Moderate alcohol consumption and heart disease

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Abstract

Objectives

This article examines patterns of alcohol consumption in relation to a subsequent new diagnosis of or death from heart disease.

Data sources

The analysis is based on longitudinal data from the first three cycles of the National Population Health Survey (NPHS), conducted by Statistics Canada in 1994/95, 1996/97 and 1998/99. The data are from a sample of 3,379 women and 2,635 men from the household population, who, in 1994/95, were aged 40 or older and reported that they had not been diagnosed with heart disease. Cause of death was established with information from the Canadian Mortality Database.

Analytical techniques

Descriptive data were produced using bivariate frequencies. Multiple logistic regression was used to examine associations between level of alcohol consumption reported in 1994/95 and a subsequent diagnosis of or death from heart disease.

Main results

Women reporting moderate alcohol consumption—two to nine drinks in the past week—had significantly lower odds of receiving a new diagnosis of or dying from heart disease between 1994/95 and 1998/99, compared with women who reported lifetime abstinence. No association between alcohol consumption and subsequent heart disease emerged for men.

Key words

alcohol drinking, risk factors, longitudinal studies, health surveys

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Numerous prospective studies have indicated that moderate alcohol consumption is protective against ischemic heart disease.[1-7] Research suggests that the association between alcohol use and heart disease is U-shaped; that is, people who consume up to two to three drinks per day have lower heart disease rates than non-drinkers, and people who have more than four to six drinks per day have a higher risk of heart disease than non-drinkers. The biological mechanisms are not thoroughly understood, but alcohol appears to have a favourable effect on lipid production, and it may prevent the formation of arterial clots.[2,8-10]

While studies focusing on alcohol use in relation to illness and mortality have been carried out in several European countries, the United States and parts of Asia, analysis based on Canadian data remains limited.[11] The National Population Health Survey (NPHS) provides data for a nationally representative sample of people followed since 1994/95, which allows an examination of the association between levels of alcohol consumption and subsequent health among Canadians.

Methods

Data source

This article is based on longitudinal data from the first three cycles of the National Population Health Survey (NPHS), 1994/95 through 1998/99. Cause of death was established with information from the Canadian Mortality Database.

The NPHS, which began in 1994/95, collects information about the health of the Canadian population every two years. It covers household and institutional residents in all provinces and territories, except persons on Indian reserves, on Canadian Forces bases, and in some remote areas. The NPHS has both longitudinal and cross-sectional components. Respondents who are part of the longitudinal component will be followed for up to 20 years.

NPHS data are stored in two files. The General file contains socio-demographic and some health information for each member of participating households. The Health file contains in-depth health information, which was collected for one randomly selected household member, as well as the information in the General file pertaining to that individual.

Among individuals in the longitudinal component in 1996/97 and 1998/99, the person providing in-depth health information about himself or herself for the Health file was the randomly selected person for the household in cycle 1 (1994/95), and was usually the person who provided information on all household members for the General file in cycles 2 and 3, if judged knowledgeable enough to do so.

The 1994/95 non-institutional sample for the 10 provinces consisted of 27,263 households, of which 88.7% agreed to participate. After application of a screening rule to keep the sample representative,[12] 20,725 households remained in scope. In 18,342 of these households, the selected person was aged 12 or older. Their response rate to the in-depth health questions was 96.1%, or 17,626 respondents. Of these 17,626 randomly selected respondents, 17,276 were eligible for re-interview in 1996/97, and 16,677 were still alive in 1998/99. A response rate of 93.6% was achieved for the longitudinal panel in 1996/97, and a response rate of 88.9%, based on the entire panel, was achieved in 1998/99. Of the 16,168 respondents in 1996/97, full information (that is, general and in-depth health information for the first two cycles of the survey or an outcome of death or institutionalization) was available for 15,670. The corresponding number for 1998/99 was 14,619 respondents.

More detailed descriptions of the NPHS design, sample, and interview procedures can be found in published reports.[12,13]

Analytical techniques

Cause of death was established by linking NPHS records for respondents who were reported to be deceased with Statistics Canada's Canadian Mortality Database. The linkage was carried out at Statistics Canada, using customized computer code to match records on personal identifiers. All records linked in this way, as well as records that could not be machine-linked because of mismatching information, were reviewed manually. People reported to be deceased for whom records could not be linked to the mortality database were excluded from the analysis.

The analysis was restricted to people aged 40 or older with no diagnosis of heart disease in 1994/95; the sample numbered 6,819. The following were excluded from the initial sample of 6,819 respondents: individuals who reported in 1994/95 that they had been diagnosed with heart disease (n = 620) or that they did not know if they had been diagnosed (n = 7); pregnant women (n = 16), because alcohol consumption during pregnancy may be less than usual; people for whom data on diagnosis of heart disease were not available for cycles 2 or 3 (n = 3); and deceased individuals for whom data on cause of death were unavailable (n = 159). The resulting sample size of 6,014 individuals comprised 3,379 women (Appendix Table A) and 2,635 men (Appendix Table B). Records for 33 women and 50 men were excluded from multivariate analysis because of other missing information.

Cross-tabulations were used to estimate bivariate relationships between level of alcohol consumption in 1994/95 and a new diagnosis of or death attributed to heart disease sometime after the cycle 1 interview in 1994/95 but before the cycle 3 interview in 1998/99. To enhance statistical power, diagnosis of heart disease and death attributed to heart disease were combined to comprise the outcome variable.

Multiple logistic regression was used to model associations between a new diagnosis of heart disease or death due to heart disease and level of alcohol consumption, while controlling for factors related to heart disease risk: age, household income, education, diagnosis of diabetes or high blood pressure, family history of heart disease, physical activity, body mass index, smoking history, and hormone replacement therapy (women only). The model was also controlled for self-perceived health. This variable was included because it is a powerful predictor of heart disease and death, probably because it reflects an awareness of changes in health before they are clinically detectable.[14,15]

All independent variables except those reflecting family medical history of heart disease were based on data collected in 1994/95. Information on family history of heart disease was collected in 1998/99 only. Interaction terms between each level of alcohol consumption and years of smoking were explored in preliminary multivariate models.

In multivariate analysis, heart disease/death due to heart disease was the dependent variable; records for respondents who reported that they had not been diagnosed with heart disease, or whose deaths were due to other causes, were coded to 0, and those with a diagnosis of or death attributed to heart disease were coded to 1.

All estimates from cross-tabulations and logistic regression were weighted to represent the Canadian population aged 40 or older in 1994/95. To account for survey design effects, standard errors and coefficients of variation were estimated with the bootstrap technique.[16-18]

This article examines the association between moderate alcohol consumption and heart disease, a leading cause of illness and death in Canada. The mortality rate from heart disease has fallen dramatically over the past few decades; however, according to vital statistics data, heart disease—of which ischemic heart disease is the major component—was the leading cause of death in 1998 (Appendix Table C).

