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Explaining US adolescent depressive symptom trends through declines in religious beliefs and service attendance

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Abstract

Over the past decade, US adolescents' depressive symptoms have increased, and changing religious beliefs and service attendance may contribute. We examined the contribution of religious factors to depressive symptoms among 417,540 US adolescents (grades: 8, 10, 12), years: 1991-2019, in survey-weighted logistic regressions. Among adolescents who felt religion was personally important, those who never attended services had 2.23 times higher odds of reporting depressive symptoms compared to peers attending weekly. Among adolescents who did not feel that religion was important, the pattern was reversed. Among adolescents, concordance between importance of religion and religious service attendance may lower risk of depressive symptoms. Overall, we estimate that depressive symptom trends would be 28.2% lower if religious factors had remained at 1991 levels.

Keywords

Adolescent; Depression; Religion

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Ethical Approval: The Monitoring the Future study is approved by the IRB of University of Michigan

Informed Consent: Parents were informed of the study and provided the option to decline participation on their child's behalf.

Availability of Data: Data are available through Monitoring the Future, which is largely publicly available

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Code availability: SAS code not available, kept in secure data enclave under MTF guidance

Introduction

Depression (Lu, 2019; Mojtabai et al., 2016) and depressive symptoms (Keyes et al., 2019) have been increasing among US adolescents since approximately 2011. In the US, the 12-month prevalence of depressive episodes in adolescents increased from 8.3% in 2011 to 12.9% in 2016 (Lu, 2019). The reasons underlying this increase remain speculative and hypothesis-driven, with particular interest in the role of established risk factors for depressive symptoms that have undergone parallel changes.

One such factor is the salience of religion, as both religious service attendance and personal importance of religion have been declining among US adolescents (Twenge et al., 2015). The strength and magnitude of the association between religious involvement and depression are heterogeneous across the existing literature (Bonelli & Koenig, 2013; Braam & Koenig, 2019; Cotton, Zebracki, Rosenthal, Tsevat, & Drotar, 2006). A recent examination of longitudinal studies concluded that among a wide array of religious factors, only participation in public religious activities and importance of religion were significantly tied to subsequent mental health, but the effect was small (Garssen et al., 2021). Braam et al. (2019) assessed 152 prospective studies, 27 of which focused on adolescents, and reported that, overall, 41% of the prospective studies on religious involvement and depression among adolescents exhibited a protective association. The relationship between religious involvement and depression among adolescents is inconsistent (Braam & Koenig, 2019; Cotton et al., 2006; Fruehwirth et al., 2019), and younger samples are less likely than older samples to report a protective effect of religious involvement on mental health (Braam & Koenig, 2019).

Religious involvement can reduce depressive symptoms as a coping mechanism for emotionally difficult life events, instilling messages of meaning and hope, and by providing a potentially supportive local community (Bonelli, Dew, Koenig, Rosmarin, & Vasegh, 2012). The extent to which changes in religious involvement have contributed to recent increases in depressive symptoms among adolescents is unclear. Further, the effect of religion on depressive symptoms is unlikely to be uniform. Nationally-representative samples with data in recent years are needed to investigate the association of religious involvement with depressive symptoms. This is particularly needed among adolescents sampled across a wide swath of historical time to document trends in these factors and investigate whether declining religious engagement contributes to increasing depressive symptoms.

Additionally, geographic area may underlie religious effect heterogeneity, as patterns of religious involvement and affiliation, and the social importance of religion, vary widely across the United States. Adolescent religiosity, specifically religious attendance and personal importance, are substantially higher in the southern US compared to other areas, with particularly high concentrations of Christian faith affiliation (Wallace et al., 2003). Regional differences in the social significance of religion may modify the strength of any potential associations between religious factors and mental health outcomes.

We used national data collected from 1991 to 2019 to examine relationships between religious factors (i.e., attendance of religious services and whether religion is personally important) and depressive symptoms among US students in grades 8, 10, and 12. We explored possible regional differences in this relationship, and the extent to which trends in depressive symptoms were attributable to the changing landscape of religiosity among adolescents.

