

Religion, Psychopathology, and Substance Use and Abuse: A Multimeasure, Genetic-Epidemiologic Study

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Objective: The authors sought to 1) understand the sources of familial resemblance for religiosity, 2) clarify the relationship between religiosity and current psychiatric symptoms, current substance use, lifetime psychiatric disorders, and lifetime substance dependence, and 3) explore the stress-buffering properties of religiosity. **Method:** Data were obtained by personal interview of 1,902 twins from female-female pairs in the population-based Virginia Twin Registry. Measures included 1) 10 items reflecting a range of religious behavior and beliefs, 2) a scale of institutional conservatism of current religious affiliation, 3) previous history of stressful life events, 4) current psychiatric symptoms and substance use, and 5) lifetime psychiatric disorders and substance dependence. Statistical methods used included factor analyses, Cox and linear regression, and twin modeling. **Results:** Personal devotion and personal and institutional conservatism were all strongly familial, and model fitting suggested that this familial resemblance was due largely to the effect of environmental factors. None of the dimensions of religiosity was strongly associated with lifetime psychopathology or current symptoms, but low levels of depressive symptoms were related to high levels of personal devotion. By contrast, personal devotion and personal and institutional conservatism were significantly and inversely associated with current levels of drinking and smoking as well as lifetime risk for alcoholism and nicotine dependence. Personal devotion, but not personal or institutional conservatism, buffered the depressogenic effects of stressful life events. **Conclusions:** The dimensions of religiosity are not strongly related to risk for psychiatric symptoms and disorders. However, religiosity may be one of the more important familial-environmental factors that affect the risk for substance use and dependence. Religious devotion but not conservatism assists in coping with stress.

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Given its importance in human society and behavior (1), religion is relatively neglected in empirical studies exploring the etiology of mental illness and sub-

stance abuse (2-5). In major psychiatric journals, measures of religion are reported only rarely, and, when assessed, over 80% of studies examined only one variable, usually affiliation (3). Such single measures are problematic because religiosity is multidimensional, including aspects of affiliation, devotion, and beliefs (6).

Religiosity is particularly interesting from a genetic-epidemiologic perspective. It is strongly familial, and resemblance in siblings is due largely to shared environmental exposure to the religious beliefs of parents, peer group, and community (7-10).

Although it is difficult to detect familial-environmental influences on personality (11) and psychiatric disorders (e.g., major depression [12-14], anxiety disorders [15, 16], and schizophrenia [17, 18]), twin and adoption studies have often found evidence for such factors in substance use and dependence (references 19-30, for example). Given the finding that religiosity may be more strongly related to substance use and abuse

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than to psychiatric disorders (2, 31–34), could religiosity be partly responsible for this pattern of findings?

The relationship between religiosity and psychopathology may not be a static one. In particular, religiosity might act as a buffer against the pathogenic effects of adversity (35–38).

In this paper, we address four questions about religiosity and psychopathology in a population-based sample of female twins ascertained from the Virginia Twin Registry: 1. With the available items, what dimensions of religious beliefs and behaviors can be identified? 2. What are the relative contributions of genetic and environmental factors to twin resemblance for these dimensions of religiosity? 3. What is the relationship between dimensions of religiosity and current psychiatric symptoms and alcohol and tobacco use on the one hand and lifetime risk for psychiatric disorders, alcoholism, and nicotine dependence on the other? 4. Do dimensions of religiosity buffer the depressogenic effects of stressful life events?

METHOD

Sample

We studied Caucasian, female, same-sex twins for this report. These twins are part of a longitudinal study of genetic and environmental risk factors for common psychiatric disorders. The twins, ascertained from the population-based Virginia Twin Registry, were eligible to participate in this study if both members of the pair had previously responded to a mailed questionnaire, to which the individual response rate was 64%. In our first personal interview, we succeeded in interviewing 92% of the eligible individuals ($N=2,163$). Ninety percent of the interviews were face-to-face; the rest were completed by telephone. Written informed consent was obtained prior to all face-to-face interviews. The mean age of the participating twins was 30.1 years ($SD=7.6$). Zygosity was determined blindly by using standard questions (39), photographs, and, when necessary, DNA (40).

