



Resiliency factors protecting against teenage alcohol use and smoking: influences of religion, religious involvement and values, and ethnicity in the Missouri Adolescent Female Twin Study

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The objective of this study was to investigate the contribution of ethnicity (African American vs European/other ancestry), family religious affiliation, religious involvement, and religious values, to risk of alcohol and cigarette use in adolescent girls; and to estimate genetic and shared environmental effects on religious involvement and values. Telephone interviews were conducted with a sample of female like-sex twin pairs, aged 13–20 ($n = 1687$ pairs, including 220 minority pairs), as well as with one or both parents of twins aged 11–20 ($n = 2111$ families). These data, together with one-year follow-up twin questionnaire data, and two-year follow-up parent interview data, were used to compare ethnic differences. Proportional hazards regression models and genetic variance component models were fitted to the data. Despite higher levels of exposure to family, school and neighborhood environmental adversities, African American adolescents were less likely to become teenage drinkers or smokers. They showed greater religious involvement (frequency of attendance at religious services) and stronger religious values (eg belief in relying upon their religious beliefs to guide day-to-day living). Controlling for religious affiliation, involvement and values removed the ethnic difference in alcohol use, but had no effect on the difference in rates of smoking. Religious involvement and values exhibited high heritability in African Americans, but only modest heritability in EOAs. The strong protective effect of adolescent religious involvement and values, and its contribution to lower rates of African American alcohol use, was confirmed. We speculate about the possible association between high heritability of African American religious behavior and an accelerated maturation of religious values during adolescence.

Keywords: alcohol, African American, religious values, adolescence

Introduction

There is remarkably consistent evidence for genetic effects on individual differences in behavior, across a wide variety of assessment domains including personality,^{1,2} social attitudes,^{1,3} cognition,⁴ a range of psychiatric disorders and emotional and behavioral problems,⁴ and substance use disorders such as alcohol dependence,⁵ persistent long-term smoking⁶ and drug abuse or dependence.⁷ Whilst there is equally robust evidence for the importance of non-shared environmental influences – environmental effects that create differences in risk even among siblings reared in the same family – on all of these outcome measures, evidence for shared environ-

mental influences has been much weaker. Even in the case of social attitude measures, whether or not there are important shared environmental influences remains controversial,^{1,3} although more robust evidence for such influences is seen in the case of adolescent social attitudes.⁸

Two domains where shared environmental influences have been consistently found are in the domain of religious affiliation,⁹ and in the initiation of alcohol use¹⁰ and tobacco use.^{6,11} In this paper, we examine the extent to which religious affiliation and religiosity are important protective factors against alcohol or tobacco use in adolescence. Since rates of alcohol use and tobacco use among African American adolescents have consistently been found to be lower than in other adolescents^{12–18} and since we know that African Americans report higher levels of religiosity and religious involvement,^{19–21} we examine the extent to which these differences in religious behavior are contributing to differences in risk of teenage alcohol and tobacco use.

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Methods

Sample

Telephone interview data were obtained from a large sample of adolescent female twin pairs and their parents, as part of a prospective study of the determinants of alcoholism risk in adolescent girls and young women. All twin pairs live-born in Missouri to Missouri-resident parents between 1968 and 1997 have been identified from a computerized database of birth records. A cohort-sequential sampling design^{22,23} was used for ascertainment of twin pairs born between July 1975 and December 1987, as summarized in Figure 1. The advantage of such a design was that over a brief 3-year period, cohorts of 13-year-olds are followed up to age 15, 15-year-olds up to age 17, 17-year-olds up to age 19, and 19-year-

olds up to age 21. Thus, over a brief period of data collection, developmental transitions across a wide age span could be studied in a genetically informative design. The fourth wave of data collection for this study is just beginning: the addition of a fourth wave of measurement increases the complexity of developmental genetic models that can be tested.²⁴

Interviews were scheduled with a delay of as much as 6 months between the timing of parent and twin interviews. During 1995 and 1996, interviews were attempted with one or both parents and both twins from female like-sex twin pairs aged approximately 19.5, 17.5, 15.5 and 13.5 years, with continuing recruitment from 1997 until July 1998 of new cohorts of 13-year-old twins. In the third year of data collection, assessment of cohorts of 11-year-olds was also added to the protocol for both scientific and

AGE AT ASSESSMENT

BIRTH COHORT:	Live Pairs	Future			
		<i>Wave 1</i>	<i>Wave 2</i>	<i>Wave 3</i>	<i>Wave 4</i>
7/75 - 6/76	195	19 → (20)	→ 21	→ (22)	
7/76 - 6/77	208		19 → (20)	→ 21	
7/77 - 6/78	207	17 → (18)	→ 19	→ (20)	
7/78 - 6/79	230		17 → (18)	→ 19	
7/79 - 6/80	245	15 → (16)	→ 17	→ (18)	
7/80 - 6/81	254		15 → (16)	→ 17	
7/81 - 6/82	259	13 → (14)	→ 15	→ (16)	
7/82 - 6/83	249		13 → (14)	→ 15	
7/83 - 6/84	280			13 → (14)	
7/84 - 6/85	274				13
7/85 - 6/86	247			11 ^P	→
7/86 - 7/87	272				11 ^P
2,920					

Figure 1 Cohort sequential sampling design employed in the Missouri Adolescent Female Twin Study (MOAFTS). ^P denotes parent interview only; () denotes abbreviated one-year twin follow-up interview and self-administered questionnaire only; all other interviews are with both twins and parents

