculated from the robust rather than standard ("naïve") statistics. However, while the estimates for the first fall stratum are essentially equivalent in these two cases, results for the other strata vary substantially according to whether coefficients are calculated from robust or from naïve methods, providing some indication as to the degree of dependence among the events. Thus, male sex, residential facility for seniors, number of home hazards, Berg balance score, and age significantly and independently predict time-to-first fall. For example, the IRR = 1.45 found for the residential facility for seniors indicated that the subjects living in such places experienced falls at a rate which was 45% higher than for those living in any other kind of housing. Similarly, the IRR of 1.12 for the home hazards indicated a 12% increase in hazard for each unit increase in number of items. However, since age has an IRR of less than 1 (i.e. 0.98), increase in age by one year led to decrease in hazard by 2%.

Table 2 also compares the results when distinct β were fit for each fall. Covariates as age, home hazards, and Berg scale show sustained and relatively constant effects across the strata. Some others differ both in the nature and magnitude of the statistically significant variables, depending on their position in the sequence. The greatest differences in IRR appear in the fifth episode. The entry, in the last step of history of falling in the three months prior to study entry, turned out to be highly significant and did not alter either the magnitude or significance of the IRR for the other variables already included in all stratum models. The right-hand section of Table 2 repeats the analysis under the constraints of overall common β (weighted average of the event-specific hazards), both when falls beyond the fifth were not applied (censored model) and when all fall data were utilized (complete model). The censored model identified seven variables, three more than the time-to-first-fall model (BMI, use of benzodiazepines, and occasional alcohol consumption in the past six months of follow-up) and one more than the complete model (alcohol consumption). However, these additional variables were no longer significant in the context of the contribution of all others, once the history of falling was joined to the censored model; furthermore, the use of benzodiazepines and alcohol consumption became insignificant in the complete set. An age-sex interaction term tested in each final model was not significant.

Discussion

This article addresses the proper method of examining falls and their determinants. No statistical technique can reproduce human behaviour exactly, and makeshift solutions to time-varying exposures and recurrence of events can lead to severe bias. To our knowledge, the first and only example where time-varying exposures and multiple falls were ascertained simultaneously was in a doctoral thesis deposited in 1991[22] and published later in a scientific review.[23] However, substantial statistical progress has appeared since then. In the current issue, we discuss the various methods for studying the exposure changes during follow-up and recurrent events in the same person. We further illustrate them by identifying the risk factors for falls in the elderly. We have concentrated on the statistical/methodological aspects and have mentioned the risk factor findings only to the extent of showing different results obtained by different analyses.

Methods that handle the aforementioned data analytical features in a statistically correct manner are now available in commercial packages. They have been addressed extensively in the statistical literature, but not yet routinely applied and reported for fall studies, as new advances in the statistical world are often slow to reach the clinical and public health fields.[4] We have presented throughout our paper our arguments as to why the WLW approach is expected to be an appropriate choice in the context of our study. It provides a natural framework for analysing time-varying exposures and multiple events data using minimal assumptions.[2,44] Other authors have reported that the WLW is robust and performs quite well in many practical situations.[14]

The differences in the estimates obtained through several statistical methods analysing the risk factors for falling, have been illustrated according to the information provided. Results clearly reveal that the usual methods, such as binary outcome using a logistic regression and time to first fall using a standard Cox, produce considerable biases, as opposed to the WLW model that uses time-dependent covariates. In addition, modeling for first events implicitly assumes that the first event is representative of all events. Our study denotes that this assumption is questionable, more in the qualitative facet of IRR estimates than in the quantitative. Our results provide additional evidence regarding the convenient choice of a stratified model rather than a non-stratified one, given that the risk of occurrence varies substantially between occurrences. Mahé and Chevret[45] expect such possibilities when the frequency of events per unit is "small", such as falls among community-dwelling elderly people.

Furthermore, our results are coherent with earlier findings, although we are more confident of the magnitude in estimates of predictors. A few findings merit comment. Number of home hazards and history of falling are strong and consistent predictors of falls, whatever their rank or pooling. Prior overall falls increase the risk of subsequent overall falls. This suggests that if the causes of past falls - for which the variable acts as a proxy - are not corrected, the chances of sustaining further falls due to the same causes are increased.[23] The people living in a residential facility for seniors are more at risk than others to fall, possibly because the variable

acts as a surrogate measure of various chronic conditions and poorer functional autonomy. Similarly, younger people reveal themselves to be at a higher risk of falling compared to the older, probably because of more vigorous lifestyle activities.

We further hope to eliminate any misunderstanding about any incidence measures reported in the research literature, especially the dubious *events per person-time* relating the number of falls (single in some subjects, multiple in others) to the cumulative time of observation of all subjects. It should not be confused with the *individual event rate adjusted for the follow-up time* that we discuss in our paper, or with the *incidence rate* widely used in epidemiology. In the events per person-time measure, the numerator does not express a number of subjects wherein the event only occurs once, but rather a number of events scattered among the study subjects. Windeler and Lange[46] have vigorously denounced this concept because it has no exact interpretation on an individual level. Hence, event rates are the same (20 per 100 person-years) whether 20 subjects are observed for 10 years and each suffers two falls, or 1000 subjects are observed for half a year and 100 (10%) of them have one fall each. Having been introduced in the '80s and still, unfortunately, sometimes reported in peer-reviewed journals[47-50], this concept should be abandoned,[46] as it impedes the search for new approaches.

Happily, prospective design, frequent contacts, repeated measures, and clinical measurements performed by a therapist limited information bias. Nonetheless, some other exposures, such as nutrition screening and alcohol use, were derived from self-reports. Differential misclassification could occur if the fact of a fall or recurrent falls affected the accuracy with which the individuals recalled relevant exposures and subsequent outcomes. This would exaggerate the magnitude of the effect on the risk of falling.[6] Also, the length of time between a fall and the measure of follow-up exposure obviously varied according to the day on which the fall occurred. Hence, an accurate assessment of exactly when a change in exposure to time-dependent covariates might have happened between each six-month follow-up was not possible. It would result in non-differential errors in the measurement of exposures, thereby diluting the observed relation. Another potential for biased results might have occurred because of dropouts, particularly when the latter do not have the same rate of outcome (risk of falling) as those who continue in the study. With the exception of people who refused the services and who were less likely to fall, as opposed to the active participants completing the study, no other reason for loss to follow-up was associated with the falls. Male sex, ageing, residential facility for seniors, first quartile deprivation index, lower Berg score, and daily alcohol consumption at baseline were associated with a significant shorter duration in participation. As Campbell *et al.*[51] have already noted, those individuals who are more frail and may be at greater risk of falling are the ones most difficult to involve and sustain in follow-up. This would also lead to an underestimation of the effects.

All the aforementioned considerations lead us to believe that the results observed in our study tend to be conservative. A practical drawback of the WLW is the pre-processing effort and care required in the dataset construction. The application of this method depends on the completeness of the reports of falls and knowledge of calendar dates of falls. Future research must make the transition from risk factors for falling to community implementation of interventions.

Finally, it would be useful to talk about two substantive clinical findings that have been deleted from the text. Firstly, the degree to which balance and gait mediate the relationship between medication and the likelihood of falling was estimated.[6] A mediator is an intermediate variable that occurs in the causal chain between an exposure and an outcome. If a variable is truly in the causal pathway, the association between the latter two variables should disappear upon adjustment for the mediator.[52] Adjustments for Berg balance scale resulted in a maximum increase of 21% in the effect of benzodiazepines, contrary to the hypothesized reduction. Consequently, the covariate does not act as a mediator or as an appreciable confounder.

Secondly, falls leading to a medical consultation were examined as a secondary outcome, hypothesized as a measure of severity. For these cases, a variable "previous falls" was included as a time-dependent covariate. It was created to consider whether a fall not resulting in a medical consultation had been reported in the three-month period preceding any fall-related medical consultation. Adjusted results identified the number of home hazards (incidence rate ratio = 1.09), the nutrition screening score (1.09), living in a residential facility for seniors (1.67) and fall history (1 prior fall = 0.59; ≥ 2 prior falls = 0.64) as significant and independent predictors for all pooled fall-related medical consultations. Having fallen in the three months before each new event under study was protective against any fall for which people sought medical attention.

Acknowledgements

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Gender and the smoking behaviour of Ethiopian immigrants in Toronto

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Abstract

The objective of this paper is to present descriptive data on gender and smoking among Ethiopian immigrants in Toronto, Canada. The study used a cross-sectional epidemiological survey design (N = 342). The main outcome measures identified subjects as current (regular or occasional) smokers, daily smokers and former smokers. Overall, 20.8% of the individuals in the sample were current smokers and 15.7% were daily smokers. Although smoking rates (current and daily) were significantly higher among males compared to females, nearly twice as many female as male daily smokers reported that they began smoking post-migration (60.0% vs. 30.2%). Furthermore, 80.0% of female compared to nearly 56% of male daily smokers reported that they were smoking more post-migration. A significantly higher proportion of males compared to females were former daily smokers (17.8% vs. 4.4%). These findings present a challenge for public health professionals in terms of preventing the adoption of smoking among Ethiopian females and facilitating smoking cessation among Ethiopian males. Correlates with current smoking suggested that smoking prevention and cessation programs in newcomer immigrant communities may benefit from incorporating social, economic and religious contexts of these newcomers' lives from a gender-specific perspective.

Key words: smoking, immigration, gender

Introduction

Smoking is a major risk factor for mortality and morbidity.[1,2] Several studies suggest that smoking rates among immigrants to Western countries have increased and this is why many cancer rates among immigrants are converging with those of the native-born population.[3-5] Risk and protective factors associated with smoking behaviour are well documented in the literature. These include age, gender, religiosity, level of education, employment, stress and social support.[6-9] Among these, gender is a particularly prominent factor for immigrant communities, with female immigrants typically exhibiting significantly lower rates of smoking than males.[10-13,16] However, few studies have examined smoking and correlates of smoking among *recent* immigrants to Canada. This information is critical to

inform the development of smoking prevention and cessation strategies targeting newcomer communities. This study draws on a community survey of Ethiopian immigrants and refugees in Toronto, Canada. The purpose of this paper is to present descriptive data on the smoking behaviour and on the risk and protective factors associated with smoking in this population.

Literature Review

Post-migration changes in smoking behaviour are well-documented[3-5]. Less well documented are the determinants of smoking in immigrant populations although proposed models to explain these changes include prolonged exposure to stressful events, adverse circumstances such as

disadvantaged socio-economic status or the loss of social networks, smoking behaviour as a coping response to discrimination and poverty, and acculturative changes in beliefs, values and norms about smoking.[14,15]

It is further recognized that immigrants are not a homogeneous group.[15] Using data from the 1996 National Population Health Survey and the 2000-01 & 2002-03 Canadian Community Health Surveys, McDonald[16] found major differences in smoking rates within Canadian immigrants characterized by gender and length of stay in the host country. For example, both immigrant males and females showed an increase in rates of smoking by length of stay in Canada but after adjusting for differences in demographic and socio-economic characteristics, there was only evidence of significant convergence for male immigrants. Regional differences were also observed. For example, among non-English speaking immigrants born in countries outside of Europe, immigrants from the Middle East and Western Asia were more likely to smoke compared to immigrants from East Asian countries (control group), while immigrants from Southern Asia were less likely to smoke compared to the control group. The log-odds ratio for daily smoking for African immigrants was not significantly different from that of the control region of birth.

Gender is increasingly being recognized as a determinant of immigrant women's health.[17] Gender is known to influence both settlement processes as well as cognitive schemas about health.[17,18] The intersections of gender with minority

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status, income, employment and social integration may impact directly on exposure to stressful events and indirectly on health.[18-20]

Few studies have examined the smoking behaviour or psychosocial and economic determinants of smoking behaviour among specific immigrant populations by gender. It seems clear that to address identified knowledge gaps, smoking research needs to include: 1) studies of the prevalence and correlates of smoking in specific immigrant communities; and 2) intersectional studies that examine smoking behaviour from both a gender and a migration perspective.

Study Background

Since the mid-1970's, Ethiopia has experienced a major exodus of refugees. An estimated 1.25 million Ethiopians fled to neighbouring countries, such as Sudan, Kenya, Djibouti and Yemen, and a relatively smaller proportion of Ethiopians immigrated to Europe and North America.[21] Between 1974 and September 1998, over 13 000 Ethiopians migrated to Ontario.[22] According to the Ethiopian Association in Toronto, the current Ethiopian population of Toronto numbers from 45 000 to 50 000. In 1997, a partnership was formed between the Culture, Community and Health Studies Program of the Centre for Addiction and Mental Health and the Ethiopian Association in Toronto to examine mental health, health, and access issues experienced by the community. The current paper draws on an epidemiological study, Pathways and Barriers to Health Care for Ethiopians in Toronto, conducted by the authors, that collected extensive data on the health and resettlement experiences of this community. Ethics approval for this research was obtained from the University of Toronto Ethics Board.

Methods

Sample and Data. The study used a cross-sectional epidemiological survey design. A variety of strategies were used to recruit subjects. Using a snowball technique, we identified all possible Ethiopian ethnic, religious, political and social organizations in Toronto and obtained membership lists from each organization. In addition, a list of Ethiopian specific names was compiled using the city telephone directory. Since some Ethiopian Islamic names (e.g. Mohammed, Osman, Fatuma) could not be readily distinguished from non-Ethiopian Islamic names, the Islamic names from the telephone directory were compiled separately and given to different Ethiopian Muslim organizations and other Ethiopian associations to identify those who were of Ethiopian origin. We speculated that the Ethiopian organizations and associations in Toronto could know some of these Muslims although they might not necessarily be included in their membership lists. The membership lists from the different organizations, the Ethiopian specific names and non-Ethiopian specific Islamic names from the telephone directory were combined to form a sampling frame.

The resulting sampling frame consisted of 4854 households. From this list, 400 households were selected using simple random sampling method and one individual, eighteen years or older, was selected from each household. Ethiopians who resided in Canada for less than 12 months were excluded from the study. The interviews were conducted by trained Ethiopian interviewers in Amharic. All interviewers underwent extensive training including interview skills training, procedures for contacting potential subjects and general information on immigration, settlement, immigrant health and mental health. The project was announced to the members of the Ethiopian community through religious organizations, community media and a community newsletter. Between May 1999 and May 2000 a total of 342 individuals completed the structured interview with an overall response rate of 85%.

Measurement. Questions on smoking were modelled on those appearing in national and provincial health surveys. All respondents were asked to classify themselves as current smokers (regular or occasional), non-smokers and former daily smokers.

For current smoking status, respondents who were smoking cigarettes at the time of survey, regularly or occasionally, were coded as 1.

Respondents who smoked cigarettes regularly or occasionally were asked whether they smoked daily. Daily smokers were then asked to provide information on the age they began smoking and the number of cigarettes smoked daily. Using information on age of arrival in Canada and the age at which respondents started smoking daily, we were able to determine the post-immigration onset of smoking – respondents who had started smoking daily in Canada. In a separate question, daily smokers were asked to indicate changes in smoking habits since leaving Ethiopia (smoking more now = 1, smoking less now = 2, no change = 3). These two variables were not mutually exclusive.

Former smoking status was determined for respondents who used to smoke daily but now classified themselves as non-smokers or occasional smokers.

An array of potential risk and protective factors were included in the analysis. Marital status was coded as: currently married (1), single, separated, divorced, widowed (0). To determine levels of religiosity respondents were asked to rate the importance of their religious beliefs. Responses were coded as: very important or important (1), not so important or not important (0). Level of education was coded as: high school or less than high school (1), college (2), and university degree (3). Employment was coded as: currently employed (1) and currently not employed (0).

To assess post-migration stress, we used the 14-item recent life events scale included in the Quebec Health Survey (QHS), which was derived from Paykel and colleagues.[23] The QHS included events specifically relevant to immigrant and minority communities (e.g. trouble because people didn't understand your language, trouble with prejudice or discrimination). Stress was computed as the count of events

experienced by the respondents during 12 months prior to the interview.

To assess exposure to pre-migration stressors, subjects were asked whether they had experienced pre-migration traumatic exposures to war and killing (coded as yes = 1, no = 0), or whether they had been interned in a refugee camp (yes = 1, no = 0).

The social support measure used was adapted from Wolchik, et al.[24] Three dimensions of social support were assessed – advice and information, instrumental, and emotional. For each dimension of support, subjective ratings of satisfaction with supports available were obtained on a scale of 1 to 10. In this study, we used the index score that combined the scores of the three dimensions. The scale had internal consistency of 0.96 as measured by Cronbach's alpha.

Data Analysis. Data analysis consisted of descriptive analysis of the study population in terms of socio-demographic characteristics and smoking behaviours. The proportion of the population considered to be former smokers was calculated. Daily smokers were described in terms of the number of cigarettes smoked per day, time of initiation of smoking (i.e. post-migration), and *changes* in smoking habits since leaving Ethiopia.

Correlates of current smoking were examined using bivariate logistic regression analysis. All analyses were gender-specific. Multivariate analyses for females were not conducted due to small cell sizes for female smokers, a limitation of the present study. Thus the results of this study do not identify a model of smoking; rather, potential risk and protective factors associated with current smoking are identified that can be tested in future studies.

Results

Sample Description. Table 1 summarizes data on the socio-demographic characteristics of the study sample by gender. Approximately 60% of the sample was male. The respondents were predominantly a young group with a mean age of 35.3 years, and female respondents were significantly younger than males. The majority of respondents were married (55.4%) and members of the Ethiopian Orthodox church (67.7%). A significantly higher proportion of female respondents considered religion to be *very important* compared to male respondents (96.2% vs. 88.5%). More than two-third of the respondents (67.8%) had some post-secondary education and the majority (78.1%) were currently employed. Compared to males, females were significantly less likely to have a university education and be employed ($p < 0.001$). The average length of stay in Canada was 9.2 years (9.5 years for males and 8.7 years for females). A significantly higher proportion of males

than females experienced pre-migration trauma (26.71% vs. 11.94%) and refugee camp internment (12.6% vs. 7.2%), although in the latter case the difference was not significant. Approximately half of male and female participants had experienced at least one stressful life event. Males and females were similar in their reported levels of satisfaction with social support.

