Exploring the association between religiosity, spirituality and cancer screening behavior: a longitudinal analysis of Alberta's Tomorrow Project

by

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A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Science
in
Public Health and Health Systems

Waterloo, Ontario, Canada, 2020

AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Background: This thesis examined the effect of religiosity/spirituality (R/S) on breast, prostate, and colorectal cancer screening behaviour. Over two-thirds of Canadians identify with some form of religion or spirituality. R/S can affect the intentions, beliefs and behaviours of individuals. Many religious and spiritual practices place an emphasis on the preservation of health. Breast, prostate and colorectal cancers account for a large proportion of cancers in Canada. Screening is an effective form of secondary prevention for cancer. R/S may provide a platform of positive influence to encourage greater cancer screening.

Objective: Data from Alberta's Tomorrow Project (ATP) were used to explore the longitudinal association between R/S and breast, prostate and colorectal cancer screening behaviour.

Methods: ATP participants between 35 and 70 years, without a history of chronic disease at baseline, were included in the analysis. For longitudinal analysis, participants had a minimum of one post-baseline screening datapoint. R/S was measured through two variables: Salience and Attendance. R/S Salience assessed the importance of religion or spirituality to ATP participants, asking them: "Do spirituality values or faith play an important role in your life?" Response options for R/S Salience were "Yes" or "No." R/S Attendance assessed whether participants attended religious or spiritual services, with response options being limited to "Attends" or "Does Not Attend." Multivariable logistic regression models were built for each R/S and cancer screening variable separately. All models were adjusted for age, social support, income, occupation, education, sex, marital status, perceived health, and smoking status.

Results: Due to the large proportion of women undergoing mammography (69% at baseline and 95% at the final follow-up period), breast cancer screening was assessed cross-sectionally. Neither R/S Salience nor R/S Attendance were found to be statistically significantly associated with breast cancer screening (odds ratio [OR]=1.10, 95% confidence interval [CI]: 0.93-1.27, and OR:1.02, 95% CI: 0.86-

1.21, respectively). Longitudinal analysis revealed that R/S Salience and R/S Attendance were also not statistically significantly associated with prostate cancer screening (OR:0.90, 95% CI: 0.68-1.19, and OR:1.18, 95% CI: 0.88-1.59, respectively). Only models for R/S and colorectal cancer screening produced statistically significant results. ATP participants who responded "Yes" to R/S Salience (compared to 'No'), and participants who attended (versus not attended) religious or spiritual services (R/S Attendance), had 1.4 times (95% CI: 1.15-1.73) or 1.5 times (95% CI: 1.12-1.89) greater odds of obtaining a sigmoidoscopy or colonoscopy, respectively.

Discussion: This thesis provided a Canadian context for the association between R/S and cancer screening, and added to the literature by incorporating both cross-sectional and longitudinal analyses; the preservation of temporality allowed us to examine whether the effects of R/S persisted over time. The current analyses were conducted using persons drawn from a large, population-based study encompassing a sample of adults aged between 35 and 70 years (n=5,014-11,977). This thesis suggested that R/S may have a positive influence on the cancer screening behaviours of Canadians. Future research should explore whether public health officials can leverage the effects of R/S to help increase the incidence of screening for cancers in populations where screening behaviour remains low.

Acknowledgements

I would like to express my gratitude and utmost appreciation to my Master's thesis committee. The value of your guidance to me cannot be determined. First and foremost, I must thank Dr. Mark Oremus whose supervision of me has been constant and unwavering, even when my confidence in myself was unsure. Your judgement and leadership along this journey have been greatly valued by me, and I know I will always hold my experiences with you in high esteem. To Dr. Ashok Chaurasia, I can say that your knowledge of your field is outstanding; that you can apply your knowledge with such common sense, and teach it to green and wide-eyed neophytes such as myself, is evidence of your skill. Your words of wisdom, both regarding statistics and life, have been immensely valuable to me along the way. To Dr. John Garcia, you live up to a reputation of expertise, experience, and admiration. Your name is recognized everywhere and in only a couple of meetings with you, I was aware of your insights and dedication.

Finally, I must take a moment to thank the Canadian Agency of Drugs and Technologies in Health (CADTH). I have had he privilege of working full time with a Canadian health technology assessment organization where my education has been put to practice, and where I have had the chance to refine and develop the lessons I have been taught. The experiences I have gained here, and the experiences I hope to continue gaining here, have opened my eyes to the applicability and relevance of all my education. Most importantly, working at CADTH showed me that my education at the University of Waterloo has been comparable to none, and I would once again like to thank my thesis committee, in addition to my peers, teachers and mentors I have been privileged to have along the way.

I have learned many lessons along this journey.

Sincerely, thank you to everyone.

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Chapter 1
Introduction

1.1 Purpose

The purpose of this thesis was to investigate the association between religiosity and spirituality (R/S), and cancer screening, in a sample of community-dwelling participants aged between 35- and 70-years residing in Alberta, Canada. Specifically, this thesis included breast cancer screening through mammography, prostate cancer screening with the prostate specific antigen (PSA) test, and colorectal cancer screening with sigmoidoscopy or colonoscopy. This thesis analysed these associations cross-sectionally and longitudinally using data from Alberta's Tomorrow Project (ATP), a longitudinal cohort study designed to investigate chronic diseases, such as cancer, with a focus on prediction and prevention (1). ATP began in 2000 and is currently ongoing within the larger Canadian Partnership for Tomorrow Project (CPTP) (2).

1.2 Research Questions

The primary research questions addressed in the thesis were:

1) Is R/S associated with breast, prostate and colorectal cancer screening behaviour, both cross-sectionally and longitudinally, over a maximum of 15 years?
2) Do the associations specified in question # 1 above change after controlling for the following covariates: age, education, income, occupation, marital status, social support, smoking status and perceived health status?

1.3 Hypotheses

The thesis candidate hypothesized that R/S would be positively associated with breast, colorectal, and prostate cancer screening behaviour, both cross-sectionally and longitudinally. Additionally, she hypothesized that these associations would persist after controlling for the covariates described in question # 2 above.

1.4 Rationale

According to the World Health Organization, cancer is a leading cause of death globally. Cancer screening serves as a preventive mechanism for early detection of cancers to reduce morbidity and mortality. Through screening tests, earlier detection of cancers leads to less intensive treatments, improved outcomes, or both. However, cancer screening practices are not routinely undertaken by all Canadians; this underutilization of cancer screening is important to explore. The data from such explorations can help public health officials develop programs to encourage more screening.

Over two-thirds of Canadians identify with some form of religion or spirituality, and researchers have suggested that R/S may play a role in predicting health behaviours (3–7). This thesis aimed to explore the impact of R/S on cancer screening behaviour in Canada.

Chapter 2
Introduction to Religion, Spirituality and Cancer

2.1 Religion and Spirituality

Religion and spirituality are constructs of faith and worship that are central to the lives of many people. According to the 2011 National Household Survey (NHS), approximately 76% of Canadians adhered to some form of religion or spirituality. Just over two-thirds of Canadians identified with a Christian denomination, with most Christians identifying as Catholic. The next most commonly reported religions were Islam (3.21%), Hinduism (1.52%), Sikhism (1.39%), and Judaism (1.00%). The NHS also reported that less than 1% of Canadians identified with Traditional (Aboriginal) Spirituality, or with another religion (7).

While often thought of as the same, religion and spirituality are two separate constructs. Koenig et al. (6) describe religion as an organized system of beliefs, practices and rituals that have developed over time, are governed through an institutional structure (e.g., 'organized religion'), and are related to community traditions. The purpose of religion is to help individuals become closer to a transcendent figure, which includes a god, higher power, or ultimate truth, and to create an understanding of an individual's relationships and responsibilities to others in a community. Religions also usually include beliefs about personal conduct and an afterlife (6).

Spirituality encompasses a search for the transcendent (e.g., the relationship between divinity and the material world) and tends to be subjective. Individuals adopt their own understandings and truths about the transcendent, as opposed to adhering to the prescripts of a religious dogma. Koenig et al. describe a key concept of spirituality as the thought of being connected to something scared and transcendent, which encompasses supernatural and mystical forces that may include, but often go beyond, organized religion (6). The connection to the transcendent is the main commonality between spiritualty and religion. Those who are religious may also consider themselves spiritual, though the reverse may not be true (6).

Unlike spiritual or religious individuals, persons who are secular do not believe in a transcendent figure (e.g., God). Secularism still places value on morals and relationships, which are guided by 'human-made' codes of conduct or cultural norms, rather than codes of conduct prescribed by religious beliefs (6).

Although religion and spirituality are different concepts, the thesis candidate could not separate participants' responses into religious or spiritual components. While the ATP data captured R/S through three survey questions (R/S salience, self-perceived R/S, and R/S attendance), each question asked about religion and spirituality together, e.g., specify the frequency of attendance at religious or spiritual services or gatherings.

2.2 Religion, Spirituality, and Health

Religion and spirituality offer societies and individuals a core set of beliefs surrounding morals and codes of conduct. Often, these beliefs endorse or prohibit behaviours specifically affecting health. For example, alcohol consumption is linked to a number of cancers, mental health problems, and heart disease (8–11). In Islam, consuming alcohol is considered sinful and immoral, and is therefore prohibited. More broadly, the Christian Bible (1 Corinthians 6:19-20) states that the body serves as a temple for the Holy Spirit; therefore, Christians are called to respect their bodies and forego unhealthy and harmful behaviours. Since religious or spiritual morals or codes of conduct emphasize the preservation and maintenance of physical health, such beliefs could positively influence a person's decision to screen for cancer.

Researchers have proposed several mechanisms to explain the effect of R/S on health. One mechanism is through peer support (12–14). In a review by Koenig in 2012, he noted that 82% of studies regarding R/S and social support found a significant positive relationship between the two constructs (14). Religion and spirituality provide individuals with a platform to meet regularly with like-minded people who can offer each other emotional and physical support. Having regular meetings also allows religious or spiritual leaders to give sermons to their congregants, which can reinforce the scriptural underpinnings of behaving in a healthy fashion (3,4). Berkman's seminal work from three decades ago first reported positive

associations between social support and health (15), and numerous studies published in the ensuing years have supported this early work (16).

Another underlying mechanism thought to explain the effect of R/S on health is the development of good coping skills (17). When stress is present over long periods of time, it can negatively alter homeostatic responses and adversely impact immune function (5,18). Lessons taught through religion and spiritualty (e.g., positive thinking about God's plan for oneself, learning to feel secure in God's presence) may provide followers with the skills to cope with stressful situations. Beyond specific coping methods, true believers in faith find a sense of comfort from their connection to God, allowing religion or spirituality to serve as an outlet for stress; adherents to faith may derive comfort and hope from praying, which may lead to decreases in stress. Social support from religious leaders and other congregants may also bring comfort and practical assistance to reduce stress.

The connection to a divine being provides the foundation for positive coping mechanisms to manage stressful situations. For example, one study found that persons with HIV used spirituality to cope with traumas related to their diagnosis and life with the illness (19). Another study found that caregivers of persons with cardiovascular disease had improved quality of life when they incorporated R/S into their lives, compared to caregivers who did not incorporate R/S into their lives (20).

Fostering a sense of hope is another way religion and spirituality are thought to affect health. Religious and spiritual scriptures often contain messages of hope, with the idea that events in life have meaning on a scale grander than the self. This can be especially important to individuals who suffer from chronic disease and who are looking for ways to cope with the suffering related to their disease. For example, a study with the purpose of determining the role of spiritual attributions to disease was conducted on women diagnosed with breast cancer (21). The study found that women with positive spiritual attributions, such as believing in a kind and supportive god, maintained feelings of hope during their cancer treatment. However, women with negative spiritual attributions, such as believing in an angry God, experienced increasing morbidity throughout their cancer treatment (21).

2.3 Potential Inverse Relations between R/S and Health Behaviours

R/S may not always promote positive health behaviours. For example, fatalism related to religion or spirituality may discourage individuals from seeking medical treatment for conditions that are assumed to be "part of God's plan". A cross-sectional study on participants across England found that women from minority ethnic groups (ie. African, Indian, Bangladeshi, Pakistani, Caribbean) showed higher cancer fatalism compared to White British Women. The authors felt that addressing fatalistic beliefs among these minority groups would increase cancer screening (22). Franklin et al. (23) studied a random sample of 1,273 African Americans in the United States and reported that fatalism impacted health behaviours in a complex way. While fatalism was not statistically significantly associated with healthcare utilization, it was associated with a diagnosis of high cholesterol. Also, individuals with a greater number of chronic illnesses, and who perceived their health as poor, tended to have a greater likelihood of endorsing fatalistic beliefs (23).

In summary, religion and spirituality contain a series of beliefs and attitudes that can minimize one's engagement in risky behaviours and promote 'positive' health behaviours (3,4). While the current body of literature has provided some possible explanations for the positive impact of R/S on health (23–26), the true causative mechanisms are unknown. The effect of social support may be the main driver of better health in religious or spiritual populations, with R/S activities serving as the vehicle through which social support is delivered to these populations.

The available literature has yet to show whether R/S exerts an influence on health and health behaviours over and above the social support component. For example, recent work examining religious service attendance and cognitive function in Canada did not find an independent effect for attendance after adjusting for functional social support, although the unadjusted models also showed no association (27). Overall, the relationship between R/S and health behaviours is complex. This thesis added to the body of literature in this area by exploring the association between R/S and cancer screening.

Chapter 3
Cancer

3.1 Biology of Cancer

The development of cancer occurs when regular cell functions related to mitosis and apoptosis are damaged. Mitosis is the process of cell division, whereby one cell is replicated into two new cells. Cell division is required to allow new cells to replace old cells and promote regeneration, thereby maintaining the genetic material that is located within each cell. For example, when an organism is injured, damaged cells are replaced by new and healthy cells through mitosis. Apoptosis allows cells to undergo a programmed death when they are damaged and no longer useful, or potentially harmful, to an organism. In the previous scenario, where cells were damaged due to injury, the damaged cells would undergo apoptosis. However, when the mitotic and apoptotic processes are damaged within cells, some cells may evade cell death, which leads to uncontrolled cell growth and cancer. Cancer can affect any part of the body. Certain races and cultures have greater incidences of specific types of cancers due to a combination of environmental, lifestyle, and genetic factors. For example, Ashkenazi Jews have low rates of lung cancer due to low tobacco use, but have higher incidences of colorectal cancer (28).

3.2 Facts and Statistics Related to Cancer in Canada

A recent report estimated that 225,800 new cases of cancer could be expected in Canada in 2020, with 83,300 cancer-related deaths. Lung cancers (n=29,800), breast cancers in females (n=27,400), colorectal cancers (n=26,900) and prostate cancers in males (n=23,300) are expected to be the most commonly-diagnosed cancers in Canada; mortality rates in persons diagnosed with cancer are expected to be 26% for lung cancer, 12% for colorectal cancer, 6% for pancreatic cancer, 6% for breast cancer and 5% for prostate cancer (29).

In 2018, Statistics Canada data showed that cancer was the leading cause of death in Canada, accounting for over 79,000 deaths, or 28.1% of all deaths overall. Canadians face a 50% probability of

developing cancer in their lifetime, with 25% of those diagnosed expected to die from the disease (30). Deaths due to cancer in Canada outranked deaths due to heart disease, cerebrovascular disease, and accidents, which accounted for 53,134, 13,480 and 13,290 deaths, respectively, in 2018 (31). Individuals 50 years of age or older are the age group with the largest proportion of cancer diagnoses in general, with nine in ten cancers expected to be diagnosed within this age group (32).

3.3 Risk Factors for Developing Cancer

The World Health Organization (WHO) states the following potential risk factors for cancer: age, lack of physical activity, overweight or obesity, poor diet, alcohol use, tobacco use, infections such as the hepatitis B or human papilloma viruses, environmental pollution, exposure to radiation, occupational carcinogens, and reproductive factors (8). While some of these risks are inherent, e.g., genetic mutations that are unalterable, many arise out of lifestyle behaviours. For example, excess weight and lack of physical activity have been associated with an increased risk of several cancers. An annual report on the status of cancers in the United States found that excess weight and lack of physical activity put individuals at increased risk for cancers of the colon and rectum, pancreas, kidneys, and breasts (33). A meta-analysis of epidemiological studies also found an inverse relation between physical activity and breast cancer mortality in women. The meta-analysis also found that a lack of appropriate physical activity increases a woman's risk of breast cancer (34).

Lifestyle risks for cancer are important to study because they are alterable through behaviour modification (e.g., tobacco cessation, improved dietary habits), which can be encouraged through health promotion programs.

3.4 Cancer Treatment and Control

Many forms of cancer treatment exist, the most common being surgery, chemotherapy, radiation therapy, and tamoxifen (the latter for breast cancer). Other forms of cancer treatment include

immunotherapy, targeted therapy, stem cell transplants, and hormone therapy. Unfortunately, many cancer treatments involve short- or long-term side effects. For example, common side effects of chemotherapy and radiation therapy include hair loss and fatigue (35). Short-term side effects usually end when treatment ends. Long-term side effects can result in much more serious problems with lasting effects. For example, radiation therapy may lead to the development of scar tissue, memory loss, infertility, or even the possibility of a second cancer (36–38). While the efficacy of treatments for cancer depends on the type of cancer, stage of disease and patient characteristics, in general cancer treatments help to extend patients' lives and, in some cases, provide cures. For example, chemotherapy is considered curative in some types of advanced cancers, including acute lymphoblastic leukemia. Newer forms of cancer treatment, such as immunotherapy, provide patients with tailored therapeutic options that are potentially mor effective and less toxic than chemotherapy (39).

When making decisions about treatment options, doctors take calculated measures to weigh the risks and benefits of providing each form of treatment, and often patients may receive multiple forms of treatment simultaneously. For example, radiation therapy may be combined with chemotherapy or surgery, or both. To reduce morbidity and mortality from cancer, the emphasis in public health is on prevention, which includes early detection. If a cancer can be caught at an early stage, treatment options may be less invasive and more effective. Stage information is useful for physicians to understand treatment options and possible outcomes of patients' disease; patients for whom cancers are caught at later stages tend to have a lower overall five-year net survival (30). The Canadian Cancer Society reported that approximately 50% of lung cancers were diagnosed at late stage (stage IV), which is reflective of its low five-year net survival of 17% (30).

Early detection of cancer can be accomplished through screening techniques. Mammography and clinical breast exams (CBEs) are forms of breast cancer screening. Early detection is performed when evidence suggests such actions will lead to less invasive and less taxing treatment options, or offer better prognoses for patients. In the case of breast cancer, one form of treatment involves surgery to remove the affected breast(s), known as a mastectomy. Through screening, it is possible to detect breast cancer early

and women may undergo partial instead of total breast removal. Also, breast cancer treatment can involve radiation or chemotherapy, although women who have their breast cancers detected early may forgo the need for either treatment (40–43). For early detection to be successful, individuals should follow screening guidelines published by the Canadian Task Force on Preventive Health Care, which are also available from the Canadian Cancer Society.

Another important component of cancer control consists of prevention (8). This involves the use of health promotion programs to encourage people to alter lifestyle risks for cancer (e.g., cease using tobacco, improve eating habits, engage in physical exercise), thereby reducing the likelihood of contracting the disease.

3.5 Breast Cancer Screening Recommendations

Available screening options for breast cancer include mammography, magnetic resonance imaging (MRI), self-breast examination (SBE), and CBE. Due to a lack of evidence, the Canadian Task Force on Preventive Health Care (CTFPHC) advised against CBE, SBE, or MRI to screen for breast cancer (44). For women who possess an average risk, with no family history or genetic mutations associated with breast cancer, mammography is recommended over MRI, SBE, or CBE. A recent report was published stating that mammography screening is recommended every one or two years for women aged 40 years or over (45). Between 50 and 74 years of age, physicians recommend screening every two or three years. Beyond this age range, patients are advised to consult their doctors for advice.

A study conducted among 40,075 Norwegian women analyzed breast cancer incidence and mortality, and reported a one-third reduction in breast cancer deaths due to screening (46). A one-third reduction was also found in the United Kingdom's screening program (46,47). While over-diagnosing is a concern related to cancer screening, mammography has been shown to reduce the incidence of late stage cancers (48–50).

3.6 Colorectal Cancer Screening Recommendations

While many colorectal cancer screening methods exist, colonoscopy is considered the gold standard (51). A colonoscopy allows physicians to analyse a patient's entire colon for polyps, which are small growths that are often benign and asymptomatic. However, even benign polyps can become cancerous, placing importance on early detection (52). Colonoscopies are recommended to be performed every 10 years for individuals 50 years of age or older who are at an average risk for colorectal cancer (53). Another form of screening includes a sigmoidoscopy, which is similar to a colonoscopy yet only reaches to a section of the large intestine known as the sigmoid colon. For individuals at average risk for colorectal cancer, a sigmoidoscopy is recommended every five years (53).

The National Cancer Institute (NCI) recommends that individuals at average risk for colorectal cancer begin screening at the age of 50 years, continuing at regular intervals until the age of 75 years (54). After the age of 75 years, NCI recommends basing screening decisions on individual patient preferences and specific health concerns.

Much evidence exists to support the use of colonoscopies and sigmoidoscopies in colorectal cancer, as both randomized controlled trials and observational studies report reductions in mortality (55,56). Based on evidence from observational studies, microsimulation modeling, and randomized controlled trials, Zauber (57) suggested that approximately 50% of the decline in incidence and deaths due to colorectal cancers in the USA were attributable to increased colorectal cancer screening. Another population-based retrospective cohort study using Ontario health data found a 48% relative decrease in colorectal cancer incidence, and an 81% decrease in mortality among individuals who were screened with colonoscopy, versus those who were not screened (58).

3.7 Prostate Cancer Screening Recommendations

Available screening tests for prostate cancer include the prostate specific antigen (PSA) test and a digital rectal exam (DRE). A PSA test determines the amount of PSA released by the prostate and present

in the blood. An individual with prostate cancer will likely have higher levels of PSA in their blood (greater than 4ng/mL); however, alternative reasons for an elevation in PSA—such as age and race—should be ruled out (59). A DRE involves the insertion of a gloved and lubricated finger by a licenced medical practitioner into a patient's rectum to estimate the size of the patient's prostate, or to feel for the presence of any irregularities.