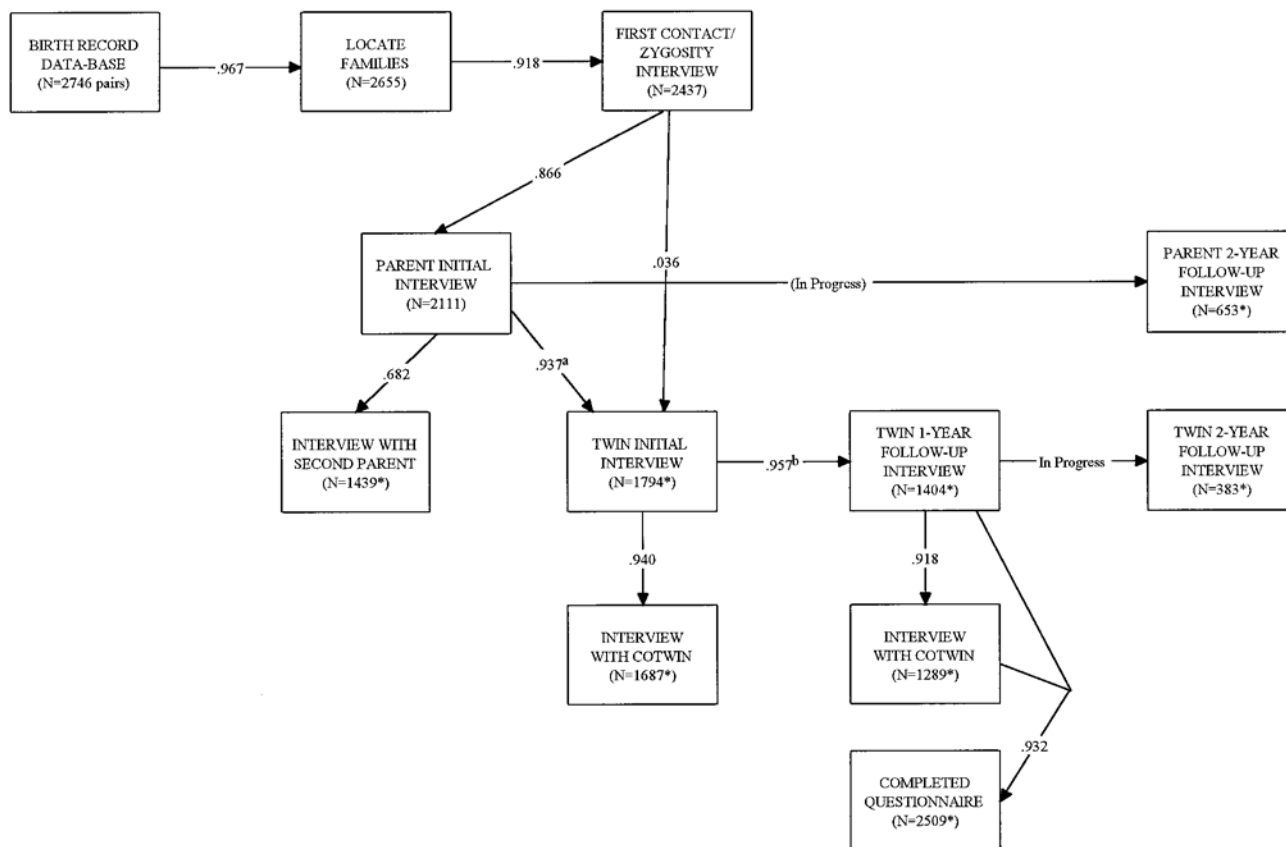


Figure 2 Progress in ascertainment, tracing and initial and follow-up assessment with female twin pairs born July 1975–December 1986. Conditional probabilities of successful completion of each stage are shown, eg 96.7% of families identified from birth records were successfully located; and 91.8% of located families completed a brief zygosity interview. In 3.6% of families we obtained a twin interview but no parent interview. ^alimited to twin pairs aged 13 years or older who were eligible for interview; ^blimited to first eight birth cohorts for whom one-year interview follow up is essentially incomplete; *interviews still in progress

pragmatic reasons: scientific, because of concern that there was a trend for mothers of older twins to be less likely to report a lifetime history of alcohol dependence than mothers of younger twins (raising concern that mothers exposed to problem-drinking in adolescent girls and their friends tended to downplay the significance of their own past problems with alcohol); and pragmatic, because of concern that possible future changes in the regulation of access to state records used to trace families would otherwise make it impossible to complete the design of the study. Excluding twin pairs from the last cohort born in 1987 who were still being traced, a total of 2746 pairs where both twins were apparently born live were ascertained from birth records.

Progress in tracing and assessment of twin pairs and their families is summarized in Figure 2. After tracing the families, using computerized tracing procedures described elsewhere,²⁵ a brief initial telephone zygosity assessment was successfully completed with one parent or guardian from each family (or occasionally a twin aged 18 or older) from 2437 families, a total of 88.8% of all families with

live-born pairs identified from birth records. Where families were cooperative, telephone interviews were scheduled with both parents and with twin pairs aged 13 years and older. For families with twin pairs aged 11 years, interviews were scheduled with the parents, but no interviews with the twins were attempted before their 13th birthday. Initial interviews have been completed with 2014 biological mothers (from 79.5% of families that had completed a zygosity interview), 1645 fathers or other adoptive or step-parents, and with 3481 female twins, including both twins from 1687 pairs. Excluding families with twins aged under 13 (who were not yet eligible to be interviewed), interviews were thus completed with both twins from 68% of all live-born pairs, and 76% of pairs from families that had been traced successfully. Included in this total were 474 minority female twins, including 220 complete pairs, most being of African American ancestry. In the analyses reported here, we focus on self-report data from 1331 pairs for whom editorial reviews of the initial adolescent interview had been completed at the time of writing (including 156 African American pairs). In

some analyses we also use data from the one-year follow-up questionnaire mailing of the twins (which was co-ordinated with a brief one-year follow-up telephone interview) and two-year telephone interview follow-up of the mothers of the twins. Since follow-up studies are still in progress, numbers are substantially reduced for these latter assessments.

