

Religion, spirituality and cardiovascular disease: research, clinical implications, and opportunities in Brazil

Religião, espiritualidade e doença cardiovascular: pesquisa, implicações clínicas e oportunidades no Brasil

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Abstract

In this paper we comprehensively review published quantitative research on the relationship between religion, spirituality (R/S), and cardiovascular (CV) disease, discuss mechanisms that help explain the associations reported, examine the clinical implications of those findings, and explore future research needed in Brazil on this topic. First, we define the terms religion, spirituality, and secular humanism. Next, we review research examining the relationships between R/S and CV risk factors (smoking, alcohol/drug use, physical inactivity, poor diet, cholesterol, obesity, diabetes, blood pressure, and psychosocial stress). We then review research on R/S, cardiovascular functions (CV reactivity, heart rate variability, etc.), and inflammatory markers (IL-6, IFN- γ , CRP, fibrinogen, IL-4, IL-10). Next we examine research on R/S and coronary artery disease, hypertension, stroke, dementia, cardiac surgery outcomes, and mortality (CV mortality in particular). We then discuss mechanisms that help explain these relationships (focusing on psychological,

social, and behavioral pathways) and present a theoretical causal model based on a Western religious perspective. Next we discuss the clinical applications of the research, and make practical suggestions on how cardiologists and cardiac surgeons can sensitively and sensibly address spiritual issues in clinical practice. Finally, we explore opportunities for future research. No research on R/S and cardiovascular disease has yet been published from Brazil, despite the tremendous interest and involvement of the population in R/S, making this an area of almost unlimited possibilities for researchers in Brazil.

Descriptors: Religion. Spirituality. Cardiovascular diseases. Cardiac surgical procedures. Research. Mortality.

Descritores: Religião. Espiritualidade. Doenças cardiovasculares. Procedimentos cirúrgicos cardíacos. Pesquisa. Mortalidade.

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Abbreviations, acronyms & symbols	
ABI	Ankle brachial index
BAR	Arterial baroreflex sensitivity
BP	Blood pressure
CABG	Coronary artery bypass graft
CAC	Coronary artery calcium
CAD	Coronary artery disease
CC-IMT	Common carotid intima-media thickness
CD	Cerebrovascular disease
CHF	Congestive heart failure
CRP	C-reactive protein
CVD	Cardiovascular disease
HRV	Heart rate variability
LOS	Length of stay
LVM	Left ventricular mass
MI	Myocardial infarction
MM	Mindfulness meditation
PTSD	Post-traumatic stress disorder
R/S	Religion and spirituality
SES	Socioeconomic status
TIA	Transient ischemic attack

INTRODUCTION

A growing research database documents a link between religion, spirituality and cardiovascular disease (CVD). Given that Brazil is a highly religious country (87% of the population says that religion is important [1]), cardiologists and cardiac surgeons need to know about this research and the clinical applications that might follow. In this paper, we explore (1) definitions of the terms religion and spirituality (R/S) for conducting research and carrying out applications at the bedside; (2) relationships between R/S and CVD risk factors; (3) R/S, cardiovascular functions, and inflammatory markers (cardiovascular reactivity, C-reactive protein, fibrinogen, etc.); (4) R/S and coronary artery disease; (5) R/S and hypertension; (6) R/S and cerebrovascular disease; (7) R/S and cardiac surgery outcomes; (8) R/S and cardiovascular mortality; (9) mechanisms by which R/S might influence cardiovascular outcomes; (10) some clinical implications of this research; and (11) future research in this area that Brazilian researchers are ideally positioned to take the lead on.

1. DEFINITIONS

The area of definitions is one of the most controversial areas in R/S and health research. Terms that need defining are religion, spirituality, secular humanism, and religious coping. Many researchers and clinicians have erred by combining all of these terms under "spirituality." We

will argue that the choice of which term to use may be quite different when conducting research (understanding relationships between R/S and CVD and how R/S impact CVD outcomes) compared to when discussing these issues at the bedside in clinical settings.

We define religion as "...beliefs, practices, and rituals related to the transcendent, where the transcendent is God, Allah, HaShem, or a Higher Power in Western religious traditions, or Brahman, manifestations of Brahman, Buddha, Dao, or ultimate truth/reality in Eastern traditions. This often involves the mystical or supernatural. Religions usually have specific beliefs about life after death and rules about conduct within a social group. Religion is a multi-dimensional construct that includes beliefs, behaviors, rituals, and ceremonies that may be held or practiced in private or public settings, but are in some way derived from established traditions that developed over time within a community. Religion is also an organized system of beliefs, practices, and symbols designed (a) to facilitate closeness to the transcendent, and (b) to foster an understanding of one's relationship and responsibility to others when living together in a community [2]"

In contrast to religion is secular humanism, which we define as follows: "The secular or secular humanist has no belief in, connection with, or desire to connect to the transcendent, the sacred, God, or the supernatural. The secular involves beliefs, behaviors, and social relationships that have value and importance on their own intrinsic merit that is not connected with anything outside of the human experience or nature. The attitude is, 'this is all we have so let's make the best of it together.' That which is real can be observed and verified, and anything that cannot be observed and verified does not exist and does not matter. The world is viewed in a rational, logical, scientific manner. Human relationships, moral values, and ethical standards are very important, and forgiveness, altruism, and gratefulness are often emphasized and practiced, all without any transcendent reference. Atheists, agnostics, and secular humanists would fall into this category. If there is any seeking or searching, then it is for purely secular objects or goals. Most would not refer to themselves as religious, and probably not as spiritual either [3]"

Finally, there is the term spirituality. This is the term over which there is the most disagreement and lack of consensus. Spirituality is a popular expression today preferred over religion. Spirituality is considered personal, something individuals define for themselves. It is often free of rules, regulations, and responsibilities associated with religion. One can be spiritual, but not religious. In fact, a "secular spirituality" is often emphasized today in circles where religion is in disfavor. Thus, spirituality is seen as non-divisive and common to all, both religious and secular. This is an excellent term to use when discussing these

issues with patients (who can define for themselves what the term means). However, trying to measure spirituality has created a real problem for quantitative researchers, who must work with terms that are clear, agreed upon, distinct and non-overlapping. The goals of quantitative research are to measure and quantify a construct and then relate that construct to similarly quantified health outcomes. The ultimate aim is to compare those with the construct (or who have more of the construct) to those without the construct (or who have less of the construct), and if there is a relationship, then develop an intervention that takes advantage of that connection to improve health outcomes. This is not possible with a construct like spirituality, especially when defined in such a nebulous, diffuse manner.

The definition of spirituality that we use in this paper is similar to religion, since religion is a distinct construct that can be measured and quantified and examined in relationship to health outcomes. We define spirituality, then, by saying that it "...is distinguished from all other things – humanism, values, morals, and mental health – by its connection to that which is sacred, the transcendent. The transcendent is that which is outside of the self, and yet also within the self – and in Western traditions is called God, Allah, HaShem, or a Higher Power, and in Eastern traditions may be called Brahman, manifestations of Brahman, Buddha, Dao, or ultimate truth/reality. Spirituality is intimately connected to the supernatural, the mystical, and to organized religion, although also extends beyond organized religion (and begins before it). Spirituality includes both a search for the transcendent and the discovery of the transcendent, and so involves traveling along the path that leads from non-consideration to questioning to either staunch non-belief or belief, and if belief, then ultimately to devotion and finally, surrender." [4]. As can be seen, our definition of spirituality is very similar to our definition of religion.