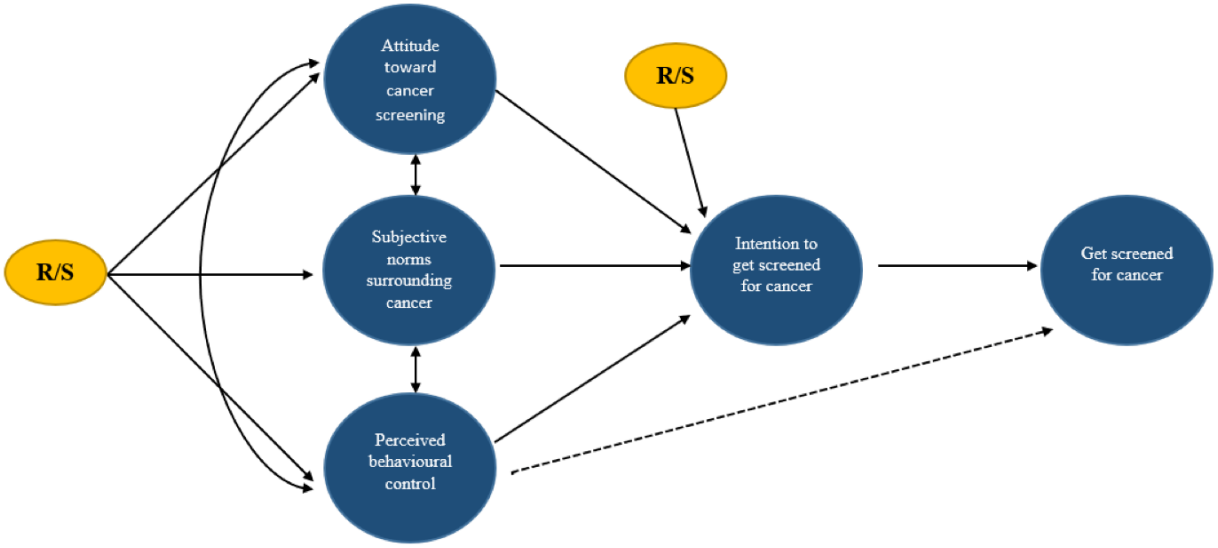
The CTFPHC does not recommend the use of PSA tests to screen for prostate cancer (60). Based on low quality evidence regarding the efficacy of PSA screening, the CTFPHC issued a strong recommendation against such screening in men under 55 years of age and men over 69 years of age. Based on moderate-quality evidence, the CTFPHC made a weak recommendation and suggested men between 55 and 69 years of age should also not obtain PSA tests (60). A meta-analysis published in the Cochrane Database of Systematic Reviews also supports these conclusions, showing that PSA testing did not result in reductions in prostate cancer mortality (61). Recommendations for PSA testing made by the US Preventive Services Task Force (USPSTF) were similar to those made by the CTFPHC; the USPSTF also acknowledged the lack of good quality evidence for PSA testing in men. The USPSTF concluded with moderate certainty that there may be a small net-benefit of PSA testing for some men aged between 55 and 69 years. However, they concluded with moderate certainty that the benefits of PSA testing for men aged 70 years or older do not outweigh the expected harms (62).

Chapter 4
Theoretical Framework

Many models or theories propose to explain health behaviour. The Theory of Planned Behaviour (TPB) is one such model, and it has been used in public health settings to predict behaviours that are susceptible to change (e.g., smoking, drinking, breastfeeding) (63).

TPB explains the relationships of interest in this thesis. Figure 1 shows a schematic application of TPB to R/S (64). R/S is an overarching mechanism that can positively affect the intentions of ATP participants to undergo breast, prostate or colorectal cancer screening; this mechanism is depicted in Figure 1.

Figure 1: Cancer Screening through the Theory of Planned Behaviour



4.1 Perceived Behavioural Control

Perceived behavioural control is a component of TPB which considers an individuals' perception of the ease or difficulty involved in performing a behaviour. Perceived behavioural control may be related to self-efficacy, or the confidence someone has in whether they will successfully accomplish a behaviour.

When intention is combined with perceived behavioural control, TPB states that one can predict the initiation of a behaviour.

The prediction of an actual behaviour using TPB is dependent on whether an individual's intentions and perceived behavioural control remain constant. Changing events or circumstances may alter an individual's intentions or perceptions of behavioural control, thereby altering the predictive capability of the model (65). However, an important concept of religion and spirituality is that it remains an unchanging constant presence for people who have a strong connection to divinity. The centrality of religion and spirituality in an individual's life can make them less likely to be phased by changing events, therefore, having a retained sense of behavioural control to complete cancer screening.

4.2 Attitudes

Attitudes toward a behaviour refers to the extent an individual positively or negatively appraises a specific behaviour. Attitudes toward a behaviour considered more favourably will reflect in greater intentions to perform a behaviour (63,65). Based on positive religious or spiritual teachings related to the preservation of health, individuals already predisposed to R/S may look favourably upon health-promoting behaviours, such as cancer screening, providing them the necessary platform for increased intentions to follow cancer screening guidelines.

4.3 Subjective Norms

Subjective norms refer to the social pressures individuals might feel in terms of whether or not to perform a behaviour. Subjective norms are an important component of understanding the processes leading to behaviours under the TPB model. These norms are influenced by societal judgements, which are the pressures arising from society that impact an individual's likelihood of performing a behaviour (64). Individual beliefs about whether a society deems their behaviour as acceptable will either encourage or hinder the performance of the behaviour. Societal judgements can include the common views held by members of religious or spiritual communities. In Florida, a program titled "Believe! Breast Cancer Prevention through Churches" is delivered to African American women in church settings, with the support

of pastors (66). Church participation lends credibility to the idea of screening, which can increase screening behaviour.

4.4 Intentions

Central to TPB is the idea of 'intention to perform' a behaviour, or the degree of effort an individual is willing to exert to perform a behaviour. The theory posits that individuals with stronger intentions to perform a behaviour will be more likely to actually go through with the behaviour (65). As mentioned in Chapter 2, religion and spirituality include morals and behaviours related to the preservation or maintenance of health (6). Through prescribed teachings and religious texts that directly or indirectly promote health, religion and spirituality can affect people's attitudes toward cancer screening.

Intentions of behaviour, according to TPB, may be influenced by other factors, including perceived behavioural control, attitudes and subjective norms; these concepts are described below.

4.5 Conclusion

Perceived behavioural control, subjective norms and attitudes are all components of TPB which will ultimately influence the intentions of an individual to perform a specific behaviour. The combination of attitudes toward a behaviour, subjective norms and perceived behavioural control affect behavioural intention. An individual with greater perceived behavioural control and more favourable attitudes toward a behaviour and subjective norms should have greater intentions of performing a given behaviour (67).

R/S serve as a strong overarching force which can motivate aspects of TPB, including attitudes, norms, perceived behavioural control and, ultimately, the intentions and actual completion of a behaviour. It is reasonable to suggest that the intentions of getting screened for cancer may be positively or negatively influenced through R/S. As religion and spirituality continue to provide a pivotal foundation for many Canadians, it is reasonable to suggest that R/S will influence behaviour as suggested by TPB. Through TPB this thesis hopes to provide possible mechanisms to help explain how religious or spiritual beliefs may be related to the behaviours of Canadians, specifically regarding cancer screening.

Chapter 5
Literature Review

5.1 Methods

A literature review was conducted to assess the current body of published research on the association between R/S and breast, colorectal and prostate cancer screening behaviour. Search terms related to cancer screening and R/S (Appendix A) were created for four research databases, with the help of a medical librarian: Medline (Pubmed), Scopus, PsycInfo and CINAHL. The search encompassed citations published between database inception and November 2019. All retrieved citations were stored and organized using Covidence (Veritas Health Innovation, Melbourne, Australia), a web-based application designed to manage citation screening in systematic reviews.

Articles retrieved in the literature search were screened for relevance to the thesis topic at two levels, title/abstract and full text. Eligibility criteria included: 1) English language only; 2) primary or secondary data analysis; 3) case-series or any study with a comparison group; 4) adults only (18 years of age or over); 5) any type of screening as a prevention program for any type of disease (later restricted to citations related to colorectal, breast and prostate cancer screening); and 6) any means of measuring religion (e.g., attendance, spirituality, etc.). Further, the citations had to report screening behaviour separately for any of the screening tests of interest, and also had to contain at least one R/S measure.

Twenty-eight articles (68–95) (Table 1, Appendix B) passed through both levels of screening and the thesis candidate extracted the following data from these articles: author(s), year of publication, study type, setting, population, sample size, age range, type of screening behaviour measured, results of the study, and type of R/S measures.

5.2 Results

Twenty-three of the 28 included studies were cross-sectional in design (68,69,72–76,79,80,83,85,87,88,90–94,96–100). The remaining studies were a cluster randomized controlled trial

(RCT) (101), a ‘standard’ RCT (102), a quasi-experimental study (82) and two cohort studies (81,89). Most studies used samples from the United States, with the exception of six studies (69,85,97,98,100,103,104). The majority of studies were undertaken in specific groups of people: 11 of 21 breast cancer studies were conducted in minority populations (68–73,76,79,81,92,93), 19 studies contained women only (69,73,81,89,93,97–101,105–112), seven studies included men and women (74,75,80,83,87,90,91), and two prostate cancer studies recruited African American males (82,96).

5.3 Religion/Spirituality Measures

Details of R/S measures used in the literature are described in Table 1. The most common measure of R/S was frequency of religious service attendance (75,86,93,102,113–118), and a few studies also assessed the frequency of attendance at other religious or spiritual related activities (although these ‘other’ activities were not defined (68,93,114–116)); Fox et al. (93) also asked respondents about their spouses’ frequency of attendance. Another common measure of R/S was religious denomination or affiliation (Table 1).

Many included articles assessed ‘religiosity’ (69,73,79,81,82,86,88,93,118,119), though the construct was inconsistently or unclearly defined. In general, most measures of religiosity encompassed self-rated assessments of R/S. For example, Othman et al. (97) measured religiosity with nine survey items that also captured the importance of religion to an individual. Padela et al. (79) measured religiosity by asking participants to rate their agreement with the phrase “I try hard to carry my religious beliefs over into all my other dealings in life.” These examples of religiosity (79,97)are similar to religious salience, as both capture the relative importance of religion to one’s life. Indeed, Benjamins and Brown (120) measured religious salience by asking individuals to directly rate the importance of religion to their lives.

Three studies examined spirituality (102,121,122). Similar to religiosity, spirituality was measured differently between studies. For example, Conway-Phillips & Janusek (121) asked respondents to describe the amount by which spirituality pervaded their lives, Katz et al. (102) asked participants about the

proximity of their relationship to God, and Ochoa-Frongia et al. (122) measured respondents' reliance on God.

Locus of control was another R/S variable reported in some studies, and it measured the extent to which individuals believed God controlled their health (72,86,113). Such a concept may be similar to fatalism, which was measured in two studies (79,123). Padela et al. (79) assessed fatalism specifically through two items associated with breast cancer practices; the first item measured whether respondents believed cancer was a death sentence, and the second item assessed whether respondents believed that health outcomes were inevitable and controlled by God. Othman et al. (123) measured respondents' belief in predestination. Both locus of control and fatalism, while consisting of different terminology in the literature, addressed the extent to which individuals believed they had control over their own health outcomes.

Table 1: Measures of R/S in the Literature

Study authors	R/S Measurement	Description
Fox et al., 1998	-Religiosity -Frequency of participation in church activities other than services -Frequency of participation at church services -Frequency of attendance of their spouse or partner at services -Religiosity	-Frequency of participation in church activities other than services*, attendance at services, and attendance of their spouse or partner at services was measured categorically with the following options: one month, or more -Religiosity was measured categorically with the following options: "very or extremely religious" or "somewhat religious (neither religious nor non-religious)"
Kinney et al., 2002	-God Locus of Health Control	-God locus of health control was measured with six items using six-point scale (1=strongly agree to 6=strongly disagree) – higher scores indicate a higher belief in god as a locus of control

Benjamins & Brown, 2004	-Religious salience -Religious denomination	-Religious salience was measured using the following question: "How important would you say religion is in your life; is it very important, somewhat important, or not too important?" – higher scores indicate higher levels of religious involvement -Religious denomination was measured categorically with the following options: Protestant, Catholic, Jewish and none.
Benjamins, 2006	-Frequency of religious service attendance -Religious denomination -Religious salience	-Frequency of religious service attendance was measured with the following categories: "More than once a week", "Once a week", "two or three times a month", "one or more times a year", or "not at all." -Religious denomination was measured with the following categories: Catholic, Evangelical Protestant, Mainline Protestant, Jewish, other religion, and non-affiliated. -Religious Salience: "How important would you say religion is in your life: is it very important, somewhat important, or not too important?"
Husaini et al., 2008	-Frequency of participation in church organizations	Frequency of participation in church organizations was measured using two items assessing frequency in church attendance and frequency in participation in other church activities*; all items were based on a three-point scale (1=seldom or never participates to 3=frequently participates).
McFall & Davila, 2008	-Attendance of church services	-Attendance of church services was measured with the following categories: Attends or Does not attend
Katz et al., 2008	-Religious affiliation -Frequency of church attendance -Spirituality	-Religious affiliation was measured with the following categories: Baptist, Holiness, Methodist, other or none. -Frequency of church attendance was measured with the following categories: high (attending church at least weekly), moderate (attending church less than weekly), or low (does not attend church). -Spirituality was measured using three questions assessing the frequency women asked God for help, proximity of their relationship to God, and extent to which their life had a religious purpose; responses to these questions were categorized as high, moderate, or low level of spirituality. Women who reported that very often they asked God for help in making decisions, had a very close relationship with God, and to a

		very large extent had a religious purpose for their life were labelled as highly spiritual. Women reporting never, seldom, or sometimes asking God for help making decisions, less than a close relationship with God, and to no or a small extent having a religious purpose for their life were labelled as having low spirituality. All other women were classified as having a moderate level of spirituality.
Holt et al., 2009	-Religious involvement	-Religious involvement was measured using a multidimensional approach incorporating a belief dimension involving spiritual beliefs and non-observable activities (ie. Feeling a close relationship with God, often aware of the presence of God in one's life) and a behavioural dimension characterized by observable spiritual behaviours and involving material from outside sources (ie. Reading religious materials, attending services). It was measured with seven items using a four-point scale (strongly agree to strongly disagree)
Steele-Moses et al., 2009	-Religiosity	-Religiosity was measured using the following nine items: "My spiritual beliefs are the foundation of my whole approach to life." "I rely on God to keep me in good health." "When I am ill, I pray for healing." "I often read religious books, magazines, or pamphlets." "I often watch or listen to religious programs on TV or radio." "I pray often." "I openly talk about my faith with others." "I have a personal relationship with God." "I am aware of the presence of God in my life." The nine items were measured with four-point scales ranging from "strongly agree" to "strongly disagree."
Azaiza et al., 2010	-Religious affiliation -Level of religiosity*	-Religious affiliation was measured categorically with the following options: Muslim or Christian *
Hatefnia et al., 2010	-Agreement/disagreement with two statements about religion and health	-Agreement/disagreement with the following statements: "Trying to keep one's health is a Muslim responsibility" "Spiritual health isn't separated from physical health"

		Agreement/disagreement was measured using a scale ranging from (1= disagreement or neutrality" to 3= "strong agreement"); religious beliefs were categorized into the following groups: low, medium and high.
Benjamins et al., 2011	-Religious service attendance	-Religious service attendance was measured with the following categorical options: at least once a week, nearly weekly, or monthly or less.
Allen et al., 2012	-Frequency of church attendance -Frequency of other activities (Related to church) -Religious support -Spiritual Health Locus of Control -Religious coping	-Frequency of church attendance and frequency of attendance at other church-related activities* was measured with categorical responses ranging from "Never" to "Every day" -Religious support was measured using two items assessing perceived positive religious support from members of the church community using a four-point scale ranging from "None" to "a great deal." -Spiritual health locus of control was measured using a scale assessing the belief that a higher power (ie. God) ahs control over one's health; three items were used to assess active spiritual health locus of control (whereby God plays a collaborative role in one's health), and three items were used to assess passive spiritual health locus of control (whereby respondents do not take protective health actions because they believe God is in sole control of their health). All items were measured using a four-point scale ranging from "Strongly disagree" to "Strongly agree." -Religious coping was measured using two scales to assess how people make use of religion to understand and cope with major problems in their life; three items were used to measure positive religious coping (ie. Benevolent religious methods of understanding and managing life stressors) using a four-point scale ranging from "Not at all" to "a great deal."
Nguyen et al., 2012	-Religiosity	-Religiosity was measured using a 20-item Religious Orientation Scale on a 5-point scale (1=strongly disagree to 5=strongly agree); religiosity was measured through three aspects: intrinsic, social extrinsic and personal extrinsic religiosity

Ochoa-Frongia et al., 2012	-Spirituality	-Spirituality was measured by asking respondents, "I rely on God to keep me in good health." Responses were measured using a four-point scale from "strongly disagree" to "strongly agree." Responses were then divided into two categories: strongly disagree/disagree or agree/strongly agree.
Othman et al., 2012	-Fatalistic beliefs	-Fatalistic beliefs were measured using the Fatalistic Scale modified for this study and consisted of four attitudinal items; a higher score indicated greater belief in predestination.
O'Reilly et al., 2013	-Religious affiliation	-Religious affiliation was determined using two questions included in the 2001 Census in Ireland. One of the questions determined affiliation categorically into the following groups: Roman Catholics, four Protestant groups (the Presbyterian Church in Ireland, Church of Ireland, Methodist Church in Ireland, and Other Christians), and no current religion.
Conway-Phillips & Janusek, 2014	-Spirituality	Spirituality was measured using the Spirituality Perspective Scale using a 10-item scale assessing a person's perspective on the extent to which spirituality pervades their lives and the extent to which they engage in spiritual related interactions; each item was rated using a 6-point scale (grater scores indicated greater spiritual perspective)
Brittain & Murphy, 2015	-Religiosity	*
Leyva et al. 2015	-Religious service attendance	-Religious service attendance: "Not including funerals and weddings, how often do you attend religious services?"
Melvin et al. 2016	-Religiosity	-Religiosity was measured using three scaled items (ie. It is important for me to pray before making decisions about cancer screening). No further details were provided.*
Padela et al., 2015	-Religiosity -Modesty -Perceived religious discrimination in healthcare -Fatalism	-Religiosity was measured using four items; one item asked respondents to rate their religiosity on a 10-point scale, another asked respondents their agreement with the following statement, "I try hard to carry my religious beliefs over into all my other dealings in life" on a five-point scale, two subscales including the positive religious coping and identification subscale and the Punishing Allah Reappraisal subscale from the PMIR.

		-Modesty was measured using eight items assessing behavioural and attitudinal components of modesty and was measuring using a rated scale. -Perceived religious discrimination in healthcare was measured using an adapted version of the DMS scale by replacing "other people or others" with "non-Muslims" to assess perceived religious discrimination. -Fatalism was measured using two items associated with breast cancer screening practices.
Sen & Kumkale, 2016	-Frequency of religious attendance -Religiosity -Locus of control	-Frequency of religious attendance was measured categorically from "Never" to "More than weekly" Religiosity was measured using a four-point scaled item (1= Not at all to 4=Very). -Locus of control was measured using five items; three items were regarding passive locus of control using a four-point scaled item (1=Often to 4=Never), one item was used to measure internal health locus of control on a seven-point scale (1=Strongly agree to 7=Strongly disagree), and one item to assess a collaborative dimension using a four-point scale (1=None to 4=A great deal).
Dickey et al. 2017	-Religiosity	-Religiosity was measured using the Religiosity Scale consisting of nine items measured on a four-point scale (1= "Strongly disagree to 4= "strongly agree"). A higher score indicates greater religiosity.
Glickasman & Glicksman, 2017	-Religious affiliation	-Religious affiliation was determined by categorizing respondents as Protestant, Catholic, Jewish, Muslim, Buddhist, None or Other. However, this publication only conducted analyses pertaining to Protestant, Catholic or Jewish affiliations.
Gyedu et al. 2017	-Religious affiliation	-Religious affiliation was determined by categorizing women as either Muslim or Christian
Lofters et al. 2018	-Religious affiliation	-Religious affiliation was categorized as a three-level variable with the following options: Muslim, other affiliation, and atheist/no religious affiliation
Speed, 2018	-Frequency of service attendance -Religiosity	-Frequency of service attendance was measured on a five-point scale (1= "Not at all" to 4= "At least once a week") answering the following question: "Not counting events such as weddings

-Religious affiliation	or funerals, during the past 12 months, how often did you participate in religious activities or attend religious services or meetings?" -Religiosity was measured on a four-point scale (1 = ''Not at all religious'' to 4 = ''Very religious'') answering the following question: ''In general would you say that you are…?'' -Religious Affiliation was measured categorically answering the following question: ''What is your religion? Specify only one denomination or religion even if you are not currently a practicing member of that group.'' – data from the CCHS grouped persons into three categories (Muslim, Hindu, Jew) and Non-religious.

* The authors did not provide a clear description of how R/S was measured in their study
Abbreviations: CCHS= 2012 Canadian Community Health Survey; PMIR=Psychological Measure of Islamic Religiousness

5.4 Breast Cancer

Screening behaviours related to breast cancer were most commonly discussed in the included studies (68–73,76–79,81,85,86,88,89,92–94,124). Of all the included studies, one contained a nationally representative sample recruited from the National Cancer Institute's 2005 Health Information National Trends Survey (74). The majority of the studies were conducted on samples of middle aged or older adults (69–71,75–81,83,85–89,92–94,124); this is expected as breast cancer screening guidelines for the general population are aimed at women 40 years of age or older. Six studies used samples of adults with ages running from 18 years and up (68,72,73,90,100,117); two of these studies sampled African (100) or African American (72) women who are known to have higher rates of death from breast cancer. Also, Kinney et al. (72) specifically sampled African American women who were known to have a BRCA1 mutation, which is associated with an increased chance of developing breast cancer.

Almost all studies used samples from the United States (68,70–76,79–81,83,86,88,89,92,93). Other studies contained participants from Palestine (69), Iran (94), Jordan (77), Ireland (78), Ghana (124) and

Canada (85,125). Husaini et al. (70) conducted a study among African American women in the United States who were recruited from church and community housing settings. Azaiza et al.'s (69) sample was quite different from the samples of other studies because it included women from Palestine whom the authors described as living under conditions of war.

Most studies of breast cancer screening behaviour used published clinical guidelines to assess women's adherence to tests such as mammography and CBE. Some studies asked participants whether they performed SBEs. A few studies measured motivation or intention to obtain breast cancer screening (77,92). Conway-Phillips & Janusek measured motivation for obtaining SBE, CBE or mammogram, in addition to actual screening. Othman et al. (77) measured the intention of obtaining a mammogram instead of actual screening.

Cross-sectional study designs were reported in 21 of the studies (68,69,72–80,83,85,86,88,92–94,124,125). The remaining study designs were cohort studies (81,89) or studies involving an intervention (70,71). Among the cross-sectional studies, 14 found R/S to be a statistically significant predictor of breast cancer screening (68,69,72–74,77,78,80,83,85,87,88,92,94,124,126). Many studies reported positive and statistically significant associations between R/S and breast cancer screening (68,72,74,78,80,83,85,87,88,92), although Azaiza et al. (69) reported the opposite. Azaiza et al.'s results could be explained by their unique sample of women from Palestine, who were different in terms of culture, setting, and life experience from the other samples of women in the included articles.

