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RELIGIOSITY AND PATIENT ACTIVATION AND HEALTH OUTCOMES AMONG
HOSPITAL SURVIVORS OF AN ACUTE CORONARY SYNDROME

A Dissertation Presented

By

HAWA OZIEN ABU

Submitted to the Faculty of the

University of Massachusetts Graduate School of Biomedical Sciences, Worcester

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DOCTOR OF PHILOSOPHY

(MARCH 27, 2019)

CLINICAL AND POPULATION HEALTH RESEARCH

RELIGIOSITY AND PATIENT ACTIVATION AND HEALTH OUTCOMES AMONG
HOSPITAL SURVIVORS OF AN ACUTE CORONARY SYNDROME

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This work was undertaken in the Graduate School of Biomedical Sciences

Clinical and Population Health Research

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DEDICATION

This dissertation is dedicated to God Almighty, my Creator in whom I live, move and have my being. My strength and abilities are not human endowed, but I do all things through Christ who strengthens me. I dedicate my endeavors to the Holy Spirit, my ever-present help who enlightens, guides, and directs me in the path of excellence and fulfilment of my life's purpose. Through the intercession of the most Blessed Virgin Mary and the Heavenly Angels and Saints I have accomplished this work dedicated to the service of humanity.

"But I will restore you to health and heal your wounds,' declares the LORD" ~ Jeremiah 30:17

"LORD my God, I called to you for help, and you healed me." ~ Psalms 30:2

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With the love, support, care, and understanding from my husband Ronny Aluede, together we journeyed through the hurdles, victories, and fulfilling moments of my doctoral research program. I am grateful for your encouragement and being my best buddy through this learning process. The presence of my precious and adorable daughter Isibhakome Audrey Aluede in my life has brought me joy, happiness and fulfilment as a mother. Your birth was timed perfectly three days after my dissertation proposal and since then you have cooperated with me all the way, filled me with smiles, and permitted me to work while you play alongside with me. I am awed by the remarkable presence and support of my family.

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ABSTRACT

Background: Religious involvement is widespread and may influence patient engagement with their healthcare (patient activation) and health outcomes. This dissertation examined the association between religiosity and patient activation, changes in health-related quality of life (HRQOL), readmissions, and survival after hospitalization for acute coronary syndrome (ACS).

Methods: We recruited 2,174 patients hospitalized for ACS in Georgia and Central Massachusetts (2011-2013) in a prospective cohort study. Participants self-reported three items assessing religiosity – strength/comfort from religion, petition prayers for health, and awareness of intercessory prayers by others. Patient activation was measured using the 6-item Patient Activation Measure. Generic HRQOL was assessed with the SF-36®v2 physical and mental component summary scores. Disease-specific HRQOL was evaluated with the Seattle Angina Questionnaire Quality of Life subscale. Unscheduled readmissions were validated from medical records. Mortality status was obtained from national and state vital statistics.

Results: After adjustment for several sociodemographic, psychosocial, and clinical variables, reports of strength/comfort from religion and receipt of intercessions were associated with high activation. Praying for one's health was associated with low activation. Prayers for health were associated with clinically meaningful increases in disease-specific and physical HRQOL. Neither strength/comfort from religion, petition, nor intercessory prayers were significantly associated with unscheduled 30-day readmissions and two-year all-cause mortality.

Conclusions: Most ACS survivors acknowledge religious practices for their health. Religiosity was associated with patient activation and changes in HRQOL. These findings suggest that religiosity may influence patient engagement in their healthcare and recovery after a life-threatening illness, buttressing the need for holistic approach in patient management.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure 1.1: Adapted conceptual framework linking religiosity with patient activation and health outcomes

Figure 4.1: Study participant selection flowchart

Figure 4.2: Kaplan-Meier survival curves for patients who survive at least 2 years after hospital discharge for an acute coronary syndrome according to the three items assessing religiosity

LIST OF ABBREVIATIONS

Abbreviation	Meaning
ACS	Acute Coronary Syndrome(s)
AHA	American Heart Association
ANOVA	Analysis of Variance
CABG	Coronary Artery Bypass Graft
CHD	Coronary Heart Disease
CVD	Cardiovascular disease
GAD-7	Generalized Anxiety Disorder 7
GRACE	Global Registry of Acute Coronary Events
HRQOL	Health-Related Quality of Life
IQR	Interquartile Range
IPW	Inverse Probability Weights
LOS	Length of index hospitalization
MCS	Mental Component Summary Score
NSTEMI	Non-ST Elevated Myocardial Infarction
PAM-6	6-item Patient Activation Measure
PCI	Percutaneous Coronary Intervention
PCS	Physical Component Summary Score
PHQ-9	Patient Health Questionnaire – 9
PSS4	4-item Perceived Stress Scale
QOL	Quality of Life
SF-36	36-Item Short Form Survey (SF-36)
STEMI	ST-Elevated Myocardial Infarction
TICS	Telephone Interview for Cognitive Status
TRACE-CORE	Transitions, Risks, and Actions in Coronary Events – Center for Outcomes Research and Education
UA	Unstable Angina

PREFACE

The work presented in this dissertation is currently under review in scientific journals, has been presented, submitted or accepted for abstract poster presentations.

Chapter II:

Abu HO, McManus DD, Kiefe CI, Goldberg RJ. **Religiosity and Patient Activation among Hospital Survivors of an Acute Coronary Syndrome.** *Patient Education and Counseling* (currently under review)

Abu HO, McManus DD, Kiefe CI, Goldberg RJ. **Religiosity and Patient Engagement in their Healthcare among Hospital Survivors of an Acute Coronary Syndrome.** *Abstract Poster Accepted for Presentation at the University of Massachusetts Community Engagement and Research Symposium. March 22, 2019. Worcester MA, USA.*

Chapter III:

Abu HO, McManus DD, Lessard D, Kiefe CI, Goldberg RJ. **Religious Practices and Changes in Health-Related Quality of Life after Hospital Discharge for an Acute Coronary Syndrome.** *International Journal of Cardiology* (currently under review)

Abu HO, McManus DD, Kiefe CI, Goldberg RJ. **Influence of Petition and Intercessory Prayers on Changes in Health-Related Quality of Life among Hospital Survivors of an Acute Coronary Syndrome.** *Abstract Poster Submitted to the American Public Health Association Scientific Conference. November 2-6, 2019. Philadelphia PA, USA.*

Chapter IV:

Abu HO, Lapane KL, Waring ME, Ulbricht CM, Devereaux RS, McManus D, Allison JJ, Kiefe CI, Goldberg RJ. **Influence of Religious Practices on 30-day Readmissions and Long-term Survival after Hospital Discharge for an Acute Coronary Syndrome.** *Journal of American Heart Association* (currently under review).

Abu HO, Lapane KL, Waring ME, Ulbricht CM, Devereaux RS, McManus D, Allison JJ, Kiefe CI, Goldberg RJ. **Association between religiosity and 30-day Unscheduled Readmissions in Hospital Survivors of an Acute Coronary Syndrome**. *Abstract Poster Presented at the Society of Behavioral Medicine Scientific Conference, April 11-14, 2018. New Orleans LA, USA.*

CHAPTER I: INTRODUCTION

Burden of Acute Coronary Syndrome (ACS) in the United States

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality worldwide, accounting for more than 17.7 million deaths in 2015 [1]. At least 1 in every 3 Americans have some form of CVD, and by 2030, approximately 2 out of every 5 American adults are projected to have some manifestation of CVD [2,3]. Acute coronary syndrome (ACS) is a common form of CVD associated with sudden, reduced blood supply to the heart tissues manifesting as life-threatening symptoms of severe chest pain, shortness of breath, and lightheadedness [4]. Despite considerable advances in acute and long-term management practices, ACS including unstable angina (UA) and myocardial infarction (MI) with or without ST-segment elevation (STEMI/NSTEMI), constitute a major source of morbidity and mortality and account for approximately one-half of all deaths due to CVD [4-7]. The ACS are associated with significant medical, social, and economic burden [4]. There is also a significant financial impact of ACS in the United States, with an approximate cost of $23,000 per patient for an initial hospitalization for an ACS, and more than $150 billion spent annually in the management of patients with this condition [7,8]. Although there have been declining trends in the mortality associated with ACS in the U.S, survivors of an ACS experience substantial limitations in their health status, impaired health-related quality of life, difficulty adhering with recommended lifestyle modifications, and are at a higher risk for recurrent events after an initial ACS [9,10].

Religiosity and Cardiovascular Health Outcomes

In the event of a potentially life-threatening illness such as an ACS, patients may search for deeper meaning and purpose in their suffering and, seek strength and consolation in their religious beliefs or faith to enable them to cope with their underlying illness [11,12]. There has been a growing interest in understanding the role of religiosity and spirituality on one's personal

health and recovery from illness, a relationship yet to be fully understood among patients with

CVD, particularly among those discharged from the hospital after an ACS.

Empirical evidence has shown how religiosity influences CVD health outcomes through psychological, behavioral, and social pathways [13-17]. In terms of the psychological mechanisms, patients may find considerable meaning, purpose, strength, and comfort in religion after stressful life events, which could facilitate coping and adaptation with considerable improvement in well-being and survival [14]. These psychological processes favorably affect patient's inflammatory, endocrine, and autonomic functions [15,16]. Among patients with coronary heart disease (CHD), the physiologic responses evoked during prayer, including declines in sympathetic nervous activity, inflammatory markers, and serum cortisol levels may be beneficial for their recovery and improved health outcomes [15]. In terms of behavioral pathways, some religious doctrines promote positive self-care practices by encouraging individuals to refrain from unhealthy lifestyle practices such as smoking and heavy alcohol consumption [14]. Lastly, religiosity may favorably influence cardiovascular health via social pathways by promoting participation in faith communities, nurturing positive social attitudes, and through offering resources for building social networks, which may facilitate one's recovery from illness [17].

Religiosity and Spirituality Constructs

Religiosity or religious involvement may be defined in terms of membership in religious groups, practices such as service attendance, and prayers, rituals, and symbols based on belief in a deity [18]. Spirituality generally refers to a deep-seated relationship with the scared or transcendent, connectedness with others, and personal values [19]. Religiosity and spirituality are overlapping concepts, both emphasizing the depth of meaning and purpose in life [20]. Some individuals, however, may refer to themselves as being spiritual but do not practice any formal

religion [20]. This dissertation focuses more on patient's religious beliefs and practices, than on the extent of their spirituality.

Patient activation is important for self-management among ACS hospital survivors

Patient activation is defined as the extent of patient's knowledge, confidence, and ability to be engaged in their healthcare and self-manage their health [21]. In general, patients with higher levels of activation are better engaged in their healthcare and experience greater treatment satisfaction with improved health outcomes [22]. The American Heart Association (AHA) recommends that patients with CHD become actively engaged in their management by adopting a number of important lifestyle modifications including smoking cessation, eating a healthy diet, increasing their levels of physical activity, and maintaining low blood pressure [23]. Poor adherence with recommended lifestyle interventions and medical treatments among patients with stable coronary artery disease is associated with an increased risk of cardiovascular readmissions (10%-40%), and cardiovascular mortality (50%-80%) [24]. To ensure sustained and effective self-management, survivors of an ACS require the appropriate skills, beliefs, and motivation needed to implement the prescribed lifestyle modifications. Therefore, better understanding of the factors that influence patient activation is important, particularly the role of religious practices on patient activation among ACS survivors. For purposes of this dissertation and consistent with other studies [25,26] patient activation will be used interchangeably with patient engagement in their healthcare.

Religiosity and patient engagement in their healthcare

Religious doctrines facilitate the adoption of healthier behaviors and discourage actions with potential harm to the body such as cigarette smoking, excessive alcohol consumption, and unhealthy dietary practices [27]. Religious practices are pivotal in shaping how people perceive

their health and engage in managing their illness [28,29]. On the other hand, certain religious beliefs may contradict recommendations by medical professionals, hinder health care utilization, and may interfere with patient's adherence to prescribed treatment regimen [30,31]. At one extreme, patients who exhibit a passive dimension of "spiritual health locus of control" (a sense of lack of control over health and illness with the belief that health outcomes are predetermined by a higher power) may hinder individuals from taking an active role in their personal health care [32]. In contrast, those with an active dimension of the "spiritual health locus of control" may be better motivated to manage their illness [32].

The relationship between religiosity and patient activation may differ by individual characteristics such as age, gender and race/ethnicity. For example, studies show that most African-American adults consider themselves religious and, are more likely to respond that religion is an important factor that influences their lives and decision-making process [33,34]. Prior research has shown that with increasing age, religion may become more salient in people's lives and women are more likely to be religious compared with men [35,36]. Since religious experiences may differ across the lifespan and among cultural and gender groups, more research is needed to understand how religiosity may influence patient engagement in their healthcare according to various sociodemographic characteristics.

Health-Related Quality of Life (HRQOL) in patients after an ACS

Health-related quality of life (HRQOL) defined by patient's self-perceived health status and well-being, is an important patient-reported outcome that has been utilized to measure the effectiveness of different management strategies and recovery from illness [37]. HRQOL is an independent determinant of survival in patients discharged from the hospital after an ACS [38,39]. Survivors of an ACS experience substantial limitations in their HRQOL, may be unable

to return to work in the months following hospital discharge for an ACS and are at increased risk of recurrent angina symptoms [40,41]. Given the extent of impairment in HRQOL among ACS survivors, it is remains of considerable importance to understand the factors that influence HRQOL after hospital discharge for an ACS. The influence of several sociodemographic and clinical factors on HRQOL among ACS survivors has been extensively studied and factors such as female gender [42-44], older age [45,46], depression [40,47], previous CVD event [48], and NSTEMI / Unstable angina [49,50], have been shown to negatively influence patient's HRQOL. However, very limited research has been conducted on understanding the influence of religiosity on HRQOL among hospital survivors of an ACS.

Religiosity and HRQOL among ACS survivors

In patients with CVD, their religious beliefs and practices are important and highly personal aspects of their disease experience [51]. These factors provide vital strategies for coping with heart disease and many patients find strength and comfort in religion during the acute phase of their illness [52, 53]. Studies on the relationship between religiosity and spirituality and quality of life (QOL) among patients with various forms of CVD have however demonstrated mixed results. The majority of studies using both cross sectional [54, 55] and longitudinal designs [56] suggest that greater religiosity/spirituality is associated with better QOL. Other observational studies, however have reported negative or null associations between religiosity and QOL [57]. There are limited data that have examined whether religiosity influences changes in QOL after hospital discharge for an ACS. In our recent systematic review [58], we were only able to identify two studies that examined the influence of patient's religiosity and spirituality on QOL after an ACS. The two studies used data obtained from the same cohort of patients [59,60]. One study evaluated the longitudinal relationship between religiosity/spirituality and QOL

among patients with an initial MI or coronary artery-bypass surgery enrolled in a 12-week

cardiac rehabilitation program [59]. In this study, only 43 of 105 patients completed the baseline

and follow-up interviews at 1-2 years, and greater religiosity, as measured by religious coping,

was associated with an increase in QOL. However, the study findings were limited by its small

sample size and study participants were recruited from a single site with homogenous religious

involvement and racial/ethnic background, limiting generalizability of their results to more

diverse populations [59]. In the same cohort of patients (n=105), after 12 weeks of cardiac

rehabilitation, there was no significant association between the dimensions of

religiosity/spirituality and QOL at baseline, nor between religiosity/spirituality measured at

baseline and QOL measured at 12-weeks follow-up [60]. Additional, contemporary population-

based longitudinal studies are needed to evaluate the influence of religiosity on QOL in patients

discharged from the hospital after an ACS with sociodemographic and religious diversity.

Hospital Readmissions and Mortality after an ACS

Hospital readmissions after discharge for ACS are common and undesirable. Upwards of

one in five Medicare patients experience an unscheduled rehospitalization within 1 month of

discharge for an ACS [61]. ACS is the most common single cause of death among adults,

accounting for approximately 30% of all deaths globally [62]. In the US, an acute coronary event

occurs every 25 seconds and death from an ACS occurs every minute [63]. Although the role of

a number of sociodemographic, psychosocial, and clinical variables has been examined as

possible predictors of hospital readmission and mortality [64-67], no contemporary studies have

examined the influence of patient's religiosity on all-cause and cause-specific hospital

readmissions and survival after an ACS.

Religiosity and readmissions and long-term survival after an ACS

To date, no prior published studies have examined whether religious beliefs and practices are associated with readmissions following hospital discharge for an ACS. Since religiosity may influence patient engagement with their healthcare, adherence with prescribed treatment, and recovery [68,69], it is important to understand whether the extent of one's religious involvement may influence their risk of readmission after hospital discharge for an ACS.

In a review examining the association between religiosity and physical health [70], only one prospective study published in the 1990's was identified which examined the influence of religiosity on ACS related mortality among 232 middle aged and older US adults who suffered an acute myocardial infarction and underwent coronary artery by-pass surgery [71]. Those who reported receiving neither strength nor comfort from religion had three times the risk of dying from all-causes at six months post-surgery compared with those who derived strength and comfort from religion. In addition, infrequent attendance at religious service was associated with an increased risk of mortality [71]. However, the study was limited by its small sample size and few deaths among the study participants.

Conceptual framework

Koenig and colleagues developed theoretical models linking religiosity with physical and mental health outcomes, through the complex interactions of behavioral, psychological, social, and physiological mechanisms [72] which we have adapted to guide our analytic plan in this dissertation (figure 1.1). Religiosity comprises multidimensional constructs such as private religiosity (praying/meditation) and intrinsic/subjective religiosity (strength and comfort from religion) which may influence patient's engagement in their healthcare management, health behaviors, the body's physiological processes (immune, endocrine and cardiovascular), and

consequently impact patient's long-term HRQOL and survival. In addition, sociodemographic characteristics (age, gender, race/ethnicity), clinical variables and psychological factors including symptoms of depression, anxiety, and perceived stress may potentially confound or modify the relationship between religiosity and patient activation, readmissions or mortality, and need to be accounted for in examining these associations. The conceptual framework used in this dissertation was designed based on existing theoretical models that have shown how religious beliefs and practices may influence health outcomes. This dissertation does not examine causal mechanisms between religiosity and health outcomes but seeks to address whether religious beliefs and practices used among survivors of an acute coronary syndrome might impact their health outcomes and engagement in their healthcare.

Study aims and hypotheses

This dissertation intends to address existing knowledge gaps in our current understanding of the role of religiosity on cardiovascular health outcomes by using longitudinal data obtained from a sociodemographically diverse cohort of patients hospitalized for an ACS across six hospitals in central Massachusetts and Georgia who were enrolled in the Transitions, Risks and Actions in Coronary Events: Center for Outcomes Research and Education (TRACE-CORE) Study [73,74]. TRACE-CORE contains an extensive and robust psychosocial, behavioral, and clinical information that will be useful for enhancing our understanding of the association between religiosity, patient activation, changes in HRQOL, hospital readmissions and total mortality among hospital survivors of an ACS. The specific aims of this dissertation are to:

Aim 1: Examine the association between religiosity and patient activation during hospitalization for ACS. Determine if this association differs according to patient's age, sex, or race/ethnicity.

Hypothesis: Religious involvement (reports of petition or intercessory prayers for health, great deal or little/some strength and comfort from religion) will be independently associated with higher levels of patient activation even after accounting for patient sociodemographic, psychosocial, and clinical characteristics.

Aim 2: Examine the association between religiosity and clinically meaningful changes in HRQOL among ACS survivors between 1- and 6- months after hospital discharge for an ACS.

Hypothesis: Patients who report religious involvement (petition or intercessory prayers for health, great deal or little/some strength and comfort from religion) will have significantly greater improvement in their HRQOL between 1- and 6-months of discharge for ACS than those without reports of religiosity.

Aim 3: Examine the association between religiosity and 30-day all-cause readmissions and all-cause mortality within 2 years of hospital discharge for an ACS.