Descriptive Data on Smoking. Table 2 describes the study population by smoking status and gender. Overall, 20.8% of the sample were current smokers (used cigarettes regularly or occasionally). The current smoking rate was 2.7 times higher among male respondents (n = 56, 27.7%) compared to female respondents (n = 14, 10.4%). The gender differential in current

TABLE 1
Description of the study of population by gender

Variable	Total (n = 342)	Male (n = 203)	Female (n = 139)
Age in years (mean ± SD)***	35.4 ± 7.2	36.7 ± 7.3	33.3 ± 6.3
Marital status (married) − (%)	55.4%	56.5%	53.7%
Religion − (%)			
Ethiopian Orthodox	67.7%	72.1%	61.0%
Protestant	22.3%	19.4%	22.3%
Roman Catholic	5.3%	3.5%	8.1%
Muslim	2.4%	2.0%	2.9%
No religion	2.4%	3.0%	1.5%
Importance of religiosity − (%)*			
Religion is important to me	91.6%	88.5%	96.2%
Religion is not important to me	8.4%	11.5%	3.8%
Level of education − (%)***			
High school or less	32.1%	26.0%	41.2%
College education	44.0%	41.0%	48.5%
University degree	23.8%	33.0%	10.3%
Currently employed − (%)***	78.1%	87.6%	64.0%
Length of stay in Canada (mean ± SD)	9.2 ± 4.5	9.5 ± 4.7	8.7 ± 4.2
Pre-migration trauma exposure − (%)**	20.8%	26.7%	11.9%
Refugee camp internment experience − (%)	10.6%	12.6%	7.2%
Number of post-migration life events − (%)			
no stressful life events	50.1%	48.0%	53.3%
1-2 stressful life events	36.2%	36.6%	35.6%
≥ 3 stressful life events	13.6%	15.3%	11.1%
Satisfaction with social support (mean ± SD)	8.3 ± 1.7	8.2 ± 1.8	8.5 ± 1.4

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

TABLE 2
Description of the study of population by smoking status and gender

Smoking variables	Total (n = 342)	Male (n = 203)	Female (n = 139)
Current smoker (regular or occasional) − (%)***	20.8	27.7	10.4
Former smoker − (%)***	12.4	18.3	4.4
Daily smoker − (%)***	15.7	21.3	7.4

Daily smoking variables	Total (n = 53)	Male (n = 43)	Female (n = 10)
Number of cigarettes smoked daily − Mean (SD)	12.0 (6.7)	12.0 (6.7)	11.8 (6.7)
Initiation of daily smoking post-migration − (%)[a]	35.8	30.2	60.0
Increase in daily smoking post-migration − (%)	60.4	55.8	80.0

*** $p < 0.001$; [a] $p < 0.1$

smoking rates was significant ($p < 0.001$). There was also a significant gender difference in the proportion of the population who were former smokers (17.8% males, 4.4% females, $p < 0.001$).

Among the 53 daily smokers, 21.3% (n = 43) were male and 7.4% (n = 10) were female ($p < 0.001$). The mean number of cigarettes smoked daily was similar for males and females (12.0 and 11.8, respectively). Approximately 35.8% of daily smokers (n = 53) started smoking post-migration and gender differences were apparent; only 30.2% of males but 60.0% of females were non-smokers *before* they

left Ethiopia, and began smoking *after* they left the homeland ($p < 0.1$). Gender differences were also apparent among the respondents to the question on changes in smoking habits since leaving Ethiopia. Approximately 56% of male smokers and 80.0% of female smokers reported an increase in smoking post-migration; this difference did not reach statistical significance.

Correlates of Current Smoking. Bivariate associations of current smoking (regular or occasional) with potential risk and protective factors were assessed using logistic regression. Results are shown in Table 3.

Among male respondents, current smokers (compared to non-current smokers), were less likely to report religion as important or very important to them and more likely to have experienced pre-migration trauma, and to have reported higher levels of satisfaction with social support. The same associations were not observed among Ethiopian females. Among Ethiopian females, current smokers (compared to non-current smokers) were less likely to be currently married and more likely to have spent more years in Canada and to have experienced post-migration life events. We found different sets of correlates for males and females. Multiple logistic regression analysis of factors associated with current smoking in men confirmed the results of the bivariate analysis among Ethiopian males. This analysis was not performed for Ethiopian females due to small sample sizes (data available upon request).

Discussion

Our study findings highlight dramatic gender differentials in the smoking behaviour of Ethiopian males and females, which persist post-migration. Striking differences were also observed in the

TABLE 3
Bivariate logistic regression of factors associated with regular/occasional smoking by gender

Variable		Male B	Male OR	Male CI	Female B	Female OR	Female CI
Age (years)		0.012	1.012	(0.97, 1.05)	0.026	1.026	(0.94, 1.11)
Currently married (= 1)		-0.465	0.628	(0.33, 1.16)	-1.587*	0.205	(0.05, 0.77)
Religion very important (=1)		-1.605***	0.201	(0.08, 0.51)	na	na	na
Education	High school or less (=1)	0.041	1.042	(0.44, 2.42)	0.365	1.440	(0.15, 13.11)
	College (=1)	0.428	1.534	(0.74, 3.17)	0.353	1.424	(0.16, 12.66)
	University (reference)		1.000			1.000	
Employment (1 = employed)		-0.235	0.791	(0.32, 1.95)	0.392	1.480	(0.43, 4.99)
Length of stay in Canada		0.031	1.032	(0.96, 1.10)	0.156*	1.169	(1.02, 1.33)
Exposed to pre-migration trauma (=1)		0.720*	2.055	(1.10, 3.99)	-0.610	0.544	(0.06, 4.46)
Refugee camp internment (=1)		0.687	1.988	(0.77, 5.07)	0.067	1.069	(0.11, 9.68)
Number of post-migration life events		0.078	1.081	(0.88, 1.32)	0.335*	1.398	(0.99, 1.97)
Satisfaction with social support		0.209*	1.232	(1.01, 1.49)	0.049	1.051	(0.68, 1.60)

OR = Odds Ratio
CI = 95% confidence interval of the estimated OR
na = No estimate due to empty cells
* $p < 0.05$; *** $p < 0.001$

correlates of current smoking by gender. Among Ethiopian males, factors associated with regular or occasional smoking included pre-migration trauma, religiosity, and satisfaction with social support. Female smokers (compared to non-smokers) were more likely to be married, have spent more years in Canada and to have experienced a higher number of stressful life events.

The results of this study are consistent with gender differentials in smoking rates observed in the 2003 Global Youth Tobacco Survey among Ethiopian students (grades 9-11), which reported smoking rates of 15.2% and 5.7% for boys and girls, respectively.[25] They are also consistent with other studies conducted among native-born and foreign-born populations in the United States that suggest that immigrant women are less likely to smoke than their male immigrant and female native-born counterparts.[9-12] Although McDonald[16] did not find significant increases in the log-odds of smoking among immigrant women by length of stay, similar trends were observed for immigrant women. It is also possible that his findings may have masked country-specific variations in immigrant smoking behaviour.

This study is the first study to collect data on the smoking behaviour of Ethiopian immigrants in Canada. Although current smoking rates in Ethiopia are not available, studies conducted in the 1980s showed that 38% of males and 3.4% of females were smokers,[26] suggesting that male Ethiopian immigrants may have had a healthier lifestyle (e.g. lower smoking rate) than Ethiopians in their home country, but females appear to exhibit the opposite pattern. Still, compared to smoking rates among males and females in the Toronto population as a whole, the smoking rate for Ethiopian males in Toronto (27.7%) was slightly higher (25.6%), whereas the rate for Ethiopian females in Toronto (10.4%) was considerably lower (17.8%).[27]

The data presented in this paper confirm other studies that suggest that immigrant behaviours, such as consumption of a high fat diet, smoking and alcohol abuse, increase over time to resemble those of the majority culture.[13,28-29] Only 44.2% of male- and 20.0% of female- daily smokers reported "no change" in smoking since migration. The vast majority of female daily smokers (80%) and over half of male daily smokers reported that they were smoking more since they left Ethiopia. Furthermore, 18.3% of Ethiopian males but only 4.4% of Ethiopian females could be classified as "former smokers." In the case of male Ethiopians, this is a positive finding, suggesting that the daily smoking rate for Ethiopian males is declining and converging with that of the Toronto male population as a whole. On the other hand, the prevalence of current smoking among females in the Ethiopian community was initially much lower than that among females in the Toronto population as a whole, but may be increasing.

Among Ethiopian males, factors associated with regular or occasional smoking included religiosity and satisfaction with social support. Religiosity had an inverse effect on smoking behaviour (i.e. highly religious people were less likely to smoke). Other studies have found strong religious beliefs and cultural retention to be associated with maintaining health-enhancing behaviour such as a traditional high-fibre diet, non-smoking and non-use of alcohol.[15,30-31] While social support is usually associated with positive health behaviours,[4,32-33] in the Ethiopian community, with regards to smoking, the opposite pattern was observed. This may be because many Ethiopian males, particularly without close family in Canada, socialise in smoking environments such as cafes and bars. The same may not be true for women because of social norms restricting women's freedom of movement and gender role expectations.[21,34]

Pre-migration traumatic experiences were associated with an increased risk of smoking, but only among males. This finding was consistent with other research suggesting strong relationships between traumatic stress and smoking behaviour in non-immigrant populations.[35-36] It is possible that this association was not observed among females because only a small subset of women experienced pre-migration trauma and smoked.

Despite the finding that Ethiopian males experienced more stressful life events compared to Ethiopian females, post-migration stressful life events were only associated with regular or occasional smoking in the latter group. The acculturative stress model proposes that immigrants turn to artificial support when they find the experience of immigration stressful and disorienting. Alternatively, it has been suggested that alcohol and substance use are "learned" as a part of an assimilation process.[37] Our findings suggest that male and female Ethiopian immigrants may use different coping behaviours in response to stress. For example, Ethiopian women may have less opportunity to consume alcohol and drugs and/or these behaviours may be considered less culturally acceptable compared with smoking.

Our finding that females who resided in Canada longer were more likely to smoke is not surprising. A study of pregnant Southeast Asian immigrant females in Montreal found that women who were in Canada longer were less likely to report adequate social support and more likely to report stressful life experiences than newcomer immigrant women.[38] Similarly newcomers' strategies for coping with stress may also change with time spent in the host country.

The present study was the first community health survey of Ethiopian immigrants in North America. Among its strengths are the attempts made to develop a comprehensive sampling frame and the excellent response rate. However the study had certain limitations that must be acknowledged. Firstly, potential candidates were excluded if they had no telephone, stable address or membership status in Ethiopian organisations. Secondly, the low prevalence rate of smoking among Ethiopian females in the study population limited statistical power and prevented the identification of interaction terms in a multivariate logistic regression analysis.

These findings present an obvious challenge for public health professionals and

the Ethiopian community; that is, how to prevent the adoption of smoking among Ethiopian females and how to facilitate smoking cessation among Ethiopian males. Feminist researchers increasingly view smoking and substance abuse not simply as a negative lifestyle choice but as a rational response to real pressures associated with gender and class inequity.[39-40] New immigrant women face multiple and more barriers to maintaining or changing health behaviour, compared to women in the general population.[42-43] Study findings suggest that smoking prevention and cessation programs in the Ethiopian community must acknowledge and address the gender, social and religious contexts of these newcomers' lives. These findings are equally relevant to other newcomer communities in Canada who may experience similar contextual and gender-specific issues.

Acknowledgements:

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Ethnicity and mental health: Conceptualization, definition and operationalization of ethnicity from a Canadian context

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Abstract

The current study provides a critical review of Canadian studies on ethnicity and mental health with respect to the definition, conceptualization and operationalization of ethnicity. It provides a discussion on the methodological issues related to these factors and their implications to guide future research and enable comparability of results across studies. Sociological Abstracts, PsycINFO, MEDLINE and CINAHL were used to identify relevant Canadian articles published between January 1980 and December 2004. The review highlights a number of key issues for future researchers to consider such as the need for: 1) clear rationales as to why ethnicity is important to their outcome of interest; 2) clarity on the definition of ethnicity, which affects its conceptualization and operationalization; 3) a theoretically driven conceptualization of ethnicity, which should be related to the research question of interest; and 4) clear rationales for the decisions made regarding the data source used, the operationalization of ethnicity, and the ethnic categories included in their studies.

Key words: ethnicity, ethnic origin, culture, race, mental health

Introduction

Canada's immigrant population originates from all over the globe with increasing numbers from Africa, Asia, the Caribbean, and the Middle East (i.e. visible minorities).[1] Its culturally diverse Aboriginal population adds to the ethnic mix.[2] Canada prides itself on being a multicultural society by acknowledging the right of every person to identify with his/her cultural background while partaking in the Canadian way of life.[3-6] This was advocated in its 1971 legislated policy on multiculturalism, which emphasized fair treatment of everyone, regardless of race, colour or ethnicity; particularly in terms of educational and occupational opportunities.[3-6] Evidence of systemic inequalities, including access to educational and employment opportunities, housing, health and mental health care, are still evident across ethnic groups,[7,8] which can impact the mental health of the population.[2,9] For instance, Aboriginal peoples continue to have poorer mental health compared to the general population and, along with visible minorities, have ongoing difficulties accessing culturally sensitive mental health care.[9] Better understanding of the relationship between ethnicity and mental health is compelling and highly relevant for policy-makers and mental health practitioners in the Canadian context.

Canadian literature on ethnicity and mental health is quite limited despite its relevance. Much of the existing studies in this area were conducted in the United States (US)[10-15] and the United Kingdom (UK),[16-19] which has uncertain applicability to Canada. The political, social and economic ramifications associated with ethnicity or ethnic identity, likely differ from country to country. Differences in the countries' ethnic compositions, histories of immigration policies and racism/slavery and ethnic or racial categorizations hinder cross-country comparisons. The history of slavery and segregation has a great deal of meaning for ethno-racial groupings in the US.[2] Furthermore, the US is seen as a society that assimilates immigrants by the "melting pot" phenomenon, in which the immigrants are expected to adapt to the American way of life rather than retaining their culture.[3] Canada has not had the same history of racial segregation and is viewed as a mosaic in which immigrants are encouraged to retain their unique cultural background while partaking in the greater Canadian society.[3,6,20] Also, Latin Americans comprise a larger component of the US immigrant population than Canada's.[2,3]

The time of arrival and ethnic composition of the immigrant population in the UK and Canada also differ. Up to 1962, citizens of previously colonized countries such as Jamaica and India (countries that remained within the Commonwealth) were granted open access and actively recruited for

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immigration to the UK.[21] During this time, Canada's immigrant population came primarily from Europe, the UK and the US.[22,23] Post-1971, when the UK changed its immigration act, the majority of its immigrant population originated from Europe and South Africa,[21] while the majority of Canada's immigrants came from Asia, Africa, the Caribbean, Latin America and the Middle East.[23-26] These points indicate that results based on UK and/or US data might not be applicable to Canada.

With respect to the operationalization of ethnicity, variations exist across the literature on ethnicity and mental health. Lack of a clear definition of ethnicity and ongoing debate regarding how the variable should be conceptualized might account for this.[27,28] Other factors such as data source used, feasibility, time period of data collection, region of study and sample size also affect the operationalization of the variable. To date, there is no seminal Canadian paper that discusses the methodological issues related to the definition, conceptualization and operationalization of ethnicity and their implications, to guide future research and to enable comparability across studies. This paper provides a critical review of the original empirical Canadian studies on ethnicity and mental health with emphasis on these issues. A general overview of the definition and conceptualization of ethnicity is first provided to guide the review process. Quantitative studies involving population-based data with more than one ethnic group are highlighted.

Methods

The bibliographic databases Sociological Abstracts, PsycINFO, MEDLINE and CINAHL were used to identify relevant original empirical studies that were quantitative in nature for this review with the application of Group 1 and 2 search terms outlined in Figure 1. Studies were included if they: 1) concerned ethnicity and mental health; 2) involved data on

Canadians; 3) involved more than one ethnic group; 4) were published between January 1980 and December 2004; and 5) were quantitative in nature.

General review articles and chapters on the theories and definition of ethnicity, not specific to Canada, were used to provide an overview on the definition and conceptualization of ethnicity. As well, they guided the critique of the identified studies on ethnicity and mental health reviewed herein. Articles on ethnicity and immigration policies specific to Canada were used to provide historical context to facilitate understanding of the ethnic composition of the Canadian population over time and its impact on the studies reviewed.

Results

After all duplicates were removed, 49 empirical quantitative studies that involved two or more ethnic groups were identified and included in this review (Figure 1) and summarized in Appendix 1. Twenty-seven studies[2,5,29-53] were based on population or community surveys with secondary data analysis, 12 were smaller studies using non-clinical samples[54-65] and 10 were smaller studies based on clinical/specialized samples.[66-75] The year and region of publication, sample size, ethnic groups included and critique regarding the definition of ethnicity are outlined in Appendix 1.

Discussion

1. Definition

The lack of consensus on the definition of ethnicity[20,76-80] was reflected in the 49 included Canadian studies on ethnicity and mental health,[2,5,29-75] which failed to explicitly define the variable. There are two major perspectives on how ethnicity emerges: the primordialist and constructivist views.[20,76,81] Traditional primordialists view ethnicity as "an ascribed status, given at birth, that is more or less fixed and

permanent."[20,76,81-85] Accordingly, the individual's identity includes the biological, cultural, political and economic conditions of the group into which s/he is born, be it dominant over, or dominated by, other groups.[20,78,81,84] A softer primordialist view stresses the social and non-biological basis of ethnicity, acknowledging that ethnic identity can also be socially constructed and based on "the circumstances at hand" thereby being "situational not biological" and "flexible not fixed."[81] The constructivists view ethnicity as "a social construction with ecological and social factors being its key determinants."[12,24-26] Kaufman[85] stated that distinction between the two perspectives is artificial, so the definition of ethnicity should include a synthesis of both. Hence, the underlying theme is that ethnicity involves sharing of a common culture, which may be based on a combination of factors such as language, religion, national identity, customs, social and/or political position within a country's social system.[81]

2. Conceptualization

There are two major perspectives on how ethnicity is conceptualized: 1) *ethnic identity* which refers to self-identification with particular cultural group/s,[20,76,80,81] **or** 2) *ethnic origin* which refers to classification due to the ethnic or cultural groups to which the individual's ancestors belong.[20] Specific cultural traits such as language, surnames, or region of birth were used as proxies for *ethnic origin* in some studies.

