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Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice (HPCDP) is a monthly online scientific journal that showcases applied science and research on disease prevention, health promotion and health equity in the areas of chronic diseases, injuries and life course health, with a key focus on the Public Health Agency of Canada's research and collaborations. Since 1980 the journal has published a unique blend of peer-reviewed feature articles from such fields as epidemiology, public/community health, biostatistics, the behavioural sciences, and health services or economics. Authors retain responsibility for the content of their articles; the opinions expressed are not necessarily those of the HPCDP editorial committee nor of the Public Health Agency of Canada.

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Editorial

Mobilizing Evidence for Impact: From *CDIC* to *Health Promotion and Chronic Disease Prevention*

Kerry Robinson, PhD, Publisher, Health Promotion and Chronic Disease Prevention in Canada
Michelle Tracy, MA, Managing Editor, Health Promotion and Chronic Disease Prevention in Canada

The journal *Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice* (HPCDP) (formerly *Chronic Diseases and Injuries in Canada* [*CDIC*]) had humble beginnings at Health Canada in 1980 as a ''New Bulletin'' aimed at publishing ''material based on research, surveillance and control aspects of non-communicable diseases or conditions such as cancer, heart disease and accidents.''[1] The main audience for this new national publication was the estimated 300 to 400 Canadian professionals involved directly or indirectly in programs related to chronic disease.

Now, 35 years later, with an impact factor of 1.22, the journal has become a credible source of peer-reviewed scientific research and an important platform for knowledge exchange within Canada's public health community. As an open-access and bilingual journal, it also serves readers in the United States, Europe and francophone Africa. To date, the journal has published hundreds of articles on a range of topics from maternal health to injuries to cancer trends. It has a robust online presence via many scientific publication indexes and aggregators, including MEDLINE, Thomson Reuters, Elsevier, SCOPUS and EBSCO.

Just as the journal's subject matter has expanded over time and we have moved from a small printing press to an online, fully accessible publication, the journal is now evolving its governance and production model. The new governance model is based on existing governance practices for government-published journals, like Statistics Canada's *Health Reports* or the *AECL (Atomic Energy of Canada Limited) Nuclear Review*. As a federal government publication, HPCDP will feature articles that showcase applied science and research on disease prevention, health promotion and health equity in the areas of chronic diseases, injuries and life course health, with a key focus on the Public Health Agency of Canada's research and collaborations. It is important to note, however, that the new model does not represent a change in topic scope for the journal, as CDIC has been publishing in each of these areas for over a decade.

The journal will maintain its high scientific credibility by maintaining central inclusion of external associate scientific editors and peer reviewers, as well as an editorial board primarily composed of members external to the federal government. These external advisors will continue to contribute their expertise to reviewing papers and ensuring that the articles published in HPCDP remain of high quality and expand upon the latest pan-Canadian knowledge in this field.

HPCDP's new model also represents a move from passive knowledge dissemination to a more integrated model involving interactive and collaborative knowledge exchange. Within the realm of knowledge translation, traditional (passive) dissemination approaches often result less successfully in uptake of public health innovations.[2] It was within this context, and within the context of a transformation of science governance as a whole within the Public Health Agency of Canada (the publisher of this journal), that a new governance and publishing model for the journal was proposed.

In the past, public health has emphasized the creation and publication of applied research; however, there is now a growing need for this knowledge to be better synthesized and translated for use by a range of decision makers.[3,4] The renewed HPCDP will showcase the breadth and quality of collaborative government science, surveillance and intervention evaluation/studies. The journal represents an important dissemination platform for the Agency's peer-reviewed health promotion and chronic disease prevention science. Our goal is to continue to grow the journal as a much-needed vehicle to share and support use of peer-reviewed public health science/research, analysis and related collaborative work with applied research, policy and practice audiences in Canada.

As part of its aim to increase policy relevant and intervention-related evidence that can help inform policy and practice decisions, HPCDP has expanded its types of articles to include evidence syntheses and evidence briefs, qualitative and mixed methods studies and intervention studies, as well as a section called ''At-a-Glance'' that allows for quick statistics updates from the latest surveillance analyses [see http://www.phac-aspc.gc.ca/publicat/hpcdp-pspmc/authinfo-eng.php].

HPCDP is also demonstrating its responsiveness to a need for increased mobilization for uptake and impact. While a 2012

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Stakeholder Satisfaction Survey showed that most respondents were satisfied with the journal (90% overall satisfaction), some remarked that using social media to promote journal content would increase awareness of and access to the journal. With this and the demand for quicker access to evidence in view, the journal has now become a monthly, online-only publication, which allows us to accelerate the frequency and timeliness of article release. We will be promoting and sharing published findings through professional social networking sites, webinars and social media platforms and looking into mobile options for the journal.

Going forward, the journal will place greater emphasis on collaborative research and analysis between government and external researchers, a range of public health practitioners, health policy planners and related professionals. As part of this new model, the journal particularly welcomes articles resulting from a substantive collaboration with the Public Health Agency or Health Canada, through co-authorship (including with staff from the Canadian Institutes of Health Research), funding or use of Public Health Agency or Health Canada data.*

In the same collaborative vein, HPCDP is being renewed to also increase access and use of a broader range of public health and community systems knowledge.[4] The Agency will be in a position to share externally in a more timely fashion the various evidence syntheses and high quality Canadian scans that we conduct in collaboration with others; these are often not published by other means on the web or disseminated broadly.

We are pleased to welcome you to this inaugural issue of the journal's new model. The original research articles ''A DASH dietary pattern and the risk of colorectal cancer among Canadian adults,'' by Jones-McLean et al., and ''Chronic fatigue syndrome and fibromyalgia in Canada: Prevalence and associations with six health status indicators,'' by Rusu et al., contribute to the Canadian evidence base in these fields. This issue also features summaries of the Agency's latest surveillance reports on two important areas, perinatal health indicators and congenital anomalies. Finally, please do look at the section ''Other PHAC Publications,'' which highlights and links to peer-reviewed article collaborations published in other venues.

We hope that you enjoy some of the features of our new journal model. On behalf of our colleagues at the Public Health Agency of Canada, we look forward to collaborating with you on the creation, synthesis and mobilization of applied research and analysis for positive impact on health promotion and chronic disease prevention in Canada.

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* PHAC/Health Canada data are defined as those datasets that are owned (solely or collaboratively) by PHAC or Health Canada, or of which PHAC or Health Canada are the custodians or guardians.

Chronic fatigue syndrome and fibromyalgia in Canada: prevalence and associations with six health status indicators

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This article has been peer reviewed.

Abstract

Introduction: Few studies have considered the factors independently associated with chronic fatigue syndrome (CFS) and/or fibromyalgia (FM) or considered the impact of these conditions on health status using population-based data.

Methods: We used data from the nationally representative 2010 Canadian Community Health Survey (n = 59 101) to describe self-reported health professional-diagnosed CFS and/or FM, and their associations with 6 health status indicators.

Results: In 2010, diagnosed CFS and FM are reported by 1.4% (95% confidence interval [CI]: 1.3%–1.6%) and 1.5% (1.4%–1.7%), respectively, of the Canadian household population aged 12 years and over, with comorbid CFS and FM affecting 0.3% (0.3%–0.4%) of that population. Prevalent CFS and/or FM were more common among women, adults aged 40 years and over, those with lowest income, and those with certain risk factors for chronic disease (i.e. obesity, physical inactivity and smoking). After controlling for differences between the groups, people with CFS and/or FM reported poorer health status than those with neither condition on 5 indicators of health status, but not on the measure of fair/poor mental health. Having both CFS and FM and having multiple comorbid conditions was associated with poorer health status.

Conclusion: Co-occurrence of CFS and FM and having other chronic conditions were strongly related to poorer health status and accounted for much of the differences in health status. Understanding factors contributing to improved quality of life in people with CFS and/or FM, particularly in those with both conditions and other comorbidities, may be an important area for future research.

Keywords: *myalgic encephalomyelitis, fibromyalgia, health status, health surveys, cross-sectional studies*

Introduction

In 2003, about 1.3% of the adult Canadian population reported having chronic fatigue syndrome (CFS) and 1.5% reported having fibromyalgia (FM).[1] CFS, or myalgic encephalomyelitis, is characterized by persistent and profound physical and cognitive fatigue, whereas FM is characterized by chronic and widespread musculoskeletal pain.[2] In addition, these 2 conditions often co-occur.[1-4] Co-occurrence of multiple chronic conditions in the same individual increases the costs and intensifies the use of health care resources[5,6] and, as demonstrated in the context of other chronic conditions, can profoundly affect people's health-related quality of life.[6-10]

A few studies in Canada[1,2] and elsewhere[11-13] have considered the impact of CFS and FM on health status. Lavergne et al.[2] showed that Canadian patients with CFS/FM had poorer health status, measured using the Short Form-36, compared to the general Canadian population. In this tertiary care / referral clinic patient population, considered by the authors to be more impaired than other people of the same sex and age range with these disorders (e.g. people with CFS and/or FM selected as part of population-based surveys), lower functioning was associated with younger age at onset, lower socio-economic status, and CFS and FM coexisting.[2] Nonetheless, data from the national population-based 2003 Canadian Community Health Survey (CCHS) indicate that Canadians with CFS and FM report poorer general health and mental health, greater dissatisfaction with life, higher prevalence of mental illness, needing more assistance in the activities of daily living and using health care services more often.[1] These data also showed that being female, older, of lower income, and of lower educational attainment are associated with prevalent CFS[1] and FM.[1,14] However, analyses did not consider whether these factors were independently associated with these conditions.

Using more recent data, from the 2010 CCHS, we sought to determine (1) the factors independently associated with having CFS and FM; (2) the impact of these conditions on health status; and (3) the factors associated with poorer health status among Canadians with these conditions.

Methods

Data source

We analyzed data from the 2010 CCHS–Annual Component Share File. The CCHS is a cross-sectional survey conducted by

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Statistics Canada that collects information related to the health of Canadians (i.e. health status, health behaviours, chronic conditions, various demographic and socio-economic health determinants, etc.). The target population was aged 12 years and older and lived in private dwellings in the 10 provinces and 3 territories of Canada. The survey did not include institutional residents, full-time members of the Canadian Forces, or people living on Indian Reserves or Crown lands or in certain remote regions, which accounted for less than 2% of the overall Canadian population aged 12 years and older. Data were collected between January and December 2010. Further details on survey methodology, including strategies to ensure representativeness of the sample, have been published elsewhere.[15] The overall household-level response rate to the survey was 80.7% and person-level response rate was 88.6%, with a final sample size of 59 302 people aged 12 years or older who agreed to share their data with certain governmental partners.

Analytical strategy

We developed our analytical strategy in 3 interrelated stages: (1) Covariates were identified a priori based on previous studies of CFS and FM, either using CCHS data[1,14] or conducted in clinical settings.[2,3] We did not consider some potential covariates, namely disease severity, duration of illness, and stressful life events,[2] because the CCHS did not measure them. (2) We examined bivariate relationships between potential covariates and CFS/FM. (3) We retained covariates in multivariate models if they were associated with CFS and FM at the bivariate level. Our analytical strategy was constrained by the available sample size. In order to produce reliable estimates for most health indicator variables and covariates, some response categories had to be combined with others and some variables were dichotomized. The sections below describe in details how each variable was analyzed.

CFS and FM

As part of the interview, respondents were asked ''Do you have chronic fatigue syndrome?'' and ''Do you have fibromyalgia?'' The following introduction was read to respondents at the beginning of the chronic conditions module: ''Now I'd like to ask about certain long-term 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.'' Answering ''yes'' to either question qualified a respondent as a case. No verification was done to confirm the diagnosis or to determine what case definition was used by the health professional who made the diagnosis.

People who either refused or did not state an answer to the questions about CFS or FM were excluded (n = 201), leaving 59 101 respondents available for analysis.

Covariates

Prevalence of CFS and FM were described by sex, age (12–39, 40–59 and 60+ years), ethnicity (white, Aboriginal, other), highest level of household education (post-secondary graduate, some post-secondary, secondary graduate, less than secondary education), marital status (single vs. widowed/separated/divorced vs. married/common-law) and adjusted income adequacy quintile. For the latter, respondents were divided into income quintiles based on the ratio of their total household income to the low income cut-off corresponding to their household and community size, as derived by Statistics Canada; this measure provides, for each respondent, a relative measure of their household income to the household incomes of all other respondents.[15]

For the education variable, we included a ''not stated'' category because 8% of participants did not provide a response to the question.