Hypothesis: Patients who report religious engagement (petition or intercessory prayers for health, great deal or little/some strength and comfort from religion) will have lower all-cause 30-day readmissions and mortality in the 2-year period after hospital discharge for an ACS compared to patients without reports of religious engagement.

Figure 1.1: Adapted conceptual framework linking religiosity with patient activation and health outcomes
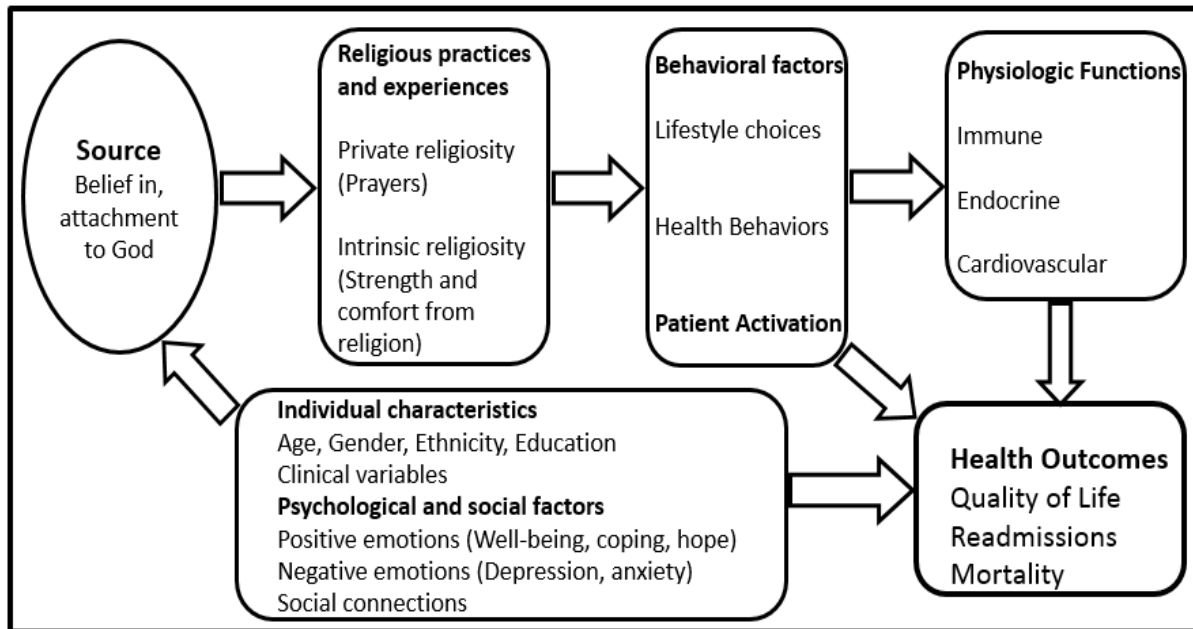
CHAPTER II: RELIGIOSITY AND PATIENT ACTIVATION AMONG HOSPITAL SURVIVORS OF AN ACUTE CORONARY SYNDROME

Abstract

Background: Optimum management after an Acute Coronary Syndrome (ACS) requires considerable patient engagement/activation. Patient activation describes how well patients understand their role in their healthcare plan and their extent of self-management. Higher patient activation levels are associated with improved health outcomes. Religious practices permeate many people's lives and may influence engagement in their healthcare. The aim of the present study was to examine the association between religiosity and patient activation in hospital survivors of an ACS.

Methods: We recruited patients hospitalized for an ACS at six medical centers in Central Massachusetts and Georgia (2011-2013). Participants self-reported three items assessing religiosity – strength and comfort from religion, making petition prayers, and awareness of intercessory prayers for health. Patient activation was assessed using the 6-item Patient Activation Measure (PAM-6). We categorized participants as either having low (levels 1 and 2) or high (levels 3 and 4) activation in examining the association between religiosity and patient activation while adjusting for sociodemographic, psychosocial, and clinical variables.

Results: Patients (n=2,067) were on average, 61 years old, 34% were women, and 81% were non-Hispanic White. Approximately 85% reported deriving strength and comfort from religion, 60% prayed for their health, and 89% received intercessions for their health. Overall, 57.5% had low activation. Reports of a great deal (aOR: 2.02; 95% CI: 1.44-2.84), and little/some (aOR: 1.45; 95% CI: 1.07-1.98) strength and comfort from religion were associated with high activation respectively, as was the receipt of intercessions (aOR: 1.48; 95% CI: 1.07-2.05). Praying for one's health was associated with low activation (aOR: 0.78; 95% CI: 0.61-0.99).

Conclusions: Strength and comfort from religion and intercessory prayers for health were associated with higher levels of patient activation, while petition prayers for health was associated with lower activation levels. These findings suggest that healthcare providers may use this knowledge to enhance patient engagement in their care.

Introduction

Approximately 1.1 million American adults are hospitalized annually for an acute coronary syndrome (ACS) [75]. Despite considerable advances in hospital and post-discharge treatment practices, the development of an ACS is associated with considerable morbidity and mortality [4-7]. The American Heart Association (AHA) recommends that patients with coronary heart disease be actively engaged in their management by undertaking lifestyle modifications and be adherent to prescribed cardiac medications [23]. For sustained and effective self-management, ACS survivors require the appropriate skills, beliefs, motivation, and confidence for successful implementation of recommended lifestyle changes.

Patient activation describes patients' understanding of their role in their healthcare plan and the extent of engagement in managing their health [21]. Higher levels of patient activation have been associated with better engagement in treatment, improved health outcomes, and greater patient satisfaction [22]. Assessing patient activation in the period following a life-threatening illness provides a potential opportunity for providers to tailor their care plans to meet patient needs prior to hospital discharge [76].

When faced with life-threatening conditions, such as an ACS, patients may experience existential concerns, and turn to their religious beliefs or faith as a means for coping with their illness [11,12]. This has led to growing interest in understanding the role of religiosity and spirituality on one's personal well-being and illness experience, a relationship that is incompletely understood among hospital survivors of an ACS. Religious practices may facilitate the adoption of healthier lifestyle behaviors and are important in shaping how people perceive their health and engage in managing their illness [28,29]. Certain religious beliefs may, however, conflict with recommendations by medical professionals, inhibit health care utilization, and may lead to poor adherence to treatment practices [30,31]. Furthermore, the association between religious practices

and patient activation may be moderated by individual patient characteristics including age, sex, and race/ethnicity.

To our knowledge, no prior study has been conducted among hospital survivors of an ACS to evaluate the association between religiosity and patient activation. We utilized data from a large and socioeconomically diverse cohort of hospital survivors of an ACS to examine the association between religiosity and patient activation and determine whether this association differed according to patient's age, sex, and race/ethnicity. We hypothesized that religious involvement (reports of petition or intercessory prayers for health, great deal or little/some strength and comfort from religion) will be independently associated with higher levels of patient activation even after accounting for patient sociodemographic, psychosocial, and clinical characteristics.

Methods

Study Population

The rationale, design, and data collection procedures of the Transitions, Risks and Actions in Coronary Events: Center for Outcomes Research and Education (TRACE-CORE) Study have been previously described in detail [73,74]. In brief, TRACE-CORE used a multi-center prospective cohort design to recruit 2,174 potentially eligible patients hospitalized with an ACS at three tertiary care and community medical centers in Worcester, MA, two tertiary care hospitals in Atlanta GA, and a large teaching hospital in Macon, GA, between April 2011 and May 2013. Eligibility criteria included adult patients aged ≥21 years, English or Spanish speaking, and discharged alive from the index hospitalization. Participating sites served a socio-demographically diverse population. Written informed consent was obtained from each patient and the Institutional Review Boards at participating sites approved this study.

Trained staff abstracted detailed information from hospital medical records at the time of study enrollment. Each validated case of an ACS was categorized as either unstable angina, non-ST segment elevation myocardial infarction (NSTEMI), or ST-segment elevation myocardial infarction (STEMI) based on a priori criteria [77]; indeterminate cases of ACS were adjudicated by a team of study physicians masked to the patient's clinical diagnosis. Trained interviewers conducted a computer assisted in-person baseline interview during the index hospitalization or by telephone within 72 hours of discharge.

Assessment of Religiosity

During the index hospitalization, patients self-reported three items assessing their religiosity. One question which was adapted from the Fetzer Institute's Brief Multidimensional Measure of Religiousness and Spirituality [78], addressed the dimension of "subjective" religiosity by asking: "How much is religion a source of strength and comfort to you?". The responses were either "none" (referent group), "a little", "some", "a great deal" and "don't know or refused". The second item assessed petition prayers for health as a non-organized religious practice by asking, "Do you use prayer specifically for your health?" with response options "Yes", "No" (referent) or "Don't know or refused". The third item assessed intercessory prayers for health by asking "Do you know of others outside of your family who are praying for your health?", response options included "Yes", "No" (referent) or "Don't know or refused". Only 3% of participants responded, "don't know or refused" for all the items evaluating religiosity, and these response options were treated as missing data. For the item which assessed strength and comfort from religion, responses of "some" or "little" were combined for analysis since the groups were similar and had too few outcomes to be examined separately.

Patient Activation

We examined patient activation during the index hospitalization for an ACS which reflects the extent of patient engagement in their healthcare in the period following a life-threatening illness. The 6-item patient Activation Measure (PAM-6), a shortened version of the validated 13 item PAM was used to assess patient's knowledge, skills and confidence in self-care [79,80]. A select item from the PAM-6 asked: "When all is said and done, I am the person who is responsible for taking care of my health". Participant responses were assessed on a 4-point Likert scale ranging from "strongly disagree" to "strongly agree". Based on guidelines from the developers, responses to the PAM-6 items were summed and transposed with resulting scores ranging from 0 (lowest possible activation) to 100 (highest possible activation) [80]. The internal consistency (Cronbach α) of the PAM-6 in the current sample was 0.66. Prior analyses of the parent PAM-13 and PAM-22 scales have shown that patient activation develops through four stages: Level 1 - lack of recognition of one's role in self-care (Disengaged, lowest activation), Level 2 - awareness of the need for self-care but lacking required skills and confidence (Aware), Level 3 - actively engaged in self-care (Taking Action), and Level 4 - maintaining self-management behaviors despite challenges (Maintaining Behaviors) [79, 81]. We used standard cut-points from the developer to categorize patients into these four stages of activation, Level 1: PAM scores $\leq$ 47.0; Level 2: PAM scores between 47.1 and 55.1; Level 3: PAM scores between 55.2-67.0; and Level 4: PAM score $\geq$ 67.1 [80]. In examining the relationship between religiosity and patient activation, we dichotomized the levels of patient activation into low (levels 1 and 2), and high (levels 3 and 4), has been used in prior studies [82,83].

Baseline covariates

We adjusted for potential confounding by sociodemographic, psychosocial, and clinical characteristics assessed during the index hospitalization for ACS. Sociodemographic variables included the patient's age, sex, self-reported race/ethnicity (non-Hispanic White, non-Hispanic Black or Hispanic), education (less than high school, some college or college graduate), and marital and employment status. Barriers to health care were measured as either a lack of a usual source of care (USOC), financial, or a transportation barrier.

Psychosocial measures included perceived stress, symptoms of depression and anxiety, health literacy, social support, cognitive impairment, and quality of life. A 4-item Perceived Stress Scale (PSS4) captured the extent to which patients found their lives "uncontrollable, unpredictable and overloading" in the prior month [84]. Symptoms of depression were assessed with the 9-item Patient Health Questionnaire (PHQ-9) with scores of 5-9, 10-14, 15-19, and ≥20 corresponding to mild, moderate, moderately severe, and severe depression, respectively [85]. Symptoms of anxiety were assessed with the Generalized Anxiety Disorder questionnaire, a 7-item validated scale (GAD-7), with possible scores of 5-9, 10-14, and >14 corresponding to mild, moderate, and severe anxiety, respectively [86]. From a brief screen for health literacy, participants were considered to have low health literacy if they reported having little or no confidence in filling out health forms [87]. Social support was measured with 5 items from the Medical Outcomes Social Support Survey Instrument [88]. From the 11-item Telephone Interview for Cognitive Status (TICS), with scores ranging from 0-41, patients with scores ≥ 33 were classified as cognitively intact, those with scores ranging from 26-32 were classified as ambiguous, while those with scores ≤25 were classified as having moderate to severe cognitive impairment [89]. Patient's overall Health Related Quality of Life (HRQOL) was assessed with the SF-36®v2 Health Survey. The physical and mental well-

being component summary scores are norm-based ranging from 0-100 (mean of 50; standard deviation of 10 in the U.S general population) [90]. Disease-specific HRQOL was measured with the Seattle Angina Questionnaire (SAQ) quality of life subscale, a validated and reliable measure for patients with coronary heart disease (CHD), with scores ranging from 0-100; higher scores indicated better HRQOL [91].

Detailed clinical characteristics were abstracted from hospital medical records during the patient's index hospitalization for an ACS. This included information on the length of hospital stay, previously diagnosed comorbidities (e.g. chronic kidney disease, congestive heart failure, diabetes mellitus, hypertension, and stroke), type of ACS, and receipt of in-hospital interventional procedures including coronary artery by-pass surgery (CABG) and percutaneous coronary intervention (PCI).

Statistical Analysis

We compared patients with and without our three items assessing religiosity (petition vs. no petition prayers, intercessory vs. no intercessory prayers, great deal vs little/some vs no strength and comfort from religion) according to baseline sociodemographic, psychosocial, and clinical characteristics. Continuous variables were summarized as means and standard deviations when normally distributed and as medians and interquartile ranges when skewed. Unpaired t-tests and ANOVA were used for group comparisons for continuous variables. Categorical factors were described using Chi-square and Kruskal Wallis tests to compare differences in these variables between respective comparison groups on the three items of religiosity. The distribution of the four levels of patient activation and the proportion of patients with low activation (levels 1 and 2) and high activation (levels 3 and 4) at baseline, was characterized according to the three religiosity items.

The association between religiosity and patient activation was examined both crudely and using logistic regression analysis to calculate multivariable adjusted odds ratios (ORs) and accompanying 95% confidence intervals (CI). We included all three religiosity items in the logistic regression model. Multicollinearity was evaluated and ruled out by using a variance inflation factor (VIF) of ≥3 to detect correlation between covariates. There was no collinearity (VIF=1.38) between the three items evaluating religiosity which enhanced the development of an all-inclusive model. For multivariable adjustment, our a priori choice of potentially confounding variables was based on clinical judgement and factors known to be associated with religiosity and/or patient activation. These variables included age, sex, race/ethnicity, perceived stress, anxiety symptoms, QOL measures, having one or more previously diagnosed comorbidity, health literacy, cognition, length of hospitalization, and in-hospital treatments received. A priori subgroup analyses were performed according to age (<55 years, 55-64 years, ≥ 65 years), sex, race/ethnicity (Non-Hispanic Whites, Non-Hispanic Blacks and Hispanics). In addition, we conducted a stratified analysis according to the study sites since the extent of religious involvement may have differed across our study sites in Massachusetts and Georgia.

Results

Among the 2,174 study participants enrolled in TRACE-CORE, we excluded those with missing information on the subtype of ACS (n=52), the PAM-6 measure (n=1), and one or more item evaluating religiosity (n=54), resulting in an analytic sample of 2,067 patients with an independently validated ACS. The sample participants were on average 61.2 years old (SD = 11.3), 33% were women, and 81% were non-Hispanic White. Approximately one-half of study participants had a high school degree or less education, one in three patients had low health literacy, one-quarter had moderate to severe depression and anxiety, and 48% had high perceived

stress. More than one-half of study participants were admitted for an NSTEMI, and 15% for an STEMI. Eighty percent of patients had one or more previously diagnosed comorbidities, 52% were hospitalized for more than 3 days, and two-thirds of participants had undergone a PCI during their index hospitalization for an ACS.

Frequency of religious involvement

Patients commonly reported receipt of a great deal of strength and comfort from religion (52%), one in three reported either little or some strength and comfort from religion, and 15% indicated none. Two-thirds of patients reported praying for their health and 89% were aware of others praying for their health. Among those who prayed for their health, 73% derived a great deal of strength and comfort from religion, and approximately one-quarter derived some/little strength and comfort from religion. About two-thirds of those who prayed for their health reported being aware of others praying for their health. Of those who were aware of intercessory prayers being made for their health, 56% derived a great deal of strength and comfort from religion and one in three reported some/little strength and comfort from religion.

Patient characteristics according to religiosity

Participants who reported deriving a great deal of strength and comfort from religion, prayed for their health, and those aware of intercessions made for their health were more likely to be women and non-Hispanic Blacks compared with their respective counterparts who did not provide affirmative responses to each measure of religiosity (Table 2.1). Participants who endorsed all three items of religiosity reported higher levels of perceived stress and lower QOL scores. Moderately severe to severe symptoms of depression, and severe symptoms of anxiety, were more prevalent among those who prayed for their health or were aware of intercessions for their health. Participants aware of others praying for their health had greater social support

(Table 2.1). Patients with affirmative responses to all three items of religiosity were more likely to be non-users of alcohol and non-smokers and were less likely to be referred for cardiac rehabilitation than patients who did not acknowledge any of the religiosity measures. A greater proportion of participants who derived strength and comfort from religion and those who prayed for their health were older, more likely to be cognitively impaired, had previously diagnosed comorbidities, had an NSTEMI, and underwent CABG during their index hospitalization compared with those who did not derive strength and comfort from religion or pray for their personal health ($p<0.05$ for all comparisons) (Table 2.1).

Extent of patient activation during hospitalization

Patient activation scores were normally distributed among the study participants (mean 59.7, SD 15.2). Self-reports of PAM according to the four levels of patient activation were: level 1: 19.9% (lowest activation); level 2: 37.6%; level 3: 20.8%; and level 4: 21.7%; 57.5% of patients had low (levels 1 and 2) activation.

Association between religiosity and patient activation

After adjustment for several sociodemographic, psychosocial, and clinical characteristics, patients who reported deriving a great deal of strength and comfort from religion had higher levels of activation (aOR: 2.02; 95% CI: 1.44-2.84), as were those who reported little/some strength and comfort from religion (aOR: 1.45; 95% CI: 1.07-1.98) compared to patients who reported none (Table 3). Similarly, reports of intercessory prayers for health were associated with significantly higher activation levels (aOR: 1.48; 95% CI: 1.07-2.05). Patients who reported praying for their health had significantly lower levels of activation compared with those who did not make petition prayers for their health (Table 2.2).

In carrying out a series of stratified analyses according to patient's age, sex, race/ethnicity, and study site, these results were similar to those of the overall study findings

with the exception of wider confidence intervals due to smaller sample sizes (Supplemental Tables 2.1-2.4). We found stronger associations between all three items of religiosity and patient activation among women than men in our study population. There was a stronger association between deriving strength and comfort from religion and patient activation among older participants, women, and non-Hispanic Whites.

Discussion

The results of this large observational study in a socioeconomically and racially diverse cohort of patients discharged from the hospital after an ACS suggests that most acknowledge receiving strength and comfort from religion, pray for their health, and have intercessory prayers made by others for their health. On the contrary, more than one-half of patients reported low levels of activation during their hospitalization for an ACS. Patients who reported deriving strength and comfort from religion, and those aware of intercessions made for their health, had high levels of activation, whereas patients who prayed for their health had low levels of activation after accounting for several potentially confounding sociodemographic, psychosocial, and clinical characteristics.

Our findings of a high prevalence of religious engagement among hospital survivors of an ACS is consistent with prior studies in other patient populations. A study of 232 older patients undergoing coronary artery bypass surgery found that 70% of patients reported deriving strength and comfort from religion [71]. In a qualitative study of 9 patients with an acute myocardial infarction in Iran, participants mentioned that trust in God, praying for their health, and deriving strength from their religion provided a coping mechanism in dealing with their life-threatening illness and aided their recovery process [92]. In the Women's Health Initiative Observational Study, 87% of 92,395 participants reported deriving strength and comfort from religion [93].