Measuring alcohol consumption

Before questions about alcohol use were asked, interviewers read the following information to respondents: "When we use the word *drink*, it means one bottle or can of beer or a glass of draft, one glass of wine or a wine cooler, or one straight or mixed drink with one and a half ounces of hard liquor."

Information from a series of questions was used to define levels of *alcohol consumption.* Because of the considerable differences in alcohol consumption between men and women, the categories were defined differently by sex.

- *Lifetime abstainer* (a report of never having had a drink) was used as the reference category for both sexes in univariate and bivariate analysis (Appendix Tables A, B, D and E) and for women in multivariate analysis.
- *Former drinkers* comprised people who reported that they had not had a drink in the past year, but that they had consumed at least 1 drink before the past year. This category was used for both sexes in univariate and bivariate analysis, and for women in multivariate analysis. For men, because of the small sample size of lifetime abstainers and resultant statistical instability (see *Limitations*), the reference category for multivariate analysis was broadened to also include those who reported no drinking in the past year but prior consumption that had never regularly exceeded 12 drinks per week. In the multivariate analysis for men, "former drinkers" included only those who reported no drinking in the past year, but regular consumption of more than 12 drinks per week at some time prior to the past year.

For people who reported that they had had at least 1 drink in the past 12 months, level of consumption was derived from the number of drinks during the week before the survey:

- *Occasional* drinkers were those who reported no drinks in the past week.
- *Light* consumption was defined as 1 drink in the past week.
- *Moderate* consumption was defined as 2 to 9 drinks in the past week for women, and 2 to 14 for men, consistent with the sex-specific weekly upper limits recommended in the *Canadian Guidelines on Low-Risk Drinking.*[19]
- *Heavy* drinking was defined as 10 drinks or more in the past week for women; 15 or more, for men.

The analysis is based on data from a sample of household residents aged 40 or older in 1994/95 and who, at that time, reported they had never been diagnosed with heart disease. Data on reported alcohol consumption were studied in relation to a new diagnosis of heart disease or death attributed to ischemic heart disease between 1994/95 and 1998/99 (see *Methods, Measuring alcohol consumption, Definitions* and *Limitations*). Multivariate analysis controls for the effects of other relevant factors, selected based on a review of the literature,[20-24] as well as availability on the NPHS: age, household income, education, self-perceived health, a diagnosis of diabetes or high blood pressure, family history of heart disease, leisure-time physical activity, body mass index, and smoking history. Given the recent report that indicated an adverse effect of long-term hormone replacement therapy (HRT) in relation to coronary heart disease,[25] HRT was also included for women.

Heart disease, alcohol consumption

Among people aged 40 or older in 1994/95 who did not report a diagnosis of heart disease at that time, an estimated 73,000 (n=42) were confirmed to have died from ischemic heart disease, and an additional 706,000 (n=437) reported a new diagnosis of "heart disease" by 1998/99. Similar percentages of women (7%) and men (8%) were reported to have been diagnosed with, or to have died from,

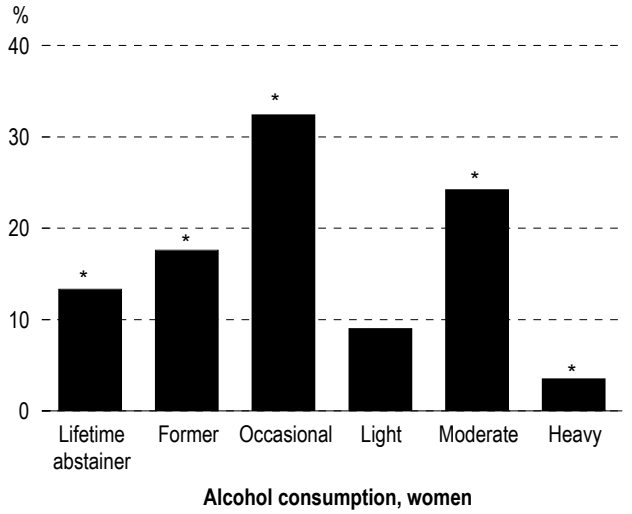
Table 1
New diagnosis of or death due to heart disease between 1994/95 and 1998/99, household population aged 40 or older with no diagnosis of heart disease in 1994/95, by sex, Canada excluding territories

	Women			Men		
	Sample size	Estimated population		Sample size	Estimated population	
		'000	%		'000	%
Total	**3,379**	**5,356**	**100.0**	**2,635**	**4,900**	**100.0**
No diagnosis of heart disease	3,134	4,980	93.0	2,401	4,496	91.8
Diagnosis of or death due to heart disease	245	375	7.0	234	404	8.2

Data source: *1994/95, 1996/97, and 1998/99 National Population Health Survey, longitudinal sample, Health file*
Notes: *Based on samples of 3,379 women and 2,635 men aged 40 or older with no diagnosis of heart disease in 1994/95. Deaths attributed to heart disease are based on records for which cause of death was available.*

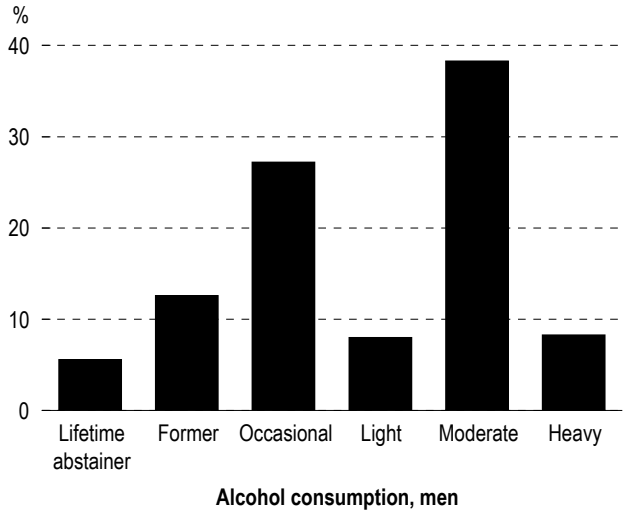
heart disease (Table 1). These figures underestimate the actual extent of heart disease mortality in the household population, because deaths for which the cause was unavailable were excluded from the analysis.

Chart 1
Level of alcohol consumption among women aged 40 or older with no diagnosis of heart disease, household population, Canada excluding territories, 1994/95



Data source: *1994/95, 1996/97 and 1998/99 National Population Health Survey, longitudinal sample, Health file*
** Significantly different ($p < 0.05$) from estimate for men in corresponding category (Chart 2)*

Chart 2
Level of alcohol consumption among men aged 40 or older with no diagnosis of heart disease, household population, Canada excluding territories, 1994/95



Data source: *1994/95, 1996/97 and 1998/99 National Population Health Survey, longitudinal sample, Health file*

Reported alcohol consumption differed substantially by sex. In 1994/95, lifetime abstinence was more common among women than men (13% versus 6%) (Charts 1 and 2, Appendix Tables A and B). A higher proportion of women than men reported drinking occasionally, while higher proportions of men reported moderate or heavy consumption. Men were also more likely than women to report exceeding the recommended weekly maximum during the previous week (9 drinks for women and 14 for men), although relatively few men or women reported heavy drinking. (See also *Drinking patterns*.)