Since the original interview, we have completed two additional waves of telephone interviews, which succeeded in interviewing 2,001 (92.5%) and 1,902 (87.9%) of the original sample, respectively. The mean number of months between the first and third interviews was 61.3 ($SD=5.1$). In the third interview, we assessed both members of 849 pairs, 496 of whom were monozygotic and 353 of whom were dizygotic.

Measures

Our first personal interview assessed lifetime diagnoses of major depression, generalized anxiety disorder, panic disorder, bulimia, phobia, and alcohol dependence. In addition, major depression and generalized anxiety disorder in the past year were assessed during the second and third waves of telephone interviews. Major depression and alcohol dependence were assessed by computer algorithm according to DSM-III-R criteria. For generalized anxiety disorder, we used the symptomatic criteria of DSM-III-R but followed DSM-III in requiring a 1-month minimum duration of illness. Phobia was defined as the presence of one of 17 specific fears that the respondent considered to be irrational, which, in the interviewer's judgment, produced objective behavioral interference with the respondent's life (41). To maximize the power of our analyses, we used broader definitions of bulimia and panic disorder because our previous analyses have shown that additional "possible" cases of illness were on the same continuum of liability as those diagnosed with greater certainty (16, 42). We also examined a broader definition of alcoholism in this sample by adding "problem drinking," which defines individuals who appear to have a milder disturbance on the same liability dimension that influences alcohol dependence (43).

At both the first and third personal interviews, current psychiatric symptoms were assessed by using 30 items selected from the SCL-90 (44). As shown elsewhere (45), VARIMAX factor analysis extracted four symptom scales—depression, panic-phobia, somatization, and insomnia—which we analyze here. We also recorded the presence and month of occurrence of nine personal and 22 network stressful life events, the details of which have been outlined elsewhere (46).

In the third interview, we assessed average monthly alcohol consumption and average daily cigarette intake over the last year. In addition, for subjects who had ever been smokers, we obtained Fagerstrom Tolerance Questionnaire (47) data at the time of their heaviest cigarette consumption. We defined as nicotine dependent any individual with a history of regular smoking and a Fagerstrom Tolerance Questionnaire score of 7 or more.

In our first interview, we assessed religious affiliation by asking the twins, "What is your religious preference—Protestant, Catholic, Jewish or something else?" If they responded "Protestant," we then inquired as to their specific denomination. "No preference" was also a permitted response. From the responses on religious affiliation, we developed an institutional conservatism scale.

The institutional conservatism scale was developed in two stages. First, on the basis of scales developed by the Institute for Social Research, we tentatively ranked the affiliations into five groups of decreasing conservatism: 1) fundamentalist Protestant, 2) Baptist, 3) Catholic, 4) mainline Protestant, and 5) other or unaffiliated. Baptists were assigned their own category both because they were the most common denomination in our sample and because, in Virginia, Baptists generally occupy a "middle ground" on principles of faith between more conservative (e.g., Church of God, Pentecostal Assembly of God, Jehovah's Witnesses) and more mainline (e.g., Episcopalian, Methodist, Presbyterian) Protestant denominations.

In the second stage of scale development, we attempted to validate our putative ordering of affiliations using as validation criteria the two self-report measures of personal devotion and personal conservatism. That is, we expected the average member of a more conservative sect to have a higher level of personal devotion and personal conservatism. Our ordering was validated by these scale scores with one exception: Catholics on average had both lower mean personal devotion and lower mean personal conservatism scores than mainline Protestants.