From a Canadian perspective, the country's policy on multiculturalism, which has guided government policies since 1971 and advocated for individuals to retain their ethno-cultural background,[8] dictates that ethnicity comprised "ethno-cultural particularism" and adherence to Canadian "values."[76] This is reflected in the conceptualization of ethnicity across national surveys, which forces participants to identify with their ancestral background regardless of time in Canada. As well, this policy accounts for the designation of all non-Aboriginal persons who originate

FIGURE 1

Results of the search strategies used across bibliographic databases to identify Canadian literature on ethnicity and mental health
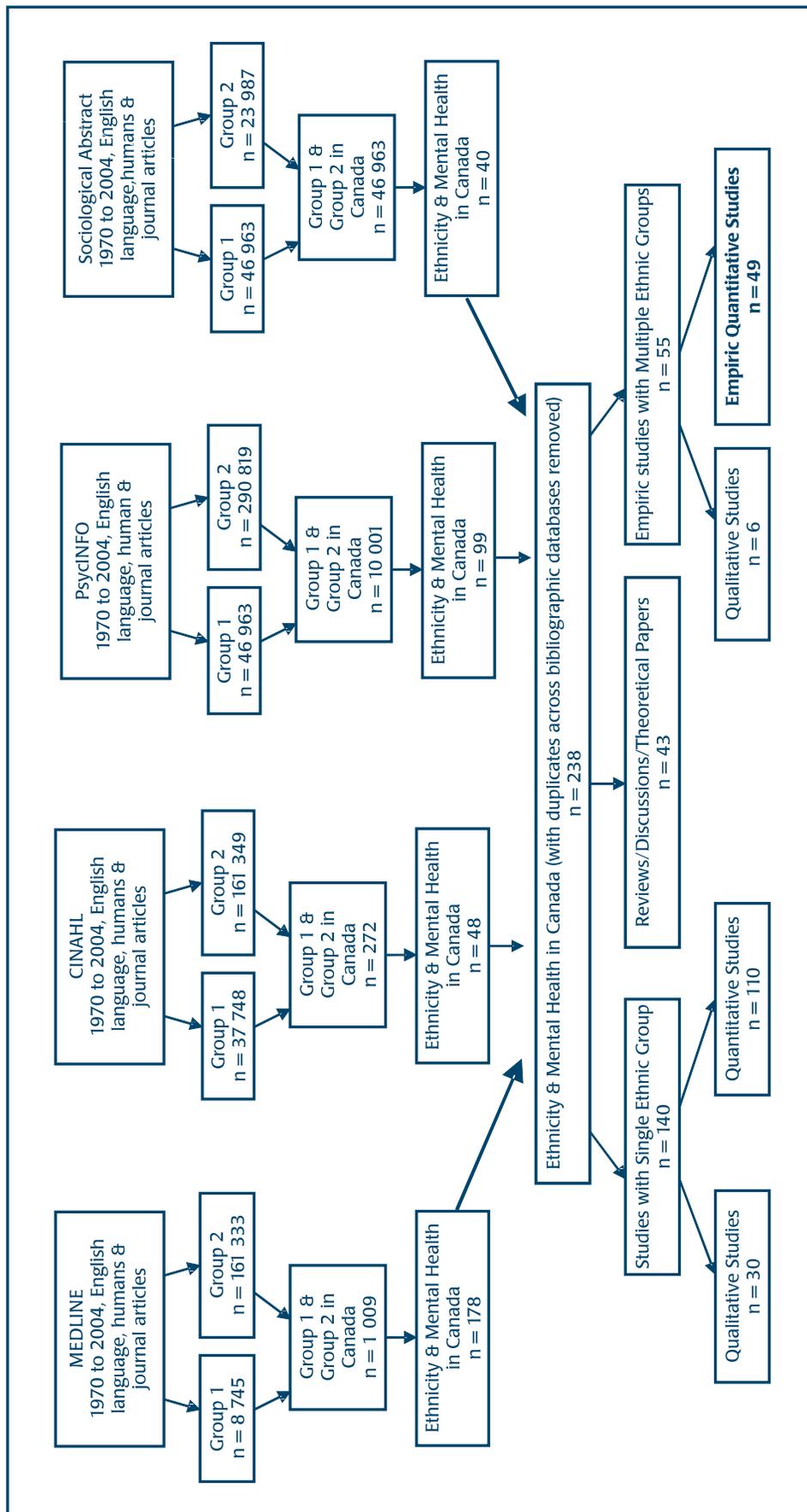
*There was considerable overlap in the articles identified in the different bibliographic databases.

[1] Group 1 search terms: "ethnicity", "race", "ethno-racial", "race/ethnicity", "culture", "ethno-cultural", "visible minority", "immigrants", "aboriginal", "First Nations", and "Inuit or Métis"

[2] Group 2 search terms: "mental health", "psychological*[3]", "depression", "psychiatric*", "well-being", "psychosocial", "alcohol*", "schizophrenia", "substance abuse", "suicide*" and "distress"

[3] Note: * symbol attached to search terms was used to tell the search engine to find all articles containing the word or term.

[4] Bolding indicates the quantitative empiric studies identified and included in this critical review.

from Africa, Asia, the Caribbean, Latin America and the Middle East, "who are non-Caucasian in race or non-white in colour" as visible minorities.[1,3,6]

Conceptualization based on Ethnic Identity

Ethnic identity can be internal or external.[20,78] Internal ethnic identity refers to the individual's self-identification with specific ethnic group/s.[78,86,87] This conceptualization reflects the individual's level of adherence to and identification with the values, customs and ideologies of a particular culture,[87] which can be internally or externally driven.[78,86-89] Individuals may choose to identify with particular ethnic group/s because of their belief in the customs, norms and ideologies and the meaning such identification gives to their life (i.e. internally driven). However, circumstances in the individuals' external environments, such as discrimination based on ethnicity and the feeling of being different from the ethnic majority, may cause some to self-identify with particular ethnic groups because of the sense of solidarity and belonging they may garner from such groups (i.e. externally driven).[78,80,87]

Since external ethnic identity relates to categorization by others based on the person's nationality or ethnic origin and does not reflect the individual's adherence to and/or identification with specific culture/s,[15] it is discussed in the context of *ethnic origin* in the ensuing section. Such external assignment of ethnicities to individuals by the dominant society might conflict with their subscription and adherence to particular ethnic groups and is potentially distressing. This was illustrated by Mahtani[6] in her interview with Canadian-born visible minority mixed-racial women who often feel forced by the ethnic majority to identify their ancestral background when asked about their ethnic identity (i.e. by the question, "but where are you *from*?").

A major weakness with self-identification of ethnicity is that it is based on the individual's perception, which may change from situation to situation and over time and likely produce different results depending on the time and research question being investigated.[27,28] This possibly accounted for the lack of conceptualization of ethnicity based on ethnic identity across studies, with the exception of the respective studies of De Wit et al.,[40] De Wit and Beneteau,[41,42] and Feldman et al.[43] De Wit et al.[40-42] conducted secondary data analysis on the 1990 Ontario Health Survey in which respondents were asked to select up to four ethnic categories that matched their "ethnic or cultural identity." De Wit and Beneteau[41,42] further utilized information on the primary language that respondents used at home to help "better identify ethnic groups." If respondents identified French or French-plus other ethnic groups but did not select French as their primary language they were reclassified as Anglophones[41,42] indicating externally driven classification of *ethnic identity*. This externally driven classification of *ethnic identity* might have been in conflict with the individual's true ethnic identity. If level of adherence to particular cultural values, customs and ideologies are important in the individual's perception of, and subsequent likelihood to acknowledge, discuss or report a mental health condition, and this is a key issue being investigated, then the use of *ethnic identity* would provide more appropriate information. Feldman et al.[43] used the item, "Please write down the term that best describes the ethnic character of your everyday home environment," which implies an *ethnic identity* conceptualization of the variable.

Conceptualization based on Ethnic Origin

Ethnic origin refers to categorization of individuals into ethnic group/s based on ancestral origins.[78] The question "To which ethnic or cultural group/s do your ancestors belong?" has been used to capture ethnic origin.[90,91,84,95] This method of conceptualization is reportedly more objective and produces well-defined ethnic groups that are representative of the population, but fails to capture level of adherence with cultural ideologies or customs.[27,92,93]

Conceptualization of ethnicity based on *ethnic origin* was observed in some Canadian studies on ethnicity and mental health, particularly those that used national or regional survey data,[2,5,31,32,35,46-48,52] including the National Population Health Survey (NPHS),[90] Canadian Community Health Survey (CCHS),[91] National Longitudinal Survey of Children and Youth (NLSCY),[94] National Survey of Giving, Volunteering and Participating (NSGVP)[95] and the 1971 Aging in Manitoba (AIM) survey.[31] Each survey inquired about the ethnic or cultural group/s of the individuals' ancestors and provided a list of ethnic categories to enable multiple choices.[90,91,94,95] This acknowledged the existence of multi-ethnic groups, which are typical of Canada,[8] and improved the reliability of the groups identified.[27] Reflective of the emphasis of the country's multiculturalism policy, survey respondents who identified themselves as "Canadian" were required to select their ancestral origin even if they were Canadian-born.

Specific Cultural Traits as Proxies for Ethnic Origin

One might assume that studies utilizing data from surveys in which ethnicity was based on *ethnic origin* would conceptualize ethnicity accordingly; however, this was not the case. Ali[5] and Ma[47] used country of birth in thinking about ethnicity despite utilization of the CCHS[91] and the NLSCY[94] data respectively, both with specific ethnicity questions. The rationale for using country of birth rather than responses to the ethnicity questions was not provided but likely due to the use of public-use data. Public-use versions of Canadian national surveys are readily available to researchers

but are stripped of unique identifying information and lack the detailed information on ethnicity and culture available in the restricted-use versions.

Penning[32] utilized the Social Change in Canada Survey (SCCS) data, in which country of birth was used to determine ethnicity. Ascertainment of ethnicity based on country of birth in the study pinpoints an inherent limitation with conducting secondary data analyses where one has to make do with whatever variables are available. With this in mind, it is still important to mention that with increasing global industrialization and migration it has become inappropriate to use country/region of birth as the sole indicator of ethnicity. Individuals might have been born in one country to parents from another country, spent only a few years in that country and returned with their parents to the countries of their ancestral background thus choosing to identify with their ancestral culture. Therefore, country/region of birth, also utilized by Ali,[5] Barnes et al.,[35] Ma,[47] Cohen and MacLean,[51] Rousseau et al.[53,61] and Aubert et al.,[65] would inaccurately classify such individuals. Most countries are comprised of many ethnic groups and most ethnic groups can be found to have many different countries of birth. Country of birth as a proxy for *ethnic origins* fails to capture such complexities and likely misclassifies some people. This does not negate the use of country/region of birth as a proxy for ethnicity but it underlines the need for detailed discussions of the inherent limitations of its use and implications for the interpretation of subsequent results.

Language and surname were proxies for ethnic origin in some studies[37,54-59] but are susceptible to misclassification of some individuals. The utilization of surnames to identify ethnic groups by Dion and Giordano[57] in their investigation of ethnic difference in depression in university students in Toronto, failed to correctly classify non-white/non-Caucasian individuals with non-ethnic last names. If specific ethnic groups were more likely to have individuals with non-ethnic surnames, for example Blacks from the Caribbean and South Asians of Christian

descent,[57] and these individuals were more or less likely to have depression, their exclusion would have biased the results obtained. Bagley[58] also used surnames and language, but in combination with an unspecified "ethnicity" question to conceptualize ethnicity. Surnames were initially used to identify Chinese elderly persons living in Calgary, Alberta, with follow-up phone calls by the study recruiters who identified eligible Cantonese-speaking individuals and inquired about their ethnicity. This combination of factors overcame the shortcomings of using surnames alone.

Walter[37] and Dion[59] used language as a proxy for ethnicity, which might have accurately classified some ethnic groups but not others (e.g. Chinese for individuals who specified Chinese dialect). The English-speaking population is ethnically heterogeneous, with English being the primary language for many countries, so treating the group as homogenous is erroneous.[59] Also, although French and Spanish are primary languages for France and Spain respectively, they are also the primary languages for some countries in the Caribbean and Africa. The assumption that all individuals who endorsed these languages are of European descent would be inaccurate.[59] Different ethnic groups may speak the same language or there may be language differences within ethnic groups, which would not be captured with language as the sole proxy for *ethnic origin*.

Ethnicity, Race or Ethnicity plus Race

In examining the studies by Weekes, et al.[71] and Cohen and McLean,[51] respectively, it became apparent that categorization was based on race, despite the use of the term "ethnicity". Also, the researchers[51,71] implied that race and culture were the same concepts despite numerous theoretical articles indicating otherwise.[28,76-79,85-99] To illustrate, Cohen and McLean[51] utilized data from the 1999 General Social Survey (GSS) in which respondents were asked about their "cultural or racial backgrounds"[96] and Weekes and colleagues[71] expressed interest in examining the "cultural sensitivity" of their outcome

scale. Ethnicity refers to mutual cultural characteristics such as religion, language, customs, and ancestry,[20,76,78] but race refers to common physical characteristics.[28,65,78,86-101] Winker,[28] Williams[77] and LaVeist[97] stressed the importance of differentiating race from ethnicity or culture. Race is a poor proxy for ethnicity despite overlapping features[28,97] and is questionable as its sole indicator in respective studies by Fry and Grover[54] and Devins et al.[74]

Wu et al.[2] used ethnic origin and racial background to create ethno-racial groups. This enabled the identification of visible minority groups[2] and acknowledged the argument that power and status differences also exist across racial groups.[77] This is important since "the dominant or minority status of the group mirrors its position within the stratification system of the larger society,"[101] which in turn affects access to social, political, and economic resources.[3,4,101] The authors[2] explained that their ethno-racial groups reflected the social stratification of the Canadian society (i.e. the vertical mosaic),[2-4,7,8] which provided a context that facilitated interpretation of results obtained. The vertical mosaic refers to the hypothesis that ethnic groups are differentially integrated in the larger Canadian society based on histories of immigration policies that were linked to changing industrial and employment demands over time.[2-4,7,8] This differential integration into the Canadian society affected the groups' socioeconomic status,[2-4] which is significantly associated with mental health outcomes.

Summary

The identified studies appeared to have conceptualized ethnicity on the basis of *ethnic origin* by using ethnicity questions, cultural traits as proxies for ethnic origin, or a combination of ethnic origin and racial background. For some studies, although the term "ethnicity" was used it was unclear how it was conceptualized and ascertained.[30,33,34,54,55,70,75] The intrinsic weaknesses of using proxy measures such as country of birth, language or surnames underline the need for ethnicity to be ascertained using rigorously tested and validated questions. Questions aimed at

capturing ethnic identity or ethnic origin are unable to tell which aspect of ethnicity the individual brings forward in response during an interview and whether this might be affected by the interviewer and/or by the specific question being asked.[76] This highlights the need for clear and theoretically driven rationales for studying ethnicity across mental health outcomes.

3. Operationalization

The operationalization of ethnicity is important for interpretation of study results and enabling cross-study comparison. However, variations existed in the operationalization of ethnicity across studies. Even studies that utilized the same data sources and conceptualized ethnicity similarly operationalized the variable differently. Factors that influenced this included diversity of the study population, time period and region of data collection, sample size restrictions and purpose of the study. The effects of these issues are discussed in the ensuing sections.

Time Period of Data Collection and Study

Time period of data collection and study influenced the operationalization of ethnicity across studies. Time period of data collection is related to changes in the immigration policy over time, which were influenced by economic changes that dictated labour shortages and the need for immigrants to fill specific employment opportunities.[20,102] Canada's earlier immigration policy was based on national origin and gave preference to immigrants from Britain, Europe and the US to fill such occupational demands.[22,25,103-105] Hence, immigrants from these regions represented approximately 95% of Canada's immigrant population up to 1986[22,25] and studies using data collected at this time had little or no representation of other ethnic groups.[29,31,32,35,66,67]

The 1967 change to a universal point system was the force behind the increased ethnic diversity of the Canadian population, with European immigrants comprising

57% of immigrants in 1970 but only 20% in 1996.[22,105] Changes in the ethnic composition of the immigrant population occurred gradually with small numbers from Africa, Asia, the Caribbean, Latin America, and the Middle East initially before their proportions increased significantly over time.[22,24,25,102,105,106] This was reflected in the 3 to 5% representation of these immigrants in Canada up to the 1980s compared to their 73% representation between 1996 and 2001.[107] Variations in the proportions of these immigrant groups relative to each other and to immigrants from Britain, the US and Europe were reflected in studies conducted with ethnicity data collected over the years. Earlier studies had little or no visible minority groups[29,31,35,66,67] but their numbers increased in later studies.[2,5,35,38,43,46-49,53,61-63] Whether these groups were kept as separate categories depended on the outcome of interest and the nature of the study (i.e. secondary data analysis using public-use data that lacked detailed ethnicity information). In the investigation of rare outcomes, such as some mental health conditions, small sample sizes for specific visible minority ethnic groups resulted in them being collapsed into a single category, which likely failed to capture the individuals' perception of their ethnic identity. This also limited the interpretation of the results of such studies.

Region of Data Collection and Study

Variations in settlement patterns of different ethnic groups in Canada resulted in different ethnic compositions across geographic regions. This affected the operationalization of ethnicity as it relates to the region of data collection and study. Settlement patterns of immigrant groups have always been related to the location of employment opportunities, which were dictated by economic changes over time.[78,102] Earlier immigrants from Britain, Europe and the US[106] came to Canada in response to the rapid expansion of the Canadian West with integration of the region with the domestic and world markets and international demand for wheat.[78] Therefore, many earlier immigrants settled in rural areas of Western

Canada to fill the demands for laborers and farmers.[66,102] Studies conducted in Western Canada (e.g. Manitoba,[31,35,70] Alberta[66] and the Northwest Territories[67]) were likely to have significant representation of British, European, North American and Aboriginal ethnic groups but almost no representation of visible minority groups.

Later immigrants from Asia, Africa, the Caribbean, Latin America and the Middle East were more likely to settle in Montreal, Toronto and Vancouver[102,108] because of their perception of better employment opportunities that corresponded to their skills and educational background.[102] Supportive data showed that only 58% of recent immigrants settled in these areas in 1981 but the percentage rose to 78% by 2001.[102] Recent studies based on data that includes these three regions had varying proportions of visible minority ethnicities.[2,5,32,43,44,46-51,53-55,57-63,65,72,74,75] Reliance on public-use data prevented examination of very specific ethnic categories because of the inaccessibility of such detailed information.

The Purpose of the Research Study

As seen in the respective studies of Barnes et al.,[35] Lavallee and Bourgault,[45] Seltzer and Langford,[67] and others,[29,30,34,37,50,51,58,61,64,66,69,70,73,75] there is flexibility in whether broad or specific categories are used when operationalizing ethnicity in descriptive or enumerative studies as long as they reflect the ethnic composition of the population under investigation.[20] However, the use of specific ethnic categories is more informative.[20] For analytic studies, operationalization of ethnicity needs to be theoretically driven to provide a framework for the analyses and interpretation of the results.[20] Operationalization of ethnicity in the analytic studies reviewed in this paper[2,5,31,32,36-43,45-49,52,58,59,75] appeared to be based on the social stratification system in Canada, though not always explicitly stated.

Studies interested in examining the mental health status or outcome in specific ethnic groups tended to be clear in their selection and ascertainment of those groups but often aggregated all other ethnic

groups.[30,31,33,34,36,38-42,44,45,51,54,61,67-71] For example, Fry and Grover[54] were interested in examining mental health outcomes in Asians compared to Caucasians and therefore only included these groups. Liban and Smart,[30] Tonkin,[34] Beiser et al.,[39] Borzecki et al.,[68] Tcheng-Laroche and Prince[33] and Dewit and Beneteau,[35,42] in their studies, were mainly interested in the mental health of Native Indians[30,34,39,68] and Francophones[33,41,42] respectively and therefore selected these groups specifically while aggregating all other ethnicities in the comparison groups.

Havens and Chappell, in investigating the effects of age, sex and ethnicity on mental health in Manitoba, included North American, British, French, Polish/Russian/Ukrainian and 'Other European' ethnic groups.[31] These groups were reflective of the time period and region of study. North Americans, British and French were among the earlier immigrants admitted to Canada to fill occupational demands based on the country's immigration policy at that time. The 'Other European' group, which included immigrants from Germany, Norway, Denmark, Sweden, Iceland, the Netherlands and Belgium,[31] was granted entry into Canada over the Polish/Russian/Ukrainian when the demand for more immigrants arose.[22,106] After World War II and prior to the change to the universal points system immigration policy, immigrants from Poland, Russia, the Ukraine and other Eastern European countries were admitted to Canada to help survivors of the Nazi Holocaust and to fill specific occupational roles.[22,106] Therefore, the ethnic groups included in the study[31] were incorporated into the social hierarchy of Canada at different levels and different points in time, emphasizing the segregation of the Canadian society along ethnic lines.[22,104] Aboriginal peoples also contributed to the ethnic diversity of Manitoba's population, specifically its rural regions,[109] but were excluded from the study to "reduce cultural bias".[31] This statement implied that cultural aspects of ethnicity were important in mental health functioning and needed to be kept constant across groups. It further implied that either the ethnic categories included in the study were culturally similar to each other yet different from Aboriginal peoples **or** that the individual ethnic groups that comprised each broader ethnic category were culturally similar but the individual ethnic groups that comprised the broader Aboriginal category were too culturally dissimilar to be combined.

