

Heart disease, family history and physical activity

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Abstract

Objectives

This article examines the association of family history of heart disease and leisure-time physical activity with incident heart disease.

Data source

The data are from the 1994/95, 1996/97 and 1998/99 longitudinal household components of Statistics Canada's National Population Health Survey. This study is based on information provided by 9,255 respondents aged 20 or older who reported that, in 1994/95, they were free of diagnosed heart disease and in good health.

Analytical techniques

Multiple logistic regression was used to estimate the association of family history and physical activity with a new diagnosis of heart disease, while controlling for age, sex, educational attainment, smoking, high blood pressure, diabetes, and body mass index.

Main results

When family history and other risk factors were taken into account, people who, in 1994/95, engaged in regular physical activity at a moderate level or beyond had lower odds of receiving a new diagnosis of heart disease than did sedentary individuals. People with a family history of heart disease who regularly participated in at least moderate physical activity had lower odds of developing heart disease than did their sedentary counterparts.

Key words

exercise, family health, longitudinal studies

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Canada, like many developed countries, has experienced a steady decline in mortality due to heart disease over the past several decades. The decrease has been attributed to improvements in nutrition, exercise and other health habits, as well as to medical management.¹⁻³ Despite falling mortality rates, heart disease remains a leading cause of death.¹⁻³ In 1997, heart disease was the second leading cause of death for Canadian men and women, behind cancer.⁴

To prevent or delay the onset of heart disease, health promotion programs advocate increasing the level of physical activity.^{5,6} Several studies have shown that regular physical activity confers major heart health benefits and that inactivity is a major risk factor for heart disease.⁷⁻¹⁷

For a number of years, researchers have focused on the role family history plays in heart disease (see *Family history*). Accumulating evidence indicates that family history is associated with increased risk of heart disease, even when controlling for other risk factors, such as serum lipids, blood pressure, diabetes, obesity and social class, and shared behaviours, including cigarette smoking, alcohol use and diet.¹⁸⁻²⁰ Nevertheless, several studies have concluded that

there is much to learn about genetic susceptibility and its interaction with lifestyle, behaviour, and environmental exposures.^{3,18-28}

This article examines the association of a new diagnosis of heart disease with a family history of heart disease (presence of the condition in at least one first-degree relative) and leisure-time physical activity (see *Methods*, *Limitations* and *Definitions*). The analysis focuses on the household population of

adults who were in good health and did not have diagnosed heart disease in 1994/95. The results control for the effects of sex, age, education, household income, smoking status, high blood pressure, diabetes, and body mass index, family history of heart disease and physical inactivity. Further analysis explores the relationship between physical activity and incident heart disease among only those with a family history of heart disease.

Methods

Data source

The analysis is based on longitudinal data from Statistics Canada's National Population Health Survey (NPHS), weighted to represent the household population in the 10 provinces in 1994. 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 living on Indian reserves, on Canadian Forces bases, and in some remote areas. The NPHS has both a longitudinal and a cross-sectional component. Respondents who are part of the longitudinal component will be followed for up to 20 years.

The data used for this analysis are from the first three NPHS cycles: 1994/95, 1996/97 and 1998/99. Of the 17,626 randomly selected respondents in 1994/95, 14,786 were eligible members of the longitudinal panel, along with 468 persons for whom only general information was collected. An additional 2,022 of the 2,383 randomly selected respondents under age 12 were also eligible for the longitudinal panel. Thus, 17,276 respondents 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 1998/99.²⁹

This study is based on information collected from the 9,255 respondents aged 20 or older who reported in 1994/95 that they were in good, very good or excellent health and who had not been told by a health professional that they had heart disease (Appendix Table A). People younger than 20 were excluded because of the low incidence of heart disease in this age group. As well, individuals who reported their health as fair or poor in 1994/95 were excluded to minimize selection bias due to pre-clinical, undiagnosed heart disease that may have resulted in a low level of physical activity.⁹

Further analysis focuses on the 3,936 respondents from the sample

described above who reported that one or both birth parent(s) and/or any biological sibling(s) had ever had heart disease (Appendix Table A).