Assessment

The mother and each twin from a pair were interviewed by different interviewers, to avoid possible interviewer bias effects. Occasionally, where this could not be logistically avoided, the father was interviewed by an interviewer who had previously interviewed another family member. However, important interviewer bias effects are unlikely in these data since the volume of interviews being conducted was very high. Interviewees were mailed a Respondent Booklet which included a consent form, reviewed with the participant before the start of the interview, as well as visual prompts which allowed participants to respond to sensitive questions with a letter or number, thus avoiding the danger of a breach of confidentiality occurring during the course of the interview. The interview proceeded only after the participant had given verbal consent.

Major variables used in the present paper, and their operationalization, were as follows.

- (i) Religious affiliation Mothers were shown a list of 20 categories (including No Religion), and asked to indicate the religion or religions in which each twin was reared for the longest period. Only the primary religion (the religion in which a twin was reared for the longest period of time) was used for analysis in those rare families where twins were reared in more than one religion.
- (ii) Family norms for religious involvement- Mothers were asked how often each twin attended religious services, with answers on a

6-point scale ranging from 'More than once a week' to 'Never'. The vast majority of mothers gave identical answers for each twin, and we interpret this scale as a measure of family norms for attendance at religious services, rather than a measure of the twins' actual behavior.

- (iii) Religious involvement Twins were asked in the one-year follow-up mailed questionnaire (mailed at the time of the one-year follow-up interview) to report their frequency of attendance at religious services over the preceding six months, with response categories ranging from 'Once a week' or more to 'Never in the past six months'.
- (iv) Religious values The one-year follow-up questionnaire also included an assessment of religious values based on the work of Jessor and Jessor.²⁶ Twins were asked to respond to 4 questions about whether it was (a) not important, (b) somewhat important, or (c) very important to them to (i) 'be able to rely on religious teachings when you have a problem', (ii) 'to believe in God', (iii) 'to rely on religious beliefs as a guide for day-to-day living', (iv) 'to be able to turn to prayer when you're facing a personal problem'. The scale had acceptable internal consistency (African American: $n = 248$; $\alpha = 0.81$; European/other ancestry: $n = 2033$, $\alpha = 0.88$). However, in preliminary analyses it became clear that a single item was explaining the association with adolescent alcohol use and smoking, and that item was retained for the regression analyses (see Results below).
- (v) Alcohol use Twins were asked 'Have you ever taken a drink of beer, wine, wine cooler, hard liquor like gin, scotch or vodka, or any other kind of drink with alcohol in it? By a drink I mean a standard can or bottle of beer, a glass of wine or a shot of liquor'. Those who denied any alcohol use were given a second chance, with

Table 1 Structure of sample as a function of ethnicity, parent-reported zygosity, and age at initial parent interview. Percentages of pairs of a given ethnicity and age group classified as monozygotic or dizygotic are reported in parentheses

Age at parent interview	No of twin pairs			
	African American		European/other ancestry	
	Monozygotic	Dizygotic	Monozygotic	Dizygotic
11-12	18 (41.9%)	25 (58.1%)	146 (62.1%)	89 (37.9%)
13-14	30 (48.4%)	32 (51.6%)	312 (57.3%)	233 (42.7%)
15-16	18 (42.9%)	24 (57.1%)	174 (55.1%)	142 (44.9%)
17-18	24 (49.0%)	25 (51.0%)	159 (62.4%)	96 (37.6%)
19-20+	17 (42.5%)	23 (57.5%)	147 (57.0%)	111 (43.0%)
TOTAL	107	129	938	671

an additional probe 'So you've never had even one drink of alcohol?'. The age at first drink was obtained for those who reported any alcohol use. These questions were taken from the SSA GA.²⁷

- (vi) Tobacco use Twins were asked 'Have you ever smoked cigarettes or tried any other form of tobacco', with a follow-up question for those who said no: 'So you have never smoked even a few puffs of a cigarette or experimented even one time with any other form of tobacco? For those who reported any cigarette use, the age at first cigarette was obtained. These items were adapted from the UM-CIDI²⁸ using a format similar to that used with the SSA GA.

In addition, standard information about family income and maternal and paternal educational level and about mother's marital status, was obtained using questions taken from the UM-CIDI.²⁸ Items about perceived peer alcohol, tobacco and drug use were taken from the National Household Survey on Drug Abuse,²⁹ and were included in both the twin initial interview and one-year follow-up questionnaire, and the parent two-year follow-up interview. Items about school and neighborhood environment that might promote increased risk of alcohol or tobacco involvement were adapted from the work of Chassin, and included in the parent two-year follow-up interview.³⁰ Ethnicity was determined based on birth record data, but was found to show good agreement with self-report ethnicity based on maternal report in the two-year follow-up interview ($n = 1118$, $\kappa = 0.93$). Standard questions about twin pair physical similarity and confusion by teachers and strangers were used to determine twin pair zygosity: such methods have typically been found to give 95% agreement with zygosity determination by genotyping.¹

Data analysis

Simple descriptive statistics were computed, comparing African American families and families of European/other ancestry (EOA). Twin pair contingency tables were computed, separately for monozygotic and dizygotic pairs, for maternally reported and self-report frequency of attendance at church services, cross-classifying the responses of first born and second born twins. Additive genetic, shared environmental and non-shared environmental variance components, and their 95% confidence intervals, were estimated using MX.³¹ Predictors of adolescent onset of smoking or alcohol use were examined by fitting proportional hazards (PH) sur-

vival models, using SAS.³² Bootstrapping,³³ ie resampling from the observed data using the twin pair as the unit for resampling, with 3000 bootstraps per analysis, was used to obtain corrected 95% confidence intervals for risk ratios estimated in the

Table 2 Religious affiliation, twins' religious involvement and other sociodemographic characteristics of families participating in the MOAFTS Study