Similarly, a report from the Pew Research Center in 2014, which surveyed more than 35,000 Americans from all 50 states about their religious affiliations, beliefs, and practices showed that more than half of Americans acknowledged that religion was very important in their lives and prayed daily [94]. The high prevalence of religious engagement in the present and prior studies suggest that patient's religiosity should be acknowledged and assessed by physicians to promote engagement in their healthcare. This is because an assessment of patient's religiosity and spirituality provides a holistic approach with patient-centered management, an opportunity to understand the patient's value system, and how their religious beliefs and practices might be utilized to enhance engagement with their acute and long-term healthcare and lifestyle practices.

The mean PAM score in the present study was 59.7 which is consistent with the average activation scores in different patient populations and settings [83,95]. However, more than one-half of our study participants had low levels of activation, in contrast with studies in patients with chronic conditions such as heart failure [96] and diabetes [82]. The extent of low patient activation in the present study may be explained by the sudden occurrence of their acute illness, not allowing sufficient time for patient engagement with their healthcare compared to patients with more chronic conditions that may require a greater extent of self-management [96]. Our findings highlight the need for healthcare providers to ascertain the extent of patient activation during hospitalization for an ACS, and to provide clear and pertinent instructions to empower patients in successfully managing their health. Furthermore, providers should consider that the immediate period following a life-threatening illness may be overwhelming for patients and should ensure sufficient provider-patient communication to address patient's concerns about their health.

We found that patients who acknowledged receipt of strength and comfort from religion had significantly high levels of patient activation compared with those who reported no strength and comfort from religion. Religious beliefs and practices promote optimism, finding purpose, comfort and meaning in suffering, and have been associated with higher quality of life in varying patient populations [97,58]. These positive attitudes can foster greater levels of motivation and influence how patients adapt to life changes due to their illness, promote engagement in their healthcare, and increase patient activation.

Research on the association between intercessory prayers and health outcomes have had equivocal findings [98,99]. In the present study, we found that being aware of others praying for their health was associated with high levels of patient activation. Awareness of others praying for one's health could foster a feeling of spiritual support and the recognition that others hope for one's healing, motivating the patient to adopt and maintain recommended lifestyle modifications.

Furthermore, if those who derived strength and comfort from religion and those who were aware of intercessions made for their health had an active dimension of spiritual health locus of control (i.e. one's belief in a higher power empowers an individual to be proactive about their health and collaborate with a higher power to stay healthy) [32], this may have influenced the likelihood of greater engagement in their healthcare and our findings of higher levels of patient activation.

Patients who prayed for their health had low levels of patient activation compared with those who did not pray for their health. A possible mechanism for this finding could be that patients who prayed for their health were more likely to believe in spiritual healing and were less inclined to take charge of their health. This finding supports prior studies that have shown that when individuals consider the role of God as a healer, or in extreme cases of religious fatalism or the

passive dimension of spiritual health locus of control, in which persons believe that their health outcomes are predetermined by God and not by their actions, patients may assume a more passive role in managing their illness [32,100, 101]. Our findings are consistent with previous studies which suggest that healthcare providers should acknowledge that spiritual beliefs may influence the extent of patient engagement in their healthcare and willingness to adopt prescribed lifestyle changes [69]. Healthcare providers need to understand the patient's belief system and values, and develop a mutual plan aimed at overcoming challenges that may impede patient adoption and maintenance of positive lifestyle health behaviors and adherence to prescribed medications.

Our results are in keeping with prior research reports that have shown that older persons have higher rates of involvement in religious/spiritual activities and tend to acknowledge religiosity and spirituality as important in their lives [35,102]. In the present study, a greater proportion of patients who acknowledged the receipt of strength and comfort from religion and prayed for their health were ≥65 years. Similarly, a majority of non-Hispanic Blacks and women in our study reported deriving strength and comfort from religion and praying for their health. This finding is consistent with previous studies showing that African Americans and women are more likely to be religious/spiritual compared with Whites and men [35,103].

In our stratified analyses, there was a stronger association between strength and comfort from religion and patient activation among older participants, women, and non-Hispanic Whites. Earlier research findings have shown that Whites have higher levels of patient activation and are more engaged in their healthcare compared with Blacks [104]. Although, on average, African Americans consider themselves religious and are more likely to respond that religion is an important factor that influences their lives and decision-making process [105], we did not show a significant association between religiosity and patient activation among Non-Hispanic Blacks.

Future research is needed to understand the functional role of religiosity on patient activation and

cardiovascular health outcomes among different sociodemographic and racial groups.

Study strengths and limitations

This is the first study to examine the association between religiosity and patient activation among hospital survivors of an ACS. We used data from a large patient cohort with sociodemographic diversity, and rich clinical, psychosocial, and behavioral information. The three items of religiosity utilized capture how survivors of a potentially life-threatening disease incorporate religious beliefs and practices in their illness experience and recovery process. However, given our observational study design, unmeasured confounders may have potentially biased the effect estimates derived. For example, an assessment of religious denomination could have provided a more comprehensive understanding of how different religious rules and regulations pertaining to health behaviors and lifestyle choices could influence patient activation. We acknowledge potential limitations with the use of the PAM-6 instrument in assessing patient activation, since there are limited data on the use and validation of this measurement tool. Study participants were recruited from six urban hospitals in two states (Georgia and Massachusetts), and our findings may have limited generalizability to other geographic sites. Future longitudinal studies should examine how religiosity measured at baseline and in the following months after hospital discharge for an ACS may affect changes in patient activation, and how this in turn may influence health outcomes.

Conclusions

We found that most hospital survivors of an ACS acknowledge strength and comfort from religion, pray for their health, and have others praying for their health. A considerable proportion of patients reported low levels of activation during hospitalization for an ACS. Deriving strength and comfort from religion, and receipt of intercessory prayers for one's health was positively associated with patient activation, while petition prayers for health was negatively associated with activation. Our

findings suggest that physicians and healthcare providers should be aware of the extent of patient engagement in their healthcare, and the importance of patient's religiosity in developing their management plans and recommendations to patients. Future research is warranted to better understand how religious beliefs, practices, and regulations may influence trends in patient activation, adherence to prescribed medications, and long-term health outcomes among hospital survivors of an ACS.

Table 2.1. Baseline sociodemographic, psychosocial and clinical characteristics of hospital survivors of an acute coronary syndrome according to religiosity, TRACE-CORE, 2011-2013

Characteristics	Strength and comfort from Religion			Petition prayers for health		Intercessory prayers for health	
	A great deal (n=1,084)	Little/Some (n=682)	None (n=301)	Yes (n=1,258)	No (n =809)	Yes (n=1,836)	No (n=231)
Socio-demographic							
Age (mean, years (sd))	62.8 (11.2)	59.7 (11.0)	59.6 (11.6)*	62.2 (11.2)	59.8 (11.2)*	61.1 (11.3)	62.2 (11.0)
Age (years, %)							
<55	25.5	33.9	35.2	27.3	33.5	30.3	24.7
55-64	29.9	33.4	32.2	30.4	33.0	31.3	32.5
≥ 65	44.6	32.7	32.6	42.3	33.5	38.4	42.8
Women (%)***	44.4	24.5	16.5	41.3	21.9	35.0	24.0
Married (%)	54.8	62.9	60.1*	56.3	62.0*	59.2	53.0
Race/Ethnicity (%)***							
Non-Hispanic Whites	72.2	88.8	95.7	74.1	92.0	80.2	88.0
Non-Hispanic Blacks	24.1	8.5	2.3	22.3	5.7	16.6	9.4
Hispanics	3.7	2.7	2.0	3.6	2.3	3.2	2.6
Education (≤ high school)	47.9	45.6	46.5	49.5	43.0*	46.5	50.7
Socioeconomic (%)							
Uninsured	8.5	10.3	12.0	9.6	9.5	9.8	8.2
Unemployed/retired (%)	65.0	52.4	51.2*	64.2	50.6*	58.7	59.7
No Usual Source of Care	9.7	12.2	11.7	10.9	10.6	10.6	12.1
Financial barrier	20.5	17.3	18.4	20.6	16.8	19.3	18.0
Transportation barrier	11.1	10.3	8.2	11.7	8.5*	10.4	10.8
Psychosocial (%)							
High perceived stress[†] ***	50.6	49.3	38.1*	53.6	40.2*	49.4	39.8*
Depressive Symptoms[§]							
None	48.6	51.1	57.3	46.1	58.0*	49.6	59.1*
Mild	27.6	27.0	24.1	27.5	26.0	27.6	21.8
Moderate	13.0	13.4	12.9	14.9	10.2	13.1	13.5
Moderately Severe/Severe	10.8	8.5	5.7	11.5	5.8	9.7	5.6
Anxiety Symptoms[‡]							
None	49.1	51.2	56.0	46.5	57.4*	49.8	58.8*
Mild	21.4	22.5	22.5	22.0	21.8	22.5	16.7
Moderate/Severe	29.5	26.3	21.5	31.5	20.8	26.7	24.5
Low health literacy	38.0	34.4	32.4	35.8	38.8	37.1	34.3
Low social support	4.7	4.4	7.7	4.8	5.3	4.3	10.9*
Cognitive impairment [¶]	26.3	16.3	8.3*	26.0	11.6*	20.9	16.5
SF-36®v2 PCS, median (IQR)***	40.0(30.6, 48.1)	43.8(35.5, 50.8)	44.7(37.1, 51.7)	40.6(31.0, 48.8)	43.9(36.3, 50.7)	41.6(32.6, 49.5)	45.6(37.0, 52.0)

SF-36®v2 MCS, median (IQR)***	49.9(37.5, 57.5)	50.7(39.5, 56.8)	52.1(42.9, 57.2)	48.9(36.8, 56.6)	52.1(42.9, 57.7)	50.3(38.8, 57.1)	52.1(42.5, 57.7)
SAQ QOL score, median (IQR)***	58.3(41.7, 83.3)	58.3(41.7, 83.3)	66.7(41.7, 83.3)	58.3(41.7, 83.3)	66.7(41.7, 83.3)	58.3(41.7, 83.3)	66.7(41.7, 83.3)
Behavioral and Clinical							
Length of stay, ≥3 days (%)***	56.8	49.6	43.9	56.3	46.7	53.7	43.3
Alcohol use (%) ***							
No alcohol use	52.6	33.3	33.3	50.4	32.7	44.1	38.3
Rare/occasional	31.4	40.0	37.7	31.9	40.2	35.3	33.5
Moderate/heavy	16.0	26.7	29.0	17.7	27.1	20.6	28.2
Smoking status (%)***							
Non-smoker	34.0	27.4	26.6	34.2	25.5	31.9	21.7
Prior smoker	45.7	47.4	41.9	44.7	47.2	46.1	42.4
Current smoker	20.3	25.2	31.5	21.1	27.3	22.0	35.9
GRACE risk score, mean (SD)#	99.4	92.4	90.1*	97.7	91.8*	95.0	97.4
Co-morbidities at admission (%)							
Chronic kidney disease	12.8	9.2	7.3*	11.9	9.2*	10.7	11.7
Congestive heart failure	17.0	12.8	9.0*	16.6	11.0*	14.2	16.5
Diabetes mellitus	34.6	28.3	26.9*	33.4	28.4*	32.0	27.3
Hypertension	81.0	70.8	69.1*	79.5	70.4*	76.3	73.2
Stroke	7.2	4.4	1.7*	6.8	3.3*	5.7	3.9
Type of ACS (%)							
Unstable Angina	32.1	27.6	28.6*	31.7	27.6*	30.4	27.3
NSTEMI	55.9	56.2	49.5	56.4	53.0	54.8	57.1
STEMI	12.0	16.2	21.9	11.9	19.4	14.8	15.6
Reperfusion therapy (%)							
Medical treatment	23.7	19.4	17.3*	23.1	18.6*	21.5	20.3
PCI	61.5	68.3	72.7	62.7	69.7	64.6	71.9
CABG	14.8	12.3	10.0	14.2	11.7	13.9	7.8
Cardiac rehabilitation referral (%)***	28.7	44.6	55.5	30.9	48.9	36.4	50.4

Abbreviations: PCS, Physical Component Summary; MCS, Mental Component Summary; SAQ QOL, Seattle Angina Questionnaire Quality of Life; NSTEMI, Non-ST segment elevation myocardial infarction; STEMI, ST segment elevation myocardial infarction; PCI, percutaneous coronary intervention; CABG, coronary artery by-pass graft
* P<0.05 across response categories for respective religiosity measure; † Cohen's Perceived Stress Scale Score (≥4 median, high perceived stress); *** P<0.05 across response categories for all 3 religiosity items; § PHQ-9 Patient Health Questionnaire 9 item score (5-9 mild; 10-14 moderate; 15-19 moderately severe; and ≥20 severe depression)
‡ GAD-7 General Anxiety Disorder 7 item score (5-9 mild; 10-14 moderate; ≥15 severe anxiety); ¶TICS Telephone Interview for Cognitive Status Score (≤ 28 impaired)
# GRACE risk score estimates mortality risk at 1 and 3 years after ACS admission. Score ranges from 0 to 263, higher scores worse. Derived from data on age, systolic blood pressure, ST segment changes, cardiac biomarkers, serum creatinine or history of renal dysfunction, Killip class or diuretic use, cardiac arrest during hospitalization for ACS.

Table 2.2. Religiosity and patient activation at baseline among hospital survivors of an acute coronary syndrome, TRACE-CORE, 2011-2013

Religiosity items	Unadjusted OR (95% CI)	Adjusted OR* (95% CI)
Strength and Comfort from Religion		
A great deal	1.65 (1.20-2.26)	2.02 (1.44-2.84)
A little/Some	1.38 (1.02-1.85)	1.45 (1.07-1.98)
None	Referent	Referent
Petition prayers for health		
Yes	0.72 (0.58-0.90)	0.78 (0.61-0.99)
No	Referent	Referent
Intercessory prayers for health		
Yes	1.52 (1.12-2.06)	1.48 (1.07-2.05)
No	Referent	Referent

*Adjusted for age, sex, race/ethnicity, level of education, perceived stress, anxiety symptoms, physical and mental component quality of life measure, cognitive impairment, health literacy, length of index hospitalization, presence of one or more comorbidities, and in-hospital treatment practices.

Supplemental Table 2.1. Age-specific association between religiosity and patient activation at baseline among hospital survivors of an acute coronary syndrome, TRACE-CORE, 2011-2013

< 55 years (n=614)

Religiosity items	Unadjusted OR (95% CI)	*Adjusted OR (95% CI)
Strength and Comfort from Religion		
A great deal	1.88 (1.08-3.29)	2.20 (1.19-4.07)
A little/Some	1.52 (0.93-2.50)	1.57 (0.92-2.67)
None	Referent	Referent
Petition prayers for health		
Yes	0.63 (0.42-0.94)	0.68 (0.44-1.07)
No	Referent	Referent
Intercessory prayers for health		
Yes	2.09 (1.15-3.82)	2.00 (1.03-3.86)
No	Referent	Referent

55 - 64 years (n=649)

Religiosity items	Unadjusted OR (95% CI)	*Adjusted OR (95% CI)
Strength and Comfort from Religion		
A great deal	1.08 (0.62-1.88)	1.25 (0.68-2.29)
A little/Some	0.99 (0.60-1.65)	1.02 (0.59-1.75)
None	Referent	Referent
Petition prayers for health		
Yes	0.74 (0.50-1.09)	0.85 (0.56-1.30)
No	Referent	Referent
Intercessory prayers for health		
Yes	1.30 (0.77-2.21)	1.28 (0.73-2.25)
No	Referent	Referent

≥65 years (n=804)

Religiosity items	Unadjusted OR (95% CI)	*Adjusted OR (95% CI)
Strength and Comfort from Religion		
A great deal	2.45 (1.39-4.32)	3.15 (1.71-5.82)
A little/Some	1.82 (1.05-3.15)	1.99 (1.12-3.54)
None	Referent	Referent
Petition prayers for health		
Yes	0.81 (0.56-1.17)	0.82 (0.55-1.22)
No	Referent	Referent
Intercessory prayers for health		
Yes	1.26 (0.78-2.04)	1.31 (0.77-2.22)
No	Referent	Referent

*Stratified analyses by age, adjusted for sex, race/ethnicity, level of education, perceived stress, anxiety symptoms, physical and mental component quality of life measure, cognitive impairment, health literacy, length of index hospitalization, presence of one or more comorbidities, and in-hospital treatment practices.

Supplemental Table 2.2. Religiosity and patient activation at baseline among hospital survivors of an acute coronary syndrome according to patient's sex, TRACE-CORE, 2011-2013

Men (n=1,359)

Religiosity items	Unadjusted OR (95% CI)	*Adjusted OR (95% CI)
Strength and Comfort from Religion		
A great deal	1.43 (0.99-2.06)	1.73 (1.17-2.55)
A little/Some	1.30 (0.93-1.80)	1.40 (1.00-1.97)
None	Referent	Referent
Petition prayers for health		
Yes	0.80 (0.62-1.04)	0.85 (0.64-1.12)
No	Referent	Referent
Intercessory prayers for health		
Yes	1.39 (0.98-1.97)	1.45 (1.00-2.10)
No	Referent	Referent

Women (n=693)

Religiosity items	Unadjusted OR (95% CI)	*Adjusted OR (95% CI)
Strength and Comfort from Religion		
A great deal	2.67 (1.29-5.55)	2.91 (1.35-6.28)
A little/Some	1.86 (0.91-3.80)	1.71 (0.82-3.59)
None	Referent	Referent
Petition prayers for health		
Yes	0.52 (0.34-0.81)	0.60 (0.38-0.96)
No	Referent	Referent
Intercessory prayers for health		
Yes	2.07 (1.10-3.93)	1.77 (0.90-3.46)
No	Referent	Referent

*Stratified analysis by sex, adjusted for age, race/ethnicity, level of education, perceived stress, anxiety symptoms, physical and mental component quality of life measure, cognitive impairment, health literacy, length of index hospitalization, presence of one or more comorbidities, and in-hospital treatment practices.

Supplemental Table 2.3. Religiosity and patient activation at baseline among hospital survivors of an acute coronary syndrome, according to patient's race/ethnicity, TRACE-CORE, 2011-2013

Non-Hispanic Whites (n=1,671)

Religiosity items	Unadjusted OR (95% CI)	*Adjusted OR (95% CI)
Strength and Comfort from Religion		
A great deal	1.57 (1.12-2.20)	1.79 (1.24-2.56)
A little/Some	1.42 (1.04-1.92)	1.48 (1.08-2.03)
None	Referent	Referent
Petition prayers for health		
Yes	0.80 (0.63-1.03)	0.80 (0.62-1.04)
No	Referent	Referent
Intercessory prayers for health		
Yes	1.56 (1.13-2.16)	1.63 (1.15-2.29)
No	Referent	Referent

Blacks and Hispanics (n=387)

Religiosity items	Unadjusted OR (95% CI)	*Adjusted OR (95% CI)
Strength and Comfort from Religion		
A great deal	1.98 (0.56-6.99)	1.18 (0.29-4.77)
A little/Some	0.85 (0.23-3.21)	3.39 (0.89-12.92)
None	Referent	Referent
Petition prayers for health		
Yes	0.62 (0.34-1.11)	0.76 (0.39-1.46)
No	Referent	Referent
Intercessory prayers for health		
Yes	1.27 (0.11-1.65)	1.51 (0.58-3.95)
No	Referent	Referent

*Stratified analysis by race/ethnicity, adjusted for age, sex, level of education, perceived stress, anxiety symptoms, physical and mental component quality of life measure, cognitive impairment, health literacy, length of index hospitalization, presence of one or more comorbidities, and in-hospital treatment practices.