Analytical techniques

The incidence rate of heart disease was calculated by dividing the sum of newly reported cases of heart disease by the amount of person-time of follow-up contributed by respondents.³⁰⁻³² Person-time of follow-up accumulated from the time of the survey interview in 1994/95 until a new diagnosis of heart disease was reported in 1996/97 or 1998/99, or until the end of the follow-up period in 1998/99. For example, people who reported in 1996/97 that they had been diagnosed with heart disease were considered to have contributed one unit of person-time. Because information was collected every two years, the unit of person-time in this study represents a two-year interval, and thus, the rate is a two-year incidence rate. Individuals who died or who were institutionalized at follow-up were excluded from the analysis because information on family history was not available.

Multivariate pooled logistic regression was used to study the relationships of family history of heart disease and physical activity with a new diagnosis of heart disease, while controlling for other known risk factors.^{15,32} The control variables were: sex, age, education, smoking status, high blood pressure, diabetes and body mass index.

For all independent variables except family history of heart disease, data from the 1994/95 interview were used. Information on family history of heart disease was collected in 1998/99 only (see *Limitations*).

To account for survey design effects, standard errors and coefficients of variation were estimated with the bootstrap resampling technique.³³

Family history, inactivity raise likelihood of heart disease

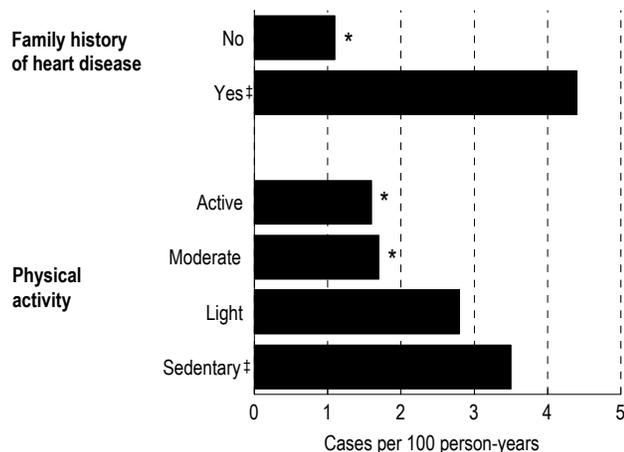
People aged 20 or older with a family history of heart disease were more likely than those with no such family history to receive a new diagnosis of the condition sometime between 1994/95 and 1998/99. The age-adjusted two-year incidence of heart disease was 4 cases per 100 person-years for those with a family history, compared with 1 case per 100 person-years for those with no family history (Chart 1).

The risk of heart disease was also lower at higher levels of physical activity. Among people who were sedentary in their leisure time, the two-year incidence of heart disease was almost twice that of individuals who were at least moderately active.

As expected, heart disease incidence also varied by age, educational attainment, smoking status, presence of high blood pressure or diabetes, and body mass index (Table 1). Many of these factors are, of course, interrelated. However, even when the effects of these risk factors were taken into

Chart 1

Age-adjusted two-year incidence of heart disease, by family history of heart disease and physical activity, household population aged 20 or older,[†] Canada excluding territories, 1994/95 to 1998/99



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

[†] Population with no diagnosis of heart disease and good health in 1994/95

[‡] Reference category

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

account, the association between a new diagnosis of heart disease and a family history of heart disease persisted. That is, individuals with no family history of heart disease had about one-quarter the odds of developing the condition, compared with people

Table 1

Two-year incidence of heart disease, by selected characteristics, household population aged 20 or older,[†] Canada excluding territories, 1994/95 to 1998/99