	African American (n=237 families)	European/ other ancestry (n=1608-1619 families)
Religious affiliation		
No religion	2.1%	6.3%
Baptist	60.9%	24.9%
Catholic	5.1%	29.7%
Church of Christ	5.1%	4.1%
Methodist	6.4%	7.8%
Lutheran	2.2%	4.3%
Presbyterian	1.3%	2.8%
Other Protestant (eg Assembly of God, Nazarene, Pentecostal etc)	10.6%	14.8%
Other religion	6.3%	5.3%
Twins' religious involvement (material report)		
Religious services		
More than weekly	22.4%	20.5%
Weekly	27.8%	26.4%
1-3 times per month	21.5%	18.0%
Less than monthly	19.0%	21.2%
Never	8.9%	13.3%
Unknown	0.4%	0.6%
Family income (annual)		
	\$	\$
10th percentile	4 500	16 500
25th percentile	10 500	28 500
50th percentile	19 500	45 500
75th percentile	37 500	62 500
90th percentile	62 500	87 500
Maternal education		
<12 years	16.0%	8.2%
12 years	37.1%	39.9%
13-15 years	35.0%	28.8%
16 years	6.8%	14.5%
17+ years	5.1%	8.7%
Paternal education		
<12 years	23.2%	10.3%
12 years	41.8%	40.7%
13-15 years	20.5%	20.3%
16 years	8.2%	15.4%
17+ years	6.4%	13.1%
Family intactness		
Biological parents still living together	28.4%	65.1%
Biological mother & step-parent	18.6%	18.6%
Biological mother, no co-parent	53.0%	16.2%
Unknown	0.0%	0.1%
Urban/rural status		
	(n=48)	(n=512)
Large city	60.4%	12.2%
Suburb of large city	22.9%	28.3%
Small city	2.1%	12.0%
Small town	12.5%	23.6%
Rural	2.1%	23.3%
Moved around a lot	-	0.6%

PH regression analyses, allowing for the non-independence of observations on twin pairs.

Results

Table 1 summarizes the breakdown of the sample by zygosity, ethnicity and age at initial assessment. The large number of twin pairs falling into the 13–14-year-old category is a consequence of the cohort-sequential sampling design being used in the study, which involved continuing recruitment of new cohorts of 13-year-old twins. The usual ethnic difference in the ratio of monozygotic to same sex dizygotic twin pairs is confirmed, with a much higher proportion of African American than European/other ancestry (EOA) pairs being dizygotic (54.7% vs 41.7%).

Table 2 summarizes the sociodemographic characteristics of families participating in the study, by ethnicity. Differences in religious involvement (assessed by mother's report of frequency of attendance at religious services) as a function of ethnicity were small, with the most marked difference being the lower percentage of African American than EOA families reporting no religious involvement of the twins (8.9% vs 13.3%). Approximately half of the African American and 47% of EOA adolescents were reported to attend church at least weekly. In this Midwestern US sample, the majority of African American families reported a Baptist affiliation (61% versus 25% for EOAs), with the next most common categories being 'other Protestant', Methodist, Catholic and Church of Christ. Roman Catholic (29.7%) was the most prevalent religion among the EOAs, with relatively high proportions of Baptists and 'other Protestant' groups also represented in the sample.

There were striking differences in socio-economic status between African American and EOA families, with a median reported family income in the former group less than half that reported for the latter group, and the 25th percentile of the income distribution of the former group approximately one third that of the latter group. Differences in parental educational attainments were most pronounced at the lowest and highest educational levels, with African American mothers and fathers twice as likely as EOA mothers and fathers to report fewer than 12 years of schooling, and only half as likely to report that they had completed 4 years of college education. The proportion of African American twin pairs coming from single-parent homes was three times higher than for EOA pairs. Finally, African American families were much more likely to be inner city residents (60.4 versus 12.2% for EOA families).

Table 3 summarized twin pair concordances and polychoric correlations for church attendance, based upon maternal report. Although mothers were asked to report separately for each twin, they appear to be describing family norms or expectations, rather than actual twin behavior. There was near perfect concordance for maternally reported church attendance for the two twins from each pair. Model-fitting analyses based on twin pair self-report church attendance obtained in the 1-year follow-up questionnaire (Table 4) confirmed a substantial shared environmental contribution to frequency of church attendance for EOA families, with a modest additional genetic contribution, but yielded a substantial heritability estimate for African American families (78%). Although the 95% confidence interval for the latter estimate was very broad, it was still significantly higher than the heritability estimate obtained for EOA pairs.

Table 3 Twin pair concordances and tetrachoric correlations (ρ for mother-reported twin religious involvement as a function of ethnicity and zygosity. Concordant pairs are shown along the diagonal, discordant pairs in the lower triangle

	Monozygotic					Dizygotic				
	I	II	III	IV	V	I	II	III	IV	V
African American pairs	(n=107)					(n=129)				
I	29					19				
II	1	26				0	36			
III	1	0	23			2	3	25		
IV	0	0	1	16		2	0	5	24	
V	0	0	0	0	10	0	2	1	1	9
Tetrachoric correlation:	$\rho^2=0.99$					$\rho^2=0.98$				
European/other ancestry pairs	(n=940)					(n=667)				
I	192					123				
II	6	241				9	160			
III	3	6	155			3	5	108		
IV	2	3	11	188		4	8	13	136	
V	1	6	7	4	115	2	2	7	12	77
Tetrachoric correlation	$\rho^2=0.96$					$\rho^2=0.95$				

^aAt least weekly attendance vs less often; I: more than once a week; II: once a week; III: 1–3 times a month; IV: less than once a month; V: never

Table 4 Estimates of additive genetic (VA), shared environmental (VC) and non-shared environmental (VE) variance components and their 95% confidence intervals, for self-report religious values and religious involvement in adolescent girls

	African American			European/Other ancestry		
	VA	VC	VE	VA	VC	VE
Religious involvement	78 (30–93)	8 (0-51)	14 (7–29)	15 (5–27)	70 (59–79)	15 (12–18)
Reliance on religious teachings	56 (0–77)	0 (0-45)	44 (23–72)	33 (11–56)	35 (14–53)	32 (27–39)
Belief in God ^a	74 (0–97)	0 (0-84)	25 (3–84)	9 (0–37)	59 (34–72)	32 (24–42)
Guidance by religious beliefs	70 (0–87)	0 (0-57)	30 (13–59)	6 (0–28)	56 (36–66)	38 (32–45)
Turning to prayer	81 (22–99)	12 (0-65)	7 (1–25)	24 (0–51)	36 (12–57)	40 (33–48)