Sen & Kumkale (86) showed that R/S was not a statistically significant predictor of mammography in logistic regression analysis; in all models which included religiousness variables, including religious attendance, religiosity and locus of control, odds ratios were reported with corresponding confidence intervals including one. They (86) also used decision trees to classify women who did and did not obtain mammograms. Their results showed that incorporating personality and religiousness into decision trees allowed for 22% accuracy in classifying women's mammography status (either those who had or had not received a mammogram). Sen & Kumkale constructed two additional decision trees, one of which contained women's demographic characteristics, and the other which incorporated all attributes of interest in their

analysis. The decision tree incorporating personality and religiousness was better able to predict mammography than the decision tree based on demographics; however, the 'all attributes' decision tree was superior to both of the other trees.

While neither of the two studies which conducted RCTs Husaini et al. (70) and Katz et al. (71) found a statistically significant association between R/S and breast cancer screening, both reported positive results. Two studies used a longitudinal design to investigate whether R/S influenced breast cancer screening. Benjamins (89) used data from the National Cancer Institute's 2005 Health Information National Trends Survey (89) to examine a nationally representative sample of employed and community-dwelling Presbyterian older adults residing in the United States. Using logistic regression and two waves of follow-up spaced two years apart, Benjamins (89) found that different constructs of R/S, including religious service attendance, religious denomination and religious salience, were significantly and positively associated with mammography and SBE. Steele-Moses et al. (81) also found a statistically significant positive association between R/S and breast cancer screening. These results are important as these studies were able to retain temporality with the use of longitudinal designs.

Benjamins (89) also conducted mediation analyses and used participant's marital status, and self-rated satisfaction with family and friends, as measures of social support. While the author found no evidence of mediation in the study, these measures of social support were not comprehensive. Social support involves a complex array of structural and functional components (127).

Structural social support is a count of the number of people in one's social network, and a count of the number of social activities one joins over the course of a specified timeframe; functional social support is the extent to which the people in one's social network can be counted upon to provide emotional support or practical help in times of need. An individual's social support cannot be adequately ascertained through a limited scope of questions.

5.5 Prostate Cancer

Five American studies examined prostate cancer screening behaviour and R/S (75,80,82,83,95) (Table 1, Appendix B). Holt et al. (95) conducted their study on African American men whose mean age was 57.9 years. Benjamins & Brown (80) studied a sample drawn from the Asset and Health Dynamics Among the Oldest old (AHEAD) study, which included non-institutionalized older adults with a mean age of 77.3 years. McFall & Davila (75) studied a sample of the elderly from the Longitudinal Study of Aging II (LSOA II), with the mean ages for men and women being 74.0 and 74.9 years, respectively. Dickey et al. (82) studied a sample of African American men with a mean age of 51 years and recruited from Northeastern Florida, and Glicksman & Glicksman (83) studied a large sample of white, Jewish, Catholic or Protestant men with a median age of 72 years. Interestingly, Benjamins & Brown (80), McFall & Davila (75), and Glicksman & Glicksman (83) contained samples of participants with average ages older than the US Preventive Services Task Force's working guideline for prostate cancer screening (55 to 69 years) (128).

Of the five studies, only Holt et al. (95) and Dickey et al. (82) were explicit in stating the specific types of prostate screening behaviour that were being measured, namely PSA and DRE. Benjamins & Brown (80) did not explicitly mention any prostate cancer screening tests, and instead asked participants generally whether they had undergone prostate cancer screening in the past two years. Glicksman & Glicksman (83) asked participants whether they had undergone prostate cancer screening as recommended, although details regarding recommendations were not provided. Similarly, McFall & Davila (75) asked participants how long it had been since they were last examined for prostate cancer.

Four of the five studies exploring prostate cancer screening behaviour were cross-sectional; these studies found positive influences of R/S on prostate cancer screening for men (75,80,83,95). Benjamins & Brown (80) reported that religious-affiliated men had greater odds of prostate cancer screening than non-affiliated men. McFall & Davila reported a significant association between church attendance and prostate cancer screening (75). Holt et al. (95) showed that while religious beliefs were not a significant predictor of DREs, men who engaged in religious behaviours (e.g., attending services or reading religious materials)

were more likely to have had a DRE within the past 12 months (DRE utilization ≤12 months, OR: 1.70, 95%CI: 1.12-2.59).

Dickey et al. (82) were the only group to explore R/S and prostate cancer using a study design that was not cross-sectional. They used a quasi-experimental study of African American men aged 40 years or over that included an intervention group consisting of educational materials about prostate cancer and the benefits of screening. The men in the control group did not receive any educational materials. Dickey et al. (82) showed that a greater proportion of men in the intervention group obtained prostate cancer screening after six months, compared to men in the control group; further, religion was correlated with prostate cancer screening (Spearman's rank correlation coefficient (*rs)*=0.353, $p<0.01$).

5.6 Colorectal Cancer

Five North American studies included in Table 1 Appendix B considered R/S factors and colorectal cancer screening (68,74,87,90,91). Three of the five studies included samples of individuals at least 18 years of age or older (68,74,90). Brittain & Murphy (91) restricted their sample to adults at least 50 years old or older. The remaining study by Lofters et al. (87) reported a mean age of 40 years (standard deviation: 13.9) for their sample.

All studies were conducted in the United States (68,74,90,91), except for Lofters et al. (87), which was undertaken in Ontario, Canada. Benjamins et al. (90) and Leyva et al. (74) studied the association between R/S and colorectal cancer screening on samples taken from a national panel survey of individuals affiliated with the Presbyterian Church, and from the National Cancer Institute's 2005 Health Information National Trends Survey, respectively. Allen et al. (68) and Brittain & Murphy (91) recruited participants from Boston and an unspecified Midwest city, respectively.

All studies assessed specific colorectal cancer screening behaviours, including screening with colonoscopy. Brittain & Murphy (91) and Lofters et al. (87) measured adherence to fecal occult blood test (FOBT) and colonoscopy, while Allen et al. (68) measured adherence to FOBT and both sigmoidoscopy

and colonoscopy; all three of these studies measured adherence to screening tests by asking participants whether they were up-to-date with their screening tests. However, Brittain & Murphy (119) also assessed adherence by asking participants whether they 'ever had' a FOBT or colonoscopy, in addition to determining whether they were up-to-date on their testing. Benjamins et al. (90) measured only colonoscopy utilization. Leyva et al. (74) measured FOBT and whether participants had a colonoscopy or sigmoidoscopy.

All studies were cross-sectional in design (68,74,87,90,91) and indicated positive associations between R/S and colorectal cancer screening. Of these cross-sectional studies, Benjamins et al. (90) and Lofters et al. (87) did not detect any statistically significant results to support an association between R/S and colorectal cancer screening. While Benjamins et al. (90) found a significant crude association between religious service attendance and colonoscopy, this effect was not maintained after controlling for confounders. Allen et al. (68), Brittain & Murphy (91) and Leyva et al. (74) detected significant associations between R/S and cancer screening. Brittain & Murphy considered both colonoscopy and FOBT, but reported a significant association between religiosity and colonoscopy only (91). In addition to finding a significant association between religious service attendance and colorectal cancer screening, Leyva et al. (74) also conducted mediation analysis and reported that the path between R/S and colorectal cancer was partially mediated through social support. They measured social support using three items asking about social networks (membership in social networks, emotional support from friends or family, and the extent to which one can rely on people living nearby who can offer assistance). Of course, Leyva et al.'s (74) results must be tempered by questions about the validity of conducting mediation analyses with cross-sectional data (129,130).

Allen et al. (68) detected a significant association between positive religious coping and age appropriate cancer screening. The results for Allen et al. (68) were not limited to colorectal cancer only; they also explored the association of R/S to screening for breast and cervical cancer. Allen et al. (68) reported combined results for colorectal, breast and cervical cancer.

5.7 Screening Behaviour Summary

Overall, 24 studies measured the association between R/S and breast cancer screening (68–81,83,85–89,92–94,124), and 14 of them were able to detect significant associations (68,69,72–76,80,81,83,85,87–89,92–94,124). Five studies measured the association between R/S and prostate cancer screening, and all of them detected significant associations (75,80,82,83,95). Five studies measured the association between R/S and colorectal cancer screening (68,74,87,90,91), and three of them were able to detect significant associations (52,56,65). Of the studies that detected statistically significant associations between R/S and cancer screening, only Azaiza et al. (69) found a negative association: Palestinian women in the West Bank who were more religious had lower odds of screening compared to women who were less religious. Breast cancer was the most commonly reported preventive service measured and was also the only type of outcome to be included in studies with designs other than cross-sectional.

5.8 Confounders

The most common potential confounders in the 28 studies included in the literature review were age (68,70–75,78–80,82,85–90,92–95,124), education (69,74,75,79–83,85,86,88–90,93–95,124), marital status (71,78,80,81,83,85,88,90,93–95,124), income (72–75,80,82,83,85,87–89,94), race (71,75,80,85,86,88–90,93), ethnicity (80,89,90,93), gender (75,80,87,90), self-rated health (75,78,80,90), socioeconomic status (SES) (70,71,78,92) and health insurance status (73,74,82,83,88–90,93). Additional confounders are reported in Table 2, Appendix B. Race and ethnicity were sometimes measured separately in different studies (80,90,93).

5.9 Conclusion

There was a lack of consistency in the definitions, measures, and terminology used to operationalize R/S in the literature. For example, some studies assessed R/S through ‘religiosity’ and others through ‘religious salience.’ While the terminology of the two constructs differs between the studies, the core

meaning behind the two terms captured a similar idea: both religiosity and religious salience, as reported in Table 2, captured the subjective importance of religion and spirituality in participants' lives.

In some cases, the measure of the same R/S variables was not consistent between different studies. Continuing with the example of religiosity, the use of different measurement tools between studies limited the ability to compare the same concept between different studies. Furthermore, it was unclear how these varying definitions of R/S impacted the interpretation of the association with cancer screening. Some studies exhibited a lack of clarity in reporting how exactly certain R/S constructs were measured, adding further complexity to interpreting the association between R/S and cancer screening.

Only two studies considered spirituality separately from religion (102,122). Although both studies sought to assess the extent to which spirituality was pervasive in people's lives, they utilized different measures of the construct (see Table 1). Overall, the literature revealed that religion and spirituality are complex and malleable constructs, and no universally agreed-upon definitions exist. As such, measures of R/S vary across studies, and the psychometric properties of some measures are uncertain.

Most of the literature discussing R/S and cancer screening was cross-sectional in nature, limiting readers' ability to ascertain whether beliefs in R/S preceded cancer screening. Many studies also recruited highly select samples, e.g., women from specific minority populations, thereby reducing our ability to compare results across studies, and limiting the ability to estimate an average effect of R/S on cancer screening. Many of the studies reported positive associations between R/S and cancer screening, though these associations did not always reach statistical significance at the 5% level. The median sample size of studies reported in Table 1 (Appendix B) consisted of 474 participants (range: 52-32,211). The absence of significance might partially be the result of low statistical power because some studies reported small sample sizes: three studies reported samples of less than 100 participants (68,82,110), five studies reported samples between 100 and 200 participants (73,91,96,97,107) and six studies recruited samples between 200 and 500 participants (69,81,99,101,108,112). The remaining studies recruited between 550 and 32,211 participants. One study did not report the sample size (118).

Overall, the main limitations of published studies in the field included a lack of clarity and consistency in defining R/S constructs, small sample sizes, highly select populations, absence of consistent controls for relevant confounders (e.g., social support), and use of cross-sectional study designs. This thesis proposes to address these limitations by clearly defining all constructs that will be used as part of the analysis, conducting analyses on a relatively large sample obtained from a longitudinal Canadian study, increasing the scope of the sample by including middle aged adults (in addition to older adults) regardless of sex, race, ethnicity or culture, and controlling for relevant confounders, as informed by the literature (including social support).

Chapter 6
Methods

6.1 Overview of Data

The data for this thesis came from ATP, a longitudinal cohort study designed to investigate risk and protective factors for cancer and other chronic conditions such as diabetes or cardiovascular disease (1). ATP enrolled participants aged between 35 and 70 years who had no known history of cancer besides non-melanoma skin cancer. ATP used mail surveys to collect data, with questions adapted from validated tools such as the 2001 California Health Interview Survey (131) for questions regarding mammograms, PSA tests and sigmoidoscopy/colonoscopy, the Canadian Community Health Survey (CCHS) (132) for R/S related questions, the Canadian National Workshop on Data for Monitoring Tobacco Use (133) for questions about tobacco exposure, and the Medical Outcomes Study (MOS) questionnaire (134) for questions about social support.

6.2 Recruitment of Participants into Alberta's Tomorrow Project

As a sampling frame, ATP used Regional Health Authorities (RHAs) as the prime geographical base for recruitment. RHAs are regional administrative units in Alberta that are designed to deliver public healthcare to Albertans. RHAs allowed ATP to estimate the distribution of eligible participants from Alberta based on age, ensuring a balanced recruitment process across the province. To identify eligible participants, ATP employed a two-stage sampling design. Random digit dialing (RDD) was used as the first stage, selecting households within the RHAs. The second stage of the sampling design involved selecting one or two eligible individuals residing within a household, whether they were related or not. Sampling was conducted by the Population Research Laboratory at the University of Alberta (1).

Individuals recruited through RDD were mailed the self-administered Health and Lifestyle Questionnaire (HLQ) at baseline, as well as a detailed consent form. If participants completed and returned both the HLQ and consent form, then they were enrolled in ATP (1). Besides age and cancer history, ATP

recruited participants who had plans to reside in Alberta for a period of at least one year and who could complete questionnaires in English.

Data for this thesis came from multiple surveys used throughout ATP. Baseline data came from the HLQ, which all ATP participants completed. After baseline, this thesis included three follow-up periods using four ATP surveys: Survey 04 (S04) at follow-up 1, Survey 08 (S08) at follow-up 2, and either the Updated Health or Lifestyle Questionnaire (UHLQ) or Core Questionnaire at follow-up 3. In total, the thesis included a maximum of four data points for each participant. However, the exact number of data points depended on the calendar date of participant recruitment, as discussed in Section 6.3.

6.3 Baseline data collection in Alberta's Tomorrow Project

ATP conducted rolling recruitment of participants, with the first wave of recruitment occurring between 2001 and 2003, a second wave between 2004 and 2007, and a third wave between 2008 and 2009. Participants enrolled during the second wave did not receive the first follow-up survey, S04, and would complete a maximum of two follow-ups after baseline (HLQ, S08, UHLQ/Core [see section 6.4.1]). Participants enrolled between 2008 and 2009 did not receive the second follow-up survey, S08, and would complete a maximum of one follow-up after baseline (HLQ, UHLQ/Core [see section 6.4.2]).

The HLQ contained items relating to personal health, reproductive history, family history, psychosocial factors, anthropometric measures, use of cancer screening services, smoking behaviour, sun exposure and socio-demographic characteristics.

6.4 Follow-up Questionnaires in Alberta's Tomorrow Project

6.4.1 Survey 2004

S04 was the first follow-up questionnaire and it was designed to update information collected at baseline for participants who joined ATP between 2000 and 2003. S04 contained additional items about lifetime history of shift work, quality of life related to heath, exposure to sun, second-hand smoke, and

alcohol consumption. Sources of items in S04 were from large-scale population studies in the USA, such as the Medical Outcomes Study (MOS) (134), Non-Hodgkins Lymphoma Study (135), Nurses' Health Study (136), National Health and Nutrition Examination Survey (137), Women's Health Initiative randomized controlled trial (138), and the Women's Interview Study of Health (139).

6.4.2 Survey 2008

The second follow-up questionnaire was S08, where participants were invited to update information regarding their health and lifestyle. S08 was mailed to participants who were enrolled in ATP between 2000 and 2007. Therefore, S08 served as the second follow-up for participants enrolled between 2001 and 2003, and the first follow-up for participants enrolled between 2004-2008. Participants enrolled between 2008 and 2009 did not complete S08, but they did complete the HLQ.

6.4.3 Alberta's Tomorrow Project and the Canadian Partnership for Tomorrow Project

In 2008, ATP merged with a pan-Canadian cohort called the Canadian Partnership for Tomorrow Project (CPTP) (1,2). A number of other Canadian studies joined CPTP, including the BC Generations Project in British Columbia (140), CARTaGENE in Quebec (141), the Ontario Health Study in Ontario (142), and the Atlantic provinces' Atlantic Partnership for Tomorrow's Health Study (Atlantic PATH) (143). The purpose of this partnership was to create a larger dataset of individuals by harmonizing data collection across the individual studies.

At the time of the merger, all ATP participants were invited to join CPTP, and those who did received the UHLQ or Core as a follow-up survey. Participants who were recruited from Alberta after the merger, between 2009 and 2015, completed the UHLQ or Core as their baseline assessment.

6.4.4 Updated Health and Lifestyle Questionnaire

The UHLQ contained items asking about participants' personal and family health histories, health check-ups, reproductive health, medication use in the past year, alcohol, smoking, sun exposure, sleep,

work and demographic information (1). The UHLQ was based on the HLQ. The Core questionnaire contained items asking about participants' personal and family medical history, current medication use, demographic characteristics, cancer screening tests, reproductive health, sleep, sun exposure, food consumed, alcohol, smoking, physical activity, work and body measurements (1).

6.5 Exposure Variables

The main exposure of interest in the thesis was religiosity/spirituality (R/S). R/S was measured via three variables in the HLQ at baseline. The first R/S variable, referred to as R/S Salience, asked: "Do spirituality values or faith play an important role in your life?" Participants responded "Yes" or "No". The "No" response option was chosen as the reference category for regression analyses.

The second R/S variable, R/S Perceived, asked about each participant's self-perceived level of R/S: "How religious or spiritual do you consider yourself to be?" Participants could respond: "Not at all", "Not very", "Moderate" or "Very". "Not at all" was chosen as the reference category.

The third R/S variable, R/S Attendance, asked about participants' religious or spiritual attendance: "Other than on special occasions (such as weddings, funerals or baptisms), on average, how often have you attended religious services or religious meetings in the past 12 months?" Participants responded: "About once a week", "At least once a month", "At least 3 or 4 times a year" or "Not at all".

Given the rolling recruitment in ATP, the HLQ was updated over the course of the study. As such, participants recruited into the study at alternate dates received slightly different versions of the R/S Attendance question. For the third version of the HLQ, the question read: "People may practice or express their spirituality in many different ways, for example through prayer or meditation, or by attending services or gatherings. On average, during the past 12 months how often have you practiced your spirituality in some way?" The available responses changed to: "Daily or almost daily", "At least once a week", "At least once a month", "At least 3-4 times a year", "At least once a year" or "Not at all".

The response patterns between both versions of R/S Attendance were similar enough to permit combination for analysis in the thesis. The categories "Daily or almost daily" and "At least once a week"

were collapsed into the category “About once a week” to reflect the responses of the first version of R/S Attendance. Therefore, the definitive version of R/S Attendance for this thesis had the following response options, “About once a week”, “At least once a month”, “At least 3 or 4 times a year” and “Not at all”. The “Not at all” response option was chosen as the reference category.

Preliminary analysis determined that enough similarity existed between R/S Salience and R/S Perceived to permit use of just one of these variables in the thesis (see Appendix C). The contingency table (Table 1, Appendix C) shows that individuals who reported religion or spirituality as being important to them also tended to report being either moderately or very spiritual/religious, and individuals who did not report religion or spirituality as being important to them tended to report being not very, or not at all, religious ($p<0.0001$). Eighty-two percent of individuals who reported being not very, or not at all, spiritual/religious for R/S Perceived also reported that they did not identify as spiritual/religious for R/S Salience. Ninety-three percent of individuals who reported being moderately or very spiritual/religious for R/S Perceived also reported that they identified as spiritual/religious for R/S Salience. Given these findings, the thesis candidate used R/S Salience in her statistical analyses instead of R/S Perceived. Indeed, R/S Salience was dichotomous and therefore more apt to avoid issues of small cell counts in regression analyses.

R/S Salience and R/S Attendance were thought to measure inherently distinct aspects of R/S, which justified their consideration as separate variables in the thesis. As such, separate regression analyses were undertaken for each of these two R/S variables as exposures.

6.6 Outcome Variables

Outcome variables were breast, colorectal, or prostate cancer screening behaviour, assessed longitudinally at each survey point in ATP. Phrasing of the screening questions is shown in Table 2. While the wording of the questions differed slightly across ATP’s various questionnaires, the inherent meaning and intent of the questions did not change (see Sections 6.6.1 – 6.6.4 below).

Table 2: Outcome Variables Across ATP Surveys

	HLQ	S04	S08	UHLQ	Core
Mammography	"Have you ever had a mammogram (a breast x-ray)?"	"Since you joined the study, did you have a mammogram (a breast x-ray)?"	"Did the participant ever have a mammogram?"	"Have you ever had a mammography or mammogram?"	"When was the last time you had a mammogram?"
Prostate specific antigen	"Have you ever had a 'Prostate Specific Antigen' test for prostate cancer?"	"Since you joined the study, have you had a Prostate Specific Antigen (PSA) test?"	"Did the participant ever have a prostate specific antigen blood test?"	"Have you ever had a PSA blood test?"	"When was the last time you had a PSA blood test?"
Colonoscopy/ sigmoidoscopy	"Have you ever had a sigmoidoscopy or colonoscopy done?"	"Since you joined the study, have you had a sigmoidoscopy?" "Since you joined the study, have you had a colonoscopy?"	"Did the participant ever have a sigmoidoscopy?" "Did the participant ever have a colonoscopy?"	"Have you ever had a sigmoidoscopy or colonoscopy?"	"When was the last time you had a sigmoidoscopy?" "When was the last time you had a colonoscopy?"

Abbreviations: HLQ= Health and Lifestyle Questionnaire; S04= Survey 2004; S08= Survey 2008; UHLQ= Updated Health and Lifestyle Questionnaire

6.6.1 Baseline Outcome Variables

At baseline, all screening questions in the HLQ asked whether participants "ever had" a particular type of screening. Response options included "Yes", "No", "Don't know" or "Not applicable". The thesis candidate treated "Don't know" or "Not applicable" responses as missing values. The "No" response option was chosen as the reference category.

6.6.2 S04 Follow-up Outcome Variables

The next follow-up questionnaire was S04. The cancer screening variables in S04 asked whether participants had undergone breast, prostate, or colorectal cancer screening since the HLQ (Table 3). Response options included “Yes”, “No”, “Don’t know”, or “Not applicable”. “Don’t know” or “Not applicable” responses were coded as missing values.

In the HLQ and UHLQ, the colorectal cancer screening variable was only one question asking whether participants ever had a sigmoidoscopy or a colonoscopy; in S04, S08, and Core, there were two separate questions, one for each test. To remain consistent with the information collected at baseline, the two colorectal cancer screening variables in S04, S08, and Core were combined to create a new variable: participants who received either a sigmoidoscopy or colonoscopy (or both) were recorded as “Yes” on the new combined variable, and participants who did not receive either test were recorded as “No”.