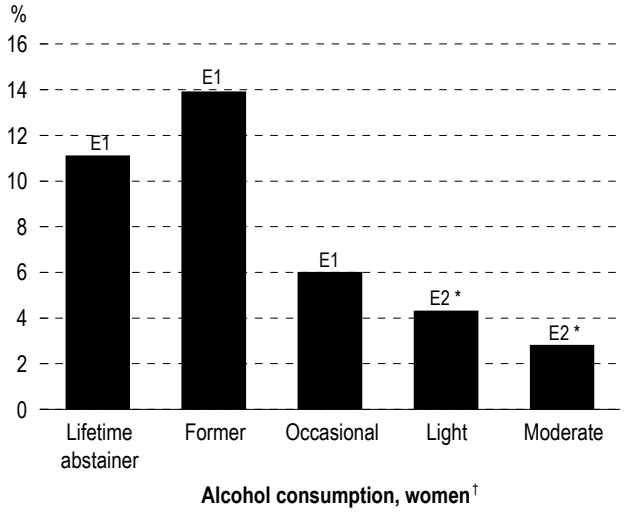
Protective effect for women

Among women aged 40 or older who reported light (one drink) or moderate drinking (two to nine drinks) in the week before the 1994/95 interview, the rates of diagnosed heart disease or death due to heart disease over the next four years were significantly lower than the rate among women who reported lifetime abstinence (Appendix Table D). For men, though, heart disease rates did not differ significantly by level of alcohol consumption (Appendix Table E). However, interpretation of this finding is limited by the instability of the estimate for male lifetime abstainers. Most previous studies have reported a protective effect of moderate drinking for both sexes.[1-7]

Among women, heart disease morbidity or mortality rates in former drinkers—that is, those who reported having at least one drink in their life, but none in the previous year—were significantly higher than rates for women who reported any level of alcohol consumption in the past week (data not shown). These findings are consistent with previous research, and support the premise that former drinkers may include people already at risk of heart disease.[3]

Although the NPHS data for women suggest a lower likelihood of heart disease in association with light or moderate alcohol consumption, the U-shaped relationship between level of consumption and risk of disease noted in previous research[1,3-6,8,26-31] was not observed (Chart 3). This was presumably because of the small sample size

Chart 3
New diagnosis of or death due to heart disease between 1994/95 and 1998/99 among women aged 40 or older with no diagnosis of heart disease in 1994/95, by level of alcohol consumption, household population, Canada excluding territories



Data source: *1994/95, 1996/97 and 1998/99 National Population Health Survey, longitudinal sample, Health file*
† Heavy drinkers not shown (coefficient of variation greater than 33.3%)
E1 Coefficient of variation between 16.6% and 25.0%
E2 Coefficient of variation between 25.1% and 33.3%
** Significantly different from "Lifetime abstainer" (p < 0.05)*

of women who reported alcohol consumption at levels associated with a higher risk of disease.

Of course, factors other than alcohol use influence heart disease risk, many of which were taken into account in this analysis: age, household income, education, self-perceived health, diagnosis of diabetes or heart disease, leisure-time physical activity, body mass index, smoking, and for women, hormone replacement therapy. Even when adjusting for these other risk factors, the protective association between moderate alcohol intake of two to nine drinks per week and a diagnosis of or death due to heart disease persisted for women (Table 2). No similar protective association was found for men (Table 3).

A meta-analysis of prospective studies of heart disease morbidity and mortality has suggested that for women, the optimal protective effect of alcohol occurs at 10 grams per day (equivalent to just under one drink), and consumption of up to 31 grams (approximately 2.5 drinks) is still protective.[1]

Table 2
Adjusted odds ratios for new diagnosis of or death due to heart disease among women aged 40 or older with no diagnosis of heart disease in 1994/95, by selected characteristics in 1994/95, household population, Canada excluding territories, 1994/95 to 1998/99

	Adjusted odds ratio	95% confidence interval
Alcohol consumption		
Lifetime abstainer (never drank)†	1.0	…
Former (1+ drink in lifetime, 0 in past year)	1.2	0.7, 2.1
Occasional (1+ drink in past year, 0 in past week)	0.7	0.4, 1.3
Light (1 drink in past week)	0.6	0.2, 1.4
Moderate (2-9 drinks in past week)	0.4*	0.2, 0.9
Heavy (10+ drinks in past week)	0.8	0.3, 2.2
Age group		
40-54†	1.0	…
55-69	3.4*	2.0, 5.7
70+	5.6*	3.3, 9.6
Household income		
Lower	0.9	0.6, 1.4
Upper†	1.0	…
Education		
Less than secondary graduation†	1.0	…
Secondary graduation or more	0.8	0.5, 1.2
Self-perceived health		
Excellent/Very good/Good	0.4*	0.3, 0.7
Fair/Poor†	1.0	…
Diabetes		
Yes	1.9	1.0, 3.9
No†	1.0	…
High blood pressure		
Yes	1.2	0.8, 2.0
No†	1.0	…
Family history of heart disease‡		
Yes	3.5*	2.0, 6.1
No†	1.0	…
Leisure-time physical activity		
Inactive†	1.0	…
Moderate/Active	0.5*	0.4, 0.8
Body mass index		
Acceptable (< 25.0)†	1.0	…
Overweight (25.0-29.9)	0.6*	0.4, 0.9
Obese (30+)	0.7	0.5, 1.2
Years of daily smoking	1.0	1.0, 1.0
Hormone replacement therapy		
Yes	0.9	0.5, 1.6
No†	1.0	…

Data source: *1994/95, 1996/97 and 1998/99 National Population Health Survey, longitudinal sample, Health file*
Notes: *Based on a sample of 3,346 women aged 40 or older with no diagnosis of heart disease in 1994/95; 33 were excluded because of missing values. "Unknown" categories for household income, education, family history of heart disease, leisure-time physical activity, body mass index and hormone replacement therapy were included in the model, but their odds ratios are not shown.*
† Reference category
‡ Collected in 1998/99 only
** Significantly different from reference category (p < 0.05)*
… Not applicable

Drinking patterns

Some research has indicated that the relationship between alcohol consumption and heart disease varies according to consumption patterns, with a protective effect associated with regular small amounts rather than the whole amount in one weekly session.[10,32] Similarly, the findings of an ecological study carried out in Sweden showed a negative relationship, observed in women but not men, between wine consumption and ischemic heart death.[33] The researchers suggest that women's typical consumption patterns—drinking in moderation with meals—together with their preference for wine rather than spirits or beer may partially account for this finding.