Supplemental Table 2.4. Religiosity and patient activation at baseline among hospital survivors of an acute coronary syndrome, according to participating study sites, TRACE-CORE, 2011-2013

Massachusetts (n=1,176)

Religiosity items	Unadjusted OR (95% CI)	*Adjusted OR (95% CI)
Strength and Comfort from Religion		
A great deal	1.58 (1.07-2.32)	1.70 (1.12-2.58)
A little/Some	1.51 (1.08-2.09)	1.56 (1.11-2.20)
None	Referent	Referent
Petition prayers for health		
Yes	0.86 (0.64-1.14)	0.83 (0.61-1.14)
No	Referent	Referent
Intercessory prayers for health		
Yes	1.57 (1.10-2.25)	1.63 (1.12-2.38)
No	Referent	Referent

Central Georgia (n=891)

Religiosity items	Unadjusted OR (95% CI)	*Adjusted OR (95% CI)
Strength and Comfort from Religion		
A great deal	1.31 (0.63-2.71)	1.54 (0.71-3.34)
A little/Some	0.83 (0.40-2.71)	0.85 (0.39-1.83)
None	Referent	Referent
Petition prayers for health		
Yes	0.60 (0.42-0.84)	0.65 (0.45-0.96)
No	Referent	Referent
Intercessory prayers for health		
Yes	1.35 (0.75-2.42)	1.22 (0.65-2.29)
No	Referent	Referent

*Stratified analysis by study sites, adjusted for age, sex, race/ethnicity, level of education, perceived stress, anxiety symptoms, physical and mental component quality of life measure, cognitive impairment, health literacy, length of index hospitalization, presence of one or more comorbidities, and in-hospital treatment practices.

CHAPTER III: RELIGIOUS PRACTICES AND CHANGES IN HEALTH-RELATED QUALITY OF LIFE AFTER HOSPITAL DISCHARGE FOR AN ACUTE CORONARY SYNDROME

Abstract

Background: Little is known about the influence of religious practices on changes in health-related quality of life (HRQOL) among hospital survivors of an acute coronary syndrome (ACS). The present study examined whether religiosity influenced clinically meaningful changes in HRQOL between 1 and 6 months of hospital discharge after an ACS.

Methods: We recruited patients hospitalized for an ACS at six medical centers in Central Massachusetts and Georgia (2011-2013). Participants reported making petition prayers for their health, awareness of intercessory prayers by others, and deriving strength/comfort from religion. Generic HRQOL was assessed with the SF-36®v2 physical and mental component summary scores. Disease-specific HRQOL was evaluated using the Seattle Angina Questionnaire Quality of Life subscale (SAQ-QOL). We examined the association of each measure of religiosity with the likelihood of experiencing clinically meaningful increases in HRQOL between 1- and 6-months post-hospital discharge.

Results: Participants (n=1,039) were, on average, 62 years old, 33% were women, and 86% were non-Hispanic White. Two-thirds reported praying for their health, 88% were aware of intercessions by others, and 85% derived strength/comfort from religion. Approximately 42%, 40%, and 26% of participants experienced clinically meaningful increases in their mental, physical, and disease-specific HRQOL respectively. After adjustment for sociodemographic, psychosocial, and clinical characteristics, petition (aOR:1.53; 95% CI: 1.12-2.10) and intercessory (aOR:1.70; 95% CI: 1.11-2.61) prayers for health were associated with clinically meaningful increases in disease-specific and physical HRQOL respectively between 1 and 6 months of hospital discharge for an ACS.

Conclusions: ACS survivors who prayed for their health and those aware of intercessions made for their health experienced improvement in their generic physical and disease-specific HRQOL

over time. These findings suggest that prayers for health may influence patient well-being and

recovery after a life-threatening illness.

Introduction

The acute coronary syndromes (ACS) constitute a major source of morbidity and mortality in the United States [75]. Due to the life-threatening experience of an ACS, patients are at increased risk for declining health status and quality of life (QOL) following hospital discharge for an ACS [40,41]. Health-related quality of life (HRQOL), which is characterized by patient's perception of their well-being, is increasingly being used as an important patient-reported outcome measure for assessing treatment effectiveness and recovery after an ACS [37]. Several studies have shown HRQOL to be an independent predictor of subsequent morbidity and mortality in hospital survivors of an ACS, with substantial impairment in HRQOL and loss of productive years [38,39].

Since ACS survivors tend to have impaired HRQOL, management strategies aimed at improving patients' clinical status and well-being are desirable [106]. While the influence of several sociodemographic, psychosocial, and clinical factors on HRQOL among survivors of an ACS has been studied [42-50], very limited research has been conducted to understand the influence of religiosity on HRQOL among hospital survivors of an ACS. Religious beliefs and practices provide vital strategies for coping with illness, including strength and optimism in the acute phase of an illness and recovery period [52,53]. Cross-sectional [54,55] and longitudinal [56] studies that have examined the relationship between religiosity/spirituality and QOL among patients with various forms of cardiovascular disease (CVD) have, however, demonstrated mixed findings. In our recent systematic review [58], we only identified two earlier studies that examined the influence of patient's religiosity/spirituality on QOL after an ACS. These studies were limited by their small sample size and participants were recruited from a single site with ethnic and religious homogeneity, precluding generalizability to more diverse settings and populations [59,60].

Using data from a large and socioeconomically diverse cohort of patients hospitalized for an ACS, we examined the association between several items assessing religiosity and clinically meaningful changes in HRQOL between 1 and 6 months after hospital discharge for an ACS. We hypothesized that patients who report religious involvement (petition or intercessory prayers for health, great deal or little/some strength and comfort from religion) will have significantly greater improvement in their HRQOL between 1- and 6-months of discharge for ACS than those without reports of religiosity.

Methods

Study design and population

The Transitions, Risks and Actions in Coronary Events: Center for Outcomes Research and Education (TRACE-CORE) study [73,74] used a multi-center prospective cohort design to enroll 2,174 adults hospitalized for an ACS at six medical centers in Central Massachusetts and Georgia (April 2011- May 2013). Two cardiologists independently validated the diagnosis of an ACS based on standard criteria [77]. Each validated case of ACS was categorized as either ST-segment elevation acute myocardial infarction (STEMI), Non-ST segment elevation acute myocardial infarction (NSTEMI), or unstable angina [77]. Trained research personnel abstracted data from electronic medical records on patient's clinical variables. In addition, we obtained information about patient sociodemographic, psychosocial, and behavioral characteristics from an extensive baseline interview during the index hospitalization in-person or within 72 hours of discharge by telephone. Patients participated in additional telephone interviews after hospital discharge. Institutional Review Boards (IRBs) at the participating sites approved the study, and participants provided written informed consent.

Assessment of Religiosity

Patients self-reported three items assessing their religiosity during hospitalization for an ACS. The first item asked: "How much is religion a source of strength and comfort to you?". Response options were "a great deal", "a little", "some", and "none" (referent group). We combined responses of "some" or "little" for analysis. The second item assessed petition prayers for health by asking, "Do you use prayer specifically for your health?" with responses "Yes" or "No" (referent). The third item inquired about intercessory prayers for health: "Do you know of others outside of your family who are praying for your health?" with responses "Yes" or "No" (referent). We evaluated the three religiosity items separately in assessing the influence of religious practices on changes in HRQOL.

Measures of HRQOL

Patient's generic HRQOL was assessed using the SF-36®v2 Health Survey with norm-based physical and mental well-being component summary scores ranging from 0-100; higher scores indicate better generic HRQOL [90]. The physical health dimension assesses bodily pain, physical functioning, role limitations due to physical health, and general well-being [90]. The mental health component assesses emotional role, vitality, social functioning and mental well-being [90]. Clinically meaningful increases in generic HRQOL was defined by changes of ≥3.0 points [107]. Disease-specific HRQOL was assessed with the 3-item quality of life subscale from the Seattle Angina Questionnaire (SAQ QOL), a validated and reliable measure for patients with coronary heart disease with scores ranging from 0-100; higher scores indicate better HRQOL [91]. The SAQ-QOL quantifies patients' physical limitations due to angina symptoms, frequency of symptoms, patient satisfaction with treatment, and the extent to which their illness influences their QOL [91]. We defined clinically meaningful increases in HRQOL by changes of ≥10.0

points [91]. Our rationale for using HRQOL measures obtained at 1-and 6-months post-hospital discharge was, that items in the SF-36®v2 questionnaire reflect patient well-being in the 4-week period after experiencing an ACS, and the 6-month window is relevant in cardiac rehabilitation since most patients typically recover within 12 weeks after an ACS [108]. Inasmuch, we examined if improvement in patient well-being was sustained in the 6-month period after an ACS.

Participant Baseline Characteristics

We obtained data on patient's age, sex, race/ethnicity, level of education, marital status, and employment status. Symptoms of anxiety were measured using the 7-item Generalized Anxiety Disorder questionnaire (GAD) [86]. Symptoms of depression were assessed with the 9-item Patient Health Questionnaire (PHQ-9) [85]. The extent to which patients found their lives "uncontrollable, unpredictable and overloading" was assessed with the 4-item Perceived Stress Scale [84]. Patients were asked how confident they were in filling out health forms; they were considered to have low health literacy if they reported having little or no confidence [87]. The 6-item patient Activation Measure (PAM-6) assessed the extent of patient's knowledge, confidence, and skills in managing their disease [79]. The 11-item Telephone Interview for Cognitive Status (TICS) assessed cognitive status 1-month post-discharge [89].

Lifestyle variables included smoking history and alcohol use. Clinical characteristics included ACS subtype (STEMI, NSTEMI, unstable angina), previously diagnosed co-morbidities, receipt of coronary reperfusion therapy, length of index hospitalization, and referral for cardiac rehabilitation. The Global Registry of Acute Coronary Events (GRACE) risk score (2.0) for long-term mortality was calculated using information on patient's age, heart rate,

systolic blood pressure, elevated cardiac enzymes, ST-segment changes, serum creatinine levels, and the presence of heart failure and cardiac arrest at hospital admission [109].

Data Analysis

We excluded participants with missing information on covariates (race=10, gender=19, social support=22, perceived stress=35, anxiety symptoms=27, depression symptoms=37, GRACE risk score=39, ACS classification=46, and referral to cardiac rehabilitation=41), religiosity items (n=41), and patients whose HRQOL measures were not available at 1 (n=163) and 6 (n=650) months post-discharge due to attrition. The analytic sample consisted of 1,039 of the original 2,174 study cohort.

Descriptive statistics were used to compare patients' baseline characteristics in accordance to the religiosity items. Unpaired t-tests and chi-square compared differences in continuous and categorical variables. We used paired t-tests to examine differences in mean HRQOL scores from 1month - 6months after hospital discharge.

Using logistic regression models, we estimated the likelihood of experiencing a clinically meaningful increase in HRQOL between 1 and 6 months after discharge according to the three items assessing religiosity. We created separate models to examine the association between each measure of religiosity and changes in generic and disease-specific HRQOL. For multivariable adjustment, potentially confounding variables were included in the model based on clinical judgement and factors known to be associated with religiosity and HRQOL. Additional potential confounders were tested to determine if their presence in the model changed the religiosity effect-estimate by more than 10% [110]. We sequentially adjusted for patient characteristics. First, we adjusted for sociodemographic characteristics (age, sex, and race/ethnicity). Subsequently, clinical variables (length of index hospitalization, type of ACS, receipt of

reperfusion therapy, referral for cardiac rehabilitation, and GRACE-risk score) were added to the models. Finally, psychosocial measures including symptoms of depression and anxiety, perceived stress, and social support were adjusted for in our models. Since clinical practices and access to healthcare may vary across the participating hospitals, we adjusted for study site in all regression models.

We also conducted sensitivity analysis using inverse probability weighting (IPW) regression models [111] to account for potential selection bias due to differential losses to follow-up among our study participants at 1 and 6 months. The IPW technique assigns a weight to each participant which is equivalent to the inverse probability of remaining in the study at the time points of interest [111]. The censoring weights are applied to the observed population, and censored participants are accounted for, by up-weighting uncensored participants with the same values of observed covariates and measures of exposure [111].

Results

Participant baseline characteristics

Participants (n=1,039) were, on average, 62 years old, 33% were women, and 86% were non-Hispanic White. In comparison with included participants, those excluded were younger, more likely to be of racial/ethnic minority group, had less than high school education and were more likely to be uninsured. Participants excluded were more likely to report higher levels of perceived stress, moderate/severe symptoms of depression and anxiety, had low health literacy, were less likely to have undergone a PCI or CABG during hospitalization, and to have been referred for cardiac rehabilitation (p<0.001). There were no significant differences in the prevalence of the three religiosity items between included and excluded study participants.

Participant characteristics according to religiosity

A high proportion of participants reported deriving a great deal (50.4%) and little/some (34.8%) strength and comfort from religion, while only a few reported deriving none (14.7%). More than one-half of participants prayed for their health (59.3%), and a majority were aware of intercessory prayers made for their health (88.3%) (Table 3.1). A higher proportion of participants who endorsed all three religiosity items were women and non-Hispanic Blacks. Severe symptoms of depression and anxiety, and higher levels of perceived stress were more prevalent among those who prayed or were aware of intercessions made for their health. Patients aware of intercessory prayers made for their health had greater social support than those unaware of intercessions made for their health. Participants with affirmative responses to all three items evaluating religiosity were more likely to report no use of alcohol, were non-smokers, and were less likely to be referred for cardiac rehabilitation than patients who did not respond in the affirmative to the religiosity measures. A greater proportion of participants who prayed for their health were older, more likely to be cognitively impaired, had more previously diagnosed comorbidities, had an NSTEMI, and underwent CABG during their index hospitalization than those who did not pray for their health (p<0.05 for all comparisons) (Table 3.1).

Generic Mental and Physical HRQOL

Overall, participants experienced a significant increase in mean MCS scores from 50.7 at 1 month to 52.5 at 6 months post-hospital discharge (p<0.001); only 42.3% of patients experienced a clinically meaningful increase in their MCS score (i.e. ≥3.0 points). A significantly higher proportion of participants who reported deriving a great deal or little/some strength and comfort from religion experienced clinically meaningful increases in their MCS-HRQOL score compared with those who derived none (47.0% vs 38.6% vs 34.6%). Similarly, a

higher proportion of patients who were aware of intercessions made for their health experienced

a clinically meaningful increase in their MCS-HRQOL score (43.4% vs 33.9%) (Table 3.2).

For all patients, the average PCS scores increased by 1.6 points from 42.3 at 1 month to

43.9 at 6 months post-hospital discharge (p<0.001) with less than half (40%) experiencing a

clinically meaningful increase in their PCS score (i.e. ≥3.0 points). Patients who endorsed all

three religiosity items had significantly lower mean PCS scores at 1- and 6-months post-

discharge compared with their respective counterparts who did not provide affirmative responses

to each measure of religiosity (Table 3.2). A significantly higher proportion of patients who had

intercessions made for their health experienced a clinically meaningful increase in their PCS-

HRQOL score compared with those unaware of intercessions made for their health (41.2% vs

30.8%) (Table 3.2).

Disease-Specific HRQOL

Overall, the mean disease-specific HRQOL scores increased from 75.5 at 1 month to 80.3

at 6 months post-discharge (p<0.001) with slightly more than one in every four patients (26.5%)

experiencing a clinically meaningful increase in their disease-specific HRQOL score (i.e. ≥10.0

points). Mean disease-specific HRQOL scores at 1 and 6 months were significantly lower for

patients who prayed for their health than those who did not make petitions for their health. A

significantly higher proportion of patients who prayed for their health experienced a clinically

meaningful increase in their disease-specific HRQOL score than those who did not make

petitions for their health (29.9% vs 21.5%) (Table 3.2).

Association between Religiosity and Changes in Generic and Disease-specific HRQOL

After adjusting for several sociodemographic, clinical, and psychosocial characteristics,

participants who responded affirmatively to the three religiosity items were more likely to

experience clinically meaningful increases in their mental HRQOL than those who did not respond in the affirmative to the religiosity items (Table 3.3). In the fully adjusted model, patients aware of intercessory prayers made for their health experienced a clinically meaningful increase in their generic physical HRQOL between 1- and 6-months post-hospital discharge compared with those unaware of intercessions made for their health (adjusted Odd Ratio [aOR]:1.65; 95% CI: 1.07-2.53). Similarly, patients who prayed for their health were more likely to experience a clinically meaningful increase in their disease-specific HRQOL than those who did not pray for their health (aOR:1.51; 95% CI: 1.10-2.07) (Table 3.3).

The results from our sensitivity analysis using IPW regression models generated effect estimates consistent with those obtained from the unweighted regression models (Supplemental Table 3.1), reducing the likelihood of potential selection bias.

Discussion

In this prospective study we examined the influence of religious practices on clinically meaningful changes in generic physical and mental, and disease-specific HRQOL between 1- and 6-months after hospital discharge for an ACS. Most participants acknowledged praying for their health, were aware of intercessory prayers made for their health, and derived strength and comfort from religion. However, less than one-half of patients experienced clinically meaningful increases in their generic mental and physical HRQOL, and only one in four patients had an increase in their disease-specific HRQOL between 1- and 6-months post-discharge. After accounting for several potentially confounding sociodemographic, clinical, and psychosocial variables, participants aware of intercessions made for their health and those who prayed for their health were more likely to experience clinically meaningful increases in their generic physical and disease-specific HRQOL over time.

Extent of religious practices for health

The high levels of religious engagement for health reported by our study participants is consistent with the findings in other patient populations. In a sample of 151 patients who underwent coronary artery bypass graft (CABG) surgery, 68% reported praying for their health to cope in the post-operative period [112]. In a nationally representative sample of 2,262 American adults with a history of cancer, 69% reported using prayers for their own health [113]. Our results and those from other studies suggest that in stressful life circumstances such as an acute illness, patients may utilize their beliefs including praying for their health or seeking strength from God to provide meaning, hope, and support in dealing with their illness [114]. To ensure a holistic approach in patient management, healthcare providers need to acknowledge the role of patient's religious beliefs in influencing their recovery from illness, perception of their well-being, and engagement with their healthcare.

Religiosity and changes in generic physical and mental HRQOL

Overall, our study participants had lower physical HRQOL scores in comparison with their mental HRQOL scores at 1- and 6-months post-discharge and were more likely to experience greater improvement in their mental than in their physical well-being. Our findings align with previous studies reporting greater impairment in physical functioning compared with mental functioning after hospital discharge for an ACS [115, 116]. The distressing physical symptoms associated with an ACS such as fatigue, dyspnea, or chest pain have been shown to negatively impact patient's physical well-being to a greater extent than their mental well-being [116]. When faced with such a potentially life-threatening illness, in addition to seeking medical intervention, patients may pray for their healing and request intercessory prayers from others for their health. The awareness of being prayed for could foster a feeling of spiritual support,

improved well-being, greater resilience, and the ability to cope with their physical symptoms [51,117]. In support of this claim, we found that study participants aware of intercessions made for their health were more likely to experience clinically meaningful increases in their physical HRQOL than those unaware of intercessions made for their health, even after adjustment for various potential confounders including receipt of coronary reperfusion therapy and referral to cardiac rehabilitation.

In the present study, patients who endorsed all three items assessing religiosity were more likely to experience clinically meaningful increases in their mental HRQOL than those who did not provide affirmative responses. However, this association was rendered non-statistically significant in the fully adjusted regression models. Prior studies have shown a positive influence of religiosity on mental health with greater life satisfaction, and reduced feelings of hopelessness when faced with challenging circumstances [27,118]. However, the influence of religiosity on mental wellbeing may be cumulative over the life course as one develops faith in God and confidence in their ability to deal with challenging situations [119]. A possible reason why our items assessing religiosity were not significantly associated with changes in mental HRQOL may be due to our inability to account for time varying confounding since we assessed religiosity at only one point in time, and not serially. Our measures did not adequately capture patient's religiosity before their illness and whether they increased or decreased their religious practices in the months after hospital discharge. This underscores the need for future longitudinal studies to better understand how changes in religious practices may influence long-term health outcomes using a life-course approach.