During S04, participants were also asked whether they had received a virtual colonoscopy. While a virtual colonoscopy is a form of colonoscopy available for individuals to undergo as a screening option, a virtual colonoscopy is too substantively different from a traditional colonoscopy to be considered as the same type of test (144,145). Therefore, the thesis excluded the virtual colonoscopy question.

6.6.3 S08 Follow-up Outcome Variables

The second follow-up survey for participants in the ATP was S08. The screening questions at S08 asked whether participants ever had a screening test (Table 3). This was different from S04, where participants were asked whether they had engaged in a screening test since the last follow-up period.

Available answers for participants were “Yes”, “No”, “Maybe” or “Don’t know”. Participants for whom the sex-specific screening questions were not applicable were instructed to move onto the next section in the survey. Responses of “Maybe” or “Don’t know” were treated as missing values.

Since the phrasing of the question asked participants whether they “ever had” a specific screening test, the thesis candidate could not accurately assess the incidence of a new screening test since the previous

survey period. Therefore, an algorithm was created to determine participants' screening status between S08 and their previous survey:

1. If a participant responded with "Yes" in their previous survey, but "No" at S08, then they were recorded as "No" during S08.
2. If a participant responded with "No" in their previous survey, but "Yes" at S08, then they were recorded as "Yes" at S08.
3. If a participant responded with "No" both in their previous survey and in S08, then they were recorded as "No" at S08.
4. If a participant responded with "Yes" both in their previous survey and in S08, then they were recorded as "Yes" at S08.

A participant's previous survey can refer to either the HLQ or S04, depending on when they were recruited. It should be noted that one cannot be certain whether participants who responded with "Yes" at both their previous survey and S08 received a screening test between these two surveys (condition 4 above). For the purpose of this thesis, the thesis candidate assumed condition 4 was true.

6.6.4 UHLQ/Core Follow-up Outcome Variables

The third follow-up period contains data from two surveys, either the UHLQ or Core. Cancer screening questions during the UHLQ asked participants whether they ever received a mammogram, PSA test, or sigmoidoscopy/colonoscopy (Table 3). Participants were provided with the option of answering "Yes", "No", or "Don't know". "Don't know" responses were treated as missing values.

Since the UHLQ inquired about whether participants ever had a screening test, the responses to these questions were re-categorized based on participants' previous screening history, as they had reported in the earlier ATP surveys. The algorithm based on the conditions mentioned in Section 6.6.3 above was used; in this instance, a participant's previous follow-up was dependent on their recruitment data and whether they received S04 or S08.

The Core Questionnaire asked participants about the timing of their last screening test (Table 3), rather than whether they ever had a screening test, or whether they received a screening test since the previous survey. For each screening question, participants were provided with the options, “Less than 6 months ago”, “6 months to less than 1 year ago”, “1 year to less than 2 years ago”, “2 years to less than 3 years ago”, “3 or more years ago”, “Never”, or “Don’t know”. To maintain consistency with the previous surveys, responses to these questions were converted into binary answers of “Yes” or “No”. Participants who responded with “2 years to less than 3 years ago”, “3 or more years ago” or “Never” were re-categorized to “No”. Participants who responded with “Less than 6 months ago”, “6 months to less than 1 year ago” or “1 year to less than 2 years ago” were re-categorized to “Yes”. This categorization assumed that ATP participants had at least a two-year gap between S08 and the Core Questionnaire. The assumption was necessary because ATP would not release precise survey completion dates due to privacy concerns.

6.7 Covariates

Covariates were chosen based on commonly reported covariates in the studies retrieved in the literature search, provided they were available in the HLQ. The covariates ultimately included in the thesis were marital status, education, income, employment status, sex, age, smoking status, self-rated health, stress, and social support.

6.7.1 Marital Status

Marital status included six possible response options: “married”, “divorced”, “not married, but living with someone”, “separated”, “widowed”, and “single, never married”. The variable was re-categorized to include fewer response options: “In a relationship” if participants reported being “married” or “not married, but living with someone”; “Not in a relationship” if they reported being “divorced”, “separated”, “widowed”, or “single, never married”. The HLQ did not provide participants with the option of being in a relationship, but not married or not living together. Therefore, one cannot be certain whether

all participants who reported “divorced”, “widowed” or “single, never married” were in a relationship when they completed the HLQ. The “Not in a relationship” response option was chosen as the reference category.

6.7.2 Highest Level of Education Achieved

The HLQ asked about participants’ highest level of education. Participants were provided with nine different options: “Did not complete Grade 8”, “Completed Grade 8, but not high school”, “Completed high school”, “Some technical school/college training completed”, “Completed technical school/college training”, “Some part of university degree completed”, “Completed university degree”, “Some part of post-graduate university degree completed”, or “Completed university post-graduate degree”. This variable was re-categorized by collapsing the original nine options into three: 1) “High school or less” if participants originally responded with “Did not complete Grade 8”, “Completed Grade 8, but not high school” or “Completed high school”; 2) “Some post-secondary” if participants originally reported “Some technical school/college training completed”, “Completed technical school/college training”, or “Some part of university degree completed”; and 3) “At least one university degree” if participants originally reported “Completed university degree”, “Some part of post-graduate university degree completed”, or “Completed university post-graduate degree”. The “High school or less” response option was chosen as the reference category.

6.7.3 Income

Income was determined by asking participants about their total annual pre-tax household income in the year before they completed the HLQ. Participants were provided with eleven available options ranging from “less than $10,000” to “$100,000 or more”. This variable was re-categorized into a new variable with four responses: “less than $40,000”, “$40,000-$69,999”, “$70,000-$99,999”, and “$100,000 or greater”. The income variable was re-organized in this manner because the proportion of participants was relatively equal across the four categories. The “Less than $40,000” response option was chosen as the reference category.

6.7.4 Sex

Respondent's sex was determined by asking whether they were male, female, or transgender. The dataset contained only one participant who reported being transgender; the thesis candidate removed this individual from the analysis to avoid the challenge of low cell counts. Males were chosen as the reference category.

6.7.5 Age

Participants recorded their age at the time they completed the HLQ. The age variable was continuous.

6.7.6 Smoking Status

The HLQ contained several variables related to smoking. To remain consistent with previous literature (71), the thesis candidate reduced an eight-level ATP variable into four levels for the thesis. The original ATP variable had the following response options: "Daily", "Occasional/former daily", "Occasional/never daily", "Occasional/unknown daily", "Current non/former daily", "Current non/former not daily", "Current non/former daily unknown", or "Never". Participants who reported "Daily", "Occasional/former daily", "Occasional/never daily", or "Occasional/unknown daily" were re-categorized as "Current smokers". Participants who reported "Current non/former daily", "Current non/former not daily", "Current non/former daily unknown" were re-categorized to "Former smokers". Participants who reported having never smoked were classified as "Never smokers". Participants identifying as "Current smokers" were chosen as the reference category.

6.7.7 Self-Perceived Health Status

Self-perceived health of participants was determined by asking participants whether they thought their general health was "Excellent", "Very good", "Good", "Fair" or "Poor". However, very few

participants responded with either “Fair” or “Poor”, so these categories were combined into the “Good/fair” category. The “Good/fair” response option was chosen as the reference category.

6.7.8 Functional Social Support

Nineteen functional social support questions were also included in the HLQ, taken from the 19-item Medical Outcomes Study-Social Support Survey (MOS-SSS) (134). Question responses were on a 5-point Likert scale: “None of the time”, “A little of the time”, “Some of the time”, “Most of the time”, or “All of the time”. To create an overall social support score for participants (146), response options for each social support item were given a numerical value ranging from 1 (“None of the time”) to 5 (“All of the time”). Each participant’s overall social support score was computed by calculating the average score across all 19 items on the survey. Lower scores indicated less available functional social support.

6.7.9 Employment Status

The HLQ asked participants to describe their employment status as “Working full-time”, “Working part-time”, “Not employed, but looking for work”, “Homemaker”, “Student”, “Retired”, or “Other”. This item was re-categorized to reflect being either “Employed Full-time or Part-time”, or “Other”. Participants who originally responded with “Working full-time” or “Working part-time” were re-categorized as “Employed full-time or part-time”. Any other response was re-categorized as “Other”. The “Other” response option was chosen as the reference category.

6.8 Analysis

6.8.1 Exploratory Data Analysis

The analytical sample for this thesis only included participants who answered at least one of the R/S questions and at least one of the screening questions. Before any data analysis occurred, the data were

cleaned such that cells with blank values or responses such as “Don’t know” or “Not applicable” were marked as missing.

All data were explored descriptively using means, standard deviations, and histograms for continuous variables, and bar charts and frequency tables for categorical variables. Baseline analysis using chi-square testing was conducted to compare the distributions of R/S Salience and R/S Attendance responses by ‘yes/no’ responses to breast, prostate and colorectal cancer screening. In addition, unadjusted odds ratios for these baseline comparisons were calculated. All baseline analyses were conducted in SAS v9.4 (The SAS Institute, Cary NC). The thesis candidate made no *a priori* assumptions about which R/S variable would be more strongly associated with cancer screening outcomes.

6.8.2 Regression Modelling

6.8.2.1 Baseline Regression Modelling

Logistic regression was used to model the association between R/S and breast cancer screening. R/S Salience and R/S Attendance were analyzed in separate models. The covariates described in Section 6.7 above were grouped into ‘blocks’ based on similarity. Each block was tested in a separate regression model with R/S and screening. The covariate blocks were:

- Social support, which formed a separate block because of the possibility that it represented the mechanism by which R/S influences screening (see Section 3.2 above);
- Socio-demographic, which included income, education, occupation, age, sex and marital status; and
- Health-related, which included perceived health status and smoking status.

Baseline cross-sectional models were conducted using the PROC LOGISTIC procedure in SAS v9.4 (The SAS Institute, Cary NC).

6.8.2.2 Longitudinal Regression Modeling

Generalized linear mixed modelling (GLMM) was used to model the longitudinal associations pertinent to this thesis. All longitudinal models had intercept and time variables as random effects to reflect the longitudinal nature of the study objectives, with the only exception being, by definition, the Unconditional Means Models (see Section 6.8.4). A random intercept incorporated in the models allowed for the between-subject variation present within the outcome to be accounted for. This variation resulted from the fact that each participant who was followed-up longitudinally had more than one recorded response on the screening variables. R/S Salience and R/S Attendance were used in separate sets of regression models. Within each set of models, PSA testing, and sigmoidoscopy/colonoscopy screening were analyzed as the outcomes. The covariates were incorporated into the longitudinal modeling in the same manner as described in Section 6.8.2.1 above.

GLMM was used for longitudinal models to handle monotone missing patterns (due to participant dropouts) in the outcome variable, with the assumption that missing data were missing at random (MAR). To conduct the longitudinal modeling, the GLIMMIX procedure was used in SAS v9.4 (The SAS Institute, Cary NC). The thesis candidate implemented the procedure using a binary distribution and a logit link.

6.8.3 Time

Due to rolling recruitment and differences in the number of surveys completed by each participant, the interval between follow-ups was not equidistant across all participants. Therefore, the longitudinal analysis was not based on calendar time (dates when surveys were completed), but on chronological order according to the number and sequence of completed follow-up surveys. The follow-up time periods for participants were identified as “Follow-up 1”, “Follow-up 2”, or “Follow-up 3”, as shown in Table 2.

Exploratory data analysis of R/S and cancer screening status with respect to time was conducted; log-odds trend plots (of screening) were created to capture average cancer screening patterns over time, depending on the exposure (see Figures D.1 to D.8, Appendix D). These plots helped visualize the best

method of accounting for time as a variable when modeling exposures and outcomes in the longitudinal ATP dataset.

The log-odds trend plots suggested a mix of linear or curve-linear patterns of time. In the case of curve-linear trends, we transformed the time variable by taking its square root ($\sqrt{time}$). Our exploratory data analyses of the trend plots suggested that the association between R/S Attendance and prostate cancer screening would be optimally modeled with a $\sqrt{time}$ trend, while the other relations would be optimally modeled with a linear time trend.

6.8.4 Model Building and Model Selection Process

Seven base models were structured for each exposure variable and cancer screening outcome.

Model 1: An unconditional means model containing no predictor variables and screening as the outcome. Using the unconditional means model, the intra-class correlation coefficient (ICC) was calculated to determine how much of the variation in screening behaviour over time was accounted for by the ATP participants themselves.

Model 2: A growth model incorporating the appropriate time-trend variable from Section 6.8.3 above as the only independent variable to assess the average effect of participants on cancer screening behaviour over time. Models 3 to 7 all incorporated time-trend variables.

Model 3: The Base Model, consisting of the variables from Model 2 and an R/S variable as the main exposure.

Model 4: In addition to Model 3, this model included social support as the covariate block.

Model 5: In addition to Model 3, this model included the socio-demographic covariate block, namely income, education, occupation, age, sex and marital status.

Model 6: In addition to Model 3, this model included the health-related block, including perceived health status and smoking status.

Model 7: This model contained Model 3 and each of the covariate blocks described in Models 4-6 above.

For cross-sectional models involving mammography, the following criteria determined the models of best fit: Bayesian Information Criterion (BIC) (lowest value), magnitude of change in the regression coefficient estimates for R/S and c-statistic (highest value) (147). BIC was chosen over Akaike Information Criterion (AIC) because it leads to a more parsimonious model. With BIC, one is more likely to choose a model that balances the fewest number of predictor variables and a greater level of prediction for the outcome variable. Since BIC values can decrease as more variables are added to regression models, therefore adversely affecting an analyst's ability to choose the best-fitting model, we also looked at the magnitude of change in the parameter estimates for R/S as a second criterion for choosing the best-fitting model.

The magnitude of change criterion involved comparing the parameter estimates of the main effect (R/S) variable in Models 4 to 7 with the regression coefficient estimate of the main effect (R/S) variable in Model 3. A 10% or greater change in parameter estimate following the addition of a covariate block to the base model (Model 3) flagged an important impact on the main effect in question. It should be noted that the regression coefficient estimate is referred to synonymously as the log odds ratio (logOR) and is referred to as such in the following sections (148).

The c-statistic is another term for the area under a curve measuring the predictive ability of the model. Values of c-statistic can range from 0.50 to 1.00, with higher values indicative of better predictive models (149).

Models with lower BIC values, the greatest change in effect size and higher c-statistic values were considered as the best models to represent R/S and mammography screening cross-sectionally. Since SAS does not produce the c-statistic in the GLIMMIX procedure, the thesis candidate used the BIC and change in effect size criteria to choose the best models for the longitudinal analyses.

For all regression analyses reported in Chapter 7 below, only Models 3 to 7 are discussed, as these are the models including both independent and dependent variables. Only the results of the final models chosen using the procedures described above are displayed in Chapter 7; the remaining models are shown in Appendices E and F.

The thesis candidate sequentially numbered each of the regression models generated in the analysis. Table 3 depicts the model numbering.

Table 3: Outline of Models Discussed

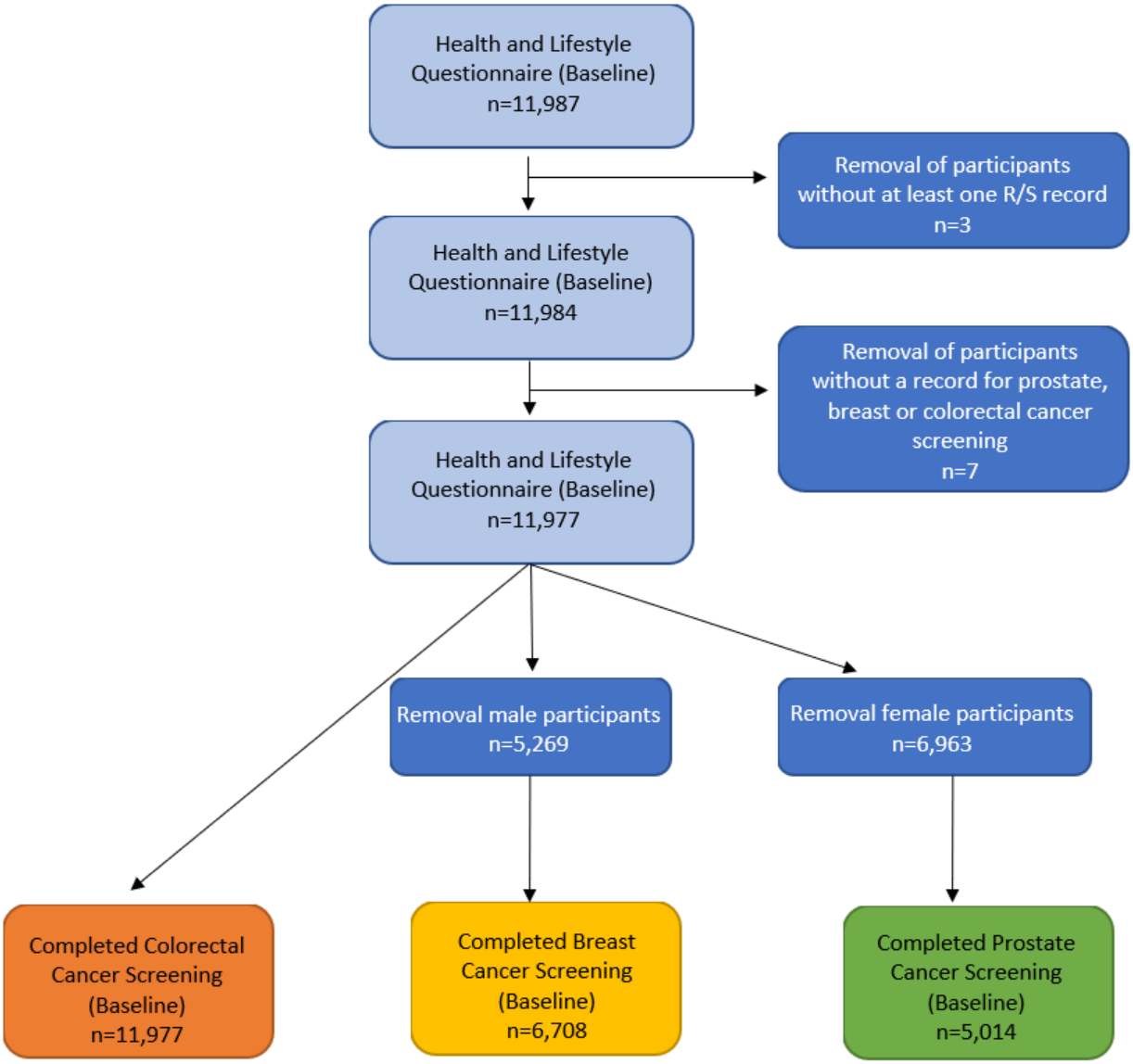
Base Models	Corresponding model discussed in results for R/S Salience	Corresponding model discussed in results for R/S Attendance
Breast Cancer Screening		
Model 3	Model 1 (Table E.7, Appendix E)	Model 6 (Table E.7, Appendix E)
Model 4	Model 2 (Table E.7, Appendix E)	Model 7 (Table E.7, Appendix E)
Model 5	Model 3 (Table E.7, Appendix E)	Model 8 (Table E.7, Appendix E)
Model 6	Model 4 (Table E.7, Appendix E)	Model 9 (Table E.7, Appendix E)
Model 7	Model 5* (Table E.7, Appendix E; Table 6, Section 7.4.2)	Model 10* (Table E.7, Appendix E; Table 6, Section 7.4.2)
Prostate Cancer Screening		
Model 3	Model 11 (Table F.1, Appendix F)	Model 16 (Table F.2, Appendix F)
Model 4	Model 12 (Table F.1, Appendix F)	Model 17 (Table F.2, Appendix F)
Model 5	Model 13 (Table F.1, Appendix F)	Model 18 (Table F.2, Appendix F)
Model 6	Model 14 (Table F.1, Appendix F)	Model 19 (Table F.2, Appendix F)
Model 7	Model 15* (Table F.1, Appendix F; Table 7, Section 7.6)	Model 20* (Table F.2, Appendix F; Table 7, Section 7.6)
Colorectal Cancer Screening		
Model 3	Model 21 (Table F.3, Appendix F)	Model 26 (Table F.4, Appendix F)
Model 4	Model 22 (Table F.3, Appendix F)	Model 27 (Table F.4, Appendix F)
Model 5	Model 23 (Table F.3, Appendix F)	Model 28 (Table F.4, Appendix F)
Model 6	Model 24 (Table F.3, Appendix F)	Model 29 (Table F.4, Appendix F)
Model 7	Model 25* (Table F.3, Appendix F; Table 8, Section 7.7)	Model 30* (Table F.4, Appendix F; Table 8, Section 7.7)
* Models were chosen as the best representations of associations between R/S and cancer screening compared to other listed models		

Chapter 7

Results

7.1 Baseline Descriptive Statistics

Figure 2: Final Baseline Sample for Thesis



After removal of participants with missing data on the two R/S variables and three cancer screening variables, 11,977 observations remained at baseline (Figure 2). The mean age of participants was 49 years, with a higher proportion of females (56%) compared to males (44%). Most participants reported being in a relationship (82%), receiving some post-secondary education beyond high school (73%) and engaging in full-time work (64%). Approximately one-third of participants (31%) reported yearly incomes over $100,000 and approximately half (52%) reported incomes between $40,000 and $99,999. Most participants were either non-smokers (42%) or former smokers (42%). When asked about their health status, most participants indicated "very good" (46%), compared to "Good/Fair" (31%) or "Excellent" (23%). ATP participants indicated high social support, with a mean score of 4.14 out of 5 on the MOS-SSS (134). Baseline data on all participants in this study can be found in Table 4.

