J Relig Health (2014) 53:141–156
DOI 10.1007/s10943-012-9609-6

ORIGINAL PAPER

The Relationship Between Religious Service Attendance and Coronary Heart Disease and Related Risk Factors in Saskatchewan, Canada

Ananya Tina Banerjee · Michael H. Boyle · Sonia S. Anand · Patricia H. Strachan · Mark Oremus

Published online: 11 May 2012

Abstract Research suggests that attending religious services could provide small yet important protective benefits against coronary heart disease (CHD) and CHD risk factors (e.g., diabetes, hypertension). The extent to which these benefits apply to Canada deserves study because approximately one-third of adult Canadians attend religious services at least monthly. Therefore, the objective of this study is to examine the association between frequency of religious service attendance and prevalence of (1) CHD, (2) diabetes, and (3) hypertension in Canada. We used the Saskatchewan sample ($n = 5{,}442$) of the Canadian Community Health Survey (CCHS-4.1) and built multivariable logistic regression models to evaluate associations between religious service attendance and self-reported CHD, diabetes, and hypertension. After controlling for demographic, socioeconomic and health behavior variables, the association between religious service attendance and prevalence of CHD was not significant (OR = 0.82; 95 % CI 0.61–1.11). However, persons who attended religious services more than once a week exhibited lower prevalence odds of diabetes (OR = 0.60; 95 % CI 0.45–0.80) and hypertension (OR = 0.82; 95 % CI 0.68–0.99) compared to persons who attended less than once a year. The findings of this

A. T. Banerjee (✉) · M. Oremus
Department of Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, ON, Canada
e-mail: banerjat@mcmaster.ca

M. Oremus
e-mail: oremusm@mcmaster.ca

M. H. Boyle
Department of Psychiatry and Behavioral Neurosciences, McMaster University, Hamilton, ON, Canada
e-mail: mboyle@mcmaster.ca

S. S. Anand
Department of Medicine, McMaster University, Hamilton, ON, Canada
e-mail: anands@mcmaster.ca

P. H. Strachan
School of Nursing, McMaster University, Hamilton, ON, Canada
e-mail: strachan@mcmaster.ca

study are the first to suggest religious service attendance may be associated with a lower prevalence of CHD risk factors in Canada.

Keywords Coronary heart disease · Diabetes · Hypertension · Religious service attendance · Canada

Background

Coronary heart disease (CHD) and the related risk factors of diabetes and hypertension are the leading causes of morbidity and mortality in Canada (PHAC 2005, 2009). There are a number of underlying determinants of CHD, diabetes, and high blood pressure. These determinants include a range of clinical (e.g., obesity and cholesterol), sociodemographic (e.g., income and ethnicity), and behavioral (e.g., exercise and diet) variables (Tanuseputro et al. 2003; Yusuf et al. 2004; Lee et al. 2009). Indicators of religion are equally important social determinants that have not been examined in Canadian studies of CHD and related risk factors.

The World Health Organization (WHO) Commission on Social Determinants of Health states that religion is a social determinant of health similar to income, gender, and ethnicity (Kelly et al. 2007) and identified in recent years as a potential influence on coronary health. In studies examining the relationship between different dimensions of religious involvement and health, associations have been stronger for religious attendance than for other dimensions such as spirituality or prayer (McCullough et al. 2000). In longitudinal studies, religious service attendance is inversely associated with CHD (Hummer et al. 1999; Oman et al. 2002; Goldbourt et al. 1993; King et al. 2001). For example, Hummer et al. (1999) examined data collected from 22,080 people participating in the eight-year follow-up study of the 1987 US National Health Interview Survey (NHIS). Compared with people who attended church more than once per week, people who did not attend church at all were 1.87 ($p < 0.001$) times as likely to die from cardiovascular disease (including CHD) after controlling for demographic variables such as age, gender, education, and ethnicity. This excess risk dropped slightly, but remained statistically significant, after controlling for health behaviors (e.g., cigarette smoking) and social ties (e.g., having friends to count on for help).

Oman et al. (2002) also found inverse associations between frequency of religious attendance and mortality from cardiovascular disease (including CHD) between 1965 and 1996 among 6,545 residents of Alameda County, California. Their results were similar to Hummer et al's longitudinal study. After adjusting for age and sex, Oman et al. found that infrequent religious service attendees (i.e., never or less than weekly) had significantly higher mortality from cardiovascular disease (including CHD) [hazard ratio = 1.41, $p < 0.0001$] compared to frequent attendees (i.e., greater than weekly). In models controlling for demographic (e.g., ethnicity, country of birth, age, education, income, and marital status), social support, and health behavior (e.g., smoking status, exercise level, and alcohol consumption) variables, infrequent attendees had higher rates of death from circulatory diseases (hazard ratio = 1.21, $p < 0.001$).

Oman et al. and with Hummer et al stated that their findings were partly due to enhanced social ties and improved health behaviors among frequent attendees. Frequent attendees had more social connections than infrequent attendees. These connections were characterized by close relatives and friends, as well as non-religious group membership (Oman et al. 2002).

The relationship between religious service attendance and diabetes has been studied less frequently. Hummer et al. (1999) reported that individuals who never attended religious

services were about 3.76 ($p < 0.05$) times more likely to die from diabetes compared to persons who attended more than once a week after controlling for age, gender, physical activity, and smoking. Studies examining an association between attendance at religious services and high blood pressure are rare and based on cross-sectional designs. Examined whether frequency of attendance at religious services is related to the prevalence of hypertension (blood pressure ≥140/90 mmHg) among 14,475 Americans participating in the Third National Health and Nutrition Examination Survey (NHANES III). After controlling for sociodemographic variables, respondent health status, and blood pressure treatment, weekly and more than weekly religious attendance versus non-attendance were associated with a significantly reduced prevalence of hypertension.

