Religious involvement has been linked to reduced risk of cardiovascular morbidity and mortality. This may reflect lower cardiovascular reactivity (CVR) among individuals high in religious involvement. The relationship between religious involvement and reactivity may overlap with the effects of other psychosocial factors. This study examined religious involvement, social support, and hostility in relation to CVR in the laboratory. Results showed an interactive effect of perceived social support and religious involvement on systolic blood pressure (SBP) reactivity. Participants reporting a high level of religious involvement showed lower SBP reactivity only when they also reported high levels of social support. These findings encourage further research on the unique and conjoint effects of religiousness and other psychosocial variables on CVR.

Religion and spirituality have received attention as psychosocial factors that may exert a positive influence on physical health outcomes, including coronary heart disease (CHD; Koenig, McCullough, & Larson, 2001). Religion and spirituality comprise a broad domain that includes affiliations with religious denominations, ties to a particular religious congregation, involvement in religious practices such as private prayer and attendance at services, and various beliefs, values, and sentiments. A meta-analysis has suggested that indicators of religious involvement, or degree of religiousness, are associated with lower risk of all-cause mortality in large population-based studies (McCullough, Hoyt, Larson, Koenig, & Thoresen, 2000). Moreover, several studies have obtained evidence of prospective associations between religion or spirituality and specific cardiovascular outcomes (e.g., Goldbourt, Yaari, & Medalie, 1993; Oman, Kurata, Strawbridge, & Cohen, 2002).

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The investigation of mechanisms that may account for a protective effect of religion or spirituality on cardiovascular health is at an early stage. Although research has identified health-related behaviors as one pathway for the salutary effects of religion, other findings support the plausibility of pathways involving the modulation of physiologic processes associated with psychological stress (Seeman, Dubin, & Seeman, 2003). More specifically, religion/spirituality may influence health through effects on cardiovascular reactivity (CVR) to psychological stressors. Behaviorally evoked elevations in blood pressure, heart rate (HR), and other hemodynamic parameters appear to reflect processes involved in the development of CHD and other cardiovascular conditions such as essential hypertension (Manuck, 1994).

Despite the availability of findings that point to an inverse relationship between religious involvement and hypertension (Koenig et al., 2001), very few studies have examined the possible association between religion and CVR. In one recent study, Masters, Hill, Kircher, Benson, and Fallon (2004) reported that religious orientation interacted with age to predict CVR to laboratory stressors. Older, extrinsically religious participants demonstrated exaggerated blood pressure reactivity when compared with older, intrinsically religious individuals. Blood pressure responses of older, intrinsically religious participants were indistinguishable from those of younger participants, whereas among extrinsically religious participants, age was associated with greater blood pressure elevations. This study provides initial evidence of an association between religious orientation and CVR, albeit one that was qualified by age. One purpose of the present study was to conduct a further examination of the effect of religiousness on CVR to laboratory stressors.

Another purpose of this study was to determine whether other psychosocial factors, such as trait hostility and perceived social support, may overlap with or mediate religion’s effect on CVR to laboratory stressors. Research indicates that both trait hostility (Suls & Wan, 1993) and social isolation (Uchino, Cacioppo, & Keicolt-Glaser, 1996) are associated with heightened CVR to psychological stressors, which may explain the relationships of these two factors to cardiovascular morbidity and mortality. There is also evidence of associations linking hostility and social support to religiousness. Positive associations between religious involvement and perceived social support have been observed in various populations (e.g., Koenig, 1998; Koenig et al., 2001), as have inverse relationships between religiousness and trait hostility (e.g., Koenig; Koenig et al.). Although some have speculated that psychosocial factors such as hostility and social support may mediate the relationship between religion and health, religion has been found to be independently associated with health conditions, even with statistical control of some of these factors (Hummer, Rogers, Nam, & Ellison, 1999; Strawbridge, Cohen, Shema, & Kaplan, 1997). Accordingly, although religiousness may overlap with hostility and social support, it is plausible to suggest
that aspects of religion may operate independently of these and other psychosocial factors in influencing health-related processes (Contrada et al., 2004). Therefore, it is important to examine the possible direct and indirect (psychosocially mediated) effects of religiousness on CVR.

Moderated effects are also of interest. In particular, previous CVR research has indicated interactive effects of social support with other factors such as trait hostility (Chen, Gilligan, Coups, & Contrada, 2005) and relationship quality (Uno, Uchino, & Smith, 2002). The effects of social support on CVR appear to depend upon the social aspects of personality and on the nature of an individual’s personal relationships. Accordingly, religious ties may modulate CVR to a greater degree among individuals reporting more (compared with less) social support to the extent that religious involvement influences cognitive appraisal and coping processes in a stress-dampening manner that depends upon positive social relationships. A similar line of reasoning leads to the expectation that stress-dampening effects of religion would be stronger among less (compared with more) hostile individuals.