Table 4: Sample Characteristics at Baseline

Variable	**Type of Screening**		
	Sigmoidoscopy/ Colonoscopy[a] n=11,977	**Mammography**[b] n=6,708	**PSA Test**[c] n=5,014
R/S Variable			
R/S Salience[d], n (%)			
Yes	7976 (66.6)	4922 (73.4)	2913 (58.1)
No	3996 (33.4)	1785 (26.6)	2097 (41.9)
Missing	5	1	4
R/S Attendance[e,f], n (%)			
Yes	9143 (76.4)	5447 (81.20)	3523 (70.32)
No	2830 (23.6)	1261 (18.80)	1487 (29.68)
Missing	4	0	4
Covariates			
Age, mean (SD)	48.7 (8.8)	48.4 (8.8)	49.2 (8.9)
Missing (n)	0	0	0
Social support, mean (SD)	4.14 (0.77)	4.12 (0.76)	4.17 (0.79)
Missing (n)	2	1	1
Smoking Status, n (%)			
Non-Smoker	4498 (42.4)	2612 (44.4)	1842 (41.0)
Former smoker	4498 (42.4)	2434 (41.44)	1967 (43.8)
Current Smoker	1571 (14.8)	833 (14.2)	685 (15.2)
Missing	1368	829	520
Sex, n (%)			
Female	6710 (56.0)	6708 (100)	
Male	5266 (44.0)		5014 (100)

Missing	1	0	0
Marital Status, n (%)			
In a relationship	9836 (82.2)	5326 (79.6)	4285 (85.5)
Not in a relationship	2136 (17.8)	1370 (20.4)	726 (14.5)
Missing	5	2	3
Income, n (%)			
>=$100,000	3663 (31.3)	1913 (29.4)	1685 34.19
$70,000-$99,999	2898 (24.8)	1541 (23.6)	1278 25.93
$40,000-$69,9990	3229 (27.6)	1781 (27.3)	1366 27.71
<$40,000	1917 (16.4)	1289 (19.8)	600 12.17
Missing	270	184	85
Occupation, n (%)			
Working Full-time	7561 (64.2)	3255 (49.4)	4093 82.87
Working Part-time	1934 (16.4)	1637 (24.8)	276 5.59
Other	2287 (19.4)	1700 (25.8)	570 11.54
Missing	195	116	75
Perceived Health Status, n (%)			
Excellent	2779 (23.4)	1729 (25.9)	1014 (20.5)
Very good	5476 (46.1)	3123 (46.8)	2245 (45.3)
Good/Fair	3629 (30.5)	1824 (27.3)	1699 (34.3)
Missing	93	32	56
Education, n (%)			
At least one university degree	3271 (27.3)	1769 (26.4)	1441 28.76
Some postsecondary	5527 (46.2)	3065 (45.7)	2340 46.70
Highschool or less	3176 (26.5)	1874 (27.9)	1230 24.55
Missing	3	0	3

Abbreviations: R/S=religiosity/spirituality; SD = standard deviation; Ref = reference category; PSA = prostate specific antigen

[a] *The dataset for colorectal cancer screening includes both males and females.*

[b] *The dataset for breast cancer screening includes only females.*

[c] *The dataset for prostate cancer screening includes only males.*

[d] *"Do spirituality values or faith play an important role in your life?"*

[e] *"People may practice or express their spirituality in many different ways, for example through prayer or meditation, or by attending services or gatherings. On average, during the past 12 months how often have you practiced your spirituality in some way?"*

[f] *R/S Attendance was recategorized from a five-level variable assessing participants' frequency of religious/spiritual service attendance, to a binary variable organizing participants into the following groups: 'Yes" and "No."*

7.2 Religiosity and Spirituality

Most participants (58%-67%) indicated they considered religion or spirituality to be important to them (R/S Salience). Participants were also active in practicing their religious or spiritual beliefs, as over 70% of participants reported attending a religious or spiritual service/meeting (R/S Attendance) (Table 4).

7.3 Cancer Screening Outcomes and their Potential Determinants: An Exploratory Analysis

7.3.1 Breast, Prostate and Colorectal Cancer Screening

At baseline, over half of women reported being screened for breast cancer via mammography. Over time, the proportion of women reporting mammography steadily increased to the point where 95% reported such screening at Follow-up 2 (Table 5). As nearly the entire sample of women reported receiving a mammography by Follow-up 2, the thesis candidate questioned the appropriateness of modeling data for R/S and breast cancer screening longitudinally. Ultimately, she assessed breast cancer screening and R/S status cross-sectionally.

Regarding prostate cancer screening (Table 5), approximately 65% of men did not report PSA testing at baseline. However, the proportion of men reporting PSA testing steadily increased until the final follow-up where approximately 65% reported having received a PSA test.

Compared to both breast and prostate cancer screening, colorectal cancer screening was least reported among ATP participants. At baseline, approximately 17% of participants reported receiving either a sigmoidoscopy or colonoscopy (Table 5). Also, while the proportions of participants answering ‘yes’ to breast and prostate cancer screening increased over time, the proportions of participants reporting colorectal cancer screening did not display such trends, with increases and decreases observed

at different timepoints. However, a slight increase in the proportion of participants who got screened for colorectal cancer was evident at the fourth follow-up compared to baseline (Figure 4).

Table 5: Breast, Prostate and Colorectal Cancer Screening over Time

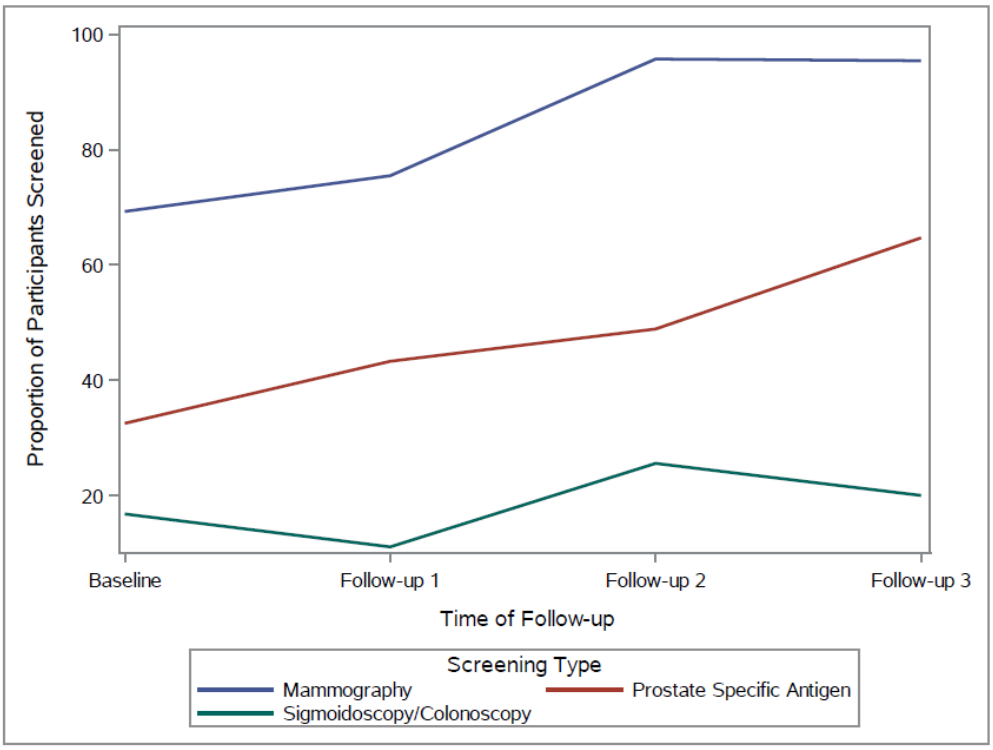
	Baseline	Follow-up 1	Follow-up 2	Follow-up 3
		n (%)		
Mammography				
Yes	4636 (69.3)	4687 (75.5)	4951 (95.7)	3327 (95.4)
No	2056 (30.7)	1523 (24.5)	221 (4.3)	159 (4.6)
PSA				
Yes	1624 (32.5)	1996 (43.3)	1999 (48.9)	1631 (64.7)
No	3372 (67.5)	2616 (56.7)	2091 (51.1)	890 (35.3)
Sigmoidoscopy/Colonoscopy				
Yes	2006 (16.8)	1188 (11.1)	1924 (25.6)	992 (20.0)
No	9946 (83.2)	9539 (88.9)	5604 (74.4)	3968 (80.0)

Crude odds ratios for R/S and each cancer screening outcome are provided in Tables E.1 to E.6 (Appendix E). Regarding R/S Salience, crude ORs and chi-square testing indicated that there was a statistically significant association between R/S and breast, prostate and colorectal cancer screening at baseline.

R/S Attendance was a categorical variable with five possible choices ranging from ‘at least once a week’ to ‘not at all.’ Bivariate associations revealed that statistically significant differences existed between participants with different frequencies of religious or spiritual service attendance and all cancer screening outcomes. However, the thesis candidate and her committee questioned the value of separating participants into multiple categories of R/S Attendance when any level of attendance, compared to no attendance whatsoever, might be a more valuable indicator of R/S than multiple attendance levels.

In addition, the thesis candidate and her committee considered that multiple response options for R/S Attendance may lead to reduced sensitivity in regression analysis, which would manifest in low cell frequencies and possible quasi-complete separation of the regression models.

Figure 3: Proportion of Participants Reporting Cancer Screening over Follow-up



7.4 Model Selection & Cross-Sectional Analysis of R/S and Breast Cancer Screening

7.4.1 R/S Salience

Table E.7 in Appendix E shows the five models (Models 1-5) that considered R/S Salience and breast cancer screening at baseline. Model 5 with all of the covariate blocks was chosen as the best model to represent the association because the BIC value was lowest, the c-statistic was highest and the change in logOR for R/S was largest compared to the base model.

In the best model, the odds of responding 'Yes' to the breast cancer screening question at baseline were 9% higher for participants who answered 'Yes' to R/S Salience, compared to participants who answered 'No', although the adjusted odds ratio (aOR) was not statistically significant at the 5% level, after controlling for covariates (aOR:1.09, 95% CI: 0.93-1.27) (Table 6).

7.4.2 R/S Attendance

Models 6-10 in Table E.7 in Appendix E were considered for the best representation of the association between R/S Attendance and breast cancer screening at baseline. For the same reasons as described in Section 7.4.1 above, Model 10 with all of the covariate blocks was chosen as the model to best represent the association of interest.

In the best model, the odds of responding 'Yes' to the breast cancer screening question at baseline was 2% higher for participants who answered 'Yes' to R/S Attendance, compared to participants who answered 'No', after controlling for covariates; although the aOR was not statistically significant at the 5% level (aOR:1.02, 95% CI: 0.86-1.21).

Table 6: Cross-Sectional Logistic Regression Models for Breast Cancer Screening

Characteristics	**Model 5: R/S Salience** [a, b]		**Model 10: R/S Attendance** [c,d, e]	
	Odds Ratio Estimate	95% Confidence Interval	Odds Ratio Estimate	95% Confidence Interval
R/S				
No	Ref	Ref	Ref	Ref
Yes	1.088	0.934-1.268	1.017	0.858-1.205
Social support				
(continuous)	0.988	0.895-1.090	0.991	0.898-1.093
Age				
(continuous)	1.236	1.220-1.252	1.236	1.221-1.252
Sex				
Male	Ref	Ref	Ref	Ref
Female	1.202	0.977-1.479	1.202	0.977-1.479
Marital status				
Not in a relationship	Ref	Ref	Ref	Ref
In a relationship	0.990	0.805-1.216	0.986	0.803-1.212
Income				
<$40,000	Ref	Ref	Ref	Ref
$40,000-%69,999	1.093	0.876-1.363	1.090	0.874-1.360
$70,000-$99,999	1.367	1.080-1.729	1.362	1.076-1.723
≥$100,000	1.592	1.253-2.023	1.577	1.242-2.004
Education				
Highschool or less	Ref	Ref	Ref	Ref

Some post-secondary	1.102	0.926-1.312	1.109	0.931-1.320
At least 1 university degree	1.102	0.894-1.359	1.106	0.897-1.362
Occupation				
Other	Ref	Ref	Ref	Ref
Working part-time	1.236	1.002-1.524	1.234	1.000-1.521
Working full-time	1.350	1.117-1.631	1.344	1.112-1.623
Smoking status				
Current Smoker	Ref	Ref	Ref	Ref
Former smoker	1.275	1.035-1.571	1.275	1.035-1.571
Non-smoker	1.205	0.976-1.488	1.210	0.980-1.496
Perceived health status				
Good/Fair	Ref	Ref	Ref	Ref
Very good	0.963	0.812-1.142	0.965	0.814-1.145
Excellent	0.987	0.809-1.204	0.988	0.810-1.205

[a] R/S Salience question: "Do spirituality values or faith play an important role in your life?"
[b] Yes (n=3,909), No (n=1,687), 1,111 missing observations
[c] R/S Attendance question, as posed to participants originally in the HLQ: "People may practice or express their spirituality in many different ways, for example through prayer or meditation, or by attending services or gatherings. On average, during the past 12 months how often have you practiced your spirituality in some way?"
[d] R/S Attendance was recategorized from a five-level variable assessing participants' frequency of religious/spiritual service attendance, to a binary variable organizing participants' into the following groups: 'Yes" and "No." Essentially, the original question was changed form asking participants the frequency of their religious/spiritual practice, to whether they attend any religious/spiritual services at all.
[e] Yes (n=3,909), No (n=1,688), 1,111 missing observations
Abbreviations: ref=reference category

7.5 Longitudinal Model Building for R/S and Prostate and Colorectal Cancer

For the longitudinal analyses, the ICCs indicated that 16% and 89% of the variation observed in prostate and colorectal cancer screening, respectively, were attributable to the participants themselves, independent of the impact of R/S and covariates.

For prostate cancer screening, Model 15 (Table F.1) and Model 20 (Table F.2) were chosen as the best models for representation of R/S Salience and R/S Attendance, respectively. For colorectal

cancer screening, Model 15 (Table F.3) and Model 20 (Table F.4) were chosen as the best models for representation of R/S Salience and R/S Attendance, respectively. These models were chosen because they produced the lowest BIC values and the largest changes in logORs for R/S compared to the base models.

7.6 Longitudinal Analysis of R/S and Prostate Cancer Screening

Table 7 reports the best models examining the association between a male's R/S status and PSA testing. Model 15 indicated that males who considered religion/spirituality to be important had 10% lower odds of getting a PSA test compared to males who did not consider religion/spirituality to be important, after controlling for covariates; however, this result was not statistically significant (aOR:0.90, 95%CI: 0.63-1.27).

Model 20 indicated that males who attended religious/spiritual services had 34% greater odds of getting a PSA test compared to males who did not attend religious/spiritual services, after controlling for covariates; however, this result was not statistically significant (aOR:1.34, 95%CI: 0.92-2.01).

Table 7: Longitudinal Multivariable Regression Models for Prostate Cancer Screening

Characteristics	**Model 15: R/S Salience** [a, b] Odds Ratio Estimate	95% Confidence Interval	**Model 20: R/S Attendance** [c,d, e] Odds Ratio Estimate	95% Confidence Interval
R/S				
No	Ref	Ref	Ref	Ref
Yes	0.89	0.63-1.27	1.34	0.92-2.01
Social support				
(continuous)	1.46	1.13-1.89	1.47	1.13-1.91
Age				
(continuous)	1.47	1.42-1.53	1.49	1.43-1.55
Marital status				
Not in a relationship	Ref	Ref	Ref	Ref
In a relationship	1.08	0.61-1.90	1.01	0.56-1.81
Income				
<$40,000	Ref	Ref	Ref	Ref
$40,000-%69,999	2.21	1.18-4.14	2.41	1.26-4.63

$70,000-$99,999	4.09	2.12-7.95	4.76	2.39-9.50
≥$100,000	8.52	4.35-16.69	10.39	5.14-21.00
Education				
Highschool or less	Ref	Ref	Ref	Ref
Some post-secondary	1.78	1.14-2.77	1.85	1.17-2.93
At least 1 university degree	3.77	2.23-6.38	4.10	2.38-7.09
Occupation				
Other	Ref	Ref	Ref	Ref
Working part-time	0.79	0.33-1.89	0.75	0.30-1.87
Working full-time	1.18	0.64-2.17	1.10	0.59-2.08
Smoking status				
Current Smoker	Ref	Ref	Ref	Ref
Former smoker	3.31	1.92-5.71	3.56	2.03-6.26
Non-smoker	3.32	1.89-5.82	3.41	1.91-6.11
Perceived health status				
Good/Fair	Ref	Ref	Ref	Ref
Very good	1.15	0.78-1.71	1.14	0.76-1.71
Excellent	1.50	0.91-2.48	1.47	0.88-2.48

[a] *R/S Salience question: "Do spirituality values or faith play an important role in your life?"*
[b] *Yes (n=6,435), No (n=7,665), 6,694 missing observations*
[c] *R/S Attendance question, as posed to participants originally in the HLQ: "People may practice or express their spirituality in many different ways, for example through prayer or meditation, or by attending services or gatherings. On average, during the past 12 months how often have you practiced your spirituality in some way?"*
[d] *R/S Attendance was recategorized from a five-level variable assessing participants' frequency of religious/spiritual service attendance, to a binary variable organizing participants' into the following groups: 'Yes" and "No." Essentially, the original question was changed form asking participants the frequency of their religious/spiritual practice, to whether they attend any religious/spiritual services at all.*
[e] *Yes (n=6,426), No (n=7,667), 6,971 missing observations*
Abbreviations: ref=reference category

7.7 Longitudinal Analysis of R/S and Colorectal Cancer Screening

Table 8 reports the best models examining the association between R/S and sigmoidoscopy/colonoscopy screening. Model 25 indicated that individuals who considered religion/spirituality to be important had 44% greater odds of getting a sigmoidoscopy or colonoscopy,

compared to individuals who did not consider religion/spirituality to be important, after controlling for covariates (aOR:1.44, 95%CI: 1.12-1.84).

Model 30 indicated that individuals who attended religious/spiritual services had 56% greater odds of getting a sigmoidoscopy or colonoscopy, compared to individuals who did not attend any religious/spiritual services, after controlling for covariates (aOR:1.56, 95%CI: 1.19-2.06).

Table 8: Longitudinal Multivariable Regression Models for Colorectal Cancer Screening

Characteristics	**Model 25: R/S Salience** [a, b]		**Model 30: R/S Attendance** [c,d, e]	
	Odds Ratio Estimate	95% Confidence Interval	Odds Ratio Estimate	95% Confidence Interval
R/S				
No	Ref	Ref	Ref	Ref
Yes	1.44	1.12-1.84	1.56	1.19-2.06
Social support				
(continuous)	0.95	0.81-1.12	0.96	0.82-1.13
Age				
(continuous)	1.16	1.14-1.18	1.16	1.14-1.18
Sex				
Male	Ref	Ref	Ref	Ref
Female	1.25	0.97-1.61	1.26	0.98-1.62
Marital status				
Not in a relationship	Ref	Ref	Ref	Ref
In a relationship	0.77	0.55-1.09	0.77	0.55-1.08
Income				
<$40,000	Ref	Ref	Ref	Ref
$40,000-%69,999	1.29	0.89-1.87	1.29	0.89-1.86
$70,000-$99,999	2.04	1.37-3.03	2.00	1.35-2.98
≥$100,000	2.65	1.77-3.87	2.57	1.72-3.84
Education				
High school or less	Ref	Ref	Ref	Ref
Some post-secondary	1.06	0.80-1.14	1.06	0.98-1.41
At least 1 university degree	1.65	1.18-2.30	1.67	1.19-2.33
Occupation				
Working part-time	1.04	0.71-1.53	1.04	0.70-1.52
Working full-time	1.11	0.80-1.54	1.12	0.81-1.55
Other	Ref	Ref	Ref	Ref

Smoking status				
Current Smoker	Ref	Ref	Ref	Ref
Former smoker	2.67	1.84-3.88	2.66	1.83-3.86
Non-smoker	2.11	1.44-3.10	2.09	1.42-3.07
Perceived health status				
Good/Fair	Ref	Ref	Ref	Ref
Very good	0.63	0.48-0.82	0.64	0.49-0.84
Excellent	0.54	0.39-0.75	0.54	0.39-0.75

[a] R/S Salience question: "Do spirituality values or faith play an important role in your life?"
[b] Yes (n=5,271), No (n=24,211), 18,426 missing observations
[c] R/S Attendance question, as posed to participants originally in the HLQ: "People may practice or express their spirituality in many different ways, for example through prayer or meditation, or by attending services or gatherings. On average, during the past 12 months how often have you practiced your spirituality in some way?"
[d] R/S Attendance was recategorized from a five-level variable assessing participants' frequency of religious/spiritual service attendance, to a binary variable organizing participants' into the following groups: 'Yes" and "No." Essentially, the original question was changed form asking participants the frequency of their religious/spiritual practice, to whether they attend any religious/spiritual services at all.
[e] Yes (n=5,271), No (n=24,209), 18,428 missing observations
Abbreviations: ref=reference category

Chapter 8
Discussion

8.1 Breast Cancer Screening

Cross-sectional findings showed that neither R/S Salience nor R/S Attendance were statistically significantly associated with mammography (aOR:1.09, 95% CI: 0.93-1.27 [R/S Salience] and aOR:1.19, 95% CI: 0.87-1.63 [R/S Attendance], respectively), after controlling for all covariates. The breast cancer screening patterns of women in ATP (95% reporting receipt of mammography by the conclusion of follow-up) align with the screening patterns of Canadian women aged between 50 and 74 years, 91% of whom reported having a mammogram in their lifetimes (150). Screening patterns of ATP women also suggested good adherence to current CTFPHC guidelines, which recommend a mammogram every two or three years for women between 50 and 69 years (151). The high prevalence of breast cancer screening among women in ATP, and among Canadian women in general, is likely attributable to the success of health promotion campaigns resulting in increased breast cancer awareness and screening uptake (152).

A majority of the articles in the literature review discussed R/S and breast cancer screening, and most of the research approached this topic cross-sectionally. Further, much of the literature regarding R/S and breast cancer screening showed statistically significant and positive associations. While the results of this thesis were not statistically significant at the 5% level, they did support a positive association between both R/S Salience and R/S Attendance, and breast cancer screening. Perhaps R/S had a minute influence on screening behaviour, but most women in the ATP sample would have received mammograms anyway.

Much of the published literature either did not control for additional covariates or did not incorporate the broad set of covariates that the thesis candidate employed in her study. Without controlling for all relevant covariates, these published studies may have been subject to residual

confounding. Some of the findings in this thesis could have been more muted than what was reported in the published literature because the presence of residual confounding in the literature could have created false results where none existed, or amplified the magnitude of existing results (153). The analyses presented in the thesis are noteworthy because they incorporated a wide array of covariates to reduce the impact of residual confounding (see Section 5).

8.2 Prostate Cancer Screening

Men who considered R/S to be important had lower odds of reporting PSA testing, while men who attended R/S services had greater odds of reporting PSA testing. However, neither association was statistically significant after controlling for all covariates (aOR: 0.90, 95% CI: 0.63-1.27 [R/S Salience]; aOR: 1.34, 95% CI: 0.92-2.01 [R/S Attendance]).

The literature review showed that only five studies looked at R/S and prostate cancer; furthermore, four of these studies were cross-sectional (75,83,120,154) and included highly specific samples (e.g., African American men (82,154), elderly men (75,120) or men of specific religious backgrounds (83)). Only Dickey et al. (82) employed a longitudinal design, though their intent was to investigate an intervention to improve prostate cancer screening, rather than examine R/S as a primary exposure.

This thesis addressed some of the limitations of the literature by assessing R/S and prostate cancer screening longitudinally, while controlling for relevant covariates and using a population-based sample. The results of this thesis partially confirm the findings of earlier studies by providing longitudinal evidence for a positive association between R/S Attendance and prostate cancer screening. Unlike past research, though, the adjusted odds ratio for R/S Salience suggested a negative association. This novel finding indicates that different components of R/S can have a differential impact on various types of cancer screening in a population-level sample, which is consistent with the multiplicity of types of R/S, cancers, and screening mechanisms.