	Incidence Cases per 100 person-years	95% confidence interval
Total	2.60	2.17, 3.03
Sex		
Men	2.80	2.08, 3.51
Women [‡]	2.41	1.88, 2.94
Age group		
20-64 [‡]	1.81	1.39, 2.23
65+	9.22*	7.13, 11.32
Family history		
Parent(s)/Sibling(s) with heart disease [‡]	4.69	3.73, 5.66
Parent(s)/Sibling(s) without heart disease	0.94*	0.65, 1.23
Missing	2.72*	1.53, 3.90
Physical activity		
Active	1.68*	1.09, 2.27
Moderate	1.69*	1.10, 2.28
Light	2.83	1.81, 3.85
Sedentary [‡]	3.36	2.49, 4.23
Educational attainment		
Less than high school graduation	4.69*	3.50, 5.87
High school graduation/Some postsecondary	2.16	1.49, 2.84
Postsecondary graduation [‡]	1.94	1.43, 2.45
Smoking status		
Current (daily/occasional)	2.40	1.55, 3.26
Former	3.31*	2.54, 4.09
Never [‡]	2.13	1.51, 2.74
High blood pressure		
Yes	6.87*	4.80, 8.95
No [‡]	2.26	1.82, 2.70
Diabetes		
Yes	9.63*	4.40, 14.86
No [‡]	2.46	2.03, 2.88
Body mass index (BMI)		
Overweight (BMI > 27)	3.92*	2.69, 5.15
Not overweight (BMI ≤ 27) [‡]	2.06	1.68, 2.43

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

[†] Population with no diagnosis of heart disease and good health in 1994/95

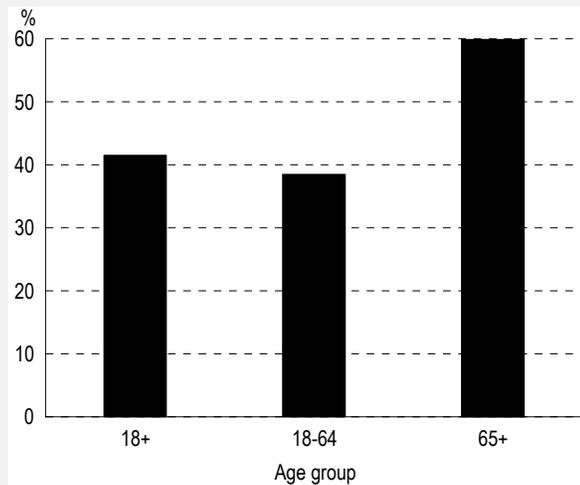
[‡] Reference category

* Significantly different from value for reference category ($p < 0.05$)

Family history

National Population Health Survey (NPHS) data representing the entire household population show that the percentage of people with a family history of heart disease is appreciable. In 1998/99, about 42% of the population aged 18 or older reported a family history of heart disease. The age of onset of heart disease and the number of first-degree relatives affected were not available from the NPHS.

Percentage of household population with family history of heart disease, by age group, Canada excluding territories, 1998/99



Data source: 1998/99 National Population Health Survey, cross-sectional sample, Health file

who did have a family history of heart disease (Table 2).

Moreover, the effect of physical activity on incident heart disease persisted even when family history was taken into account. The odds of developing heart disease were significantly lower for people who were active or moderately active during their leisure-time, compared with those who were sedentary. This is consistent with previous studies showing that regular physical activity, even at a moderate level of energy expenditure, is beneficial to heart health.⁷⁻¹⁵

Not surprisingly, the odds of developing heart disease increased with age. As well, individuals who were overweight had higher odds of a new diagnosis of heart disease, compared with those who were not overweight.

Table 2

Adjusted odds ratios for newly diagnosed heart disease, by selected characteristics, household population aged 20 or older,[†] Canada excluding territories, 1994/95 to 1998/99

	Odds ratio	95% confidence interval
Sex		
Men	1.29	0.87, 1.91
Women [‡]	1.00	...
Age (in years)[§]		
	1.05 *	1.04, 1.07
Family history		
Parent(s)/Sibling(s) with heart disease [‡]	1.00	...
Parent(s)/Sibling(s) without heart disease	0.28 *	0.18, 0.43
Physical activity		
Active	0.44 *	0.26, 0.73
Moderate	0.52 *	0.32, 0.84
Light	0.78	0.46, 1.30
Sedentary [‡]	1.00	...
Educational attainment		
Less than high school graduation	1.23	0.82, 1.86
High school graduation/Some postsecondary	0.95	0.59, 1.51
Postsecondary graduation [‡]	1.00	...
Smoking status		
Current (daily/occasional)	1.34	0.81, 2.20
Former	1.22	0.83, 1.79
Never [‡]	1.00	...
High blood pressure		
Yes	1.15	0.71, 1.84
No [‡]	1.00	...
Diabetes		
Yes	1.71	0.75, 3.92
No [‡]	1.00	...
Body mass index (BMI)		
Overweight (BMI > 27)	1.62 *	1.06, 2.49
Not overweight (BMI ≤ 27) [‡]	1.00	...