For respondents with missing income information, Statistics Canada uses nearest neighbour donor imputation that models income based on family structure, sociodemographics, some health variables and income based on aggregate tax information; income was imputed for 33% of respondents (18% based on fully reported income; 4% based on partially reported income; and 12% without income information).[15] We also included a ''not stated'' category for the remaining 2.4% who had missing values for the income variable; this proportion represents the residents of the 3 territories, for whom Statistics Canada does not calculate an adjusted income adequacy quintile.

Prevalence of CFS and FM were also described by body mass index (BMI), based on self-reported height and weight (underweight/normal weight < 25 kg/m^2, overweight 25–29 kg/m^2; and obese ≥ 30 kg/m^2), alcohol consumption (weekly alcohol consumption, less than weekly and did not consume any alcohol in the past 12 months), smoking status (never, former, current), fruit and vegetable consumption (< 5 vs. ≥ 5 servings/day) and physical activity (active, moderately active, inactive). The physical activity index is based on total estimated daily energy expenditure calculated from self-reported frequency and duration of leisure-time and transportation-related physical activities for the 3 months prior to the interview.[15]

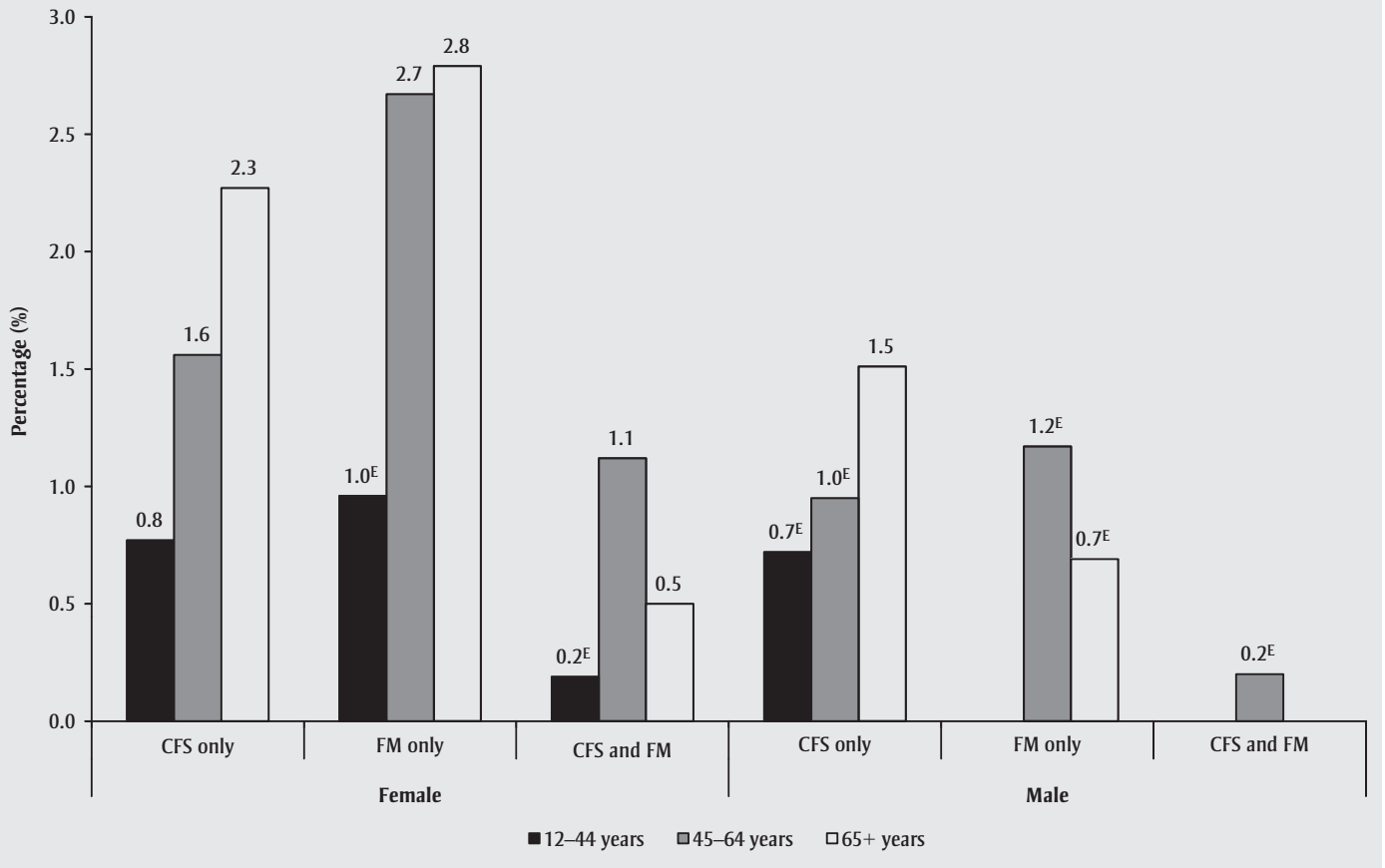
We also examined the presence of other chronic conditions. We defined comorbidity as the total number of other chronic conditions reported and categorized these in 2 groups: less than 3 versus 3 or more. This cut-off was determined based on the results of our bivariate analysis that showed that a feature of CFS and FM is that almost all of respondents with the conditions had at least 1 or 2 other chronic conditions. The chronic conditions included in the 2010 CCHS were asthma, arthritis, back problems, chronic obstructive pulmonary disease (COPD), bowel disorders, multiple chemical sensitivities, migraine, high blood pressure, heart disease, diabetes, cancer, stomach ulcer, urinary incontinence, mood disorder, anxiety disorder, Alzheimer or other dementia, amyotrophic lateral sclerosis, cerebral palsy, dystonia, epilepsy, hydrocephalus, Huntington disease, muscular dystrophy, multiple sclerosis, Parkinson disease, spina bifida, stroke, Tourette syndrome and neurological conditions caused by brain and/or spinal cord injury and/or tumour.

Health status indicators

Six self-reported health status indicators were estimated among Canadians with both CFS and FM, CFS only, FM only and neither CFS nor FM: fair/poor general health, fair/poor mental health, activity limitations, help needed for tasks, severe level of impairment and presence of pain.

- *Fair/poor general and mental health.* We based general health and mental health status on the self-report items ''In general, would you say your health is: excellent, very good, good, fair, poor?'' and ''In general, would you say your mental health is: excellent, very good, good, fair, poor?'' We dichotomized the responses as fair/poor versus excellent/very good/good for each respective question.
- *Activity limitations.* We derived a measure of the limitations in a respondent's daily activities based on the responses—often, sometimes or never—to a series of 5 questions: (1)''Do you have any difficulty hearing, seeing, communicating, walking, climbing stairs, bending, learning or doing any similar activities?'' and ''Does a long-term physical condition or mental condition or health problem reduce the amount or the kind of activity you can do... (2) at home?... (3) at school?... (4) at work?... (5) in other activities, for example, transportation or leisure?'' We categorized respondents as having activity limitations if they answered often or sometimes to any of the 5 questions.
- *Help needed for tasks.* We classified respondents as needing help for tasks if they reported requiring the help of another person to perform any 1 of 6 activities of daily living: preparing meals, getting to appointments/running errands, doing housework, personal care, moving about inside the house and looking after personal finances.
- *Severe level of impairment.* We measured health-related quality of life using the Health Utilities Index (HUI). The HUI health states are defined by 8 attributes (vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain and discomfort), with 5 or 6 levels of functioning for each attribute. A utility function is used to

FIGURE 1
Prevalence of chronic fatigue syndrome, fibromyalgia and both conditions by age and sex, Canadians 12 years and older, 2010 Canadian Community Health Survey



Abbreviations: CFS, chronic fatigue syndrome; FM, fibromyalgia.

Note: Prevalence estimates for males with FM only aged 12–44 and for males with comorbid FM and CFS aged 12–44 and 65+ are not shown due to high sampling variability.

[E] Interpret with caution – coefficient of variation between 16.6% and 33.3%.

TABLE 1
Prevalence of chronic fatigue syndrome and fibromyalgia by sociodemographic and health characteristics, ≥ 12 years, 2010 Canadian Community Health Survey

Characteristics	Chronic Fatigue Syndrome			Fibromyalgia		
	N	%	Multivariate PR (95% CI)	N	%	Multivariate PR (95% CI)
Sex						
Male	313	1.0	Referent	157	0.7[E]	Referent
Female	693	1.8	**1.7 (1.2–2.2)**	956	2.4	**3.5 (2.3–5.4)**
Age, years						
12–39	160	0.8	Referent	103	0.4[E]	Referent
40–59	378	1.8	**2.1 (1.3–3.4)**	472	2.3	**4.3 (2.7–6.9)**
≥ 60	468	2.2	**2.0 (1.3–3.2)**	538	2.6	**3.5 (2.2–5.8)**
Ethnicity						
White	861	1.5	Referent	996	1.6	Referent
Aboriginal off-reserve	66	2.3[E]	1.5 (0.9–2.4)	54	1.7[E]	1.2 (0.7–1.9)
Other	60	1.2[E]	0.9 (0.5–1.5)	47	1.2[E]	0.6 (0.3–1.5)
Education						
Post-secondary graduate	440	1.3	Referent	562	1.5	Referent
Some post-secondary	76	1.2[E]	1.4 (0.9–2.2)	73	1.5[E]	1.0 (0.6–1.6)
Secondary school graduate	180	1.7	0.9 (0.6–1.3)	177	1.6	0.8 (0.5–1.1)
Less than secondary school	287	1.8	1.1 (0.8–1.5)	281	1.6	0.8 (0.6–1.1)
Not stated	57	1.5[E]	1.4 (0.8–2.5)	48	1.5[E]	1.2 (0.5–3.2)
Income adequacy						
Quintile 5 (highest)	94	0.8[E]	Referent	139	1.0	Referent
Quintile 4	126	0.9	1.1 (0.7–1.8)	172	1.7	**1.7 (1.1–2.6)**
Quintile 3	148	1.3	1.5 (0.8–2.5)	190	1.4	1.2 (0.7–1.9)
Quintile 2	245	1.6	1.6 (1.0–2.7)	252	1.4	1.1 (0.8–1.7)
Quintile 1 (lowest)	379	2.5	**2.3 (1.4–3.9)**	347	2.1	1.6 (1.0–2.4)
Not stated	—	[F]		—	[F]	
Marital status						
Single	191	1.0	Referent	137	0.6	Referent
Married/common-law	462	1.4	1.1 (0.7–1.8)	402	3.8	1.6 (0.9–2.8)
Widowed/separated/divorced	348	2.7	1.0 (0.6–1.4)	571	1.5	1.2 (0.7–1.8)
Body mass index, kg/m^2						
< 25	375	1.1	Referent	371	1.2	Referent
25–29	281	1.4	1.2 (0.9–1.6)	356	1.6	1.3 (0.9–1.7)
≥ 30	254	1.8	1.2 (0.9–1.6)	319	2.3	**1.5 (1.1–2.1)**
Physical activity						
Active	151	0.8	Referent	170	1.0	Referent
Moderately active	170	1.1	1.2 (0.8–1.9)	234	1.1	0.8 (0.6–1.3)
Inactive	624	1.8	**1.6 (1.2–2.2)**	688	2.0	1.4 (1.0–1.8)
Drinks alcohol						
At least weekly	237	0.9	Referent	296	1.2	Referent
Less than weekly	419	1.7	**1.5 (1.2–2.0)**	435	1.6	1.3 (1.0–1.8)
Not in past 12 months	336	2.0	**1.8 (1.3–2.6)**	369	2.1	**1.8 (1.3–2.5)**
Smoking status						
Never smoker	272	1.0	Referent	333	1.3	Referent
Former smoker	392	1.4	**1.7 (1.2–2.4)**	499	1.8	1.2 (0.8–1.8)

Continued on the following page

obtain an overall score for health states that range from −0.36 to 1.0 (−0.36 = health status worse than death, 0.0 = health status equal to death and 1.0 = perfect health). We grouped HUI scores into 2 categories reflecting level of impairment: none to moderate (0.70–1.00) and severe (< 0.70).

- *Presence of pain* was assessed with the following question: ''Are you usually free of pain or discomfort?'' [Yes vs. no].