8.3 Colorectal Cancer Screening

Longitudinal analyses of R/S and colorectal cancer screening revealed that both R/S Salience and R/S Attendance led to statistically significantly greater odds of ATP participants reporting a sigmoidoscopy or colonoscopy, after controlling for all covariates (aOR: 1.44, 95% CI: 1.12-1.84 [R/S Salience] and aOR: 1.56, 95% CI: 1.19-2.06 [R/S Attendance], respectively). These results align with published evidence from North America (113,115,117,155), including Ontario, Canada (125). However, the thesis did not simply confirm these earlier results, but improved upon them. The published literature is composed of cross-sectional studies mostly undertaken in select groups (e.g., only African Americans (117,155), Hispanic Americans (113), or elderly individuals (115)). This thesis extended the published findings to a population-level sample using longitudinal analyses.

Recent data from 2017 showed that approximately 48% of Canadians between 50 and 74 years reported having a sigmoidoscopy or colonoscopy in their lifetime. Most individuals reported colonoscopies (87%) over sigmoidoscopies (3%) or both (9%) (150). Compared to all Canadians, Albertans in ATP reported less colorectal cancer screening during all survey time points. This is noteworthy because colorectal cancer is the third most commonly diagnosed cancer in Canada, and estimates anticipate 26,900 new cases in 2020; over half of these cases are expected to occur among Canadians who fall within the ages recommended for screening (50 to 74 years) (29). With such a high disease prevalence, greater screening rates may reduce the burden Canadians experience as a result of the disease. Through R/S venues and settings (e.g., church services, online announcements on church websites or after services in the current climate of social distancing), public health officials can promote cancer screening inexpensively and without undue effort, while targeting a group of individuals whose health-focused belief systems render them amendable to change. Through the use of screening messages, delivered via R/S channels, intentions to get screened can increase, leading ultimately to an increased likelihood of cancer screening (see Section 8.5 for an elaboration of this point).

8.4 Social Support

Previous literature has explored the influence of social support on the association between R/S and cancer screening. To this effect, one of the studies discussed in Section 5.2.4 incorporated mediation analysis and found that social support accounted for some yet not all of the association between R/S and colorectal cancer screening (117). Chapter 2 of the thesis described how R/S is sometimes regarded as a form of social support, and indeed the organizational structures of R/S provide both structural and functional elements of social support. Structural social support is the extent to which an individual is socially connected (e.g., number of social ties, frequency of participating in events outside the home); functional social support is an individual's perception of the level of emotional or tangible support that s/he would have available in times of need (156). This thesis was able to control for functional social support, which was assessed in ATP using the MOS-SSS (134).

Due to the important potential contribution of social support to the impact of R/S on health, the discussion in Sections 8.4.1 to 8.4.3 below focuses on how social support may affect the relations studied in the thesis. This discussion involved the models for R/S and breast, prostrate and colorectal cancer screening that included only social support as a covariate (Models 2 & 7 for breast cancer screening; Models 12 & 17 for prostate cancer screening; Models 22 & 27 for colorectal cancer screening), which were compared to their corresponding base models to assess the impact of social support.

8.4.1 Breast Cancer Screening

When social support was added to the base model as a covariate, the regression coefficients, or logORs, for both R/S Salience and R/S Attendance did not change substantially ($\Delta < 10\%$) (157). The lack of change in regression coefficient for the social support model, compared to the base model, suggests that the effect of R/S is largely independent from social support.

8.4.2 Prostate Cancer Screening

The regression coefficient for R/S Attendance changed by 9% after adding social support to the base model, while the regression coefficient for R/S Salience changed by 15%. Assuming a ±10% change indicates a substantive effect, functional social support plays more of a role through R/S for men and prostate cancer screening than for women and breast cancer screening (157).

8.4.3 Colorectal Cancer Screening

Compared to breast and prostate cancer screening, the addition of social support to the base models for both R/S Salience and R/S Attendance, and colorectal cancer, changed the regression coefficients by less than 1%. Therefore, R/S may impact colorectal cancer screening independently of social support.

Overall, these results suggest that R/S impacts cancer screening in a way that cannot completely be accounted for by social support alone. However, social support is a variable that is relevant to the association between R/S and cancer screening. These results mirror Leyva et al.'s findings (117), which showed that social support may account for some of the effect of R/S, but that there is still an effect of R/S and colorectal cancer screening independent of social support. Future analyses of R/S and cancer screening should incorporate social support to account for the effects it may have on behaviour through R/S, and may also consider the changing impact of social support on different measures of R/S. In addition, the results of this thesis suggested that functional social support may affect certain types of R/S more so than others. Future research considering the effects of R/S on screening behaviours longitudinally may consider exploring the mediating effects of social support, as well as examining the structural, as well as functional, forms of social support (158).

8.5 R/S and Screening Behaviour

Religion and spirituality play an important role in many Canadians' lives and provide a system of beliefs that can impact the motivations and intentions behind health behaviours. TPB was used in this thesis to provide a theoretical foundation to help understand how R/S may impact cancer screening behaviour. As described in Chapter 4, perceived behavioural control, subjective norms, attitudes and intentions are central to TPB (65).

8.5.1 Subjective Norms & Attitude

Religion and spirituality can directly affect the attitudes and norms surrounding certain behaviours; specifically, R/S can generate positive attitudes and norms toward cancer screening practices. For example, colorectal cancer screening remains low for both men and women, perhaps in part due to psychological barriers. A study of 2,000 subjects in Singapore (159) identified perceptions of pain and embarrassment related to colonoscopy as a disincentive to screening (159). Such perceptions may negatively influence the intentions individuals have toward screening. R/S may serve as a conduit for positive messaging to help convince people that the benefits of cancer screening outweigh the barriers or risks. For example, religious or spiritual leaders (e.g., priests, imams, etc.) may be ideal messengers of public health messages pertaining to cancer screening, as they hold positions of power and trust, which can be leveraged to deliver messages of self care and spiritual guidance to congregants. A study of Islamic community leaders in Indonesia found that religious community leaders were willing to provide support for introduction of new vaccines and provide further advocacy for immunization as part of an ongoing program (160); this highlights the important role spiritual leaders can have as part of public health campaigns aimed at adjusting the negative beliefs and attitudes of vaccination within Islamic communities (161–164). Such messages from trusted leaders within a community can influence the attitudes of members of a congregation, and adjust the normative beliefs surrounding cancer screening behaviour.

8.5.2 Perceived Behavioural Control

The use of public health messaging through religious or spiritual leaders can also help to positively influence the perception that congregants have about the control over their ability to get screened for cancer, as well as the control they have after receiving a diagnosis. Being a member within a religious and spiritual community provides individuals with the physical supports that are required to get screened (e.g., help with setting up or getting to appointments), and the emotional support that may be needed following a diagnosis.

8.5.3 Intentions

R/S, as forces that guide individuals' motivations for certain lifestyle practices, can be a vehicle for encouraging Canadians to get screened for cancer. By targeting subjective norms, attitudes and perceived behavioural control, R/S can be an ideal platform for influencing individuals' intentions of getting screened for cancer. A study by Holt et al. (96) assessed men's intentions of getting screened for prostate cancer in addition to assessing their actual utilization of DREs; this study found statistically significant positive associations with both actual utilization of DREs and intentions of booking an appointment for a DRE within the next six months. Individuals who prescribe to R/S are already within a targetable mindset for increased cancer screening as religious and spiritual beliefs often include messages of health and preservation. By encouraging cancer screening through positive messaging from trusted sources, individuals' intentions to obtain cancer screening can increase resulting in increased likelihood of actually obtaining cancer screening (65).

8.6 Implications for Future Research and Policy

The results of this thesis suggest the need for further investigation to help policy makers and researchers better understand whether they can tap into elements of R/S to encourage cancer screening. Since the results were equivocal, e.g., mostly positive associations yet not all associations were

statistically significant nor large in magnitude, the thesis candidate acknowledges that her findings may not be sufficient to support the use of R/S in health promotion activities for cancer screening. However, the thesis does not dismiss the potential for R/S in this regard. The pursuit of efforts to increase Canadian cancer screening rates is worthwhile in addressing the increasing cancer rates expected in the future (29); the results of this thesis provide insight on specific areas where health promotion may best be utilized to increase cancer screening among Canadians. Specifically, the results of the literature search, combined with the statistically significant positive association between R/S and colorectal cancer in the thesis, support the idea that R/S environments may serve as ideal locations for promoting colorectal cancer screening. Future research may also consider investigating associations between other forms of screening that were not considered in this thesis. As this thesis provides a Canadian context for exploration of associations between R/S and cancer screening, future projects may also wish to assess feasibility of promotional cancer screening campaigns within Canadian communities.

Using R/S as a means of promoting cancer screening has been previously explored and has shown promising results. For example, a study which obtained information from pastors in seven African American churches found that colorectal cancer was a topic pastors felt their congregants did not discuss due to a number of perceived barriers, including discomfort, fear and a lack of knowledge and awareness. However, the pastors expressed that the church could be used as a social marketer of colorectal cancer health promotion and would be an ideal place for interventions to occur (165).

8.7 Strengths & Limitations

8.7.1 Strengths

This thesis analyzed the effects of R/S on prostate and colorectal cancer screening longitudinally through the use of data from ATP; previous literature (Chapter 5) has mostly consisted of cross-sectional studies, which cannot be used to assess temporality between exposures and outcomes.

Since religion and spirituality do not operate in a closed-loop fashion to affect cancer screening behaviour in isolation from other factors, controlling for relevant covariates is an important component of conducting research in the field. The ATP dataset also contained a large number of variables that were relevant to R/S and cancer screening, thus permitting the thesis candidate to minimize residual confounding. Specifically, this thesis was able to control for relevant covariates that were found to be important in the literature search (e.g., social support).

The ATP data provided a Canadian perspective on R/S and cancer screening behaviour. Of all studies reported in the literature review, only one included a Canadian sample, which was cross-sectional and captured only individuals enrolled within a family practice. Much of the literature was based on samples from the United States, where the structure of health care differs greatly from Canada. Since Canada's healthcare system is based on a single-payer public model, cancer screening literature from the United States may not easily be transferable to Canada. As Canadians do not typically consider cost of health care resources as part of doctor visits, United States-based studies which do not control for economic variables may present with residual confounding making generalization of results to the Canadian context problematic. The literature search also revealed that the majority of research was focused on breast cancer screening; this thesis adds to the body of literature pertaining to R/S and prostate and colorectal cancer screening, for which there is limited information.

8.7.2 Limitations

A limitation of this analysis was that R/S and mammography could not be analyzed longitudinally because almost all women enrolled in ATP reported undergoing breast cancer screening at follow-up. Also, the ATP recruited participants in Alberta and the applicability of results to other Canadian provinces and territories might be restricted.

This thesis made several assumptions related to the cancer screening status of participants at follow-up timepoints. Details regarding how screening status was determined are shown in Section 6.6.3. The algorithm required assumptions about the timing of participants' cancer screening, which may not reflect participants' true screening status. Since the algorithm was developed without the knowledge of participants' true screening status, any errors that occurred were likely to be random, thereby resulting in a bias toward the null.

The exploratory data analysis revealed missing data issues in the outcome and predictor variables as well as covariates. The mixed models for prostate and colorectal cancer screening handled monotone missing data in the outcome variables using maximum likelihood estimation, which assumes the outcome are missing at random. This method handles cases with missing R/S or covariate data by ignoring it in the analyses; the estimates produced through this method are less biased than analyses which use complete case analysis (CCA) which are known to be severely biased and unreliable (166). For models which explored R/S and breast cancer screening, they were conducted using CCA because the explored the association cross-sectionally. In addition, potential biases from this removal of participants without complete data were likely to be minimal because less than 1% of participants had missing exposure or outcome data.

R/S is a complex construct thought to involve many underlying mechanisms, which are difficult to capture through a limited number of questions. R/S Salience and R/S Attendance are two aspects of R/S and do not encompass the whole construct of R/S. Results of this thesis should be interpreted specifically for R/S Salience and R/S Attendance, and not for other variables related to religion or spirituality. A systematic review on instruments measuring spirituality acknowledged that no gold standard for measuring R/S currently exists, although several commonly used scales do exist for measuring R/S in clinical research (167). The multiplicity of different R/S measures was also acknowledged in Section 5.2.1 of this thesis. The conclusions of this thesis may have differed had the

thesis candidate utilized different R/S measures, though she was restricted to the measures available in ATP. Future methods research in this area should focus on standardizing the assessment of R/S using a limited number of valid and reliable tools.

8.8 Conclusion

Cross-sectional analysis revealed that R/S was not associated with breast cancer screening for women in ATP. Longitudinal analysis revealed that R/S was also not associated with PSA testing among men in ATP. However, R/S Salience and R/S Attendance were statistically significantly associated with colorectal cancer screening. The results of this thesis provide some evidence that R/S is a factor that may influence cancer screening behaviour, which is consistent with the theoretical framework of TPB. Religion and spirituality serve as central forces affecting aspects of the individual as well as the population, which can influence the intentions of individuals to achieve an outcome.

The results of this thesis add to the current literature by providing analyses of R/S and cancer screening using a population-based sample and assessing associations over time. In addition, numerous covariates considered appropriate through examination of the literature were incorporated into the analyses to diminish the possibility of residual confounding. This thesis can help to inform future research, as it provides a foundation for expanding on concepts related to R/S and cancer screening. Also, while the results showed statistical significance between only R/S and colorectal cancer, R/S seemed to show positive effects for breast and prostate cancer screening as well; this information may be useful to public health officials because cancer screening rates for prostate and colorectal cancer are low, while the morbidity caused by these cancers is high. R/S is a promising factor through which healthy behaviours, such as cancer screening, may be promoted, as religious or spiritual persons may be more likely to undergo screening. Therefore, public health officials may consider launching health promotion programs in religious settings to encourage greater cancer screening.

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Appendix A

Search Strategies for the Literature Search

PubMed Search Strategy:

1. religi*[Title/Abstract]
2. religion[MeSH Terms]
3. spirit*[Title/Abstract]
4. spirituality[MeSH Terms]
5. spiritual therapies[MeSH Terms]
6. faith healing [MeSH Terms]
7. cancer screening[Title/Abstract]
8. mass screening [Title/Abstract]
9. Early Detection of Cancer [MeSH]
10. Mammogra*[Title/Abstract]
11. clinical breast exam[Title/Abstract]
12. breast exam* [Title/Abstract]
13. breast cancer*[Title/Abstract]
14. breast neoplasms[MeSH Terms])
15. prostate cancer* [Title/Abstract]
16. prostate neoplasms [MeSH]
17. prostate exam* [Title/Abstract]
18. prostate specific antigen [Title/Abstract]
19. psa test [Title/Abstract]
20. colorectal cancer*[Title/Abstract]
21. colorectal neoplasms[MeSH Terms]
22. colonoscop*[Title/Abstract]

23. colonoscopy[MeSH Terms]
24. 1 OR 2 OR 3 OR 4 OR 5 OR 6
25. 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23
26. 24 AND 25

Scopus Search Strategy:

1. TITLE-ABS-KEY (religi*)
2. TITLE-ABS-KEY (spiritual*)
3. TITLE-ABS-KEY ("spiritual therapies")
4. TITLE-ABS-KEY ("faith healing")
5. TITLE-ABS-KEY (cancer AND screening)
6. TITLE-ABS-KEY ("breast cancer screening")
7. TITLE-ABS-KEY (mammogra*)
8. TITLE-ABS-KEY ("clinical breast exam")
9. TITLE-ABS-KEY ("self breast exam")
10. TITLE-ABS-KEY ("prostate cancer screening")
11. TITLE-ABS-KEY ("prostate specific antigen")
12. TITLE-ABS-KEY ("psa test")
13. TITLE-ABS-KEY (prostate AND exam*)
14. TITLE-ABS-KEY (breast AND exam*)
15. TITLE-ABS-KEY ("colon cancer screening")
16. TITLE-ABS-KEY (sigmoidoscop*)
17. TITLE-ABS-KEY (colonoscop*)
18. 1 OR 2 OR 3 OR 4
19. 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17
20. 18 AND 19

PsychInfo Search Strategy:

1. **Index Terms**: {Religious Beliefs}
2. **Index Terms**: {Religious Experiences}
3. **Index Terms**: {Religious Education}
4. **Index Terms**: {Religious Literature}
5. **Index Terms**: {Religious Organizations}
6. **Index Terms**: {Spirituality}
7. **Index Terms**: {Theology}
8. **Index Terms**: {Religious Practices}
9. **Index Terms**: {Religiosity}
10. **Index Terms**: {Religion}
11. **Index Terms**: {Cancer Screening}

12. {Mammography}
13. {Physical Examination}
14. {Health Promotion}
15. {Self-Examination (Medical)}
16. {Cancer Screening}
17. **Title**: "breast cancer screening"
18. **Keywords**: "breast cancer screening"
19. **Abstract**: "breast cancer screening"
20. **Any Field**: "breast cancer screening"
21. **Any Field**: mammogra*
22. **Title**: mammogra*
23. **Abstract**: mammogra*
24. **Title**: "prostate cancer screening"
25. **Keywords**: "prostate cancer screening"
26. **Abstract**: "prostate cancer screening"
27. **Title**: "prostate specific antigen"
28. **Keywords**: "prostate specific antigen"
29. **Abstract**: "prostate specific antigen"
30. **Title**: "psa test"
31. **Keywords**: "psa test"
32. **Abstract**: "psa test"
33. **Keywords**: "colon cancer screening"
34. **Title**: "colon cancer screening"
35. **Abstract**: "colon cancer screening"
36. **Title**: colonoscop*
37. **Abstract**: colonoscop*
38. **Keywords**: colonoscop*
39. **Title**: sigmoidoscop*
40. **Keywords**: sigmoidoscop*
41. **Abstract**: sigmoidoscop*
42. **Keywords**: "breast exam*"
43. **Abstract**: "breast exam*"
44. **Title**: "breast exam*"
45. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10
46. 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31 OR 32 OR 33 OR 34 OR 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41 OR 42
47. 43 AND 44

CINAHL Search Strategy:

1. (MH "Religion and Medicine") OR (MM "Religion and Religions+") OR (MH "Prayer") OR (MH "Religious Personnel") OR (MM "Spirituality") OR (MH "Spiritual Healing+") OR (MH "Spiritual Care")
2. TI religion OR AB religion OR TI (religiosity and spirituality) OR AB (religiosity and spirituality) OR TI spiritual therapy OR AB spiritual therapy

3. (MH "Cancer Screening") OR (MH "Mammography") OR (MH "Breast Examination") OR (MH "Breast Self-Examination") OR (MH "Colonic Neoplasms") OR (MH "Sigmoid Neoplasms")
4. ((MH "Prostatic Neoplasms") OR (MH "Prostate-Specific Antigen")) OR TI prostate specific antigen test OR AB prostate specific antigen test OR TI prostate exam OR AB prostate exam OR AB psa test OR TI psa test OR TI mammogram OR AB mammogram AND (mammograms and early detection of breast cancer)
5. TI clinical breast exam OR AB clinical breast exam OR TI colorectal cancer screening OR AB colorectal cancer screening OR TI colonoscopy OR AB colonoscopy OR TI sigmoidoscopy OR AB sigmoidoscopy OR TI mass screening OR AB mass screening
6. 1 OR 2
7. 3 OR 4 OR 5 OR 6
8. 7 AND 8

Appendix B

Extraction Tables for Literature Search

Table 1: Extraction Summary of Included Articles

Author, date	Study type	Setting	Population	N	Age Range Mean age (SD)*	Screening outcome of interest	Results
Allen et al., 2012	CS	USA (Boston, Massachusetts)	Hispanic women	78	18+ 19-39 n=37 (39.7%) 40-49 n=17 (21.8%) 50-59 n=22 (28.2%) ≥60 n=8 (10.3%)	Adherence to mammography, CBE, colonoscopy screening recommendations (FOBT, sigmoidoscopy, colonoscopy)	-54% of women had all recommended examinations for their age. -Strong association between positive religious coping and adherence to age-appropriate screening after controlling for relevant covariates. -Passive spiritual locus of control was negatively associated with age-appropriate screening but did not reach statistical significance -High level of church participation in this sample.
Azaiza et al., 2010	CS	West Bank, Palestine	Palestinian women	397	30-65 41.7(8.88)	Breast cancer screening performance: Frequency of mammography, CBE, SBE Knowledge of breast cancer screening recommended guidelines	-None of the participants knew the correct recommended frequency of mammography. 41.3% and 29.5% reported the correct recommended frequency for CBE and SBE, respectively. - 18.39%, 11.08%, and 29.47% of women performed mammography, CBE and SBE as recommended.

							-Women had a medium fatalist perception regarding breast cancer being incurable or fatal -Women had similar perceptions of effectiveness regarding mammography, CBE and SBE -Less religious and more educated women attended mammography and CBE and performed SBE more frequently -Lower level of religiosity, lower perceived personal barriers, and lower sense of fatalism predicted an increased likelihood of attending mammography -Lower religiosity or being Christian increased likelihood of undergoing CBE
Benjamins & Brown, 2004	CS	USA	Non-institutionalized elderly adults born before 1924	6,055	70-103 77.3(NA)	Mammography, SBE, prostate screening utilization	-Approximately half of women in this sample reported SBE or mammogram, and almost 75% of men reported prostate cancer screening -Jewish women were 3.05 and 4.95 times more likely than non-affiliated women to have breast exams and mammograms, respectively. -Protestant, Catholic and Jewish men were 2.29 ($p<.01$), 2.15 ($p<.05$) and 8.88 ($p<.05$) times more likely to report prostate cancer

							screening compared to non-affiliated men, respectively. -Levels of religiosity were different by denomination
Benjamins, 2006	Longitudinal	USA	Non-institutionalized older women (pre-retirement age women)	4,253	51-61 55.66(3.08)	Mammography, SBE screening utilization	-Logistic regression including controls and mediating variables showed that all levels of religious attendance increased odds of getting a mammogram compared to women who did not attend religious services. -Mainline Protestant individuals had greater odds of mammogram use compared to Evangelical Protestant after including controls and mediating variables in logistic regression model (OR:1.35). -Religious salience was not associated with mammography, however was associated with SBE.
Benjamins et al., 2011	CS	USA	Members of Presbyterian church (active elders and other active members)	1,076	18-96 59.81(13.54)	Colonoscopy screening utilization	-High and medium church attendance was associated with greater odds of colonoscopy compared to low church attendance, however this effect was not maintained after inclusion of control variables. -Age and gender were consistently associated with screening outcomes; compared to older adults and men, younger individuals and women were less likely to get a colonoscopy.