Overall, available research indicates that attending religious services could provide small yet protective benefits against CHD and related risk factors. There is evidence that better CHD outcomes for people who frequently attend religious services are explained partially by better health behaviors (physical activity and not smoking), which suggests that religious involvement may serve a general health promotion function (Oman et al. 2002). In this health promotion function, attending religious services could provide the impetus for people to engage in positive lifestyle and health behaviors that result in the reductions in risk for CHD, diabetes, and hypertension (e.g., via healthy diets, not smoking, and exercising) (Hummer et al. 1999; Oman et al. 2002).

No data exist on the association between frequency of religious attendance and the prevalence of CHD and related risk factors among Canadians. Studies from the United States are not necessarily generalizable to Canada, where the combined rate of weekly and monthly religious service attendance is approximately 32 %, compared to 40 % in the United States (Eagle 2011). Further, differences in health care between the United States and Canada, including greater reliance on private funding and for-private delivery, as well as markedly higher expenditures, in the United States, may result in different health outcomes (Ross et al. 2001).

Given the large numbers of people who are religiously active, the association between religious indicators, including religious service attendance, and CHD is relevant for many persons living in Canada. The large sample size of, and extensive data collected through, the 2007–2008 Canadian Community Health Survey (CCHS 4.1) provides a first and unique opportunity to examine the possible association between religious service attendance and CHD and related risk factors. The purpose of this study is to examine the association between the frequency of attending religious services and the prevalence of each of the following health conditions in Canada: (1) CHD; (2) diabetes; and (3) hypertension. We hypothesize that the frequency of attending religious services is inversely associated with the prevalence of each health condition.

Methodology

Data Source and Study Population

This study uses information collected in the Canadian Community Health Survey 2007/2008 (CCHS 4.1). The CCHS 4.1 contains nationally representative, cross-sectional data on health determinants, health status, and health system utilization (Statistics Canada 2007a). A detailed description of the survey design, sample, and interviewing procedures may be found elsewhere (Beland 2002).

In 2007, Statistics Canada included religion as optional content in CCHS 4.1. Saskatchewan and Nunavut were the only jurisdictions to ask Statistics Canada to administer the optional content on religion. Thus, our sample frame included only participants in Saskatchewan who were eligible to be asked the question on religious service attendance. Nunavut was excluded from this study because the sample size was small ($n = 350$) and drawn from a limited number of communities.

CCHS 4.1 contained 7,144 participants from Saskatchewan who were 18 and over. However, 1,629 (21.4 % of 7144) were deemed ineligible for our study because they identified no religious affiliation and were not asked about religious service attendance. Among the participants who were eligible to be asked this question by specifying a religious affiliation ($n = 5{,}515$), 73 (1.2 %) were missing data for ethnicity and health outcomes including CHD, diabetes, and hypertension and were removed from this study. The total sample was 5,442 for this study (see Fig. 1).