Statistical analysis

We analyzed data using SAS Enterprise Guide version 5.1 (SAS Institute Inc., Cary, NC, US). Significance was specified as a p value of less than 0.05 in all analyses. To account for sample allocation and survey design, all estimates were weighted using survey weights generated by Statistics Canada, and 95% confidence intervals (CI) were estimated using bootstrap resampling method. Associations were quantified using prevalence ratios (PRs) estimated using multivariate binomial regression, using an intercept of −4 to improve convergence.[16]

Results

Prevalence of CFS and FM

In 2010, about 411 000 (1.4%; 95% CI: 1.3%–1.6%) and 444 000 (1.5%; 95% CI: 1.4%–1.7%) of Canadians aged 12 years and older reported having been diagnosed with CFS and FM, respectively. About 0.3% (95% CI: 0.3%–0.4%) of the total household population reported having both conditions. Approximately 1 in 4 people with CFS (23.0%) also reported having FM, and 1 in 5 people with FM (21.2%) also reported having CFS. Overall, the prevalence of CFS and/or FM was higher in women across all age groups (Figure 1).

Factors associated with prevalent CFS and FM

After adjusting for covariates, women, adults aged 40 years and over and those with the lowest income were more likely to report having been diagnosed with CFS or FM (Table 1). In addition, prevalent

TABLE 1 (continued)
Prevalence of chronic fatigue syndrome and fibromyalgia by sociodemographic and health characteristics, ≥ 12 years, 2010 Canadian Community Health Survey

Characteristics	Chronic Fatigue Syndrome			Fibromyalgia		
	N	%	Multivariate PR (95% CI)	N	%	Multivariate PR (95% CI)
Current smoker	336	2.3	**2.7 (1.9–3.8)**	276	1.6	1.3 (0.8–1.9)
Fruit and vegetable consumption						
< 5 servings/day	549	1.3	Referent	572	1.6	Referent
≥ 5 servings/day	336	1.3	1.2 (0.9–1.6)	467	1.4	0.9 (0.7–1.1)

Abbreviations: CI, confidence interval; PR, prevalence ratio.

Note: Statistically significant associations ($p < 0.05$) are bolded.

[E] Interpret with caution (coefficient of variation is between 16.6% and 33.3%).

[F] Too unreliable to be reported (coefficient of variation >33.3%).

CFS was associated, in multivariate analysis, with physical inactivity, former or current smoking and less frequent consumption of alcohol. FM was associated with obesity and less than weekly or no consumption of alcohol. Comorbidities were largely present in people with CFS and/or FM, as 65.2% (95% CI: 59.9–70.6) reported 3 or more comorbidities.

Impact of CFS and/or FM on health status

Canadians with CFS and/or FM reported having indicators of poor health status more commonly than did Canadians with neither of these conditions (Table 2). After controlling for differences in the number of other chronic conditions, sociodemographics and health risk factors, people with CFS and/or FM were 1.2 to 1.9 times more likely to report poor health status (5 indicators) compared to those without these conditions (Table 3). No significant difference was found for the sixth indicator, self-reported fair/poor mental health.

Factors associated with poor health status in people with CFS and/or FM

The factors most consistently associated with indicators of poor health status among people with CFS or FM were (1) being diagnosed with both CFS and FM; (2) being diagnosed with 3 or more other chronic conditions; and (3) being physically inactive (Table 4), independent of sociodemographic and health characteristics. Compared to those with either CFS or FM, people with both conditions were 1.3 to 1.6 times more likely to report fair to poor general health, a severe level of impairment (based on health utility index score), pain, having activity limitations and requiring assistance in the activities of daily living. In addition, people with CFS and/or FM and with 3 or more other chronic conditions had 1.6 to 2.9 times the likelihood of reporting these indicators of poor health. Finally, people classified as physically inactive were 1.2 to 1.8 times more likely to report fair to poor general health, severe level of impairment, activity limitations and needing help with tasks. Furthermore, some sociodemographic and lifestyle factors were associated with 1 or 2 indicators of poor health status (Table 4).

Discussion

We used data from a nationally representative population-based survey of Canadians to estimate the prevalence and correlates of CFS and FM. In 2010, approximately 1.4% and 1.5% of the Canadian household population reported having been diagnosed with CFS and FM, respectively, representing 411 000 and 444 000 Canadians aged 12 years and older.

Consistent with other Canadian and recent worldwide data,[1,14,17] we found that female sex, being 40 years of age and older and low income were associated with prevalent CFS and FM. Whether lower socio-economic status is a determinant or a consequence of CFS/FM remains unclear, given the cross-sectional nature of the survey. CFS and FM may affect a person's ability to work and, as a result, affect total household income. In a study of people with CFS living in the United Kingdom, Collin et al.[18] found that 50% discontinued their employment due to symptoms related to CFS. The authors estimated that CFS cost the UK economy £75 to £129 million in lost

TABLE 2
Health status outcomes in Canadians 12 years and older with self-reported health-professional-diagnosed chronic fatigue syndrome and/or fibromyalgia, 2010 Canadian Community Health Survey

Health status outcome	CFS and FM (n = 270)	CFS only (n = 736)	FM only (n = 843)	Neither CFS nor FM (n = 57 252)
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Fair/poor general health	77.0 (69.4–84.6)	60.3 (54.0–66.6)	38.7 (32.4–44.9)	10.4 (10.0–10.8)
Fair/poor mental health	40.9 (30.4–51.4)	32.4 (25.5–39.2)	16.5 (10.5–22.5)[E]	4.7 (4.4–5.0)
Severe level of impairment	81.0 (74.0–87.9)	53.3 (46.6–60.1)	45.2 (38.0–52.5)	11.5 (11.0–11.9)
Presence of pain	94.8 (92.0–97.6)	56.7 (50.1–63.3)	73.6 (67.3–79.9)	16.0 (15.4–16.5)
Activity limitation	92.8 (88.1–97.4)	79.0 (73.1–84.9)	71.0 (63.9–78.2)	27.3 (26.7–28.0)
Help needed for tasks	65.5 (57.2–73.8)	41.7 (35.3–48.1)	31.6 (25.3–37.9)	8.2 (7.9–8.6)

Abbreviations: CFS, chronic fatigue syndrome; CI, confidence interval; FM, fibromyalgia.

[E] Interpret with caution (coefficient of variation is between 16.6% and 33.3%).

TABLE 3
Associations between chronic fatigue syndrome and fibromyalgia and indicators of health status in Canadians 12 years and older, 2010 Canadian Community Health Survey

CFS and/or FM	Fair/poor general health	Fair/poor mental health	Severe level of impairment	Presence of pain	Activity limitations	Help needed for tasks
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
Crude						
Ref: neither CFS nor FM	1.0	1.0	1.0	1.0	1.0	1.0
CFS and FM	**7.4 (6.7–8.2)**	**8.8 (6.7–11.6)**	**7.0 (6.4–7.8)**	**5.9 (5.7–6.2)**	**3.4 (3.2–3.6)**	**7.9 (6.9–9.2)**
CFS only	**5.8 (5.2–6.5)**	**6.9 (5.6–8.6)**	**4.6 (4.1–5.3)**	**3.5 (3.1–4.0)**	**2.9 (2.7–3.1)**	**5.0 (4.3–5.9)**
FM only	**3.7 (3.2–4.4)**	**3.5 (2.5–5.1)**	**3.9 (3.1–5.3)**	**4.6 (4.2–5.1)**	**2.6 (2.3–2.9)**	**3.8 (3.3–5.9)**
Partially adjusted[a]						
Ref: neither CFS nor FM	1.0	1.0	1.0	1.0	1.0	1.0
CFS and FM	1.2 (0.9–1.7)	1.0 (0.3–3.0)	1.3 (0.7–2.3)	**1.7 (1.0–2.8)**	1.0 (0.5–2.1)	1.4 (0.8–2.3)
CFS only	**1.4 (1.2–1.7)**	**2.7 (1.9–3.8)**	1.3 (0.9–2.0)	**1.2 (1.0–1.4)**	1.2 (0.9–1.6)	1.3 (0.9–1.9)
FM only	**1.2 (1.0–1.4)**	1.2 (0.6–2.4)	**1.3 (1.0–1.7)**	**1.8 (1.5–2.1)**	**1.2 (1.0–1.5)**	1.2 (0.9–1.7)
Fully adjusted[b]						
Ref: neither CFS nor FM	1.0	1.0	1.0	1.0	1.0	1.0
CFS and FM	**1.4 (1.1–1.7)**	1.4 (0.9–2.2)	**1.5 (1.2–1.9)**	**1.9 (1.2–2.9)**	1.1 (0.8–1.4)	**1.4 (1.1–1.7)**
CFS only	**1.4 (1.2–1.6)**	1.4 (0.9–2.1)	**1.3 (1.1–1.5)**	**1.2 (1.0–1.3)**	**1.2 (1.0–1.3)**	**1.2 (1.0–1.4)**
FM only	**1.3 (1.1–1.5)**	0.8 (0.5–1.4)	**1.4 (1.2–1.6)**	**1.8 (1.6–2.1)**	**1.2 (1.1–1.4)**	**1.2 (1.0–1.3)**

Abbreviations: CFS, chronic fatigue syndrome; CI, confidence interval; FM, fibromyalgia; PR, prevalence ratio; Ref, referent.

Note: Statistically significant associations ($p < .05$) are shown in bold.

[a] Adjusted for number of comorbid chronic conditions (continuous).

[b] Adjusted for sex, age, ethnicity, household education level, income, marital status, body mass index, physical activity, alcohol use, smoking status, fruit and vegetable consumption, and number of comorbid chronic conditions (continuous).

productivity.[18] Similarly, Reynolds et al.[19] estimated a 37% decline in household productivity and a 54% reduction in labour force productivity as a result of CFS. The annual total value of lost productivity in the United States was about $9.1 billion or $20 000 per person with CFS. Knight et al.[20] estimated that FM costs the US economy $7333 per patient in lost productivity due to disability and $1228 per patient in lost productivity due to absenteeism. Thus, inability to work or reduced work time due to CFS or FM may affect income, as opposed to lower income being a determinant of these conditions.

We also showed, consistent with findings from the 2000–2001 CCHS,[14] that lifestyle risk factors for chronic disease (i.e. obesity, physical inactivity and smoking) were associated with CFS and/or FM, but again the direction of the relationship is unclear given the cross-sectional nature of the data. In the current analysis, people who were obese were 1.5 times more likely to report having FM. Ursini et al.[21] hypothesized a number of mechanisms linking FM and obesity including reduced physical activity, sleep disturbances, depression, thyroid dysfunction, and hormonal disturbances involving the deregulation of insulin-like growth factor.

In our analysis, self-reported physical inactivity was related to reporting a diagnosis of CFS. Using data from the prospective 1958 *National Child Development Study* birth cohort in England, Wales, and Scotland, Goodwin et al.[22] showed that weekly physical activity at age 23 and 33 years was unrelated to the development of CFS by the age of 42 years. This lack of correlation is in contrast to the finding from the 1946 birth cohort in these same countries that showed more frequent exercise in childhood and early adulthood predicted CFS by the age of 53 years.[23] Although only 2 prospective studies, to our knowledge, have examined this relationship, these findings suggest that physical inactivity is more likely a consequence of CFS than a cause. Physical inactivity may arise from greater physical impairment, fatigue and pain in CFS and FM, and was associated with these factors in our analysis.

Our study found that former and current smoking was also related to CFS; to our knowledge no study has prospectively considered whether smoking is a risk factor for CFS.