In the studies we will cite in this article, spirituality has been assessed either using (1) measures of religious belief and practice, (2) measures of positive psychological states (i.e., meaning and purpose, deep inner peace, harmony, well-being, social connections), or (3) measures of positive character traits (i.e., being forgiving or altruistic, having high moral standards). Unfortunately, assessing spirituality using positive psychological states or positive character traits creates a situation where the predictor (spirituality) is contaminated by the outcome (mental health), which results in tautological relationships between spirituality and mental health outcomes (and probably physical health outcomes as well, given the mind-body relationship). The result of such research is meaningless, un-interpretable findings. Thus, only when spirituality is measured using measures of religious involvement (a construct that is

distinctive and non-overlapping with mental health) does it provide meaningful results. For a thorough discussion of the issue of measurement overlap and contamination, which is beyond the scope of the present article, see the following cited resources [5-8]. In reviewing the research below, then, we use spirituality and religion synonymously (i.e., R/S). Furthermore, we have distinguished studies that assess spirituality using contaminated measures by assigning quality scores to each of the studies. In the original review of this research, we usually assigned quality scores of 7 or higher (on a 1 to 10 scale) only to studies that measured spirituality or religion using religious variables that were distinct from mental health outcomes and thus avoided measurement tautology [9].

Religious coping is another term that deserves definition, given its importance as a mechanism by which R/S could affect CVD risk (see section "Understanding Mechanisms" below). By religious coping we mean, "the use of religious beliefs or practices as a way of adapting to the physical, psychological, and social challenges caused by medical illness. For example, in Western religious traditions, religious coping may involve praying to God for strength and comfort, wisdom and direction, health or healing, or help for loved ones. It may involve reading inspirational materials, such as the Holy Scriptures (Torah, Christian Bible, or Holy Qur'an) or reading popular books or magazines on religious topics. R/S coping may involve getting together with members of one's faith tradition for worship services, singing hymns, prayer, or scripture study. It also may involve the practice of religious rituals related to health and healing, such as lighting candles or participating in sacraments, such as the Eucharist or Confession, or the practice of immersion in a Mikveh or wearing of Tefillin. R/S coping may involve asking others to pray for oneself, praying for others, seeking religious counseling, providing religious support to others, or participating in religious rituals focused on healing." [10].

In discussing the research, we will rely heavily on our systematic review of the literature conducted in 2010 that searched the major online databases (PsycINFO, MEDLINE, etc.) using the terms "religion," "religiosity," "religiousness," and "spirituality" to identify original quantitative data-based research on R/S and health. The online database search was supplemented by asking researchers in the field of R/S and health for any published reports of research that they had conducted on this topic. Furthermore, studies that were cited in the reference lists of the reports identified in this manner were tracked down and included in the review. In this way, the systematic review identified over 3,200 studies that reported data on the relationship between R/S and health. Nearly two-thirds of this research was published between the year 2000 and mid-2010 (e.g., more research on this topic was published

during that 10-year period than in the previous 128 years). Each of these studies, particularly those summarized below on R/S and CVD, is described in the appendices of the two editions of the Handbook of Religion and Health [11,12]. For both positive and negative findings summarized below, we provide the original citations for a sample of the studies included in the review. However, given the very large number of studies, we cite only a few of the higher quality ones that examine relationships between R/S and cardiovascular risk factors (section 2). In contrast, we try to cite all studies that examine relationships between R/S and specific CVD functions or outcomes (sections 3-8). We also cite more recent research that either confirms or contradicts earlier reports identified in the systematic review.

2. CARDIOVASCULAR RISK FACTORS

Standard modifiable risk factors for CVD are cigarette smoking, excess alcohol, physical inactivity, poor diet/nutrition, high blood cholesterol, obesity, diabetes mellitus, high blood pressure, and psychosocial stress (including depression, anxiety, and personality traits such as hostility) [13]. Each of these risk factors is related in one way or another to R/S.

2a. Cigarette smoking. The risk factor most strongly related to both CVD and R/S is tobacco use, a habit that contributes to 30% of all coronary heart disease deaths each year in the U.S. [14]. The problem is of similar or greater magnitude in Brazil, where 18% of adults smoke and this contributes to 45% of all deaths from coronary heart disease [15]. We uncovered 137 studies that had examined the relationship between R/S and smoking, and of those, 123 (90%) reported inverse relationships. No studies found positive relationships. When examining the 83 methodologically most rigorous studies (ratings of 7 or higher on a 1 to 10 quality scale), 75 of those (again 90%) reported inverse relationships with R/S involvement [16-18]. If those who are more R/S smoke less, then this should influence their risk for developing CVD.

2b. Alcohol and drug use. Heavy alcohol use is known to affect cardiac function (alcoholic cardiomyopathy, arrhythmias), blood pressure, and increase risk of stroke [19]. A similar relationship has been found with chronic use of illicit drugs [20]. At least 278 studies have now examined relationships between alcohol use, abuse, or dependence and R/S. The vast majority of those (86%, i.e., 240 studies) found inverse relationships with R/S involvement. Only four of 278 (1%) studies reported positive relationships. The higher quality studies are even more likely to report this finding. Of the 145 studies that were rated 7 or higher in quality, 90% (i.e., 131 studies) found inverse relationships [21-23]; only one study reported a positive

relationship [24]. The results from studies examining R/S and drug use parallel those on R/S and alcohol. Among 185 studies on the relationship between R/S and drug use, 84% (155 studies) found inverse relationships. Only two studies of the 185 found significant relationships with greater drug use. Of the 112 better designed studies (rated 7 or higher in quality), 96 (86%) reported this finding [25-27], whereas only one study found a positive relationship [28]. Most of these studies were conducted in younger adults, typically high school or college students, a time when alcohol and drug use habits are just beginning to develop and will affect their cardiovascular systems for the remainder of their lives.

2c. Physical inactivity. A sedentary lifestyle is known to increase the risk of CVD, and regular exercise is known to decrease that risk [29,30]. Research shows that those who are more R/S are more likely to be physically active or more likely to exercise. Of 37 studies that have examined the association between R/S and physical activity, 25 (68%) found greater exercise or physical activity among those who were more R/S. Of the 21 methodologically most rigorous studies, over three-quarters (76% or 16 studies) reported positive relationships [32,33] whereas only two (10%) found negative relationships [34,35].

2d. Poor diet/nutrition. Numerous studies have linked diets high in saturated fat, low in omega-3 fatty acids, and low in fruits, vegetables, nuts, and whole grains to increased CVD morbidity and mortality [36-38]. By healthy we mean a high intake of fiber, green vegetables, fruit, fish, and a low intake of processed foods and fat. Regular vitamin intake, eating breakfast, and overall better nutrition are also part of a healthy diet. Again, many studies show that persons who are more R/S consume a healthier diet. Our systematic review uncovered 21 studies that examined this relationship. Nearly two-thirds (62% or 13 studies) found a positive link between R/S and a healthier diet, and only one study reported a worse diet [39]. Of the 10 highest quality studies, seven (70%) reported an association between greater R/S and a healthier diet [40-42]; no high quality study reported a worse diet among those who were more R/S.

2e. High cholesterol. A healthier diet might also be expected to affect the level of cholesterol in the blood. Serum cholesterol is strongly linked with all types of CVD. For example, a 10% decrease in LDL is associated with a 10% reduction in risk of myocardial infarction [43]. In our systematic review, we identified 23 studies that had examined associations between R/S and serum cholesterol. The majority (12 of 23) reported significantly lower cholesterol among those who were more R/S. Similarly, of the nine highest quality studies, five (56%) found either lower cholesterol in those who were more R/S [44,45] or reported that a R/S intervention lowered cholesterol [46-

48]; one study reported higher cholesterol, but only in a subgroup of the sample (Mexican-American men) [49].

2f. Obesity. Many studies show that those who are overweight have an increased risk of CVD [50]. The one characteristic of R/S persons that increases their risk of CVD is heavier weight. We located 36 studies examining associations between weight and R/S involvement, of which 14 (39%) found that R/S was associated with greater weight or higher body mass index. In contrast, only seven studies (19%) found that R/S was associated with lower weight. The findings from more rigorously designed studies support this conclusion. Of the 25 best studies, 11 (44%) reported greater weight [51,52] and five (20%) found lower weight (or less underweight) [53,54] among those who were more R/S.