Penning[32] included similar ethnic groups as Havens and Chappell[31] in examining the same hypothesis with psychosocial well-being as the outcome and using a nationally representative sample of Canadians aged 30 and over. The groups also mirrored the social stratification of the Canadian society. Havens and Chappell,[31] but not Penning,[32] found ethnic differences in mental health functioning with a "triple jeopardy" effect of age, sex and ethnicity. Methodological issues related to differences in the definition and ascertainment of the mental health outcomes, the conceptualization (e.g. use of country of birth[32] versus a specific ethnicity question[31]) and operationalization of ethnicity, the ethnic and age composition of the study populations, and the regions of study likely played a role in the discrepancy observed.

Since Penning[32] used country of birth to ascertain ethnicity and mentioned no excluded ethnic groups, it is assumed that Aboriginal peoples and any Canadian-born visible minority individuals, though minimal, were included into the Canadian group. This would make the Canadian group heterogeneous and different from those included in the North American group in Havens and Chappell.[31] Also, since Penning[32] utilized data from a national survey, the ethnic category 'Other' probably comprised participants who were members of Canada's visible minority groups whereas these groups were excluded by Haven and Chappell[31] because of small sample size. Penning,[32] separated Canadians and Americans while combining immigrants from France, Germany, Norway, Denmark, Sweden, Iceland, the Netherlands and Belgium into a Northern European group. These factors affected the ability to compare the results of the two studies.

Understanding the mental health of Canada's immigrant population in terms of depression and alcohol dependency was the aim of the study by Ali.[5] Ethnic differences were examined as a secondary objective in the immigrant group only.[5] Using region of birth, the ethnic groups examined (i.e. US/Mexico, South and Central America and the Caribbean, Europe, Africa and Asia) mirrored the variation in time of entry into Canada by the different immigrant groups and their differential incorporation in the social hierarchy of the country. This provided a framework for analyses and interpretation of the results. Disaggregation of only the immigrant group based on ethnicity implied that either the investigation of ethnic variation in mental health was only important for immigrant groups and not Canadian-born **or** all Canadian-born individuals had similar experiences that potentially affected their mental health. Since the Canadian-born group probably had many first generation Canadians who likely had similar experiences as their immigrant parents, these assumptions were likely inaccurate. Given the report of poor mental health in Canada's Aboriginal population,[8] combining them into the Canadian-born group might not be appropriate. The use of region of birth has numerous drawbacks that could have potentially biased the results obtained but was likely used because of the lack of ethnicity-related information in the public-use version of the CCHS Cycle 1.1 dataset, which is assumed to be the data source used by Ali.[5]

In examining behavioural and emotional problems in immigrant versus non-immigrant children in Canada, Ma[47] considered ethnicity relevant but only for the immigrant group. Immigrant children were disaggregated into ethnic groups based on region of birth, including those from the US, Europe, Asia and other regions[47] possibly due to the use of the

public-use version of the NLSCY.[94] These ethnic categories differed from Ali[5] despite the same method of conceptualizing ethnicity. The studies tested different hypotheses, and were interested in different populations and different outcomes, which affected the ability to compare results across studies.

Beiser et al.[46] utilized NLSCY[94] data to examine familial poverty and emotional and behavioural problems in immigrant children versus Canadian-born and included ethnicity as a control variable. Unlike Ma,[47] ethnicity was examined in the entire sample[46] thereby eliminating the ambiguities observed in interpreting the results of the former studies. Although the study utilized a data source in which various ethnic categories were available, ethnicity was operationalized by using four broad categories including White/European, Asian, Black and Other.[46] This implied an interest in, or expectation of, an effect based on visible minority status. The NLSCY included Aboriginal peoples living off-reserves,[94] and since there was no explicit indication of their exclusion, it is assumed that they were either combined in the 'Other' category **or** included in the 'White/ European' category. The appropriateness of the inclusion of Aboriginal children into either category is questionable given major cultural and social differences.

The NSGVP[95] was utilized by Mata[48] to investigate satisfaction with life in Canada across ethnic groups and to test the hypothesis that any variations could be explained by ethnic differences in socioeconomic status (SES). Nineteen mutually exclusive ethnic categories were derived for the study with sample size limitations being integral in the collapsing of different ethnic groups into broader categories (e.g. 'Black', 'South Asian', 'Italian' and 'Portuguese' ethnic groups collapsed into 'Black/South Asian' and 'Italian/Portuguese').[48] The distinction between certain other ethnic categories was unclear. For instance, the categories 'European', 'Italian/Portuguese', 'German', 'French' 'Ukrainian', 'Polish', etc., all of definite European origin were used without the provision of a clear rationale. This combination of specific and broad ethnic

categories without rationale limited the interpretation and comparability of the results. It would have been beneficial if the ethnic categories were guided by a theoretical framework so as to provide more meaning to the results and decrease the observed ambiguity.[20]

Wu et al.[2] tested the hypothesis that ethnic differences in depression could be explained by variations in SES and access to social support resources (1996 NPHS[90] data). The included 'ethno-racial' groups were 'East/ Southeast Asian', 'Chinese', 'South Asian', 'Aboriginal', 'Black', 'Arabic/West Asian', 'Latin American', 'Jewish', 'French', 'English', 'Other Whites', and 'mixed racial', were "representative of the social stratification of the Canadian society" and reflected differences in SES and access to social support resources.[2] The partial disaggregation of the Asian group into 'East/Southeast Asian' and 'Chinese' was likely due to the overwhelming presence of 'Chinese' (approximately 56%) in the group, which would have obscured the interpretation of any association with depression. A clear rationale for this partial disaggregation was not provided but left to the readers to assume. Lack of sufficient sample size prevented the disaggregation of other ethnic groups including Blacks and South Asians.[2]

Wang and El-Guebaly[52] used a 'White' versus 'non-White' dichotomy in operationalizing ethnicity despite the utilization of the 1996 NPHS[90] data. This was likely due to the use of the public-use version of the survey data, though not explicitly stated. This dichotomy, although handy in separating visible minorities from the ethnic majority, has been criticized for its inadequacy in giving a clear view of ethnic differences in mental health.[2,27,104] Refinement is needed to account for cultural and/or ecological differences within such broad ethnic groups,[104] which might include cultural biases in reporting mental health issues. Although the specific ethnicities within the broad 'non-White' group are distinct from each other in languages, histories, customs and social mobility,[2] discrimination in educational and occupational opportunities based on visible minority status[2,22,103,109] lends some

support to combining the groups into this category. The use of such a broad ethnic category is appropriate if the researchers were asserting that it is the common experience of being 'non-White' that impacts mental health above and beyond the effect of cultural differences in individuals' perceptions of, and attitudes towards, mental health problems, but this was not stated.[98]

Dion and Giordano included 'Anglo-Celtics', 'North European', 'South European', 'East European', 'East Asian', and 'South Asian' in their study.[57] These ethnic groups were said to parallel the ethnic composition of the University of Toronto population in 1988[57] and reflected variations in immigration experiences, entrance status and adaptation to life in Canada with respect to parental conflicts, and the likelihood to perceive economic discrimination.[57] According to the study, 'South Asians' and 'Southern Europeans' were more likely to suffer depression than the 'Anglo-Celtics' and 'Northern Europeans' because of higher likelihood of parental conflict and perceived economic discrimination.[57] Surnames were used to ascertain ethnicity,[57] which likely misclassified 'Blacks' and 'South Asians' of Christian background. Since 'South Asian' was an ethnic group of interest in the study,[57] this misclassification would have likely affected the results obtained by diluting the measure of effect and affected the generalizability of the results to all 'South Asians' in Toronto. The researchers[57] explained that since an earlier study including 300 students at the same university found less than 3% indicating West Indian heritage, the potential misclassification by surnames created little or no bias to their results. This inaccurately implied that among 'South Asians' only those of West Indian heritage had non-ethnic last names. India's Christian population accounted for about 2.3% of its total population according to its 1991 and 2001 censuses.[110]

Summary

In summary, the operationalization of ethnicity in the existing Canadian studies differed depending on how the variable

was conceptualized, on which data sources were used, on time period and region of data collection, the purpose of the study, and whether the study involved secondary data analysis using public-use versions of national surveys. Some studies tried to disaggregate ethnic categories but were faced with sample size limitations that led to collapsing of distinct ethnic groups while keeping others disaggregated, with no clear rationale. Sample size limitations were found across national survey datasets, particularly for the visible minority ethnic groups, thus underlining the need for future population surveys aimed at providing information on the health and/or mental health of the Canadian population to over-sample these groups. This would enable the examination of mental health differences across visible minority groups, which is important for the planning of mental health programs to serve Canada's ethnically diverse population.

Conclusions

This critique of the definition, conceptualization and operationalization of ethnicity across Canadian studies on ethnicity and mental health uncovered a number of key issues that are highlighted below.

a) Ethnicity is a complex and abstract term for which a single and generally accepted definition has not been derived. However, the underlying theme is that it involves the sharing of a common culture. Across studies, ethnicity was not defined *a priori*, which was likely due to lack of consensus on its definition. Therefore, as suggested by reviewers from the US[28,77,79] and UK,[27,92,93] clear rationales as to why ethnicity is important to the outcome of interest are necessary.

b) Examination of the relationship between ethnicity and mental health needs to be encouraged with better infrastructure involving improved funding opportuni-

ties, given the relevance to the Canadian context. Secondary data analysis is valuable in such research efforts. Therefore, making detailed information on ethnicity more readily available to researchers while maintaining survey participants' confidentiality is vital.

c) Some researchers seemed to have utilized public-use versions of survey data, which hindered their ability to disaggregate ethnic groups due to lack of such detailed information in these files. Their use need to be stated explicitly and their inherent limitations discussed.

d) Ethnicity can be conceptualized based on *ethnic origin*, *ethnic identity*, or a combination of ethnic origin and race. Each method has strengths and weakness. Its conceptualization should be theoretically driven and related to the research question of interest. The identified studies conceptualized ethnicity based on *ethnic origin*, whether through the use of a specific questions or proxy measures such as language, surname or country of birth. Countries of birth, language and surnames are prone to misclassification of certain ethnic groups and biased results if rate of misclassification differed across outcome groups. This does not negate their use as proxies for ethnicity; however, there is a need for researchers to clearly outline their inherent limitations and the implications for the results obtained.

e) Ethnicity based on *ethnic origin* can be more stable if participants are given a list of ethnic categories with the option of choosing multiple categories.[27,93] This list should be based on preliminary fieldwork to identify common ethnic categories. An open-ended 'other' option should be included so as not to restrict the individuals' choices. The list should be appended to the research results or made available upon request to enable study replication and to enable readers

to ascertain the representativeness of the ethnic categories to the general population.

f) Operationalization of ethnicity varied from very broad to very specific ethnic categories even if ethnicity was conceptualized similarly or the same data source was used. These variations were related to the lack of a clear definition of ethnicity, differences in the time period, region of study and data collection, the purpose of the studies and the utilization of public-use data. Researchers are encouraged to provide a clear outline of the decisions made regarding the data source used (particularly in secondary data analysis), the operationalization of ethnicity, and the categories included in their studies. This will facilitate the interpretation of the results and attempts to replicate the research findings.

g) Differences in the outcomes of interest, how such outcomes were measured and variability in the relevant variables controlled for were additional factors that affected the ability to compare results across studies. Therefore, researchers should clearly define their outcomes of interest and summarize the strengths and weaknesses of the measures used to ascertain outcomes and other relevant variables.

Acknowledgements

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APPENDIX I
Quantitative empiric studies on ethnicity and mental health conducted in Canada (or with Canadian data) that included two or more ethnic groups

N = Sample size of study, A = Age range of study individuals, S = Source(s) of data, D = Data type, DA = Data analyses, T = Type of study, DV = Dependent Variable, IV = Independent Variable

Author(s), year of publication & region of study	Study Sample (sample size, data source, age group included and study design)	Ethnic groups included	Outcome Examined	Comments
Studies based on population-based or large community-based surveys/samples (n = 27)				
1. Murphy, 1980 (Canada)[29]	N = not given A = 15+ S = Dominion Bureau of Statistics reports on first admissions to Canadian Mental Hospitals in 1961 and the 1961 Population Census. D = Cross-sectional DA = Standardized Morbidity Ratio (SMR) T = Descriptive	German Origin; Dutch Origin; Scandinavian Origin; Canadian-born	DV: Mental hospitalizations	1. A clear definition of ethnicity not given. 2. Ethnicity based on "country from which the individual's ancestors on the male side came when they settled in Canada", therefore an *ethnic origin* conceptualization. 3. Ethnic groups reflective of the immigration pattern in Canada during the time period (i.e. 1960's)
2. Liban & Smart, 1982 (Ontario, Canada)[30]	N =128 A = 10 to 20 (i.e. Grade 7 to 13) S = 1979 Survey of Alcohol and Drug Use among Ontario students D = Cross-sectional DA = Descriptive and Chi-square analyses T = Descriptive	Native Indian [64]; Non-Native Indian [64]	DV: Frequency and problems with alcohol and drug use	1. A clear definition of ethnicity not given. 2. Ethnicity based on cultural background but how ascertained not specified. 3. Although cultural background in the survey included a breakdown into English Canadian, French Canadian, Asian, Native Indian and other, the non-Native Indian categories were aggregated for the study based on matching.
3. Havens & Chappell, 1983 (Manitoba, Canada)[31]	N = 3647 A = 65+ S = Aging in Manitoba Survey (1971) D = Cross-sectional DA = ANOVA T = Analytic	North American [370]; British [1633] French [216]; Polish/Russian/Ukrainian [685]; Other European (German, Norwegian, Danish, Swedish, Icelandic, Dutch, Belgian) [743]	DV: Perceived well-being, perceived health status, mental health functioning	1. The ethnic groups in the study not representative of the whole of Canada but of Manitoba specifically. 2. Ethnic groups reflective of the immigration pattern in the province and of the time period. 3. *Ethnic origin* based on ethnicity question in the survey
4. Penning, 1983 (Canada)[32]	N = 2253 A = 30+ S = Social Change in Canada Survey (1977) D = Cross-sectional DA = ANOVA T = Analytic	Canadian [1720]; American [57]; British [159]; North European (France, Germany, Austria, Scandinavia, Netherlands) [96]; South European (Greece, Portugal, Spain, Italy) [65]; East European (Russia, Hungary, Poland) [96]; Others [62]	DV: Perceived psychological well-being	1. A clear definition of ethnicity not given. 2. Some ethnic categories not clearly explained for example the ethnic group referred to as "Other". 3. *Ethnic origin* based on country of birth.
5. Tcheng-Laroche & Prince, 1983 (Montreal, Quebec, Canada)[33]	N = 128 A = not given S = Community survey of a representative sample of separated or divorced mothers in Montreal D = Cross-sectional DA = Chi-square, ANOVA T = Analytic	Francophone [62]; Anglophone [66]	DV: Psychosocial stress per the Langner Scale, self-esteem per the RSE and life satisfaction	1. A clear definition of ethnicity not given. 2. Study interested in examining "cultural effects". 3. Study included French- and English-Canadians in Montreal. It is unclear how being French and/or English-Canadian were ascertained.
6. Tonkin, 1984 (British Columbia, Canada)[34]	N = 122 A = < 20 years old S = Vital statistics data (with follow-up review of all deaths reported to the provincial Chief Coroner's office 1978/9) D = Cross-sectional DA = Descriptive and chi-square analyses T = Descriptive	Native Indian [33]; Non-Natives [89]	DV: Suicides and psychiatric diagnoses	1. A clear definition of ethnicity not given. 2. Ethnicity used as a covariate but how it was ascertained not indicated because it was abstracted from the coroners' records. 3. The rationale for the inclusion of ethnicity as a covariate not explained.
7. Barnes et al., 1988 (Winnipeg, Manitoba, Canada)[35]	N = 524 A = 18 to 80 S = 1983 Winnipeg Area Study D = Cross-sectional DA = ANOVA, X^2, & multiple classification analyses T = Exploratory	English [84]; East European [62]; West European [82]; Canadian [193]; Other [97]	DV: Depression (CES-D)	1. Ethnicity examined as a predictor of depression. 2. Ethnic groups reflective of the ethnic composition region of study. 3. *Ethnic origin* based on country of birth.

Author(s), year of publication & region of study	Study Sample (sample size, data source, age group included and study design)	Ethnic groups included	Outcome Examined	Comments
8. Sack et al., 1993 (Canada & US)[36]	N = 1115 A = 7 to 9 (Grades 2 and 4) S = Flower of Two Soils Project D = Prospective and longitudinal (3 year follow-up) DA = Correlation analyses, ANOVA, chi-square analyses T = Analytic	First Nation children from the Plains (South Dakota, US), Northern Woodlands (Manitoba, Canada), Desert (New Mexico, US) and Coastal (British Columbia, Canada) compared to a sample of non-Native children at each site	DV: Depressive symptoms using new measures of psycho-pathology and mental health (the SOS)	1. No explicit definition given for ethnicity. 2. Study specifically interested in cultural differences between the various First Nation groups across North America, hence it is implied that ethnicity is based on culture.
9. Walters, 1993 (Hamilton, Ontario, Canada)[37]	N = 356 A = 21+ S = A stratified random sample of women in Hamilton D = Cross-sectional DA = Chi-square T = Descriptive	English-speaking vs. other language	DV: Stress, anxiety and depression	1. Ethnic origin based on primary language. 2. No definition for ethnicity. 3. Language stated as a possible proxy for ethnicity.
10. Beiser et al., 1994 (Vancouver, British Columbia, Canada)[38]	N = 1667 A = ? S = 1348 refugees from the Refugee Resettlement Project and an area-probability sample of 319 Vancouver residents matched to refugees on age and sex D = Cross-sectional DA = Grade of Membership analysis (GOM: a multivariate clustering technique) T = Analytic	Southeast Asians [1348]; Resident Canadians [319]; Southeast Asian group disaggregated: Chinese [755]; Vietnamese/Laotian [593]	DV: Psychiatric disorders including depression, anxiety and somatization per the CES-D, DIS and the Senegal Health Scales	1. No explicit definition given for ethnicity. 2. Researchers interested in "psychopathological expression among different ethno-cultural groups", therefore ethnicity based on culture. 3. Ethnicity based on where the individual emigrated from.
11. Beiser et al., 1998 (Canada & US)[39]	N = 1708 A = 7 to 9 (Grades 2 and 4) S = Flower of Two Soils Project D = Prospective and longitudinal DA = Principal component factor analysis on the psychopathology measure, correlation analyses, ANOVA, chi-square analyses T = Analytic	First Nation children from the Plains (South Dakota, US), Northern Woodlands (Manitoba, Canada), Desert (New Mexico, US) and Coastal (British Columbia, Canada) [1251] compared to a sample of non-Native children at each site [457]	DV: Depressive symptoms using new measures of psychopathology and mental health (the SOS)	1. No explicit definition given for ethnicity. 2. Study specifically interested in cultural differences between the various First Nation groups across North America.
12. DeWit et al., 1999 (Ontario, Canada)[40]	N = 4531 A = 19+ S = Native Ontario Community Survey and the Mental Health Supplement of the Ontario Health Survey. D = Cross-sectional (but age at onset information used to look at incidence) DA = Descriptive and chi-square and survival analyses T = Analytic	Native Indian [876]; Non-Natives [3655]	DV: Alcohol drug use and onset	1. No explicit definition given for ethnicity. 2. Study specifically interested in cultural differences between Native Indians and non-Natives in Canada.
13. DeWit and Beneteau, 1999 (Ontario, Canada)[41]	N = 5150 A = 16+ S = 1990 Ontario Health Survey D = Cross-sectional but age at onset information allowed survival analyses DA = Chi-square, survival and logistic regression analyses T = Analytic	Anglophone [4023]; Francophone [1127]	DV: Alcohol consumption (i.e. frequency and volume); alcohol-related problems (i.e. driving under the influence, family conflicts, work conflicts, sought help for drinking, hospitalization for drinking, and/or arrested for drunk behaviour)	1. No explicit definition of ethnicity given. 2. Ethnicity based on a combination of ethnic identity and primary language used at home.
14. DeWit and Beneteau, 1999 (Ontario, Canada)[42]	N = 5150 A = 16+ S = 1990 Ontario Health Survey D = Cross-sectional but age at onset information allowed survival analyses DA = Chi-square, survival and logistic regression analyses T = Analytic	Anglophone [4023]; Francophone [1127]	DV: Daily tobacco consumption (i.e. frequency and volume)	1. No explicit definition of ethnicity given. 2. Ethnicity based on a combination of ethnic identity and primary language used at home.
15. Feldman et al., 1999 (Toronto, Ontario, Canada)[43]	N = 1236 A = Grade 9 to 13 students S = 1994 Survey of Grade 9 to 13 students in the Borough of East York, Toronto D = Cross-sectional DA = descriptive analyses, stratified analyses and multiple logistic regression analyses T = Analytic	Canadian [379]; European [277]; Asian [314]; Other [140]; Not stated [126]	DV: Alcohol use beliefs and behaviour	1. No definition given for ethnicity. 2. "Please write down the term that best describes the ethnic character of your everyday home environment" was used to ascertain ethnicity indicating an *ethnic identity* conceptualization.