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

[†] Population with no diagnosis of heart disease and good health in 1994/95

[‡] Reference category, for which odds ratio is always 1.00

[§] Treated as a continuous variable

* $p < 0.05$

... Not applicable

Exercise beneficial, even with family history

NPHS data suggest that physical activity has heart health benefits for people with a family history of heart disease. When the other factors were taken into consideration, for this group, the odds of being diagnosed with heart disease at some point between 1994/95 and 1998/99 were lower for people who

Table 3

Adjusted odds ratios for newly diagnosed heart disease, by selected characteristics, household population aged 20 or older† with family history of heart disease, Canada excluding territories, 1994/95 to 1998/99

	Odds ratio	95% confidence interval
Sex		
Men	1.46	0.96, 2.23
Women‡	1.00	...
Age (in years)§	1.06 *	1.04, 1.08
Physical activity		
Active	0.44 *	0.24, 0.81
Moderate	0.46 *	0.27, 0.80
Light	0.66	0.35, 1.24
Sedentary‡	1.00	...
Educational attainment		
Less than high school graduation	1.32	0.83, 2.12
High school graduation/Some postsecondary	0.92	0.51, 1.66
Postsecondary graduation‡	1.00	...
Smoking status		
Current (daily/occasional)	1.10	0.61, 1.97
Former	0.94	0.61, 1.46
Never‡	1.00	...
High blood pressure		
Yes	0.82	0.48, 1.41
No‡	1.00	...
Diabetes		
Yes	1.57	0.63, 3.94
No‡	1.00	...
Body mass index (BMI)		
Overweight (BMI > 27)	1.60	0.96, 2.67
Not overweight (BMI ≤ 27)‡	1.00	...

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

† Population with no diagnosis of heart disease and good health in 1994/95

‡ Reference category, for which odds ratio is always 1.00

§ Treated as a continuous variable

* $p < 0.05$

... Not applicable

engaged in active or moderate physical activity, compared with those who were sedentary during leisure time (Table 3).

Concluding remarks

This analysis, based on longitudinal data from the first three cycles of the National Population Health Survey, is consistent with clinical and epidemiological observations indicating that people with a family history of heart disease have higher odds of developing the condition than people who do not

Limitations

National Population Health Survey (NPHS) data are self- or proxy-reported, and the degree to which they are inaccurate because of reporting error is unknown. Although respondents were asked if heart disease or other chronic conditions had been diagnosed by a health professional, there was no independent source to confirm diagnosis. Nor was family history of heart disease validated through medical record review.

In this analysis, as is commonly done, family history of heart disease is defined as the presence of the condition in any first-degree relative; that is, biological parent(s) and/or biological sibling(s). The age at onset and the number of first-degree relatives would have been useful in a definition of family history,³⁴⁻³⁷ but this information is not available from the NPHS. To explore the association between family history and early onset of heart disease, additional analysis was performed with the sample restricted to respondents aged 20 to 64. The independent associations between family history and physical activity with a new diagnosis of heart disease persisted (Appendix Table B). For this group, risk factors associated with increased odds of developing premature heart disease also included age, current smoking, diabetes, and overweight.

A substantial number (707) of the sample respondents reported that they did not know if their parents and/or siblings had a history of heart disease. These respondents, who tended to have a higher incidence of heart disease than respondents without a family history of heart disease (Appendix Table A), were excluded from the first analysis (Table 2). However, additional analysis showed that the independent associations of family history and physical activity with incident heart disease emerged even when the 707 respondents who did not provide information on family history were included and categorized as having no family history of heart disease (Appendix Table C).

Research indicates that direct assessments of physical fitness may yield more accurate measurements of activity levels than self-reports.³⁸ Self-reported physical activity may be susceptible to misclassification, which tends to underestimate the true association.^{12,17,39} But, despite this possible attenuation, self-reported physical activity remained associated with reduced odds of developing heart disease when family history and other potential risk factors were controlled.