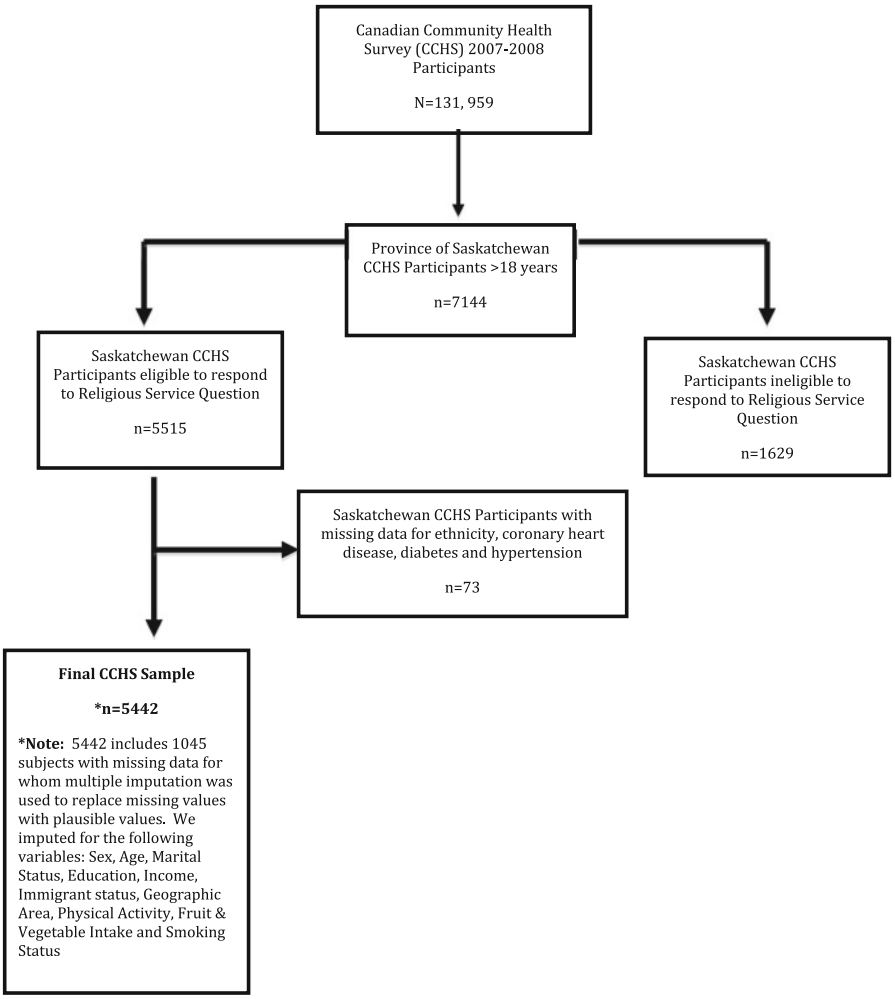

Fig. 1 Sample selection

Concepts and Measures

The main independent variable in this study is religious service attendance in the past 12 months. In CCHS 4.1, *religious service attendance* was assessed by asking participants, "Not counting events such as weddings or funerals, during the past 12 months, how often did you participate in religious activities or attend religious services or meetings?" Five response options were given, including *once a week or more, once a month, 3 or 4 times a year, once a year,* and *not at all*. Because this question is restricted to only worship services, overreporting of religious attendance is minimized (Statistics Canada 2007a). The responses were collapsed for the analyses in that *once a week or more* and *3 or 4 times a year/once a week* were dummy coded (took on a value of '1' if applicable or '0' if not applicable) while the responses *once a year/not at all* served as the reference category.

CCHS 4.1 interviewers assessed the prevalence of CHD, diabetes, and hypertension by asking, "Now I'd like to ask about certain chronic health conditions that have lasted 6 months or more and have been diagnosed by a health professional, do you have heart disease (or diabetes or high blood pressure)?" Participants answered *yes* (1) or *no* (0) separately for each condition.

We also included demographic, socioeconomic, and health behavior variables to serve as control variables in regression modeling. Selection of these variables was based on previous research (Hummer et al. 1999; Oman et al. 2002). The demographic variables were age, sex, marital status, immigrant status, ethnicity, and geographic area. Education and household income were the socioeconomic variables. Health behaviors included physical activity, fruit and vegetable consumption, and smoking status.

Analysis

Proportions and means were computed for all variables. Prior to modeling the associations between religious service attendance and the three health outcomes, we tested for potential moderating effects of age, sex, and ethnicity.

Four sequential multivariable models were used to assess the impact of potential confounding variables on the association between religious service attendance and CHD and related risk factors. Model building in the present study followed the order for predictor variables established in prior research (Hummer et al. 1999; Oman et al. 2002). The first model was unadjusted; the second model was adjusted for the demographic block, including age, sex, marital status, immigrant status, ethnicity, and geographic location; the third model adjusted for the demographic block and the socioeconomic block, including education and income; the fourth and "full" model adjusted for the demographic and socioeconomic blocks, along with the health behaviors block (physical activity, fruit and vegetable intake, and smoking status).

All statistical analyses were performed using SPSS v18 (IBM Corporation, Armonk, NY). We used multiple imputation to replace missing values with plausible values on sociodemographic and health behavior variables (Rubin 1987). Multiple imputations were conducted using an iterative Markov Chain Monte Carlo (MCMC) method in SPSS to impute for missed responses.

Statistics Canada produced a set of weights for use to analyze and present CCHS data in reports and publications (Statistics Canada 2007a). These weights correct for sample selection probabilities and non-response to approximate the distribution of demographic variables in the overall Canadian population. Household weights for the area frame and random digit-dialing frame were calculated separately and integrated to produce one set of

weights for the entire sample. Person-level adjustments were then applied to create person-level weights, followed by a combined post-stratification/seasonal adjustment step where the weights were post-stratified to projected population counts based on the most recent census (Statistics Canada 2009). The sampling weights developed by Statistics Canada were used to calculate all estimated regression coefficients.

Results

The *unweighted* characteristics of the demographic and health outcomes were compared between eligible ($n = 5{,}442$) and ineligible ($n = 1{,}629$) respondents to the question on religious service attendance in CCHS 4.1. Eligible respondents were significantly older (43.3 ± 18.3 vs. 48.1 ± 18.4, $p < 0.0001$) and less likely to be men (46.3 vs. 59.0 %, $p < 0.0001$). Further, respondents were more likely to be married (60.1 vs. 46.1 %, $p < 0.0001$), held Canadian citizenship (94.5 vs. 87.1 %, $p < 0.0001$), had higher education (61.3 vs. 52.9 %, $p < 0.0001$) and were diagnosed with CHD (5.8 vs. 4.4 %, $p = 0.02$) hypertension (25.4 vs. 18.53 %, $p < 0.0001$).

Table 1 presents the *weighted* sample characteristics of the 5,442 study participants living in Saskatchewan who were included in the analysis. The mean age was 48.1 years, and roughly half the participants were men (53.0 %). A majority of the sample was married (60.1 %), most had at least a post-secondary education (61.6 %), and almost all were White (97.2 %) and Canadian citizens (94.6 %). Approximately 27.4 % of the sample attended religious services more than once a week. The prevalence of CHD, diabetes, and hypertension was 5.9, 6.8, and 20.3 %, respectively. Some participants reported being very (21.3 %) or moderately (24.2 %) physically active. Reported fruit and vegetable intake was low, with 60.1 % of participants eating less than five servings per day. Approximately three-quarters of the sample did not smoke.

Gender, age, and ethnicity did not moderate the association between religious service attendance and CHD or related health outcomes. Therefore, interaction terms were not included in the multivariable models.