Although information on the type of alcohol consumed is not available from the National Population Health Survey (see *Limitations*), the survey does include questions intended to measure heavy episodic drinking and daily drinking patterns. The frequency of heavy episodic drinking (consuming five or more drinks on one occasion, at least once each month during the past year) was much more common among men (14%) than women (2%) (data not shown). However, when a variable reflecting heavy episodic drinking was included in the multivariate models, there was no significant association with heart disease for either sex (data not shown).

The *Canadian Guidelines on Low-Risk Drinking* recommend an upper daily limit of two drinks.[19] Although the difference between the sexes for daily drinking patterns was not as great as it was for heavy episodic drinking, the percentage of men (25%) reporting more than two drinks on at least one day during the past week considerably exceeded the percentage of women reporting this pattern (10%) (data not shown). However, similar percentages of men (30%) and women (27%) reported alcohol consumption for the previous week that fell within the daily recommended limit. When alcohol consumption was coded to reflect these patterns (that is, at least one drink in the past week, but no more than two drinks on any day), only among women did an association with heart disease emerge. The odds of diagnosed heart disease or heart disease death were significantly lower in women who reported consuming at least one drink during the week, but no more than two drinks on any day during the past week, compared with women who reported lifetime abstinence.

Adjusted odds ratios for new diagnosis of or death due to heart disease among household population aged 40 or older with no diagnosis of heart disease in 1994/95, by drinking pattern and sex, Canada excluding territories, 1994/95 to 1998/99

	Women		Men	
Drinking pattern	Adjusted odds ratio	95% confidence interval	Drinking pattern	Adjusted odds ratio	95% confidence interval
Lifetime abstainer (never drank)†	1.0	...	Abstainer (lifetime abstainers and former drinkers who never regularly drank >12 drinks/week)†	1.0	...
Former (1+ drink in lifetime, 0 in past year)	1.2	0.7, 2.1	Former (at some time regularly drank > 12 drinks/week, 0 in past year)	1.8	0.8, 4.3
Occasional (1+ drink in past year, 0 in past week)	0.7	0.4, 1.3	Occasional (1+ drink in past year, 0 in past week)	1.5	0.8, 2.7
Within recommended daily limit (1+ drink in past week, no more than 2 drinks/day in past week)	0.4*	0.2, 0.9	Within recommended daily limit (1+ drink in past week, no more than 2 drinks/day in past week)	1.8	1.0, 3.6
Exceeded recommended daily limit (>2 drinks at least 1 day in past week)	0.7	0.3, 1.5	Exceeded recommended daily limit (> 2 drinks at least 1 day in past week)	0.9	0.5, 1.9

Data source: *1994/95, 1996/97 and 1998/99 National Population Health Survey, longitudinal sample, Health file*
Notes: *Based on samples of 2,585 men and 3,346 women aged 40 or older with no reported diagnosis of heart disease in 1994/95; 33 women and 50 men were excluded because of missing variables. Except for variables reflecting alcohol consumption in the context of recommended daily limits, the full model includes all variables (Appendix Tables F and G). "Unknown" categories for household income, education, family history of heart disease, leisure-time physical activity, body mass index and hormone replacement therapy were included in the model, but their odds ratios are not shown.*
† Reference category
** Significantly different from reference category ($p < 0.05$)*
··· Not applicable

Table 3
Adjusted odds ratios for new diagnosis of or death due to heart disease among men aged 40 or older with no diagnosis of heart disease in 1994/95, by selected characteristics in 1994/95, household population, Canada excluding territories, 1994/95 to 1998/99

	Adjusted odds ratio	95% confidence interval
Alcohol consumption		
Abstainer (lifetime abstainers and former drinkers who never regularly drank > 12 drinks/week)†	1.0	…
Former (at some time regularly drank > 12 drinks/week, 0 in past year)	1.9	0.8, 4.4
Occasional (1+ drink in past year, 0 in past week)	1.5	0.8, 2.7
Light (1 drink in past week)	1.7	0.7, 4.3
Moderate (2-14 drinks in past week)	1.6	0.8, 3.0
Heavy (15+ drinks in past week)	0.7	0.3, 1.9
Age group		
40-54†	1.0	…
55-69	2.3*	1.4, 3.7
70+	4.3*	2.4, 7.5
Household income		
Lower	0.9	0.5, 1.4
Upper†	1.0	…
Education		
Less than secondary graduation†	1.0	…
Secondary graduation or more	0.9	0.6, 1.4
Self-perceived health		
Excellent/Very good/Good	1.0	0.6, 1.7
Fair/Poor†	1.0	…
Diabetes		
Yes	2.4*	1.2, 5.0
No†	1.0	…
High blood pressure		
Yes	1.3	0.8, 2.2
No†	1.0	…
Family history of heart disease‡		
Yes	3.6*	2.1, 6.2
No†	1.0	…
Leisure-time physical activity		
Inactive†	1.0	…
Moderate/Active	0.6*	0.4, 0.9
Body mass index		
Acceptable (< 25.0)†	1.0	…
Overweight (25.0-29.9)	1.5*	1.0, 2.2
Obese (30+)	1.8*	1.1, 3.0
Years of daily smoking	1.0	1.0, 1.0

Data source: *1994/95, 1996/97 and 1998/99 National Population Health Survey, longitudinal sample, Health file*
Notes: *Based on a sample of 2,585 men aged 40 or older with no diagnosis of heart disease in 1994/95; 50 were excluded because of missing values. Because of rounding, some confidence intervals with 1.0 as lower/upper limit are significant. "Unknown" categories for household income, education, family history of heart disease, leisure-time physical activity and body mass index were included in the model, but their odds ratios are not shown.*
† Reference category
‡ Collected in 1998/99 only
** Significantly different from reference category ($p < 0.05$)*
… Not applicable

Another meta-analysis, which focussed on non-fatal myocardial infarction, reported that as little as half a drink per day can confer the full protective effect.[5] In the NPHS analysis, the lower odds of heart disease or heart disease death for women reporting two to nine drinks in the past week (compared with lifetime abstainers) corroborates the findings of these meta-analyses.

Age, health status predict heart disease

As expected, the risk of heart disease was higher beyond middle age, and age was strongly predictive of heart disease in both sexes. Women in the 55-to-69 age group had over three times the odds of receiving a new diagnosis of or dying from heart disease, compared with women aged 40 to 54 (Table 2). For elderly women, the odds were over five times as high. The pattern was similar among men, with those aged 55 to 69 and 70 or older having over two and four times the odds, respectively, of receiving a new diagnosis of or dying from heart disease, compared with 40- to 54-year-old men (Table 3).