2g. Diabetes. Two-thirds of diabetics die of CVD, and the risk of coronary artery disease alone is up to four times higher in those with diabetes [55]. Despite their heavier weight, those who are more R/S do not have a greater risk of being diabetic. At least 14 studies conducted between 2000 and 2010 examined this relationship. Of those, five (36%) found less diabetes, lower blood sugar, a lower HgbA1C [56,57], or improvement in response to a R/S intervention [58-60], four (29%) reported more diabetes [61] or higher indicators of diabetes [62-64], and the remaining studies reported mixed findings [65] or no association. Thus, overall, the research finds no consistent relationship between R/S and diabetes. Perhaps a better diet, or perhaps better compliance with treatment, makes up for the heavier weight of those who are more R/S (neutralizing the risk of diabetes that heavier weight confers).

2h. Blood pressure. The majority of studies find that R/S involvement is related to lower blood pressure. See section 5 on hypertension.

2i. Psychosocial stress. High emotional stress, loneliness, and social isolation are associated with atrial and ventricular arrhythmias [66], left ventricular dysfunction, myocardial ischemia [67], recurrent myocardial infarction [68], and increased risk of cardiac death [69], as well as other cardiac abnormalities. Likewise, personality traits such as cynical hostility [70], and emotional states such as depression [71] and anxiety [72], are linked to increased risk of CVD and worse prognosis. Lower risk, however, has been found for optimism, [73] agreeableness, 74 and other positive emotions [75].

Our systematic review identified 75 studies that examined relationships between R/S and stress level. Of those, 46 (61%) reported lower levels of psychological stress in those who were more R/S and 12% reported higher levels of stress. We also identified 74 studies examining R/S and social support, of which 61 (82%) found significant positive relationships and none found negative relationships; of the 29 best studies, 27 (93%)

reported significantly greater social support among those who were more R/S [76-78]. We also identified 27 studies examining R/S and hostility, of which 18 (67%) reported inverse relationships [79-81]. Our review uncovered many studies examining connections between R/S, depression, and anxiety. Of 444 studies assessing relationships between R/S and depression, 272 (61%) reported lower depression among the more R/S, including 119 (67%) of the 178 highest quality studies [82-84]. Of 299 studies examining relationships with anxiety, 147 (49%) reported inverse associations with R/S, and of the 67 highest quality studies, 38 (55%) did so [85-87]. With regard to optimism, at least 32 studies examined relationships with R/S, and of those, 26 (81%) reported significant positive associations [88-90], and none found the opposite. Concerning the personality trait "agreeableness," 30 studies have examined associations with R/S, and of those, 26 (87%) found that R/S was related to greater agreeableness [91-93]. Finally, with regard to well-being and happiness, we identified 326 quantitative studies examining associations with R/S, and of those, 256 (79%) found positive relationships; of the 120 highest quality studies, 98 (82%) reported that those who were more R/S experienced higher well-being, happiness, or life satisfaction [94-96] and only one study found lower well-being [97].

Thus, in the vast majority of studies, greater R/S is related to fewer negative emotions that predict an increased risk of CVD disease and to more positive emotions that predict a reduced risk of CVD. Likewise, other than being heavier in terms of weight and neutral in terms of diabetes, those who are more R/S are less likely to smoke cigarettes, use or abuse alcohol/drugs, be physically inactive, consume a poor diet, have high cholesterol, and have high blood pressure, each of which is related to a greater risk of CVD morbidity and mortality.

3. CARDIOVASCULAR FUNCTIONS AND INFLAMMATORY MARKERS

Given the relationship between R/S and the CVD risk factors above, we would predict that those who are more R/S might also have better cardiovascular functions when tested in the laboratory (i.e., lower cardiovascular reactivity, brachial artery vasoreactivity, peripheral resistance) and lower levels of inflammatory markers (pro-inflammatory cytokines, C-reactive protein, fibrinogen).

3a. Cardiovascular reactivity. Regarding cardiovascular reactivity (a known risk factor for CVD[98]), at least eight studies have examined relationships with R/S, and of those, four (50%) found inverse relationships [99-101] or a reduction in cardiovascular reactivity with a R/S intervention [102]. One study reported a positive relationship (in a situation of unresolved justice) [103],

two studies reported mixed findings (significant positive or significant negative relationships, depending on R/S characteristic) [104,105], and one study found that transcendental meditation had no effect on brachial artery vasoreactivity [106].

3b. Heart rate variability and other cardiovascular functions. Reduced heart rate variability (HRV) is a known risk factor for CVD [107]. At least four studies have examined relationship between R/S and HRV or assessed the effects of a R/S intervention on HRV. Three of these studies reported positive findings (one showing a positive relationship between R/S and HRV [108] and two finding that Eastern forms of meditation increased HRV [109,110]), whereas one study found that transcendental meditation had no effect [111]. Two additional studies have assessed other cardiac functions. One study examined the effects of saying the Ave Maria (rosary prayer) in Latin or a Tibetan Buddhist mantra (in the original language) on arterial baroreflex sensitivity (BAR) [112]. A reduction in BAR is known to predict future coronary artery disease and heart failure. Results indicated an increase in BAR with both forms of meditation. The second study examined relationships between R/S, coronary artery calcium, and left ventricular mass, finding no relationship [113].

3c. Inflammation. High levels of inflammatory markers in the blood are known to increase the risk of CVD [114-117]. The relationship between R/S and inflammatory markers is a complex one, since the mechanism by which R/S affects inflammatory markers is indirect acting through psychological, social, and behavioral pathways. Furthermore, psychological states (and certain mental disorders) may influence inflammatory marker levels in opposite directions; for example, depression is associated with high levels of the pro-inflammatory marker IFN- γ [118], whereas PTSD and acute stress have been associated with low levels of IFN- γ [119]. As a result, treatments for these mental disorders may either decrease or increase IFN- γ in order to normalize levels. With these complexities mind, we review studies that have examined relationships between R/S and inflammatory markers or have assessed the effects of a R/S intervention on pro-inflammatory cytokines such as interleukin-6 (IL-6) or interferon gamma (IFN- γ), other pro-inflammatory markers such as C-reactive protein (CRP) and fibrinogen, and the anti-inflammatory cytokines interleukin-4 (IL-4) and interleukin-10 (IL-10).

3c.1. Interleukin-6. At least nine studies have examined relationships between R/S and blood levels of IL-6. Of those, five (56%) reported significant inverse relationships [120,121] or a reduction in IL-6 in response to a R/S intervention [122-124]. In contrast, IL-6 levels appear to be increased in cardiac surgery patients undergoing existential stress related to religious struggles [125] or

may be increased in response to a spiritual intervention [126].

3c.2. Interferon gamma. As noted above, IFN- γ is increased in major depression [127] and decreases in response to treatment [128]. However, IFN- γ is suppressed by cortisol [129], decreases in response to acute psychological stress [130], and may actually increase in response to treatment in those with low INF- γ levels [131,132]. Three studies have examined the effects of R/S interventions on INF- γ levels in blood. All three found that the R/S intervention significantly increased INF- γ levels [133-135].

3c.3. C-reactive protein. There is strong evidence that pro-inflammatory CRP plays a role in the development of atherosclerosis and coronary heart disease [136]. Eight studies have now examined relationships with R/S. Of those, four (50%) reported significant inverse relationships [137-139] or a reduction in CRP in response to a R/S intervention [140]; the other four studies found no association. More recent research supports an inverse relationship between R/S and CRP [141].

3c.4. Fibrinogen. Only one study, to our knowledge, has examined relationships between serum fibrinogen (a key factor in the development of CVD [142]) and R/S. That study examined the relationship between frequency of religious attendance (as part of a two-item social index) and fibrinogen levels, finding a significant inverse relationship after controlling for multiple covariates [143].

3c.5. Anti-inflammatory cytokines. Anti-inflammatory cytokines such as IL-4 and IL-10 have the opposite effect of pro-inflammatory cytokines on the development of atherosclerotic plaque [144]. At least two studies have now examined the relationship between R/S and anti-inflammatory cytokines. In our systematic review, we identified one study that examined the effects of Buddhist-based mindfulness meditation (MM) on IL-4 and IL-10 levels in 66 women recently diagnosed with breast cancer [145]. Those receiving MM experienced a significant reduction in IL-4 and IL-10 levels compared to controls (approximating that of women without breast cancer) during the 8-week follow-up. Note, however, that anti-inflammatory cytokines may be increased in situations of acute stress [146]. A more recent study examined cytokine levels in 33 very elderly persons with cardiovascular disease (mean age 87) who participated in weekly 30-minute sermons by chaplains over 20 months [147]. Plasma IL-10 and IL-6 levels were compared to 26 age-matched controls (mean age 85) without the intervention. Results indicated that the IL-10/IL-6 ratio was significantly higher in those listening to the sermons compared to controls (3.96 vs. 1.79, $P < 0.05$).