Methods

The 1991 through 2019 *Monitoring the Future* (MTF) surveys included nationally representative, annual, cross-sectional surveys of school-attending adolescents (Johnston et al., 2019) Schools were selected under a multi-stage random sampling design and invited to participate for two years. Schools that declined participation were replaced with schools with similar geographic location, size, and urbanicity. By grade and year, student response rates ranged from 79% (e.g. grade 12, 2017) to 91% (e.g. grade 8, 2012). Self-administered questionnaires were given to students. Since surveys are only distributed to students in grades 8, 10, and 12, the two years of data from a given school reflect different samples of students. The Institutional Review Boards of University of Michigan and Columbia University approved the study protocol and analytic aims, respectively. The final analytic sample included 417,540 respondents, approximately 15,000 per year, who were each assessed at a single time point and assigned to various versions of the survey, or “subforms”, that included relevant study variables. No data on religious variables were available for one state from 1997 onward. Characteristics of the analytic sample are provided in Appendix Table 1.

Measures

Religion was queried across service attendance, importance, and denomination. (1) “How often do you attend religious services?”: “Never”, “Rarely”, “Once or twice a month”, “About once a week or more”; (2) “How important is religion in your life?”: “Not important”, “A little important”, “Pretty important”, and “Very important”. For primary analyses, the response options were collapsed into “Not important” vs “Any importance”, as previous analyses of this variable have suggested stark increases in adolescents reporting that religion is “not important” (Twenge et al., 2015). We hypothesized that the potential psychological benefits of religious attendance may not translate to adolescents endorsing religion as “not important”. Sensitivity analyses utilizing all four distinct religious importance groups built on these analyses for further nuance. These two items, religious attendance and dichotomized religious importance, were combined to create eight groups, ranging from “attending services weekly and feels religion is personally important” to “never attends religious services and does not feel religion is personally important”. The remaining religion item “What is your religious preference?”, which addresses a respondent’s religious denomination with 18 response options, was used as a covariate.

Four items were used to measure depressive symptoms, with responses ranging from 1 (Disagree) to 5 (Agree) with the following statements: “Life often seems meaningless”, “The future often seems hopeless”, “It feels good to be alive”, and “I enjoy life as much as

anyone". The latter two questions were reverse coded. Scores were summed, ranging from 4 to 20 with a mean of 7.87 (95% CI: 7.85, 7.90) and median of 7.0, indicating that the mean and median scores were close to the "disagree somewhat" response. This scale exhibited sufficient internal consistency in our study (Cronbach's alpha for each grade and each year varied between 0.72 and 0.83).

This scale is based on the Bentler Medical and Psychological Functioning Inventory's scale for depression personality trait (Newcomb, Huba, & Bentler, 1981), and these items have been used as a proxy measure of depressive symptoms in prior research (Coley et al., 2019; Maslowsky, Schulenberg, & Zucker, 2014; Maslowsky, Schulenberg, O'Malley, et al., 2014). These items exhibit strong reliability in adolescent samples (Newcomb, Huba, & Bentler, 1986)..

Respondents missing data on one of the four items (2.2%) had their missing item multiply imputed (see Statistical Analysis for details); respondents missing data on 2+ items (12.2%) were excluded due to substantial missingness of other variables. While those excluded for missing depressive symptom data had similar religious characteristics to the adolescents who were included, excluded students featured more adolescents who were male, non-white, and younger (Appendix Table 2). Depressive symptom data and religious variable data for any given respondent were collected concurrently in each yearly cross-sectional survey.

Depressive symptom scores were highly right-skewed, thus we created dichotomies. Because there is no empirically validated clinical cut score, we used a range of potential cut scores, including >10 (24.4% of sample), >12 (11.9% of sample), and >15 (4.7% of sample). These roughly correspond to approximately the 75^{th}, 90^{th}, and 95^{th} percentiles.