Tables 2, 3, and 4 show the multivariable adjusted effects of attending religious services on the prevalence of CHD, diabetes, and hypertension. The first model of Table 2 displays the crude odds ratio of CHD and religious service attendance. Those who attended more than once a week exhibited increased odds of prevalent CHD (OR = 1.56; 95 % CI 1.20–2.03; $p < 0.05$) compared to those who attended less than once a year. This association was not significant after adjusting for demographic (Model 2), socioeconomic (Model 3), and health behavior (Model 4) variables. Participants who attended 3–12 times a year had significantly lower odds of CHD (OR = 0.74; 95 % CI 0.55–0.99; $p < 0.05$) compared to those who attended less than once a year (Model 1). The association remained significant even after controlling for demographic variables (Model 2), but was not significant after, controlling for socioeconomic and health behavior variables.

In the initial model, there was no significant association between religious service attendance and the prevalence of diabetes (Table 3). However, after controlling for demographic variables in Model 2, participants who attended more than once a week had a significantly lower odds of prevalent diabetes (OR = 0.57; 95 CI% 0.43–0.75; $p < 0.05$) compared to those who attended less than once a year. The magnitude of this association did not alter and remained significant after controlling for socioeconomic and health behavior variables (Models 3 and 4). There was no significant association between

Table 1 Sample characteristics of final CCHS 4.1 sample for study ($n = 5,442$)—weighted

Variable	(%)
Age mean (SD)	48.1 (18.4)
Sex	
Male	53.0 %
Female	47.0 %
Marital status	
Married	60.1 %
Single/common law	25.9 %
Widowed/separated/divorced	14.0 %
Education	
Less than high school	18.9 %
High school	19.5 %
Post-secondary	61.6 %
Household income	
Less than $19,999	8.4 %
$20,000 to $29,999	9.4 %
$30,000 to $39,999	11.6 %
$40,000 to $49,999	10.5 %
$50,000 to $59,999	11.1 %
$60,000 to $79,999	16.5 %
Greater than $80,000	32.5 %
Immigrant status	
Canadian citizen	94.6 %
Immigrant	5.4 %
Ethnicity	
White	97.2 %
Non-white	2.8 %
Geographic area	
Urban	73.6 %
Rural	26.4 %
Health condition	
Coronary heart disease	5.9 %
Diabetes	6.8 %
Hypertension	20.3 %
Health behaviors	
Physical activity level	
Inactive	54.5 %
Moderately active	24.2 %
Active	21.3 %
Fruit and vegetable intake	
Less than 5 per day	60.1 %
5–10 per day	36.3 %
Greater than 10 per day	3.6 %
Smoking status	
Not at all	74.6 %

Table 1 continued

Variable	(%)
Occasionally	4.8 %
Daily	20.6 %
Frequency of religious service attendance	
Less than once a year	37.7 %
3–12 times a year	34.9 %
More than once a week	27.4 %

participants who attended 3–12 times a year and those who attended less than once a year across all models.

Attending religious services more than once a week was significantly positively associated with a higher prevalence of hypertension in Model 1 (Table 4). The association reversed direction and became negative after adjusting for demographic variables (OR = 0.81; 95 % CI 0.67–0.97; $p < 0.05$) in Model 2. This association remained negative and significant after further adjustment for socioeconomic and health behaviors (Model 3 and 4). There was no significant association between participants who attended 3–12 times a year and those who attended less than once a year across all models.

Discussion

Published data from other countries show that attending religious services is associated with a lower incidence or prevalence of CHD, diabetes, and hypertension (Hummer et al. 1999; Oman et al. 2002; Goldbourt et al. 1993; King et al. 2001; Koenig et al. 1998; Larson et al. 1998; Graham et al. 19781978; Gillium 2006). Since about one-third of adults in Canada attend religious services at least monthly (Statistics Canada 2009), this study was conducted to examine whether the relation between religious service attendance and these three health conditions holds in Canada. Overall, participants who attended religious services more than once a week had lower prevalent odds of CHD ($p > 0.05$), diabetes ($p < 0.05$), and hypertension ($p < 0.05$) compared to participants who attended less than once a year after adjustment for a number of demographic, socioeconomic, and health behavior factors. Previous studies showed people who attend places of worship more than once a week have a significantly lower risk of developing CHD (Hummer et al. 1999; Oman et al. 2002). Our results were consistent with these findings, but did not reach statistical significance at the 5 % level. Lack of power could be an issue because our power calculation was based on a one-tailed directional test to evaluate the hypothesis that frequent religious service attendance is associated with decreased prevalent odds of CHD.

To the best of our knowledge, no published studies exist to support our finding of a significant inverse association between religious service attendance and a lower prevalence of diabetes. However, published studies have been conducted to examine the association between religious service attendance and inflammatory markers among people with diabetes. King et al. (2002) examined the National Health and Nutrition Examination Survey III 1988–1994 and found that persons with diabetes who did not attend religious events were more likely than attendees with diabetes to have elevated C-reactive protein (CRP) after controlling for demographic variables, health status, smoking, social support,

Table 2 Odds ratio of coronary heart disease by frequency of religious service attendance—weighted