Comorbidity, whether having both CFS and FM or having other chronic conditions in addition to CFS or FM, is a central issue in the population examined in this study. Other studies have shown that patients diagnosed with both FM and CFS reported a worse disease course, worse overall health, greater dissatisfaction with health and greater disease impact than those with CFS or FM alone.[2,24] Our results also show that a person's level of comorbidity may substantially affect their health status outcomes. In addition, 2 out of 3 people with CFS and/or FM reported at least 3 other chronic conditions. Our analysis showed that the number of concurrent health conditions among those with CFS and/or FM largely accounted for much of

TABLE 4
Multivariate-adjusted associations between characteristics and health status indicators in Canadians 12 years and older with chronic fatigue syndrome or fibromyalgia (n = 1849), 2010 Canadian Community Health Survey

Characteristics	Fair/poor general health	Fair/poor mental health	Severe level of impairment	Presence of pain	Activity limitations	Help needed for tasks
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
CFS or FM comorbidity						
Ref: either CFS or FM	1.0	1.0	1.0	1.0	1.0	1.0
Both CFS and FM	**1.3 (1.1–1.5)**	1.4 (0.9–2.0)	**1.3 (1.0–1.6)**	**1.6 (1.1–2.4)**	**1.3 (1.0–1.7)**	**1.4 (1.1–1.7)**
Number of other chronic conditions						
Ref: 0–2	1.0	1.0	1.0	1.0	1.0	1.0
≥ 3	**2.0 (1.4–2.7)**	**2.7 (1.6–4.5)**	**2.0 (1.3–3.1)**	**1.6 (1.1–2.4)**	**1.6 (1.1–2.2)**	**2.9 (2.0–4.2)**
Gender						
Ref: female	1.0	1.0	1.0	1.0	1.0	1.0
Male	1.1 (0.9–1.3)	1.3 (0.9–1.8)	1.2 (0.9–1.4)	1.0 (0.8–1.2)	0.9 (0.8–1.1)	0.9 (0.7–1.1)
Age, years						
Ref: 12–39	1.0	1.0	1.0	1.0	1.0	1.0
40–59	0.9 (0.6–1.4)	0.8 (0.3–2.1)	1.7 (0.9–3.2)	**2.3 (1.2–4.4)**	1.3 (0.9–1.8)	1.4 (0.6–3.5)
60+	0.8 (0.5–1.3)	0.5 (0.2–1.3)	1.5 (0.8–2.8)	1.8 (1.0–3.3)	1.2 (0.9–1.8)	1.7 (0.7–4.2)
Ethnicity						
Ref: White	1.0	1.0	1.0	1.0	1.0	1.0
Aboriginal off-reserve	1.2 (0.9–1.6)	1.6 (0.9–2.6)	1.1 (0.8–1.4)	1.1 (0.8–1.4)	0.8 (0.6–1.1)	1.2 (0.8–1.8)
Other	0.9 (0.6–1.4)	1.4 (0.8–2.5)	0.8 (0.5–1.2)	0.9 (0.6–1.3)	0.7 (0.5–1.1)	1.2 (0.7–1.9)
Education						
Ref: Post-secondary graduate	1.0	1.0	1.0	1.0	1.0	1.0
Some post-secondary	1.2 (1.0–1.6)	1.5 (0.9–2.6)	1.2 (0.9–1.5)	1.0 (0.8–1.2)	1.0 (0.8–1.2)	1.2 (0.9–1.7)
High school graduate	1.2 (1.0–1.6)	0.7 (0.4–1.1)	1.1 (0.9–1.4)	1.0 (0.8–1.2)	**1.2 (1.0–1.5)**	1.1 (0.8–1.5)
Less than high school	**1.3 (1.1–1.6)**	1.2 (0.8–1.8)	1.1 (0.9–1.3)	0.9 (0.7–1.0)	1.0 (0.8–1.2)	0.9 (0.7–1.2)
Not stated	1.3 (0.8–2.0)	1.8 (0.6–5.5)	0.8 (0.5–1.5)	0.7 (0.4–1.3)	1.0 (0.6–1.6)	1.1 (0.6–1.5)
Income adequacy						
Ref: Quintile 5 (highest)	1.0	1.0	1.0	1.0	1.0	1.0
Quintile 4	1.3 (0.9–1.9)	1.4 (0.7–2.6)	1.1 (0.8–1.7)	1.2 (0.9–1.6)	1.1 (0.8–1.5)	1.0 (0.6–1.5)
Quintile 3	1.4 (1.0–2.1)	1.7 (0.8–3.5)	0.9 (0.6–1.3)	1.1 (0.9–1.5)	**1.4 (1.0–1.9)**	1.2 (0.7–1.9)
Quintile 2	1.4 (1.0–1.9)	**1.9 (1.0–3.6)**	1.2 (0.9–1.7)	1.3 (1.0–1.6)	**1.4 (1.0–1.6)**	1.3 (0.8–2.0)
Quintile 1 (lowest)	**1.5 (1.0–2.1)**	1.8 (1.0–3.3)	1.3 (0.9–1.8)	1.3 (1.0–1.8)	**1.5 (1.1–2.1)**	1.5 (1.0–2.3)
Not stated	0.6 (1.0–2.3)	0.5 (0.0–6.6)	0.8 (0.4–1.5)	1.0 (0.5–1.8)	0.9 (0.4–1.8)	0.7 (0.2–1.9)
Marital status						
Ref: Single	1.0	1.0	1.0	1.0	1.0	1.0
Married/common-law	1.1 (0.9–1.4)	0.7 (0.5–1.2)	0.8 (0.7–1.0)	1.1 (0.9–1.4)	0.8 (0.7–1.1)	**0.7 (0.5–1.0)**
Widowed/separated/divorced	1.1 (0.9–1.4)	**0.6 (0.4–0.9)**	0.9 (0.7–1.0)	1.1 (0.9–1.4)	0.9 (0.7–1.1)	0.9 (0.7–1.2)
Body mass index, kg/m^2						
Ref: < 25	1.0	1.0	1.0	1.0	1.0	1.0
25–29	0.9 (0.8–1.1)	1.2 (0.8–1.8)	1.0 (0.8–1.2)	1.0 (0.9–1.3)	**1.3 (1.0–1.6)**	0.9 (0.7–1.2)
≥ 30	1.0 (0.8–1.1)	**1.4 (1.0–1.9)**	1.2 (1.0–1.4)	1.1 (0.9–1.3)	**1.4 (1.1–1.8)**	1.1 (0.9–1.4)
Physical activity						
Ref: Active	1.0	1.0	1.0	1.0	1.0	1.0
Moderately active	1.2 (0.9–1.7)	0.7 (0.4–1.3)	1.3 (0.8–1.9)	1.2 (0.9–1.6)	1.1 (0.8–1.4)	1.0 (0.6–1.6)
Inactive	**1.7 (1.3–2.3)**	1.1 (0.7–1.8)	**1.4 (1.1–2.0)**	1.3 (1.0–1.8)	1.2 (1.0–1.4)	**1.5 (1.0–2.2)**

Continued on the following page

TABLE 4 (continued)
Multivariate-adjusted associations between characteristics and health status indicators in Canadians 12 years and older with chronic fatigue syndrome or fibromyalgia (n = 1849), 2010 Canadian Community Health Survey

Characteristics	Fair/poor general health	Fair/poor mental health	Severe level of impairment	Presence of pain	Activity limitations	Help needed for tasks
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
Drinks alcohol						
Ref: At least weekly	1.0	1.0	1.0	1.0	1.0	1.0
Less than weekly	**1.5 (1.1–1.9)**	**1.7 (1.1–2.5)**	1.1 (0.9–1.3)	1.1 (0.9–1.3)	1.2 (1.0–1.4)	1.2 (0.9–1.6)
Not in past 12 months	**1.4 (1.1–1.8)**	**1.7 (1.2–2.6)**	1.1 (0.9–1.4)	1.2 (1.0–1.4)	1.0 (0.9–1.2)	**1.4 (1.0–1.9)**
Smoking						
Ref: Never smoker	1.0	1.0	1.0	1.0	1.0	1.0
Former smoker	**1.3 (1.0–1.6)**	1.4 (0.9–2.0)	0.9 (0.7–1.1)	0.8 (0.7–1.0)	0.9 (0.8–1.1)	1.2 (0.9–1.6)
Current smoker	**1.4 (1.1–1.8)**	**1.6 (1.1–2.5)**	1.1 (0.9–1.4)	0.9 (0.7–1.1)	1.2 (1.0–1.6)	**1.4 (1.1–1.9)**
Fruit and vegetable consumption, servings per day						
Ref: <5 servings	1.0	1.0	1.0	1.0	1.0	1.0
≥ 5	1.1 (0.9–1.2)	0.8 (0.5–1.2)	1.0 (0.8–1.1)	1.1 (1.0–1.3)	1.0 (0.9–1.2)	**1.4 (1.1–1.7)**

Abbreviations: CFS, chronic fatigue syndrome; FM, fibromyalgia; Ref, referent; PR, prevalence ratio.

Note: Statistically significant associations ($p < 0.05$) are bolded.

the differences in health status when compared to those with neither condition. Thus, our findings point to the importance of considering the cumulative effects of coexisting chronic conditions and CFS/FM when examining health outcomes in people with either or both conditions.

Strengths and limitations

Our study is strengthened by our use of a large, population-based survey of the Canadian population living in the community, with a good response rate. The CCHS provides comprehensive data on descriptive variables, enabling in-depth analysis of the health status of people living with CFS and FM as well as allowing comparisons with different subgroups. The CCHS relies on self-reporting of chronic conditions and health events. While it is the most practical method of assessing disease status in large population studies, self-reporting of diagnosis is susceptible to misclassification, resulting in potential under- or over-estimation of disease prevalence and societal burden. In our study, CCHS respondents self-reported their disease history (including the diagnosis of CFS and/or FM), and there was no third-party corroboration or verification of these self-reports. Research has found acceptable to good agreement between self-reported physical health conditions and diagnoses made by medical professionals,[25] but validation of self-reported CFS and FM in particular has not, to our knowledge, been specifically undertaken. Studies of diagnostic practices, focussing on the case definition used by health professionals in diagnosing CFS/FM, are scarce and have yet to be done in Canada.

As previously acknowledged, the cross-sectional design of the survey does not allow the examination of possible causal pathways or mechanisms, so it is unclear whether the associations we found with lifestyle risk behaviours could be viewed as (a) risk factors for developing the conditions or (b) a result of the condition. Etiological studies (such as case-control or cohort studies) are required to determine whether, in the context of CFS and FM, these represent potential preventable risk factors or not. Finally, while we have included in our analytical strategy the important covariates identified in the CFS and FM literature, our analysis was restricted to the set of variables collected by the CCHS. This may have precluded the inclusion of other important covariates that may have been confounders of the associations we examined in this study, such as disease severity or duration of illness.

Conclusion

We found that, in 2010, CFS and FM were reported by approximately 1.4% and 1.5%, respectively, of the Canadian household population 12 years of age and older. We observed that prevalent CFS and FM were related to female sex, adults 40 years and older and lifestyle risk factors for chronic diseases, although the reasons behind these associations are unclear. These findings may warrant further research to examine whether these lifestyle risk factors are part of the causal pathway or are the effects of the conditions. Co-occurrence of CFS and FM and having other diagnosed chronic conditions were strongly related to poorer health status and accounted for much of the differences in health status. Comorbidity as a driving force behind poorer health status cannot be ignored.

Given the relative paucity of data on CFS and FM, these results from a community-based survey are relevant to the field of public health. They reinforce prior findings that these conditions frequently co-occur with a range of other diseases. Because CFS or FM without comorbidities is actually rare, researchers and clinicians can anticipate substantial complexity in their studies and clinical care. In particular, research that does not exclude patients with comorbidities would be most relevant to health professionals and public health practitioners. Finally, understanding the factors that contribute to improved quality of life in people with CFS and/or FM, particularly in those with both conditions and other comorbidities, may be an important area for future research.

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A DASH dietary pattern and the risk of colorectal cancer in Canadian adults

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This article has been peer reviewed.

Abstract

Introduction: Colorectal cancer (CRC) is a high incidence cancer affecting many Canadian adults each year. Diet is important in the etiology of CRC with many dietary components identified as potential risk factors. The Dietary Approaches to Stop Hypertension (DASH) diet is a well-established pattern to characterize overall eating. The purpose of this study was to characterize a DASH pattern within the Canadian context and to assess its relationship to the risk of CRC in Canadian adults.

Methods: Unconditional multiple logistic regression with control for confounding variables was performed using data from the National Enhanced Cancer Surveillance Study. Dietary intake was captured for this case-control study through a food frequency questionnaire (FFQ) and categorized into a DASH score ranging from 0 to 10 representing a poor to a strong DASH pattern respectively.

Results: Consuming a strong DASH pattern of eating (score $\geq$ 8) was not common in the 3161 cases and 3097 controls. Overall, only 10.8 % of men and 13.6 % of women had a strong DASH pattern. Multivariate analysis demonstrated a trend for decreasing risk of CRC in men with increasing DASH scores (p value for trend = .007). Men with a strong DASH score had a 33% reduction in risk of CRC compared to those with a low DASH score. There were no significant trends for women for CRC or for colon or rectal cancers separately.