Religiosity and changes in disease-specific HRQOL

Consistent with our hypothesis, we found that patients who prayed for their health experienced clinically meaningful increases in their disease-specific HRQOL. Praying for one's health during recovery from illness has been associated with high levels of optimism, making meaning of an illness experience, and fosters well-being. [120]. Our results are consistent with reports from prior studies [121, 122]. Among cardiac patients undergoing bypass surgery, positive aspects of religious coping such as seeking spiritual support and healing from God, was associated with less distress and fatigue [123]. Similarly, in those living with HIV/AIDS, praying at least once daily was associated with improved quality of life and emotional well-being [122]. It is important to note, however, that with religious struggle and negative religious coping where those who pray for their health focus solely on being healed, this may lead to increased levels of anxiety and negatively impact their recovery and wellbeing [123]. Healthcare providers need to acknowledge the possibility of negative religious coping and refer to hospital chaplains to assist patients in overcoming such religious struggle or negative coping detrimental to their health.

Study strengths and limitations

The present study has several strengths. To the best of our knowledge, this is the first contemporary inquiry into the influence of prayers for health and strength/comfort from religion on changes in HRQOL among hospital survivors of an ACS from a large cohort with racial and sociodemographic diversity. Our measures of religiosity directly captured patient's utilization of their religious beliefs and practices during recovery from a potentially life-threatening cardiovascular disease. In addition, we adjusted for several psychological factors known to impact quality of life including symptoms of depression, anxiety, perceived stress, and social support [124]. Despite adjusting for several important potentially confounding factors, there

remains the likelihood of residual and unmeasured confounding given our observational study design. In addition, our findings of high religious engagement among our study participants in the immediate period of a life-threatening illness may not be generalizable to more chronically ill patients who may have adapted to their illness. Despite these limitations, our study demonstrates that praying for one's recovery might influence their well-being, hence buttressing the need for holistic approach in patient management, addressing the needs of the body, mind, and spirit for a healthier being.

Conclusions

Most ACS survivors in a contemporary, multiracial cohort acknowledged praying for their health, were aware of others praying for their health, and reported deriving strength and comfort from religion. Petition and intercessory prayers for health were associated with greater improvement in disease-specific and generic physical HRQOL over a 6-month follow-up period. Our findings are consistent with a recent scientific statement by the American Heart Association (AHA) which suggest that meditation practices, including prayers, are beneficial in improving cardiovascular health outcomes with notably low costs of implementation [125]. This AHA expert panel also recommended that meditation practices be considered as an adjunct to guideline directed cardiovascular risk reduction, especially for patients interested in lifestyle modification.

Table 3.1. Baseline sociodemographic, psychosocial and clinical characteristics of hospital survivors of an acute coronary syndrome according to religiosity, TRACE-CORE, 2011-2013

Characteristics	Strength and comfort from religion			Petition prayers for health		Intercessory prayers for health	
	A great deal (n=524)	Little/Some (n=362)	None (n=153)	Yes (n=616)	No (n=423)	Yes (n=918)	No (n=121)
Socio-demographic							
Age (mean, years (sd))	63.9 (10.5)	61.1 (10.6)	61.0 (11.3) *	63.2 (10.6)	61.5 (10.9) *	62.3 (10.7)	63.7 (11.0)
Age (years, %)							
<55	20.8	28.2	31.4	22.7	28.1	25.6	19.8
55-64	29.4	35.6	27.4	30.7	32.2	31.5	29.8
≥ 65	49.8	36.2	41.2	46.6	39.7	42.9	50.4
Women (%) ***	45.4	22.9	17.0	41.9	21.0	35.5	17.4
Married (%)	58.6	68.2	61.4*	61.2	64.1	62.4	62.0
Race/Ethnicity (%) ***							
Non-Hispanic Whites	78.0	92.0	96.0	80.0	93.6	84.6	92.6
Non-Hispanic Blacks	19.7	5.2	2.0	17.4	4.3	13.0	5.0
Hispanics	2.3	2.8	2.0	2.6	2.1	2.4	2.4
Education (≤ high school) (%)	41.8	40.6	38.6	43.3	37.3	41.0	40.5
Unemployed/retired (%)	65.3	53.9	47.1*	63.6	51.3*	58.6	58.7
Uninsured (%)	6.1	6.3	7.8	6.5	6.4	6.4	6.6
Psychosocial (%)							
High perceived stress†	44.8	43.1	35.9	44.3	32.2*	47.7	35.9*
Depressive Symptoms§							
None	52.5	54.7	60.8	50.8	59.8	52.9	66.1
Mild	29.0	28.4	20.3	28.4	26.2	28.7	19.0
Moderate	12.0	10.5	12.4	13.3	9.0	11.4	12.4
Moderately Severe/Severe	6.4	6.4	6.5	7.5	5.0*	6.0	2.5*
Anxiety Symptoms‡							
None	55.3	56.6	62.8	53.1	62.4	55.7	66.1
Mild	20.6	22.7	18.3	20.6	21.5	21.7	15.7
Moderate/Severe	24.1	20.7	18.9	26.3	16.1*	22.6	18.2
Low health literacy	38.0	34.4	32.4	37.1	34.3	35.8	38.8
Low social support	4.2	2.8	7.2	4.2	4.0	3.5	9.1*
Cognitive impairment ¶ ***	18.9	10.8	5.2	19.2	6.6	15.0	6.6
Patient Activation Level (%)							
1: Disengaged (lowest)	19.3	22.4	19.0	20.4	20.1	19.9	23.2
2: Aware	33.6	34.2	47.7	35.1	37.1	35.6	38.0
3: Taking Action	22.9	18.5	22.2	20.1	22.9	21.5	19.8
4: Maintaining Behaviors	24.2	24.9	11.1*	24.4	19.9	23.0	19.0

Behavioral and Clinical

Length of stay, ≥3 days (%) ***	42.9	66.0	77.8	52.6	31.2	45.5	31.4
Alcohol use (%) ***							
No alcohol use	49.8	32.3	32.7	47.2	32.4	42.5	31.4
Rare/occasional	32.8	40.6	39.2	33.1	41.4	36.8	33.9
Moderate/heavy	17.4	27.1	28.1	19.7	26.2	20.7	34.7
Smoking status (%) ***							
Non-smoker	35.7	26.5	29.4	34.9	26.7	32.7	23.1
Prior smoker	49.4	50.8	46.4	49.2	49.9	49.7	47.9
Current smoker	14.9	22.7	24.2	15.9	23.4	17.6	29.0
GRACE risk score, mean (SD)#	99.6 (26.4)	93.1 (26.3)	92.3 (26.9) *	98.2 (26.1)	93.5 (27.1) *	96.2 (26.9)	96.9 (25.6)
Co-morbidities at admission (%)							
Chronic kidney disease	11.4	8.6	7.2	11.8	9.9	13.8	8.3
Congestive heart failure	13.7	9.7	8.5	13.8	8.3*	11.8	9.9
Diabetes mellitus	33.8	28.7	28.8	32.0	30.3	31.5	29.7
Hypertension	80.0	69.6	69.3*	77.9	70.2*	75.4	70.2
Stroke	5.7	4.7	0.6*	6.2	2.4*	4.9	2.5
Type of ACS (%)							
Unstable Angina	33.4	28.2	26.8	33.3	19.4	30.6	30.6
NSTEMI	54.6	55.5	53.4	55.4	53.9	54.8	54.5
STEMI	12.0	16.3	19.6	11.3	26.7*	14.6	14.9
Reperfusion therapy (%)							
Medical treatment	20.8	16.0	18.3	20.1	16.8	19.2	15.7
PCI	64.5	71.8	71.9	65.1	72.6	67.0	76.9
CABG	14.7	12.2	9.8	14.8	10.6*	13.8	7.4
Cardiac rehabilitation referral (%) ***	33.8	49.4	55.6	35.9	52.0	40.7	55.3

Abbreviations: NSTEMI, Non-ST segment elevation myocardial infarction; STEMI, ST segment elevation myocardial infarction; PCI, percutaneous coronary intervention; CABG, coronary artery by-pass graft

* P<0.05 across response categories for respective religiosity measure; † Cohen's Perceived Stress Scale Score (≥4 median, high perceived stress); *** P<0.05 across response categories for all 3 religiosity measures; § PHQ-9 Patient Health Questionnaire 9 item score (5-9 mild; 10-14 moderate; 15-19 moderately severe; and ≥20 severe depression)
‡ GAD-7 General Anxiety Disorder 7 item score (5-9 mild; 10-14 moderate; ≥15 severe anxiety); ¶TICS Telephone Interview for Cognitive Status Score (≤ 28 impaired)
# GRACE risk score estimates mortality risk at 1 and 3 years after ACS admission. Score ranges from 0 to 263, higher scores worse. Derived from data on age, systolic blood pressure, ST segment changes, cardiac biomarkers, serum creatinine or history of renal dysfunction, Killip class or diuretic use, cardiac arrest during hospitalization for ACS.

Table 3.2. Generic and disease specific HRQOL scores, mean change and clinically meaningful increase in survivors of acute coronary syndrome after 1 to 6 months for hospital discharge, TRACE-CORE, 2011-2013

	Strength and comfort from religion			Petition prayers for health		Intercessory prayers for health	
	A great deal (n=524)	Little/Some (n=362)	None (n=153)	Yes (n=616)	No (n=423)	Yes (n=918)	No (n=121)
Generic SF36v2 MCS							
1 month post-discharge, Mean (SD)	50.1 (11.4)	50.9 (10.8)	52.1 (11.5)	49.9 (11.3)	51.9 (10.9)*	50.5 (11.2)	51.8 (11.2)
6 months post-discharge, Mean (SD)	52.2 (11.4)	52.5 (10.5)	53.3 (10.6)	51.8 (11.4)	53.4 (10.4)*	52.3 (11.2)	53.5 (9.2)
Change in MCS-QOL score, Mean (SD)	2.1 (10.1)	1.6 (9.0)	1.1 (9.1)	1.9 (9.7)	1.6 (9.3)	1.8 (9.7)	1.7 (8.4)
Clinically meaningful increase (%)	47.0	38.6	34.6*	44.5	39.1	43.4	33.9*
Generic SF36v2 PCS							
1 month post-discharge, Mean (SD)	41.0 (10.4)	43.1 (9.9)	44.6 (10.3)*	41.1 (10.5)	43.9 (9.7)*	41.9 (10.3)	45.3 (9.7)*
6 months post-discharge, Mean (SD)	42.4 (11.6)	45.0 (11.5)	46.4 (10.8)*	42.9 (11.6)	45.3 (11.4)*	43.6 (11.5)	45.7 (11.6)*
Change in PCS-QOL score, Mean (SD)	1.4 (8.6)	1.9 (7.9)	1.8 (9.2)	1.8 (8.3)	1.4 (8.6)	1.8 (8.5)	0.5 (8.1)
Clinically meaningful increase (%)	38.0	42.9	40.1	39.9	40.2	41.2	30.8*
Disease Specific SAQ-QOL							
1 month post-discharge, Mean (SD)	74.2 (23.7)	76.4 (22.6)	77.4 (21.8)	72.6 (23.7)	79.5 (21.5)*	74.8 (23.2)	80.2 (21.8)
6 months post-discharge, Mean (SD)	79.1 (21.7)	81.0 (21.7)	83.2 (17.9)	78.6 (22.2)	82.9 (19.3)*	79.9 (21.4)	83.5 (19.5)
Change in SAQ-QOL score, Mean (SD)	4.8 (20.6)	4.6 (18.8)	5.7 (20.0)	5.9 (20.2)	3.3 (19.3)	5.1 (19.9)	3.4 (19.5)
Clinically meaningful increase (%)	28.2	23.2	28.1	29.9	21.5*	27.3	19.8

* $P<0.05$ across response categories for respective religiosity measure.

Note: The SF36v2 MCS (mental component summary) and SF36v2PCS (physical component summary) scores are norm-based ranging from 0-100 with a mean of 50 (SD= 10) in the US general population and higher scores indicate better generic health related quality of life (HRQOL). A clinically meaningful increase was defined as ≥3.0 points change in generic HRQOL from 1 to 6 months post discharge for an acute coronary syndrome.

The Seattle Angina Questionnaire Quality of Life (SAQ-QOL) subscale contains 3 items scored on a scale of 0-100 with higher scores indicative of better disease-specific health related quality of life (HRQOL). A clinically meaningful increase was defined as ≥10.0 points change in disease specific HRQOL from 1 to 6 months post discharge for an acute coronary syndrome.

Table 3.3. Association between religiosity and clinically meaningful increase in generic and disease specific HRQOL among survivors of acute coronary syndrome after 1 to 6 months for hospital discharge, TRACE-CORE, 2011-2013

Religiosity items	Clinically meaningful increase in MCS-QOL		Clinically meaningful increase in PCS-QOL		Clinically meaningful increase in SAQ-QOL	
	Unadjusted model OR (95% CI)	Fully adjusted model* OR (95% CI)	Unadjusted model OR (95% CI)	Fully adjusted model* OR (95% CI)	Unadjusted model OR (95% CI)	Fully adjusted model* OR (95% CI)
Strength and comfort from religion						
A great deal	1.67 (1.15-2.44)	1.48 (0.98-2.24)	0.92 (0.63-1.32)	1.07 (0.71-1.62)	1.01 (0.67-1.50)	0.99 (0.64-1.54)
Little/Some	1.19 (0.80-1.76)	1.15 (0.76-1.72)	1.12 (0.76-1.65)	1.17 (0.78-1.74)	0.77 (0.50-1.19)	0.75 (0.48-1.16)
None	Ref	Ref	Ref	Ref	Ref	Ref
Petition Prayers for health						
Yes	1.25 (0.97-1.60)	1.06 (0.81-1.40)	0.99 (0.76-1.27)	1.17 (0.88-1.54)	1.55 (1.16-2.07)	1.51 (1.10-2.07)
No	Ref	Ref	Ref	Ref	Ref	Ref
Intercessory Prayers for health						
Yes	1.50 (1.00-2.23)	1.31 (0.86-1.98)	1.57 (1.04-2.37)	1.65 (1.07-2.53)	1.52 (0.95-2.43)	1.40 (0.86-2.27)
No	Ref	Ref	Ref	Ref	Ref	Ref

*Adjusted for age, sex, race/ethnicity, perceived stress, symptoms of depression and anxiety, social support, length of index hospitalization, type of ACS, GRACE-risk score, receipt of reperfusion therapy, referral for cardiac rehabilitation, and study sites.

Supplemental Table 3.1. Inverse probability weighted regression estimates on the association between religiosity and clinically meaningful increase in generic and disease specific HRQOL among survivors of acute coronary syndrome after 1 to 6 months for hospital discharge, TRACE-CORE, 2011-2013

Religiosity items	Clinically meaningful increase in MCS-QOL		Clinically meaningful increase in PCS-QOL		Clinically meaningful increase in SAQ-QOL	
	Unadjusted model OR (95% CI)	Fully adjusted model* OR (95% CI)	Unadjusted model OR (95% CI)	Fully adjusted model* OR (95% CI)	Unadjusted model OR (95% CI)	Fully adjusted model* OR (95% CI)
Strength and comfort from religion						
A great deal	1.62 (1.09-2.41)	1.50 (0.97-2.32)	0.79 (0.53-1.16)	0.91 (0.59-1.40)	1.05 (0.69-1.59)	1.05 (0.67-1.66)
Little/Some	1.06 (0.70-1.61)	1.05 (0.68-1.61)	1.05 (0.70-1.58)	1.12 (0.74-1.71)	0.77 (0.49-1.59)	0.74 (0.46-1.17)
None	Ref	Ref	Ref	Ref	Ref	Ref
Petition Prayers for health						
Yes	1.30 (0.99-1.70)	1.13 (0.84-1.52)	0.89 (0.68-1.16)	1.07 (0.80-1.44)	1.54 (1.13-2.09)	1.52 (1.10-2.09)
No	Ref	Ref	Ref	Ref	Ref	Ref
Intercessory Prayers for health						
Yes	1.53 (1.01-2.32)	1.34 (0.88-2.04)	1.53 (1.00-2.33)	1.69 (1.10-2.60)	1.41 (0.87-2.29)	1.33 (0.81-2.20)
No	Ref	Ref	Ref	Ref	Ref	Ref

*Adjusted for age, sex, race/ethnicity, perceived stress, symptoms of depression and anxiety, length of index hospitalization, type of ACS, GRACE-risk score, receipt of reperfusion therapy and study sites.

CHAPTER IV: RELIGIOUS PRACTICES AND 30-DAY READMISSIONS AND LONG-TERM SURVIVAL AFTER HOSPITAL DISCHARGE FOR AN ACUTE CORONARY SYNDROME

Abstract

Background: Prior studies of healthy populations have found an association between religious practices and long-term survival. However, no contemporary cohort studies have examined whether religious practices are associated with rates of 30-day readmissions and long-term mortality after hospital discharge for an acute coronary syndrome (ACS). In the present study, we examine the association between religiosity and 30-day unscheduled readmissions risk and 2-year all-cause mortality among hospital survivors of an ACS.

Methods and Results: Patients hospitalized for an ACS were recruited from six medical centers in Central Massachusetts and Georgia (2011-2013). Strength and comfort from religion, petition prayers for health, and awareness of intercessory prayers by others were self-reported during the patient's index hospitalization. Multivariable Poisson regression and Cox proportional hazards models were used to estimate the risk of 30-day hospital readmissions and 2-year all-cause mortality, respectively. The mean age of the study participants (n=2,068) was 61 years, 34% were women, and 81% were non-Hispanic Whites. Eighty-five percent reported deriving strength and comfort from religion, 61% prayed for their health, and 89% were aware of intercessions by others. Overall, 10.8% experienced an unscheduled 30-day hospital readmission and 6% died within two years of hospital discharge. Derivation of strength and comfort from religion, nor petition or intercessory prayers for health were significantly associated with unscheduled 30-day readmissions or two-year all-cause mortality after multivariable adjustment for potential confounders.

Conclusions: Most survivors of an ACS acknowledge praying for their health, receiving intercessions, and deriving strength and comfort from religion. Although the reported religious

practices were not associated with hospital readmissions or post-discharge survival, identifying and addressing the religious needs of patients ensures a holistic approach in patient management.

Introduction

The acute coronary syndromes (ACS) are a life-threatening condition which account for approximately one-half of all cardiovascular disease related mortality and upwards of one-third of all deaths globally [4-7]. Despite considerable advances in the management of patients with an ACS, approximately 30% of discharged patients require hospital readmission with substantial clinical and financial implications [61]. Although the role of sociodemographic, psychosocial and clinical variables has been studied extensively as predictors of post-discharge hospital readmissions and mortality [64-67], little is known about whether patients' religious beliefs and practices influence hospital readmissions and survival after hospital discharge for an ACS.

Religiosity influences cardiovascular health outcomes through a variety of psychological, behavioral, and social pathways [13-17]. Patients may find considerable meaning and purpose in religion after stressful life events, which could facilitate coping and adaptation with illness which may be accompanied by higher levels of well-being and optimism [14]. These psychological processes have been shown to favorably affect patient's inflammatory, endocrine, and autonomic functions [15,16] Moreover, some religious doctrines encourage positive self-care practices by encouraging individuals to refrain from unhealthy lifestyle behaviors [14]. Religiosity may also favorably affect cardiovascular health via social pathways by promoting involvement in communities of faith and nurturing positive social attitudes and support networks, which may reinforce emotional well-being [17].