In summary, the majority of studies find that cardiovascular reactivity and other cardiovascular

responses are healthier (lower risk in terms of CVD) in those who are more R/S or receiving R/S interventions. Likewise, except in situations of acute psychological stress, the majority of studies find that R/S or R/S interventions are associated with lower levels of inflammatory markers known to be involved in CVD pathogenesis.

4. CORONARY ARTERY DISEASE

We have been focusing on R/S and risk factors for CVD. We now shift to examine research that has directly measured relationships between R/S and specific cardiovascular disorders, beginning first with coronary artery disease (CAD).

One of the first studies demonstrating an association between R/S and CAD was published in 1986. Friedlander et al. compared the religious orthodoxy of 539 patients in Israel experiencing their first myocardial infarction (MI) with a matched control group of 686 patients without heart disease [148]. Among those with MI, 51% of men and 50% of women described themselves as secular (vs. religious) compared with 21% of men and 16% of women controls. Controlling for age, ethnicity, education, smoking, physical exercise, and body mass index, researchers found that secular men were over four times more likely to have MI compared to religious men (OR=4.2, 95% CI 2.6-6.6) and secular women were over seven times more likely than religious women (OR=7.3, 95% CI 2.3-23.0).

Even before that report, Comstock et al. had published a study in 1971 that found significantly fewer deaths from atherosclerotic cardiovascular disease in those attending religious services weekly or more compared to those attending less than weekly [149]. During this 3-year follow-up of 378 white males ages 45-64 in Washington county, Maryland (USA), there were 189 deaths due to atherosclerotic or degenerative heart disease. Those who died were matched by age, race, and sex with men who did not die from heart disease. The risk of dying from atherosclerotic heart disease was over twice as great in men attending church less than once per week, compared to those attending services once weekly or more (RR 2.02, $P<0.01$). Even after controlling for smoking, SES, hard water, and other risk factors, the increased risk for less frequent attendees remained significantly higher.

In a 23-year follow-up of 10,000 middle-aged men employed in civic or municipal occupations in Israel (the Israel Ischemic Study), investigators examined the relationship between religious orthodoxy and death rate from myocardial infarction. Religious orthodoxy was measured using a three-item scale: having a religious vs. secular education, self-identified as orthodox, traditional, or secular, and frequency of synagogue attendance. The most religious group (those scoring in the top one-fifth

on this measure of religious orthodoxy) experienced a significantly lower mortality rate from CAD over the 23-year follow-up compared to the least religious group (those scoring in the bottom one-fifth on the religious measure). There were 38 deaths from CAD in the most religious group during follow-up, compared to 61 deaths in the least religious group. There were 135 deaths from other causes in the most religious group, compared to 168 deaths in the least religious group. Overall, the risk of dying from CAD in the most religious group was 20% lower than in the least religious group. Controlling for age, systolic blood pressure, cholesterol, smoking, diabetes, body mass index, and baseline CAD could not explain these results.

Overall, then, our systematic review identified 19 studies that examined associations between R/S and CAD. Of those, 12 (63%) reported a significant inverse relationship. Of the 13 most rigorously designed studies, nine (69%) reported inverse relationships [150-158] and one found a positive relationship [159]. The latter study was an 8-year follow-up of 92,395 women ages 50-79 participating in the U.S. Women's Health Initiative Observational Study. R/S was measured with three questions: religious affiliation, attendance at religious services, and strength/comfort derived from religion. Only the uncontrolled analysis was reported. Women who indicated a religious affiliation at baseline (93% of the sample) were more likely than those with no religious affiliation to experience a coronary event during follow-up (2.7% vs. 1.9%, $P<0.0001$). Those attending religious services weekly or more (44% of the sample) were also more likely than those attending less than weekly to experience a coronary event (2.7%, vs. 2.5%, $P=0.03$). Finally, those who received "a great deal" of strength/comfort from religion were more likely than those receiving no strength/comfort from religion to have a coronary event during follow-up (2.8% vs. 2.0%, $P<0.0001$). Note that these findings, unlike other studies, did not control for race or age. Older women and women from minority groups (African-American or Hispanic) tend to be much more religious (and at greater risk for CVD) than young or white women. Therefore, controlling for these factors may have explained the association.

5. HYPERTENSION

Given the relationship between blood pressure (BP) and psychological stress [160] and the influence that R/S has in helping people to cope with stress, we expect R/S and BP to be related.

The systematic review identified 63 studies that measured degree of religious involvement and BP or diagnosis of hypertension. Of those, 36 (57%) reported lower BP or less hypertension in those who were more R/S, whereas seven (11%) reported higher BP. When

examining the higher quality studies (those rated 7 or higher on a 1-10 scale), 24 (62%) reported lower BP or less hypertension among those who were more R/S [161-173] or in response to a R/S intervention [174-184] (including two reports from a single study, one reporting results for the overall sample and one for the sample stratified by race). In contrast, seven studies reported higher blood pressure among the more religious, including two lower quality studies [185,186] and five high-quality studies (13%) [187-191]. Why would R/S be associated with higher blood pressure? Perhaps in some populations, greater religious involvement might be associated with higher stress, anxiety or guilt, which in turn might increase BP. There is another explanation, however. Note that three of the five studies linking R/S to higher BP included a large proportion of African-Americans (36% to 100% of the sample). Research shows that nearly 40% of African-Americans have high blood pressure [192]. Research also shows that African-Americans are very religious (much more religious than white Americans). Efforts to statistically control for such a powerful confound, then, may not always be successful.

Thus, the majority of studies find that R/S is related to lower BP and less hypertension. A smaller number of studies including high quality ones, however, find that R/S is related to higher BP, which needs to be better understood.

6. CEREBROVASCULAR DISEASE

Much less attention has been paid to the relationship between R/S and cerebrovascular disease (CD). We know that CAD and hypertension are related to CD, and so there may also be a relationship between R/S and CD. This is particularly likely given that R/S is related to many of the other risk factors for CD (high serum cholesterol, poor diet, physical inactivity, cigarette smoking, heavy alcohol or drug use, and psychological factors such as stress, anxiety and depression). Of course, heavier weight and perhaps emotional excitement during religious services might also increase the risk of CD. Alternatively, an inverse relationship between R/S and CD (particularly in cross-sectional studies) may simply indicate that those disabled with CD are simply less able to engage in R/S activities, particularly when this involves attending religious services. Finally, those who are disabled by CD may also turn to R/S for comfort in order to cope with their disability, increasing the likelihood of a positive correlation between R/S and CD. Thus, numerous factors need to be considered when studying his relationship.

Our systematic review identified a number of studies that had examined relationships between R/S and two cerebrovascular disorders: stroke and dementia. With regard to stroke, there are at least nine studies that

measured R/S. Four of those (44%) reported a lower risk of stroke among the more religious, and all of these were high quality studies [193-196]. Of the remaining five studies, four found no association and one reported greater carotid artery thickening in those who were more R/S, placing them at higher risk for stroke [197]. In that cross-sectional study (n=5,474), researchers found that those who attended religious services were 12% to 64% more likely (depending on frequency of attendance) than those who never attended to be above the 90th percentile in common carotid intima-media thickness (CC-IMT). Results were controlled for hypertension, diabetes, smoking, hypercholesterolemia, obesity, age, gender, race, education, and income. Frequency of attendance was also positively associated with obesity. Again, note that 30% of the sample were African-American, who also frequently attended religious services (50% of those who attended religious services daily were African-American). Although race was controlled for, the latter may have influenced the results. Interestingly, no association was found between religious attendance and coronary artery calcium (CAC), left ventricular mass (LVM), or ankle brachial index (ABI). Furthermore, religious attendance was the only R/S characteristic associated with greater CC-IMT; neither frequency of prayer/meditation nor frequency of daily spiritual experiences were related to CC-IMT, CAC, LVM, or ABI. Likewise, when participants were followed for three years, none of the religious variables predicted incident CVD events (myocardial infarction, unstable angina, CAD death, stroke, TIA, CHF, or other CVD death).