Conclusion: Our findings are similar to other researchers suggesting a benefit with a strong DASH pattern associated with a decreased risk of CRC, especially in men. Research should further investigate our gender-based differences.

Keywords: *diet, colorectal neoplasms, primary prevention*

Introduction

Colorectal cancer (CRC) is the second leading cause of cancer deaths in Canada, with 5000 males and 4200 females forecast to die from the disease in 2013.[1] Risk factors for CRC include family history, certain genetic syndromes (e.g. familial adenomatous polyposis), medical conditions (e.g. inflammatory diseases), medications, as well as lifestyle behaviours associated with excess body weight (e.g. low physical activity level) and diet.[2] Modifiable dietary factors are believed to be crucial in the etiology of CRC.[3]

The relationships between diet and complex chronic diseases such as CRC can be examined by investigating dietary patterns. Chronic diseases are likely mediated by the culmination of multiple dietary components interacting synergistically or antagonistically over time. Examining dietary patterns by capturing combinations of specific foods or dietary components and expressing these as a summary exposure measure may accurately and comprehensively describe dietary exposure. Common dietary patterns include the Western, the Prudent and the Mediterranean dietary patterns, but the list continues to grow.[4]

One established dietary pattern is the Dietary Approaches to Stop Hypertension (DASH) diet, which is rich in fruit, vegetables, whole grains, low-fat dairy products and legumes/seeds but low in saturated fat, sodium and added sugars.[5] Initially designed and evaluated for reducing blood pressure,[6] the DASH diet has now been studied in relation to outcomes such as cardiovascular disease, kidney function, metabolic syndrome and gestational diabetes.[7-9]

Few studies have looked at the DASH diet in relation to risk of CRC despite that many of the foods or nutrients the DASH diet recommends are associated with a lessened risk of CRC.[10] Studies by Dixon et al.[11] and Fung et al.,[12] as well as one on eating frequency using the DASH diet[13] used different methodologies to characterize a DASH pattern. Recognizing possible differences across countries with respect to food choices, we set out to establish a DASH pattern within the Canadian context and to determine if adherence to this pattern is associated with a decreased risk of CRC. We hypothesized that with increasing DASH pattern scores, the risk of CRC in Canadian adults would decrease.

Despite the availability of other dietary patterns or indices, we chose to focus on the DASH pattern because many Canadians may already be following this diet to prevent

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or treat hypertension. In Canada, the prevalence of hypertension is high; in 2010, 17.1% of all Canadians aged 12 years or older were diagnosed with high blood pressure, with those aged 65 years or older having a significantly higher prevalence (i.e. 40%).[14]

Methods

Between 1994 and 1997, the National Enhanced Cancer Surveillance Study (NECSS) collected data from a population-based sample that included people with 19 types of cancer. Cases as well as controls lived in the Canadian provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Prince Edward Island, Nova Scotia and Newfoundland and Labrador. Ontario provided controls but no cases and, as a result, was excluded from our current analyses.

Details of the NECSS and diet-based analyses are available elsewhere.[15-17]

Cases

Participating provincial cancer registries ascertained 5112 (2227 women and 2885 men) histologically confirmed incident cases of CRC aged 20 to 76 years. Of these, 325 people (6.4 %; 111 women and 214 men) had died by the time of physician contact, and 341 (6.7%; 177 women and 164 men) were not contacted because the attending physician refused consent (generally because the patient was too ill). Of 4446 questionnaires sent by provincial cancer registries, 3174 were completed, a response rate of 62.1% of cases ascertained or 71.4% of patients contacted. Cases were confirmed using definitions from the current International Classification of Diseases for Oncology (ICD-O-2)[18] and resulted in 1 male and 2 female cases being excluded due to missing ICD-O codes. Our study analysed the resulting sample of 1816 male and 1355 female cases.

Controls

We selected people without cancer from a random sample within each participating province, with an age/sex distribution similar to that of all cancer cases in the NECSS. The selection of controls made sure that at least one sex-specific control was chosen for each case within a 5-year age group and for each type of cancer. The sampling strategy for population-based controls was determined for each province based on research experience with specific databases, access to data and data quality as well as database confidentiality conditions. As such, the sampling strategy for selecting controls varied by province. Data from provincial health insurance plans were used in British Columbia, Saskatchewan, Manitoba, Prince Edward Island and Nova Scotia. The Ontario Ministry of Finance Property Assessment Database provided Ontario's controls. Random digit dialling provided controls for Alberta and Newfoundland and Labrador. Controls were also collected over the whole calendar year to ensure an even distribution of responses that may be influenced by seasonality (e.g. on questions of diet and physical activity). A nominal financial incentive was tried in Ontario to improve response rates.

Of 5119 questionnaires sent to potential controls, 81 were returned because they were incorrectly addressed; of the remainder, 3097 (1635 men and 1462 women) were completed, yielding a response rate of 61.5% of controls contacted.[19-20]

Data collection

The provincial cancer registries identified most cases within 1 to 3 months of diagnosis through pathology reports. After obtaining physician consent, the registries mailed questionnaires to potential participants (cases and controls). If a completed questionnaire was not returned, a reminder postcard was sent out after 14 days, and a second copy of the questionnaire at 4 weeks. After 6 weeks, recipients who had not yet completed the questionnaire were reminded to do so by telephone. Information was collected from controls using the same protocol as for cases.

Information was collected on socio-economic status, self-reported height and weight, smoking history, alcohol consumption, physical activity, menstrual and reproductive history and diet.

For self-reported weight, participants were asked to recall their weight 2 years before the study to calculate body mass index (BMI, in kg/m^2).[21]

We defined ''ever smokers'' as those who had smoked at least 100 cigarettes in their entire life and ''current smokers'' as those who were still smoking during the year before the interview.

Information on recreational physical activity was obtained by asking about the time spent doing both moderate and strenuous activities 2 years prior to the study.

We derived dietary information from a semi-quantitative food frequency questionnaire (FFQ) based on 2 validated instruments: the short Block questionnaire[22] and the Willett questionnaire.[23] The FFQ was used to determine usual dietary intake 2 years before participants' enrollment in the study. The FFQ included 69 specific foods/beverages that were categorized into 8 food groups: (a) breads and cereals; (b) meat, poultry, fish, eggs and cheese; (c) vegetables; (d) fruit; (e) sweets; (f) miscellaneous foods such as peanut butter and nuts; (g) beverages made with water such as coffee, tea and juices/drinks; (h) other beverages such as soft drinks, milk and alcohol. For each food item, participants were asked to describe how often (per day, per week, per month) they consumed, on average, the specified serving size. We used a nutrient database based on the Canadian Nutrient File to estimate nutrient and total energy intake according to the nutrient profile of foods at that time.[24]

We derived a 10-point score to describe participants' DASH pattern intake (see Table 1), rather than use a 9-point scoring system as reported in some studies.[11,25] We based our scoring system on the foods or food groups in the DASH Eating Plan from the Dietary Guidelines for Americans[26] and from a related publication[11] to capture intake of whole grains, vegetables, fruit, low-fat dairy, red and processed meats, sweets, alcohol, saturated fat, and nuts, legumes and seeds. We modified our scale by including a tenth item, sodium intake, as other researchers have done.[12]

We controlled for total energy intake by establishing quartiles based on the energy distribution in controls. For each of the

TABLE 1
DASH-Pattern scoring scheme

Dietary component	Examples of FFQ items (or nutrient calculation)	Excluding
POSITIVE	1 point for intakes ≥ median; 0 points for intakes < median	
Whole grains	Bran, granola cereals, shredded wheat, cooked cereals, dark and whole grain bread	White bread, rice, macaroni
Vegetables	Tomatoes, carrots, broccoli, cabbage, cauliflower, Brussels sprouts, spinach or other greens, winter squash, sweet potatoes, any other vegetable including green beans, corn, peas	French fries, soups with vegetables or tomato, vegetable juice
Fruit	Apples, pears, oranges, bananas, cantaloupe, other fruit, fresh or canned, orange or grapefruit juice	Items with added sugar such as drinks from frozen concentrate, crystals
Low-fat dairy products	2% milk, 1% milk, skim milk	Whole milk, regular cheese, ice cream
Nuts/seeds/legumes	Nuts, tofu, soybeans, baked beans or lentils	High fat peanut butter
NEGATIVE	1 point for intakes ≤ median; 0 points for intakes > median	
Meat (red, processed)	Beef, pork, lamb as a main or mixed dish, hamburger, sausage, hotdog, smoked or corned beef, luncheon meats, liver	Fish, poultry, eggs
SFAs	Total dietary SFA intake from all foods in the FFQ, as defined by: % = Saturated Fat (g) x 9 (kcal) / Total energy of the diet (kcal)	
Sodium	Total dietary sodium intake from all foods of FFQ	
Alcohol	Beer, wine, liquor	
Sweets	Cake, cookies, doughnuts, pastry, pies, ice cream, chocolate, soft drinks, drinks from powdered drink crystals, etc.	

Abbreviations: DASH, Dietary Approaches to Stop Hypertension; FFQ, Food Frequency Questionnaire; SFA, saturated fat.

quartiles, we calculated specific median intakes for all 10 dietary components using the intake of controls, stratified by sex. Our energy quartiles were 1458 kcal/day or less, 1459 to 1843 kcal/day, 1844 to 2284 kcal/day and 2285 kcal/day or more. Study participants received a point for intakes at or above the energy sex-specific median for the following ''positive'' dietary components: whole grains, vegetables, fruit, low-fat dairy and legumes/nuts/seeds. Intakes below the median for these components were scored a zero. Alternatively, a point was given to each intake at or below the median for ''negative'' dietary components: red and processed meat; saturated fat; alcohol; and sweets. For these, a zero was assigned to intakes above the median.

We assigned foods from the FFQ into the appropriate food groups and calculated the number of servings of each food based on existing DASH pattern methodology.[5,11,26] When information was lacking, we supplemented this approach by examining common nutrients across foods within a food group to ensure nutrient equivalency. This was especially important for groups that contained heterogeneous food items such as the sweets group. Because the Canadian Nutrient File[24] is limited in reporting the sugar content of foods, we assessed foods in the sweets group according to calories. As such, one cookie was equivalent to 1 serving (54 kcal) and one glass of soft drink to 2 servings (98 kcal). For saturated fat and sodium intakes, we did not rely on consumption of specific FFQ items as with the other food groups; rather, we scored people based on their total intakes of these nutrients across all foods captured in relation to the median total intakes across the energy quartiles.

The DASH score could range from 0 to 10. In this study, DASH scores represent a DASH-like pattern as they are based on estimates over or under the sex- and energy-specific medians. As such, a DASH score of 8 or higher is a strong DASH pattern of eating while a score of 2 or less is a poor DASH pattern.

Statistical analysis

We used unconditional logistic regression, stratified by sex, to estimate odds ratios (OR) and the corresponding 95% confidence intervals (CI), including terms for age groups (20–49, 50–59, 60–69, ≥ 70 years), province, education (≤ 8, 9–13, ≥ 14 years), BMI (< 25.0, 25.0–29.9, ≥ 30.0 kg/m^2), pack-years of smoking, income, moderate and strenuous leisure-time physical activity, calcium supplementation and age at first pregnancy. Confounding variables, except for age group, province, BMI and sex, were treated as continuous variables in the models. Tests for trend were assessed for each study variable by substituting the variable in the model in continuous form.

All analyses were carried out using statistical package SAS version 9.01 (SAS Institute Inc., Cary, NC, US).[27]

Results

Study participants included 3171 cases and 3097 controls, with 23% more men (n = 3451) than women (n = 2817). The majority of participants had a high school education or higher, had middle- to high-level family incomes and were ever and current smokers. Cases tended to be older and have a higher BMI, and women with CRC tended have been over the age of 20 years when they had a child. Of those reporting family income, there was no statistical difference between cases and controls (Table 2).