^aFor African American pairs, this was recoded as a binary item (very important vs somewhat/not important)

Table 5 Prevalence of mother-reported and twin-reported environmental risk factors for adolescent alcohol and tobacco use

	African American	European/other ancestry
Maternal report		
School environment	(n=48)	(n=512)
Teachers poor/fair	31.3%	18.4%
School unsafe	18.8%	6.6%
Many students use drugs	25.0%	21.7%
Many students use alcohol	35.4%	59.4%
Many students use cigarettes	35.4%	51.0%
Many students go to college	58.3%	77.3%
Local neighborhood		
A lot/some		
violent crime	33.3%	7.0%
trouble with drug dealers	39.6%	14.2%
trouble with gangs	18.8%	3.1%
trouble with (non-violent) crime	29.2%	10.5%
teenage drinking	35.4%	42.7%
teenage drug use	31.3%	32.4%
teenage pregnancy	47.9%	29.7%
Perceived peer selection/peer influences:		
	(n=96)	(n=1022)
Most friends use drugs	4.2%	3.8%
Any closest friends use drugs	19.8%	20.3%
Most friends use alcohol	7.3%	21.5%
Any closest friends use alcohol	38.5%	47.8%
Most friends use cigarettes	3.1%	13.2%
Any closest friends use cigarettes	31.3%	39.9%
Twin self-report		
Perceived peer selection/peer influences:		
	(n=233)	(n=2027)
follow-up questionnaire		
Most friends use alcohol	18.9%	27.5%
Most friends get drunk at least once a week	10.4%	15.6%
Most friends use cigarettes regularly	9.9%	26.1%
Most friends use cannabis	21.6%	9.2%

Figure 3 shows frequency distributions for the four measures of religious values included in the questionnaire assessment. African American adolescents were more likely to report that religious values were somewhat or very important to them. For example, 91.1% of AA twins but only 78.3% of EOA twins reported that belief in God was very important; and 76.9% vs 54.4% felt that turning to prayer when facing a personal problem was very important. Also shown in Table 4 are estimates of genetic and shared environmental variance components for religious values. Because of the small sample sizes and highly

skewed response distribution for these items, for African American pairs the 95% confidence intervals for variance component estimates were extremely broad, with the hypothesis of no genetic effects rejected at the 5% significance level only in the case of a single item, turning to prayer. Nonetheless, point estimates showed the same pattern for religious values that was seen for religious involvement, with substantial heritability in AA twins, but modest or zero heritability in EOA twins.

Table 5 summarizes the prevalence of possible school and neighborhood risk factors for adolescent substance involvement as a function of ethnicity, based on maternal reports in the two-year follow-up interviews. AA mothers were nearly twice as likely to report that teachers in their children's schools did only a fair or poor job; were nearly three times as likely to report that the schools were unsafe; were three to four times as likely to report trouble with violent crime or other non-violent crime in the neighborhood where they lived; six times as likely to report trouble with gangs; and nearly three times as likely to report trouble with drug dealers. There was no ethnic difference for maternal report of use of drugs by students at the schools attended by the twins, nor for use of drugs by most friends, or any closest friend, of a twin. African American mothers were, however, significantly less likely to report student or peer alcohol or tobacco use. In self-report data, African American twins were more likely to report peer use of marijuana, but again less likely to report peer alcohol or tobacco use.

Tables 6 and 7 summarize the results of a series of proportional hazards regression analyses predicting onset of alcohol use, or onset of smoking, respectively, as a function of ethnicity, religious affiliation, family religious norms, and personal religious values. In the first step, ethnicity and maternal and paternal educational level and current family income were used to predict onset of alcohol or cigarette use. Since no significant effects of family income, nor in the case of onset of alcohol use of maternal educational level, were observed, these variables were dropped from the analyses. Paternal education of 12 years or less predicted increased risk of adolescent alcohol use. Paternal or maternal completion of 4 years of college was associated with

Table 6 Associations between adolescent alcohol use and (a) ethnicity and family socioeconomic level, (b) family religious affiliation, (c) family norms for religious involvement, and (d) adolescent religious values. Risk ratios (RR) and their 95% confidence intervals (95% CI), estimated under a proportional hazards regression model, are reported

Predictors	a		a+b		a+b+c		a+b+c+d	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
(a) Ethnicity plus socioeconomic level								
African American	0.77	0.63–0.95	0.83†	0.67–1.02	0.85†	0.69–1.05	0.89†	0.72–1.10
Paternal education <12 years	1.34	1.08–1.66	1.46	1.17–1.83	1.37	1.09–1.71	1.39	1.11–1.74
12 years	1.24	1.06–1.46	1.31	1.11–1.54	1.24	1.06–1.46	1.26	1.07–1.49
13–15 years	1.17†	0.96–1.41	1.19†	0.98–1.45	1.18†	0.97–1.43	1.18†	0.97–1.43
16 or more years	1.00	–	1.00	–	1.00	–	1.00	–
(b) Family religious affiliation								
Baptist			1.03†	0.77–1.40	1.14†	0.84–1.54	1.17†	0.87–1.59
Roman Catholic			1.40	1.20–1.64	1.41	1.20–1.65	1.33	1.13–1.56
Other Protestant			0.75	0.62–0.92	0.82†	0.68–1.01	0.85†	0.70–1.04
No religion			1.41	1.06–1.86	1.20†	0.89–1.62	1.12†	0.83–1.51
Other religion			1.00	–	1.00	–	1.00	–
(c) Family norms for religious involvement								
More than weekly church attendance					0.50	0.40–0.61	0.56	0.45–0.69
Weekly church attendance					0.70	0.60–0.83	0.77	0.65–0.91
No church attendance					0.99†	0.82–1.21	0.97†	0.80–1.18
Church attendance several times monthly/less often					1.00	–	1.00	–
(d) Adolescent religious values								
Guidance by religious beliefs not important							1.72	1.38–2.14
somewhat important							1.55	1.30–1.85
very important							1.00	–

†not significant

a decreased risk of adolescent smoking. Consistent with other studies, even when these socio-economic variables were controlled for, African American girls were less likely to report use of either alcohol or tobacco.