Although religiosity is associated with survival in population-based studies of healthy individuals [126,127], inconclusive findings about the influence of religiosity on cardiovascular health outcomes persist. Published investigations examining the association between religious involvement and cardiovascular outcomes have been cross sectional in nature, lacked adjustment for potentially confounding prognostic variables, or used a single item to assess religiosity, such

as religious service attendance, which may not adequately reflect the full extent of an individual's religiosity [128-130]. We examined the associations between religiosity and 30-day unscheduled all-cause hospital readmissions, and 2-year all-cause mortality following hospital discharge for an ACS, using data from a large, socioeconomically diverse prospective cohort of hospital survivors of an ACS. We hypothesized that patients who report religious engagement (strength and comfort from religion, petition and intercessory prayers for health) will have lower all-cause 30-day readmissions and mortality in the 2-year period after hospital discharge for an ACS compared to patients without reports of religious engagement.

Methods

Study design and population

The Transitions, Risks and Actions in Coronary Events Center for Outcomes Research and Education (TRACE-CORE) Study used a multi-center prospective cohort design to recruit 2,174 patients hospitalized with an ACS at six medical centers in Central Massachusetts and Georgia between April 2011 and May 2013 [73,74]. Eligibility for study enrolment included adult patients aged ≥21 years having a confirmed ACS and discharged alive from the index hospitalization. Patients diagnosed with dementia or delirium, who were receiving palliative care, expected to move out of the area within 18 months, or were a prisoner were ineligible. Written informed consent was obtained from each patient and the Institutional Review Boards at participating sites approved this study.

Trained study staff abstracted data from hospital medical records and conducted a computer assisted in-person interview during the index hospitalization or by telephone within 72 hours of discharge. Additional follow up telephone interviews were conducted at 1, 3, 6, and 12 months following hospital discharge.

In the present study, we included only validated cases of an ACS (n=2,122) categorized as either unstable angina, non-ST segment elevation myocardial infarction (NSTEMI), or ST-segment elevation myocardial infarction (STEMI) based on a priori criteria [77]. Patients without information on the three religiosity items (n=54) were excluded, resulting in an analytic sample of 2,068 patients with a confirmed ACS (Fig 1).

Assessment of Religiosity

During the index hospitalization for an ACS, patients self-reported their religious experience based on three items assessing religiosity. One question adapted from the Fetzer Institute's Brief Multidimensional Measure of Religiousness/Spirituality [78], asked: "How much is religion a source of strength and comfort to you?". Response options included "a great deal", "a little", "some", and "none" (referent group). Responses of "some" or "little" were combined for analysis as few events of readmission and mortality occurred in these categories. The second question assessed non-organized religious practice on petition prayers for health by asking, "Do you use prayer specifically for your health?" with response options "Yes" or "No" (referent). The third item on intercessory prayers for health asked: "Do you know of others outside of your family who are praying for your health?", with responses "Yes" or "No" (referent). For all three items evaluating religiosity, 3% of participants responded, "don't know or refused" and these were handled as missing data. Consistent with previous studies that have examined the influence of various aspects of religion on health [71] the three items were evaluated separately since they reflect different conceptual dimensions of religiosity.

Readmissions and Mortality

The primary study outcomes were unscheduled 30-day all-cause hospital readmissions and death from any cause within 2 years after hospital discharge for an ACS. Participants reported

hospital readmissions during the follow up telephone interview at 1 month, which were validated by review of medical records at participating study hospitals. Only validated hospital readmissions at the participating sites were used for purposes of analysis. We identified the cause of hospital readmission based on the primary discharge code. Cardiovascular related hospital readmissions were defined using ICD-9 codes 390-459. Among 275 subsequent hospital readmissions, 52 were scheduled during the patient's index hospitalization, which we excluded from the present analyses, resulting in a total of 223 unscheduled all-cause hospital readmissions (Fig 1).

All cause-mortality within 2-years of hospital discharge was ascertained by the review of medical records at participating study hospitals. In addition, death certificates were examined at local, state, and national vital registry records.

Patient Baseline Characteristics

We collected information on patient's age, sex, race/ethnicity (non-Hispanic White, non-Hispanic Black or Hispanic), highest level of education, and marital and employment status. Psychosocial and psychological variables included quality of life, perceived stress, anxiety, depression, health literacy, patient activation, and cognitive impairment. Patient's overall Health Related Quality of Life (HRQOL) was assessed using the SF-36®v2 Health Survey with norm-based physical and mental well-being component summary scores ranging from 0-100 [90]. Disease-specific HRQOL was measured with the Seattle Angina Questionnaire (SAQ) quality of life subscale, a validated and reliable measure for patients with coronary heart disease with scores ranging from 0-100 [91]. Higher scores from the SF-36 and SAQ indicate better HRQOL [90,91]. The 4-item Perceived Stress Scale (PSS4) assessed the extent to which patients found their lives "uncontrollable, unpredictable and overloading" in the preceding month [84]. The 7-item Generalized Anxiety Disorder questionnaire (GAD) measured symptoms of anxiety with scores of

5-9, 10-14, and >14 corresponding to mild, moderate, and severe anxiety, respectively [86]. Symptoms of depression were assessed with the 9-item Patient Health Questionnaire (PHQ-9) with scores of 5-9, 10-14, 15-19, and ≥20 corresponding with mild, moderate, moderately severe, and severe depression, respectively [85]. Participants were asked how confident they were in filling out health forms; they were considered to have low health literacy if they reported having little or no confidence [87]. The extent of patient's knowledge, confidence, and skills in managing their disease was assessed with the 6-item patient Activation Measure (PAM-6) [79]. Cognitive status at 1 month after hospital discharge was examined using the 11-item Telephone Interview for Cognitive Status (TICS), with scores ranging from 0-41, and categorized as ≥ 33, 26-32, and ≤25, indicating intact cognition, ambiguous, and moderate to severe cognitive impairment respectively [89].

Behavioral variables included a history of cigarette smoking and alcohol use. Clinical characteristics included ACS subtype (STEMI, NSTEMI, unstable angina), previously diagnosed co-morbidities (e.g., chronic kidney disease, heart failure, diabetes mellitus, hypertension, and stroke), in-hospital procedures (coronary artery by-pass surgery, percutaneous coronary intervention), clinical complications (e.g., atrial fibrillation, ventricular fibrillation/tachycardia), receipt of cardiac medications during hospitalization, length of hospital stay, and referral for cardiac rehabilitation. The Global Registry of Acute Coronary Events (GRACE) risk score (2.0) for long-term mortality was calculated using data on patient's age, heart rate, systolic blood pressure, elevated cardiac enzymes, ST-segment changes, serum creatinine levels, and the presence of heart failure and cardiac arrest at the time of hospital admission [109].

Statistical Analysis

Descriptive statistics were used to compare patients' baseline characteristics in relation to their degree of religiosity. We used unpaired t-tests and ANOVA for between group comparisons for continuous variables. We used Chi-square and Kruskal Wallis tests to compare differences across categorical variables.

We used modified Poisson regression modelling with robust error variance as a conservative method for direct estimation of 30-day readmission risk. Kaplan-Meier survival curves were constructed to examine the unadjusted relationship between each measure of religiosity and 2-year survival after hospital discharge for an ACS. The log-rank test was used to determine the statistical significance of between group differences in post-discharge survival across the three religiosity items. Cox-proportional hazards regression models estimated the unadjusted and adjusted multivariable hazard ratios (HR) with accompanying 95% confidence intervals (CIs). We inspected Schoenfeld residuals and log-log plots to ascertain that the three religiosity items and baseline covariates satisfied the proportional hazards assumption. The proportional hazards assumption was sufficiently met by the exposure variables and covariates included in the models.

For multivariable adjustment we included all three religiosity items in the respective modified Poisson and Cox regression models. Multicollinearity was tested and ruled out with a variance inflation factor (VIF) of ≥3 to determine the presence of correlation between the items assessing religiosity. We observed no collinearity (VIF=2.29) which enhanced the development of an all-inclusive model. The choice of various confounding variables to be included in the models was based on clinical judgement and factors known to be associated with religiosity, early readmissions, and all-cause mortality such as age, sex, race/ethnicity, length of index hospitalization, type of ACS, receipt of coronary reperfusion therapy, and the GRACE-risk score.

Other potential confounders were tested to determine if their presence in the model changed the religiosity effect estimates by more than 10%. Three psychosocial variables met this threshold: depression, anxiety, and the physical component of the SF-36 QOL measure. To understand the impact of adjustment on effect estimates by different groups of variables, sociodemographic characteristics (age, sex, and race/ethnicity) were first adjusted for in the models. Next, clinical measures (length of index hospitalization, type of ACS, receipt of reperfusion therapy, and GRACE-risk score) were included in the models. Finally, psychosocial measures including symptoms of depression, anxiety, and the physical component of the SF-36 QOL measure were adjusted for in our regression models.

We conducted the following sensitivity analysis. First, we stratified our findings by geographic location of the study sites (Central Massachusetts and Georgia) since religiosity may differ across these regions, and varying clinic practices across sites may influence readmissions and mortality. In addition, we constructed separate models to examine the association between religiosity and cardiovascular related and non-cardiovascular related 30-day unscheduled hospital readmissions. All statistical analyses were conducted using Stata software 13 (StataCorp). A two-sided p<0.05 was considered statistically significant.

Results

Patient Characteristics

The average age of study participants was 61 years, one-third were women, and 81% were non-Hispanic White. Fifty-five percent of patients were diagnosed with an NSTEMI, 30% with unstable angina, and 15% with a STEMI. Approximately 80% of patients had one or more previously diagnosed comorbidities, 52% were hospitalized for more than 3 days, and two-thirds

of participants had undergone a percutaneous coronary intervention (PCI) during their index hospitalization for an ACS.

Approximately half of the sample (52%) reported a great deal of strength and comfort from religion, 34% reported obtaining some or little comfort, and 14% indicated none. Approximately 60% of patients prayed for their health and 89% were aware of others praying for their health.

Patient characteristics according to religiosity

Participants who endorsed each religiosity item, were more likely to be women and non-Hispanic Blacks, reported higher levels of perceived stress and had lower QOL scores compared with their respective counterparts who did not respond in the affirmative to each religiosity measure. A higher prevalence of severe symptoms of depression and anxiety was observed among those who made petition prayers for their health (versus those who did not pray for their health) and those aware of intercessions made for their health by others (versus those unaware of intercessions made for their health). Patients who had others praying for their health had greater social support than those without others praying for their health. (Table 1).

For each item assessing religiosity, a greater proportion of participants who provided affirmative responses were non-smokers and non-users of alcohol and were less likely to have a referral to cardiac rehabilitation than patients who did not acknowledge any of the religiosity items (Table 2). Patients who derived strength and comfort from religion and prayed for their health were on average older, had higher prevalence of previously diagnosed comorbidities, moderate to severe cognitive impairment, higher GRACE risk scores, and were more likely to have undergone CABG surgery during their index hospitalization compared with those who did not derive strength and comfort from religion or pray for their health ($p<0.05$ for all comparisons).

Association between religiosity and 30-day unscheduled hospital readmissions

Overall, 10.8% (n=223) of our sample experienced an unscheduled readmission within 30 days of discharge for an ACS. Reports of a great deal of strength and comfort from religion were not significantly associated with early unplanned readmissions (relative risk [RR]: 0.91; 95% CI: 0.57-1.45), nor were reports of the receipt of intercessory prayers for health (RR: 0.80; 95% CI: 0.53-1.21; Table 3). After adjusting for several sociodemographic and clinical characteristics, petition prayer for health was associated with an increased risk of early-unscheduled readmissions (RR: 1.53; 95% CI: 1.10-2.13). After further adjustment for psychosocial measures, the association between petition prayers and early-unplanned readmission was no longer statistically significant (RR: 1.34; 95% CI: 0.96 -1.89; Table 3).

Within 30-days of hospital discharge, 6.7% (139/2,068) of our study participants experienced a cardiovascular related readmission. Consistent with the overall results, neither strength nor comfort from religion, receipt of intercessory prayers, nor petition prayers for health were significantly associated with either cardiovascular or non-cardiovascular related readmissions. (Tables S1-S2).

Association between religiosity and 2-year mortality after hospital discharge

Of the 2,068 study participants, a total of 123 deaths (5.9%) occurred within 2 years of hospital discharge for an ACS. Patients who derived a great of strength and comfort from religion had the highest risk of dying within 2 years compared with those who derived little/some and none, respectively (7.3% vs. 5.0% vs 3.3%, p=0.01). Patients who prayed for their health experienced a higher risk of dying within 2 years compared with those who did not offer petition prayers for their health (8.9% vs. 4.4%, p=0.001). Participants who were aware of intercessions made for their health experienced a lower 2-year risk of mortality (5.9% vs. 6.5%, p=0.71). (Fig 2). We observed

no significant associations between strength and comfort from religion nor intercessory prayers for health with all-cause 2-year mortality in the multivariable adjusted models. After accounting for sociodemographic characteristics, petition prayer for health was associated with an increased risk of 2-year all-cause mortality (HR: 1.64; 95% CI: 1.01-2.66). With further adjustment for clinical and psychosocial variables, however, the association between petition prayers and 2-year all-cause mortality was no longer statistically significant (HR: 1.24; 95% CI: 0.75 -2.02; Table 4).

In examining the association between religiosity and hospital readmission/mortality stratified by geographic region of the study sites, there was minimal evidence of heterogeneity in the site-specific results. The findings across sites were consistent with the overall findings, except for a slightly increased risk of readmission among participants from Georgia who derived strength and comfort from religion. However, these results were not statistically significant with wide confidence intervals due to the small sample size of the referent group (i.e. none) (Tables S3-S4).

Discussion

In this prospective investigation of over 2,000 hospital survivors of an ACS, more than one-half of study participants reported religious engagement, including deriving strength and comfort from religion, petition, and intercessory prayers made for their health. One in ten patients experienced an unscheduled all-cause 30-day hospital readmission, and six percent of study participants died within two years of hospital discharge for an ACS. After multivariable adjustment for several potentially confounding sociodemographic, clinical, and psychosocial characteristics, reports of religiosity were not significantly associated with all-cause 30-day readmissions, nor two-year total mortality.

Prevalence of Religious Involvement

The high prevalence of religious engagement reported by patients in the present study is consistent with an earlier study conducted in the 1990's of 232 middle-aged and older US adults who underwent CABG surgery or aortic valve replacement; 70% of these individuals reported deriving at least some strength and comfort from religion [71]. Similarly, two nationally representative studies using data from the National Health Interview Survey (NHIS) found that approximately two-thirds of 2,474 American adults with diabetes reported praying for their health, while 69% of 2,262 cancer survivors prayed for their health during recovery [113, 131]. Our study findings and results from prior research reinforce that many patients turn to their religious beliefs and practices as part of their coping strategies during recovery from their illness. Hence, there remains a need to better understand the role of religiosity as a potentially facilitating factor which may influence health seeking behaviors and health outcomes, and how patient's belief system may be more optimally used to enhance their recovery process.

We found that the prevalence of different aspects of religiosity varied according to patient sociodemographic characteristics. A greater proportion of study participants who reported receiving strength and comfort from religion and those who prayed for their health were 65 years and older. This observation is consistent with previous findings which have found that religion tends to be more salient among older people possibly due to declines in their health and the accompanying need for comfort or consolation [36, 102]. A higher proportion of Non-Hispanic Blacks and women in the present study reported receiving strength and comfort from religion and prayed for their health than Non-Hispanic Whites and men, similar to previous research reports [35, 103]. Since people's religious experience may differ across the lifespan and among cultural

groups, further research is needed to understand the functional role of religiosity on cardiovascular health outcomes according to various sociodemographic characteristics.

Religiosity and 30-day unscheduled all-cause hospital readmissions

The risk of rehospitalization for patients in the present study is comparable to prior published findings [66, 132]. Previous studies have identified several patient level factors that increase the risk of an unscheduled rehospitalization including a lack of social support [133, 134]. Membership in religious groups, participation in religious activities, and having others pray for one's health may be accompanied by a high level of social support and general well-being [17], which could facilitate recovery from an ACS and reduce the likelihood of readmissions. Although, not statistically significant, we found that patients who derived strength and comfort from religion and those who had intercessions made by others for their health were less likely to experience an unscheduled hospital readmission. Future studies are needed to better understand how social support conferred by membership in religious communities may enhance patient recovery and potentially reduce the likelihood of hospital readmissions.

After adjusting for several sociodemographic and clinical variables, we found higher risk of early-unplanned readmissions among those who reported praying for their health. However, this association was no longer statistically significant after accounting for psychosocial characteristics including symptoms of depression and anxiety. There are several possible reasons why praying for one's health might be associated with an increased risk of an early-unplanned readmission. Since prayers are a common form of complementary and alternative medicine [135], it is possible that in response to a life-threatening illness such as an ACS, patients with poorer health status who are at greater risk for worse health outcomes increase their engagement in private religious practices, such as praying, as a coping mechanism during their recovery. Another possibility is that patients

who prayed for their health may have been experiencing religious struggle in the absence of a positive relationship with God, which has been associated with negative health outcomes [136]. Furthermore, if those who prayed for their health had a passive dimension of "spiritual health locus of control" believing that a higher power had complete control over their health [32], they may have been less likely to engage in their healthcare, adhere with prescribed treatment or adopt recommended lifestyle changes. In our prior research using the TRACE-CORE data (dissertation chapter II), we found that patients who made petition prayers for their health during hospitalization for an ACS had low levels of patient activation and were less likely to be engaged in their healthcare [137]. This underscores the need for future research to better understand how religious beliefs and practices may hinder patient engagement with their healthcare and impact outcomes. In the present study, however, our findings suggest that the higher risk of unscheduled hospital readmissions among patients who prayed for their health may be attributable to the potential negative influence of severe symptoms of depression and anxiety which was more common among those who prayed for their health.

Religiosity and post-discharge mortality

In the present study, we found a higher risk of 2-year mortality among patients who acknowledged deriving strength and comfort from religion compared with those who reported none. Our findings are in contrast with the results noted in healthy populations that have examined the association between religiosity and cardiovascular health outcomes. In a 23-year prospective study of slightly more than 10,000 Israeli males, in comparison with nonreligious men, Orthodox men had a 20% reduced risk of fatal coronary heart disease (CHD) which persisted even after adjustment for the commonly established risk factors for CHD [129]. In the Nurses' Health Study, among more than 70,000 study participants followed for 16 years, attending religious service

weekly was associated with a 27% lower risk of cardiovascular related mortality [130]. A likely explanation for better survival among those who attend church service is that people who are healthy or strong enough may be more likely to attend religious service, making the survival effect more biased towards already healthy persons. While in the present study which focused on ill individuals, they may have been less likely to attend religious service but utilize more private religious activities such as prayers for health and tended to have poorer survival outcomes. Furthermore, the duration of follow-up has varied substantially across studies. Most publications reporting a positive association between religiosity and cardiovascular health have used longer follow up periods providing sufficient time from a life-course perspective that is optimal for observing the health effect of religious practices [138].

The use of intercessory prayers for healing and recovery from illness has been examined in several studies with inconclusive results of either no association, better, or worse cardiovascular health outcomes associated with the receipt of intercessory prayers [98, 139]. In a clinical trial of 748 patients who underwent a PCI and were randomized to receive intercessory prayers or not, no between group differences in either mortality or hospital readmissions after 6 months were observed [140]. Similarly, we did not observe an association between awareness of intercessory prayers being made for one's health and 2-year all-cause mortality. While the scientific rationale of possible health benefits associated with distant intercessory prayer has been questioned, proximal intercessory prayers have a clearer scientific basis through mind-body mechanisms [139]. The measure of intercessory prayers in the present study did not consider the physical and socio-emotional proximity of those praying for patients, which may be an important consideration for future studies.