	Model 1	Model 2	Model 3	Model 4
Religious service attendance				
Less than once a year (ref)				
3–12 times a year	0.74 (0.55–0.99)*	0.72 (0.52–0.98)*	0.73 (0.53–.1.00)*	0.75 (0.55–1.03)
More than once a week	1.56 (1.20–2.03)*	0.819 (0.612–1.10)	0.80 (0.60–1.07)	0.82 (0.61–1.11)
Demographics				
Age		1.09 (1.08–1.10)*	1.08 (1.07–1.09)*	1.08 (1.07–1.09)*
Sex				
Male (ref)				
Female		1.30 (1.01–1.69)*	1.37 (1.06–1.78)*	1.35 (1.03–1.76)*
Marital status				
Married (ref)				
Single/common law		0.82 (0.52–1.30)	0.73 (0.46–1.16)	0.74 (0.46–1.18)
Separated/divorced/widowed		1.05 (0.78–1.42)	0.98 (0.72–1.34)	0.98 (0.71–1.35)
Immigrant status				
Canadian citizen (ref)				
Immigrant		0.57 (0.31–1.06)	0.569 (0.305–1.06)	0.58 (0.31–1.08)
Ethnicity				
White (ref)				
Non-white		1.51 (0.45–5.01)	1.51 (0.456–5.06)	1.52 (0.46–5.08)
Geographic area				
Urban (ref)				
Rural		0.98 (0.76–1.28)	0.97 (0.74–1.26)	0.96 (0.71–1.23)
Socioeconomic				
Education				
Less than high school (ref)				
High school			0.80 (0.53–1.20)	0.81 (0.54–1.21)
Post-secondary			1.00 (0.75–1.34)	1.03 (0.77–1.38)
Household income				
Less than $19,999 (ref)				
$20,000 to $29,999			1.05 (0.688–1.61)	1.05 (0.68–1.61)
$30,000 to $39,999			0.882 (0.566–1.37)	0.89 (0.57–1.39)
$40,000 to $49,999			0.499 (0.294–0.845)*	0.51 (0.30–0.86)*
$50,000 to $59,999			0.850 (0.517–1.40)	0.85 (0.52–1.41)
$60,000 to $79,999			0.874 (0.530–1.44)	0.90 (0.54–1.46)
Greater than $80,000			0.507 (0.300–0.858)*	0.51 (0.30–0.88)*
Health behaviors				
Physical activity				
Inactive (ref)				
Moderately active				0.85 (0.646–1.11)
Active				0.77 (0.49–0.89)*
Fruit and vegetable intake				
Less than 5 per day (ref)				
5–10 per day				1.01 (0.74–1.39)
Greater than 10 per day				0.74 (0.50–1.11)

Table 2 continued

	Model 1	Model 2	Model 3	Model 4
Smoking				
Not at all (ref)				
Occasionally				1.05 (0.89–1.09)
Daily				0.82 (0.76–1.03)

* $p < 0.05$

mobility. CRP is an acute inflammatory marker found among diabetic patients that increases their risk for cardiovascular disease (Morrow and Ridker 2000).

We found a significant negative association between attending religious services at least once a week and the prevalence of hypertension after controlling for several covariates that were not included in previous studies (e.g., physical activity and fruit and vegetable intake). Our finding is consistent with other older cross-sectional studies (Koenig et al. 1998; Larson et al. 1998; Graham et al. 1978; Gillium 2006).

Prior studies primarily dichotomize religious service attendance and focus on individuals who attend religious services more than once a week in comparison with individuals who do not attend at all. This study was able to assess the effects of attending religious services 3–12 times a year on the prevalence of CHD, and our findings show these individuals have a significantly lower prevalence of CHD compared to non-attenders, after adjusting for demographic factors. This finding highlights the importance of examining a linear trend for dose–response relations between religious service attendance and health outcomes. Health benefits may accrue to persons with moderate levels of religious service attendance. It is possible that individuals who attend religious services a few times a year do so during only stressful events. There is a growing body of literature that suggests people often turn to places of worship to cope with stressful situations (Ano and Vasconcelles 2005).

The socioecological model could explain the relation between religious service attendance and the lower prevalence of CHD and related risk factors. This model comprehensively integrates multiple levels of influence, for example, community, organizational, and institutional factors, and shows how they impact health behaviors and outcomes (Stokols 1996). Because many individuals spend a substantial amount of time in institutional settings, such as places of worship, institutional structures and processes in religious settings can have an impact on CHD, diabetes, and hypertension, as well as on health behaviors that might affect these three health conditions. While individuals are responsible for initiating and maintaining lifestyle changes necessary to reduce CHD risk and improve health, church attendance may expose individuals to organizational forces that affect their health behaviors. For example, positive health behaviors encouraged during religious services could be one mechanism through which attendance can affect CHD and related risk factors. Adherence to religious precepts can lead to indirect and formal prohibitions against specific risky behaviors (e.g., poor diet, smoking, alcohol consumption), as well as encouragement of behaviors that are conducive to health (e.g., regular physical activity, stress management). These distinctive patterns of lifestyle and health behaviors could indirectly result in lower prevalent rates of chronic and acute illness among people who attend religious institutions regularly (Chatters et al. 1998; Chatters 2000).

Table 3 Odds ratio for diabetes by frequency of religious service attendance—weighted