Of the 1,902 subjects in the sample, 297 (15.6%) were fundamentalist Protestant, 656 (34.5%) were Baptist, 668 (35.1%) were mainline Protestant, 177 (9.3%) were Catholic, and 104 (5.5%) were other or unaffiliated. The mean personal devotion and personal conservatism levels, respectively, for fundamentalist Protestant, were 0.24 ($SD=0.96$) and 0.49 ($SD=0.81$); for Baptist, 0.11 ($SD=0.93$) and 0.37 ($SD=0.82$); for mainline Protestant, 0.00 ($SD=0.99$) and -0.31 ($SD=0.97$); for Catholic, -0.27 ($SD=1.01$) and -0.48 ($SD=0.91$); and for other or unaffiliated, -0.79 ($SD=1.04$) and -0.53 ($SD=1.25$). Although the mean levels of personal devotion and personal conservatism declined monotonically across the categories, it is noteworthy that substantial variation existed within each group.

In our first interview, we also inquired about the frequency of attendance at religious services or meetings; the six possible responses ranged from "more than once a week" to "never." The third interview inquired again about the frequency of attendance at religious services and also contained nine other questions designed to assess a range of attitudes and beliefs about religion. These items, summarized in table 1, were selected from those used in the National Comorbidity Survey (48), a Gallup poll (1), and the religiousness scale of Strayhorn et al. (49).

Statistical Methods

Factor analysis was conducted by using the method of rotated principal components (50) (SAS routine PROC FACTOR [51]) and traditional eigenvalue criteria. Both orthogonal VARIMAX and oblique PROMAX rotations were used. The relationships between the dimensions of religiosity and psychiatric symptoms and current alcohol and cigarette use were assessed by using linear regression analysis.

We assessed the "buffering" effect of religiosity by examining interactions, in linear regression, between stressful life events (occurring

TABLE 1. Factor Structure of 10 Religiosity Items for 1,902 Female Twins From the Virginia Twin Registry

Religiosity Item Summary	Factor Loading	
	Personal Devotion	Personal Conservatism
Importance of religious beliefs	0.82	0.25
Frequency of church attendance	0.75	0.16
Consciousness of religious purpose	0.79	0.22
Frequency of seeking spiritual comfort	0.80	0.18
Frequency of private prayer	0.80	0.26
Dissatisfaction with spiritual life	-0.57	0.17
Belief in God	0.22	0.40
Belief that God rewards and punishes	-0.06	0.76
Belief in being "born again"	0.41	0.51
Literal belief in Bible	0.09	0.75

in the month of the interview and the previous month) and the dimensions of religiosity in the prediction of depressive symptoms. To reduce the possibility of correlated errors of measurement, we performed these analyses using religiosity as assessed at our third interview to predict the depressive response to stressful life events assessed 5 years earlier at our first personal interview with this sample of twins.

The relationship between the religiosity dimensions and lifetime risk for psychiatric and substance dependence disorders was assessed by using the Cox proportional hazards method (operationalized in the PHREG procedure in SAS [51]). Given the multiple tests performed, we report as significant only results with two-tailed $p \leq 0.01$, noting results with p values of 0.01 and 0.05 as trends.

Twin model fitting was carried out by using Mx (52). Further details of twin model fitting can be found elsewhere (53, 54). Very briefly, the goal of model fitting is to partition the variance in the dimensions of religiosity into those due to genetic effects, those due to familial-environmental effects, and those due to environmental experiences unique to the individual (which cannot, with a single occasion of measurement, be distinguished from measurement error). We began by testing a full model containing all three parameters. We then tested, by chi-square difference tests, the fit of two simpler models against this full model: 1) a model postulating that familial resemblance for religiosity is due solely to familial-environmental effects, and 2) a model postulating that familial resemblance for religiosity is due solely to additive genetic effects. We then report parameter estimates from the best-fitting model.

For the two factors derived from our religiosity items, we performed twin analyses directly on the variance-covariance matrices for monozygotic and dizygotic pairs. The analysis of denominational affiliation was more problematic. We assumed that our institutional conservatism scale could be treated as an ordinal scale. With multiple categories, the validity of this model can be directly tested using contingency tables for monozygotic and dizygotic twins (55). For institutional conservatism, these models fail badly, largely due to a deficiency of twin pairs where one was Catholic and the other Baptist or mainline Protestant. Lacking a more satisfactory approach to analysis, we ignored this complication and proceeded with model fitting of the scale, assuming unidimensionality.