In this article, we report further analyses of data from Chen et al. (2005) to evaluate religiousness as an additional predictor of CVR. Participants were subjected to two standardized psychological stressors. Selection of these two stressors was designed to create variation in social threat and personal relevance. In a speech task, participants spoke aloud about the most stressful problem they were currently facing. This task was administered in a manner intended to heighten social threat and personal relevance. In a mental arithmetic task, participants solved simple arithmetic problems under time pressure. Cardiovascular activity was measured during a resting baseline period and during task performance. Levels of religiousness, trait hostility, and perceived social support were measured with a questionnaire packet administered following task performance. Multiple regression analysis was used to examine the main effects and mediation effects, and interactions linking these factors to CVR to the two stressors. It was expected that greater religiousness would be associated with lower CVR. It also was expected that this relationship would be at least partially independent of trait hostility and perceived social support and that the effects of religious involvement would be greatest among individuals high in social support and low in hostility.

Methods

Participants

College students completed the study in return for course credit for an introductory psychology class. Of the 110 participants, data for 2 were excluded from all analyses because of their failure to meet inclusion criteria: One smoked
cigarettes and the other consumed caffeinated beverages, both within 90 minutes prior to the session. One participant was excluded from all analyses because of missing data. The final sample consisted of 53 men and 54 women. Their average age was 19.6 years (standard deviation $SD = 2.5$). Participants reported their ethnic/racial group membership as follows: White/Caucasian, 43.5%; Asian/Pacific Islander, 36.1%; Black/African American, 8.3%; Hispanic/Latino, 7.4%; and other, 4.6%.

Procedure

Students who signed up to participate in the experiment were instructed to refrain from smoking, consuming caffeinated beverages, and exercising for at least 90 minutes before their scheduled sessions. Upon arrival, the participant was given a brief introduction to the study, and informed consent was obtained. The participant then sat alone in one room, with the blood pressure cuff and microphone placed on the nondominant arm, while the experimenter monitored his or her blood pressure from an adjoining control room. A 5-minute resting baseline period then ensued to permit cardiovascular activity to stabilize. Next, participants received instructions for and performed the public speaking and mental arithmetic tasks. The sequence in which the tasks were introduced and administered was counterbalanced.

Speech task. The experimenter instructed the participants to make a 3-minute speech about a current stressful problem. Participants were told that the problem must fall into one of the following categories: romantic, family, academic, or roommate related. In order to heighten social threat, participants sat in front of a video camera during the speech task and were informed that their speech would be recorded and evaluated later. Then, participants were given 3 minutes to prepare the speech. As an additional means of increasing social threat, the experimenter implied the presence of multiple observers by speaking through the intercom at the end of the task instructions, saying, “Is everybody ready to begin back there?” After the 3-minute preparation period, participants delivered their 3-minute speech. If the participants paused or stopped before the end of the 3-minute period, they were prompted to provide more information about the stressful event.

Mental arithmetic task. Participants engaged in a 5-minute mental arithmetic exercise. During this task, participants were instructed to solve a series of mental arithmetic problems under time pressure. The problems involved adding two numbers displayed on a computer screen and then adding or subtracting another displayed number. They were instructed to try their best and told they would receive a prize if they performed well. The task lasted for 5 minutes. Once
the participants completed both tasks, they were escorted to a different room and given a questionnaire packet containing the psychosocial measures. Regardless of their performance, all participants were given a choice of various candy bars at the end of the experiment as a prize for the mental arithmetic task.

Measures

Cardiovascular activity. Systolic blood pressure (SBP), diastolic blood pressure (DBP), and HR were measured using a Spacelabs model 2600B (version 5.0) automated blood pressure and HR monitor. The experimenter placed an occluding cuff around the participant’s nondominant arm, with a microphone positioned over the brachial artery to detect Korotkoff sounds. SBP and DBP were measured in millimeters of mercury (mmHg), and HR was measured in beats per minute (BPM). Blood pressure readings were obtained at minutes 1, 3, and 5 of the baseline and mental arithmetic periods, and minutes 1 and 3 during the speech task. HR also was measured by the Spacelabs unit based on the detection of pulses during cuff inflation. Baseline cardiovascular measures (SBP, DBP, HR) were computed as the mean of the minutes 3 and 5 readings. CVR for each task was calculated by subtracting baseline measures from the mean of the readings for each task. Each analysis of reactivity included the corresponding baseline measure as a covariate.