Statistical Analysis

We conducted survey-weighted logistic regression analyses to examine the association between religious importance/attendance category and depressive symptoms. Survey weights were used to approximate a random distribution of the target population accounting for probability of school and sample selection. Logistic regression was used for binary outcomes, e.g. binary cut scores for high depressive symptoms. These analyses are presented both unadjusted and adjusted for sex (male, female), race/ethnicity (white, Black, Hispanic/Latino, Multiracial, Other), grade (8, 10, 12), religious affiliation/denomination, subform (different versions of survey content given randomly), academic performance (typical self-reported letter grades: A's, B's, C's, D's), parental education (Less than High School Grad, High School Grad, College Grad), urbanicity (Metropolitan Statistical Area vs not), binge drinking (any past two weeks), marijuana use (any past month), and year in two-year categories (e.g., students sampled in 2018 or 2019 are in the year category 2018-2019).

Missingness of covariates and the depressive symptom outcome ranged from 1.2% (academic performance) to 6.4% (binge drinking) and was handled with multiple imputation by chained equations (k=5) in Stata 15.1. By utilizing analytic tools from the "*mi*" set of commands in Stata in conjunction with the "*svy*" prefix to account for survey weighting, final results were pooled from imputed datasets to account for imputation uncertainty and survey design.

Explaining Trends in Depressive Symptoms

While the above analyses focus on cross-sectional associations, we also estimated the extent to which changes in depressive symptoms over time were attributable to changing religious importance and attendance. To do this, we projected what the trend in depressive symptoms would have been if religious factors were held at their 1991 distribution. We created a projected mean depressive symptom score for all adolescents by year by setting the distributions of religious importance and attendance groups to the level that they were in 1991. All other variables were allowed to vary in order to isolate the specific contribution of changing religion to trends in depressive symptoms. To calculate the projected mean depressive symptom scores for each year from 1991 to 2019, we computed the year-specific mean depressive symptom score for each of the eight religious attendance/importance groups and combined them per their 1991 proportions.

To illustrate the difference between the observed and projected mean, the observed 2019 overall mean in depressive symptoms would equal the sum of each religious attendance/importance group prevalence in 2019 times that group's mean depressive symptom score in 2019. The projected mean simply takes that same formula but replaces the 2019 prevalences with the 1991 prevalences to illustrate the overall mean that would have been observed if the size of these religious attendance/importance groups was static since 1991. This approach has been used elsewhere to examine adolescent health using Monitoring the Future data (Miech et al., 2020).We took a similar approach with total depressive symptom score >15. We have used this method in other analyses (Kreski et al., 2021).

Examining Temporal Relationships Between Depressive Symptoms and Religious Factors at the Population Level

Using overall prevalence of religious factors and average depressive symptoms among all adolescents by year, we assessed whether annual changes in religious salience/service attendance prevalence predict future changes in depressive symptoms, or vice versa, using lagged analysis. For each year, we estimated the overall prevalence of two religious outcomes (monthly or higher religious service attendance and religion being personally unimportant) as well as the overall depressive symptom mean score. We regressed annual mean depressive symptom score onto each annual religious factor in separate models (i.e., assessing whether mean depressive symptom score in Year X is associated with religious service attendance in Year X). We then created additional models where we lagged the prevalence of the religion variables one year at a time, from three years before the depressive symptom score (i.e., assessing whether mean depressive symptom score in Year X is associated with religious service attendance in Year X-3) through three years after the observed symptom score (i.e., assessing whether mean depressive symptom score in Year X is associated with religious service attendance in Year X+3) to examine how that connection changes. When the time lag is before the observed symptom score, each estimate can be interpreted as the extent to which religious variables predict later depressive symptoms. When the time lag is after the observed symptom score, each estimate can be interpreted as the extent to which depressive symptoms are connected to later religious factors. This helps to assess the possibility that shifts in one trend are linked to later shifts in another.

Sensitivity Analyses

Sensitivity analyses of the overall associations between religious factors and depressive symptoms examined the associations using four levels of religious importance ("Not important", "A little important", "Pretty important", and "Very important"), rather than the dichotomization between "Not important" and "Any level of importance". Additional sensitivity analyses were stratified by region (Northeast, North Central, South, and West).