Author(s), year of publication & region of study	Study Sample (sample size, data source, age group included and study design)	Ethnic groups included	Outcome Examined	Comments
16. Beiser et al., 2000 (Canada & US)[44]	N = 2044 A = 7 to 9 (Grades 2 and 4) S = Flower of Two Soils Project and the School Option for Native Children Study D = Prospective and longitudinal DA = Principal component factor analysis on the psychopathology measure, correlation analyses, ANOVA, chi-square analyses T = Analytic	First Nation children from the Plains (South Dakota, US), Northern Woodlands (Manitoba, Canada), Desert (New Mexico, US) and Coastal (British Columbia, Canada) [1555]; compared to a sample non-Native children at each site [489].	DV: Attention Deficit/Hyper-activity Disorder (ADHD) per DSM symptom criterion but items measured by the TIF, the CAP and the SOS scales which contained items drawn from the CBCL, the CPTRS and the DIS for Children	1. No explicit definition given for ethnicity. 2. Study specifically interested in cultural differences between the various First Nation groups across North America, hence it is implied that ethnicity is based on culture.
17. Lavallee & Bourgault, 2000 (Canada)[45]	N = 27 130 women A = 15+ S = 1991 Cree Health Survey, 1992 Inuit Health Survey & 1992-93 Quebec Health and Social Survey D = Cross-sectional DA = Weighted Frequency distribution, Chi-square and ANOVA analyses T = Descriptive	Cree [1999]; Inuit [1597]; Southern Quebecers [23 564]	DV: Alcohol consumption, illicit drug use, psychological distress, lifetime suicidal thoughts	1. Researchers interested in the mental health of Cree, Inuit and Southern Quebec women, so no mention or definition of ethnicity. 2. The group 'Southern Quebec' likely included multiple ethnic groups.
18. Ali, 2002 (Canada)[5]	N = 92 379 A = 15 to 75 S = Canadian Community Health Survey, Cycle 1.1 D = Cross-sectional DA = Multiple logistic regression analysis T = Analytic	US/Mexico [952]; S. America, C. America, Caribbean [2273]; Europe [7749]; Africa [1139]; Asia [6314]	DV: Depression & alcohol dependence	1. Ethnic origin based on region of birth. 2. Although immigrants broken down into regions migrated from, the Canadian-born group wasn't, which limited comparisons based on ethnicity.
19. Beiser et al., 2002 (Canada)[46]	N = 13 349 A = 4 to 11 S = National Longitudinal Survey of Children & Youth (NLSCY/1994-1995) D = Cross-sectional DA = Multiple logistic regression analyses T = Analytic	Immigrants [684]; Born in Canada to immigrant parents [2573]; Canadian-born to Canadian-born parents [10 092]. Ethnicity then examined (Asian, Black, other, White/European).	DV: Emotional and behavioural problems	1. Ethnicity examined as a covariate. 2. Ethnic origin based on ethnicity question. 3. The "Others" race/ethnicity category not clearly defined.
20. Ma, 2002 (Canada)[47]	N = 2304 A = 7 to 11 S = NLSCY 1994/5 D = Cross-sectional DA = Factor analysis and mixed level modeling T = Analytic	Immigrant Children [182]; Non-immigrant Children [2122]. Ethnicity then examined as a covariate (US, Europe, Asia, other regions).	DV: Conduct disorder, indirect aggression, property offences, hyperactive behaviour, pro-social disorder, emotional disorder & a composite behavioural /emotional disorder index	1. Ethnic origin based on region of birth. 2. Ethnicity examined as a covariate. 3. No definition given for ethnicity.
21. Mata, 2002 (Canada)[48]	N = 17 109 A = 15+ S = National Survey of Giving, Volunteering and Participating D = Cross-sectional DA = Multiple regression analyses T = Analytic	19 Single/multiple ethnic categories (Canadian, French, British, German, Ukranian, Polish, Italian/Portuguese, Dutch, Chinese, Black/South Asian, Aboriginal, Canadian & French, Canadian & British, Canadian & Other, British & French, French & Other, European, Rest of singles, Rest of multiples)	DV: Life satisfaction (4-pt Likert scale)	1. Ethnic origin based on the ethnicity question in the survey. 2. Mutually exclusive ethnic groupings driven in part by sample size issues. 3. Rationale for some ethnic groupings unclear. 4. No definition of ethnicity.
22. Wu & Hart, 2002 (Canada)[49]	N = 3009 elderly immigrants A = 65+ S = National Population Health Survey (NPHS, 1996) D = Cross-sectional component DA = Descriptive and multiple linear regression analyses T = Analytic	Chinese/South Asian [274]; Other [2735]	DV: Emotional problems and psychological distress (CIDI)	1. Ethnicity based on the ethnic origin question in the survey. 2. The combination of Chinese and all South Asians indicate that ethnic origin based on large geo-cultural region.
23. Wu et al., 2003 (Canada)[2]	N=70 538 A=12+ S= NPHS, 1996 D=Cross-sectional component DA: Descriptive and multiple linear regression analyses T = Analytic	East & Southeast Asian [624]; Chinese [800]; South Asian [809]; Aboriginal [975]; Black [788]; Arabic & West Asian [325]; Latin American [176]; Jewish [197]; French [5580]; English [9281]; "Other" Whites [50 294]; Mixed race [689]	DV: Depression (CIDI)	1. Ethnicity based on the ethnic origin question in the survey and in combination with race used to create ethno-racial groups. 2. Offered definitions of race and ethnicity *a priori*.

Author(s), year of publication & region of study	Study Sample (sample size, data source, age group included and study design)	Ethnic groups included	Outcome Examined	Comments
24. Blackstock et al., 2004 (Canada)[50]	N = 3159 A = childhood (range not given) S = 1998 Canadian Incidence Study of Reported Child Abuse and Neglect (CIS-98) D = Cross-sectional DA = Chi-square and ANOVA analyses T = Descriptive	Aboriginal [614]; White [2114]; Other Visible Minority [431]	DV: Frequency of Child Maltreatment (physical and sexual abuse and neglect); psychosocial problems	1. No explicit definition of ethnicity given. 2. Ethno-racial classification determined by ethno-racial status of one or both biological parents. 3. Conceptualized based on *ethnic origin*.
25. Cohen & Maclean, 2004 (Canada)[51]	N = 26 000 A = 15+ S = All females from the 1999 General Social Survey D = Cross-sectional DA = z-test with $p < 0.05$ significance level T = Descriptive	Visible minority vs. non-visible minority; Aboriginal vs. non-Aboriginal	DV: Physical, sexual, financial or emotional abuse; medication use for anxiety, depression or insomnia in those abused.	1. Ethnicity based on country of birth. 2. No definition given for visible minority.
26. Wang & El-Guebaly, 2004 (Canada)[52]	N = 72 940 A = 12+ S = NPHS (1996/7) D = Cross-sectional DA = Multiple logistic regression analyses T = Analytic	White [67 802]; Non-White [5138]	DV: Major depressive episode (MDE), alcohol dependence (AD) and mental health service use	1. Ethnicity examined as a covariate. 2. No description of the groups included in the non-white category. 3. Non-white population likely included Aboriginals, a group with great likelihood of MDE and AD, which likely explains the higher risk observed in non-immigrant non-whites. 4. Race only categorization despite use of the term "ethnicity".
27. Rousseau & Drapeau, 2004 (Montreal, Quebec, Canada)[53]	N = 1871 A = 15 to 87 S = Quebec Cultural Communities Survey (survey of recent immigrants living in the metropolitan Montreal area who landed in Canada between 1988 and 1997) D = Cross-sectional DA = Chi-square, t-test, ANOVA T = Descriptive	Chinese; Arab; Haitian; Hispanics Note: indicated in the article that equal numbers of each ethnic group were selected from the registry to represent the target population [n = 750 * 4 = 3000] but the eligible population was 1871 with no breakdown of the numbers in each ethnic group	DV: Emotional distress (i.e. depression and anxiety) per the SCL-25 based on the Hopkins Symptom Checklist	1. Explicit definition of ethnicity not given. 2. Researchers interested in recent immigrants in the Montreal area who were born in one of four geocultural areas (China, Hong Kong, Taiwan and Macao [Chinese], Haiti [Haitian], North Africa and the Middle East [Arabs] and Latin America [Hispanics]. Therefore, ethnicity conceptualized based on region of birth.
Smaller studies with primary data collection – non-clinical sample (n = 12)				
28. Fry & Grover, 1982 (Canada & USA)[54]	N = 320 A = 65 to 80 S = Random sample drawn form professional clubs, community associations, recreation centres for elderly, social welfare agencies and private homes. D = Cross-sectional DA = ANOVA T = Analytic	Asian-Indian [160]; Caucasian [160]	DV: Depression (per the BDI), life stress [per the Life Event Inventory], cognitive appraisal and locus of control	1. Definition of ethnicity not given. 2. How ethnicity ascertained unclear. 3. Seem to be a race only categorization.
29. Dyal & Chan, 1985 (Waterloo, Ontario, Canada)[55]	N = 251 A = 17 to 29 S = Samples of convenience (i.e. students in undergraduate courses and some volunteers) D = Cross-sectional DA = ANOVA and ANCOVA T = Analytic	Euro-Canadian [112]; Hong Kong Chinese [100]; Chinese immigrants to Canada [39]	DV: Stressful life events per the Problems with Living Adjustment scale (developed for the study); distress per the DSS based on Langer 22-item scale of impaired functioning; 12- items from the DDS; worry per the worry scale of the SEAS.	1. No explicit definition given for ethnicity. 2. Implication that ethnicity based on culture since the study interested in cross-cultural differences. 3. Unclear whether the Euro-Canadian groups actually identified themselves as such or if this categorization based on the researchers' observations.
30. Blandford & Chappell, 1990 (Winnipeg, Manitoba, Canada)[56]	N = 390 A = 50 and over S = Survey of Natives in Winnipeg in 1981 D = Cross-sectional DA = Chi-square and logistic regression analyses T = Analytic	Natives [193] Non-Natives [197]	DV: Satisfaction with life; loneliness per the UCLA Loneliness Scale	1. Ethnicity not specifically defined. 2. Conceptualized based on ethnic identity but no indication of how ethnic identity was ascertained.
31. Dion & Giordano, 1990 (Toronto, Ontario, Canada)[57]	N = 352 A = 1st-year university students – mean age of 20.32 years (1988) S = A sample of undergraduate students in an introductory psychology course D = Cross-sectional DA = ANOVA, X^2, and multivariate log-linear analyses T = Analytic	Anglo-Celtic [165]; North European [22]; South European [79]; East European [36]; East Asians [25]; South Asians [25] IV: Sex and ethnicity	DV: Depression (total & item scores for the BDI)	1. *Ethnic origin* based on surnames, with the aid of a number of dictionaries of surnames/family names. 2. This limited the ability to identify black individuals with West Indian ethno-cultural background and South Asians of Christian background.

Author(s), year of publication & region of study	Study Sample (sample size, data source, age group included and study design)	Ethnic groups included	Outcome Examined	Comments
32. Bagley, 1993 (Calgary, Alberta, Canada & Kowloop, Hong Kong, China)[58]	N = 300 A = 60 to 74 years old S = The 100 Canadian-dwelling elderly Cantonese-speaking Chinese sample was recruited by randomly selecting Chinese surnames from the telephone directory with an initial call by a Cantonese-speaking individual who established the presence of an elderly person (aged 60 to 74) and then inquired about and established the ethnic origin of the individual. Stratified sampling of young to elderly in Kowloop, Hong Kong to match the age and sex profile of Canadian-dwelling Cantonese-speaking elderly Chinese group. D = Cross-sectional DA = Comparison of the standardized scores T = Descriptive	Canadian born of European descent [100]; Chinese immigrants long established in Canada [50]; Chinese immigrants newly arrived in Canada [50]; Chinese in Hong Kong [100]	DV: Physical and mental health as measured by the GHQ; loneliness per the UCLA Loneliness Scale; quality of life & acculturation; & global satisfaction with life	1. Explicit definition given for ethnicity. 2. Different techniques seem to have been used to establish ethnicity across groups. Surnames, language and unknown question for Canadian dwelling Chinese; country of birth for Hong Kong Chinese and unknown method for Euro-Canadians.
33. Dion, 1996 (Toronto, Canada)[59]	N = 950 A = ?18-21 : 1st-year university students S = Convenience sample D = Cross-sectional DA = ANOVA T = Exploratory	Language as indicator of *ethnic origin* English; Chinese; European	DV: Alexithymia (TAS-20) and three under-lying factors (DIF= difficulty identifying feelings, DDF= difficulty describing feelings, EOT= externally oriented thinking)	1. Language identified by Dion as a possible proxy of ethnicity (i.e. ethnic origin). 2. No definition for ethnicity.
34. Heine and Lehman, 1999 (Canada & Japan)[60]	N = 402 A = 18 to 25? S = Survey of university students D = Cross-sectional DA = ANOVA with post hoc tests (Tukey's HSD) T = Analytic	Japanese [161]; Asian-Canadian [151]; Euro-Canadian [90]	DV: Personality traits: 20 items to capture the individuals' ratings of their actual & ideal self and what they thought described the average student traits; difference between actual & ideal self, and importance of traits to success in one's country were also assessed; depression (ZSDS)	1. No explicit definition given for ethnicity; it appeared to be based on culture. 2. Method of sample selection unclear. 3. SES and/or SS hypotheses not tested.
35. Rousseau et al., 2001 (Montréal, Canada)[61]	N = 113 A = 20 to 65 S = Sample of refugees who sought help from community organizations that provide services to refugees/immigrants in the Montreal area D = Qualitative & cross-sectional quantitative design combined DA = Descriptive analyses and Spearman rank correlation and t-tests for comparative analyses T = Descriptive	Latin American [60]; African American [53]	DV: Emotional profile of subjects based on the SCL-90R; Post-traumatic stress disorder per the DSM-IV.	1. Ethnic origin based on geo-cultural region of birth. 2. Explicit definition of ethnicity not given.
36. Howard et al, 2003 (Toronto, Ontario, Canada; USA; Taipei City, Taiwan)[62]	N = 3030 A = not given S = All participants from Canada are volunteers recruited through newspaper and flyer advertisements in Toronto; Taiwanese recruited at the Taipei City Psychiatric Center; African American smokers recruited at the University of Kansas Medical Center (Clinical and community settings) D = Association Analysis (Cross-sectional) DA = ANOVA; T-test, Mann-Whitney U-test and Chi-square analyses T = Analytic	From Canada: Indo-Asian [48]; Chinese [210]; Japanese [128]; African Canadian [58]; Native Indian [228]; Caucasian [1734] Elsewhere: Taiwanese [420]; African American [204]	DV: CYP2E1*1D allele; alcohol inactivation	1. Ethnicity not explicitly defined. 2. Ethnic background based on the individual's grandparents therefore an *ethnic origin* conceptualization.
37. Tweed et al., 2004 (British Columbia, Canada and Japan)[63]	N = 123 (Study 1) 415 (Study 2) A = 18 to 47 S = Undergraduate students from the University of British Columbia, Canada and from Ritsumeikan University (Study 1) or Kurume University (Study 2), Japan D = Cross-sectional DA = MANCOVA T = Analytic	Study 1: Western European Canadian [22]; East Asian Canadian [57]; South Asian/Mixed descent Canadian [18]; Japanese [26] Study 2: European Canadian [68]; East-Asian Canadian [106]; Japanese [241]	DV: Stressful and negative life events; coping skills per the WCCL and Japanese coping items	1. Ethnicity not explicitly defined but based on culture. 2. Conceptualized based on descent, therefore *ethnic origin*.

Author(s), year of publication & region of study	Study Sample (sample size, data source, age group included and study design)	Ethnic groups included	Outcome Examined	Comments
38. Khanlou, 2004 (Hamilton, Ontario, Canada)[64]	N = 550 A = Grades 9 to 13 S = Survey of students at 4 secondary schools in the Hamilton Wentworth region in 1998 D = Cross-sectional DA = Chi-square and ANOVA analyses T = Descriptive	Information given for the three most frequently occurring ethnic/cultural background of the mothers and fathers of the students. Based on mother: Italian [48]; Portuguese [43]; Irish [35]; English [35] Based on Father: Italian [69]; Portuguese [42]; Canadian [38]	DV: Self-esteem per the RSE and the CSE scales	1. No definition given for ethnicity. 2. Ethnicity based on the "parents' original ethnic or cultural background" indicating an *ethnic origin* conceptualization. 3. Specific ethnic groupings were used with some having very small sample size. As a result comparison only done on the top three ethnic categorizations. 4. The study indicated that close to 30% of the sample reported 2 or more ethnic backgrounds indicating a "mixed" ethnic group.
39. Aubert et al., 2004 (Canada)[65]	N = 170 A = 18+ S = Convenience sample of students D = Cross-sectional DA = ANOVA T = Analytic	Other Canadian [81]; Chinese Canadian [89]	DV: Hostility (HDHQ); suicide probability (SPS); lifetime aggressive behaviour incl. suicide attempt; suicidal thoughts and deliberate self harm	1. Ethnicity examined as a covariate 2. It is unclear if "Other Canadian" group include ethnicity other than Anglo-Canadians. 3. Ethnic origin based on country of birth.