	Model 1	Model 2	Model 3	Model 4
Religious service attendance				
Less than once a year (ref)				
3–12 times a year	0.84 (0.66–1.08)	0.85 (0.657–1.09)	0.86 (0.66–1.11)	0.90 (0.69–1.16)
More than once a week	0.87 (0.67–1.13)	0.57 (0.431–0.752)*	0.56 (0.42–0.74)*	0.60 (0.45–0.80)*
Demographics				
Age/mean (SD)		1.05 (1.04–1.06)*	1.04 (1.03–1.05)*	1.04 (1.03–1.05)*
Sex				
Male (ref)				
Female		1.29 (1.03–1.61)*	1.33 (1.06–1.66)*	1.36 (1.08–1.72)*
Marital status				
Married (ref)				
Single/common law		0.80 (0.57–1.13)	0.69 (0.48–0.98)*	0.69 (0.48–0.99)*
Separated/divorced/widowed		0.89 (0.67–1.19)	0.79 (0.59–1.08)	0.79 (0.58–1.07)
Immigrant status				
Canadian citizen (ref)				
Immigrant		0.61 (0.34–1.09)	0.60 (0.33–1.09)	0.61 (0.33–1.11)
Ethnicity				
White (ref)				
Non-white		1.79 (0.74–4.32)	1.80 (0.74–4.37)	1.76 (0.72–4.34)
Geographic area				
Urban (ref)				
Rural		0.94 (0.74–1.19)	0.90 (0.70–1.14)	0.88 (0.69–1.12)
Socioeconomic				
Education				
Less than high school (ref)				
High school			0.77 (0.55–1.09)	0.79 (0.56–1.12)
Post-secondary			0.79 (0.60–1.04)	0.83 (0.63–1.09)
Household income				
Less than $19,999 (ref)				
$20,000 to $29,999			1.00 (0.66–1.52)	0.98 (0.65–1.49)
$30,000 to $39,999			0.77 (0.50–1.19)	0.77 (0.50–1.19)
$40,000 to $49,999			0.66 (0.41–1.06)	0.66 (0.41–1.06)
$50,000 to $59,999			0.68 (0.42–1.09)	0.68 (0.42–1.09)
$60,000 to $79,999			0.77 (0.49–1.22)	0.79 (0.50–1.25)
Greater than $80,000			0.57 (0.37–0.89)*	0.59 (0.38–0.93)*
Health behaviors				
Physical activity				
Inactive (ref)				
Moderately active				0.70 (0.52–0.93)*
Active				0.49 (0.35–0.72)*
Fruit and vegetable intake				
Less than 5 per day (ref)				0.98 (0.77–1.25)
5–10 per day				1.55 (0.86–2.77)
Greater than 10 per day				

Table 3 continued

	Model 1	Model 2	Model 3	Model 4
Smoking				
Not at all (ref)				
Occasionally				1.07 (1.04–1.12)
Daily				1.00 (0.94–1.06)

* $p < 0.05$

Physical activity was statistically significant in the multivariable models for all three health outcomes in our study, which concurs with previous studies showing active physical activity to be inversely associated with disease prevalence, controlling for religious service attendance (Oman et al. 2002; Kennedy et al. 1996; Strawbridge et al. 2001). Though we treated physical activity as a confounder in this study, Strawbridge et al. showed that over 28 years, weekly religious service attendees were more likely to start exercising, suggesting a possible mediating role for religious service attendance in improved physical activity and in reduced CHD mortality and morbidity (Strawbridge et al. 2001). Due to the cross-sectional nature of this study, we were unable to test the mediating effects of physical activity on the association between religious service attendance and health outcomes.

Two health behavior variables of interest in this study are fruit and vegetable intake and smoking status. Fruit and vegetable intake was not significant in the multivariable models of CHD, diabetes, and hypertension perhaps because of limited variation in consumption levels. Approximately 60 % of the study sample consumed less than five fruits and vegetables per day, which could be attributed to seasonal effects.

Smoking is a known risk factor for CHD, and it is surprising that smoking status remained a non-significant covariate in the multivariable models examining the relation between religious service attendance and this health outcome. A possible explanation for this result could be the presence of "healthy smoking effect" (Xu et al. 1994) in our study population (i.e., smokers who are more resistant to the effects of smoking or who have not been diagnosed with CHD). The positive association between smoking and hypertension prevalence supports this hypothesis in our study since smokers were more likely to have prevalent hypertension compared to non-smokers, a known risk factor for CHD.

The present study has some limitations. The cross-sectional nature of CCHS 4.1 prevented us from assessing the temporal exposure–outcome sequence between religious service attendance and CHD, diabetes, and hypertension (Maxwell and Cole 2007). The associations found in this study might reflect reverse causality bias, whereby attending religious services has been the consequence, rather than the antecedent, of CHD and related risk factors. Until religious service attendance and health outcomes are measured prospectively in studies such as the Canadian Longitudinal Study on Aging (Raina et al. 2009), any associations suggested by cross-sectional analyses remain hypothesis-generating.

It is crucial to differentiate between the behavioral and functional aspects of religious service attendance. Our study contains what is primarily a behavioral indicator of religion (e.g., frequency of religious service attendance), and the findings suggest what appears to be the "result" of religious attendance (e.g., lower prevalence of health outcomes). Religious service attendance is likely to be a marker for multiple factors that influence CHD-related health outcomes. It is likely factors such as mobility, good health, or other healthy behaviors (e.g., physical activity) act all to increase the frequency of religious participation

Table 4 Odds ratio for hypertension by frequency of religious service attendance—weighted