With regard to dementia, which is often the result of multiple strokes, a number of studies have examined associations with R/S. The systematic review uncovered 21 studies examining R/S and dementia or level of cognitive functioning. Nearly half (48% or 10 studies) reported less dementia or better cognitive functioning in those who were more R/S. Of the 14 studies with the most rigorous designs, eight (57%) reported positive relationships with better cognitive function [198-205]. Three studies, however, reported worse cognitive functioning in those who were more R/S [206-208]. The latter may be due to the fact that R/S persons tend to live longer than less religious individuals, increasing the likelihood that they will live to an older age when cognitive problems tend to develop. Recent research supports a positive relationship between R/S and better cognitive function in those with dementia [209] and in those of advanced age [210].

7. CARDIAC SURGERY OUTCOMES

Psychological stress is known to influence the speed of wound healing. Research shows that it can delay healing

by up to 60% in older animals and humans [211]. Adverse effects of stress on wound closure can also be demonstrated in young [212] and middle-aged adults [213], as well as in persons undergoing surgical operations [214]. Some investigators have explained this phenomenon as being due to changes in pro-inflammatory cytokines IL-1B, IL-6, and TNF-alpha at the wound site, perhaps the result of higher levels of cortisol stimulated by the stress response [215]. If R/S helps to reduce psychological stress and improve coping, it might also influence the speed of wound healing and successful recovery from cardiac surgery.

Unfortunately, very little research has examined the relationship between R/S and either speed of wound healing or recovery from surgery. However, several studies have examined relationships between R/S and infection, a factor that strongly influences the speed of wound healing. Our systematic review identified 12 studies that examined relationships between R/S and susceptibility to infection or concentration of infectious agents in blood (viral load). Of those, eight (67%) reported lower infection rates or lower viral load in those who were more R/S, and no study found greater infection or higher viral load. Of the 10 best studies, seven (70%) found significant inverse associations between R/S and infection or viral load [216-222]. There is also a wealth of research linking R/S involvement or interventions to better immune function (14 of 27 studies) [223] and endocrine function (lower cortisol levels in 19 of 29 studies) [224], both of which are known to influence both infection risk and speed of wound healing.

Thus, given the impact that psychological stress may have on wound healing by increasing susceptibility to infection and adversely affecting immune/endocrine functions – and the relationships between R/S and lower psychological stress, lower susceptibility to infection, and better immune and endocrine functions – there is every reason to predict that R/S involvement might influence the speed of wound healing and surgical outcomes. As noted above, there is little research examining the direct impact of R/S on outcomes from cardiac surgery. However, we located five studies that have examined this relationship (four observational studies and one clinical trial), which we now describe.

In the first study, published in 1995, researchers at Dartmouth Medical Center in Lebanon, New Hampshire (USA), examined the effects of religious attendance, importance of religion, and comfort/support from religion on 6-month mortality rates in 232 patients following coronary artery bypass graft (CABG) surgery [225]. Most of participants were either Protestant (63%) or Catholic (25%), and all were age 55 or older. Among those attending religious services at least once every few months, only 5% died; among those who never or rarely attended, 12%

died ($P=0.06$). Among those who described themselves as deeply religious ($n=37$), mortality was 0% compared to 11% in other patients ($P=0.04$). Finally, mortality in those who indicated they obtained strength/comfort from religion was 6%, compared to 16% in those who did not receive strength/comfort from religion ($P=0.01$). When logistic regression was used to control for other covariates, such as history of previous cardiac surgery, impairments of physical functioning, age, and frequency of group social activity, patients who said they did not receive strength/comfort from religion were three times more likely to die than those who said they received strength/comfort from religion ($OR=3.25$, 95% CI 1.09-9.72). There was also an interaction between social participation and receiving strength/comfort from religion, such that those who said they neither received strength/comfort from religion nor participated in social groups were over 14 times more likely to die ($OR=14.32$, 95% CI 2.37-86.56), controlling for other risk factors.

In a second observational study, researchers from Rutgers University in New Brunswick, New Jersey (USA) followed 142 patients hospitalized for elective cardiac surgery (coronary artery bypass grafting, CABG), examining the relationship between religiosity and post-operative surgical complications [226]. Surgical complications, assessed by medical record review, were determined only during the time the patient was in the hospital. Religiosity was measured by frequency of religious attendance, frequency of prayer or meditation, and a 5-item scale assessing intrinsic religious commitment. After controlling for demographic, biomedical, and psychosocial variables, scores on intrinsic religious commitment were inversely related to complications following surgery ($B=-0.32$, $P<0.01$). No effect was found for frequency of religious attendance or prayer/meditation. In a second and separate study by this Rutgers University research group, they examined the relationship between religiosity and length of stay (LOS) in 405 patients undergoing elective CABG [227]. Patients were interviewed an average of 5 days prior to surgery, and LOS was determined by medical record review. Religiosity was assessed using a 6-item devotional activities scale and a 7-item beliefs scale. After controlling for social support and depressive symptoms, neither measure of religiosity predicted LOS (effect on other surgical outcomes and complications were not examined).

In a fourth study, a randomized clinical trial, researchers at the University of Nebraska Heart Institute (USA) examined the effects of listening to prayer during surgery [228]. They randomized 78 cardiac surgery patients to one of three groups: (1) patients who listened to a CD that played a generic prayer, (2) patients who

listened to a CD with a standard relaxation technique, or (3) patients who listened to a tape with no sound (placebo). The CD's were played starting with the beginning of the unconscious anesthetic period prior to surgery and continued throughout the surgical procedure. The prayer was the following: "Dear God, Please come to my aid. Help me to be at peace during this surgery and in my recovery. Strengthen me and help me to remember you are always present, that your healing love and spirit surround me at all times, and that I am held in your tender care. Amen." Mortality, sepsis, supraventricular tachycardia, and amount of pain medication (assessed in hospital and 30-days post surgery) were compared between the three groups. No significant differences were found on any outcome between groups. Since the tapes were played while patients were under anesthesia, they were not conscious of the tapes' contents. The mechanism by which R/S is thought to influence health outcomes is through conscious cognitive processes that reduce stress levels and improve coping. Thus, we would not expect that a religious intervention during an unconscious period to have an impact on surgical outcomes. If prayer has an effect on cardiac outcomes following surgery, this study suggests that it probably doesn't have its effect through unconscious processes.

The last and final study (to our knowledge) is one conducted by researchers at the University of Michigan (UM) that examined the effects of religious involvement on post-operative complications following CABG at the UM Medical Center in Ann Arbor, Michigan (USA) [229].

A total of 177 patients undergoing CABG were assessed two weeks prior to surgery when data were collected on frequency of religious attendance, private prayer, and importance of religion. The 9-item INSPIRIT and a 4-item religious reverence scale were also administered at that time prior to surgery. Cardiac surgery complications were assessed using a standard measure (Thoracic Surgeons Database). Controlling for other significant predictors of post-operative complications, researchers found that patients who prayed frequently prior to surgery were 45% more likely to have no post-operative complications (OR=1.45, 95% CI 1.03-2.06). No other religious variables significantly predicted post-operative complications when frequency of prayer was controlled for in the model.

Thus, three of five studies examining outcomes following cardiac surgery found that R/S predicted significantly better health outcomes and two studies found no effect. These results are positive enough to warrant further studies to examine the effects of R/S or R/S interventions on outcomes following cardiac surgery – especially in other countries. To date, no research has been published from countries outside the United States.