Smaller studies with primary data collection – clinical/specialized sample (n = 10)

Author(s), year of publication & region of study	Study Sample (sample size, data source, age group included and study design)	Ethnic groups included	Outcome Examined	Comments
40. Bland & Orn, 1981 (Alberta, Canada)[66]	N = 43 (33 non-immigrants & 10 immigrants) A = 15 to 49 S = 1963 First episode hospitalization data D = Retrospective follow-up on a cohort of persons with schizophrenia compared to the general population DA = Descriptive and Chi-square analyses T = Descriptive	10 immigrants classified as "other European" [6], & Eastern European [4]	DV: Schizophrenia	1. Ethnicity examined as a covariate. 2. The term "ethnic group" used but no definition of what it means. 3. *Ethnic origin* based on place of birth.
41. Seltzer & Langford, 1984 (Northwest Territories, Canada)[67]	N = 85 A = 15 to 25 S = Sample of convenience (i.e. all persons referred by the courts or legal counsel to the Department of Psychiatry at the regional hospital in the calendar year 1981) D = Cross-sectional DA = Descriptive T = Descriptive	Inuit [41]; Métis/Dene [27]; Caucasian [17]	DV: DSM-III psychiatric diagnosis and type of criminal offences committed	1. No explicit definition given for ethnicity. 2. The Native group broken down into Inuit and Metis, indicating cultural distinctions, but the Caucasian group not disaggregated.
42. Borzecki et al., 1988 (Saskatoon, Saskatchewan, Canada)[68]	N = 275 (all males) A = 28.41 = mean age at admission S = successive 1st admission to the facility between January 1978 and September 1982 D = Cross-sectional DA = ANOVA, ANCOVA, and Pearson's correlation T = Analytic	Natives (i.e. Inuit, Métis, and Indians) [57]; Non-Natives [218]	DV: Psychological profile per the MMPI	1. No explicit definition of ethnicity given. 2. Ethnicity based on ancestry (*ethnic origin)*, at least for the native sample, while all non-natives, despite ancestral heterogeneity are grouped together.
43. Chandrasena et al., 1991 (Ontario, Canada)[69]	N = 117 A = range not given S = All suicides in 3 psychiatric facilities in Ontario between 1967 and 1990 D = Cross-sectional DA = Descriptive Analyses T = Descriptive	Canadian-born [94]; Foreign-born [23]	DV: Suicide	1. Ethnicity mentioned but not defined. 2. Canadian-born versus foreign-born indicate a country of birth conceptualization but not explicitly stated.
44. Norton et al., 1995 (Manitoba, Canada)[70]	N = 80 A = ? S = Attendees at the Alcoholism Foundation of Manitoba D = Cross-sectional DA = Chi-square T = Descriptive	Native-Canadians [37]; Anglo-Canadians [43]	DV: Suicidal ideation (per NIMH Epidemiologic Catchment Area survey), panic (PAQ), chemical abuse (the BMAST & DAST) and depression (BDI)	1. No explicit definition of ethnicity given. 2. Unclear how ethnicity was ascertained.
45. Weekes et al., 1995 (Ontario, Canada)[71]	N = 301 A = 18 to 59 S = Sample of convenience: Adult males incarcerated in a medium security federal prison D = Cross-sectional DA = MANOVA, T-TEST, correlation and principal component analyses T = Analytic	Caucasian [203]; Native [59]; Métis [39]	DV: Psychopathology per the MCMI	1. No explicit definition of ethnicity 2. The terms ethnicity, "cultural group", and "racial identification" used in the article but categorization based on the individuals self-report of "racial identification".

Author(s), year of publication & region of study	Study Sample (sample size, data source, age group included and study design)	Ethnic groups included	Outcome Examined	Comments
46. Pawliuk et al., 1996 (Montreal, Canada)[72]	N = 34 multiethnic families (one parent included) with a total of 48 children (of which 8 born in Asia and 3 in India. No other mention of the ethnic breakdown of the children). A = age range of parents not given but children ranged in age from 6.5 to 17 years old S = convenience sample of the parents and their children seen in a Pediatric Clinic in Montreal, Canada D = Cross-sectional DA = ANOVA and MANOVA T = Analytic	Ethnic breakdown of the parents given but not for the children. Asian [26]; European [5]; Indian/S. American/Middle Eastern [3]	DV: Revised CBCL; Depression Self-rating Scale; the What I Think and Feel Scale; the Children's Psycho-somatic Symptom Checklist; and the Hare Self-Esteem Scale.	1. No explicit definition given for ethnicity 2. There were 34 parents and 48 children so unclear of the ethnicity breakdown of the children. 3. Since ethnicity for parents given but not for children, it appears that ethnicity based on region/place of parent's birth.
47. Zapf et al., 1996 (Vancouver, British Columbia, Canada)[73]	N = 790 A = not specified S = Adult males randomly selected from Vancouver Pretrial Service Centre between August 1, 1989 and July 31, 1990 D = Cross-sectional DA = Chi-square and Pearson Correlation Analyses T = Descriptive	Although the term "ethnicity" used, there was no breakdown of the ethnic group.	DV: Mental disorder per the BPRS and the Diagnostic Profile	1. Ethnicity stated as a covariate. 2. No definition given for ethnicity. 3. No indication of how ethnicity conceptualized or operationalized.
48. Devins et al., 2000 (Canada & US)[74]	N = 405 A = not specified S = The Arthritis, Rheumatism and Aging Medical Information System Lupus Project D = Longitudinal DA = Principal component and path analyses T = Analytic	White [335]; Black [40]; Asian [30] (all female)	DV: Psychosocial well-being (ABS); learned helplessness (RAI); emotional distress (CES-D); musculo-skeletal pain (HAQ); overall psycho-social well-being	1. The Black and Asian groups comprised of mostly (i.e. 97% & 83%) individuals from the US, whereas almost equal proportion of whites from the US and Canada). 2. Racial classification rather than ethnicity.
49. Hodelet, 2001 (British Columbia, Canada)[75]	N = 175 A = 19 to 75 S = Secure Forensic Psychiatry Hospital, all case records for patients in hospital between December 1, 1998 and February 28, 1999 D = Cross-sectional DA = Chi-square and ANOVA analyses T = Descriptive	White [153]; Native American [26]; Oriental/East Asian [11]; South Asian [5]; Black [1]	DV: Type of offence; type of psychiatric diagnosis; psychosis; psychotic drive	1. Explicit definition of ethnicity not given. 2. "Ethnic origin" indicated but unclear how this was ascertained in the individuals' medical records.

Association of comorbid mood disorders and chronic illness with disability and quality of life in Ontario, Canada

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Abstract

Mood disorders are more prevalent in individuals with chronic physical illness compared to individuals with no such illness. These disorders amplify the disability associated with the physical condition and adversely affect its course, thus contributing to occupational impairment, disruption in interpersonal and family relationships, poor health and suicide. This study used data collected in the Canadian Community Health Survey, cycle 3.1 (2005) to examine factors associated with comorbid mood disorders and to assess their association with the quality of life of individuals living in Ontario. Results indicate that individuals with chronic fatigue syndrome, fibromyalgia, bowel disorder or stomach or intestinal ulcers had the highest rates of mood disorders. The odds of having a comorbid mood disorder were higher among women, the single, those living in poverty, the Canadian born and those between 30 and 69 years of age. The presence of comorbid mood disorders was significantly associated with short-term disability, requiring help with instrumental daily activities and suicidal ideation. Health care providers are urged to proactively screen chronically ill patients for mood disorders, particularly among the subgroups found to have elevated risk for these disorders.

Key words: Ontario, mood disorders, chronic diseases, quality of life, short-term disability

Introduction

Mood disorders (major depressive disorder, bipolar disorder, mania or dysthymia) are the most prevalent of all mental disorders. One in 7 adults (13.4%) living in Canada reported symptoms that met the criteria for a mood disorder at some point in their lives and about 5.3% of the Canadian population aged 15 years and over were identified as suffering from a mood disorder in 2002.[1] The burden of depression to individuals and societies is such that the World Health Organization has projected that by the year 2020, unipolar major depression will be the leading cause of disability-adjusted life years (DALYs) after cardiovascular disease.[2] Evidence exists that the prevalence of mood disorders in individuals with chronic physical illness is noticeably higher compared to individuals with no such illness. According to the 2002 Mental Health and Well-being Survey, an individual with a chronic physical condition was twice as likely as an individual without such a condition to have a mood disorder.[3] Depressive disorders often accompany chronic illnesses such as heart disease, stroke, Parkinson's disease, cancer and HIV/AIDS (Evans et al, 2005).[4] For example, reported prevalence rates of depression range from 17% to 27% in patients with cardiac disease, from 22% to 29% in patients with cancer and from 9% to 26% in patients with diabetes.[4] Fuller-Thomson and Sulman[5] reported that among Canadians who had inflammatory bowel disease in 2002, 16.3% suffered from depression.

High prevalence of mood disorders among individuals with chronic physical conditions represents a significant burden to individuals and society. At the individual level, they can lead to occupational impairment, disruption in interpersonal and family relationships, poor health and suicide.[6] Existing research suggests that major depression interacts with physical illness to amplify the disability associated with many physical conditions as well as adversely affect the course of physical illnesses.[4] Individuals with physical health problems often experience anxiety or depression, which affects their response to the treatment of their physical illness. On the other hand, individuals with mental illness can develop physical symptoms and illnesses, such as weight loss and biological disturbances associated with eating disorders. Most of the research done in this field focuses on the impact of depression on quality of life after adjusting for the severity of physical illness (e.g. Vali and Walkup[7] and Ades, et al.[8]) rather than comparing the impact of comorbid mental disorders in individuals with and without physical illness. These studies usually find that depression adversely affect patients' quality of life after adjusting for severity of physical illness. Ferketich, et al.[9] analyzed data collected in a National longitudinal study and found that depressed men had a 71% greater risk of developing heart disease and were 2.34 times more likely than non-depressed men

to die from this condition. Simon, et al.[10] compared SF-36 subscale ratings on a clinical sample of depressed patients with and without chronic physical illness and concluded that depressive disorders and chronic physical illness produced differing patterns of impairment, and that comorbid depressive disorders created a substantial burden of additional functional impairment. Katon[11] estimated medical costs for patients with major depression to be almost 50% higher than the costs of chronic physical illness alone. The associations between other mood disorders such as bipolar disorder or dysthymia and physical illness and their effect on the quality of life of the physically ill have not been examined.

At the national level, comorbid mood disorders can adversely affect the economy through reduced productivity and higher health care costs. Several studies have investigated the impact of comorbid depressive disorders on the cost of health services using patients with specific physical conditions such as arthritis.[7] In a study of the economic burden of mental health in Canada, Stephens and Joubert[12] estimated work-related productivity losses due to mood disorders alone to be $4.5 billion annually. Little is known about the impact of comorbid mood disorders on individuals' productivity, daily functioning and quality of life in the Canadian population. Further, the cost to society of the comorbidity of mental disorders and physical conditions requires further investigation.

The widely reported under-treatment of mood disorders magnifies and reinforces their adverse impact on the lives of the physically ill and society as a whole. Although effective interventions for the treatment of mood disorders are available, most individuals who suffer from them fail to consult health professionals. Strakes, et al.[13] reported that only 40% of people with probable depression in Atlantic Canada consulted a general practitioner or a mental health specialist about their condition. Despite a universal coverage of physician and hospital services in Canada, only 56.4% of Canadian women identified as having at least one major depressive episode (MDE) in 2002 reported accessing health care resources in the 12 months prior to the interview.[14] Among Canadians with inflammatory bowel disease who were identified as having major depression, only 40% were using antidepressants, and between one third and one half were not consulting any mental health professionals.[5] Identification of the socio-demographic characteristics of physically ill individuals at high risk of having mood disorders provides health care providers with essential knowledge for targeting high risk individuals leading to early diagnosis and intervention.

Most studies that explored the comorbidity of mental disorders and physical conditions have used clinical samples, which may lead to biased results. Thus, researchers have highlighted the role of population-based studies in determining the extent and nature of comorbidity between mental disorders and physical illness and the impact of such comorbidity on the afflicted individuals and the society at large. To date, only a few studies which have examined the comorbidity between mental disorders and physical conditions have been conducted in community based samples. In addition, most of these studies used self-reported diagnosis of physical conditions or self-reported symptoms of mental disorders. The present investigation was based on the most recent data available on a representative sample of individuals living in the province of Ontario, Canada. This investigation had two objectives. First, it examined the relationship between socio-demographic characteristics and mood disorders in Ontarians with chronic physical conditions. Second, it assessed short-term disability, limitations in activities of daily living and suicidal ideation in individuals with comorbid mood disorders compared with those with chronic physical illness only.

Methods

Sample

This research was based on a subset of the data collected by Statistics Canada in cycle 3.1 of the Canadian Community Health Survey and are available for public use.[15]

The survey was conducted in 2005 and employed a multistage stratified cluster probability sampling in which dwelling was the final sampling unit. The sample was stratified by province, and urban versus rural regions, within province. The survey sample represented approximately 98% of the Canadian population aged 12 or older who resided in private dwellings in the ten provinces and the three territories. Persons living on Indian Reserves, residents of institutions, full-time members of the Canadian Armed Forces and residents of certain remote regions were excluded from the survey. Fifty percent of the respondents were inter-viewed face-to-face using the computer-assisted personal interviewing (CAPI) method and 50% were interviewed by telephone using the computer-assisted telephone interviewing (CATI) method. Cycle 3.1 of the CCHS included a list of common questions to be used in all provinces and a number of lists of optional questions for provinces to select among them. This was done to allow each province to select questions related to their particular needs and priorities. Consequently, not all variables are available for all provinces. Data collected from Ontario participants included all the variables required for the present analysis. Hence, Ontario data were used in this research.

Measures

Participants were asked the following question, "Now I'd like to ask about certain chronic health conditions which you may have. We are interested in long-term conditions, which are expected to last or have already lasted 6 months or more and that have been diagnosed by a health professional." The list of chronic physical illnesses included food allergies, other allergies, asthma, fibromyalgia, arthritis or rheumatism, back problems, high blood pressure, migraine headaches, chronic bronchitis, emphysema, pulmonary disease, diabetes, epilepsy, cancer, heart disease, bowel disorder, cataracts, glaucoma, thyroid condition, chronic fatigue syndrome, mood disorders (such as major depressive disorder, bipolar disorder, mania or dysthymia), and anxiety disorders (such

as phobia, obsessive-compulsive disorder or panic disorder).

Two variables were used to measure short-term disability: the number of disability days during the two weeks prior to the interview and whether the participants required help with their usual daily activities. Survey participants were asked about the number of days they stayed in bed for all or most of the day due to illness or emotional/mental health during the two weeks prior to the interview. They were also asked a series of questions about whether they needed help with instrumental activities of daily living such as preparing meals, shopping for groceries and other necessities, getting to appointments, doing everyday housework, personal care or moving about inside their home because of a long-term health condition. A long-term health condition was defined as a condition that is expected to last or has lasted 6 months or more. In addition, survey participants who live in Ontario were asked whether they had considered suicide in the 12 months prior to the interview.

Socio-demographic characteristics and health indicators used in this research included gender, age group (12 to 29 years, 30 to 49 years, 50 to 69 years, 70 years or older), marital status (married/common law versus divorced/separated/widower/never married), immigration status (immigrant versus Canadian born), education level (less than secondary school degree, secondary school graduate, some post secondary education and post secondary graduate) and income level (low 30%, middle 40% and upper 30% of the income distribution in Ontario). The income level variable was derived by Statistics Canada to measure the participant's household income relative to the household incomes of all participants living in the province and having the same household size.[15] First, an adjusted ratio of the participant's total household income to the low-income cutoff corresponding to their household size and community size was calculated. The adjusted ratios were then divided into deciles, i.e. 10 categories including approximately the same percentage of residents.

Data analyses

Prevalence of comorbid mood disorders among individuals with chronic physical conditions was calculated. Expected probabilities of random co-occurrence of chronic physical conditions and mood disorders were calculated and compared with the observed probabilities. Chi-square tests were used to assess bivariate relationships between prevalence of comorbid mood disorders and socio-demographic characteristics in individuals with chronic physical illness as well as bivariate relationships between mood disorders and quality of life. Logistic regression analysis was used to identify socio-demographic factors associated with a high risk of having mood disorders in individuals with chronic physical illness. Sampling weights were rescaled and used in all analyses. Rescaling the weights to have an average of one has two advantages. First, it takes into account the unequal probabilities of selection of survey participants and adjusts the sample results to the demographic composition of Ontario population so that the results represent the population of Ontario and not just the sample itself. Second, it keeps the total sample size unchanged to guard against inflating the sample size for hypothesis testing.

Results

Table 1 shows the prevalence of chronic physical illness and mood disorders by gender. Based on data presented in this table, the prevalence of mood disorders among men with chronic physical illness was 6.5% compared with 1.9% among men with no such illness. The prevalence of mood disorders among women with chronic physical illness was 10.5% compared with 3.8% among women with no chronic physical illness. Using the sampling weights published by Statistics Canada, it can be estimated that approximately 2 557 000 men and 3 170 000 women of Ontario residents were living with chronic physical illness in 2005. Among them, approximately 165 000 men and 334 000 women had been diagnosed with at least one mood disorder.

As shown in Table 1, 10 105 of all men (49.3%) were diagnosed by a health professional as having a chronic physical illness and 4.1% of all men were diagnosed as having a mood disorder. If these conditions were independent, the probability that they co-occur by chance alone would be 2.02% (49.3% x 4.1%). However, the observed probability of their co-occurrence was 3.18% indicating an association bet-

TABLE 1
Prevalence of chronic physical illness and mood disorders by gender, Ontario 2005 (sample size = 41 701)

| Mood disorders | | Chronic physical condition | | |
		Yes Number (%)	No Number (%)	Total
Men	Yes	652 (6.5%)	198 (1.9%)	850 (4.1%)
	No	9 453 (93.5%)	10 191 (98.1%)	19 644 (95.9%)
	Total	10 105	10 389	20 494
Women	Yes	1 319 (10.5%)	334 (3.8%)	1 653 (7.8%)
	No	11 209 (89.5%)	8 345 (96.2%)	19 554 (92.2%)
	Total	12 528	8 679	21 207
Total	Yes	1 971 (8.7%)	532 (2.8%)	2 503 (6.0%)
	No	20 662 (91.3%)	18 536 (97.2%)	39 198 (94.0%)
	Total	22 633	19 068	41 701

ween the two conditions. Similarly, the observed probability of chronic physical illness and mood disorders in women was found to be 6.22% compared with a probability of 4.61% of the two conditions occurring by chance alone.

The prevalence rates of comorbid mood disorders among individuals with different demographic and health characteristics are presented in Table 2. Higher prevalence of mood disorders were found among women, individuals 30 to 49 years of age, lower income groups, Canadian-born, and individuals who were divorced, separated, widowed or never married. The highest proportions of individuals with mood disorders were found among individuals who were diagnosed with chronic fatigue syndrome, fibromyalgia, bowel disorder, stomach or intestinal ulcers, chronic bronchitis or those suffering from the effects of a stroke.

Bivariate chi-square tests indicated that the prevalence of comorbid mood disorders was significantly associated with the individual's gender, age, marital status, immigration status, and education and income levels. Hence, these variables were used in a logistic regression analysis to predict presence of mood disorders in the physically ill. Logistic regression analysis results shown in Table 3 indicate that the odds of having a mood disorder were higher among women, the single, those living in poverty, the Canadian-born and those between 30 and 69 years of age. Chronically ill woman were 65% more likely than chronically ill men to have mood disorders. The odds of suffering from mood disorders among chronically ill individuals 30 to 49 years of age were almost three times higher than the odds for individuals 70 years or older. Those who were 50 to 69 years old had more than twice the odds of suffering from mood

disorders than individuals 70 years of age or older. The odds of having mood disorders for those in the lower 30% of income distribution were twice the odds of high income individuals. Respondents who were divorced, separated, widowed or never married were 50% more likely to have mood disorders than those with partners. Education level was not a significant predictor of mood disorders.