	Model 1	Model 2	Model 3	Model 4
Religious service attendance				
Less than once a year (ref)				
3–12 times a year	1.06 (0.908–1.25)	1.07 (0.90–1.27)	1.08 (0.909–1.29)	1.08 (0.907–1.30)
More than once a week	1.37 (1.16–1.61)*	0.81 (0.67–0.97)*	0.81 (0.67–0.97)*	0.82 (0.68–0.99)*
Demographics				
Age/mean (S.D)		1.06 (1.06–1.07)*	1.06 (1.05–1.06)*	1.06 (1.05–1.06)*
Sex				
Male (ref)				
Female		0.93 (0.80–1.08)	0.95 (0.82–1.11)	0.99 (0.85–1.16)
Marital status				
Married (ref)				
Single/common law		0.75 (0.60–0.95)*	0.67 (0.54–0.87)*	0.69 (0.54–0.87)*
Separated/divorced/ widowed		0.79 (0.64–0.96)*	0.72 (0.59–0.89)*	0.72 (0.59–0.90)*
Immigrant status				
Canadian citizen (ref)				
Immigrant		0.78 (0.54–1.11)	0.77 (0.53–1.11)	0.81 (0.56–1.17)
Ethnicity				
White (ref)				
Non-white		0.72 (0.36–1.45)	0.73 (0.36–1.46)	0.66 (0.33–1.33)
Geographic area				
Urban (ref)				
Rural		1.02 (0.87–1.20)	0.99 (0.84–1.16)	0.98 (0.84–1.16)
Socioeconomic				
Education				
Less than high school (ref)				
High school			1.06 (0.84–1.34)	1.07 (0.852–1.35)
Post-secondary			0.87 (0.72–1.05)	0.89 (0.74–1.08)
Household income				
Less than $19,999 (ref)				
$20,000 to $29,999			0.87 (0.65–1.22)	0.88 (0.64–1.21)
$30,000 to $39,999			1.12 (0.82–1.52)	1.09 (0.80–1.49)
$40,000 to $49,999			0.77 (0.56–.1.07)	0.78 (0.56–1.08)
$50,000 to $59,999			0.84 (0.601–1.16)	0.82 (0.59–1.15)
$60,000 to $79,999			0.87 (0.629–1.20)	0.87 (0.63–1.20)
Greater than $80,000			0.69 (0.50–0.98)	0.68 (0.50–0.93)*
Health behaviors				
Physical activity				
Inactive (ref)				
Moderately active				1,00 (0.83–1.19)
Active				0.64 (0.52–0.80)*
Fruit and vegetable intake				
Less than 5 per day (ref)				
5–10 per day				1.13 (0.96–1.33)
Greater than 10 per day				0.86 (0.55–1.35)

Table 4 continued

	Model 1	Model 2	Model 3	Model 4
Smoking				
Not at all (ref)				
Occasionally				1.04 (1.03–1.07)*
Daily				1.62 (1.60–1.67)*

* $p < 0.05$

and to promote better health. Further research is needed to clarify which interpretation is most informative.

The exclusion of social support variables in the analyses deserves special attention. CCHS 4.1 did not collect measures of social support from Saskatchewan participants, so we could not test for this variable in the regression models. Although many studies control for social support, these studies have also suggested social support to be a potential mediator as risk ratios were largely reduced once social support variables were included in models for CHD, diabetes, and hypertension (Hummer et al. 1999; Oman et al. 2002; Gillium 2006). Research has shown that people involved in religious practices enjoy increased social support, which is recognized as being an important potential mediator in physical health (Hummer et al. 1999; Oman et al. 2002; Gillium 2006).

Caution must be exercised when generalizing this study's results to the Canadian population. Our sample contains many older, white, Christian, non-immigrant individuals of higher education and income, which is similar to other samples in the published literature (Hummer et al. 1999; Oman et al. 2002), but not representative of the Saskatchewan and Canadian population as indicated by the 2006 Census. This is likely the result of selection bias considering our study sample included only participants eligible to respond to the question on religious service attendance on the premises of indicating a religious affiliation in CCHS 4.1. Lastly, our findings may not be easily generalizable to populations outside of Canada or to smaller ethnic subgroups or populations within Canada.

The exploration of religious factors in relation to CHD, diabetes, and hypertension remains a promising and important pursuit in Canada. This study is valuable in identifying possible associations, raising further questions, and guiding subsequent research. Prospective studies are needed to understand the temporal ordering of the relationship between exposure to religious factors and the incidence of CHD and related risk factors. Further, these studies will enable the understanding of pathways for the effect of religious factors on CHD mortality and morbidity, such as the availability of social support and promotion of health behaviors. Conceptual models such as the socioecological model should be tested to determine the relation between religious service attendance and health outcomes at the individual and institutional level. Finally, the effect of ethnicity deserves further inquiry since Canada's ethnic population is growing much faster than its total population.

The findings have clinical implications (Matthews et al. 1998). Religion is important to many Canadians, particularly older adults, and health-care providers should be aware of how religious factors can affect CHD and related risk factors. Providers might adopt practices that will help them assess the health-relevant aspects of patients' religious commitment. For example, health-care providers can encourage patients to make use of potentially health-promoting religious resources from patients' own religious institutions and traditions to help reduce the risk of CHD, diabetes, and hypertension.

Conclusion

The findings of this study are the first to suggest religious service attendance may be associated with the prevalence of CHD, diabetes, and hypertension in Canada. This study supports further investigation of religious factors influencing these health outcomes in longitudinal studies and investigation of pathways. Such findings will add to our understanding of how religious factors might contribute to the prevention of CHD and related risk factors.

References

Ano, G. G., & Vasconcelles, E. B. (2005). Religious coping and psychological adjustment to stress: A meta-analysis. *Journal of Clinical Psychology, 61*, 461–480.

Beland, Y. (2002). Canadian community health survey-methodological overview. *Health Report, 13*, 9–14.

Chatters, L. M. (2000). Religion and health: Public health research and practice. *Annual Review of Public Health, 21*, 335–367.

Chatters, L. M., Levin, J. S., & Ellison, C. G. (1998). Public health and health education in faith communities. *Health Behavior & Education, 25*, 689–699.

Eagle, D. E. (2011). Changing patterns of attendance at religious services in Canada, 1986–2008. *Journal for the Scientific Study of Religion*. doi:10.1111/j.1468-5906.2010.01559.x.

Gillium, R. F. (2006). Frequency of attendance at religious services, hypertension, and blood pressure: the third national health and nutrition examination survey. *Psychosomatic Medine, 68*, 382–385.

Goldbourt, U., Yaari, S., & Medalie, J. H. (1993). Factors predictive of long-term coronary CHD mortality among 10,059 male Israeli civil servants and municipal employees: A 23-year mortality follow-up in the Israeli Ischemic CHD Study. *Cardiology, 82*, 100–121.