RESULTS

Factor Analysis

Two factors were extracted; we called these factors "personal devotion" and "personal conservatism." The factor loadings, obtained by VARIMAX rotation, are given in table 1. The factor of personal devotion had high loadings (≥ 0.75) on five items reflecting the level of personal religious commitment and devotion.

The three items with the highest loading for this factor were 1) "How important are your religious and spiritual beliefs in your daily life?" 2) "When you have problems or difficulties in your family, work, or personal life, how often do you seek spiritual comfort?" and 3) "Other than at meal time, how often do you pray to God privately?"

The factor of personal conservatism had high loadings (≥ 0.75) on two items ("Do you believe that God or a universal spirit observes your actions and rewards or punishes you for them?" and "Do you agree with the following statement: 'The Bible is the actual word of God and is to be taken literally, word for word?') and moderate loadings (≥ 0.40) on another two (including the belief in being "born again"). We called this factor "personal conservatism" because these items reflect traditional, fundamentalist, and/or conservative Christian beliefs. We also submitted these items to an oblique PROMAX rotation. The factor structure obtained was very similar to that seen in table 1. The correlation between personal devotion and personal conservatism was $r = 0.33$.

While these factors reflected personal beliefs, we also created a five-category scale of institutional conservatism. The Spearman rank correlations between institutional conservatism and personal devotion and personal conservatism ($N = 1,860$) were moderate: $r_s = 0.18$ and $r_s = 0.38$, respectively (both $p < 0.0001$).

Twin Analysis

The correlation in levels of personal devotion, personal conservatism, and institutional conservatism far exceeded chance expectations in both monozygotic and dizygotic twins (table 2). Long-term test-retest reliability was available for only one item: frequency of church attendance. For this item, over a mean of 61 months, $r_s = 0.61$ ($N = 1,855$)—a correlation similar to that found previously (35).

Correlations were higher in monozygotic than in dizygotic twins for all three measures, although the differences were quite modest for both personal and institutional conservatism. Model fitting suggested that family environment made an important contribution to twin resemblance in all three dimensions of religiosity. For personal conservatism, no evidence was found for the impact of any genetic factors, but for institutional conservatism such factors appeared to play a minor role. By contrast, according to the best-fitting twin model, over a quarter of the variance of personal devotion was due to the influence of genetic factors.

Prediction of Current Symptoms and Substance Use

By regression analysis (all $df = 1,854$), age was positively related to personal devotion ($t = 8.84$, $p < 0.0001$) and institutional conservatism ($t = 2.29$, $p = 0.02$) and negatively related to personal conservatism ($t = 2.82$, $p = 0.005$). Number of years of education was positively associated with personal devotion ($t = 5.34$, $p < 0.0001$) but negatively associated with personal conservatism ($t =$

TABLE 2. Correlations Between Twins and Model Fitting for Three Dimensions of Religiosity Among 1,902 Female Twins From the Virginia Twin Registry

Dimension of Religiosity	Correlation (r) Between Twins		Model Fitting ^a (χ^2)			Parameter Estimate of Best-Fitting Model ^b (proportion of variance)		
			Three Parameters (df=4)	Familial-Environmental Effects (df=5)	Genetic Effects (df=5)	Additive Genetic Effects	Common or Familial Environment	Individual-Specific or Unique Environment
	Monozygotic	Dizygotic						
Personal devotion	0.52	0.40	2.29 ^c	11.10	9.03	0.29	0.24	0.47
Personal conservatism	0.47	0.43	3.30	4.95 ^c	17.32	—	0.45	0.55
Institutional conservatism	0.63	0.57	0.00 ^c	2.90	43.75	0.12	0.51	0.37

^aModels were fit to variance-covariance matrices for personal devotion and personal conservatism and to polychoric correlations for institutional conservatism. Therefore, the degrees of freedom are correct as given for the first two variables, but for institutional conservatism they are 0, 1, and 1, respectively.

^bFamilial resemblance in religiosity due to genetic effects, familial-environmental effects, and environmental experiences unique to the individual.

^cBest-fit model by Akaike's information criterion (56).