8. OVERALL MORTALITY AND CARDIOVASCULAR MORTALITY

In our systematic review, we identified 121 studies on R/S and mortality, of which 82 (68%) found that greater R/S predicted significantly greater longevity [230]. Six studies (5%) reported shorter longevity. Considering the 63 methodologically most rigorous studies, 47 (75%) found greater longevity. With regard to CVD mortality in particular, we identified 12 studies that had examined relationships with R/S. Of those, eight (67%) reported significance inverse relationships during periods of follow-up that ranged from 6 months to 31 years [231-238]. In addition, two found no association [239,240] (one study with a follow-up of only 19 months), one reported mixed results [241] (CVD as a cause of death was greater among Catholic sister radiology technicians compared to other female radiology technicians, but was significantly lower compared to US females in general), and one reported greater mortality (although uncertain if statistically significant) in women reporting they received comfort/strength from religion [242]. In several of these studies, all cause mortality was the primary focus (not CVD), but when investigators examined the disease in which the inverse relationship between R/S and mortality was strongest, it was CVD [243,244]. Furthermore, in an independent systematic quantitative review of this research, investigators reported the effects of R/S on mortality were greater in CVD than in any other disease (HR=0.72, 95% CI 0.58-0.89) [245]. No studies of cardiovascular morbidity or mortality have been published from Brazil.

9. EXPLANATORY MECHANISMS

As emphasized throughout this article, the way that R/S affects the cardiovascular system must be through psychological, social, or behavioral pathways. At least these are the pathways that we can study using the methods of science that researchers have available to them, i.e., through observational studies, experimental studies, and clinical trials.

9.1. Psychological pathways. By decreasing the probability of stressful life events (by influences on behavior), by providing meaning and purpose to stressful life events that do occur, and by providing role models in sacred scriptures of exemplary individuals dealing with adversity, R/S provides psychological resources that facilitate coping and adaptation. The result is the experience of more positive emotions (well-being, happiness, optimism, meaning and purpose) and fewer negative emotions (depression, anxiety, low self-esteem, hopelessness). These psychological benefits of R/S

are known to affect immune, inflammatory, endocrine, and autonomic functions, which in turn influence cardiovascular health. Based on the amount of variance in health outcomes explained by R/S factors in regression models, we estimate that psychological factors account for about 50% of the effect of R/S on cardiovascular outcomes.

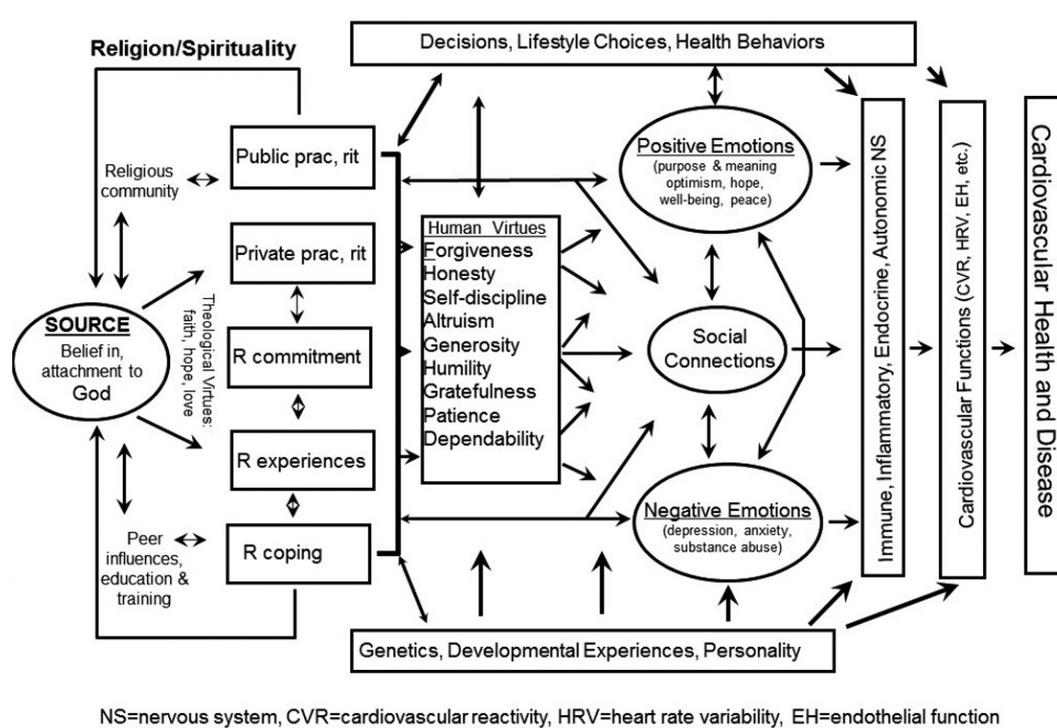
9.2 Social pathways. By encouraging involvement in the faith community, promoting forgiveness, and nurturing pro-social attitudes and activities, R/S provides social resources to build and maintain family, marital, and friendship networks that will be available to facilitate adaptation and coping (thereby positively influencing mental health). Social support of this kind also influences attitudes and behaviors that affect the ability to obtain an education and a job, influence work ethics, and help persons obtain financial stability that will enable them to access health resources. Finally, social contacts from involvement in a faith community will increase the flow of health information, increasing awareness of the latest research findings, disease screening opportunities, and available medical treatments. We estimate that social pathways account for about 15% of the effects of R/S on cardiovascular outcomes (again, based on regression models).

9.3. Behavioral pathways. By doctrines that promote care for the physical body (as the "temple of the Holy Spirit" in the Christian tradition, for example), R/S affects health behaviors such as cigarette smoking, alcohol and drug use, exercise and physical activity, and diet. Likewise, R/S doctrines discouraging sexual activity outside of marriage and delinquent or criminal activities will influence development of sexually transmitted diseases and risk of motor vehicle crashes and other accidents that could lead to the development of CVD. Our systematic review of research in this area revealed that of 95 studies examining relationships between R/S and risky sexual activities, 82 (86%) found inverse relationships. Likewise, of 104 studies examining associations between R/S and delinquency/crime, 82 (79%) reported inverse relationships. Finally, R/S attitudes encourage honesty and accountability, influencing compliance with medical treatments and adherence to disease screening practices (blood pressure monitoring, blood glucose checks, etc.). In the systematic review, we found that 27 studies examined relationships between R/S and compliance with medical treatments; of those, 15 (56%) reported positive associations. Furthermore, of 44 studies that examined relationships with disease screening, 28 (64%) found that those who were more R/S were more likely to engage in disease screening activities. Thus, a major pathway by which R/S may influence cardiovascular functions and risk of CVD is through health behaviors, lifestyle choices, compliance with medical treatments, and participation

in disease screening. We estimate that these pathways account for about 35% of the total effects of R/S on cardiovascular outcomes.

9.4. Supernatural pathways. Some researchers have sought to explain the relationship between R/S and CVD by invoking mechanisms that lie outside of the natural world (i.e., Divine or supernatural pathways). Classic examples are double-blinded intercessory prayer studies conducted in patients undergoing CABG, including the Byrd study [246] at San Francisco General Hospital, the Kansas City Mid-America Heart Institute study [247], and the multi-site Harvard study [248]. In the latter study, Harvard investigators randomized 1800 CABG patients to prayer or no prayer (a study published in the *American Heart Journal*). To the disappointment of the researchers in the Harvard study, the findings of this multi-million dollar project indicated that being prayed for made no difference in cardiac outcomes and, in fact, if patients were told they were being prayed for, they actually did significantly worse (i.e., they were more likely to have atrial arrhythmias). This resulted in an article published in *Newsweek* magazine that was titled "Don't pray for me! Please! [249]". These studies are neither theologically nor scientifically credible, and so we have not discussed them in this paper. Interested readers are referred elsewhere for a thorough treatment of these studies and why they should not be done [250,251].