TABLE 2
Distribution of colorectal cancer cases (n = 3171) and population-based controls (n = 3097) based on selected covariates, NECSS, Canada, 1994–1997

	Cases		Controls		*p* value for Chi-Square
	n	%	n	%	
Sex					
Men	1816	57.2	1635	52.8	
Women	1355	42.8	1462	47.2	
Age, years					
20–49	378	11.9	838	27.1	< .0001
50–59	645	20.4	605	19.5	
60–69	1342	42.3	1043	33.7	
≥ 70	806	25.4	611	19.7	
Education, years					
≤ 8	577	18.2	471	15.2	< .0001
9–13	1818	57.3	1689	54.5	
≥ 14	711	22.4	900	29.1	
Missing values	65	2.1	37	1.2	
Family income[a]					
Low	584	18.4	584	18.9	0.32
Lower-middle	570	18.0	585	18.9	
Upper-middle	758	23.9	779	25.2	
High	474	14.9	440	14.2	
Missing values	785	24.8	709	22.9	
Pack-year smoking					
Never smokers	995	31.4	1123	36.5	< .0001
≤ 10	626	19.7	705	23.0	
11–20	525	16.6	470	15.3	
21–30	377	11.9	302	9.8	
> 30	592	18.7	447	14.5	
Missing values	56	1.8	50	1.6	
BMI, kg/m^2					
< 25.0	1175	37.1	1461	47.2	< .0001
25.0–29.9	1345	42.4	1176	38.0	
≥ 30.0	637	20.1	447	14.4	
Missing values	14	0.2	13	0.4	
Moderate physical activity, hour/month					
≤ 4.22	598	18.9	638	20.6	< .0019
4.23–11.57	645	20.3	702	22.7	
11.58–24.44	720	22.7	725	23.4	
≥ 24.45	730	23.0	636	20.5	
Missing values	478	15.1	396	12.8	

Continued on the following page

Median intakes of foods or nutrients tended to increase with increasing energy intake. The exception was alcohol, which appeared relatively stable for women across the energy quartiles (Table 3). Saturated fat intake was similar for men and women at between 1.5% and 1.7% of total energy intake, across all energy quartiles.

Consuming foods largely to a DASH pattern (i.e. a score of ≥ 8) was not common in study participants (Table 4). Overall, only 10.8 % of all men (374/3451) and 13.6 % of all women (382/2817) scored 8 or higher (Table 4). Similarly, only a small percentage of participants had a low DASH score (≤ 2) representing a poor DASH pattern of eating; 10.1% of men (349/3451) and 10.2% of women (286/2817) scored 2 or less. Approximately 50% of study participants had DASH scores in the mid-range of 4 to 6.

Our analyses showed a significant trend towards decreased risk of CRC with increasing DASH scores (p value for trend = .007) in men. After adjusting for confounders, men who scored ≥ 8 on the DASH scale had a 33% reduced risk of CRC compared to men with lower DASH scores. Men showed a decreasing trend for risk of rectal cancer (p = .003), but not colon cancer (p = .09), with increasing DASH scores, although a similar pattern was evident. For women, trends with increasing DASH scores for either colon or rectal cancers or both cancers combined were not significant.

We stratified analyses according to BMI (Table 5) and found no interaction between DASH scores and risk of CRC. The trend for rectal cancer (p = .01) was significant and the trend for CRC (p = .05) was borderline significant in men who were not overweight/obese (BMI < 25.0 kg/m^2). Men had a 50% and 36% risk reduction for rectal cancer and CRC respectively with a strong DASH pattern. In men who were overweight/obese (BMI ≥ 25.0 kg/m^2), CRC was reduced by 35% in those with a strong DASH pattern though this was borderline significant (p = .05). Although not statistically significant (p = .07), there seemed to be a decreasing risk of rectal cancer in overweight/obese men with increasing DASH scores.

Trends for increasing DASH scores and risk of any cancers for women in either weight status group were not statistically significant.

We also assessed parity in women, for potential confounding, but found no sta-

TABLE 2 (continued)
Distribution of colorectal cancer cases (n = 3171) and population-based controls (n = 3097) based on selected covariates, NECSS, Canada, 1994–1997

	Cases		Controls		*p* value for Chi-Square
	n	%	n	%	
Strenuous physical activity, hour/month					
Never	1324	41.8	1146	37.0	< .0006
≤ 0.19	174	5.5	162	5.2	
0.20–3.68	565	17.8	644	20.8	
≥ 3.69	597	18.8	647	20.9	
Missing values	511	16.1	498	16.1	
Calcium supplementation					
Never	1944	61.3	1849	59.7	< .0001
Not regularly	603	19.0	649	20.9	
Regularly	369	11.6	430	13.9	
Missing values	255	8.0	169	5.5	
Age at first pregnancy, years					
≤ 20	270	19.9	358	24.5	< .01
21–23	343	25.3	343	23.5	
24–26	238	17.6	239	16.4	
> 26	302	22.3	283	19.4	
Missing values	202	14.9	239	16.4	

Abbreviations: BMI, body mass index; NECSS, National Enhanced Cancer Surveillance Study.

[a] Family income was indicated as a categorical variable with the following values: low:< $20 000 with ≤ 3 people or $30 000 with ≥ 4 people; lower-middle: $20 000–$30 000 with ≤ 3 people or $30 000–$50 000 with ≥ 4 people; upper-middle: < $50 000 with ≤ 3 people or $50 000–$100 000 with ≥ 4 people; high: ≥ 50 000 for ≤ 3 people or ≥ 100 000 for ≥ 4 people.

tistical difference between cases and controls (data not shown).

Discussion

This is the first published Canadian study to investigate the DASH pattern in relation to risk of CRC.

Our results parallel other studies that showed an inverse relationship between a strong DASH pattern and risk of CRC with some variability across sex.[11-13,28] Fung et al.[12] reported a protective association for proximal colon cancer in women, but not men, who followed a DASH or Mediterranean type of diet. In our study, adherence to a DASH dietary pattern was protective for men but not for women. Our findings agree with those of Dixon et al.[11] who demonstrated a significant trend for increased DASH scores with lower risk of distal CRC adenomas in men regardless of other factors such as body weight or smoking status. Other studies have also shown inverse relationships between strong DASH patterns or other healthy diet indices in men, but not women,[13,29] with some researchers explaining these differences as being due to the differences in the etiology of CRC between men and women.[29]

Some researchers strongly suggest that men and women respond differently to dietary

TABLE 3
Median intakes of foods or nutrients by sex and energy levels, NECSS, Canada, 1994–1997

Food Components[a] (servings/day)	Energy Level (Kcal/day)							
	≤ 1458		1459–1843		1844–2284		≥ 2285	
	Men	Women	Men	Women	Men	Women	Men	Women
Whole grains	0.71	0.79	1.29	1.64	1.99	2.14	2.13	2.43
Vegetables	0.86	1.20	1.28	1.71	1.42	1.85	1.78	2.21
Fruit	0.23	1.23	1.42	1.88	1.67	2.12	2.15	2.76
Low-fat dairy products	0.14	0.17	0.79	0.79	1.00	1.00	1.00	1.00
Nuts/seeds/legumes	0.07	0.07	0.10	0.07	0.10	0.10	0.11	0.14
Meat	0.79	0.70	1.11	1.05	1.43	1.24	1.93	1.71
Sweets	1.35	1.10	2.26	2.18	3.14	2.66	4.57	4.60
Sodium (mg/day)	1408.54	1451.54	2043.39	2025.40	2458.56	2491.16	3388.26	3198.28
Saturated fats (% of total energy)	0.016	0.015	0.016	0.015	0.017	0.016	0.016	0.016
Alcohol	0.13	0.00	0.35	0.07	0.50	0.07	0.56	0.07

Abbreviations: CI, confidence interval; DASH, Dietary Approaches to Stop Hypertension; OR, odds ratio; NECSS, National Enhanced Cancer Surveillance Study.

[a] The food components are the same as in Table 1.

TABLE 4
Odds ratios[a] and 95% confidence intervals of colorectal cancer according to median score by sex, NECSS, Canada, 1994–1997

Cancer site	DASH score							*p* value for trend
	≤ 2	3	4	5	6	7	≥ 8	
Colon								
Men								
Cases	93	124	169	174	177	130	89	
Controls	181	226	272	279	242	217	216	
OR (95% CI)	Ref.	0.98 (0.68–1.41)	1.07 (0.76–1.51)	1.06 (0.75–1.50)	1.20 (0.85–1.70)	0.92 (0.63–1.33)	0.65 (0.44–0.97)	.09
Women								
Cases	71	89	135	149	111	99	108	
Controls	152	173	259	251	225	202	196	
OR (95% CI)	Ref.	1.04 (0.69–1.57)	1.12 (0.76–1.64)	1.06 (0.72–1.55)	1.01 (0.67–1.51)	1.00 (0.66–1.51)	1.15 (0.76–1.74)	.81
Rectum								
Men								
Cases	75	128	173	158	143	110	69	
Controls	181	226	272	279	242	217	216	
OR (95% CI)	Ref.	1.32 (0.91–1.93)	1.57 (1.10–2.25)	1.27 (0.88–1.83)	1.26 (0.87–1.83)	1.01 (0.68–1.50)	0.64 (0.42–0.98)	.003
Women								
Cases	63	67	79	112	108	82	78	
Controls	152	173	259	251	225	202	196	
OR (95% CI)	Ref.	1.02 (0.66–1.57)	0.79 (0.52–1.19)	0.98 (0.65–1.47)	1.23 (0.81–1.97)	0.92 (0.59–1.42)	1.03 (0.66–1.60)	.58
Colorectum								
Men								
Cases	168	252	342	332	320	240	158	
Controls	181	226	272	279	242	217	216	
OR (95% CI)	Ref.	1.13 (0.84–1.53)	1.31 (0.98–1.75)	1.17 (0.88–1.57)	1.25 (0.93–1.68)	0.97 (0.71–1.32)	0.66 (0.47–0.92)	0.007
Women								
Cases	134	156	214	261	219	181	186	
Controls	152	173	259	251	225	202	196	
OR (95% CI)	Ref.	1.05 (0.74–1.48)	0.96 (0.70–1.33)	1.04 (0.75–1.42)	1.10 (0.79–1.53)	0.96 (0.68–1.35)	1.09 (0.77–1.54)	.70

Abbreviations: CI, confidence interval; DASH, Dietary Approaches to Stop Hypertension; OR, odds ratio; NECSS, National Enhanced Cancer Surveillance Study; Ref., reference.

Note: Totals may vary due to missing values.

[a] Adjusted for 10-year age group (20–49, 50–59, 60–69, 70–76 years), province, education, body mass index (< 25.0, 25.0–29.9, ≥ 30.0), pack-year smoking, moderate and strenuous activity, calcium supplementation and age at first pregnancy for women.

interventions.[30,31] In one Canadian study, men were found to have better two-hour post-load insulin concentrations than women after both stayed on a Mediterranean diet.[30] In addition, only the male participants experienced a statistically significant reduction in BMI with the Mediterranean diet. Both findings were attributed to improved insulin sensitivity and homeostasis in males.[30]

In another group of adults, adherence to a Mediterranean diet was associated with greater insulin sensitivity in young men but not in pre-menopausal women.[31] Although these sex-specific findings were not assessed with regard to CRC or any other cancer, insulin response has important implications for colorectal cancer risk. Insulin and insulin-like growth factor 1 together can promote CRC by activating several signalling pathways associated with an elevated risk of oncogenesis.[32] That insulin may play a role in the development of CRC is supported by the association between type 2 diabetes and an elevated risk of cancer including CRC.[33,34] Since the Mediterranean and DASH diets are very similar (e.g. emphasis on whole grains, nuts and legumes, limited sweets) and highly correlated,[12] it is possible that our findings in men may only be related to metabolic processes involving insulin sensitivity.

We stratified study participants according to BMI since dietary patterns may influence the risk of CRC only in those at high risk of insulin resistance (i.e. with a high BMI).[35] However, we did not observe the influence of a protective DASH pattern in only the overweight or the obese. We observed a protective effect of a strong DASH pattern for rectal cancer in normal weight men and a protective effect that was borderline significant for CRC in normal, overweight and obese males. We found no statistical trends for rectal, colon or combined cancers for women.