Religiousness. Religiousness was assessed using single-item measures of attendance, prayer, self-rated religiousness, and the degree of strength and comfort derived from religion. Responses to the attendance item were made on a scale of 0–4 (never, several times a year, several times a month, once a week, and more than once a week). Responses to the prayer measure were made on a scale of 0–4 (never, occasionally, several times a week, once a day, and more than once a day). Responses to the self-rated religiousness item were made on a scale of 0–3 (not at all religious, slightly religious, fairly religious, and deeply religious). Responses to the strength and comfort measure were made on a scale of 0–3 (none at all, a little, a moderate amount, and a great deal). Measures such as these have been linked to mortality in previous research (McCullough et al., 2000; Oxman, Freeman, & Manheimer, 1995). To increase reliability, they were used to create a four-item scale in the present study. To evaluate this measurement approach, responses to the four items were subjected to a principal axis factor analysis with oblique (Promax) rotation. Examination of the scree plot revealed a one-factor solution (eigenvalue = 2.66). Cronbach’s alpha ($\alpha$) for the four-item religiousness scale is .83. Responses to the four items were therefore recoded into a single response scale before averaging them to create a measure of overall religiousness, with higher numbers indicating more religiousness.
Perceived social support. Perceived social support was measured with the 12-item appraisal subscale of the Interpersonal Support Evaluation List (ISEL; Cohen & Hoberman, 1983). This scale assesses the perceived availability of someone with whom one can comfortably discuss problems and difficulties. It was selected because it is brief and it measures a major function of supportive social networks that is conceptually relevant to processes involved in responses to psychological stressors. Appraisal support has been linked to physiological activity in previous research (Brownley, Light, & Anderson, 1996; Turner-Cobb, Sephton, Koopman, Blake-Mortimer, & Spiegel, 2000). Cronbach’s alpha (α) for the ISEL Appraisal scale is .80.

Trait hostility. Trait hostility was measured using the 50-item Cook–Medley Hostility Scale (Cook & Medley, 1954). As in several previous studies (e.g., Guyll & Contrada, 1998; Weidner, Friend, Ficarrotto, & Mendell, 1989), a 6-point Likert-type agree/disagree response scale was used in this study, rather than the original true-false response format. Cronbach’s alpha (α) for the scale is .89.

Results

Associations Between Religiousness and Other Psychosocial Factors

Contrary to some previous research, there was no significant correlation linking religiousness to either trait hostility or perceived social support (rₛ = −.01 and .03, respectively, ps > .73).

Baseline Cardiovascular Measures

The mean baseline SBP was 117.0 mmHg (SD = 13.0), mean baseline DBP was 66.2 mmHg (SD = 10.2), and mean baseline HR was 74.3 BPM (SD = 9.9). Multiple regression analyses were conducted to examine the relationships between the psychosocial and demographic predictors and each of the baseline cardiovascular measures. Inclusion of the religiousness measure had little impact on the results reported by Chen et al. (2005). Men had significantly higher baseline SBP (M = 123.0 mmHg) than women (M = 111.2 mmHg, β = −11.11, p < .001). No gender differences were found for baseline DBP or HR (ps > .10). Moreover, no significant differences or interactions were found linking trait hostility, perceived social support, or religiousness to any of the baseline cardiovascular measures (ps > .80).

Speech Topic Categories

A series of one-way analyses of variance were conducted to determine whether participants who chose different speech topics (i.e., romantic, family, academic,
roommate related) differed with regard to the main study variables. No differences were found for religiousness \((p > .37)\), just as none had previously been reported for hostility \((p > .44)\) or perceived social support \((p > .68)\).

**CVR**

**Main effects analysis.** Relationships of predictors with CVR were examined using a mixed-model multiple regression analysis. First, a main effects model evaluated religiousness, hostility, and perceived social support as continuous between-subjects factors, and task as a two-level within-subjects factor, controlling for gender and baseline cardiovascular measures. No main effect of religiousness was found for SBP \((p > .21)\), DBP \((p > .37)\), or HR \((p > .13)\). Similarly, no main effect of hostility, perceived social support, or gender was found for SBP \((p > .27)\), DBP \((p > .44)\), or HR \((p > .23)\). Baseline cardiovascular values were significantly related to reactivity measures, with higher baselines associated with smaller change-scores for SBP \((b = -.41, p < .001)\), DBP \((b = -.33, p < .001)\), and HR \((b = -.18, p < .009)\). Further analysis involving the hierarchical entry of the psychosocial factors indicated that the main effects described above were unaltered by the sequence in which they were entered into the model. The absence of these main effects rules out mediational hypotheses in which any of the psychosocial predictors influences reactivity through pathways involving the others (Baron & Kenny, 1986; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002).

**Predictor \(\times\) Task interactions.** The next step was to examine the two-way interaction effects involving task and each of the main predictors. None of these interactions was found to approach statistical significance \((p > .36)\).

**Moderation analyses.** We then centered the data and used the appropriate product terms to examine the two-way interaction effects between religiousness and trait hostility/social support, and the corresponding three-way interactions involving the task variable.