Our findings of higher death rates among patients who prayed for their health may be subject to potential reverse causation as we did not account for time-dependent confounding of the religiosity measures. We only assessed religiosity at baseline study enrollment, in the acute phase of serious illness when patients and their families may have intensified their praying for the patient to get well, especially among those with poorer health status. There remains an ongoing need for a more in-depth understanding of how praying for one's health may influence cardiovascular risk, survival, and post-discharge outcomes among patients discharged for an ACS. In a recent scientific statement by the American Heart Association (AHA), meditation practices, including prayer, was found to be beneficial in reducing the risk of cardiovascular disease, with notably low costs of implementation and associated risks [125] The AHA further recommends that meditation practices be considered as an adjunct to guideline directed cardiovascular risk reduction especially for patients interested in lifestyle modification.

Study Strengths and Limitations

To our knowledge, this is the first contemporary study to examine the influence of religiosity on 30-day unscheduled readmissions and long-term survival among patients discharged from the hospital after an ACS. Data used in the present study were obtained from a large prospective study of a socio-demographically diverse patient cohort, enhancing the generalizability of our findings. We analytically accounted for several sociodemographic, psychosocial, and pertinent clinical variables which could affect the risk of being readmitted to the hospital or influence post-discharge survival. The extent of patients' religious engagement was assessed by three separate items providing a unique opportunity for understanding the association between religiosity and outcomes following hospitalization for an ACS. Unscheduled hospital readmissions were validated by medical records to reduce measurement error from patient's self-

reports. Our prior research has shown that the vast majority of 30-day readmissions among study patients were captured by the included study hospitals [67].

Our findings should be considered in light of several potential limitations. With respect to measurement error, the life-threatening experience of an ACS may have caused patients to over-report the extent of their religious beliefs and practices, which may have introduced non-differential misclassification of patient's religiosity. There was no ascertainment of the duration of engagement in the reported religiosity measures, which is an important consideration since these are not static behaviors but may change in response to the patient's physical and mental health status. In addition, we did not have information on patients' religious affiliation and rituals/practices, and therefore could not explore whether the association between religiosity and outcomes post-discharge for an ACS differ according to religious affiliation or rituals. Lastly, despite adjusting for several important potentially confounding variables, there remains the possibility for residual and unmeasured confounding given the observational study design.

Conclusions

In this prospective cohort study, the majority of hospital survivors of an ACS derived strength and comfort from religion, prayed for their health, and were aware of others praying for their health. Although religiosity did not influence the risk of early hospital readmissions or long-term survival after an ACS, identifying the religious needs of patients and referral for appropriate clerical intervention in accordance with the Joint Commission on Accreditation of Healthcare Organizations standards (JCAHO 1999), would contribute to a holistic approach to patient management and may help to facilitate their recovery. Future longitudinal studies are needed to evaluate the religious beliefs and practices of patients and how this may influence disease self-management following hospitalization for an ACS, including evaluating whether patients

recovering from an ACS may be experiencing religious struggle or negative coping, which may

lead to adverse short and/or long-term health outcomes.

Table 4.1. Baseline sociodemographic and psychosocial characteristics of hospital survivors of an acute coronary syndrome by religiosity measures, TRACE-CORE, 2011-2013

Characteristics	Strength and comfort from Religion			Petition prayers for health		Intercessory prayers for health	
	A great deal (n=1,084)	Little/Some (n=682)	None (n=302)	Yes (n=1,259)	No (n =809)	Yes (n=1,837)	No (n=231)
Age (mean, years (sd))	62.7 (11.2)	59.7 (11.0)	59.4 (11.6)*	62.2 (11.2)	59.7 (11.2)*	61.1 (11.3)	62.2 (11.0)
Age (years, %)							
<55	25.5	33.9	35.2	27.3	33.5	30.3	24.7
55-64	29.9	33.4	3/2.2	30.3	33.0	31.3	32.5
≥ 65	44.6	32.7	32.6	42.4	33.5	38.4	42.8
Women (%)***	44.4	24.5	16.5	41.3	21.9	35.0	24.0
Married (%)	54.8	62.9	60.1*	56.3	62.0*	59.2	53.0
Race/Ethnicity (%)***							
Non-Hispanic Whites	72.2	88.8	95.7	74.1	92.0	80.2	88.0
Non-Hispanic Blacks	24.1	8.5	2.3	22.3	5.7	16.6	9.4
Hispanics	3.7	2.7	2.0	3.6	2.3	3.2	2.6
Education (≤ high school)	47.9	45.6	46.5	49.5	43.0*	46.5	50.7
Unemployed/retired (%)	65.0	52.4	51.2*	64.2	50.6*	58.7	59.7
Uninsured (%)	8.5	10.3	12.0	9.6	9.5	9.8	8.2
High perceived stress (%) [†] ***	50.6	49.3	38.1*	53.6	40.2*	49.4	39.8*
Depressive Symptoms (%) [§]							
None	48.6	51.1	57.3	46.1	58.0*	49.6	59.1*
Mild	27.6	27.0	24.1	27.5	26.0	27.6	21.8
Moderate	13.0	13.4	12.9	14.9	10.2	13.1	13.5
Moderately Severe/Severe	10.8	8.5	5.7	11.5	5.8	9.7	5.6
Anxiety Symptoms (%) [‡]							
None	49.1	51.2	56.0	46.5	57.4*	49.8	58.8*
Mild	21.4	22.5	22.5	22.0	21.8	22.5	16.7
Moderate/Severe	29.5	26.3	21.5	31.5	20.8	26.7	24.5
Low health literacy (%)	38.0	34.4	32.4	35.8	38.8	37.1	34.3
Low social support (%)	4.7	4.4	7.7	4.8	5.3	4.3	10.9*
Cognitive impairment (%) [¶]	26.3	16.3	8.3*	26.0	11.6*	20.9	16.5
Patient Activation, Mean (SD)	60.0 (15.2)	60.0 (15.7)	58.2 (14.2)	59.6 (15.4)	59.9 (15.0)	60.1 (15.2)	57.3 (15.1)*
SF-36®v2 PCS, median (IQR)***	40.0(30.6, 48.1)	43.8(35.5, 50.8)	44.7(37.1, 51.7)	40.6(31.0, 48.8)	43.9(36.3, 50.7)	41.6(32.6, 49.5)	45.6(37.0, 52.0)
SF-36®v2 MCS, median (IQR)***	49.9(37.5, 57.5)	50.7(39.5, 56.8)	52.1(42.9, 57.2)	48.9(36.8, 56.6)	52.1(42.9, 57.7)	50.3(38.8, 57.1)	52.1(42.5, 57.7)
SAQ QOL score, median (IQR)***	58.3(41.7, 83.3)	58.3(41.7, 83.3)	66.7(41.7, 83.3)	58.3(41.7, 83.3)	66.7(41.7, 83.3)	58.3(41.7, 83.3)	66.7(41.7, 83.3)

Abbreviations: PCS, Physical Component Summary; MCS, Mental Component Summary; SAQ QOL, Seattle Angina Questionnaire Quality of Life; * P<0.05 across response categories for respective religiosity measure; *** P<0.05 across response categories for all 3 religiosity measures; § PHQ-9 Patient Health Questionnaire 9 item score (5-9 mild; 10-14 moderate; 15-19 moderately severe; and ≥20 severe depression); † Cohen's Perceived Stress Scale Score (≥4 median, high perceived stress); ‡ GAD-7 General Anxiety Disorder 7 item score (5-9 mild; 10-14 moderate; ≥15 severe anxiety); ¶TICS Telephone Interview for Cognitive Status Score (≤ 28 impaired)

Table 4.2. Baseline behavioral and clinical characteristics of hospital survivors of an acute coronary syndrome according to religiosity, TRACE-CORE, 2011-2013

Characteristics	Strength and comfort from Religion			Petition prayers for health		Intercessory prayers for health	
	A great deal (n=1,084)	Little/Some (n=682)	None (n=302)	Yes (n=1,259)	No (n =809)	Yes (n=1,837)	No (n=231)
Alcohol use (%) ***							
No alcohol use	52.6	33.3	33.3	50.4	32.7	44.1	38.3
Rare/occasional	31.4	40.0	37.7	31.9	40.2	35.3	33.5
Moderate/heavy	16.0	26.7	29.0	17.7	27.1	20.6	28.2
Smoking status (%) ***							
Non-smoker	34.0	27.4	26.6	34.2	25.5	31.9	21.7
Prior smoker	45.7	47.4	41.9	44.7	47.2	46.1	42.4
Current smoker	20.3	25.2	31.5	21.1	27.3	22.0	35.9
Physiologic measures at admission							
Heart rate (beat/min, median, IQR)	75 (65-88)	75(65-88)	75 (64-86)	76 (65-88)	74 (64-87)	75 (65-88)	76 (64-87)
Systolic BP (mmHg, median, IQR)	140 (123-156)	141 (125-157)	141 (126-158)	140 (124-156)	142 (125-158)	140 (124-157)	140 (125-153)
Diastolic BP (mmHg, median, IQR)	78 (67-88)	80 (71-91)	81 (71-93)*	78 (68-89)	80(70-91)*	79 (69-90)	79 (68-91)
Laboratory values at admission							
Creatinine (mg/dl, median, IQR)	1.0 (0.8-1.2)	1.0 (0.8-1.2)	1.0 (0.8-1.1)	1.0 (0.8-1.2)	1.0 (0.8-1.2)	1.0 (0.8-1.2)	1.0 (0.8-1.2)
Glucose (mg/dl, median, IQR)	126 (104-168)	127 (106-168)	127 (106-180)	125 (104-168)	128 (107 -171)	127 (105-168)	124 (107-170)
Potassium (mmol/l, median, IQR) ***	4.0 (3.7-4.3)	4.1 (3.7-4.4)	4.1 (3.8-4.4)	4.0 (3.7-4.3)	4.1 (3.8-4.4)	4.0 (3.7-4.3)	4.2 (3.8-4.4)
WBC count (10^9cell/L, median, IQR)	8.1 (6.6-10.4)	8.9 (7.0-11.2)	9.0 (7.3-11.6)*	8.2 (6.6-10.7)	8.9 (7.1-11.2)*	8.5 (6.8-10.8)	8.7 (6.9-11.4)
GRACE risk score, mean (SD)#	99.4	92.4	90.1*	97.7	91.8*	95.0	97.4
Co-morbidities at admission (%)							
Chronic kidney disease	12.8	9.2	7.3*	11.9	9.2*	10.7	11.7
Congestive heart failure	17.0	12.8	9.0*	16.6	11.0*	14.2	16.5
Diabetes mellitus	34.6	28.3	26.9*	33.4	28.4*	32.0	27.3
Hypertension	81.0	70.8	69.1*	79.5	70.4*	76.3	73.2
Stroke	7.2	4.4	1.7*	6.8	3.3*	5.7	3.9
Type of ACS (%)							
Unstable Angina	32.1	27.6	28.6*	31.7	27.6*	30.4	27.3
NSTEMI	55.9	56.2	49.5	56.4	53.0	54.8	57.1
STEMI	12.0	16.2	21.9	11.9	19.4	14.8	15.6
Reperfusion therapy (%)							
Medical treatment	23.7	19.4	17.3*	23.1	18.6*	21.5	20.3
PCI	61.5	68.3	72.7	62.7	69.7	64.6	71.9
CABG	14.8	12.3	10.0	14.2	11.7	13.9	7.8
In-hospital medications (%)							
ACEI/ARB	60.1	62.9	64.2	61.7	61.4	60.5	70.1*

Anticoagulants	69.6	75.4	78.5*	71.0	75.6*	72.3	76.6
Aspirin	96.1	97.5	98.3	96.3	97.8	96.6	99.6*
Beta-Blockers	89.8	90.8	93.0	89.7	92.0	90.3	93.1
Lipid lowering medication	87.5	93.4	90.1*	89.3	90.7	89.8	90.0
$P2Y_{12}$ receptor antagonists	80.4	82.5	88.4*	80.4	85.3*	81.9	85.3
In-hospital complications (%)							
Acute kidney injury	8.7	3.2	1.0*	7.6	2.8*	6.0	3.5
Atrial fibrillation	8.7	5.7	7.0	8.3	6.1*	7.3	8.2
Bleeding	1.3	1.8	1.0	1.3	1.6	1.5	0.4
Ventricular tachycardia/fibrillation	4.8	4.4	5.6	4.8	4.8	4.8	4.3
Length of hospital stay, ≥3 days (%)***	56.8	49.6	43.9	56.3	46.7	53.7	43.3
Cardiac rehabilitation referral (%)***	28.7	44.6	55.5	30.9	48.9	36.4	50.4

Abbreviations: BP, blood pressure; WBC, white blood cell; NSTEMI, Non-ST segment elevation myocardial infarction; STEMI, ST segment elevation myocardial infarction; PCI, percutaneous coronary intervention; CABG, coronary artery by-pass graft; * $P<0.05$ across response categories for respective religiosity measure; *** $P<0.05$ across response categories for all 3 religiosity measures; # GRACE risk score estimates mortality risk at 1 and 3 years after ACS admission. Score ranges from 0 to 263, higher scores worse. Derived from data on age, heart rate, systolic blood pressure, ST segment changes, cardiac biomarkers, serum creatinine or history of renal dysfunction, Killip class or diuretic use, cardiac arrest during hospitalization for ACS.

Table 4.3. Association between religiosity and all-cause unscheduled 30-day readmissions among patients hospitalized for an acute coronary syndrome, TRACE-CORE, 2011-2013

Religiosity measures	Participants (n)	Risk of 30-day readmissions (%)	Unadjusted Model RR (95% CI)	Model 1* RR (95% CI)	Model 2** RR (95% CI)	Model 3*** RR (95% CI)
Strength and Comfort from Religion						
A great deal	1,084	12.3	0.91 (0.58-1.42)	0.89 (0.56-1.41)	0.84 (0.45-1.09)	0.91 (0.57 - 1.45)
A little/Some	682	8.6	0.74 (0.47-1.15)	0.73 (0.47-1.14)	0.70 (0.53-1.33)	0.73 (0.47 – 1.15)
None	302	10.3	Referent	Referent	Referent	Referent
Petition prayers for health						
Yes	1,259	12.4	1.54 (1.11-2.15)	1.55 (1.11-2.17)	1.53 (1.10 – 2.13)	1.34 (0.96-1.89)
No	809	8.3	Referent	Referent	Referent	Referent
Intercessory prayers for health						
Yes	1,837	10.7	0.81 (0.54-1.22)	0.82 (0.54-1.25)	0.81 (0.54-1.21)	0.80 (0.53-1.21)
No	231	11.7	Referent	Referent	Referent	Referent

Note: Unadjusted model includes all three items assessing religiosity
*Model 1: Adjusted for sociodemographic variables: age, gender, and race/ethnicity
**Model 2: Adjusted for the sociodemographic variables in Model 1, and clinical variables: type of acute coronary syndrome, receipt of reperfusion therapy, length of index hospitalization, GRACE risk score
***Model 3: Adjusted for the sociodemographic and clinic variables in Model 2, and psychosocial variables: symptoms of depression and anxiety

Table 4.4. Risk of 2-year all-cause mortality among patients discharged from the hospital following an acute coronary syndrome according to religiosity, TRACE-CORE, 2011-2013

Religiosity items	Deaths (n)	Person-years	Unadjusted Model HR (95% CI)	Model 1* HR (95% CI)	Model 2** HR (95% CI)	Model 3*** HR (95% CI)
Strength and Comfort from Religion						
A great deal	79	1815.0	1.64 (0.76-3.52)	1.39 (0.64-3.00)	1.07 (0.50-2.28)	1.25 (0.57-2.73)
A little/Some	34	1160.4	1.32 (0.63-2.78)	1.31 (0.62-2.75)	1.03 (0.48-2.19)	1.26 (0.57-2.74)
None	10	494.9	Referent	Referent	Referent	Referent
Petition prayers for health						
Yes	92	2070.7	1.81 (1.11-2.95)	1.64 (1.01-2.66)	1.50 (0.93-2.42)	1.24 (0.75 -2.02)
No	31	1399.6	Referent	Referent	Referent	Referent
Intercessory prayers for health						
Yes	108	3087.5	0.60 (0.33-1.07)	0.69 (0.38-1.23)	0.75 (0.41-1.35)	0.80 (0.43-1.48)
No	15	382.8	Referent	Referent	Referent	Referent

Note: Unadjusted model includes all three items assessing religiosity
*Model 1: Adjusted for sociodemographic variables: age, sex, and race/ethnicity
**Model 2: Adjusted for the sociodemographic variables in Model 1, and clinical variables: type of acute coronary syndrome, receipt of reperfusion therapy, length of index hospitalization, comorbidities at admission, GRACE risk score
***Model 3: Adjusted for the sociodemographic and clinic variables in Model 2, and psychosocial variables: symptoms of depression and physical component of SF-36 Quality of Life measure

Supplemental Table 4.1. Association between religiosity and cardiovascular related unscheduled 30-day readmissions (n=139) among patients hospitalized for an acute coronary syndrome, TRACE-CORE, 2011-2013

Religiosity measures	Participants (n)	Unadjusted Model RR (95% CI)	Adjusted Model* RR (95% CI)
Strength and Comfort from Religion			
A great deal	76	1.90 (1.01-3.55)	1.70 (1.02 - 2.82)
A little/Some	42	1.28 (0.70-2.30)	1.15 (0.47-1.20)
None	21	Referent	Referent
Petition prayers for health			
Yes	96	1.00 (0.67-1.48)	0.99 (0.70 -1.39)
No	43	Referent	Referent
Intercessory prayers for health			
Yes	121	0.83 (0.51-1.36)	0.85 (0.52-1.40)
No	18	Referent	Referent

*Adjusted for age, sex, race/ethnicity, type of acute coronary syndrome, receipt of reperfusion therapy, length of index hospitalization, grace risk score, symptoms of depression and anxiety

Supplemental Table 4.2. Association between religiosity and non-cardiovascular related unscheduled 30-day readmissions (n=1,929) among patients hospitalized for an acute coronary syndrome, TRACE-CORE 2011-2013

Religiosity measures	Participants (n)	Unadjusted Model RR (95% CI)	Adjusted Model* RR (95% CI)
Strength and Comfort from Religion			
A great deal	1,008	0.75 (0.42-1.32)	0.85 (0.47 - 1.56)
A little/Some	640	0.66 (0.38-1.13)	0.67 (0.38-1.20)
None	281	Referent	Referent
Petition prayers for health			
Yes	1,163	1.46 (0.95-2.24)	1.27 (0.82 -1.98)
No	766	Referent	Referent
Intercessory prayers for health			
Yes	1,716	0.86 (0.50-1.48)	0.80 (0.46-1.39)
No	213	Referent	Referent

*Adjusted for age, sex, race/ethnicity, type of acute coronary syndrome, receipt of reperfusion therapy, length of index hospitalization, grace risk score, symptoms of depression and anxiety

Supplemental Table 4.3. Site specific association between religiosity and all-cause unscheduled 30-day readmissions among patients hospitalized for an acute coronary syndrome, TRACE-CORE, 2011-2013

Massachusetts (n=1,177)

Religiosity measures	Participants (n)	Risk of 30-day readmissions (%)	Unadjusted Model RR (95% CI)	Adjusted Model* RR (95% CI)
Strength and Comfort from Religion				
A great deal	439	14.3	1.00 (0.60-1.66)	1.03 (0.63-1.71)
A little/Some	472	9.1	0.73 (0.46-1.16)	0.75 (0.47-1.20)
None	266	11.3	Referent	Referent
Petition prayers for health				
Yes	580	13.8	1.46 (0.97-2.21)	1.21 (0.81 -1.83)
No	597	9.4	Referent	Referent
Intercessory prayers for health				
Yes	1,001	11.5	0.83 (0.52-1.33)	0.84 (0.53-1.32)
No	176	11.9	Referent	Referent

*Adjusted for age, sex, race/ethnicity, type of acute coronary syndrome, receipt of reperfusion therapy, length of index hospitalization, grace risk score, symptoms of depression and anxiety