To further help understand this protective association with men but not women, we

TABLE 5
Odds ratios[a] and 95% confidence intervals of colorectal cancer according to median DASH score stratified by body mass index and sex, NECSS, Canada, 1994–1997

Cancer site	DASH Score							*p* value for trend
	≤2	3	4	5	6	7	≥8	
BMI < 25.0 kg/m²								
Colon (n = 629)								
Men (n = 274)	Ref.	1.30 (0.68–2.51)	0.84 (0.45–1.60)	0.86 (0.45–1.63)	1.39 (0.74–2.62)	0.94 (0.48–1.85)	0.69 (0.34–1.40)	.40
Women (n = 355)	Ref.	1.53 (0.79–2.96)	1.49 (0.81–2.73)	1.53 (0.82–2.84)	2.09 (1.13–3.89)	1.60 (0.84–3.05)	1.65 (0.86–3.17)	.16
Rectum (n = 546)								
Men (n = 268)	Ref.	1.55 (0.80–3.01)	1.34 (0.72–2.51)	0.89 (0.46–1.72)	1.25 (0.64–2.43)	0.91 (0.45–1.83)	0.50 (0.24–1.07)	.01
Women (n = 278)	Ref.	0.97 (0.51–1.84)	0.77 (1.43–1.39)	0.88 (0.48–1.60)	0.91 (0.49–1.69)	0.74 (0.39–1.40)	1.04 (0.56–1.95)	.96
Colorectum (n = 1175)								
Men (n = 542)	Ref.	1.48 (0.87–2.52)	1.18 (0.71–1.95)	0.92 (0.55–1.55)	1.40 (0.83–2.36)	0.98 (0.57–1.70)	0.64 (0.36–1.14)	.05
Women (n = 633)	Ref.	1.32 (0.79–2.20)	1.10 (0.69–1.76)	1.17 (0.72–1.89)	1.43 (0.88–2.32)	1.13 (0.68–1.87)	1.32 (0.80–2.19)	.41
BMI ≥ 25.0 kg/m²								
Colon (n = 1084)								
Men (n = 681)	Ref.	0.85 (0.55–1.32)	1.13 (0.75–1.72)	1.14 (0.75–1.72)	1.13 (0.74–1.72)	0.88 (0.56–1.38)	0.61 (0.38–0.99)	.15
Women (n = 403)	Ref.	0.74 (0.44–1.24)	1.03 (0.63–1.69)	0.74 (0.45–1.21)	0.73 (0.42–1.25)	0.75 (0.44–1.30)	0.78 (0.42–1.45)	.30
Rectum (n = 891)								
Men (n = 586)	Ref.	1.21 (0.77–1.91)	1.64 (1.05–2.56)	1.45 (0.93–2.26)	1.24 (0.79–1.96)	1.06 (0.66–1.71)	0.70 (0.41–1.17)	.07
Women (n = 305)	Ref.	1.02 (0.56–1.86)	0.75 (0.41–1.38)	1.10 (0.63–1.92)	1.58 (0.90–2.80)	1.06 (0.58–1.93)	0.65 (0.50–1.82)	.47
Colorectum (n = 1974)								
Men (n = 1267)	Ref.	0.99 (0.68–1.43)	1.35 (0.95–1.94)	1.29 (0.91–1.84)	1.18 (0.82–1.70)	0.95 (0.65–1.39)	0.65 (0.43–0.98)	.05
Women (n = 707)	Ref.	0.85 (0.53–1.36)	0.88 (0.56–1.38)	0.96 (0.62–1.48)	0.85 (0.54–1.35)	0.83 (0.52–1.33)	0.93 (0.57–1.52)	.78

Abbreviations: BMI, body mass index; DASH, Dietary Approaches to Stop Hypertension; CI, confidence interval; OR, odds ratio; NECSS, National Enhanced Cancer Surveillance Study.

Note: Totals may vary due to missing values.

[a] Adjusted for 10-year age group (20–49, 50–59, 60–69, 70–76 years), province, education, smoking, strenuous and moderate activity, calcium supplementation and age at first pregnancy for women.

considered reproductive health factors. We were able to assess parity, a factor that may be associated with decreasing risk of CRC,[36-38] but the difference between female cases and controls was not statistically significant. We did not collect data on the use of hormone replacement therapy (HRT) and of oral contraceptives (OC), although these variables are related to CRC risk. HRT is inversely associated with risk of CRC in most studies including the Women's Health Initiative, which showed a 36% decreased risk of CRC with use of HRT.[39-41] The predominant age group for HRT use is 50 to 69 years. In our study, 63% of the cases and 53% of the controls were in that age range. During this study period, usage of HRT was peaking at almost 40% in Canadian women aged 50 to 59 years and approaching 20% for those aged 60 to 69 years.[42] Thus HRT could have been a protective factor for a high percentage of the female participants. Nonetheless, another study that controlled for HRT in the logistic modelling did not report significant findings with a DASH diet in women, even though findings in men were significant.[11] In younger women, the use of OC may have attenuated the effect of a low DASH-type of diet as some studies[43,44] have shown an inverse relationship between OC use and risk of CRC in past or current OC users. Yet we suspect the potential influence of OC use on risk of CRC to be negligible.

Our finding that adhering to a strong DASH pattern was associated with a reduced risk of CRC in men is consistent with evidence for the link of certain dietary factors with CRC. A global assessment of diet and prevention of cancer[10] identified all of our score's food components or their dominant nutrients—with the exception of sodium—as potentially contributing to risk for CRC, with varying strengths of association. Specifically, these components include fibre-containing foods (e.g. legumes), vegetables, fruit, meat, milk and vitamin D/calcium-rich foods, sugar, alcohol, saturated fat and selenium-rich foods such as nuts, seeds and whole grains. This global assessment of diet and reference to specific foods offers a scientific basis from which to explore the DASH pattern to study the risk of CRC and offers biological plausibility to support our finding of an inverse association between a high score and a lower risk of CRC in men.

Differences between cases and controls in intakes of some DASH components varied by sex. Some components may have been more influential than others. For males, higher consumption of saturated fat, alcohol and sweets (negative nutrients) was reported in the cases. This pattern of greater negative nutrients was not evident in females. For females, greater consumption of fruit and whole grains (positive nutrients) were reported in cases, suggesting the

presence of other factors that negate the positive effects of these dietary components. These findings align with reports from other researchers that high alcohol intakes (along with high intakes of meat and refined grains) increased the risk of CRC—a risk that was attenuated with increased intakes of fruit, vegetables and whole grains.[4]

Limitations

The case-control design of this study inherently imparts weaknesses associated with recall bias. This may be particularly relevant to having to recall diet from 2 years before.

Applying dietary patterns involves some degree of subjectivity.[4,11,45] This is true also for how authors define and determine adherence to a DASH diet.[28,46-48] In our study, we relied on available information to define food groups and to add relevant foods to each group, including assigning equivalent serving sizes. In this regard, we may have misclassified some foods, thereby possibly misclassifying participants into an adjacent DASH score and possibly over-populating mid-range DASH scores. Mid-range scores are difficult to interpret as they may represent a lack of positive attributes, a presence of many negative attributes or a combination of both. Our finding that few study participants achieved a high DASH score is an observation reported in another similar study.[11] Further, the FFQ used in this study was a shortened version of the Block and Willett questionnaires and included only 69 items. Compared with other FFQs,[11,12] ours may have been too limiting to capture all foods contributing to the DASH pattern.

All 10 food groups were given equal weight for a final DASH score. However, the effect on CRC of some dietary components probably differ.[29] For example, red and processed meats are convincingly associated with increased risk of CRC while saturated fats are less convincingly linked.[10] The sex differences we observed may further point to the importance of weighting some foods differently, especially between sexes. For example, alcohol is convincingly associated with CRC in men but only of probable risk for women.[10]

Conclusion

Our findings suggest that a DASH pattern of eating may be associated with a lower risk of CRC, especially in men. Further research could investigate the gender differences we observed and assess the potential importance of a DASH pattern beyond prevention of CRC.

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Report Summary

Congenital Anomalies in Canada 2013: A Perinatal Health Surveillance Report by the Public Health Agency of Canada's Canadian Perinatal Surveillance System

B. Irvine, MA; W. Luo, MSc; J. A. León, MD

Congenital anomalies (birth defects or congenital malformations) are abnormalities that are present at birth, even if not diagnosed until months or years later. They may be present from conception, as is the case with a chromosome defect (e.g. Down syndrome) or gene mutation (e.g. achondroplasia), and they also include those structural defects that occur in the embryonic period up to the end of the seventh week of gestation (e.g. spina bifida) or in the early fetal period between 8 and 16 weeks gestation, (e.g. orofacial clefts).

Congenital anomalies are an important health issue because of their impact on the health and wellbeing of Canadian infants and children and their families and because of the health resources they require for management and treatment. Approximately 1 in 25 Canadian babies is diagnosed with 1 or more congenital anomalies every year. Between 1998 and 2009, the national congenital anomalies prevalence rate decreased from 451 to 385 per 10 000 total births, probably due to 3 factors: (1) increased prenatal diagnosis and subsequent pregnancy termination; (2) mandatory folic acid fortification of food; and (3) changes in health behaviours and practices such as a reduction in tobacco smoking in pregnancy. Despite the decrease in the overall prevalence rate, congenital anomalies are second only to immaturity as the leading cause of infant death.

Congenital Anomalies in Canada 2013: A Perinatal Health Surveillance Report is the second national surveillance report from the Public Health Agency of Canada dedicated to congenital anomalies.* It provides comprehensive data on congenital anomalies in Canada, focussing on 6 categories of congenital anomalies: Down syndrome, neural tube defects, congenital heart defects, orofacial clefts, limb deficiency defects and gastroschisis. The report presents national-level birth prevalence data and temporal trends, provincial and territorial estimates, and international comparisons. Known risk factors, prevalence-related impacts of prenatal diagnosis and preventative measures are also discussed.

The report points to maternal obesity as an important emerging risk factor for some congenital anomalies. It also notes that alcohol use and smoking during pregnancy remain key risks that require ongoing public health measures for prevention and prevalence reduction.

The report also highlights the difference between primary and secondary prevention of congenital anomalies. Primary prevention involves avoiding disease through deliberate strategies that mitigate the risks associated with low socio-economic status, obesity and poor nutrition, environmental contaminants, chronic diseases such as hypertension and diabetes, and the influence of older maternal age. Secondary prevention involves the early identification of congenital anomalies through prenatal testing, and subsequent treatment or pregnancy termination for the purpose of reducing or preventing morbidity.

Prevalence rates of 6 categories of congenital anomalies in Canada

Anomaly	Time frame[a]	Rate per 10 000 total births[b]
Down syndrome	1998–2007	14.1
Neural tube defects	2004–2007	4.0
Congenital heart defects	2009	85.1
Orofacial clefts	1998–2007	16.3
Limb deficiency defects[c]	2007	3.5
Gastroschisis	2002–2009	3.7

[a] Time frames vary depending on the data source used for ascertainment of information.

[b] Total births include live births and stillbirths.

[c] For limb deficiency defects, total births include pregnancy terminations over 20 weeks occurring in hospitals.

* The first report, published in 2002 by Health Canada was entitled *Congenital Anomalies in Canada – A Perinatal Health Report, 2002*.

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The surveillance information presented in the report is meant to describe trends and patterns of congenital anomalies in Canada and to enhance our knowledge of these conditions, thus contributing to the evidence base that public health and health care programs, policies and practices need for effective prevention and management.

To download an electronic version of the report, go to http://publications.gc.ca/collections/collection_2014/aspc-phac/HP35-40-2013-eng.pdf.

Report Summary

Perinatal Health Indicators 2013: a Surveillance Report by the Public Health Agency of Canada's Perinatal Surveillance System

B. Irvine, MA; S. Dzakpasu, PhD; J. A. León, MD

Glossary of Definitions:

- The maternal mortality rate is the number of maternal deaths (occurring during pregnancy, childbirth, or within 42 days of delivery or termination of pregnancy) divided by the number of deliveries.
- The fetal mortality rate is the number of late fetal deaths per 1000 total births (live births and stillbirths).
- The infant mortality rate is the number of deaths of live-born babies in the first year after birth per 1000 live births.
- Neonatal death is the death of a newborn aged 0–27 days.
- Post-neonatal death is the death of an infant aged 28–364 days.
- The preterm birth rate is the number of live births with a gestational age at birth of less than 37 completed weeks as a proportion of all live births.
- The postterm birth rate is the number of live births with a gestational age at birth of 42 or more completed weeks of pregnancy as a proportion of all live births.
- The small-for-gestational-age birth rate is the number of singleton live births whose birth weight is below the 10th percentile of the sex-specific birth weight for gestational age reference as a proportion of all singleton live births.
- The large-for-gestational-age birth rate is the number of singleton live births whose birth weight is above the 90th percentile of the sex-specific birth weight for gestational age reference as a proportion of all singleton live births.

Introduction

The Canadian Perinatal Surveillance System (CPSS) is a national health surveillance program of the Public Health Agency of Canada. The CPSS mandate is to monitor and report on key indicators of maternal, fetal and infant health. These indicators include both determinants and outcomes of perinatal health.