16.64, $p < 0.0001$) and institutional conservatism ($t = 5.67$, $p < 0.0001$). None of the three dimensions of religiosity differed significantly in monozygotic compared with dizygotic twins. Therefore, further analyses of personal devotion, personal conservatism, and institutional conservatism were controlled for education and age.

Only one of the 12 associations examined between religiosity and current psychiatric symptoms was statistically significant: personal devotion was inversely related to depressive symptoms (table 3). By contrast, all three dimensions of religiosity were significantly and inversely related to current alcohol use (table 3). Current tobacco use was significantly and inversely related to levels of personal devotion and institutional conservatism (table 3).

Prediction of Lifetime Psychiatric and Substance Use Disorders

Of the 15 associations examined between dimensions of religiosity and the lifetime risk of psychiatric disorders, one was statistically significant: institutional conservatism was inversely related to lifetime risk for major depression (table 4). By contrast, personal devotion, institutional conservatism, and personal conservatism were all inversely and significantly related to the risk for problem drinking (table 4). Only institutional conservatism was significantly related to risk for narrowly defined alcoholism, although both personal devotion ($\chi^2 = 6.17$, $df = 1$, $p = 0.013$) and personal conservatism ($\chi^2 = 4.45$, $df = 1$, $p = 0.04$) were associated at the trend level (table 4). The risk of lifetime nicotine dependence was significantly and inversely related to levels of personal devotion, and a trend in the same direction was noted for institutional conservatism ($\chi^2 = 4.67$, $df = 1$, $p = 0.03$) (table 4).

Religiosity as a Buffering Agent

The number of stressful life events in the 2 months prior to interview was associated with a significantly higher number of depressive symptoms ($t = 8.16$, $df = 1660$, $p < 0.0001$). Controlling for age, educational level, and

TABLE 3. Results of Regression Analyses of Relationship Between Three Dimensions of Religiosity and Current Psychiatric Symptoms, Alcohol Use, and Cigarette Consumption

Symptom Dimension	Regression Coefficient (df=1854)		
	Personal Devotion	Personal Conservatism	Institutional Conservatism
Depression ^a	-0.09**	0.02	-0.03
Panic-phobia ^a	-0.01	0.02	0.00
Somatization ^a	0.03	0.05	0.02
Sleep ^a	-0.02	-0.01	0.04
Alcohol use ^b	-2.77**	-2.10**	-2.43**
Smoking ^c	-1.59**	-0.41	-0.58*

^aExpressed in standardized units (e.g., a value of -0.09 means that for every standard deviation change in personal devotion, depressive symptoms decline 9% of a standard deviation). Psychiatric symptoms were measured by subscales of the SCL-90 (44).

^bIn units of drinks per month.

^cIn units of cigarettes per day.

* $p < 0.01$. ** $p < 0.0001$.

the interaction between educational level and stressful life events, we found that high levels of personal devotion were associated with less of a response to the depressogenic effects of stressful life events (regression coefficient = -0.04, $t = 2.50$, $p = 0.01$). However, neither personal conservatism (regression coefficient = 0.03, $t = 1.44$, $p = 0.15$) nor institutional conservatism (regression coefficient = 0.01, $t = 0.45$, $p = 0.65$) were associated with a significant change in sensitivity to the depressogenic effects of stressful life events.

DISCUSSION

Although we examined only a limited number of aspects of religious behavior and beliefs (6), our results show that religiosity is a multidimensional construct. We found two distinct factors, personal devotion and personal conservatism, that were only modestly correlated. Since these two factors reflected personal beliefs, we also included a measure of religious affiliation—the most commonly used religiosity measure in mental health research (3).