In the second step, religious affiliation was entered into the prediction equation. Twins reared in Roman Catholic homes, and twins reared in no religion, were more likely to report alcohol use, with those affiliated with 'other Protestant' religious groups were less likely to use alcohol. The ethnic difference was no longer significant when differences in religious affiliation were controlled for, though there was still a trend for lower African American alcohol involvement. For onset of smoking, the reduced risk in African American girls remained unchanged, but a family religious affiliation of 'other Protestant' was again associated with decreased risk of smoking. There was a trend for being reared as a Baptist to be a risk factor for smoking.

In the third step, the variable family religious norms (ie twins' church attendance as reported by the mother) was entered into the prediction equation. Church attendance more than weekly, or weekly, was a strong protective factor against onset of alcohol use or smoking. The absence of any church attendance predicted increased risk of smoking, but not alcohol use, compared with those from families where the twins attended church occasionally. Controlling for church attendance resulted in

the increased risk of smoking associated with being reared a Baptist reaching statistical significance.

Finally, individual religious values were entered into the equation. A single item, about how important it was to the respondent 'To rely on your religious beliefs as a guide for day-to-day living', was a strong predictor of adolescent initiation of alcohol or tobacco use; and inclusion of additional religious values items did not improve prediction of adolescent substance involvement. Compared with those who felt it was very important to be guided by religious values, twins who thought that this was unimportant or only somewhat important were at much higher risk for the onset of smoking and alcohol use. For initiation of alcohol use, once guidance by religious values and church attendance were controlled for, the only significant effect of religious affiliation that remained was the increased risk of alcohol use associated with a Roman Catholic religious affiliation. For initiation of tobacco use, Baptist affiliation remained a significant risk factor, and African American ancestry a significant protective factor.

Discussion

The identification of resiliency factors that promote a healthy lifestyle can be achieved with greatest power by studying individuals who have been

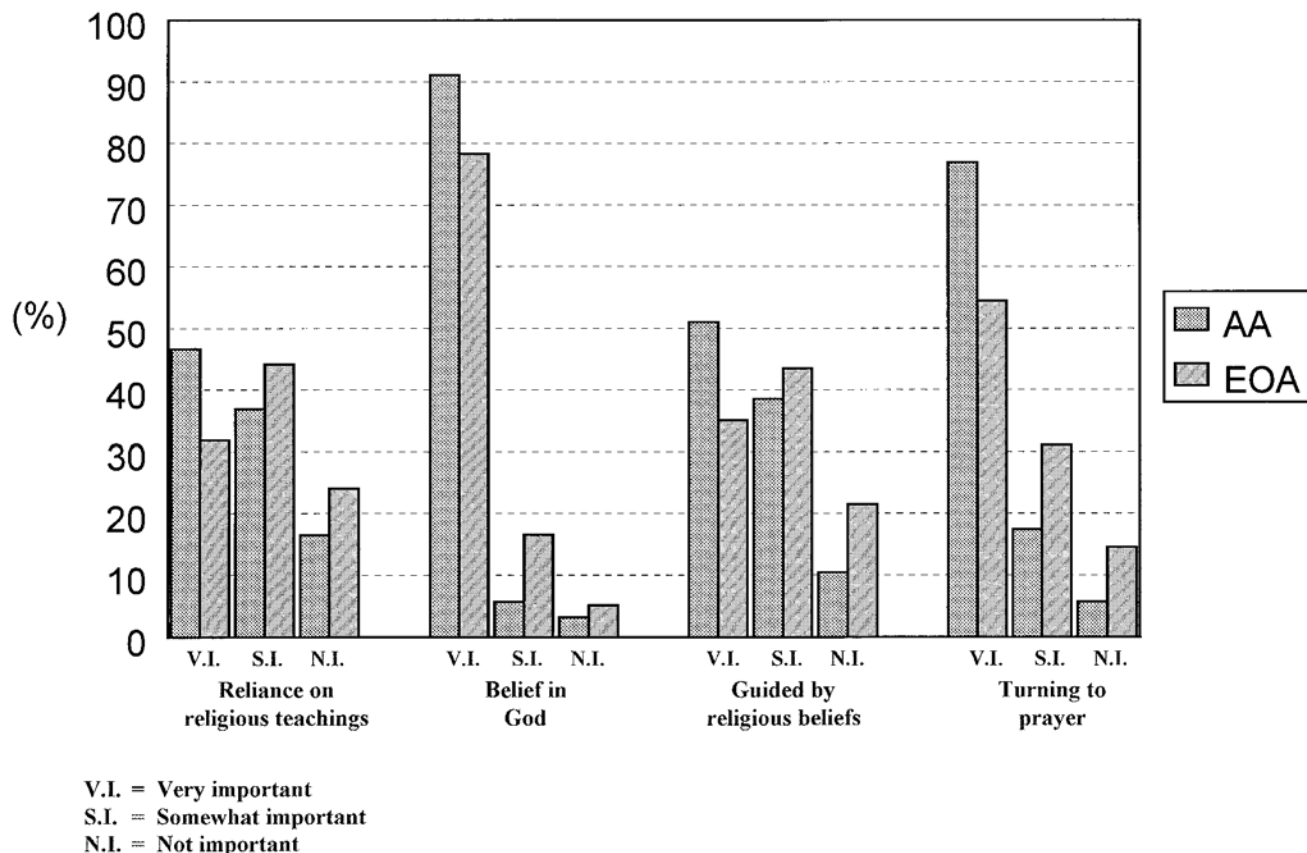


Figure 3 Beliefs about the importance of religion in African American (AA) (n = 247) and European/other ancestry (EOA) twins (n = 2033)

exposed to high levels of environmental adversity, but do not develop a particular health or behavioral problem. African American families were much more likely to report low maternal or paternal education, low family income, and living in a large city. Girls from these families were much more likely to be reared by a single parent. The mothers were more likely to assess the teachers at their daughters' schools as being only poor or fair, and to report that the schools were unsafe. They were more likely to report problems with violent crime and non-violent crime, with drug dealers and gangs, and with teenage pregnancy, in their neighborhood. Despite these environmental risk factors, however, consistent with findings in other studies, we found that African American adolescent girls were less likely to report any alcohol use or cigarette use than their white counterparts. This difference was confirmed in maternal reports about alcohol and tobacco use in the schools their daughters attended, and by adolescent self-report of peer alcohol and tobacco use.