Not surprisingly, several variables reflecting health status were significantly associated with heart disease. Women who reported that their overall health was excellent, very good or good had less than half the odds of receiving a new diagnosis of or dying from heart disease over the next four years, compared with women reporting that their health was fair or poor. This association with self-perceived health was not found for men. But for men reporting diabetes in 1994/95, the odds of a new diagnosis of heart disease or heart disease death were over twice as high as for men without diabetes. Insufficient statistical power likely explains why the odds ratio for diabetes did not attain significance for women.

Some researchers have suggested that controlling for variables that are influenced by alcohol intake, and are thus intermediate in the causal pathway between alcohol and heart disease, may result in an underestimate of the association between alcohol and heart disease.[1,34] To test the effect of two possible intermediate variables on the odds ratio estimates for alcohol, the variables for diabetes and high blood pressure were excluded from multivariate

logistic regressions. The odds ratio estimates for alcohol consumption remained unchanged (data not shown).

Family medical history

Family medical history was strongly predictive of heart disease for both sexes (Tables 2 and 3). People who reported (a) parent(s) or sibling(s) with heart disease had over three times the odds of being diagnosed or dying from the condition, compared with those without such a family medical history. Although this finding is consistent with previous reports,[35,36] recall bias may partly account for the association that emerged in the NPHS data (see *Limitations*).

Lifestyle: BMI and physical activity

A protective association between physical activity and heart disease emerged. Men and women who reported in 1994/95 that they were at least moderately active in their leisure time had about half the odds of receiving a diagnosis of or dying from heart disease, compared with people who were inactive.

Body mass index (BMI) in 1994/95 was significantly associated with a diagnosis of or death from heart disease in the next four years, but in different directions for men and women (Tables 2 and 3). Men who were overweight or obese in 1994/95 had higher odds of a subsequent diagnosis of heart disease. However, women categorized as

Definitions

National Population Health Survey (NPHS) respondents were asked if they had any of a number of "long-term health conditions that have lasted or are expected to last six months or more and that have been diagnosed by a health professional." Interviewers read a list of conditions, including heart disease, diabetes and high blood pressure. For this analysis, *heart disease* was defined as a diagnosis of heart disease reported in 1996/97 or 1998/99, or death due to ischemic heart disease (*International Classification of Diseases, Ninth Revision* [ICD-9],[37] underlying cause-of-death codes 410 through 414), among respondents who reported in 1994/95 that they had not been diagnosed with heart disease. *Diabetes* and *high blood pressure* were measured by reported diagnosis for each condition in the 1994/95 interview.

Three *age groups* were established: 40 to 54, 55 to 69, and 70 or older.

Household income was based on household size and total household income from all sources in the 12 months before the interview. The following groups were derived:

Household income group	Number of people in household	Total household income
Lower	1 or 2	Less than $15,000
	3 or 4	Less than$20,000
	5 or more	Less than $30,000
Upper	1 or 2	$15,000 or more
	3 or 4	$20,000 or more
	5 or more	$30,000 or more

Education was categorized as less than high school graduation, and high school graduation or more.

Respondents rated their health as excellent, very good, good, fair or poor. For this analysis, two categories of *self-perceived health* were established: excellent/very good/good, and fair/poor.

The 1998/99 NPHS asked respondents about the medical history of their immediate family. For this analysis, *family history of heart disease* was considered to be present if the respondent reported that at least one first-degree relative (biological parent[s] and/or biological sibling[s]) had ever had heart disease.

Two levels of *leisure-time physical activity* were defined: active/moderate (1.5 or more kilocalories per kilogram of body weight per day) and inactive (less than 1.5 kilocalories per kilogram of body weight per day). An example of a moderate level of activity would be walking for an hour, four times per week. A person who reported only gardening or yardwork for an hour per week would be categorized as inactive.

Body mass index (BMI) is calculated by dividing weight in kilograms by the square of height in metres. Three BMI levels were defined for this analysis, based on the World Health Organization's standards:[38] acceptable (under 25.0), overweight (25.0 to 29.9), and obese (30.0 or higher).

Smoking status was determined by asking individuals if they smoked cigarettes daily, occasionally, or not at all. Three groups were established: never, former, and current daily or occasional (less than daily). A continuous variable reflecting the reported number of years of daily smoking was used for multivariate analysis.

Use of *hormone replacement therapy* was determined by asking women aged 30 or older if they had taken "hormones for menopause or aging symptoms" in the month before the 1994/95 NPHS interview.

Limitations

An important methodological feature of research on alcohol consumption is differentiating between two types of non-drinkers: lifetime abstainers and former drinkers. It is preferable to use lifetime abstainers, rather than all non-drinkers, as the reference category for comparisons, because former drinkers may have quit because of poor health.[39] In this analysis of NPHS data, however, the small sample (n=16) of male lifetime abstainers who reported a new diagnosis of heart disease or who died from heart disease resulted in an estimate with a coefficient of variation greater than 33.3%. Therefore, to avoid statistical instability due to small cell size, multivariate modelling was conducted using a reference category that grouped men who were lifetime abstainers with those reporting that they had had no drinks in the past year and had never regularly consumed more than 12 drinks per week. Former heavy drinkers—those who reported that they had regularly consumed more than 12 drinks per week and were more likely to have quit for health reasons—were grouped separately. The upper limit of 12 drinks per week for prior consumption was necessitated by the wording of the NPHS question. Respondents who reported that they had not had a drink in the previous 12 months were then asked if they had ever had a drink. Those who answered "yes" were asked if they "ever regularly drank more than 12 drinks per week."

The lack of complete information on alcohol use before the 1994/95 interview limited the precision with which respondents could be classified. Because differences in the duration of exposure to alcohol could not be considered in the analysis, the consumption categories were not entirely homogeneous. This heterogeneity of exposure within variable categories likely weakened the association between the independent and dependent variables.

Categorization of respondents into alcohol consumption levels was based partly on the reported number of drinks consumed during the week before their NPHS interview in 1994/95. Respondents whose alcohol use during that week was atypical of their usual consumption may have been misclassified.

It would have been preferable to use a multivariate model, such as the Cox proportional hazards model, that incorporates the timing of the occurrence of the outcome variable. While the date of death was available from the NPHS, information on the date of onset or diagnosis of heart disease (n=437) was not. Therefore, the dependent variable (a reported diagnosis of heart disease or death attributed to ischemic heart disease) was defined as a dichotomous variable, and logistic regression was used to model its relationship to the selected covariates.

The four-year follow-up interval, 1994/95 to 1998/99, may be too brief for the full effect of associations between variables to emerge. Also, excluding 159 deaths for which data on cause of death were not yet available limited the statistical power of the analysis. Because ischemic heart disease is a major cause of death, it is likely that a substantial number of the excluded cases were due to heart disease. For these reasons, the analysis may underestimate associations that would appear over a longer period, or when more complete data become available.