TABLE 4. The Relationship Between Three Dimensions of Religiosity and the Lifetime Risk of Psychiatric Disorders and Substance Dependence

Disorder	Relative Risk ^a		
	Personal Devotion	Personal Conservatism	Institutional Conservatism
Major depression	1.02	0.94	0.91*
Generalized anxiety disorder	0.98	0.97	0.96
Panic disorder	0.95	0.86	0.97
Phobia	0.99	0.96	1.04
Bulimia	0.91	1.07	0.90
Alcoholism	0.82	0.83	0.80*
Problem drinking	0.82*	0.82*	0.81*
Nicotine dependence	0.79*	0.89	0.86

^aRelative risk by Cox Proportional Hazard, controlling for birth year and educational status; relative risk standardized to reflect change in risk per standard deviation change in predictor variable.

* $p < 0.01$.

The validity of these factors was tested in three ways. First, they were substantially correlated in twin pairs. Second, the pattern of twin resemblance differentiated personal devotion from personal conservatism. Third, the pattern of relationships between these dimensions of religiosity and our outcome measures differed significantly.

The "Genetics" of Religiosity

Twin resemblance for personal conservatism could be explained solely on the basis of shared environmental experiences (e.g., community, parental, and peer group influences). Similarity for institutional conservatism in twins also largely resulted from shared environment, although genetic factors played a minor role. By contrast, family environment and genetic factors made similar contributions to twin resemblance for personal devotion. Although measures of religious conservatism appear to be largely cultural in origin, the intensity of an individual's personal religious involvement appears to be influenced by both environmental experiences and temperamental factors that are partly under genetic control (57).

Twin studies of religiosity are relatively rare. In adolescent twins, Loehlin and Nichols (7) found that the frequency of religious activities (e.g., prayer and Bible reading) were substantially correlated in twin pairs and that there were only modestly higher correlations in monozygotic than in dizygotic pairs. Rose (9) found a similar pattern for the religious orthodoxy factor from the MMPI in young adult twin pairs. In contrast to the MMPI scales assessing temperament, where twin resemblance was mostly genetic in origin, twin resemblance for religious orthodoxy was largely due to familial environmental influences (familial environmental influences=0.61, additive genetic effects=0.10). In a large twin-family study, Truett et al. (10) reported that resemblance in relatives for frequency of church attendance is substantially influenced by familial-environmental factors. By contrast, Waller et al. (58) examined five measures of religiosity in adult twins reared together and apart and reported substantial heritability

for all scales, including an MMPI-based measure of religious fundamentalism. Their analyses suggested that familial-environmental factors played at most a minor role in their religiosity dimensions.

Religiosity and Psychiatric Symptoms and Illness

We found little overall evidence for a relationship between religiosity and current psychiatric symptoms or lifetime psychopathology. Of the 27 separate analyses, two were statistically significant—both involving an inverse relationship between religiosity and depression. Several previous reviews have indicated a range of relationships between religiosity, variously defined, and a wide array of mental health measures. Bergin (59) reported that 23% of studies found a negative relationship between religiosity and mental health, 47% a positive relationship, and 30% no relationship. In a more recent review, Larson and Larson (3) noted 16% negative, 72% positive, and 12% no relationship.

Our finding, however, is not without specific precedent. Gartner et al. (2) concluded that "the preponderance of evidence suggests that religiosity is associated with lower levels of depression." Overall, our data suggest that, aside from a possible relationship between religious devotion and symptoms of depression, individual differences in religiosity in a general population sample bear little relationship to individual differences in current or lifetime psychopathology.

Religiosity and Substance Use and Dependence

Both population surveys (32, 33, 60) and clinical studies (2, 31) have noted that religiosity is significantly and inversely related to alcohol and drug use. Our results extend and confirm these observations. Nicotine and alcohol use are significantly related to one or more of our three dimensions of religiosity. Consistent with the findings of previous studies (2), current use of alcohol and nicotine were most strongly and negatively related to personal devotion. In addition, religiosity was negatively associated with a lifetime history of alcoholism and nicotine dependence, and the strength of the associations was slightly stronger for personal devotion and institutional conservatism than for personal conservatism.