9.5 Comprehensive theoretical model. We present here a theoretical causal model (Figure) adapted from a model presented in the Handbook [252]. The ultimate driving "source" of the cardiovascular benefits (and health benefits more generally) from R/S, according to the three major Western monotheistic traditions, is attachment to God. In Judaism, it is the 1st commandment of the 10 commandments ("Thou shalt have no other gods before Me" [Exodus 20:3]) and emphasized by Moses as the core of the Jewish faith ("Thou shalt love the Lord thy G-d with all thy heart, and with all thy soul, and with all thy mind" [Deuteronomy 6:5]). In Islam, it is in the opening stanza of the Qur'an ("You [alone] we worship, You [alone] we ask for help [for each and everything]" [Al-Fatihah 1:5], and repeated many times elsewhere (e.g., "...those who have attained to faith Love God more than all else" [Al-Baqara 2:165], and "...worship God [alone], and do not ascribe divinity, in any way, to aught beside Him" [An-Nisa 4:36]). In Christianity, Jesus said (quoting Moses) that it is the first and greatest commandment and necessary to inherit eternal life ("Thou shalt love the Lord thy God with all thy heart, and with all thy soul, and with all thy mind" [Matthew 22:37]; this teaching is repeated twice more in Mark 12:30 and Luke 10:27). There is no debate here. Belief in, attachment to, and relationship with God is at the core of the monotheistic traditions above.



This relationship with God is then manifested in terms of the theological virtues (love of God, faith or trust in God, hope in God). These virtues are taught and nourished within a religious community, although influenced by peers, education, and training. They are manifested in a person's life by public religious practices (attending religious services and other social group related religious activity), private religious activity (prayer or meditation, reading religious scriptures, watching religious TV, listening to religious music), intrinsic religious beliefs or commitments, religious experiences, and religious coping. The latter we call "religion" or "spirituality" (used synonymously in this paper – see earlier discussion). Religion/spirituality is then seen as influencing day-to-day decisions made at work, in the family, with friends and colleagues, as well as affecting life-style choices and health behaviors, which in turn influence mental and social health. R/S is also viewed as promoting the "human virtues" (as distinct from the theological virtues) that include forgiveness, honesty, courage, self-discipline, altruism (caring for others), humility, gratefulness, patience, and dependability. The human virtues, in turn, enhance social relationships, increase positive emotions, and reduce negative emotions.

R/S has both "indirect" and "direct" effects on health

outcomes. This includes the indirect effects through positive emotions (well-being, meaning and purpose, optimism, hope, etc.), through negative emotions (mental disorders such as depression, suicide, anxiety, substance abuse), and through social relationships (social support, marital stability). R/S also indirectly influence mental, social, and physical health outcomes by effects on decision-making, lifestyle choices, and health behaviors, as well as through encouraging human virtues. Besides indirect effects, R/S also has "direct" effects on positive emotions, negative emotions, and social relationships. Mental health (positive and negative), social health, and health behaviors (including diet, exercise, smoking, etc.) are seen as the key factors that influence physiological systems on which healthy cardiovascular functions depend (immune/inflammatory, endocrine, sympathetic/parasympathetic nervous systems), ultimately affecting rates of CVD. Note that R/S has no "direct" influences on cardiovascular functions or on cardiovascular health/disease. Rather, R/S always operates through psychological, social, and behavioral pathways.

This entire system, rests on genetic influences, early developmental experiences during childhood and adulthood, and personality influences that result from an interaction of genetics and developmental forces. Note that

these genetic and environmental factors (and the interaction of genetics and environment) influence the development of human virtues, decision-making and health behaviors, positive emotions (set-point for happiness and well-being), negative emotions (tendencies toward depression or anxiety or vulnerability to alcoholism or drug use), social connections (sociability, extroversion, etc.), and of course, physiological systems underlying cardiovascular functions and cardiovascular diseases themselves. Genetic and environmental factors also influence the person's capacity for religious or spiritual experiences, such that it may be "easier" for some individuals to be spiritual or religious because of their genetic makeup, temperament, or environmental experiences (including race, gender, education, economic situation). For example, the presence of genetic polymorphisms of the promoter region of the serotonin transporter gene may convey an emotional sensitivity to life events that makes an individual more likely to have spiritual or religious experiences, or more vulnerable to emotional distress, which in turn causes people to turn to R/S for comfort and emotional regulation. Indeed, there is growing interest in and research now being done on the genetic basis of spirituality.

Thus, the relationship between R/S and cardiovascular health and disease is extremely complex, involving decision-making that is under the individual's control as well as genetic and environmental factors over which the individual has no control. Concluding that a person has a cardiovascular disease (myocardial infarction, cardiac arrhythmia, atherosclerosis, high blood pressure, stroke or vascular dementia) because he or she is "not religious enough," then, is not possible because of the huge amount of information that is needed on which to base such a conclusion (including knowledge about the person's genetic makeup).

10. CLINICAL APPLICATIONS

Although scientific exploration on the influences that R/S has on cardiovascular health and disease is only in its infancy, and much further research is needed to better understand these relationships and effects, there is probably enough known already for us to make some suggestions on how to apply this knowledge to clinical practice. Bear in mind that the suggestions we provide here are largely based on common sense and clinical experience caring for patients with CVD, rather than on systematic research. Furthermore, space limitations allow us only to summarize our recommendations here and do so quite briefly. For a more detailed and comprehensive description of clinical recommendations (and limitations/boundaries), the reader is referred elsewhere [253].

In brief, here is what we would suggest:

10.1. Take a spiritual history. Cardiologists and cardiovascular surgeons should consider taking a brief spiritual history on all seriously ill patients whom they admit to the hospital. This also applies to patients seen for the first time in the outpatient setting, particularly those with chronic cardiovascular disorders that challenge ability to cope. The "screening" spiritual history is quite different from the comprehensive assessment that a chaplain would do when evaluating a patient. The screening spiritual history performed by the physician should take no more than 2-3 minutes, and usually consists of asking the patient about (1) his or her religious denomination, (2) R/S beliefs that assist with coping (or that might be causing distress), (3) R/S beliefs that might influence treatment decisions or conflict with medical care, (4) participation in a faith community and whether supportive, and (5) any other spiritual needs that are present and related to the patient's health or healthcare [254,255].

Besides gathering crucial information that will assist in the medical and surgical care of the patient, a spiritual history sends an important message to the patient: that the doctor is open to discussing these issues and will not avoid them or delegate them to others. When the physician takes a spiritual history, this has been shown to enhance the doctor-patient relationship [256]. However, before taking a spiritual history, the physician should prepare the patient by explaining why he or she is asking these questions. The reason for the questions has nothing to do with the severity of the patient's cardiac condition. Rather, the intention is to provide culturally sensitive care that addresses the whole person – mind, body and spirit. If the doctor fails to provide such an explanation beforehand, the patient may get the wrong impression, i.e., that the reason the doctor is asking these questions is because the end of life is near and their condition is hopeless.

10.2. Value and support. When taking a spiritual history or discussing R/S matters, the doctor should always communicate to patients that he or she values and respects their R/S beliefs, and is supportive of them. This is true when the doctor has different religious beliefs than the patient, and even if the R/S beliefs of the patient conflicts with medical or surgical treatments. In the latter case, respecting and showing support for the patient's R/S beliefs will enhance the doctor-patient relationship and will likely increase the patient's adherence to medical treatments more generally and increase the likelihood that he will either ultimately comply or at least tell the physician if he doesn't comply. Rejecting or arguing with patients about firmly held R/S beliefs that conflict with treatment is usually disastrous, putting a wedge between the doctor and the patient and increasing the likelihood of resistance or subtle non-compliance.

10.3. Refer to chaplain services. If any but the most

simple of R/S needs come up during the spiritual history, the doctor should refer the patient to a chaplain or pastoral counselor for further evaluation. The physician doesn't have the time or the training to address most patients' spiritual needs, and so should refer patients to experts in this area, especially if there are complex issues at stake. For example, a patient may tell the doctor that she feels that God is punishing her or doesn't care about her, or may even feel that she is going to hell. This is something that chaplains are trained to deal with. Doctors are not. Sometimes, however, if the patient refuses to see a chaplain, then the doctor will have to listen to these concerns and try to understand them (not argue about or dismiss them).