Results for SBP reactivity revealed a significant interaction between religiousness and social support \((b = -.22, p < .02)\). The three-way interaction involving task did not approach significance, reflecting the similar patterns obtained for the Simple Religiousness \(\times\) Social Support interaction for the speech and math tasks \((p > .84)\). A plot of the two-way interaction, presented in Figure 1, showed that greater religious involvement was associated with less SBP reactivity among participants reporting a high level of social support, whereas among those reporting low social support, religious involvement tended to be associated with greater SBP reactivity. Simple effects analysis revealed that the slope representing the effect of religiousness for subjects high in social support was significantly
different from zero ($\beta = -.34, p < .04$), whereas the slope for religiousness for subjects low in social support was not ($p > .87$). No interaction was found between religiousness and hostility ($p > .95$). The analysis of SBP data revealed no other significant interactions involving religiousness and any of the other predictors ($ps > .95$).

Analysis of DBP and HR data revealed no significant interactions involving religiousness ($ps > .64$). Further analysis indicated that there were no interactions between gender and any of the main study variables for SBP ($ps > .29$), DBP ($ps > .13$), or HR ($ps > .21$). In addition, there was no evidence that gender or hostility qualified the Religiousness × Social Support interaction that was obtained for SBP ($p > .25$).

Discussion

Results of this study indicate that perceived social support and religiousness interact in predicting CVR to acute laboratory stressors. Higher levels of religious involvement were associated with less SBP reactivity only among participants reporting high levels of social support. Thus, the findings suggest that social support moderates the effects of religiousness on reactivity, whereas there was no evidence of mediational effects or independent main effects of religious involvement. These results have several implications for the study of religion and social support in relation to CVR.
The effect of religious involvement on reactivity should be viewed guardedly, given that it was only observed in the data for SBP. Contrary to expectations, results from this study did not indicate main effects of religiousness, as at least one previous study did (Tartaro, Luecken, & Gunn, 2005). However, it does accord with recent findings of interactive effects between measures of religion and other predictors of CVR and ambulatory blood pressure measures. Masters et al. (2004) found that religious orientation interacted with age to predict blood pressure reactivity to laboratory stressors, Steffen, Hinderliter, Blumenthal, and Sherwood (2001) reported interactive effects of religious coping and ethnicity in predicting ambulatory blood pressure, and Tartaro et al. found interactions between composite religiosity/spirituality and other measures of religiousness and gender in predicting blood pressure. Moreover, qualified effects of psychosocial factors on reactivity have been reported in previous studies. For example, Uno et al. (2002) found that social support offered by an ambivalent friend was associated with greater increase in DBP than support from a purely positive friend. Similarly, as mentioned earlier, a previous report based on the current study found that the effects of trait hostility on CVR were qualified by social support (Chen et al., 2005). The significance of these findings lies in their implications for characterizing the interplay between religiousness and other psychosocial factors that may influence cardiovascular risk, and in the plausibility of hypotheses in which these factors are linked to health outcomes through pathogenic physiological processes.

The data pattern we obtained might reflect effects attributable to the quality rather than the amount of religious involvement. That is, religious activities that accompany engagement in supportive social interactions may be more protective of health than those that are not. Indeed, under the conditions of the present study, participants high in religiousness who reported low levels of social support showed a relatively high degree of SBP reactivity (see Figure 1). Given the paucity of relevant studies, precisely how religiousness interacts with perceived social support in influencing CVR is a matter for speculation at the present time. However, results from this study support conceptualizing social support as a multidimensional construct (Uchino et al., 1996) and provide a further basis for suggesting that its effects on CVR interact with those of other psychosocial factors such as religiousness and trait hostility (e.g., Smith, Ruiz, & Uchino, 2004).

**Limitations**

As previously discussed, this study evaluated only the limited aspects of multidimensional constructs such as religiousness and social support. Inclusion of other measures such as religious orientation and specific forms of religious involvement and social relationships may provide additional insight into the
effects of religion and social support on CVR. Moreover, given the nature and possible interplay of religion and social support, the use of more relevant stress tasks may be an important consideration. For example, research that taps into more severe stress experiences in which religion’s role is more salient (Fontana & Rosenheck, 2004) or that manipulates the participants’ social relationships (e.g., Gallo, Smith, & Kircher, 2000) may be appropriate to identify the processes that underlie statistical interactions between religiousness and perceived social support in predicting CVR.

Conclusions

Religious involvement, which has only recently begun to attract attention as a possible protective factor in the development of CHD, may interact with psychosocial risk factors, such as social isolation, in influencing CVR. Replications of these results, and extensions that involve the explicit measurement of social network structure and quality, may provide greater insight into the contribution of personality and social relationships to cardiovascular disorders than would research directed at detecting simple main effects or examining predictors of CVR that are not linked epidemiologically to CHD.

References