Although individuals may expend considerable energy at work or while doing household chores, information on non-leisure time physical activity is not available from the NPHS. However, a recent study indicates that the inverse association between physical activity and cardiovascular disease mortality was even *stronger* in women when total energy expenditure was based on both leisure- and non-leisure activities.⁴⁰

Body mass index based on self-reported weight and height may be somewhat inaccurate, especially for people aged 65 or older.

Definitions

In the 1994/95, 1996/97 and 1998/99 cycles of the 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 to be expected to last six months or more and that have been diagnosed by a health professional." An interviewer read a list of conditions, which included heart disease, high blood pressure and diabetes.

The incidence rate of heart disease was defined as the reported number of new diagnoses of heart disease among respondents who, in 1994/95, reported that they had not been diagnosed with heart disease by a health care professional. The incidence rate had as its numerator the number of new cases that accumulated over the four-year period between 1994/95 and 1998/99, and as its denominator the number of person-years contributed by the population who were at risk over the four-year period of follow-up. Rates were expressed as cases per 100 person-years in each two-year interval.

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.

The level (or amount) of physical activity was based on total energy expenditure (EE) during leisure time. Information about energy expenditure at work was not available. Values for energy expenditure were calculated using information on the frequency and duration of respondents' reported leisure-time activities in the previous three months, as well as the metabolic energy demand (MET) of each of these activities. The MET value is the metabolic cost (oxygen consumption) of physical activity. NPHS respondents were not asked to specify the intensity of their activities, since individuals tend to overestimate this aspect of physical activity. The MET values, which correspond to the low intensity value of each type of reported activity,

were independently established and provided by the Canadian Fitness and Lifestyle Research Institute.⁴¹

$$EE = \sum(N_i * D_i * MET_i / 365 \text{ days}), \text{ where}$$

N_i = number of occasions of activity i in a year,

D_i = average duration in hours of activity i , and

MET_i = a constant value for metabolic energy requirement of activity i .

EE was expressed as total kilocalories expended per kilogram of body weight per day (kcal/kg/day or KKD).

Frequency of physical activity was based on the number of times in the previous three months that respondents had participated in a physical activity for more than 15 minutes. Categories were defined as regular (12 or more times per month) or irregular (11 or fewer times per month).

Four *physical activity* categories were defined:⁴¹

- Active: 3 or more KKD of regular activity
- Moderate: 1.5 to 2.9 KKD of regular activity
- Light: under 1.5 KKD of regular activity
- Sedentary: irregular activity regardless of EE

Age (in years) was defined as a continuous variable in all analytical models. For descriptive analysis, age was grouped as: 20 to 64 and 65 or older (Table 1; Appendix Table A).

Educational attainment was categorized as less than high school graduation; high school graduation/some postsecondary; and postsecondary graduation.

Smoking status was determined by asking individuals if they smoked cigarettes daily, occasionally, or not at all. Three groups were established: current (daily and occasional), former, and never smokers.

Body mass index (BMI), which was calculated by dividing weight in kilograms by the square of height in metres, was grouped into two categories: overweight (a BMI of more than 27) and not overweight (a BMI of 27 or less).⁴²

have such a history. The extent to which the genetic component of the familial risk, as opposed to acquired risk factors such as diet or smoking, contributes to the risk of heart disease could not be addressed in this analysis. Nevertheless, the excess incidence of heart disease among individuals with a family history of the condition may be attributable both to genetic and to other risk factors.^{3,18,19,27,43}

The findings based on the NPHS also provide suggestive evidence that, even among people with a family history of heart disease, physical activity confers some protection against its development. This is in line with other studies suggesting that, through participation in physical activity, people with a family history of heart disease may be able to prevent or delay its onset.^{25,37} ●

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Appendix

Table A

Characteristics of household population aged 20 or older with no diagnosis of heart disease and good health, Canada excluding territories, 1994/95