Despite an extensive scientific literature documenting ethnic differences in adolescent alcohol and tobacco involvement, the extent to which these differences are accounted for by religious behavior

and values has received almost no attention. In our sample, African American mothers reported more regular church attendance by their daughters, and their daughters also reported stronger religious values. Controlling for these variables, plus religious affiliation, removed the ethnic difference in rates of alcohol use, but did not diminish the importance of the ethnic difference in tobacco use. Perhaps the inconsistency of findings reflects the greater impact of biological differences on differences in tobacco use. The protective effect of religious affiliation appeared to be chiefly related indirectly to differences in risk of alcohol or tobacco use, via associated differences in probability of religious involvement (as assessed by frequency of church attendance) and differences in the importance attached to guidance in day-to-day living by religious values.

From a behavioral genetic perspective, the most striking difference to emerge in these data was the substantially higher heritability of religious involvement in African American girls compared to EOA girls, with a trend in the same direction for higher heritability of religious values. It seems plausible that, for religious values and involvement, as for other aspects of social attitudes,⁸ the importance of

Table 7 Associations between adolescent smoking and (a) ethnicity and family socioeconomic level, (b) family religious affiliation, (c) family norms for religious involvement, and (d) adolescent religious values

Predictors	a		a+b		a+b+c		a+b+c+d	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
(a) Ethnicity plus socioeconomic level								
African American	0.52	0.42–0.65	0.53	0.42–0.66	0.54	0.43–1.68	0.55	0.44–0.70
Paternal education <12 years	1.95	1.53–2.49	1.99	1.56–2.55	1.80	1.40–2.30	1.76	1.37–2.25
12 years	1.66	1.39–2.00	1.71	1.42–2.06	1.58	1.31–1.90	1.55	1.29–1.87
13–15 years	1.50	1.23–1.82	1.49	1.22–1.81	1.45	0.19–1.76	1.42	1.17–1.73
16 or more years	1.00	–	1.00	–	1.00	–	1.00	–
Maternal education <12 years	1.64	1.25–2.15	1.69	1.29–2.21	1.65	1.26–2.17	1.65	1.25–2.17
12 years	1.11†	0.91–1.35	1.10†	0.91–1.34	1.14†	0.93–1.38	1.15†	0.94–1.40
13–15 years	1.29	1.07–1.55	1.29†	1.06–1.55	1.25	1.04–1.52	1.26	1.04–1.52
16 or more years	1.00	–	1.00	–	1.00	–	1.00	–
(b) Family religious affiliation								
Baptist			1.30†	0.98–1.72	1.48	1.11–1.96	1.53	1.15–2.03
Roman Catholic			1.16	1.00–1.35	1.19	1.02–1.38	1.15†	0.99–1.34
Other Protestant			0.79	0.65–0.96	0.85†	0.70–1.02	0.87†	0.72–1.05
No religion			1.23†	0.95–1.60	0.93†	0.70–1.23	0.88†	0.66–1.17
Other religion			1.00	–	1.00	–	1.00	–
(c) Family norms for religious involvement								
More than weekly church attendance					0.58	0.48–0.71	0.65	0.53–0.79
Weekly church attendance					0.72	0.61–0.84	0.77	0.66–0.91
No church attendance					1.29	1.07–1.55	1.27	1.06–1.53
Church attendance several times monthly/less often					1.00	–	1.00	–
(d) Adolescent religious values								
Guidance by religious beliefs not important							1.58	1.28–1.95
somewhat important							1.40	1.18–1.68
very important							1.00	–

†not significant

family environmental influences is gradually diminished through the normal processes of adolescent maturation. Under this hypothesis, the ethnic difference may reflect a faster rate of maturation of religious behavior in African American than in EOA girls, a difference that would parallel the earlier onset of pubertal development.³⁵

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References

- 1 Eaves LJ, Eysenck HJ, Martin NG. Genes, Culture, and Personality: An Empirical Approach. Academic Press: London, 1989.
- 2 Loehlin JC. Genes and Environment in Personality Development: Individual Differences and Development Series, Vol 2. Sage Publications: Newbury Park, CA, 1992.
- 3 Martin NG, Eaves LJ, Heath AC, Jardine R, Feingold L, Eysenck HJ. Transmission of social attitudes. *Proc Natl Acad Sci USA* 1986; 83: 4364–4368.
- 4 Plomin R, DeFries JC, McClearn Y, Rutter M. Behavioral Genetics, 3rd edn. WH Freeman: New York, 1997.
- 5 Heath AC, Slutske WS, Madden PAF. Gender differences in the genetic contribution to alcoholism risk and to alcohol consumption patterns. In: Wilsnack RW, Wilsnack SC (eds). Gender and Alcohol: Individual and Social Perspectives. Rutgers University Press: Rutgers, NJ, 1997, pp 114–149.
- 6 Heath AC, Madden PAF, Martin NG. Statistical methods in genetic research on smoking. *Stat Methods Med Res* 1998; 7: 165–186.
- 7 Tsuang MT, Lyons MJ, Eisen S, Goldberg J, True W, Meyer J, Eaves L. Genetic influences on DSM-III-R drug abuse and dependence: A study of 3372 twin pairs. *Am J Med Genet* 1996; 67: 373–377.
- 8 Eaves LJ, Martin N, Heath A, Schieken R, Meyer J, Silberg J, Neale M, Corey L. Age changes in the causes of individual differences in Conservatism. *Behav Genet* 1997; 27: 121–124.
- 9 Eaves LJ, Martin NG, Heath AC. Religious affiliation in twins and their parents: Testing a model of cultural inheritance. *Behav Genet* 1990; 20: 1–22.
- 10 Heath AC, Jardine R, Martin NG. Interactive effects of genotype and social environment on alcohol consumption in female twins. *J Stud Alcohol* 1989; 50: 38–48.
- 11 Heath AC, Madden PAF. Genetic influences on smoking behavior. In: Turner JR, Cardon LR, Hewitt JK (eds). Behavior Genetic Applications in Behavioral Medicine Research. Plenum Publishing Corporation: New York, NY, 1995.