Results

Trends

Religious importance and attendance were mostly stable until the early 2000's, when the percentage of students attending religious services at least monthly declined from a peak of 58.0% in 2002 to 43.9% in 2019, and the percentage of students who felt religion was personally important declined from a peak of 88.0% in 2000 to 75.5% in 2019 (Figure 1). The group who felt religion was "a little" important stayed mostly static in proportion, always close to its average of 24.5%, whereas there were downward trends for those who felt religion was "pretty" important (peak, 1991: 32.9% to 2019: 26.4%) and those who felt religion was "very" important (peak, 2002: 34.0% to 2019: 21.8%). On average, attending religious services at least monthly declined by 0.40 percentage points per year, and the personal importance of religion declined by 0.42 percentage points per year. Depressive symptoms increased, especially since 2012.

The Relationship between Religious Factors and Depressive Symptoms

Personal importance of religion has a clear link to adolescent depressive symptoms, as adolescents who say religion is not personally important have 2.94 times the odds of high depressive symptoms (score>15) compared to peers who say religion is important (95% CI: 2.83, 3.05). The role of religious attendance, however, varied based on this personal importance of religion. For adolescents who felt that religion was personally important, less frequent service attendance was consistently associated with higher depressive symptoms. Compared to adolescents who attended weekly services, those who never attended religious services had 2.23 (Table 1, 95% CI: 2.08, 2.39) times the odds for high depressive symptoms. Adjustment for demographics, substance use, and other personal characteristics attenuated this association (Table 1, aOR [adjusted odds ratio] = 1.50, 95% CI: 1.39, 1.61).

However, this pattern did not hold for students who felt that religion was not important. Among these adolescents, across all cut scores examined [to be discussed later], the highest odds of depressive symptoms were observed among weekly attendees of religious services. This was 5.60 (Table 1, 95% CI: 4.96, 6.31) times the odds of depressive symptoms (score >15) compared to those who felt that religion was personally important and attended church equally as often. These relationships were robust to adjustment for demographic characteristics, substance use, and other personal characteristics, including religious group affiliation (Table 1, aOR = 4.31, 95% CI: 3.79, 4.89). For adolescents who felt religion was unimportant, the lowest depressive symptoms were consistently exhibited among those attending religious services "rarely". The interaction between religious attendance and

importance indicated that the magnitude of association for religious attendance varied across levels of religious importance, $F(3, 5596.3) = 112.51$, $p < .001$.

Sensitivity Analyses

Sensitivity analyses were conducted with different thresholds (>10 and >12) to examine the consistency of the relationships between religious factors and depressive symptoms (Appendix Table 3). Patterns were similar to those in the main analysis. Additionally, sensitivity analyses compared all categories of personal importance of religion to examine nuance in the connections between religious attendance and depressive symptoms (Appendix Tables 4 and 5). The lowest depressive symptoms were observed among groups with concordant or near-concordant religious importance and attendance (e.g., Very Important/Weekly Attendance, Pretty Important/Monthly Attendance, down to Not Important/Rare Attendance).

Geographic Heterogeneity

Geographic region was examined as a potential modifier of the connection between religious factors and depressive symptoms. The most notable regional differences were greater religious attendance and importance concentrated in the Southern US. Adolescents in the South had a higher prevalence of weekly religious attendance (43.4%) and religion being very important (37.8%) than any other region ($p<.001$ for both attendance and importance) (Appendix Table 6). While prevalence of high depressive symptoms (score >15) differed by region ($p<.001$), the range of prevalences was narrow, from 4.4% in the South to 5.1% in the West.

We stratified the results by region to better understand the magnitude of differences across region. Weekly attendees of religious services who felt religion was personally unimportant in the South had 6.67 (Table 2, 95% CI: 5.51, 8.07) times the odds of high depressive symptoms compared to weekly attendees who felt religion was important, a relationship that remained after adjustment (Table 2, aOR = 4.90, 95% CI: 3.97, 6.04). Still, while this relationship was strong, the number of adolescents impacted was small, given that the group attending services weekly who felt that religion was personally unimportant represents less than 1% of the adolescents examined.