10.4. Engage. Should cardiologists or cardiac surgeons engage in religious or spiritual activities with patients? The most likely issue that comes up is praying with patients. Many religious patients (and even some non-religious patients), particularly when serious medical illness is present, would like to pray with their doctors, especially after hearing a bad diagnosis or prior to undergoing cardiac surgery. We believe it is appropriate for cardiologists and cardiac surgeons to pray with their patients – if this is something they feel comfortable doing. However, the doctor should only do so after taking a spiritual history and if the patient asks them to pray. If the doctor asks patients to pray, this increases the risk of coercion (i.e., the patient may not want to pray with their doctor, but feel forced to do so in order not to offend or disappoint the doctor). Thus, if doctors are open to praying with patients, they should inform patients that they are willing to do so, but tell patients to ask for prayer at a later time if they wish to do so. In this way, the patient is free to either ask the doctor to pray (if the patient really wants prayer) or not, and no coercion will be involved.

10.5. Prescribe. Given the potential health benefits of R/S, should cardiologists or cardiac surgeons prescribe religious beliefs or activities to patients who are not currently engaged in them [257]? The answer is a resounding "no." Prescribing R/S is not appropriate and possibly unethical. When patients are sick and vulnerable, this is not a time to introduce new R/S beliefs or practices. However, in the vast majority of cases, patients will already be religious or spiritual, and no prescription is necessary. Supporting and encouraging the R/S beliefs and practices of the patient, though, may help to boost the effectiveness of those beliefs in helping the patient cope with their illness.

10.6. Limitations and boundaries. There are limitations to what physicians can do and boundaries across which they should not cross. First, as noted above, doctors should not prescribe R/S beliefs or practices to non-religious patients. Second, physicians should not force a spiritual history if the patient is not R/S (instead, switch the topic to

a discussion of what gives life meaning and purpose in the context of their illness and ask how this can be supported). Third, don't coerce patients in any way regarding R/S; this is a very sensitive and important topic to most patients and they need to feel in control. Fourth, do not pray with patients before taking a spiritual history and unless patients ask for prayer. Fifth, the doctor should not try to spiritually counsel patients unless he or she has the training to do so. Finally, the doctor should not do any activity related to R/S that is not patient-centered and patient-directed. Patient-centered medicine is now considered the standard of medical care, and this especially applies to addressing R/S issues.

10.7. Medical education. A recent survey of medical deans at Brazilian medical schools reported that many schools are beginning to address spiritual issues in the medical curriculum [258]. Researchers surveyed 86 of Brazil's 180 medical schools, finding that 5% had a required course dedicated to R/S and health and 6% had an elective course of this type (combined, nine of 86 schools with required or elective dedicated courses). In addition, 14 other medical schools said that they included a lecture on R/S and health at some point in the curriculum, and 12 more schools said that while they did not have a specific course or lecture on R/S and health, the topic was integrated into another course or lecture. Thus, 41% of the schools surveyed (35 of 86) had some type of content on R/S and health in the curriculum, either on a required or elective basis. Furthermore, when medical deans were asked whether their institution considered R/S and health important for their students, 54% said "very important", 36% "somewhat important", 11% "of little importance," and 0% "not important". These findings are similar to a recent survey of 122 medical schools in the U.S. that found that 7% of the 115 schools that responded had a dedicated required course on R/S and health, and 34% said they offered an elective course dedicated to R/S and health [259]. Likewise, about 40% of medical deans said that including R/S and health in the medical curriculum is important. Thus, many medical schools in both Brazil and the U.S. are now exposing students to spirituality and health in their curricula and there is a growing desire among medical school deans to include more such content in the future.

11. FUTURE RESEARCH NEEDS

Because of the influences that psychological, social, and behavioral factors have on cardiovascular health and disease (influences that are stronger than in most other medical conditions), and the influence that R/S has on those psychological, social and behavioral factors, the potential for R/S affecting cardiovascular health and

disease is more likely than in any other organ system. The possible avenues for research on R/S and cardiovascular disease are almost endless, especially in Brazil where no research on this topic has yet been published in the peer-review literature. Given the religiousness of the population of Brazil and interest in R/S, particularly among those who are sick with CVD who use R/S to cope with illness, there is a huge opportunity to systematically study these relationships in Brazil. This also means opportunity to conduct research on the benefits or harm of physicians addressing R/S issues in the care of patients with CVD. Below are the types of studies that are needed.

11.1. *Observational studies.* Both cross-sectional and longitudinal cohort studies are needed on the relationship between R/S and all types of CVD. Prospective studies are needed to determine whether R/S involvement influences coronary artery calcification, left ventricular mass, ankle brachial index, carotid artery intima-media thickness, etc., over time, or predicts negative cardiovascular events. A model study is that of Feinstein et al. [260], but the design should follow patients over a longer time period and assess exposure to R/S across the lifespan rather than only R/S activity at baseline. Of particular importance are studies examining the interaction between R/S and pharmaceutical, biological, and surgical treatments for CVD. In other words, do highly R/S patients respond more quickly to treatment and with fewer complications, and maintain their response longer, compared with patients who are less R/S? Such studies are relatively simple and inexpensive to conduct. For example, if an investigator plans to study the effects of either a medication or a surgical procedure on cardiac outcomes, then measures of R/S could be added to the baseline interview and the effects assessed over time in terms of response to the treatment. There would be no additional cost to such a study, other than adding a few questions to the baseline interview. Time and expertise, however, would be needed to conduct the statistical analysis after the project is completed, and then write up the results for publication. The benefits of R/S to treatments for coronary artery disease, valve problems, heart failure, hypertension, peripheral vascular disease, or stroke could all be assessed using this low cost research strategy.

11.2. *Experimental studies.* Single group experimental studies conducted in the laboratory are also needed to determine whether prior R/S involvement or current R/S spiritual activities influence basic cardiovascular functions (cardiovascular reactivity, heart rate variability, ejection fraction, etc.) in response to an experimentally induced psychological or physical stressor. While a few studies have been done, more of these are needed that involve larger samples, that measure R/S in greater detail, and that more precisely assess cardiovascular functions.

11.3. *Randomized clinical trials.* Randomized clinical

trials are also needed that examine the effects of a R/S intervention on medical or surgical outcomes. The intervention might involve a religious cognitive-behavioral therapy that influences attitudes toward and coping with CVD, particularly among seriously ill, chronically disabled cardiac patients. Alternatively, an intervention could be designed that involves chaplain or clergy visits before and after cardiac surgery, followed by an examination of short-term and long-term surgical outcomes (complications, hospital stay, re-admission rates, speed of wound healing, infection rates, need for pain medication, and mortality, for example). Another intervention might involve studying the effects of cardiac surgeons praying with patients (*vs.* no prayer with surgeon) on patient satisfaction, other psychological and behavioral outcomes, and surgical outcomes described above. A similar randomized clinical trial could examine the effects of medical cardiologists praying with patients, perhaps following a first-time acute myocardial infarction or a re-infarction.

We have discussed here a few high priority areas that might be of interest to cardiovascular researchers. For a more comprehensive resource that outlines and ranks in priority the studies that are needed and their likely cost, and exhaustively describes how to conduct research on spirituality and health, the reader is referred to another resource [261]. This resource includes a description of the different research methodologies, R/S measurement tools, ways of conducting statistical analyses, writing up the results, and publishing the findings, as well as ways of funding this type of research.

12. SUMMARY

Given the mechanism by which we think religion/spirituality influences physical health, *i.e.*, through psychosocial and behavioral pathways, and the strong influence that psychosocial and behavioral factors have on risk of developing cardiovascular disease, there is no medical condition that R/S is more likely to influence than CVD. Compared to the massive volume of research on R/S and health overall (over 3,200 quantitative studies), relatively little research has examined the effects of R/S on cardiovascular morbidity or mortality. Thus, there is a wide-open door for cardiovascular researchers in Brazil – one of the most religious countries in the world – to conduct groundbreaking research that establishes (or refutes) the effects that R/S may have on CVD. The fact is that in developed countries, cardiovascular diseases are now the most common cause of both death and functional disability [262]. If R/S beliefs and practices have any influence on CVD, no matter how small, then demonstrating this through research may lead to both a higher quality and longer life for millions worldwide.

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