- 12 Barnes GM, Welte JW, Hoffman JH, Dintcheff BA. Changes in alcohol use and alcohol-related problems among 7th to 12th grade students in New York State, 1983–1994. *Alc Clin Exper Res*, 1997; 21: 916–922.
- 13 Ellickson PL, McGuigan KA, Adams V, Bell RM, Hays D. Teenagers and alcohol misuse in the United States: by any definition, it's a big problem. *Addiction* 1996; 91: 1489–1503.
- 14 Epstein JA, Botvin GJ, Diaz T. Ethnic and gender differences in smoking prevalence among a longitudinal sample of inner-city adolescents. *J Adolesc Health* 1998; 23: 160–166.
- 15 Faulkner DL, Merritt RK. Race and cigarette smoking among United States adolescents – the role of lifestyle behaviors and demographic factors. *Pediatrics* 1998; 101: E41–E45.
- 16 Flint AJ, Yamada EG, Novotny TE. Black–White differences in cigarette smoking uptake – progression from adolescent experimentation to regular use. *Preventive Med* 1998; 27: 358–364.
- 17 Harrell JS, Bangdiwala SI, Deng SB, Webb JP, Bradley C. Smoking initiation in youth – the roles of gender, race, socioeconomic, and developmental status. *J Adolesc Health* 1998; 23: 271–279.
- 18 Reifman A, Barnes GM, Dintcheff BA, Farrell MP and Uhteg L. Parental and peer influences on the onset of heavier drinking among adolescents. *J Stud Alcohol* 1998; 59: 311–317.
- 19 Martin WT. Religiosity and United States suicide rates, 1972–1978. *J Clin Psychol* 1984; 40: 1166–1169.
- 20 Herd D, Grube J. Black identity and drinking in the US: a national study. *Addiction* 1996; 91: 845–857.
- 21 Amey CH, Albrecht SL, Miller MK. Racial differences in adolescent drug use: the impact of religion. *Subst Use Misuse* 1996; 31: 1311–1332.
- 22 Bell RQ. Convergence: An accelerated longitudinal approach. *Child Dev* 1953; 24(2): 145–152.
- 23 Duncan TE, Duncan SC, Hops H. The effects of family cohesiveness and peer encouragement on the development of adolescent alcohol use: a cohort-sequential approach to the analysis of longitudinal data. *J Stud Alcohol* 1994; 55(5): 588–599.
- 24 Hewitt JK, Eaves LJ, Neale MC, Meyer JM. Resolving causes of developmental continuity or 'tracking'. I. Longitudinal twin studies during growth. *Behav Genet* 1988; 18: 133–151.
- 25 Heath AC, Madden PAF, Bucholz KK. A note on ascertainment of a twin sample by computerized record matching, with assessment of possible sampling biases. *Behav Genet*, submitted.
- 26 Jessor R, Jessor S. *Problem Behavior and Psychosocial Development: A Longitudinal Study of Youth*. Academic Press: New York, 1977.
- 27 Bucholz KK, Cloninger CR, Dinwiddie SH, Hesselbrock VM, Nurnberger J, Reich T, Schmidt I, Schuckit MA. A new, semi-structured psychiatric interview for use in genetic linkage studies: A report of the reliability of the SSAGA. *J Stud Alcohol* 1994; 55: 149–158.
- 28 Kessler RC, McGonagle KA, Zhao S, Nelson CB, Hughes M, Eshleman S, Wittchen H, Kendler KS. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders among persons aged 15–54 in the United States: results from the National Comorbidity Study. *Arch Gen Psychiatry* 1994; 51: 8–19.
- 29 Office of Applied Studies, SAMHSA. *National Household Survey on Drug Abuse: Main Findings 1996*. SAMHSA: Rockville, MD, 1996.
- 30 Chassin L, Presson CC, Rose JS, Sherman SJ. The natural history of cigarette smoking from adolescence to adulthood: demographic predictors of continuity and change. *Health Psychol* 1996; 15(6): 478–484.
- 31 Neale MC. *Mx: Statistical Modeling*. Department of Psychiatry, Virginia Commonwealth University: Richmond, Virginia, 1998.
- 32 SAS Institute Inc. *SAS/STAT User's Guide*. Version 6, 4th edn. SAS Institute, Inc: Cary, NC, 1990.
- 33 Efron B, Tibshirani R. Bootstrap methods for standard errors, confidence intervals, and other measures of statistical accuracy. *Stat Sci* 1986; 1: 54–77.
- 34 Perez-Stable EJ, Herrera B, Jacob P, Benowitz NL. Nicotine metabolism and intake in black and white smokers. *JAMA* 1998; 280: 152–156.
- 35 Hermangiddens ME, Slora EJ, Wasserman RC, Bourdony CJ, Bhapkar MV, Koch GG, Hasemeier CM. Secondary sexual characteristics and menses in young girls seen in office practice – a study from the Pediatric Research in Office Settings Network. *Pediatrics* 1997; 99: 505–512.