Brittain & Murphy, 2015	CS	USA (urban Midwest city)	African Americans	129	50+ 50-59 n=81(63.8%) 60-69 n=36(28.4%) 70-79 n=5(3.9%) ≥80 n=5(3.9%)	Adherence to CRC screening (FOBT, colonoscopy)	-Religiosity was moderately, significantly correlated to having a colonoscopy (*r*=0.32, p<.01). -Multiple regression revealed that religiosity and having a primary care provider were significant predictors of colonoscopy (*t*=2.132, p<.05, and *t*=3.306, p<.05, respectively).
Conway-Phillips & Janusek, 2014	CS	USA (Illinois)	African American women	134	45-85 57(8.4)	Breast cancer screening behaviour (motivation to get and having gotten a CBE, SBE, or mammography)	-Of all predictor variables included in this study, only spirituality was a significant predictor of an increase in BCS motivation (b=.30, SE=.09, t(63)=3.25, p=.002). -Of the covariates, only education significantly contributed to BCS motivation (b=.94, SE=.44, t(63)=2.13, P=.037). -None of the predictor variables, including spirituality, were significant predictors of breast cancer screening behaviours. -No single variable was able to independently predict if a woman intended to, or already had a mammogram.
Fox et al., 1998	CS	USA (Los Angeles)	White, black, Latino churchgoing women	2,027	50-80 50-64 n=1,161 (57.3%) 65-80 n=866 (42.7%)[a]	Adherence to mammography and CBE	-At bivariate analysis, subjective religiosity and activity in church were significant predictors of adherence to breast cancer screening (p<.05 and p<.001, respectively). -Final logistic regression model containing only church

							activity, found that church activity was not a significant predictor of adherence to breast cancer screening.
Hatefnia et al., 2010	CS	Tehran, Iran	Iranian women	320	35+ 35-39 n=100 (31.3%) 40-44 n=105 (32.8%) 45-49 n=79 (23.8%) ≥50 n=39 (12.2%)	Mammography uptake (ever had and time since last test)	-At bivariate analysis, there were significant differences in mammography screening by religious beliefs (χ^2=22.0, p<.001) -Using multivariate logistic regression, religious beliefs and were significantly associated with mammography screening.
Holt et al., 2009	CS	USA (Alabama counties)	African American men	199	40-92 57.85(12.22)	PSA and DRE utilization in the past, and planned future utilization	-Individuals with higher scores on the religious behaviour scale had greater odds of having a DRE within the past 12 months (OR:1.70, CI:1.12-2.59, p<.05). -Individuals with higher scores on the religious behaviour scale had greater odds of thinking about getting a DRE within the next six months (OR:2.12, CI:1.14-3.96, p<.05). -Individuals with higher scores on the religious belief scale had reduced odds of thinking about getting a DRE within the next six months, and OR:0.55, CI:0.29-1.04). -Individuals with higher scores on the religious behaviour scale had greater odds of having a DRE appointment within the next six months (OR:7.10, CI:1.03-49.15, p<.05).

							-Religious beliefs and behaviours were not predictive of any PSA behaviours.
Husaini et al., 2001	Cluster RCT	USA	African American women	364	40+ Program group: 56.2 (n/a) Control group: 51.2 (n/a)	Mammogram status: mammogram was obtained in the last year; a mammogram was obtained between wave 1 and wave 2 data collection; a mammogram was not obtained despite having no mammogram in the previous year.	-Church participation was not a significant predictor of mammogram status in this sample of women. -Women participating in the educational program were more likely to get mammograms compared to controls. -Depressive symptoms can negatively impact breast cancer screening; programs in the future should contain

							components addressing mental health.
Katz et al., 2008	RCT	USA (Robeson County, North Carolina)	Native American, white, and African American women	851	40+ No Mammogram Group 40-49 n=244 (44) 50-59 n=150 (27) 60-69 n=84 (15) 70-79 n=56 (10) 80+ n=19 (4) Received Mammogram Group 40-49 n=119 (40) 50-59 n=89 (30) 60-69 n=54 (18) 70-79 n=33 (11) 80+ n=3 (1)	Mammography utilization	-Using logistic regression, both church attendance and spirituality did not have a significant impact on the likelihood of a woman obtaining a mammogram (p=0.299, p=0.401, respectively). -After inclusion of confounders in logistic regression models, church attendance and spirituality continued not to show any significant impact on mammogram screening (p=0.499, p=0.405, respectively). -There were no significant interactions between religion and confounding variables.
Kinney et al., 2002	CS	USA (rural, Southeaster Louisiana)	African American women (K2099) with BRCA1 mutation	52	18-78 37(12.6)	Adherence to breast cancer screening for high-risk women: Time since last mammography and CBE Frequency of SBE	-God locus of health control (GLHC) was found to be the only predictor of adherence to CBE and mammography (OR:0.88, CI:0.77-1.00, p=0.05). -Women ≥25 years old with higher GLHC scores were less likely to be adherent to recommendations of CBE and mammography compared to

							women with lower GHLC scores (p=0.04). -There was no significant association between GLHC scores and SBE utilization (p=0.25).
Nguyen et al., 2012	CS	USA (Richmond, Virginia metropolitan area)	Vietnamese women	111	18-70 40.23(14.23)	Adherence to mammography, CBE	-Acculturation was found to moderate the relation of both intrinsic (β=-.03, $\chi^2(1)=33.79$, p=.02) and extrinsic religiosity and having had a Pap test (β=.06, $\chi^2(1)=4.44$, p=.04) -For more accultured females, higher intrinsic religiosity was associated with greater likelihood of having had a Pap test. For less accultured females, higher intrinsic religiosity was associated with decreased likelihood of having had a Pap test. -For less accultured females, higher extrinsic religiosity was associated with decreased likelihood of having had a Pap test. For more accultured women, greater personal extrinsic religiosity was associated with greater likelihood of having had a Pap test. -Using hierarchical linear regression, acculturation significantly moderated relation of social extrinsic religiosity to self-efficacy for breast cancer screening (β=-.29, t(109)=-2.46, p=.02).

Leyva et al. 2015	CS	USA	Non-Hispanic blacks, non-Hispanic whites, Hispanics	5102	18+ 52(17.88)	Adherence to mammography, colorectal cancer screening (stool blood test, sigmoidoscopy or colonoscopy)	Mammography: -Greater religious service attendance was associated with higher likelihood of recent receipt of a mammogram (b = .70, v2 (1) = 3.96, p B .001). -There was a significant positive association between religious service attendance and social support (b = .62, t(1,284) = 13.31, p B .001). -Findings did not indicate a mediated model regarding social support. -There was no evidence of moderation via race between religious service attendance and social support. Colorectal Cancer Screening: -Directly between religious service attendance and recent colorectal cancer screening, the association was significant (b = .40, v2 (1) = 2.63, p B .001]. -There was a positive association between religious service attendance and social support (b = .61, t(1,367) = 13.86, p B .001). -There was a significant positive association between social support and recent screening (b = .28, v2 (1) = 3.21, p B .001), suggesting a partially mediated model. -There was no evidence of moderation via race between

							religious service attendance and social support.
McFall & Davila, 2008	CS	USA	Elderly adults	4,419	70-85 Women 74.9 (n/a) Men 74.0 (n/a)	Current cancer screening status (mammography, prostate exam)	-Attending church was associated with prostate cancer screening for men (OR:1.60, CI:1.20-2.15). -Attending church was not associated with obtaining a mammogram.
Ochoa-Frongia et al., 2012	CS	USA (New York City area)	African American women	946	<39 years to >80 years ** <39 years n=177 (20.9%) 40-49 years n=177 (20.9%) 50-59 years n=188 (22.2%) 60-69 years n=170 (20.1%) 70-79 years n=105 (12.4) 80+ years n=30 (3.5)	Breast screening adherence (mammography, CBE, BSE)	-Women most likely to be adherent to mammography guidelines were between the ages of 50 to 59 (64.7%), and 60 to 69 (74.1%). -Women least likely to be adherent to mammography guidelines were 80 years of age or greater (39.3%, p<.001). -There was a significant association between the R/S statement and BSE adherence (p=.044).
Othman et al., 2012	CS	Jordan (Zarqa, Amman)	Women	142	40-74 47.8(7.1)	Intention to get a mammogram	-21.1% of women reported having ever had a mammogram. -Fatalistic beliefs in predestination was found to be correlated with perception of benefits from mammography and perception of self-efficacy to undergo mammography. -Using logistic regression, combination of knowledge,

							health beliefs, subjective norms, fatalistic beliefs and demographic characteristics contributed significantly to intention to obtain mammography (p<.001). -Repeated multiple regression tests revealed that fatalistic beliefs and demographic factors did not have a significant association with intention to have a mammogram.
O'Reilly et al., 2013	CS	Northern Ireland	Women	32,211	48-64 <55 years (46.2%) 55-64 years (53.8%)	Uptake of breast cancer screening	-Lowest breast cancer screening uptake was among women with no religious affiliation. -Women with no religious affiliation were 23% less likely than Catholics to attend screening (OR:0.77, CI:0.71-0.83), after fully adjusting for all covariates. -Of women who had no current religious affiliation but who had religious upbringing, there was no difference in screening uptake between Catholics and Protestant upbringings. -Of women who had no current religious affiliation but who had religious upbringing, women with no religious upbringing had lower screening uptake compared to women with Catholic or Protestant upbringings.

Padela et al., 2016	CS	USA (Chicago)	Muslim women	240	40-85 40-49 n=89 (43) 50-74 n=108 (52) ≥75 n=9 (4)[b]	Ever having a mammogram or CBE Having undergone mammogram in previous 2 years	-None of the religious variables were found to be significantly associated with ever having a mammogram. -Fatalism and factors related to Islam were significantly associated with ever having a mammogram on bivariate analysis (α=.01), but not using multivariate models adjusting for sociodemographic variables. -Women with greater religiosity and greater religious coping mechanisms were less likely to have had a mammogram in the past two years in bivariate and multivariate models (OR:0.44 p<.01). -In bivariate and multivariate models, perceptions of religious discrimination were negatively associated with having had a mammogram in the past two years (OR:0.79 p<.01).
Steele-Moses et al., 2009	Cohort	USA (Midwest)	Low income African American women	321	41-75 41-45 n=113 (35.2%) 46-50 n=84 (26.2%) 51-55 n=46 (14.3%) 56-60 n=31 (9.7%) 61-65 n=18 (5.6%) 66-70 n=16 (5.0%)	Mammogram adherence	-Religiosity was a significant predictor of mammography adherence six months after completion of the intervention after controlling for education (OR:1.124, CI:1.044-1.211). Based on the Stages of Change Model, religiosity was a significant predictor of stage progression, controlling for marital status (OR:1.112, CI:1.039-1.190).

					71-75 n=13 (4.0%) 50 (8.73)		-Overall, women with greater religiosity were more likely to get a mammography and to move forward in mammography stage.
Dickey et al. 2017	Quasi-experimental design	Northeastern Florida	African American men a	**Initial recruitment:** 76 Experimental arm: n=37 Control: n=39 **Post 6-month follow-up**: n=54 Experimental arm: n=26 Control arm: n=28	40+ 51 (NR)	Prostate cancer knowledge and screening (DRE and PSA screening)	-Intervention group consisted of providing educational interventions for prostate cancer and screening. At the 6-month follow-up 79% of the intervention group received prostate cancer screening, versus 21% in the control arm. -At the six-month follow-up, through bivariate correlation, prostate cancer screening was significantly associated with religion (*rs*=0.353, p<0.01)
Glickasman & Glicksman, 2017	CS	Pennsylvania (Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties)	White non-Hispanic, Jewish, Catholic or Protestant respondents	2,072 Jewish: 228 Catholic: 976 Protestant: 868	60+ Median: 72	CBE, mammography, prostate exam	-Logistic regression showed that religious membership/affiliation was statistically significantly associated with prediction of prostate exam, CBE, and mammography(p<0.05). -Frequently attending religious services was statistically significantly associated with prediction of mammography (p<0.05), but not prostate cancer screening (p>0.05).
Gyedu et al. 2017	CS	Kumasi, Ghana	Women	771 Muslim: 432 Christian: 339	18-90 40 (NR)	CBE	-Chi-square testing showed statistically significantly more Christian women had ever performed BSE compared to Muslim women (p<0.001);

							statistically significantly greater Christian women performed CBE compared to Muslim women (p<0.001). -Logistic regression showed Muslim women had lower odds of ever performing a BSE compared to Christian women (adjusted OR: 0.51; 95%CI: 0.29-0.88); no significant differences of performing monthly SBEs. Muslim women also had lower odds of undergoing CBE compared to Christian women (adjusted OR: 0.48; 95%CI: 0.27-0.84).
Lofters et al. 2018	CS	Toronto, Ontario, Canada	Canadians enrolled in a family practice	5,311	50-74 49 (13.9)	Up-to-date screening status: Breast cancer screening, overall CRC, colonoscopy, FOBT	Mammography: -In bivariate analysis, Muslim women were more likely to be up-to-date on breast cancer screening than women of other religions/faiths and atheistic women. (p=0.0062). Colorectal cancer screening: -There were no statistically significant differences between Muslims and other religious affiliations or atheists regarding CRC (p>0.05).
Melvin et al. 2016	CS	USA	Hispanic Black, non-Hispanic White, or Hispanic women	550	40-75 53.4 (9.3)	Mammography	-Via multivariate logistic regression, odds of not being screened were higher for non-Hispanic White women compared to non-Hispanic Black women (OR:2.16, 95%CI: 0.26-0.82) and Hispanic women (OR:4.17, 95%CI: 0.12-0.48).

							-Via multivariate logistic regression, women who were less confidence had greater odds of not being screened compared to more confident women (measure of self-efficacy) (OR:2.43, 95%CI: 1.26-4.73). -Women with greater levels of religious or spiritual values were at greater odds of not having been screened (OR:1.42, 95%CI: 1.00-2.00), although this result was not statistically significant.
Speed, 2018	CS	Canada (New Brunswick, Manitoba)	Women	NR	NR	Mammography	-Via logistic regression, women who attended church at a frequency of once a year, once a month, once a week or more had statistically significantly greater odds of ever receiving a mammogram compared to women who never attend church (OR:6.24, 95%CI: 2.04-19.04; OR:2.53, 95%CI: 1.03-6.22; OR:2.27, 95%CI: 1.05-4.90, respectively). -There was no statistically significant association between ever having received a mammography and perceived religiosity or religious affiliation.
Sen & Kumkale 2016	CS	USA	Women	474	41+ 57.3 (10.48)	Mammography	-Via logistic regression, R/S (assessed through attendance, religiosity and locus of control) did not statistically significantly help to predict

mammography among women.
-Logistic regression models were found to be poor predictors of non-attendance of mammography.
-The use of decision trees was found to better classify women who do not adhere to mammography guidelines; 22% of women were correctly classified using decision trees using personality and religiousness, compared to only 3.3% who were predicted through logistic regression.
-Age was the most important attribute incorporated into decision trees that predicted mammogram attendance; other important variables included conscientiousness, future time-orientation, neuroticism, and passive locus of control.

**Mean and standard deviation reported unless otherwise reported. Some studies reported means while others reported proportions of age groups included in their study.*
*** Actual age range not reported.*
[a] *Sample n values were reverse calculated from the original publication. Data were originally reported in the following manner:*

	Church members (n=1,517) %	**Community (n=510) %**
Age 50-64 (vs. 65-80)	57	58

[b] *Median age reported to be 51*
c Age range was unclear in the publication. Authors indicated that for churches to be eligible in their study, they have to have a predominantly African American congregation with a minimum of 100 active members aged 50 years or older.

Abbreviations: CBE=clinical breast exam; SBE=self breast exam; FOBT=fecal occult blood test; DRE=digital rectal exam; CRC=colorectal cancer screening; BAP=breast awareness practice; NR=not reported; rs=Spearman's rho; OR=odds ratio; CI=confidence interval; SD=standard deviation; CS=cross sectional

Table 2: Confounders Table of Included Studies

	Study											
Controls	Allen et al., 2012	Azaiza et al., 2010	Benjamins & brown, 2004	Benjamins, 2006	Benjamins et al., 2011	Brittain & Murphy, 2015	Conway-Phillips & Janusek, 2014	Fox et al., 1998	Hatefnia et al. 2010	Holt et al., 2009	Husaini et al., 2008	Katz et al., 2008
Age	X		X	X	X		X	X	X	X	X	X
Education		X	X	X	X			X	X	X		
Race			X	X	X			X				X
Born in Canada												
Preferred language												
Ethnicity			X	X	X			X				
Marital status			X		X			X	X	X		X
Income			X	X					X			
Employment status												
Sex			X		X							
SES							X				X	X
Social support												

Foreign born status			X				
Geographical location	X						
Low income housing project							X
Functional status		X					
Chronic conditions		X					
Self-rated health		X		X			
Pain		X					
Psychiatric problems		X					
Family history of breast cancer						X	
1st degree relative with breast cancer	X						
Planfulness				X			

Trust in one's physician			X				
Presence of a primary healthcare provider				X			
Physician characteristics					X		
Health insurance status	X		X		X		
Presence of private insurance							X
Health network			X				
Barriers to breast cancer screening					X		
Breast cancer risk factors					X		
Ever had a breast about							

which they were worried												
Ever been taught SBE												
Receipt of CBE												X
Religious denomination		X										
Religiosity		X				X						
Active church behaviour								X				
Smoking status												X
Theory related variables									X			
Personality related variables												
TOTAL	1	5	12	7	11	2	4	8	6	3	4	6

*The cross-marks in this table are meant to serve as markers that the study mentioned in the column headings reported use of the confounder noted in the row headings.

Table 2 continued…

	Study							
Controls	Dickey et al.	Glicksman & Glicksman, 2019	Gyedu et al. 2019	Lofters et al. 2016	Melvin et al. 2018	Speed, 2018	Sen & Kumkale, 2016	**Total**
Age	X		X	X	X	X	X	**16**
Education	X	X	X		X	X	X	**13**
Race					X	X	X	**8**
Born in Canada				X				**1**
Preferred language				X				**1**
Ethnicity								**4**
Marital status		X	X		X	X		**10**
Income	X	X		X	X	X		**8**
Employment status					X			**1**
Sex				X				**3**
SES								**3**
Social support					X			**1**
Foreign born status								**1**

Geographical location			X		**2**
Low income housing project					**1**
Functional status					**1**
Chronic conditions					**1**
Self-rated health					**2**
Pain					**1**
Psychiatric problems					**1**
Family history of breast cancer				X	**2**
1st degree relative with breast cancer	X				**2**
Planfulness		X			**2**
Trust in one's physician					**1**

Presence of a primary healthcare provider					**1**
Physician characteristics					**1**
Health insurance status	X	X		X	**6**
Presence of private insurance				X	**2**
Health network					**1**
Barriers to breast cancer screening					**1**
Breast cancer risk factors					**1**
Ever had a breast about which they were worried			X		**1**

Ever been taught SBE			X					**1**
Receipt of CBE								**1**
Religious denomination		X		X				**3**
Religiosity					X		X	**4**
Active church behaviour								**1**
Smoking status								**1**
Theory related variables	X				X			**3**
Personality variables							X	**1**
Total	5	5	6	6	12	6	6	

*The cross-marks in this table are meant to serve as markers that the study mentioned in the column headings reported use of the confounder noted in the row headings.

Appendix C

Baseline Exploratory Data Analysis of R/S Variables

Table C.1: Contingency Table between R/S Salience and R/S Perceived (Baseline)

	R/S Perceived					
R/S Salience Freq (%)	Not at all	Not very	Moderate	Very	Total	p-value
Yes	23 (0.19)	524 (4.38)	5157 (43.08)	2271 (18.97)	7975 (66.62)	<.0001
No	1069 (8.93)	2239 (18.70)	686 (5.73)	2 (0.02)	3996 (33.36)	
					11971 (100.00)	

Spearman's correlation coefficient (r_s) = 0.71

Table C.2: Contingency Table between R/S Salience and R/S Attendance (Baseline)

	R/S Attendance						
R/S Salience Freq (%)	At least once a week	At least once a month	At least 3-4 times a year	At least once a year	Not at all	Total	p-value
Yes	4839 (40.43)	1146 (9.58)	906 (7.57)	520 (4.34)	562 (4.70)	7973 (66.62)	<.0001
No	116 (2.90)	183 (1.53)	526 (4.40)	904 (7.55)	2266 (18.93)	3995 (33.38)	
						11968 (100.00)	

Spearman's correlation coefficient (r_s) = 0.68

Table C.3: Contingency Table between R/S Perceived and R/S Attendance (Baseline)

	R/S Attendance						
R/S Perceived Freq (%)	At least once a week	At least once a month	At least 3-4 times a year	At least once a year	Not at all	Total	p-value
Not at all	6 (0.05)	4 (0.03)	10 (0.08)	52 (0.43)	1019 (8.51)	1019 (8.51)	<.0001
Not very	113 (0.94)	152 (1.27)	467 (3.90)	811 (6.77)	1220 (10.19)	2763 (23.08)	
Moderate	2723 (22.75)	1106 (9.24)	928 (7.75)	545 (4.55)	542 (4.53)	5844 (48.82)	
Very	2113 (17.65)	66 (0.55)	29 (0.24)	17 (0.14)	48 (0.40)	2273 (18.99)	
						11971 (100.00)	

Spearman's correlation coefficient (r_s) = 0.72

Appendix D

Log-Odds Trend Plots

Figure D.1: Log-odds plot of colorectal cancer screening by participant's status of religious/spiritual salience across time (linear)

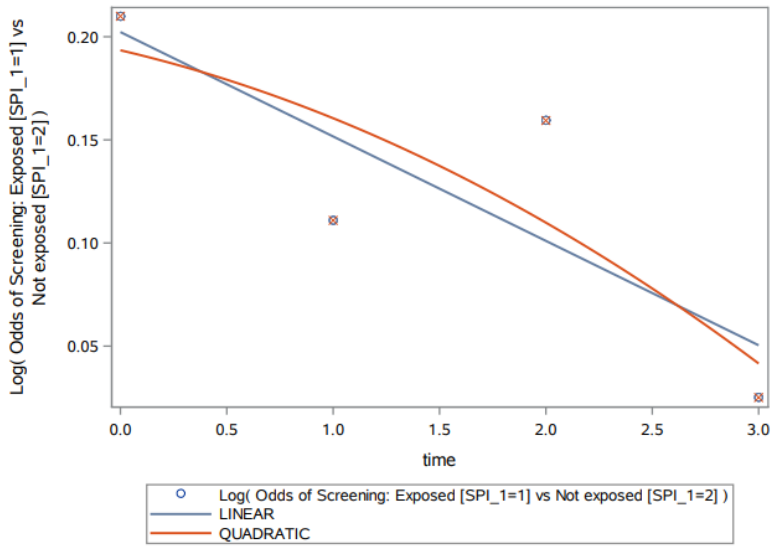


Figure D.2: Log-odds plot of colorectal cancer screening by participant's status of religious/spiritual salience across time ($\sqrt{time}$)