Explaining Trends in Depressive Symptoms

We additionally documented how much the change in religious importance and attendance explains the increase in depressive symptoms in the US. Figure 2 shows the observed and projected depressive symptom scores from 1991 to 2019. The gap between observed and projected depression scores has been widening since the early 2000s. Depression scores dropped from 1991 to 2012. The decrease in mean depressive symptoms scores would have been 0.53 points if prevalence of religious factors was static since 1991, rather than the observed decrease of 0.41 points, meaning the drop would have been 28.2% larger. Depression scores increased from 2012 to 2019. The increase in mean depressive symptoms score would have been 1.33 points, as opposed to the observed increase of 1.53 points, meaning this increase would have been 13.0% smaller. Over the entire study period from 1991 to 2019, the increase in depressive symptoms would have been 0.80 points, rather

than the observed increase of 1.12 points. This means that, if the distribution of the eight attendance-religious importance groups was stable over time, the overall increase would have been 28.2% lower. Appendix Figure 1 shows a similar trend for a binary depressive symptom cut score (>15).

Population-Level Temporality through Lagged Analysis

When the time lag is before the observed symptom score (top three rows, Appendix Tables 7 and 8), religion variables predict later depressive symptoms. For instance, a one percentage point increase in the prevalence of religion being personally unimportant predicts a .0854-point increase in depressive symptoms three years later. However, when the time lag is after the observed symptom score (bottom three rows), where depressive symptoms are linked to later prevalence of religious factors, the relationship is much weaker. Estimates decrease in size with each additional year of lag, reaching non-significance after just one or two years. This further emphasizes the likelihood that the direction of the association, at least at the population level, is religious factors influencing depressive symptoms, not the reverse.

Discussion

The association between religious attendance and reduced depression and depressive symptoms has been documented in previous research (Balbuena, Baetz, & Bowen, 2013; Braam & Koenig, 2019; Dew et al., 2008; Maselko, Gilman, & Buka, 2009; Vanderweele, 2017). Among adolescents, our findings indicate that variation based on personal importance is an important qualifying consideration. In a large nationally-representative sample of adolescents from 1991 to 2019, for adolescents who report that religion is important to them, less frequent religious attendance is associated with higher depressive symptoms. For adolescents who do not report religion as important, the relationship was the opposite, with weekly service attendees having higher odds of depressive symptoms than any other group. These results suggest that concordance between importance of religion and religious service attendance is beneficial. This is true at all levels of importance; e.g., among those who say religion is only “a little” important, attending religious services rarely or monthly was associated with lower depressive symptoms than attending weekly or never.

It is also worth considering alternative interpretations, however. It is unclear whether structured religious involvement leads to changes in mental health, or whether reverse causation explains this association, with worsening depressive symptoms and hopelessness leading people to disengage from their religious communities and beliefs as they do with other social activities (Ang et al., 2017). Some studies have addressed these relationships with longitudinal data (Balbuena et al., 2013; Braam & Koenig, 2019; Garssen et al., 2021; Li et al., 2016; Min et al., 2016; Strawbridge et al., 2001; Van Voorhees et al., 2008; VanderWeele et al., 2016), which can clarify this temporal order and control for confounding due to baseline depression or other factors. Among these longitudinal studies, the most common outcome is religious involvement predicting lower depression and depressive symptoms over time, though the strength of this connection diminishes in younger populations. While there is some evidence that depression also influences religious engagement (Li et al., 2016), this relationship is bi-directional and complex, with the

potential for a reinforcing loop if lower religious engagement leads to worse mental health, which sustains religious disengagement.

The effect that religious attendance can have on depression operates through a wide variety of mechanisms. At a psychological level, religious involvement may bolster individual coping with life stressors, providing meaning or hope during difficult life events and daily struggles that could otherwise worsen mood (Koenig, 2018; Park, 2005; Siegel et al., 2001). Socially, individuals attending religious services can have access to a community for social support, which might further protect against depression or other adverse mental health outcomes (Hodges, 2002; Koenig, 2018; Schnittker, 2019).

For those who felt religion was not important, depressive symptoms were lowest in the group who rarely attended religious services. Among these adolescents, attending services more frequently, either weekly or monthly, may be the product of caregiver pressure, which might adversely impact their experience of religious participation. Our results suggest that benefits of religious attendance on depressive symptoms for adolescents are not universal, and depend on how important religion is to the adolescent.