Family history of heart disease is an important risk factor. However, unlike the data for all other independent variables, which were collected in 1994/95, data on family medical history were not collected until 1998/99. Therefore, this information might be subject to recall bias, which might partially account for the strong association observed between family medical history and a new diagnosis of heart disease. Recall bias would occur if people reporting a diagnosis of heart disease were more likely to recall a family history of such problems, compared with people not reporting heart disease. Because data on family medical history were not collected until cycle 3, this information was not available for people who had died or who had moved into an institution by that time.

Not all factors known to be associated with incident heart disease could be examined. For example, the NPHS does not collect data on diet, aspirin use, or biological and physical measures such as blood lipids.

The data are self- (or proxy-) reported, and the degree to which they are biased because of reporting error is unknown. In particular, reporting error may affect the accuracy of information about socially sensitive behaviours, such as alcohol consumption or smoking. A tendency of heavy drinkers to underestimate alcohol consumption would contribute to misclassification and dilute associations between high alcohol use and heart disease. To minimize reporting error in data related to chronic conditions (including heart disease), respondents were instructed to report only conditions that had been "diagnosed by a health professional." However, reported diagnoses are not validated with clinical information. Validation studies of self-reports of a diagnosis of heart disease or other conditions made by a doctor have reported accuracy rates at levels of 80% and 84%.[40,41] It is not known what effect the wording "diagnosed by a health professional" (rather than a doctor) might have on the validity of the data.

NPHS respondents are asked if they have "heart disease," but no information is collected on the specific type. Therefore, while a reported diagnosis may refer to coronary artery disease, which has been protectively linked with alcohol consumption, it could also refer to other manifestations of heart disease, such as dilated cardiomyopathy, dysrhythmias and hypertensive cardiovascular disease, for which alcohol is a risk factor.[39,42] The need to use the all-inclusive report of "heart disease" as the dependent variable likely dilutes the estimate of association between alcohol and coronary artery disease.

Combining deaths attributed to heart disease with reported diagnoses of heart disease further contributes to the non-specificity of the outcome variable. Although it would have been preferable to limit the outcome to confirmed fatalities due to ischemic heart disease, the low number (42) precluded this option.

The failure of interaction terms to achieve statistical significance in multivariate regression may have been partially due to insufficient statistical power. For example, in a model of new heart disease or death due to heart disease for men, an interaction term between the variables occasional alcohol consumption and years of smoking fell just short of the designated significance level of 0.05 (odds ratio = 1.02; p = 0.06).

Finally, although a lively debate has emerged about the protective effects of wine compared with other alcoholic beverages,[33,43-45] no information on the type of alcohol consumed is available from the NPHS.

overweight, with a BMI in the 25.0-to-25.9 range, had significantly lower odds of a new diagnosis of heart disease, relative to women with a lower BMI. Even for women with a BMI of 30.0 or more, no positive association with heart disease emerged.

Previously published research indicates that being overweight is a major risk factor for heart disease and for death due to coronary heart disease; however, the follow-up period has usually been longer than four years. For example, in two major prospective studies, people were studied for 10 and 14 years, respectively.[46,47] Despite the shorter follow-up period for the NPHS, the findings for women were not anticipated. Further analysis of the NPHS data revealed that the negative association in women between BMI and subsequent heart disease diagnosis was most pronounced in the 55-to-69 age group (data not shown).

Research has firmly established smoking as a risk factor for heart disease.[22-24] In preliminary analysis of the NPHS data, unadjusted for the effects of other influences, there was a significant positive association between years of smoking and heart disease (data not shown). This finding underscored the importance of controlling for other variables, including smoking, when studying the association between heart disease and alcohol consumption. In full multivariate models, smoking was not significantly related to heart disease, possibly because of its correlation with other variables such as income, education, and the biomedical risk factors included. Interaction terms between smoking and level of alcohol use were explored, but because none was statistically significant, they were excluded from the final models (see *Limitations*).

The availability of information on hormone replacement therapy (HRT) from the NPHS is an advantage that has been lacking in previous research.[21] Because of the role that HRT may play in relation to heart disease, it is important to account for the influence of HRT in multivariate analysis. However, no significant association between heart disease and HRT was observed, perhaps because the analysis did not differentiate between users of estrogen alone and users of combined therapy, or perhaps because of insufficient statistical power (only 14% of women reported using HRT; Appendix Table A).

Concluding remarks

Longitudinal data from the National Population Health Survey indicate a protective relationship between moderate alcohol consumption and a subsequent diagnosis of or death attributed to heart disease—for women.

Compared with lifetime abstainers, women who, in 1994/95, reported that they had consumed two to nine drinks in the past week had less than half the odds of receiving a diagnosis of or dying from heart disease over the next four years. Furthermore, women who reported at least one drink during the past week but no more than two drinks on any day had lower odds of a subsequent diagnosis of heart disease or heart disease death, compared with women who had never had a drink. These associations persisted when controlling for the effects of other factors known to influence the risk of heart disease. Given the small size of the survey sample relative to other cohorts that have been studied, it is remarkable that an association between moderate alcohol consumption and heart disease in women emerged within only four years.

In addition to the small sample size, the short follow-up period of the NPHS longitudinal panel may partially explain the apparent lack of an association between level of alcohol consumption and heart disease in men. In previous studies reporting a protective effect of alcohol against heart disease, the period of study has usually been much longer than four years.[21,29-31,48] An exception was a much larger study of over 50,000 men in the United States: after only two years, a strong, inverse relationship emerged between level of alcohol consumption and coronary disease.[49]

The availability of data from future cycles of the NPHS will provide the opportunity for longer follow-up and further study of the relationship between alcohol consumption and subsequent health outcomes for both men and women. ●

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Appendix

Table A

Distribution of selected characteristics, female household population aged 40 or older with no diagnosis of heart disease, Canada excluding territories, 1994/95

	Sample size	Estimated population	
		'000	%
Total	**3,379**	**5,356**	**100.0**
Alcohol consumption†			
Lifetime abstainer (never drank)	486	694	13.0*
Former (1+ drink in lifetime, 0 in past year)	628	901	16.8*
Occasional (1+ drink in past year, 0 in past week)	1,101	1,749	32.7*
Light (1 drink in past week)	311	493	9.2
Moderate (2-9 drinks in past week)	726	1,303	24.3*
Heavy (10+ drinks in past week)	114	190	3.6*
Missing	13	26	0.5
Age group			
40-54	1,449	2,648	49.4
55-69	1,100	1,734	32.4
70+	830	974	18.2
Household income			
Lower	832	998	18.6
Upper	2,390	4,086	76.3
Missing	157	272	5.1
Education			
Less than secondary graduation	1,255	1,785	33.3
Secondary graduation or more	2,115	3,552	66.3
Missing	9	18	0.3
Self-perceived health			
Excellent/Very good/Good	2,832	4,569	85.3
Fair/Poor	547	787	14.7
Diabetes			
Yes	172	255	4.8
No	3,207	5,100	95.2
High blood pressure			
Yes	658	905	16.9
No	2,721	4,450	83.1
Family history of heart disease‡			
Yes	1,082	1,795	33.5
No	1,854	2,871	53.6
Missing	443	690	12.9
Leisure-time physical activity			
Inactive	2,167	3,413	63.7
Moderate/Active	1,147	1,796	33.5
Missing	65	147	2.7
Body mass index			
Acceptable (< 25.0)	1,733	2,747	51.3
Overweight (25.0-29.9)	1,037	1,693	31.6
Obese (30.0+)	547	812	15.2
Missing	62	104	1.9
Smoking			
Never	1,549	2,560	47.8
Former	1,028	1,584	29.6
Daily/Occasional	799	1,201	22.4
Missing	3	11	0.2
Hormone replacement therapy			
Yes	435	728	13.6
No	2,920	4,578	85.5
Missing	24	51	0.9