Table 4 includes a comparison of quality of life measures in individuals with chronic physical conditions with and without mood disorders. Data presented in this table show that 41.7% of men with mood disorders had disability days in the two weeks prior to the interview, compared with only 17.7% without mood disorders ($p < 0.0005$). Forty-four percent of women with mood disorders reported disability days compared with 22.0% without mood disorders ($p < 0.0005$). Thirty-six percent

TABLE 2
Prevalence of mood disorders in individuals with chronic conditions by socio-demographic characteristics, Ontario 2005 (sample size = 22 633)

Characteristic	Total Number	% With mood disorder	Characteristic	Total Number	% With mood disorder
Men	10 105	6.5%	Chronic condition:		
Women	12 528	10.5%	Food allergies	2 108	11.7%
Age group, years:			Other allergies	7 636	10.9%
12 to 29	3 721	8.1%	Asthma	3 325	11.4%
30 to 49	7 512	10.9%	Fibromyalgia	637	26.5%
50 to 69	7 699	8.7%	Arthritis/rheumatism	7 140	10.9%
70+	3 701	4.9%	Other back problems	8 089	11.7%
Married/common law	14 803	7.6%	High blood pressure	6 365	8.1%
Single/Sep/Div/Widowed	7 811	10.8%	Migraine headaches	4 721	14.1%
Education level:			Bronchitis	1 009	16.9%
Less than second. school	4 975	8.6%	Diabetes	2 014	9.3%
Second. school grad.	3 670	9.1%	Epilepsy	215	13.5%
Some post-secondary	1 621	10.8%	Heart disease	1 997	9.8%
Post-secondary graduate	11 571	8.4%	Cancer	621	10.1%
Immigrant	6 421	7.2%	Stomach/intest. ulcers	1 296	17.0%
Canadian-born	15 500	9.4%	Effects of smoke	476	15.5%
Income within Ontario:			Bowel disorder	1 672	17.3%
Low	6 127	11.2%	Cataracts	1 861	8.2%
Middle	7 727	8.6%	Glaucoma	610	6.9%
High	5 490	6.6%	Thyroid condition	2 183	10.9%
			Chronic fatigue syndrome	543	37.2%

TABLE 3
Socio-demographic factors associated with comorbid mood disorders among individuals with chronic physical illness, Ontario 2005 (sample size = 19 213)

Variable	Odds ratio (95% CI)	*p*-value
Female	1.65 (1.49, 1.84)	< 0.0005
Age group, years:		
12 to 29	1.42 (1.14, 1.76)	< 0.0005
30 to 49	2.89 (2.40, 3.49)	< 0.0005
50 to 69	2.31 (1.90, 2.79)	< 0.0005
70+ (reference)	–	
Single/Sep/Div/Widowed	1.51 (1.35, 1.70)	< 0.0005
Married/common law (reference)	–	
Immigrant	0.64 (0.57, 0.73)	< 0.0005
Canadian-born (reference)	–	
Income within Ontario:		
Low	1.96 (1.70, 2.25)	0.002
Middle	1.38 (1.20, 1.58)	< 0.0005
High (reference)	–	

of chronically ill men and 43.7% of chronically ill women with mood disorders reported needing help in activities of their daily living such as preparing meals, getting to appointments, doing housework, personal care or moving about inside their home. In contrast, only 15.2% of men and 25.1% of women with no comorbid mood disorders reported experiencing such limitations. Data in Table 4 also show that 14.9% of chronically ill men with mood disorders reported having suicidal thoughts in the 12 months prior to the interview compared with only 1% of those without a mood disorder (*p* < 0.0005). In women, the percentages were 11.7% in those with a mood disorder compared to 0.7% without a mood disorder (*p* < 0.0005). Using the sampling weights published by statistics Canada, it can be estimated that among Ontarians with comorbid mood disorders and chronic physical illness in 2005, approximately 24 000 men and 39 000 women had suicidal thoughts.

Discussion

The rates of mood disorders in chronically ill individuals living in Ontario in 2005 ranged between 7.9% in those with cataracts and 37.2% in those with chronic fatigue syndrome compared with 2.8% in individuals with no chronic physical conditions. The prevalence of mood disorders in chronically ill men was more than three-fold than in men with no chronic illness. In women with one or more chronic physical condition, it was almost three-fold than in non chronically ill women. Prevalence of mood disorders were highest among individuals who had been diagnosed as having fibromyalgia, bowel disorder, stomach or intestinal ulcers, chronic bronchitis or those suffering from the effects of a stroke. Rates of mood disorders in individuals with heart disease, cancer and diabetes observed in this study were lower than those reported in the literature.[4] This is not surprising since this is a community sample that included those individuals with cancer in remission. Individuals with comorbid mood disorders were more likely to be female, middle aged, living in poverty, without a partner and born in Canada. These characteristics are similar to those of individuals with depression in the general population.[16]

Findings of this investigation showed a highly significant impact of the presence of

TABLE 4
Relationship between comorbid mood disorders and quality of life of individuals with chronic physical conditions by gender, Ontario 2005 (sample size = 22 633)

	Mood disorder			
	Yes number (%)	No number (%)	Chi-square (df = 1)	*p*-value
Men				
Disability days in last 2 weeks ≥ 1 day	272 (41.7%)	1 671 (17.7%)	232.4	< 0.0005
Need help with daily activities	234 (35.9%)	1 438 (15.2%)	189.1	< 0.0005
Suicidal thoughts	97 (14.9%)	95 (1.0%)	629.7	< 0.0005
Total – Men	652	9 453		
Women				
Disability days in last 2 weeks ≥ 1 day	575 (43.6%)	2 469 (22.0%)	304.0	< 0.0005
Need help with daily activities	576 (43.7%)	2 814 (25.1%)	205.2	< 0.0005
Suicidal thoughts	154 (11.7%)	83 (0.7%)	760.3	< 0.0005
Total – Women	1 319	11 209		

mood disorders on all measures of quality of life for the chronically ill. The presence of mood disorders was associated with more than double the risk of short-term disability for men and almost double the risk for women. It was also associated with double the proportions of chronically ill men and women requiring help with their daily living activities. In addition, the presence of comorbid mood disorders was associated with an increase in the proportion of those having suicidal ideation – 15-fold in men and 17-fold in women.

A bidirectional relationship between mood disorders and chronic physical illness has been proposed that may explain their high comorbidity.[4] A diagnosis of a disabling physical illness and the associated decline in physical health may cause enough distress to trigger a depressive episode in vulnerable persons. On the other hand, research is discovering that depression itself may act as a risk factor for a variety of chronic illnesses. Goodman and Whitaker (2002)[17] noted that patients with major depression had higher rates of unhealthy behaviors such as smoking and overeating, which may lead to higher incidence of diabetes and heart disease. Depression has also been shown to be an independent risk factor for type 2 diabetes mellitus.[18] Perretta, et al.[19] suggested that depression and mania may act as risk factors for HIV infection by promoting high-risk behaviors. Large population studies indicate that depressed mood or stressful life events may increase the risk of cancer.[4] In addition, the presence of depression can hinder compliance to treatment and weaken cognitive function, thus, adversely affecting patients' prognosis and increasing their morbidity.

Ample research has focused on trying to understand the mechanisms of the relationship between depression and cardiovascular disease. In addition to promoting unhealthy behaviors and noncompliance with cardiac rehabilitation and medical regimens, some of the possible biologic mechanisms that may explain the increased risk associated with depression in heart disease patients

are that depressed patients have decreased heart rate variability,[20] increased platelet aggregation[21] and higher levels of inflammatory risk markers.[22] Other mood disorders may also act as risk factors for physical illnesses and/or adversely affect their prognosis; however, the underlying mechanisms are not as extensively researched as those of depression.

This study has a number of limitations. The identification of individuals as having mood disorders and/or chronic physical illness was not done by clinicians. The survey did not include individuals living in nursing homes, mental institutions or chronic care hospitals, thus, the data underestimate the prevalence of both mood disorders and chronic illnesses. Participants were not asked about each mood disorder separately. Instead, major depressive disorder, bipolar disorder, mania or dysthymia were combined in one question. Consequently, the prevalence and impact of each of these disorders on quality of life cannot be inferred. Further, the cross-sectional nature of the data precluded an examination of the temporal sequence of onset of mood disorders and chronic physical conditions. Given these limitations, the present study determined the prevalence and correlates of mood disorders among individuals with physical chronic illness using the most up-to-date data available on a representative sample of Canadians living in Ontario. In addition, survey respondents were asked to only report mood disorders and physical conditions that had been diagnosed by a health professional. To the authors' knowledge, this is the first study to examine the associations between comorbid mood disorders and short-term disability, limitations of daily activities and suicidal ideation in this population.

Results of this study indicate that detecting and treating depression is as important as treating the physical illness for maintaining quality of life and helping the individual cope with and manage the physical illness. The identification of subgroups of physically ill individuals who are at high risk of

suffering from mood disorders provide clinicians with important knowledge for targeting these vulnerable groups for the purpose of early diagnosis and intervention. Health care providers are urged to proactively screen chronically ill patients for mood disorders, particularly among the subgroups found to have elevated risk for these disorders. Based on a survey done by the Depression and Bipolar Support Alliance,[23] it was concluded that most primary care physicians lacked knowledge about mood disorders in general and bipolar disorder in particular. Findings of this study stressed the importance of providing physicians with more information about the connection between mental and physical health and of including the treatment of the patient's mood disorders as an integral part of the treatment plan of the chronic condition.

It is also imperative to encourage individuals with physical illness to communicate their psychological symptoms to their health care providers and not to accept such symptoms as natural consequence to their physical condition. Barriers to seeking help for mental health, whether perceived or real, should be recognized and removed. The collection of data on cultural and social factors, such as beliefs about stigma and shame in association with mental illness and trust in health care providers, is essential for developing innovative and creative strategies for promoting mental health. Culturally appropriate psycho-educational programs could help Canadians learn to recognize the symptoms of mood disorders and be aware of the importance and potential benefits of treatment. Such programs could promote self-identification and lead to early diagnosis and intervention.

Acknowledgements

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Costs associated with mood and anxiety disorders, as evaluated by telephone survey

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Abstract

Costing studies are central to health policy decisions. Available costing estimates for mood and anxiety disorders in Canada may, however, be out of date. In this study, we estimated a set of direct health care costs using data collected in a provincial telephone survey of mood and anxiety disorders in Alberta. The survey used random digit dialing to reach a sample of 3394 household residents aged 18 to 64. A telephone interview included items assessing costs without reference to whether these were incurred by the respondent, government or a health plan. The survey interview also included the Mini Neuropsychiatric Diagnostic Interview (MINI). Costs for antidepressant medications appear to have increased since the last available estimates were published. Surprisingly, most medication costs for antidepressants were incurred by respondents without an identified disorder. Also, an unexpectedly large proportion of medication costs were for psychotropic medications other than antidepressants and anxiolytic-sedative-hypnotics. These results suggest that major changes have occurred in the costs associated with antidepressant treatment. Available cost-of-illness data may be outdated, and some assumptions made by previous studies may now be invalid.

Key words: *Cross-sectional studies, Depressive Disorders, Costs and Cost Analysis*

Background

Depressive disorders present an important challenge to population health.[1] According to the Global Burden of Disease Project, unipolar major depression is the 4th leading contributor to disease burden world-wide, ranking second in developed countries such as Canada.[2] The impact of this condition on population health relates partially to its high prevalence: approximately 5% of Canadians experience an episode of major depression in any given year.[3] However, its impact is magnified by a peak prevalence in the 25-44 year age group[4] which is a critical period for education, establishment of relationships and economic productivity. Major depression is also a recurrent condition, and one that is frequently associated with psychiatric and medical comorbidity.[5,6] All of these factors tend to magnify its impact on population health. Finally, major depression has an impact on mortality.[7]

Around the world, a variety of costing studies for depressive disorders have been carried out. Typically, the goal of these studies has been to estimate overall costs, including direct and indirect treatment costs. Population-based costing studies typically use data from a variety of sources such as government reports, administrative data and national surveys. This is because data collected from any particular source (e.g. a national survey) are unlikely to be comprehensive enough for detailed costing.

Recently, Thomas and Morris[8] published cost-of-illness estimates for depression in England. Their study integrated data from a large number of sources and provides what has been considered the best available estimates for Europe.[9] However, the approach taken to assess some costing elements was crude. For example, in the assessment of medication costs, treated prevalence was estimated using a formula that began with administrative data for physician visits. The estimated number of people making visits for depression was multiplied by the proportion of antidepressant medications prescribed nationally in specific antidepressant categories, and in turn, by the average costs of prescriptions in those categories. This approach assumes that the total cost can be conceptualized as the treated prevalence multiplied by the cost per treated person. The approach seems reasonable on the surface, but does not consider that antidepressant treatment is often continued long after the remission of depressive episodes.[10]

Stephens and Joubert[11] estimated the total burden of major depression and distress in Canada in 1998, also using data from a variety of sources. Their overall cost estimate was $14.4 billion. Their analysis was based partially on data from the National Population Health Survey (NPHS) and partially on data collected by the 1998 Economic Burden of Illness in Canada (EBIC) project (http://www.phac-aspc.gc.ca/publicat/ebic-femc98/index.html). All of the data on medication costs came from EBIC. In turn, the EBIC estimates were taken from a cost tracking database at the Canadian Institute for Health Information (CIHI) containing cost estimates from a private-sector company: IMS Health Canada. This approach is useful because IMS Health Canada databases can identify both the total volume of medication sales and the proportion of treatment recom-

mendations for specific indications. According to EBIC, $108 million was spent on drugs for anxiety states, and $252 million, for depressive disorders. However, this analysis is now 10 years old, and some of its estimates are nearly 15 years old. The ensuing period of time has seen increasing recognition of major depression as a health problem, likely diminishing stigma related to the condition and the emergence of new pharmacological and non-pharmacological treatments.

In 2003, sponsored by the Alberta Mental Health Board, a provincial mental health survey was conducted in Alberta, called the Alberta Mental Health Survey.[12] In 2004 another initiative, sponsored by Alberta Health and Wellness and Administered by the Institute of Health Economics, called the Alberta Depression Initiative, was established. As a component of this latter initiative, a second provincial telephone survey focusing on mental health was carried out in the following year, this time with an emphasis on depression. Some of the survey results are relevant to future costing studies for mood and/or anxiety disorders in Canada and are summarized in this report.

Methods

Survey Data Collection

Alberta is a Canadian province with a population of 3.3 million residents, dispersed over an area of 661 190 km^2. Telephone survey methods were the most feasible strategy for obtaining an approximately representative sample in this geographically dispersed population. Approximately 2/3 of the Alberta population resides in two cites: Edmonton and Calgary. The sampling procedure was stratified so that 1/3 of the sample would come from each of these cities, with the balance coming from remaining rural areas. Data collection was restricted to household residents between the ages of 18 and 64 with a residential telephone line.

Data collection was carried out by the population survey unit of the Quality, Safety and Health Information (QSHI)

portfolio in the Calgary Health Region (www.calgaryhealthregion.ca) during 2005. A listing of provincial, residential telephone numbers was initially sampled and the last digit was substituted with a random integer in order to increase coverage of unlisted numbers[13,14] and to avoid bias that might be introduced if households with unlisted numbers differed from those with listed numbers. When a household was reached, a pseudo-random procedure, the "last birthday method" was used to randomly select a single subject from the household. As many as nine call-backs were made in an effort to reach all sampled individuals. These calls were distributed over working hours, evening and weekends.

The Mini Neuropsychiatric Interview (MINI), a brief structured diagnostic interview,[15,16] was used as a diagnostic indicator for Major Depression (MD) and a set of other common mood and anxiety disorders. For major depressive episodes, past-14-day prevalence was assessed (essentially, the point prevalence for this disorder), for dysthymia, past-2-year prevalence was assessed. For panic disorder, agoraphobia, generalized anxiety disorder and social phobia, current prevalence was also assessed. Since it has been shown that differences between survey instruments often relate to the role of "clinical significance" probes in the scoring algorithms,[17] we incorporated an interference item asking respondents whether their psychiatric symptoms interfered with their life. Episodes were considered clinically significant if respondents reported "a lot" of interference.

A pharmacoepidemiology module and a module designed to identify non-pharmacological treatment were also included in the interview. The pharmacoepidemiology module operated with a cyclical item-flow structure, initially asking about medications taken for the treatment of broadly defined but relevant symptoms ("Do you currently take any prescription medications for anxiety, depression, stress, energy levels, sleeping, pain management, fibromyalgia or migraine headaches?"), and then looping through each reported medication with a series of items inquiring about the number and size of tablets, reasons for use

of the medication and duration of use. Respondents were prompted to report information directly from their pill bottle labels to ensure accuracy of this information. Dosage was determined by combining information about the size(s) and number of relevant tablets or capsules taken, including *pro re nata* (prn) schedules. The dosages were recorded in milligrams per day. The survey interview also included items evaluating the frequency of use of health services. These items were typically paired, with an initial item asking about use of the service and a second quantifying the frequency of use. For example, one item asked: "In the past 6 months have you consulted with a specialist physician other than a general practitioner, family doctor, emergency room physician or psychiatrist about your health?" If the answer was "yes" this was followed by "How many times?" Similar items assessed visits with family physicians, psychiatrists, psychologists and social workers, as well as emergency and walk-in clinic attendance, radiological procedures, and hospitalizations.

Costing Procedures

We obtained costs per milligram for each medication from the provincial drug plan costing guide (http://www.pao.gov.ab.ca/benefits/choice/prescription-drug-plan.pdf). In situations where various dosage forms had different per milligram costs, we calculated the cost for the lowest milligram dosage for each drug. The costs associated with generic preparations were used when a generic preparation was available, since pharmacists can substitute the lowest cost alternative when filling a prescription. When a person was taking more than one drug from a particular class, the costs were estimated in the same way for each drug, and the costs of individual drugs were added together. For ease of interpretation, the daily costs were multiplied by 365 to project an annual medication cost. This approach seemed reasonable since 80 % of survey respondents who reported taking antidepressants in the survey reported taking them for longer than one year. The same procedure was followed for anxiolytic-sedative-hypnotic and antipsychotic medications.

For utilization of professional services, fee codes for the various professional groups were used. For physicians, fee codes from the Alberta Health Care Insurance Plan (AHCIP) were used. For family physicians, a basic code for an office visit not requiring a complete history and evaluation was used (fee code 03.03A). Emergency room visits were handled separately, using an estimated cost per single visit at twice the fee for a visit to a family physician. For specialist physicians, the fee code for a single referred consultation visit for 15 minutes was used (fee code 03.03FA). Fees associated with 45 minutes of clinical management time were used for psychiatrists (skill level code 08.19A) and for psychologists, fee schedules published by the Provincial Psychological Association were used.

It was not feasible to itemize radiological procedures and laboratory tests reported by survey participants. Instead, representative mid-point costing estimates were identified for common or typical procedures within each category. In this study these were: a chest X-ray, basic CT of the head and a basic MRI of the head. The per procedure costing estimates used in the study came from a costing guide produced by the Calgary Health Region. This guide is intended to ensure cost recovery in research projects, including materials and supplies and personnel-related costs. Similarly, mean per diem costs associated with hospitalizations from across the province used estimates developed by the Calgary Health Region for administrative purposes. The documents from the Calgary Health Region were considered to be a reasonable source since the Region includes the city of Calgary, but also rural areas stretching southwest of the city to the border with British Columbia.