Perinatal Health Indicators 2013 reports on 13 priority indicators using the most recent data from vital statistics, hospitalizations, the Canadian Community Health Survey and the National Longitudinal Survey of Children and Youth.

The report includes the following main findings:

Behaviours and practices

Between 1993–1996 and 2005–2008, overall maternal smoking during pregnancy decreased from 21.9% to 12.3%. Smoking prevalence decreased with age; the smoking rate was seven times higher in mothers aged less than 20 years (38.8%) than in those aged 35 to 39 years (5.6%).

The rate of maternal alcohol consumption also decreased over the same time, from 15.5% to 10.7%.

Between 2005 and 2009–2010, the rate of breastfeeding initiation remained stable at approximately 88%, while the rate of exclusive breastfeeding for six months increased from 20.3% to 25.9%.

Between 2001 and 2010, the rate of live births to teenage mothers (15–19 years old) decreased while the rate of live births to older mothers (35–49 years old) increased. Among mothers aged 15 to 17 and 18 to 19 years, the rate decreased from 9.1 to 7.7 and 31.1 to 25.8 per 1000 females respectively. Among mothers aged 35 to 39, 40 to 44 and 45 to 49 years, the rate increased from 32.0 to 49.3, 5.2 to 9.2 and 0.2 to 0.4 per 1000 females, respectively. As a result of these trends, the proportion of all live births to teenage mothers declined from 5.6% to 4.2%, while the proportion to older mothers increased from 14.7% to 17.0%.

Maternal outcomes

Between 2003–2004 and 2010–2011, the rate of severe maternal morbidity fluctuated between 13.2 and 15.4 per 1000 deliveries. The most common severe maternal morbidities were blood transfusion, postpartum hemorrhage with blood transfusion and hysterectomy. Between 2001–2002 and 2010–2011, the rate of Caesarean delivery increased from 23.4% to 28.0%.

Between 2003–2004 and 2010–2011, the rate of maternal mortality fluctuated between 8.2 and 6.1 per 100 000 hospital deliveries. The most common diagnoses associated with maternal deaths were diseases of the circulatory system, post-

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partum hemorrhage and hypertension complicating pregnancy, childbirth and the puerperium.

Infant outcomes

Between 2001 and 2010, the fetal mortality rate increased from 5.9 to 6.7 per 1000 total births. In 2010, the mortality rates for fetuses weighing 500 g and over and 1000 g and over were 5.1 and 3.7 per 1000 total births, respectively. Between 2000 and 2009, the infant mortality rate varied between 4.9 and 5.4 per 1000 live births.

Neonatal death constituted 74% of infant deaths in 2009. Immaturity and congenital anomalies were the leading causes of neonatal death. Congenital anomalies and Sudden Infant Death Syndrome were the leading causes of post-neonatal death. After decreasing between 2001 and 2007 from 460 to 377 per 10 000 total births, the overall prevalence of congenital anomalies increased to 397 per 10 000 total births in 2010.

Between 2001 and 2010, the rate of preterm birth fluctuated between 7.5% and 8.2% of live births and was 7.7% in 2010. During this 10-year period, the rate of post-term birth declined from 1.1% to 0.6%. The rate of small-for-gestational-age birth among singleton infants fluctuated between 7.8% and 8.3% while the rate of large-for-gestational age birth among singleton infants decreased from 11.8% to 10.4%. The rate of multiple births increased from 2.8% to 3.2% of total births.

Conclusion

The picture of national perinatal health provided by *Perinatal Health Indicators 2013* is meant to enhance current knowledge in the field and to provide evidence that using public health/health system programs, policies and practices improves the health of mothers and babies in Canada.

To obtain an electronic copy of the report, please contact the Canadian Perinatal Surveillance System at CPSS-SCSP@phac-aspc.gc.ca.

Release notice

Data release for the Canadian Longitudinal Study on Aging

The first major data release from the Canadian Longitudinal Study on Aging (CLSA) is underway. The June 2014 release includes data collected from 21 242 participants who each completed a 60-minute telephone interview. Additional data from these interviews will become available early in 2015.

The process for accessing biospecimens and physical assessment data from an additional 30 000 participants who were interviewed in person and have visited one of 11 data collection sites across the country, is currently being developed in anticipation of the first release of these data in 2016.

Canadian and international public sector researchers interested in accessing the CLSA platform are invited to visit the DataPreview Portal on the CLSA website for detailed information about the available data and the application process.

Data will be available to researchers following review of applications by the CLSA Data and Sample Access Committee. For more information, visit www.clsa-elcv.ca.

With thanks to our 2014 peer reviewers

We are grateful to the following people for their significant contribution to *Chronic Diseases and Injuries in Canada* as peer reviewers in 2014. Their expertise ensures the quality of our journal and promotes the sharing of new knowledge among peers in Canada and internationally.

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Other PHAC publications

Researchers from the Public Health Agency of Canada also contribute to work published in other journals. Look for the following articles published in 2014:

Auger N, **Gilbert NL**, Naimi AI, Kaufman JS. Fetuses-at-risk, to avoid paradoxical associations at early gestational ages: extension to preterm infant mortality. Int J Epidemiol. 2014;43(4):1154-62.

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Article Types

Peer-reviewed Articles

Original Research Articles

Article Reporting on Quantitative Research: Maximum 3500 words in English (or 4400 words in French) for main text body (excluding abstract, tables, figures, references) in the form of original research, surveillance reports, or methodological papers. Please include a structured abstract (maximum 250 words in English, or 345 words in French) with the following headings: Introduction, Methods, Results, Discussion, Conclusion. No more than 30 references.

Article Reporting on Qualitative Research or Mixed Methods: Maximum 5000 words in English (or 6500 in French) for main text body (excluding abstract, tables, figures, references). Methodological papers welcomed. Process evaluations that accompany qualitative analyses are welcomed. Please include a structured abstract (maximum 250 words in English, or 345 words in French) with the following headings: Introduction, Methods, Results, Discussion, Conclusion. No more than 30 references. *The HPCDP Journal* follows the guidelines for qualitative articles as set by *Social Science and Medicine* : http://www.elsevier.com/wps/find/journaldescription.cws_home/315/authorinstructions

Article Reporting on Public Health Intervention: "Population health interventions are policies, programs and resource distribution approaches that impact a number of people by changing the underlying conditions of risk and reducing health inequities." [CIHR, Population Health Research Initiative for Canada] Quantitative, qualitative or mixed methods studies and evaluations of interventions are welcomed. Maximum 3500-5000 words in English (4400-6500 words in French) for main text body (excluding abstract, tables, figures, references). Please include a structured abstract (maximum 250 words in English, or 345 words in French) with the following headings: Objectives, Participants, Setting and Context, Intervention, Evaluation Methods, Results, Conclusion. No more than 30 references.

Evidence Synthesis

Provides a systematic assessment of literature and relevant data sources (systematic review, meta-analysis), a scoping review, realist review or an environmental scan. Authors should report the type of review they undertook and describe their methods for performing the review, including the ways information was searched for, selected, analyzed and summarized. Process evaluations that accompany systematic reviews are welcomed. Please follow accepted standards for the reporting of meta-analyses or systematic reviews (e.g. AMSTAR, PRISMA, QUORUM, MOOSE). Purely qualitative syntheses are accepted (e.g. realist reviews). Please follow accepted standards in qualitative reviewing (e.g. RAMSES for realist reviews/meta-narrative reviews). Maximum 4000 words in English (5000 words in French) for main text body (excluding abstract, tables, figures, references). Please include a structured abstract (maximum 250 words in English, or 345 words in French) with the following headings: Introduction, Methods, Results, Discussion, Conclusion. References: no limit.

Evidence Brief

Describes results of interest to a broad audience of public health and related professionals. There should be no more than 6 figures or tables (total). Maximum 1500 words in English, or 1950 words in French. Please include an unstructured abstract (maximum 100 words in English, or 130 words in French). The unstructured abstract has no more than 5 sentences, each one corresponding to the subheadings in the body of the paper: Introduction, Methods, Findings, Discussion, Conclusion. No more than 20 references.

Non-Peer-reviewed Articles

Status Report

Describes ongoing national health promotion or chronic disease/injury prevention programs, studies or information systems bearing on pan-Canadian public health (maximum 2000 words in English, or 2600 words in French). May be peer reviewed and an abstract may be required at the request of the Editor-in-Chief. No more than 40 references.

At-a-Glance

Infographic, chart or diagram depicting trends or providing at-a-glance information on a specific public health issue with pan-Canadian relevance. May be accompanied by explanatory text of 500 words maximum (630 words in French) supporting or explaining the depicted information. No more than 6 references.

Release Notice/Report Summary

Maximum 1000 words in English, or 1300 words in French. The "Report Summary" allows authors of grey literature to have a summary of key findings appear in PubMed as "News". Abstract not required.

Book/Media Review

Usually solicited by the editors (maximum 800 words in English, or 1000 words in French), but requests to review are welcomed. Abstract not required.

Letter to the Editor

Commentary on recently published journal articles or issues will be considered for publication (maximum 500 words in English, or 630 words in French). Comments must be received within one month of publication date to be considered. Abstract not required. No more than 6 references.

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Signed by corresponding or first author, stating that all authors have seen and approved the final manuscript. Must confirm that the material has not been published in whole or in part elsewhere and that the paper is not currently being considered for publication elsewhere. Must state that all authors meet the following conditions of authorship: authors were involved in design or conceptualization of the study, **and/or** analysis or interpretation of the data, **and/or** drafting of the paper. Should declare if an author has a conflict of interest, if applicable.

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First title page

Concise title; full names, institutional affiliations and highest academic degree of all authors; name, postal and email addresses, and telephone and fax numbers for corresponding author only; separate word counts for abstract and text; indicate number of tables and figures.

Second title page

Title only; start page numbering here as page 1.

Abstract

Structured (Introduction, Methods, Results, Conclusion) where applicable; include 3 to 8 key words (preferably from the Medical Subject Headings [MeSH] of Index Medicus).

Key Findings Box

Maximum 100 words (130 in French) to describe the key findings of the paper in plain language.

Text

In Microsoft Word. Double-spaced, 1 inch (25 mm) margins, 12-point font size. For Original Research articles, please structure the paper with the following subheadings: Introduction, Methods, Results, Discussion, Conclusion. The Discussion section should contain a "Strengths and Limitations" subsection. The Conclusion should avoid statements that are not supported by the results of the investigation. For Public Health Intervention articles, please structure the paper with the following subheadings: Objectives, Participants, Setting and Context, Intervention, Evaluation Methods, Results, Conclusion. The Conclusion should avoid statements that are not supported by the results of the investigation.

Acknowledgments

Include disclosure of financial and material support in acknowledgements; if anyone is credited in acknowledgements authors should state in their cover letter that they have obtained written permission.

References

In Vancouver style (for examples see: http://www.ncbi.nlm.nih.gov/books/NBK7256/); listing up to six authors (first three and "et al." if more than six). Numbered in superscript in the order cited in text, tables and figures. Please do not use an automatic reference numbering feature found in word processing software. Any unpublished observations/data or personal communications used (discouraged) to be cited in the text in parentheses (authors are responsible for obtaining written permission). Authors are responsible for verifying accuracy of references and hyperlinks.

Tables and Figures

If created in Word, please place at the end of the main manuscript. If created in Excel, please place in one separate file. They must be as self-explanatory and succinct as possible; numbered in the order that they are mentioned in the text; explanatory material for tables in footnotes, identified by lower-case superscript letters in alphabetical order; figures limited to graphs, flow charts or diagrams, or maps (no photographs). If figures are submitted in Word, raw data will be requested if the manuscript is accepted for publication.

Ethics in Publishing

Since the journal generally adheres to the "Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals" as approved by the International Committee of Medical Journal Editors, authors should refer to this document for information regarding ethical considerations.

Revision Process

For peer-reviewed articles: Submitted articles first undergo an initial assessment by the Editor-in-Chief and an external Associate Scientific Editor as to the suitability of the manuscript for publication with our journal. If the manuscript fits within our mandate, it will need to pass through a streamlined institutional review process prior to peer-review. Then the article will undergo a double-blind peer-review process. Once the reviews have been received, the Associate Scientific Editor assigned to the article will adjudicate the reviews and make one of the following recommendations: "accept," "reconsider after minor revisions," "reconsider after major revisions" or "reject."

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