It is worth noting that the odds of depressive symptoms were higher for all “not personally important groups” compared to their “personally important” counterpart. These differences may be due to fewer coping resources and lessened social support (Hodges, 2002; Koenig, 2018), indicating that efforts to improve adolescent health may benefit from considering the strengths of religious involvement. Religious engagement may support forgiveness and gratitude, and those attending religious services may hear messages surrounding other health behaviors, like avoiding substance use, all of which can support mental health (Levin, 2010).

Strengthening the social and coping resources outside of religion available to adolescents might be especially helpful when these adolescents have other identities that render them marginalized by some religious groups. For instance, lesbian, gay, bisexual, and transgender (LGBT) adolescents may be compelled to attend religious services that could contain anti-LGBT messaging, and this group already faces higher rates of depression and depressive symptoms than their heterosexual peers (Luk et al., 2018; Reisner et al., 2016). Accounting for the unique experiences of marginalized people is a priority, ensuring both accuracy and representation within results.

Geographic differences in the magnitude of these associations were evident, with particularly strong associations in the Southern US. It may be that the added social emphasis on religion in certain regions, such as the Southern US, renders those who do not emphasize religion as isolated or stigmatized. People who are non-religious often face discrimination socially, especially in parts of the Southern US, and this social stigma may carry over to individuals who consider religion personally unimportant (Cragun et al., 2012). Further analyses might take a fine-grained spatial approach to these associations between religion and mental health, nuance that is not currently possible with these data.

Lastly, a substantial component of the changing trends in depressive symptoms appears attributable to the changing landscape of religious attendance and importance. Had trends in these religious factors stayed flat since 1991, the overall increase in depressive symptoms

would have been attenuated, more noticeably so in the past decade. Declines in religious involvement explain about 28% of the overall increase in depressive symptoms from 1991 to 2019 among US adolescents. Even though this is a substantial part of the increase, over 70% of that increase remains unexplained, indicating that other mechanisms explain increases in adolescent depressive symptoms. Even within the 28% that is explained, we do not know the specific component of religious involvement that is most important to mental health well-being, or the underlying causes of why religious factors are declining. Still, for adolescents who do feel that religion is important, promoting religious attendance concordant with the level to which religion is personally important may provide valuable psychological benefits. Religion can be more thoroughly integrated into discussions surrounding adolescent mental health.

The present study was strengthened by the use of a large sample of adolescents across a wide age range. Examining religious attendance and importance simultaneously while stratifying by region allowed for a nuanced characterization of patterns and differences in depressive symptom outcomes. While there was no clinically-defined cut score for the depressive symptoms scale, results are consistent across multiple cut scores. Patterns were particularly strong at higher cut scores, suggesting that findings may be especially relevant for more severe cases of depressive symptoms.

Limitations are noted. Given the cross-sectional nature of these data, the causal directions of observed associations cannot be established, though our lagged analyses suggest that it is more likely religion informing depressive symptoms, rather than the reverse. There may be other religious factors that contribute to adolescent mental health that could not be assessed here. These include private spirituality and discrimination, either due to religious identity or from a religious institution due to other personal identities. Nuanced changes in the nature and content of religious services could not be assessed with these data. Furthermore, there was no information on reasons for religious attendance or importance, which might provide additional context. We were unable to address parental or caregiver religiosity, or discordance between that factor and adolescent religiosity, which may have psychosocial impacts.

Results may vary among adolescents outside of grades 8 through 12, youth who are not in school, or non-US youth. Results may also vary across the lifespan, as trajectories of religion moving from adolescence into adulthood show significant changes, like lower attendance but higher importance of religion over time (Dew, Fuemmeler, & Koenig, 2020).