Data source: *1994/95, 1998/99 National Population Health Survey, longitudinal sample, Health file*

Note: *Because of rounding, detail may not add to totals.*

† Significance testing of differences between estimated values for men and women was carried out for alcohol consumption only (see Charts 1 and 2).

‡ Collected in 1998/99 only

** Significantly different from estimate for men in corresponding category (Table B)*

Table B

Distribution of selected characteristics, male household population aged 40 or older with no diagnosis of heart disease, Canada excluding territories, 1994/95

	Sample size	Estimated population	
		'000	%
Total	**2,635**	**4,900**	**100.0**
Alcohol consumption†			
Abstainer (never drank)	142	274	5.6
Former (1+ drink in lifetime, 0 in past year)	418	613	12.5
Occasional (1+ drink in past year, 0 in past week)	705	1,321	27.0
Light (1 drink in past week)	183	387	7.9
Moderate (2-14 drinks in past week)	948	1,861	38.0
Heavy (15+ drinks in past week)	221	401	8.2
Missing	18	42	0.9
Age group			
40-54	1,337	2,791	57.0
55-69	827	1,464	29.9
70+	471	644	13.2
Household income			
Lower	423	627	12.8
Upper	2,086	4,005	81.7
Missing	126	268	5.5
Education			
Less than secondary graduation	1,001	1,563	31.9
Secondary graduation or more	1,628	3,324	67.9
Missing	6	12	0.3
Self-perceived health			
Excellent/Very good/Good	2,248	4,343	88.6
Fair/Poor	387	557	11.4
Diabetes			
Yes	136	239	4.9
No	2,499	4,661	95.1
High blood pressure			
Yes	362	591	12.1
No	2,273	4,309	87.9
Family history of heart disease‡			
Yes	940	1,854	37.8
No	1,139	2,111	43.1
Missing	556	935	19.1
Leisure-time physical activity			
Inactive	1,490	1,811	37.0
Moderate/Active	958	2,683	54.8
Missing	187	406	8.3
Body mass index			
Acceptable (< 25.0)	956	1,829	37.3
Overweight (25.0-29.9)	1,255	2,287	46.7
Obese (30.0+)	408	753	15.4
Missing	16	30	0.6
Smoking			
Never	632	1,465	29.9
Former	1,219	2,181	44.5
Daily/Occasional	783	1,249	25.5
Missing	1	5	0.1

Data source: *1994/95, 1998/99 National Population Health Survey, longitudinal sample, Health file*

Note: *Because of rounding, detail may not add to totals.*

† Significance testing of differences between estimated values for men and women was carried out for alcohol consumption only (see Charts 1 and 2).

‡ Collected in 1998/99 only

Table C
Leading causes of death, population aged 40 or older, by sex, Canada, 1998

Cause of death (ICD-9 code)	Number of deaths	
	Women	Men
Ischemic heart disease (410-414)	19,306	23,541
Cancer of trachea, bronchus or lung (162)	6,188	9,964
Cerebrovascular disease (430-438)	9,074	6,416
Chronic obstructive pulmonary disease (490-496)	4,188	5,800
Pneumonia and influenza (480-487)	4,936	4,032
Breast cancer (174)	4,720	…
Prostate cancer (185)	…	3,664
Colorectal cancer (153, 154)	3,013	3,325
Diabetes (250)	2,842	2,844
Suicide (E950-E959)	†	1,501
Accidental falls (E833-E835, E880-E888)	1,472	1,055
Alzheimer's disease (331.0)	1,914	‡

Data source: *Canadian Vital Statistics Database*
† Did not rank in top 10 causes for women
‡ Did not rank in top 10 causes for men
… Not applicable

Table D
Percentage of women aged 40 or older with no diagnosis of heart disease in 1994/95 who reported new diagnosis of or died from heart disease, by selected characteristics in 1994/95, household population, Canada excluding territories, 1994/95 to 1998/99

	Estimated population	
	'000	%
Total	**374**	**7.0**
Alcohol consumption		
Lifetime abstainer (never drank)†	77E1	11.1E1
Former (1+ drink in lifetime, 0 in past year)	125E1	13.9E1
Occasional (1+ drink in past year, 0 in past week)	105E1	6.0E1
Light (1 drink in past week)	21E2	4.3*E2
Moderate (2-9 drinks in past week)	37E2	2.8*E2
Heavy (10+ drinks in past week)	F	F
Age group		
40-54†	60E1	2.3E1
55-69	165	9.5*
70+	151	15.5*
Household income		
Lower	103E1	10.3E1
Upper†	248	6.1
Education		
Less than secondary graduation†	187	10.5
Secondary graduation or more	188	5.3*
Self-perceived health		
Excellent/Very Good/Good	244	5.4*
Fair/Poor†	131E1	16.7E1
Diabetes		
Yes	F	23.0*E2
No†	317	6.2
High blood pressure		
Yes	116	12.8*
No†	259	5.8
Family history of heart disease‡		
Yes	269	9.4*
No†	53E1	3.0E1
Leisure-time physical activity		
Inactive†	277	8.1
Moderate/Active	77	4.3*
Body mass index		
Acceptable (< 25.0)†	208	7.6
Overweight (25.0-29.9)	94E1	5.5E1
Obese (30+)	64	7.9
Smoking		
Never†	207	8.1
Former	91	5.8
Daily/Occasional	68E1	5.7E1
Hormone replacement therapy		
Yes	35E2	4.8E2
No†	335	7.3

Data source: *1994/95, 1996/97 and 1998/99 National Population Health Survey, longitudinal sample, Health file*
Note: *Based on a sample of 3,379 women aged 40 or older in 1994/95.*
† Reference category
‡ Collected in 1998/99 only
E1 Coefficient of variation between 16.6% and 25.0%
E2 Coefficient of variation between 25.1% and 33.3%
F Coefficient of variation greater than 33.3%
** Significantly different from reference category (p < 0.05)*