Graham, T. W., Kaplan, B. H., Cornon-Huntley, J. C., James, S. A., Becker, C., Hames, C. G., et al. (1978). Frequency of church attendance and blood pressure elevation. *Journal of Behavioral Medicine, 1*(1), 37–40.

Hummer, R. A., Rogers, R. G., Nam, C. B., & Ellison, C. G. (1999). Religious involvement and US adult mortality. *Demography, 36*, 271–285.

Kelly, M. P., Morgan, A., Bonnefoy, J., et al. (2007). *The social determinants of health: developing an evidence base for political action (measurement and evidence knowledge network)*. Geneva, Switzerland: World Health Organization.

Kennedy, G. J., Kelman, H. R., Thomas, C., & Chen, J. (1996). The relation of religious preference and practice to depressive symptoms among 1,855 older adults. *The Journals of Gerontology, Series B: Psychological Science and Social Sciences, B51*, P301–P308.

King, D. E., Mainous, A. G., & Pearson, W. S. (2002). C-reactive protein, diabetes and attendance at religious services. *Diabetes Care, 25*(7), 1172–1176.

King, D. E., Mainous, A. G., Steyer, T. E., & Pearson, W. (2001). The relationship between attendance at religious services and cardiovascular inflammatory markers. *International Journal of Psychiatry in Medicine, 31*, 415–525.

Koenig, H. G., George, L. K., Hays, J. C., Larson, D. B., Cohen, H. J., & Blazer, D. G. (1998). The relationship between religious activities and blood pressure in older adults. *International Journal of Psychiatry in Medicine, 28*, 189–213.

Larson, D. B., Koenig, H. G., Kaplan, B. H., Greenberg, R. S., Logue, E., & Tyroler, H. A. (1998). The impact of religion on men's blood pressure. *Journal of Religion and Health, 28*(4), 265–278.

Lee, D. S., Chiu, M., Manuel, D. C., et al. (2009). Trends in risk factors for cardiovascular disease in Canada: Temporal, socio-demographic and geographic factors. *Canadian Medical Association Journal, 181*(3–4), E55–E66.

Matthews, D. A., MCCullough, M. E., Larson, D. B., Koenig, H. G., Swyers, J. P., & Milano, M. (1998). Religious commitment and health status: A review of the research and implications for family medicine. *Archives of Family Medicine, 7*, 118–124.

Maxwell, S. E., & Cole, D. A. (2007). Bias in cross-sectional analyses of longitudinal mediation. *Psychological Methods, 12*(1), 23–44.

McCullough, M. E., Hoyt, W. T., Larson, D. B., & Koenig, H. G. (2000). Religious involvement and mortality: A meta-analytic review. *Health Psychology, 19*, 211–222.

Morrow, D. A., & Ridker, P. M. (2000). Risk factor modification for cardiac disease: C-reactive protein, inflammation, and coronary risk. *Medical Clinics of North America, 84*(149–161), 2000.

Oman, D., Kurata, J. H., Strawbridge, W. J., & Cohen, R. D. (2002). Religious attendance and cause of death over 31 years. *International Journal of Psychiatry in Medicine, 32*, 69–89.

Public Health Agency of Canada. (2005). *Integrated strategy on healthy living and chronic disease*. Available from http://www.phac-aspc.gc.ca/media/nr-rp/2005/2005_37bk3-eng.php. Accessed 2010/09/13.

Public Health Agency of Canada. (2009). *Tracking heart disease and stroke in Canada*. Available from http://www.phac-aspc.gc.ca/publicat/2009/cvd-avc/index-eng.php. Accessed 2010/09/13.

Raina, P. S., Wolfson, C., Kirkland, S. A., Griffith, L. E., Oremus, M., Pattersonm, C., et al. (2009). The Canadian longitudinal study on aging (CLSA). *Canadian Journal of Aging, 28*, 221–229.

Ross, N. A., Woflson, M. C., Dunn, J. R., Berthelot, J. M., Kaplan, G. A., & Lynch, J. W. (2001). Relation between income inequality and mortality in Canada and in the United States: Cross sectional assessment using census data and vital statistics. *British Medical Journal, 320*(7239), 898–902.

Rubin, D. B. (1987). *Multiple imputation for nonresponse in surveys*. New York: Wiley.

Statistics Canada. (2007a). *Canadian Community Health Survey (CCHS) 2007. Microdata files*. User guide. Available from http://www.statcan.ca/english/sdds/document/3226_D7_T9_V4_E.pdf. Accessed 2008/10/23.

Statistics Canada. (2009). *2006 Census: Portrait of the Canadian Population in 2006: Findings*. Available from http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=97-550-XWE2006001&lang=eng. Accessed 2008/10/23.

Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion, 10*, 282–298.

Strawbridge, W., Shema, S., Cohen, R., & Kaplan, G. (2001). Religious attendance increases survival by improving and maintaining good health behaviors, mental health, and social relationships. *Annals of Behavioral Medicine, 23*, 68–74.

Tanuseputro, P., Manual, D. G., Leung, M., et al. (2003). Risk factors for cardiovascular disease in Canada. *Canadian Journal of Cardiology, 19*, 1249–1259.

Xu, X., Weiss, S. T., Rijcken, B., & Schoute, J. P. (1994). Smoking, changes in smoking habits, and rate of decline in FEV1: New insight into gender differences. *European Respiratory Journal, 7*(6), 1056–1061.

Yusuf, S., Hawken, S., Ounpuu, S., et al. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case–control study. *Lancet, 364*, 937–952.