The items examining depressive symptoms within this study had certain limitations in domain coverage. The depression items cover anhedonia and hopelessness, but not depressed mood, sleep or appetite disturbances, worthlessness, guilt, fatigue or other cardinal symptoms of depression and therefore the findings might vary with a broader more robust measure of depressive symptoms. However, trends in depressive symptoms were consistent with other national sources of information on depressive episodes (Mojtabai et al., 2016), underscoring that these measures are consistent with established indicators of adolescent mental health. We also lacked information on whether adolescents had received treatment for their mental health problems. However, only a minority of individuals with

depression receive treatment (Hasin et al., 2005), suggesting that treatment is unlikely to have had a large impact on the sample's symptom scores.

Conclusion

The relationship between religious involvement and attendance with depressive symptoms among adolescents is nuanced. For adolescents who find their faith to be personally important, promoting and providing space for religious service attendance may be an effective way to improve their mental health. For adolescents who do not feel religion to be personally important, other approaches may be useful, but these approaches can learn from the strengths of religious involvement, fostering social support and coping strategies. Public health and counselling professionals should encourage effective coping among adolescents directly with efforts to reduce maladaptive coping behaviors, such as self-blame or behavioral disengagement, and promote effective behaviors, such as coping that incorporates acceptance and cognitive reappraisal of stressors (Compas et al., 2017; Horwitz et al., 2011). The landscape of adolescent religiosity has been changing over several years, underscoring the importance of engaging vulnerable populations with helpful strategies directly and highlighting the research challenges of exploring the complex relationships between religion and mental health.

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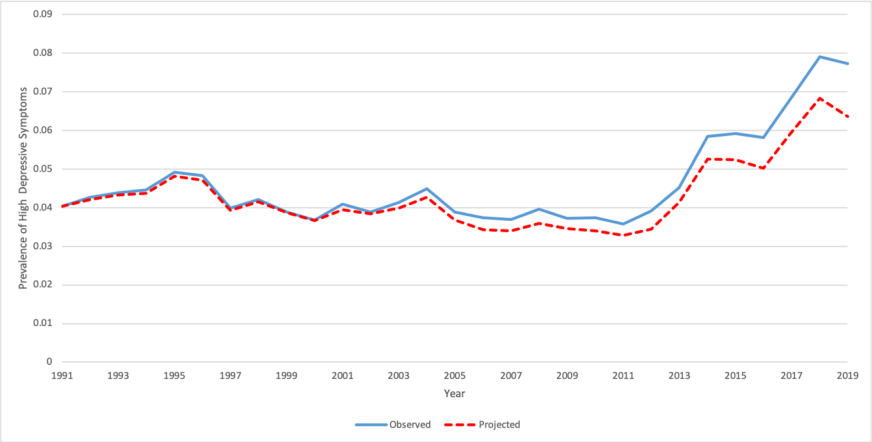
Biography

Corresponding Author Autobiographical Paragraph: Noah T. Kreski, MPH is a data analyst at the Columbia University Mailman School of Public Health's department of epidemiology. They focus on determinants, disparities, and impacts of adolescent suicide and internalizing symptoms.

Appendix



Appendix Figure 1:
Observed trend in high (score>15) depressive symptoms (blue line) among US adolescents from 1991 to 2019, and projected trend in high depressive symptoms (red line) if US religious service attendance and importance had remained fixed at 1991 levels

Appendix Table 1:

Sample Characteristics, N=417,540

Characteristics	Number of Respondents	Weighted Percent of Respondents	Unweighted Percent of Respondents
Religious importance/attendance			
Important, Attends Weekly	151,500	37.14	36.28
Important, Attends Monthly	65,696	15.56	15.73
Important, Attends Rarely	102,774	24.35	24.61
Important, Attends Never	26,463	6.31	6.34
Not Important, Attends Weekly	3,397	0.79	0.81
Not Important, Attends Monthly	2,780	0.65	0.67
Not Important, Attends Rarely	20,393	4.76	4.88
Not Important, Attends Never	44,537	10.43	10.67
Grade			
8	178,874	43.02	42.84
10	175,169	41.74	41.95
12	63,497	15.24	15.21
Region			
Northeast	89,739	19.09	21.49
North Central	114,118	27.80	27.33
South	160,474	39.34	38.43
West	53,209	13.77	12.74
Urbanicity			
Metropolitan Statistical Area	320,004	74.60	76.64