Table E

Percentage of men aged 40 or older with no diagnosis of heart disease in 1994/95 who reported new diagnosis of or died from heart disease, by selected characteristics in 1994/95, household population, Canada excluding territories, 1994/95 to 1998/99

	Estimated population	
	'000	%
Total	**404**	**8.2**
Alcohol consumption		
Abstainer (never drank)†	F	F
Former (1+ drink in lifetime, 0 in past year)	64[E1]	10.4[E1]
Occasional (1+ drink in past year, 0 in past week)	118	8.9
Light (1 drink in past week)	41[E2]	10.5[E2]
Moderate (2-14 drinks in past week)	137	7.4
Heavy (15+ drinks in past week)	F	F
Age group		
40-54†	106[E1]	3.8[E1]
55-69	159	10.8*
70+	139	21.6*
Household income		
Lower	57[E1]	9.1[E1]
Upper†	316	7.9
Education		
Less than secondary graduation†	181	11.6
Secondary graduation or more	219	6.6*
Self-perceived health		
Excellent/Very Good/Good	331	7.6*
Fair/Poor†	73[E1]	13.0
Diabetes		
Yes	55[E1]	23.2*[E1]
No†	348	7.5
High blood pressure		
Yes	82	13.8*
No†	322	7.5
Family history of heart disease‡		
Yes	197	9.3*
No†	50[E1]	2.7[E1]
Leisure-time physical activity		
Inactive†	265	9.9
Moderate/Active	108	5.9*
Body mass index		
Acceptable (< 25.0)†	120	6.6
Overweight (25.0-29.9)	203	8.9
Obese (30+)	74[E1]	9.9[E1]
Smoking		
Never†	80[E1]	6.4
Former	213	9.8
Daily/Occasional	111	7.6

Data source: *1994/95, 1996/97 and 1998/99 National Population Health Survey, longitudinal sample, Health file*
Note: *Based on a sample of 2,635 men aged 40 or older in 1994/95.*
† Reference category
‡ Collected in 1998/99 only
E1 Coefficient of variation between 16.6% and 25.0%
E2 Coefficient of variation between 25.1% and 33.3%
F Coefficient of variation greater than 33.3%
** Significantly different from reference category (p < 0.05)*

Table F

Adjusted odds ratios for new diagnosis of or death due to heart disease among women aged 40 or older with no diagnosis of heart disease in 1994/95, by drinking pattern and selected characteristics in 1994/95, household population, Canada excluding territories, 1994/95 to 1998/99

	Odds ratio	95% confidence interval
Drinking pattern		
Lifetime abstainer (never drank)†	1.0	...
Former (1+ drink in lifetime, 0 in past year)	1.2	0.7, 2.1
Occasional (1 drink in past year, 0 in past week)	0.7	0.4, 1.3
Within recommended daily limit (1+ drink in past week, no more than 2 drinks/day in past week)	0.4*	0.2, 0.9
Exceeded recommended daily limit (>2 drinks at least 1 day in past week)	0.7	0.3, 1.5
Age group		
40-54†	1.0	...
55-69	3.4*	2.0, 5.8
70+	5.8*	3.4,10.0
Household income		
Lower	0.9	0.6, 1.4
Upper†	1.0	...
Education		
Less than secondary graduation†	1.0	...
Secondary graduation or more	0.8	0.5, 1.2
Self-perceived health		
Excellent/Very good/Good	0.4*	0.3, 0.7
Fair/Poor†	1.0	...
Diabetes‡	1.9	1.0, 3.9
High blood pressure‡	1.2	0.8, 1.9
Family history of heart disease‡§	3.5*	2.0, 6.1
Leisure-time physical activity		
Inactive†	1.0	...
Moderate/Active	0.5*	0.4, 0.8
Body mass index		
Acceptable (< 25.0)†	1.0	...
Overweight (25.0-29.9)	0.6*	0.4, 0.9
Obese (30+)	0.7	0.5, 1.2
Years of daily smoking	1.0	1.0, 1.0
Hormone replacement therapy		
Yes	0.9	0.5, 1.7
No†	1.0	...

Data source: *1994/95, 1996/97, 1998/99 National Population Health Survey, longitudinal sample, Health file*
Notes: *Based on a sample of 3,346 women; 33 were excluded because of missing values. "Unknown" categories for household income, education, family history of heart disease, leisure-time physical activity, body mass index and hormone replacement therapy were included in the model, but their odds ratios are not shown.*
† Reference category
‡ Reference category is absence of condition
§ Collected in 1998/99 only
** Significantly different from reference category (p < 0.05)*
··· Not applicable

Table G

Adjusted odds ratios for new diagnosis of or death due to heart disease among men aged 40 or older with no diagnosis of heart disease in 1994/95, by drinking pattern and selected characteristics in 1994/95, household population, Canada excluding territories, 1994/95 to 1998/99

	Odds ratio	95% confidence interval
Drinking pattern		
Abstainer (lifetime abstainers and former drinkers who never regularly drank >12 drinks/week)†	1.0	...
Former (at some time regularly drank > 12 drinks/ week, 0 in past year)	1.8	0.8, 4.3
Occasional (1 drink in past year, 0 in past week)	1.5	0.8, 2.7
Within recommended daily limit (1+ drink in past week, no more than 2 drinks/day)	1.8	1.0, 3.6
Exceeded recommended daily limit (> 2 drinks at least 1 day in past week)	0.9	0.5, 1.9
Age group		
40-54†	1.0	...
55-69	2.1*	1.3, 3.4
70+	3.9*	2.2, 6.9
Household income		
Lower	0.9	0.5, 1.4
Upper†	1.0	...
Education		
Less than secondary graduation†	1.0	...
Secondary graduation or more	0.9	0.5, 1.4
Self-perceived health		
Excellent/Very good/Good	1.0	0.6, 1.7
Fair/Poor†	1.0	...
Diabetes‡	2.3*	1.2, 4.8
High blood pressure‡	1.4	0.8, 2.2
Family history of heart disease†§	3.7*	2.2, 6.4
Leisure-time physical activity		
Inactive†	1.0	...
Moderate/Active	0.6*	0.4, 0.9
Body mass index		
Acceptable (< 25.0)†	1.0	...
Overweight (25.0-29.9)	1.5	1.0, 2.2
Obese (30.0+)	1.8*	1.0, 3.0
Years of daily smoking	1.0	1.0, 1.0

Data source: *1994/95, 1996/97, 1998/99 National Population Health Survey, longitudinal sample, Health file*

Notes: *Based on a sample of 2,585 men; 50 were excluded because of missing values. "Unknown" categories for household income, education, family history of heart disease, leisure-time physical activity, body mass index were included in the model, but their odds ratios are not shown. Because of rounding, some confidence intervals with 1.0 as lower/upper limit are significant.*

† Reference category

‡ Reference category is absence of condition.

§ Collected in 1998/99 only

** Significantly different from reference category (p < 0.05)*

··· Not applicable