	Sample size	Estimated population	
		'000	%
Total	9,255	17,056	100
Sex			
Men	4,162	8,437	49
Women	5,093	8,620	51
Age group			
20-64	7,917	15,235	89
65+	1,338	1,822	11
Family history			
Parent(s)/Sibling(s) with heart disease	3,936	6,849	40
Parent(s)/Sibling(s) without heart disease	4,612	8,739	51
Missing	707	1,468	9
Physical activity			
Active	1,548	2,798	16
Moderate	1,991	3,558	21
Light	1,451	2,559	15
Sedentary	3,882	7,284	43
Missing	383	858	5
Educational attainment			
Less than high school graduation	2,192	3,511	21
Secondary graduation/Some postsecondary	3,871	7,333	43
Postsecondary graduation	3,180	6,188	36
Missing	12	24	0
Smoking status			
Current (daily/occasional)	2,851	5,091	30
Former	2,922	5,241	31
Never	3,478	6,708	39
Missing	4	16	0
High blood pressure			
Yes	804	1,265	7
No	8,451	15,792	93
Diabetes			
Yes	191	348	2
No	9,064	16,709	98
Body mass index (BMI)			
Overweight (BMI > 27)	2,778	4,891	29
Not overweight (BMI ≤ 27)	6,253	11,762	69
Missing	224	404	2

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

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

Table B

Adjusted odds ratios for newly diagnosed heart disease, by selected characteristics, household population aged 20 to 64,† Canada excluding territories, 1994/95 to 1998/99

	Odds ratio	95% confidence interval
Sex		
Men	1.35	0.82, 2.22
Women‡	1.00	...
Age (in years)§	1.05*	1.03, 1.08
Family history		
Parent(s)/Sibling(s) with heart disease‡	1.00	...
Parent(s)/Sibling(s) without heart disease	0.32*	0.18, 0.57
Physical activity		
Active	0.37*	0.17, 0.80
Moderate	0.50*	0.27, 0.90
Light	0.90	0.47, 1.73
Sedentary‡	1.00	...
Educational attainment		
Less than high school graduation	0.93	0.53, 1.64
High school graduation/Some postsecondary	0.91	0.51, 1.61
Postsecondary graduation‡	1.00	...
Smoking status		
Current (daily/occasional)	2.18*	1.15, 4.14
Former	1.61	0.87, 2.88
Never‡	1.00	...
High blood pressure		
Yes	1.16	0.55, 2.42
No‡	1.00	...
Diabetes		
Yes	4.00*	1.26, 12.70
No‡	1.00	...
Body mass index (BMI)		
Overweight (BMI > 27)	1.98*	1.16, 3.37
Not overweight (BMI ≤ 27)‡	1.00	...

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

† Population with no diagnosis of heart disease and good health in 1994/95

‡ Reference category, for which odds ratio is always 1.00

§ Treated as a continuous variable

* $p < 0.05$

... Not applicable

Table C

Adjusted odds ratios for newly diagnosed heart disease, by selected characteristics, household population aged 20 or older† including those who did not respond to family history question, Canada excluding territories, 1994/95 to 1998/99

	Odds ratio	95% confidence interval
Sex		
Men	1.41	0.97, 2.04
Women‡	1.00	...
Age (in years)§		
	1.06 *	1.04, 1.07
Family history		
Parent(s)/Sibling(s) with heart disease‡	1.00	...
Parent(s)/Sibling(s) without heart disease	0.34 *	0.23, 0.48
Physical activity		
Active	0.52 *	0.33, 0.81
Moderate	0.47 *	0.30, 0.75
Light	0.78	0.48, 1.25
Sedentary‡	1.00	...
Educational attainment		
Less than high school graduation	1.21	0.81, 1.80
High school graduation/Some postsecondary	1.01	0.65, 1.56
Postsecondary graduation‡	1.00	...
Smoking status		
Current (daily/occasional)	1.51	0.96, 2.39
Former	1.24	0.85, 1.80
Never‡	1.00	...
High blood pressure		
Yes	1.25	0.77, 2.02
No‡	1.00	...
Diabetes		
Yes	1.63	0.75, 3.53
No‡	1.00	...
Body mass index (BMI)		
Overweight (BMI > 27)	1.60 *	1.07, 2.39
Not overweight (BMI ≤ 27)‡	1.00	...

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

Note: Respondents who did not provide information on family history were included and categorized as having no family history of heart disease.

† Population with no diagnosis of heart disease and good health in 1994/95

‡ Reference category, for which odds ratio is always 1.00

§ Treated as a continuous variable

* $p < 0.05$

... Not applicable