Georgia (n=891)

Religiosity measures	Participants (n)	Risk of 30-day readmissions (%)	Unadjusted Model RR (95% CI)	Adjusted Model* RR (95% CI)
Strength and Comfort from Religion				
A great deal	645	10.8	2.15 (0.27-16.97)	2.07 (0.23-18.64)
A little/Some	210	7.6	2.62 (0.33-20.99)	1.57 (0.18-13.76)
None	36	2.8	Referent	Referent
Petition prayers for health				
Yes	679	11.2	1.90 (1.11-2.15)	1.72 (0.82 -3.61)
No	212	5.2	Referent	Referent
Intercessory prayers for health				
Yes	836	9.8	0.84 (0.35-1.98)	0.88 (0.34-2.23)
No	55	9.1	Referent	Referent

*Adjusted for age, sex, race, ethnicity, type of acute coronary syndrome, receipt of reperfusion therapy, length of index hospitalization, grace risk score, symptoms of depression and anxiety

Supplemental Table 4.4. Site specific association between religiosity and all-cause 2-year mortality among patients hospitalized for an acute coronary syndrome, TRACE-CORE, 2011-2013

Massachusetts (n=1,177)

Religiosity measures	Deaths (n)	Person-years	Unadjusted Model HR (95% CI)	Adjusted Model* HR (95% CI)
Strength and Comfort from Religion				
A great deal	25	782.3	1.69 (0.62-4.54)	1.03 (0.63-1.71)
A little/Some	20	828.3	0.42 (0.57-3.52)	0.75 (0.47-1.20)
None	7	443.1	Referent	Referent
Petition prayers for health				
Yes	32	1016.1	1.39 (0.70-2.75)	1.21 (0.81 -1.83)
No	20	1037.7	Referent	Referent
Intercessory prayers for health				
Yes	45	1748.5	0.84 (0.36-1.95)	0.84 (0.53-1.32)
No	7	305.2	Referent	Referent

*Adjusted for age, sex, race/ethnicity, type of acute coronary syndrome, receipt of reperfusion therapy, length of index hospitalization, grace risk score, symptoms of depression, and physical component of SF-36 Quality of Life measure

Georgia (n=891)

Religiosity measures	Deaths (n)	Person-years	Unadjusted Model HR (95% CI)	Adjusted Model* HR (95% CI)
Strength and Comfort from Religion				
A great deal	54	1032.7	2.15 (0.27-16.97)	2.07 (0.23-18.64)
A little/Some	14	332.1	2.62 (0.33-20.99)	1.57 (0.18-13.76)
None	3	51.8	Referent	Referent
Petition prayers for health				
Yes	60	1054.6	1.90 (1.11-2.15)	1.72 (0.82 -3.61)
No	11	361.9	Referent	Referent
Intercessory prayers for health				
Yes	63	1339.0	0.84 (0.35-1.98)	0.88 (0.34-2.23)
No	8	77.6	Referent	Referent

*Adjusted for age, sex, race, ethnicity, type of acute coronary syndrome, receipt of reperfusion therapy, length of index hospitalization, grace risk score, symptoms of depression, and physical component of SF-36 Quality of Life measure
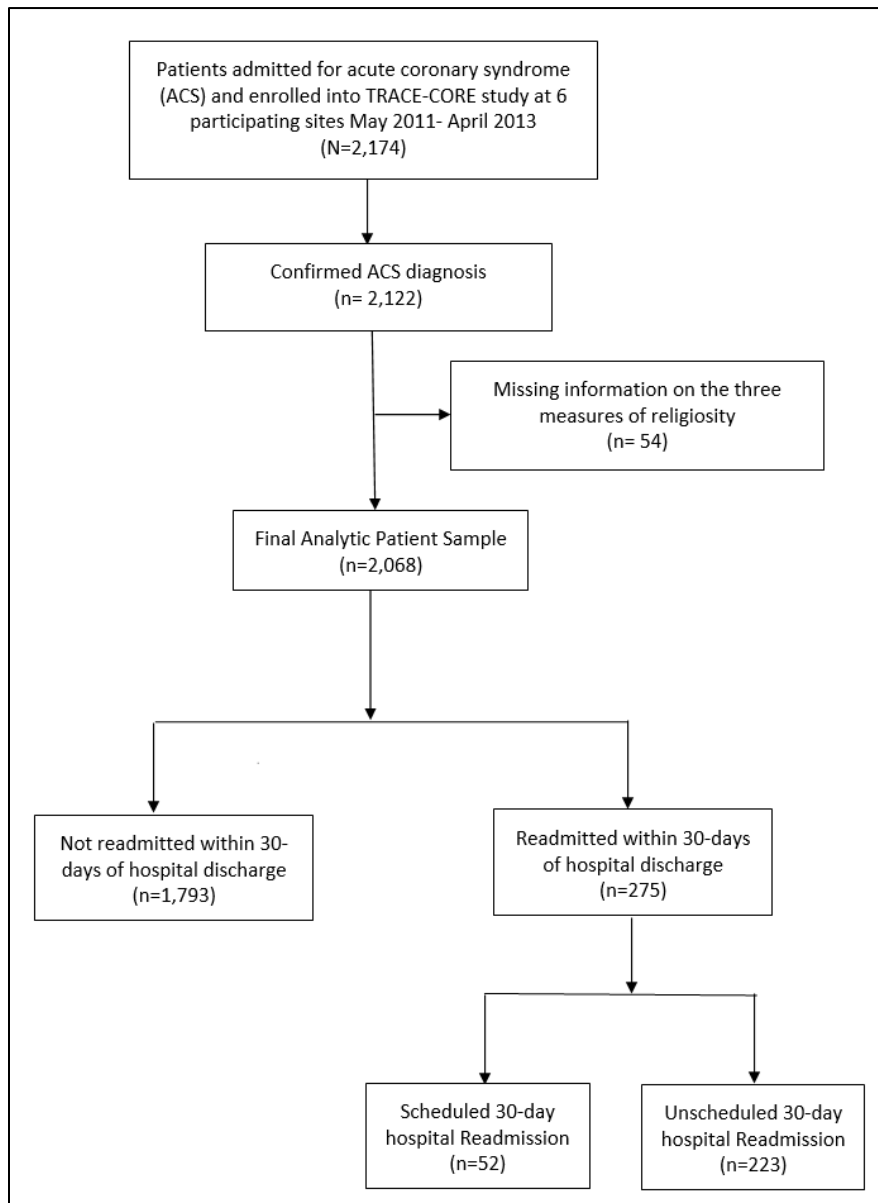
Figure 4.1. Study participant selection flowchart

Figure 4.2. Kaplan-Meier survival curves for patients who survive at least 2 years after hospital discharge for an acute coronary syndrome according to the three items assessing religiosity: (A) Petition prayer/No petition prayer for health; (B) Intercessory prayer/No intercessory prayer for health; (C) Strength and comfort from religion (None, Some/Little, Great Deal)
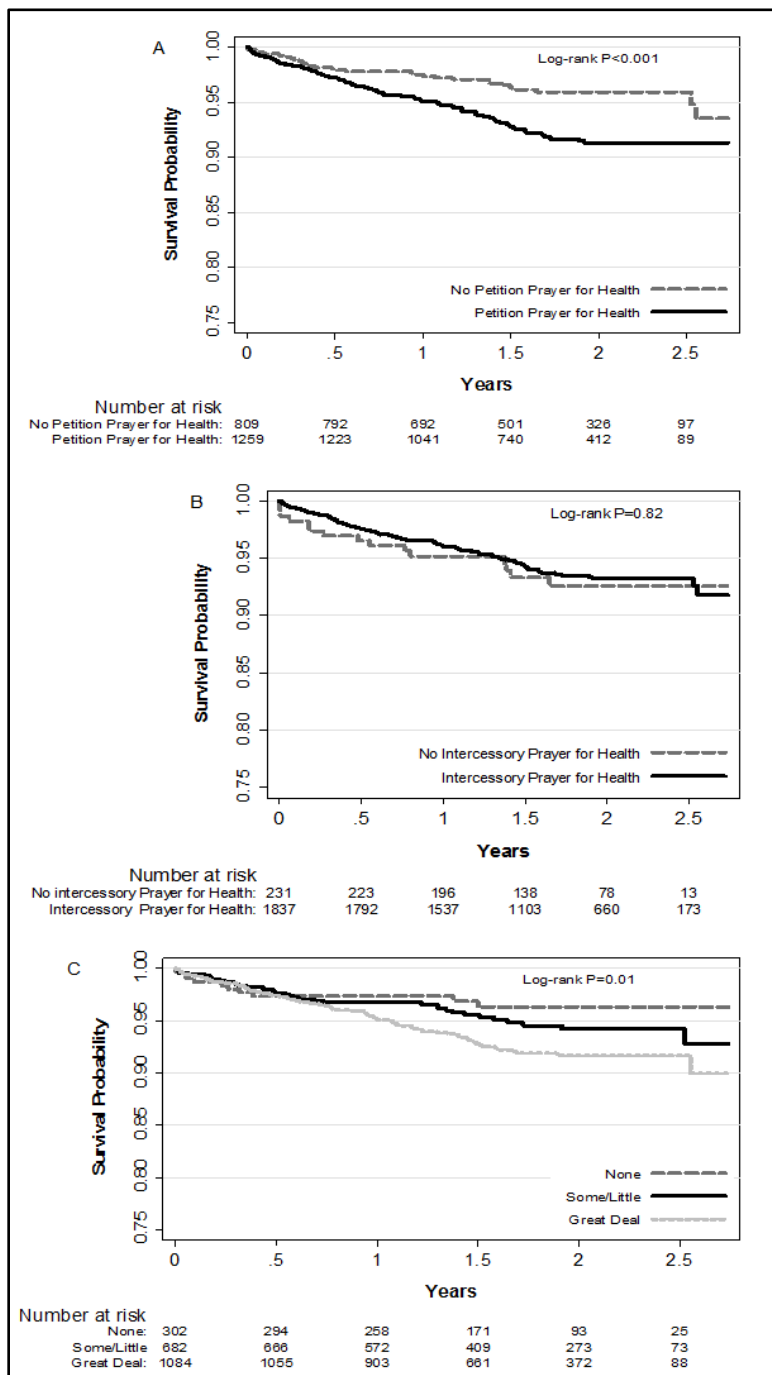
CHAPTER V: DISCUSSION AND CONCLUSIONS

Discussion

This dissertation examined religious beliefs and practices among patients hospitalized for an ACS, and its influence on patient activation, changes in HRQOL, unscheduled 30-day readmissions, and 2-year all-cause mortality. Using data obtained from a large sociodemographically diverse contemporary cohort of ACS survivors, we found that most study participants acknowledged making petition prayers for their health, were aware of intercessory prayers made for their health by others, and derived strength and comfort from religion.

In the first aim of this dissertation, we found that deriving strength and comfort from religion and awareness of intercessory prayers made for health were associated with high levels of patient activation, while petition prayers for health were associated with low levels of patient activation during hospitalization for ACS. In the second aim, we observed that petition and intercessory prayers for health were associated with clinically meaningful increases in generic physical and disease-specific HRQOL between 1 and 6 months after hospital discharge for an ACS. The final dissertation aim examined whether religiosity was associated with the risk of unscheduled 30-day readmissions and 2-year total mortality post-discharge for an ACS. We observed an initially higher risk of 30-day readmissions and 2-year all-cause mortality among those who prayed for their health than in those who did not pray for their health. After accounting for several sociodemographic, clinical, and psychosocial measures, we found no significant association between the three religiosity items and the risk of 30-day readmissions and 2-year mortality.

Religiosity and spirituality in healthcare

Recent inquiry into the role of religiosity and spirituality on health demonstrates that patients desire spiritual care to be integrated in their management [141, 142]. However, most of

the research to date has been conducted among patients diagnosed with cancer, HIV/AIDS, and among those undergoing palliative care [141-143]. A very limited number of investigations have examined the extent of religious involvement and its impact on health outcomes among patients with CVD, especially among those with an acute condition such as an ACS.

Overall, we found that most hospital survivors of an ACS engaged in religious practices for their health, a finding consistent with the reports from other studies [75, 112, 113]. In a nationally representative survey in the U.S that examined the prevalence and patterns of the use of prayers, 75% of those who prayed reported they made petitions for their well-being to prevent future illness and maintain health and vitality, yet only 1 in 10 of those who used prayer for their health concerns discussed using prayer with their physicians [144]. An important question, however, remains which this dissertation did not explore, whether healthcare professionals acknowledge patient's religious and spiritual practices to better understand the moral underpinnings that may influence care-seeking behaviors, adherence to prescribed treatment regimens, and health outcomes. In a multicenter patient survey in six academic medical centers across three states in the U.S, of the 456 study participants, 1 in 3 patients welcomed the discussion of their spiritual beliefs in a regular office visit and 70% desired to discuss about their religiosity/spirituality in making end of life decisions [145]. Existing guidelines on integrating spiritual care in patient management draw upon an interdisciplinary and collaborative effort from the healthcare team including physicians, nurses, and hospital chaplains [146, 147]. The role of physicians and nurses in spiritual care is to conduct screening for patients' spirituality which would include an initial history asking about the role of religiosity or spirituality in patient's illness experience and their spiritual concerns. Ongoing reassessments of patients' spiritual concerns are helpful in identifying patients who may need referral to hospital chaplains [148].

Challenges to integrating patient's religiosity or spirituality into their healthcare may arise from inadequate training of healthcare professionals, discomfort handling issues on religious/spiritual beliefs and practices, time constraints, fear of imposing one's religious views on their patients, or the belief that addressing spiritual issues is not the physician's responsibility [149]. Since the Joint Commission for Accreditation of Hospital Organization recommends that a spiritual history be taken on all patients admitted to hospitals, nursing homes, or home health care, adequate steps should be taken to overcome current concerns and perceived barriers by healthcare providers and ensure that healthcare professionals are sufficiently trained to handle the integration of spirituality or religiosity into their healthcare practices within professional boundaries. Furthermore, a helpful screening tool has been developed that can serve as a guide for physicians and healthcare professionals in assessing four main areas of patient's spirituality: i) sources of hope, meaning or comfort; ii) belonging to a religious community and its importance; iii) personal spiritual practices independent of religion and one's relationship with God; and iv) effect of spirituality/religiosity on medical care and end-of-life issues (handling spiritual conflicts, referral for chaplain intervention) [150].

Religiosity and patient engagement in their healthcare

Strategies for effective patient engagement in their healthcare are increasingly focused on more patient-centered approaches including shared decision-making [151]. For satisfactory patient engagement, physicians and other healthcare providers need to consider patients' cultural characteristics including their religious and spiritual beliefs and practices which may influence their medical decisions, conflicts and concerns about their treatment, and their adherence with prescribed treatments [69]. In support of this claim, we observed that study participants who derived strength and comfort from religion and those who were aware of being prayed for by

others had higher levels of patient activation than those who did not derive strength and comfort from religion or were unaware of being prayed for by others.

Our findings on the association between religiosity and patient activation shed light on an important construct which healthcare providers need to be aware of namely the "Spiritual Health Locus of Control" (SHLOC) construct. The SHLOC was developed and utilized in African American communities to examine how one's belief that a higher power has control over one's health would influence their health-related behaviors [32]. Two dimensions are described within the SHLOC: an active dimension where belief in a higher power empowers one to be proactive about their health and collaborate with a higher power to remain in good health, and a passive dimension where a person believes that a higher power controls one's well-being and health outcomes with no motivation to be engaged in healthy behaviors [32]. With increasing awareness of the potential influence of one's belief systems and values on the adoption of recommended treatments and lifestyle modification, physicians should develop mutual plans to overcome potential barriers that may hinder patient engagement in their healthcare and impact their health outcomes.

Religious involvement and important patient health outcomes

In a recent systematic review that evaluated the influence of religious/spiritual practices on various health outcomes, the authors concluded that the influence of prayer on cardiovascular related morbidity and mortality was inconsistent [152].

This dissertation extends current research on religiosity and health outcomes in patients with CVD finding that petition and intercessory prayers for health were associated with clinically meaningful increases in generic physical and disease-specific HRQOL between 1 and 6 months after hospital discharge for an ACS. Our results have important implications for healthcare

providers. In managing patients who have experienced a life-threatening illness such as an ACS, physicians should discuss with patients' about utilizing their support system, including their religious beliefs and practices, to better cope with their illness and improve their well-being. This also provides an opportunity for physicians to identify patients who may be experiencing negative spiritual coping or religious struggle and refer for hospital chaplaincy intervention.

In examining the association between religious involvement and 30-day readmissions and 2-year total mortality, contrary to our hypothesis, we observed a higher risk of readmissions and all-cause mortality among those who prayed for their health than in those who did not pray for their health. However, after accounting for several potentially confounding variables the observed associations were attenuated and non-statistically significant. Our findings buttress the need for more extensive inquiry on how patients adopt and utilize religious beliefs and practices during an acute illness and identifying those with negative religious coping which could interfere with their recovery. Furthermore, patients' experience of heightened levels of fear, worry, and distress after a life-threatening illness could hinder the effective use of prayers for their healing. Also, we recognize that patients may have over reported praying for their health especially around the period of an acute illness when we obtained our measures of religiosity, with the likelihood of misclassification bias. Although we observed no significant association between our measures of religiosity and the risk of unscheduled 30-day readmissions and 2-year all-cause mortality, this dissertation adds to the limited research that have examined the role of religiosity on readmissions and survival among patients discharged from the hospital after an ACS.

Beyond the explanations provided in this dissertation on how religiosity may impact health outcomes we acknowledge that religious or spiritual persons may attribute the outcomes of their prayers, beliefs, or practices to supernatural or divine intervention [123].

Future Directions

Based on our findings of an association between religiosity and patient activation during hospitalization for an ACS, we recommend future longitudinal studies to better understand how religiosity may influence changes in patient activation over time, adherence with recommendations from healthcare providers, and long-term health outcomes among ACS survivors. In addition, in-depth qualitative interviews can be used to explore the role of religious beliefs and practices in coping with a life-threatening illness and how this may influence health behaviors and overall well-being in the months following hospital discharge for an ACS.

This dissertation did not examine potential mechanisms by which religiosity impacts changes in HRQOL. More research using analytic methods such as mediation analysis can be used to improve our understanding of the causal pathways by which religious beliefs and practices influence changes in HRQOL after an ACS. Although our measures of religiosity captured to a large extent how survivors of a potentially life-threatening disease incorporate religious beliefs and practices in their illness experience, other validated instruments that assess both religiosity and spirituality such as the DUREL scale [153] may provide better insights to the association between spirituality and health outcomes among patients hospitalized for an ACS.

Furthermore, additional data are needed to ascertain how participation in organized religious activities such as service worship attendance, membership in religious groups, or religious doctrines and regulations pertaining to health behaviors may influence patients' physical and mental well-being and survival outcomes after a potentially life-threatening illness. In addition, we suggest that organized religious groups increase their participation in health-related activities such as prevention and screening programs aimed at improving the well-being of their members. We also recommend obtaining measures of patient religiosity and spirituality

at more than one time point to reduce the likelihood of time-varying confounding and account

for changes in religiosity/spirituality after an illness.

Conclusions

This dissertation has examined how patients hospitalized for an ACS may utilize their religious beliefs and practices to cope with their illness and how religious involvement may influence patient engagement in their healthcare, changes in their health status over time, and long-term outcomes including survival. Our contemporary study is timely given the recent scientific statement by the American Heart Association (AHA) that meditation practices, including prayer, may be beneficial in reducing the risk of cardiovascular disease and considered as an adjunct to guideline directed cardiovascular risk reduction [125]. In accordance with developed guidelines, healthcare providers may acknowledge patients' religious beliefs and practices to ensure patient centered care and a holistic approach in patient management to promote body, mind, and spiritual well-being.

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