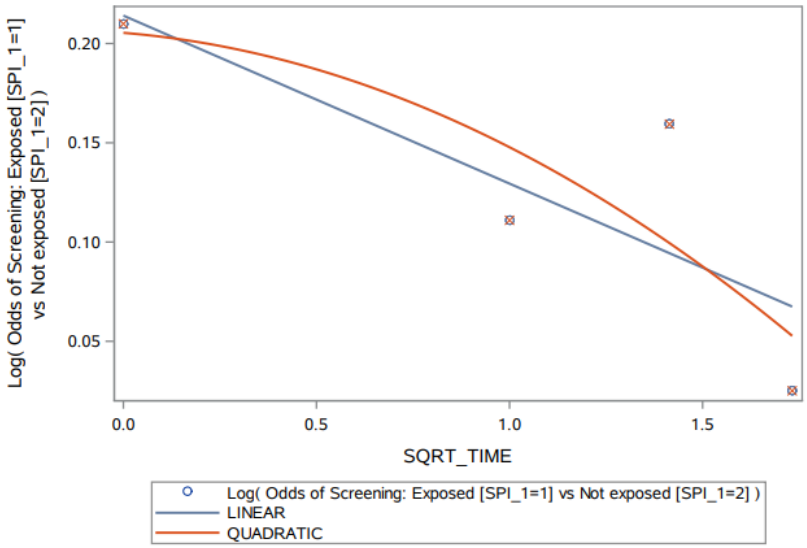


Figure D.3: Log-odds plot of colorectal cancer screening by participant's status of religious/spiritual service attendance (time)

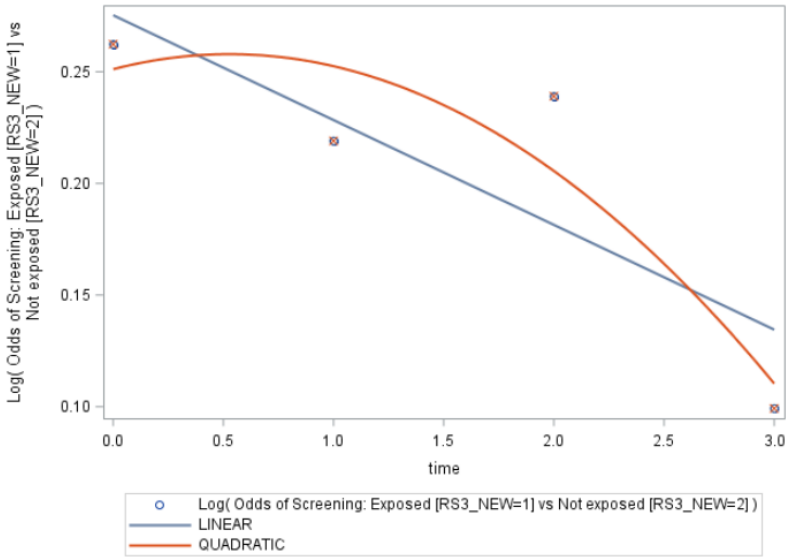


Figure D.4: Log-odds plot of colorectal cancer screening by participant's status of religious/spiritual service attendance ($\sqrt{time}$)

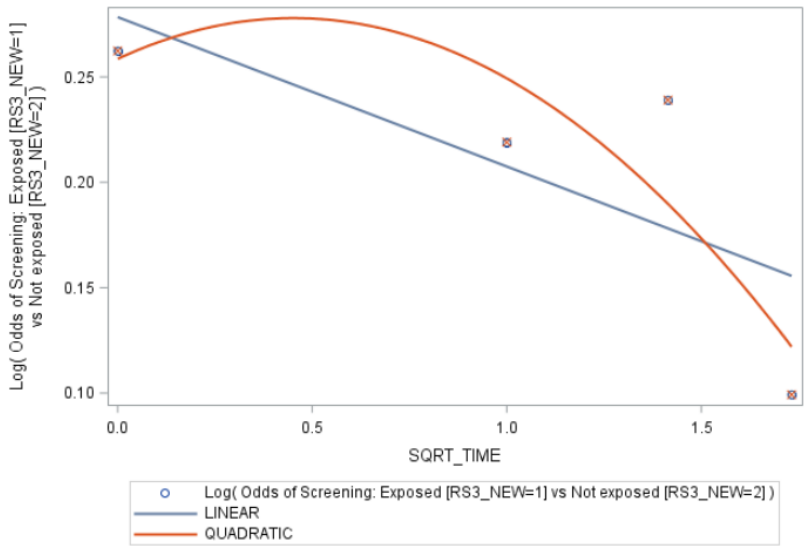


Figure D.5: Log-odds plot of prostate cancer screening by participant's status of religious/spiritual salience (time)

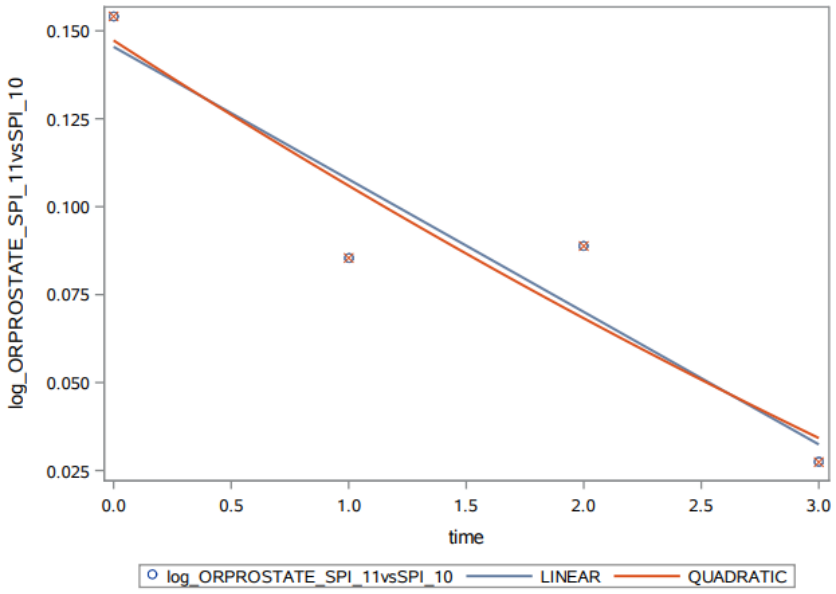


Figure D.6: Log-odds plot of prostate cancer screening by participant's status of religious/spiritual salience ($\sqrt{time}$)

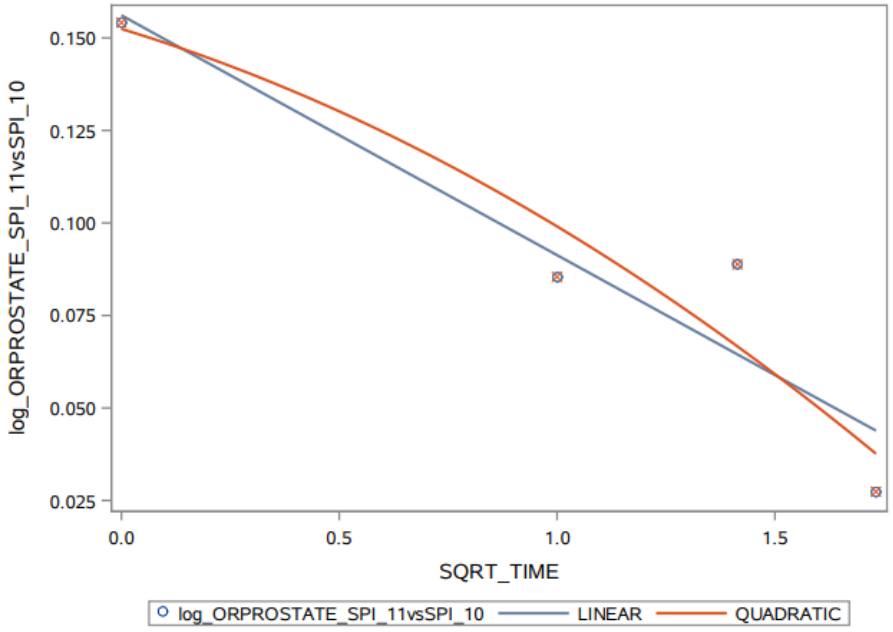


Figure D.7: Log-odds plot of prostate cancer screening by participant's status of religious/spiritual service attendance (time)

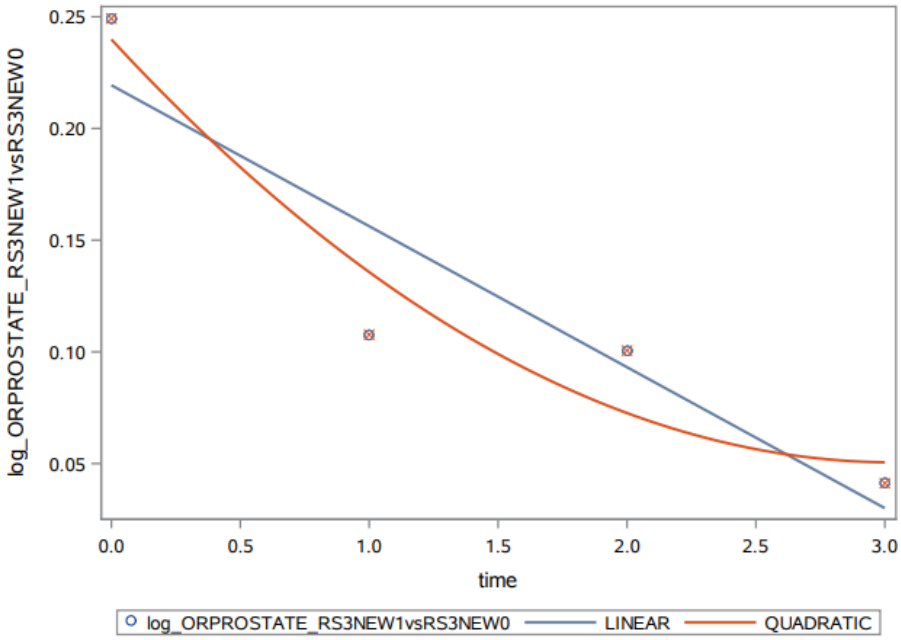
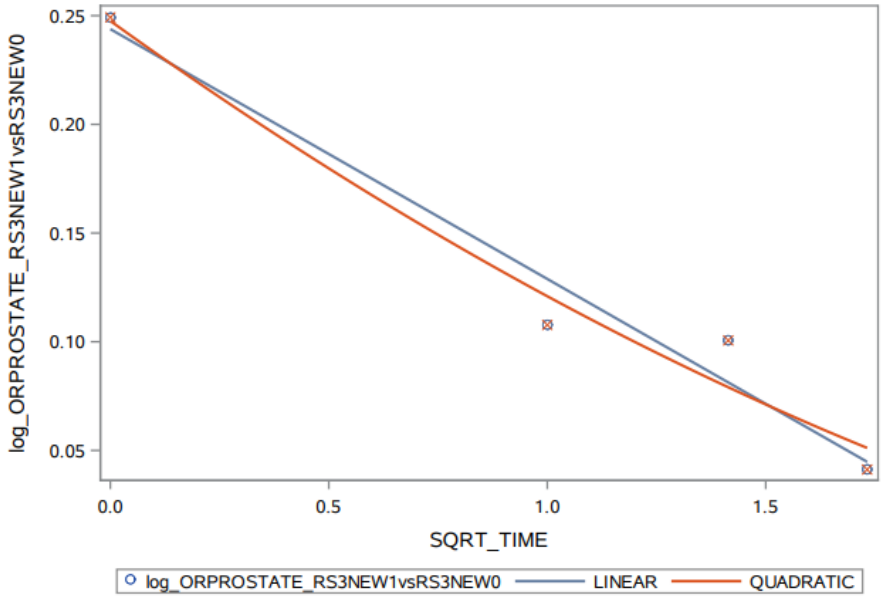


Figure D.8: Log-odds plot of prostate cancer screening by participant's status of religious/spiritual service attendance ($\sqrt{time}$)



Appendix E

Exploratory Data Analysis of R/S and Cancer Screening

Table E.1: Breast Cancer Screening by Religious/Spiritual Salience of Women at Baseline

Mammography Freq (%)	**R/S Salience** Yes	No	Chi-square (p-value)	Crude OR (95% CI)
Baseline, n (%)				
Yes	3464 (70.38)	1184 (66.33)	0.0015	1.20 (1.07-1.35)
No [Ref]	1458 (29.62)	601 (33.67)		
Missing	1			

Table E.2: Breast Cancer Screening Status by Frequency of Religious/Spiritual Practice (R/S Attendance) of Women at Baseline

Mammography Freq (%)	**R/S Attendance** At least once a week	At least once a month	3-4 times a year	At least once a year	Not at all [Ref]	Chi-square (p-value)
Yes	2259 (71.15)	558 (72.28)	540 (68.10)	449 (63.51)	842 (66.77)	
No [Ref]	916 (28.85)	214 (27.72)	253 (31.90)	258 (36.49)	419 (33.23)	<.0001
Crude OR (95% CI)	1.22 (1.06-1.41)	1.29 (1.06-1.58)	1.06 (0.88-1.28)	0.86 (0.71-1.05)	1	

*The category of "At least once a week" was originally two separate options in the HLQ as "Daily or almost daily" and "At least once a week." It was decided that enough similarity existed between the two original options to be collapsed into the category now referred to as "At least once a week."

Table E.3: Prostate Cancer Screening by Religious/Spiritual Salience of Men at Baseline

PSA Test Freq (%)	**R/S Salience** Yes	No [Ref]	Chi-square (p-value)	Crude OR (95% CI)
Yes	1008 (34.60)	622 (29.66)	0.0002	1.21 (1.08-1.36)
No [Ref]	1905 (65.40)	1475 (70.34)		

Table E.4: Prostate Cancer Screening Status by Frequency of Religious/Spiritual Practice of Men at Baseline

	R/S Attendance					
PSA Test Freq (%)	At least once a week*	At least once a month	3-4 times a year	At least once a year	Not at all [Ref]	Chi-square (p-value)
Yes	607 (35.65)	180 (33.27)	215 (35.60)	223 (32.94)	403 (27.10)	
No [Ref]	1,094 (64.32)	361 (66.73)	389 (64.40)	454 (67.06)	1,084 (72.90)	<.0001
Crude OR (95% CI)	1.42 (1.23-1.64)	1.21 (0.99-1.50)	1.46 (1.20-1.76)	1.31 (1.09-1.58)	1	

**The category of "At least once a week" was originally two separate options in the HLQ as "Daily or almost daily" and "At least once a week." It was decided that enough similarity existed between the two original options to be collapsed into the category now referred to as "At least once a week."*

Table E.5: Colorectal Cancer Screening Status by Status of Religious/Spiritual Salience of Participants at Baseline

	R/S Salience			
Sigmoidoscopy/ Colonoscopy Freq (%)	Yes	No [Ref]	Chi-square (p-value)	Crude OR (95% CI)
Yes	1,426 (17.91)	579 (14.52)		
No [Ref]	6,534 (82.09)	3408 (85.48)	<.0001	1.29 (1.16-1.43)
Missing	30			

Table E.6: Colorectal Cancer Screening Status by Frequency of Religious/Spiritual Practice of Participants at Baseline

	R/S Attendance					
Sigmoidoscopy/ Colonoscopy Freq (%)	At least once a week*	At least once a month	3-4 times a year	At least once a year	Not at all [Ref]	Chi-square (p-value)
Yes	901 (18.20)	242 (18.25)	256 (17.88)	221 (15.54)	385 (13.65)	
No [Ref]	4,047 (81.79)	1,084 (81.75)	1,176 (82.12)	1,201 (84.46)	2,435 (86.35)	<.0001
Crude OR (95%CI)	1.41 (1.24-1.60)	1.41 (1.18-1.68)	1.38 (1.16-1.64)	1.64 (0.97-1.39)	1	
Missing	29					

**The category of "At least once a week" was originally two separate options in the HLQ as "Daily or almost daily" and "At least once a week." It was decided that enough similarity existed between the two original options to be collapsed into the category now referred to as "At least once a week."*

T**able E.7:** Model Selection for Cross-Sectional Analysis of R/S and Mammography at Baseline

Model	**BIC**	**c-statistic**	**R/S Reg. Coef.**	**p-value**	**Odds Ratio (95% CI)**
R/S Salience					
Model 1: Predictor only	8279.698	0.519	0.0937	0.0015	1.206 (1.07-1.35)
Model 2: Predictor + Social Support Covariate	8285.976	0.515	0.0946	0.0014	1.208 (1.08-1.36)
Model 3: Predictor + Sociodemographic Covariates	5805.016	0.845	0.0228	0.5323	1.047 (0.91-1.21)
Model 4: Predictor + Personal Health Covariates	7166.283	0.556	0.1124	0.0004	1.252 (1.11-1.42)
Model 5: Predictor + All Covariates	5065.332	0.846	0.0423	0.2790	1.088 (0.93-1.27)
R/S Attendance					
Model 6: Predictor only	8287.463	0.511	0.0717	0.0316	1.154 (1.01-1.32)
Model 7: Predictor + Social Support Covariate	8293.825	0.512	0.0723	0.0303	1.156 (1.01-1.32)
Model 8: Predictor + Sociodemographic Covariates	5806.155	0.845	-0.0105	0.7970	0.979 (0.83-1.15)
Model 9: Predictor + Personal Health Covariates	7176.296	0.551	0.0809	0.0219	1.176 (1.02-1.35)
Model 10: Predictor + All Covariates	5067.317	0.847	0.00845	0.8452	1.017 (0.86-1.21)

Abbreviations: BIC= Bayesian Information Criteria; c-statistic=concordance statistic; R/S=Religiosity/Spirituality; Reg. Coef. = regression coefficient; CI = confidence interval
Social support covariate: social support
Sociodemographic covariates: age, marital status, income, education, occupation
Personal health covariates: smoking status, perceived health status

Appendix F

Model Selection Results for Longitudinal Analyses of R/S and Prostate & Colorectal Cancer Screening

Table F1: Longitudinal models for R/S Salience and prostate cancer screening

Model	Odds Ratio[a] (95% CI)	Reg. Coef. [a]	BIC
Linear Models			
Model 11: R/S Salience + Time	1.93 (1.32-2.83)	0.6566	15839.18
Model 12: R/S Salience + Time + Social Support Covariate	1.75 (1.19-2.56)	0.5584	15798.60
Model 13: R/S Salience + Time + Sociodemographic Covariates	0.97 (0.70-1.34)	-0.02784	13852.42
Model 14: R/S Salience + Time + Personal Health Covariates	1.77 (1.17-2.69)	0.5745	13756.85
Model 15: R/S Salience + Time + All Covariates	0.89 (0.63-1.27)	-0.1113	12034.39

** Parameter estimate are not reported since this model only contains the intercept.*
*** Parameter estimates are reported for linear time and do not contain R/S Salience*
[a] Estimates refer to the R/S parameters in each model
Abbreviations: BIC=Bayesian Information Criteria; Reg. Coef. = regression coefficient; CI = confidence interval; R/S=religiosity and spirituality
Social support covariate: social support
Sociodemographic covariates: age, marital status, income, education, occupation
Personal health covariates: smoking status, perceived health status

Table F2: Longitudinal models for R/S Attendance and prostate cancer screening

Model	Odds Ratio[a] (95% CI)	Reg. Coef. [a]	BIC
Square Rooted Models			
Model 16: R/S Attendance + Time	1.88 (1.24-2.86)	0.6308	15853.76
Model 17: R/S Attendance e + Time + Social Support Covariate	1.78 (1.16-2.71)	0.5756	15819.08
Model 18: R/S Attendance + Time + Sociodemographic Covariates	1.39 (0.98-1.97)	0.3276	13967.37
Model 19: R/S Attendance + Time + Personal Health Covariates	1.84 (1.14-2.97)	0.6077	13782.99
Model 20: R/S Attendance + Time + All Covariates	1.36 (0.92-2.01)	0.3064	12117.16

** Parameter estimate are not reported since this model only contains the intercept.*
*** Parameter estimates are reported for linear time and does not contain R/S Attendance*
[a] Estimates refer to the R/S parameters in each model
Abbreviations: BIC=Bayesian Information Criteria; Reg. Coef. = regression coefficient; CI = confidence interval; R/S=religiosity and spirituality
Social support covariate: social support
Sociodemographic covariates: age, marital status, income, education, occupation
Personal health covariates: smoking status, perceived health status

Table F3: Longitudinal models for R/S Salience and colorectal cancer screening

Model	Odds Ratio[a] (95% CI)	Reg. Coef. [a]	BIC
Linear Models			
Model 21: R/S Salience + Time	1.60 (1.27-2.03)	0.4723	25347.98
Model 22: R/S Salience + Time + Social Support Covariate	1.60 (1.27-2.03)	0.4716	25356.74
Model 23: R/S Salience + Time + Sociodemographic Covariates	1.36 (1.09-1.69)	0.3070	23878.71
Model 24: R/S Salience + Time + Personal Health Covariates	1.74 (1.33-2.26)	0.5523	22079.85
Model 25: R/S Salience + Time + All Covariates	1.44 (1.12-1.84)	0.3631	20836.27

** Parameter estimate are not reported since this model only contains the intercept.*
*** Parameter estimates are reported for linear time and does not contain R/S Salience*
[a] Estimates refer to the R/S parameters in each model
Abbreviations: BIC=Bayesian Information Criteria; Reg. Coef. = regression coefficient; CI = confidence interval; R/S=religiosity and spirituality
Social support covariate: social support
Sociodemographic covariates: age, marital status, income, education, occupation
Personal health covariates: smoking status, perceived health status

Table F4: Longitudinal models for R/S Attendance and colorectal cancer screening

Model	Odds Ratio[a] (95% CI)	Reg. Coef.[a]	BIC
Linear Models			
Model 26: R/S Attendance + Time	1.77 (1.36-2.29)	0.5679	25349.43
Model 27: R/S Attendance + Time + Social Support Covariate	1.77 (1.36-2.30)	0.5701	25351.66
Model 28: R/S Attendance + Time + Sociodemographic Covariates	1.50 (1.18-1.92)	0.4055	23879.64
Model 29: R/S Attendance + Time + Personal Health Covariates	1.87 (1.39-2.50)	0.6247	22082.74
Model 30: R/S Attendance + Time + All Covariates	1.56 (1.19-2.06)	0.4475	20832.69

** Parameter estimate are not reported since this model only contains the intercept.*
*** Parameter estimates are reported for linear time and does not contain R/S Attendance*
[a] Estimates refer to the R/S parameters in each model
Abbreviations: BIC=Bayesian Information Criteria; Reg. Coef. = regression coefficient; CI = confidence interval; R/S=religiosity and spirituality
Social support covariate: social support
Sociodemographic covariates: age, marital status, income, education, occupation
Personal health covariates: smoking status, perceived health status