For each category, a cost projection to the total population was made. The weighted prevalence for the mood and/or anxiety disorder diagnostic category was multiplied by the total provincial population in the studied age range, the proportion using the specific procedure, treatment or service and by the mean cost associated with it to produce a final cost estimate. Sampling weights were calculated as the inverse of an estimated selection probability within age and sex categories in each of the three sampling regions for the provincial population. The resulting weight was further adjusted by multiplying it by the ratio of the number of eligible residents in each household divided by the number of telephone lines going into the household. The weights were treated as relative weights in the analysis.

Results

In total, 18 113 telephone numbers were called. More than half of these were disqualified from the sample for the following reasons: 1663 households had no eligible residents, 329 were blocked calls, 846 reached only answering machines or voice mailboxes (i.e. no person could be contacted with call-backs), 1747 were business lines, 3333 were not in service, 1385 reached fax machines, 378 reached non-English-speaking households, 845 were never answered during the call-back protocols, 11 met with hostile interruptions and 79 were disqualified for miscellaneous reasons. There were 7497 calls that successfully reached eligible households. At the household level, there were 3443 refusals (45.9%). Of the 4054 households from which respondents could be selected, there were 635 individual refusals (15.7%). Of the 3419 consenting respondents, interviews were completed in all but 25 (0.7%), so that 3394 interviews were completed. After checks for data completeness and accuracy, 45 records were removed from the data set because of concerns about data quality. The final analysis included data collected from the remaining 3345 individuals (82.5% of individuals who were invited to participate and provided adequate data). If the response rate is calculated using the number of eligible households in the denominator, however, it is 44.6%. Using the Marketing Research and Intelligence Association (MRIA) method of calculation (http://www.tpsgc-pwgsc. gc.ca/por/text/pebptel-intro-e.html), 7628 of the 18 113 can be classified as "out of scope" leading to a response rate of 31.9%.

There were 168 survey participants with a mood disorder (current major depression or dysthymia) according to the MINI, leading to a prevalence estimate of 4.6%. This estimate is consistent with existing literature. The 30-day prevalence of major depression in the *Canadian Community Health Survey, Mental Health and Wellbeing* (CCHS 1.2) was 1.8%.[4] The CCHS 1.2 did not assess dysthymic disorder, but a systematic review by Waraich estimated a past-year prevalence of approximately 2%.[18] One hundred and ninety two respondents had one or more anxiety disorders, leading to a prevalence estimate of 6.3%. This is slightly higher than the CCHS 1.2 past-year estimate of anxiety disorder prevalence (4.7%),[19] but the CCHS 1.2 did not assess generalized anxiety disorder, which has an annual population prevalence of 3.1% in the US.[20] Most respondents with disorders had comorbid mood and anxiety disorders. Only 2.2% had a mood or anxiety disorder without having both. 4.1% had comorbid mood and anxiety disorders. Since the MINI is a brief screening instrument, its ability to distinguish between mood and anxiety disorders is questionable. The analysis therefore focussed on two groups: respondents with a mood or anxiety disorder (but not both) and respondents with a comorbid mood and anxiety disorder.

With respect to medication use at the time of the survey, 7.4% of the population reported taking an antidepressant, 3.1% reported taking a sedative hypnotic medication and 1.5% took another medication potentially related to the management of mood disorders: mood stabilizers, psychostimulants or atypical antipsychotic medications. Although the latter group of medications are pharmacologically distinct, they were grouped together in the subsequent analysis because there were insufficient numbers to examine these categories separately. It should also be noted that the question stems indicated that the medications of interest were those taken for psychotropic purposes, and this category

would not include, for example, anticonvulsant mood stabilizers taken for the treatment of epilepsy.

Of the 2.2% of the population with non-comorbid mood or anxiety disorders, 20.4% were taking one or more antidepressant medications. Of those with comorbid mood and anxiety disorders, 44.4% were taking one or more antidepressant medications. In the group with no detected mood or anxiety disorders, 5.6% were taking an antidepressant. The estimated mean annual cost for antidepressants in each of these groups is summarized in Table 1. At the time of the survey, there were 2 105 167 provincial residents in the 18 to 64 age range. The average cost per person multiplied by the estimated prevalence and number of people in the province in each diagnostic category led to a total cost estimate of $124 million for antidepressants. This included $7 million for people with a noncomorbid mood or anxiety disorder, $35 million for people with comorbid disorders and $83 million for those with no MINI-detected disorder.

Although the frequency with which antidepressants were taken by respondents without detected mood or anxiety disorders was relatively low at 5.6%, and while the projected annual per person cost in this group was slightly lower than the group with MINI-detected disorders (see Table 1), the overall cost in this group was highest because the number of people in this category was the highest. This suggests that most of the costs associated with antidepressant treatment now occur in the continuation and maintenance phases[10] of treatment since these respondents no longer met symptomatic criteria for mood or anxiety disorders. The result is in itself not necessarily surprising since acute treatment with antidepressants usually takes 6 to 8 weeks, whereas maintenance treatment lasting one year or longer is generally recommended, and indefinite treatment may be indicated in those with highly recurrent disorders.[10] There are however, other possible explanations for this result, as discussed below.

A similar pattern was seen for sedative-hypnotic medications (see Table 1). In people with mood or anxiety disorders, the frequency of use of these medications was much higher than that of respondents without these disorders. However, most people taking these medications did not have a mood or anxiety disorder. Hence, most of the costs occurred in the no-disorder group. The estimated total cost of sedative-hypnotic use in the population was $8 million, much lower than the cost of antidepressants.

A variety of other medications were reported by the survey respondents: lithium (n = 7), carbamazepine (n = 3), valproate (n = 5), gabapentin (n = 9), lamotrigine (n = 1), topiramide (n = 20), dexamphetamine (n = 6), chlorpromazine (n = 1), olanzapine (n = 10), quetiapine (n = 8), clozapine (n = 2) and risperidone (n = 20). Ninety-two respondents reported taking one or more of these medications. Unfortunately, only 69 of these respondents (75%) were willing or able to provide dosage information. Considered as a group, an estimated 1.5% of the total population was taking one or more medications from this category. The frequency of use in respondents with non-comorbid mood or anxiety disorders was similar to that of the total population (see Table 1), but the frequency was much higher in the group with comorbid disorders (16.4%). Approximately 1% of the population without a mood or anxiety disorder was taking one of these medications – approximately consistent with the prevalence of psychotic disorders in the population. The projected total cost was $38 million, $25 million of which was accounted for by the group with no detected disorder. These results suggest, however, that a sizable proportion of treatment costs for mood and anxiety disorders may now occur outside of the pharmaceutical classes traditionally believed to be most important in the treatment of mood and anxiety disorders: antidepressant medications and sedative-hypnotic medications.

Table 2 presents the costs associated with utilization of services provided by mental health professionals. The frequency with which the services of psychiatrists and psychologists were utilized was much higher in people with mood and anxiety disorders, especially in the comorbid category. Having a mood or anxiety disorder was associated with a three-fold increase in these costs, whereas a more than eight-fold increase was seen in the comorbid group. However, most of the costs for psychologists occurred in the group with no MINI-defined disorder, suggesting that these professionals may often be engaged in treatment activities not specifically directed at these disorders, e.g. marital therapy. Table 3 presents the costs associated with service utilization for family physicians and specialist physicians other than psychiatrists. The respondents with mood and anxiety disorders were more likely to see a physician, and to have more visits. Both factors contributed to higher per-respondent costs in the group with mood and anxiety disorders.

Costing data for diagnostic tests are presented in Table 4. In the case of radiological procedures, the frequency of testing (and hence, per-subject costs according to the procedures employed in this study) did not differ by disorder category. However, the proportion of subjects in the various subgroups having these tests was higher in subjects with mood and anxiety disorders. As shown in Table 5, the costs associated with emergency room visits and hospitalizations were also elevated in respondents having comorbid mood and anxiety disorders.

Conclusions

Many of the results presented here are consistent with an existing literature of costing studies for depressive disorders. They illustrate that costs associated with medication use and utilization of services are increased in people with these disorders. As expected, this was true both for measures of mental health care and for general medical care. An important interpretive issue is that mood disorders are strongly associated with long-term medical conditions,[21-23] such that these increased costs may reflect an indirect effect of non-psychiatric conditions. When one considers that approximately 10% of the Canadian population live in Alberta, the results suggest a substantial increase in the costs of pharmacotherapy for depression since the publication of the 1998 EBIC. In the

EBIC, the total national costs for medications for mood and anxiety disorders was only twice as high as that found in the province of Alberta alone. In other words, if one assumes that 10% of the $360 million estimated by the EBIC was spent in Alberta, the provincial estimate would be approximately $36 million; however, the current study indicates that the cost of antidepressant medications in Alberta may be between 3 and 4 times higher than that. The increase in cost is not unexpected, as both the number of retail prescriptions for medications and the average cost per prescription are increasing in Canada.[24]

Although antidepressants and sedative-hypnotic medications were the most frequently taken medications, an appreciable number of respondents reported taking other medications such as atypical antipsychotics. These medications now appear to make a substantial contribution to total treatment costs. Future analyses should include costs for atypical antipsychotics, stimulants and mood stabilizers.

Another interesting finding is the high proportion of costs in the no-disorder group. It should be emphasized that the MINI would not detect treated disorders that are in remission, so in some proportion of instances these costs may represent appropriate use of the medications. However, it is likely that some of the medication use in the no-disorder group is inappropriate (i.e. no disorder indicating treatment is present). Symptoms of depression and anxiety can occur in response to losses, threats and stressors. The Canadian health system is not well-structured for delivering the brief psychological interventions that would generally be appropriate in such cases. In Canada, primary mental health care is usually funded on a fee-for-service model. Primary care practices in Canada typically see large volumes of patients for brief visits. Antidepressants may sometimes be prescribed inappropriately due to a lack of time or expertise on the part of primary care physicians. Similarly, the use of sedative-hypnotic and atypical antipsychotic medications in the comorbid group may partially reflect poor access to non-pharmacologic treatments such as sleep hygiene and relaxation techniques. Finally, some proportion of medication use in this group may be due to treatment for conditions other than mood and anxiety disorders. For example, antidepressants are frequently used for chronic pain and migraine prophylaxis.

The results may have important implications for future costing studies. For example, the UK study discussed above[8] used billing data to identify treated prevalence, but people on long-term maintenance treatment may not have visits coded specifically for a mood or anxiety disorder. In fact, any approach that begins with prevalence data is likely to miss a large proportion of medication costs, since the treated disorders may be in remission and may also be missed in symptom-based prevalence measures used in surveys.

There are several limitations associated with this study. First, the study focused on psychotropic medication use. Since some chronic medical conditions are associated with mood and anxiety disorders, it is likely that increased costs associated with non-psychiatric procedures and treatments would occur in the subjects with mood and anxiety disorders. It was not considered feasible to record all medications being

TABLE 1
Annual and six-month costs associated with medication use, by disorder category

			Current mood or anxiety disorder	Current comorbid mood and anxiety disorders	No current mood or anxiety disorder
			Prevalence 2.2%	Prevalence 4.1%	Prevalence 93.7%
Antidepressants	% Utilizing		20.4	44.4	5.6
	Mean cost/person	Annual	$800	$910	$754
		6-month	$400	$455	$377
	Provincial total cost	Annual	$7,573,665	$34,868,074	$82,684,848
		6-month	$3,786,832	$17,434,037	$41,342,424
Sedative-hypnotics	% Utilizing		3.9	24.0	2.2
	Mean cost/person	Annual	—*	$140	$98
		6-month		$70	$49
	Provincial total cost	Annual	—*	$2,894,450	$4,272,739
		6-month		$1,447,225	$2,136,370
Antipsychotics, mood stabilizers, stimulants	% Utilizing		1.6	16.4	0.9
	Mean cost/person	Annual	$1,208	$926	$1,388
		6-month	$604	$463	$694
	Provincial total cost	Annual	$899,391	$13,107,662	$24,638,358
		6-month	$449,695	$6,553,831	$12,319,179

* numbers too small to support estimation.

TABLE 2
**Utilization of services provided by mental health specialists, by disorder category
(during the 6 months prior to the survey)**

		Current mood or anxiety disorder Prevalence 2.2%	Current comorbid mood and anxiety disorders Prevalence 4.1%	No current mood or anxiety disorder Prevalence 93.7%
Psychiatrist	% Utilizing	6.1	26.1	1.8
	Mean number of visits	2.4	10.4	3.2
	Mean cost/person	$351	$1,501	$467
	Provincial total cost	$996,754	$33,811,137	$16,544,730
Psychologist	% Utilizing	6.2	14.5	1.7
	Mean number of visits	4.7	6.6	4.2
	Mean cost/person	$698	$987	$632
	Provincial total cost	$2,013,150	$12,354,147	$21,110,090

other than antidepressants and sedative-hypnotics may limit the validity of those estimates.

Telephone survey methods are unlikely to be sufficient, in themselves, as a source of data for cost-of-illness studies. However, as the results of this study show, data collected in telephone surveys can help to inform the planning and interpretation of comprehensive cost-of-illness studies. The focus of this study was restricted to direct costs associated with mood and anxiety disorders. A detailed cost of illness study would also need to include indirect costs such as diminished productivity due to the effects of these disorders. Another limitation of the current study is the lack of assessment of substance dependence and abuse. Since this was not measured, it was not possible to determine whether the frequency of sedative-hypnotic use, in particular, may have been related to abuse or dependence on these substances.

Even though many of the cost estimates in the current study were based on approximations, these approximations were made in the same way across disorder categories, which should facilitate valid comparisons. However, the comparisons may be misleading if the assumptions employed are variably valid across disorder groups. For example, if hospital admissions for mood

taken by the subjects during the telephone interview, however. Second, the recording of costs was certainly not exhaustive. In particular, indirect costs were not assessed. Whereas various categories of cost were estimated in respondents with and without evidence of a disorder, it does not follow that the disorders are necessarily the cause for the costs. For example, we looked at the costs associated with hospitalization for any reason. Since chronic illnesses are associated with mood disorders, the hospital costs may more closely reflect these medical comorbidities than the depression itself. Mechanisms linking depression to health care costs are likely to be complex. For example, a negative effect of depression on self-management of chronic conditions could lead to an increased frequency of hospital admissions. It is doubtful whether such costs can confidently be attributed to a specific diagnostic category.

Additional limitations pertain to the use of telephone survey methods. Declining response rates to telephone surveys in recent decades have heightened concerns about vulnerability of such studies to bias (see recent report by Public Works and Government Services Canada at http://www.pwgsc.gc.ca/por/text/pebptel-intro-e.html). Because brevity is needed in telephone survey interviews, the assessment of utilization was necessarily crude. However, telephone-based data collection did allow the collection of data from a large

sample dispersed across a large geographical region, and this included more detailed information about medication use than has generally been available in prior costing studies. However, response rates were less than ideal, raising questions about the validity of the estimates. Also, the interviewers encountered some difficulty with the collection of detailed information about dosages from respondents who were taking multiple medications or medications that involve variable dosages or prn schedules. A high frequency of missing data, for example, in the case of medications

TABLE 3
**Costs associated with service utilization, family and specialist physicians
(not including psychiatrists), by disorder category
(during the 6 months prior to the survey)**

		Current mood or anxiety disorder Prevalence 2.2%	Current comorbid mood and anxiety disorders Prevalence 4.1%	No current mood or anxiety disorder Prevalence 93.7%
Family physician	% Utilizing	58.1	74.5	53.1
	Mean number of visits	4.9	7.2	2.8
	Mean cost/person	$113	$168	$130
	Provincial total cost	$3,076,347	$10,815,008	$68,375,547
Other physician	% Utilizing	28.7	42.8	22.0
	Mean number of visits	2.2	5.8	2.8
	Mean cost/person	$80	$216	$105
	Provincial total cost	$3,725,192	$18,653,716	$208,201,753

TABLE 4
Diagnostic testing, by disorder category (during the 6 months prior to the survey)

		Current mood or anxiety disorder	Current comorbid mood and anxiety disorders	No current mood or anxiety disorder
		Prevalence 2.2%	Prevalence 4.1%	Prevalence 93.7%
X-ray	% Utilizing	17.6	28.9	14.4
	Mean number of tests	1.6	2.6	2.3
	Mean cost/person	$142	$226	$165
	Total cost	$1,164,288	$5,636,873	$46,827,952
CT scan	% Utilizing	2.8	11.6	2.6
	Mean number of tests	1.3	1.5	1.2
	Mean cost/person	$224	$255	$209
	Total cost	$292,946	$2,551,402	$10,669,647
MRI	% Utilizing	1.0	10.7	3.2
	Mean number of tests	1.9	1.2	1.1
	Mean cost/person	$1,206	$749	$669
	Total cost	$561,240	$6,915,813	$42,095,483
Lab tests	% Utilizing	38.8	55.4	33.7
	Mean number of tests	2.5	7.8	2.3
	Mean cost/person	$22	$70	$20
	Total cost	$401,824	$3,329,481	$13,278,868

and anxiety disorders are less expensive than hospitalizations for other reasons, bias could be introduced.

In Canada, future costing studies will need to maximize the use of available data about the frequency of maintenance treatment and adopt a broad view of drug costs in order to obtain valid cost estimates. The economic "landscape" associated with mood and anxiety disorders appears to be evolving over time and future costing studies will need to accommodate these new realities.

Acknowledgements

TABLE 5
Emergency room visits and hospitalizations, by disorder status (during the 6 month prior to the survey)

		Current mood or anxiety disorder	Current comorbid mood and anxiety disorders	No current mood or anxiety disorder
		Prevalence 2.2%	Prevalence 4.1%	Prevalence 93.7%
Emergency room visits	% with a visit	12.3	26.9	10.7
	Mean number of visits	1.3	3.1	1.5
	Mean cost/person	$61	$144	$68
	Total cost	$351,360	$3,348,484	$14,209,483
Hospitalizations	% with a hospitalization	9.4	23.7	5.6
	Mean number of hospital days	4.7	23.5	5.0
	Mean cost/person	$4,988	$25,151	$5,338
	Total cost	$21,714,793	$514,496,354	$587,712,652

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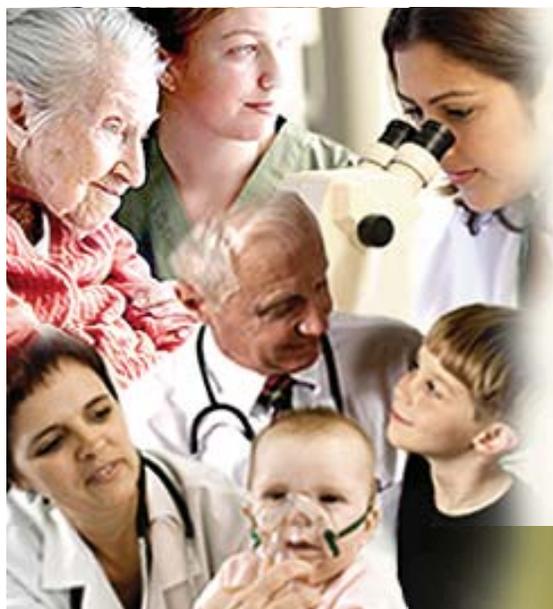
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