We explored further the relationship between religiosity and alcohol and nicotine use and dependence. First, although all three dimensions of religiosity were strongly associated with current alcohol consumption rather than abstinence, among current drinkers, the amount of alcohol consumed was strongly related to personal devotion and institutional conservatism but not to personal conservatism. Second, high levels of personal devotion, personal conservatism, and institutional conservatism were all associated with a low risk for a lifetime history of regular smoking. Among individuals who were ever regular smokers, current smoking status was significantly related only to personal de-

votion and not to either personal conservatism or institutional conservatism. Among current smokers, the number of cigarettes consumed was significantly associated only with personal devotion.

Although further work will be needed to refine these analyses, they suggest that the dimensions of religiosity may have an impact at different points in the causal pathway to substance use and abuse. Traditional religious beliefs may be most important in the decision to ever use a substance, but religious devotion may particularly influence the ability to quit or maintain low levels of use.

Religiosity and Stress

Consistent with most previous studies (35–38), we found that high levels of religiosity were associated with lower levels of the depressogenic effects of stressful life events. This finding was restricted to personal devotion—*not* to measures of religious conservatism. Pressman et al. (38) found that a measure of religiosity similar to our personal devotion scale significantly predicted better psychological and physical coping in elderly women after hip fracture. In a general population sample from New Haven, Conn., Williams et al. (35) found that frequency of religious attendance (an item on our personal devotion scale), but *not* affiliation, significantly buffered the impact of stressful life events on a general psychological distress measure.

Main Conclusions

We draw four major conclusions from this work. First, religiosity is a prominent and complex aspect of human culture that has been relatively neglected in comprehensive biopsychosocial models of psychopathology. Second, in contrast to most forms of psychopathology, religiosity is strongly influenced by familial environmental factors. Third, religiosity has a stronger relationship with substance use and abuse than with current or lifetime psychiatric symptoms or disorders. Fourth, the evidence for familial-environmental effects commonly detected in twin and adoption studies for drug and alcohol use and abuse but only rarely for psychiatric disorders may be a result of religiosity.

Limitations

The results presented here rely on assessment of religiosity at a single time point, limiting our ability to infer the causal nature of the observed relationships. Although the associations may be causal (e.g., high levels of religiosity might directly reduce the risk for alcoholism), two other mechanisms are plausible. First, religiosity could be a consequence of psychiatric dysfunction or substance abuse/dependence (e.g., high levels of alcohol intake might lead to increased religiosity as part of an effort to abstain from alcohol). Second, the more public aspects of religiosity, particularly church attendance, could be reduced by the adverse

impact of psychopathology or substance abuse on social and occupational functioning (e.g., attending church requires transportation, comfort in social circumstances, etc.) (61).

We evaluated the first hypothesis in two ways. To explore if individuals with alcohol problems use religion as a means to reduce alcohol intake, we examined the association between religiosity and alcohol intake after removing all individuals with a history of alcohol problems. The association between the dimensions of religiosity and current alcohol intake remained highly significant.

Because we have longitudinal data over a 5-year period on both alcohol intake and frequency of church attendance, we also examined the first hypothesis by using a cross-lagged panel structural equation model (62), which allowed us to examine whether alcohol intake at time 1 predicted church attendance at time 2 and vice versa. Both cross-variable, cross-time correlations were highly significant. However, the association between church attendance at time 1 and alcohol intake at time 2 was stronger than between alcohol intake at time 1 and church attendance at time 2.

Addressing the second hypothesis, we noted that all the items loading highly on our personal devotion scale except church attendance reflected personal beliefs rather than public behaviors. Therefore, we examined whether psychopathology and substance use reduced public religious observance because of social or occupational dysfunction by repeating our analyses after removing church attendance from the personal devotion scale. The association between personal devotion and current and lifetime psychopathology and substance use or dependence changed very little. Although not definitive, these additional analyses suggest that at least part of the observed relationship between religiosity and depressive symptoms and alcohol and nicotine use and abuse is likely to be causal.

The second potential methodologic limitation of this study is that our twin modeling did not include parental measures of religiosity. Parents are likely to be highly correlated for various dimensions of religiosity, and such assortative mating can inflate estimates of the familial environment (63).

A third limitation is that our twin sample consisted only of women, and there is evidence that the relationship between psychopathology and religiosity may differ between genders (64).

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