Characteristics	Number of Respondents	Weighted Percent of Respondents	Unweighted Percent of Respondents
Not MSA	97,536	25.40	23.36
Subform (Version of Questionnaire)			
2	180,214	43.13	43.16
4	91,361	21.88	21.88
5	6,450	1.55	1.54
6	57,047	13.69	13.66
8	82,468	19.75	19.75
Year			
1991	16,141	3.85	3.87
1992-1993	32,748	7.83	7.84
1994-1995	32,223	7.73	7.72
1996-1997	30,263	7.25	7.25
1998-1999	26,687	6.52	6.39
2000-2001	25,989	6.32	6.22
2002-2003	27,734	6.69	6.64
2004-2005	30,171	7.30	7.23
2006-2007	29,548	6.98	7.08
2008-2009	27,749	6.55	6.65
2010-2011	28,758	6.82	6.89
2012-2013	25,474	6.15	6.10
2014-2015	26,278	6.23	6.29
2016-2017	29,556	7.05	7.08
2018-2019	28,221	6.73	6.76
Depression Score Outcomes			
>15	18.980	4.66	4.66
>12	48,160	11.87	11.83
>10	98.717	24.39	24.25
Sex			
Male	195,995	46.95	46.94
Female	213,326	51.09	51.09
Missing	8,219	1.96	1.97
Race			
White	265,515	63.79	63.59
Black	50,571	11.97	12.11
Hispanic/Latino	52,107	12.57	12.48
Multiracial	9,053	2.15	2.17
Other	32,158	7.62	7.70
Missing	8,136	1.90	1.95
Highest Parental Education			
Less than High School	26,707	6.64	6.40
High School Graduate	147,663	36.19	35.36

Characteristics	Number of Respondents	Weighted Percent of Respondents	Unweighted Percent of Respondents
College Graduate	219,286	51.40	52.52
Missing	23,884	5.77	5.72
Academic Performance (in Letter Grade)			
D's	10,694	2.55	2.56
C's	82,791	19.89	19.83
B's	179,289	43.00	42.94
A's	139,983	33.41	33.53
Missing	4,783	1.15	1.15
Marijuana Use, Past Month			
None	357,805	85.99	85.69
Any	51,986	12.17	12.45
Missing	7,749	1.84	1.86
Binge Drinking, Past Two Weeks			
None	331,752	79.47	79.45
Any	59,195	14.06	14.18
Missing	26,593	6.47	6.37
Religious Affiliation			
Baptist	77,032	19.33	18.45
Churches of Christ	31,634	7.72	7.58
Disciples of Christ	1,664	0.40	0.40
Episcopal	4,592	1.07	1.10
Lutheran	16,820	4.34	4.03
Methodist	20,879	5.18	5.00
Presbyterian	9,966	2.31	2.39
United Churches of Christ	5,285	1.27	1.27
Other Christian	23,290	5.67	5.58
Unitarian Universalist	698	0.17	0.17
Roman Catholic	93,096	20.87	22.30
Eastern Orthodox	1,780	0.38	0.43
Jewish	6,277	1.44	1.50
Latter- Day Saints	5,522	1.53	1.32
Muslim	3,638	0.85	0.87
Buddhist	3,950	0.89	0.95
Other Religion	29,722	7.20	7.12
None	70,075	16.63	16.78
Missing	11,620	2.75	2.76

Appendix Table 2:

Demographic Characteristics for Included Adolescents and those Excluded for Insufficient Depressive Symptom Data

		Included			Excluded		
Characteristics		**n=417,540**	**Weighted Percent**	**Unweighted Percent**	**n=57,913**	**Weighted Percent**	**Unweighted Percent**
Religion's Importance	Not	71,107	16.64	17.03	8,654	14.87	14.94
	A Little	104,079	24.50	24.93	14,135	24.25	24.41
	Pretty	122,817	29.46	29.41	17,352	29.85	29.96
	Very	119,537	29.40	28.63	17,772	31.03	30.69
Religious Attendance	Never	71,000	16.75	17.00	10,272	17.62	17.74
	Rarely	123,167	29.11	29.50	18,670	31.99	32.24
	Monthly	68,476	16.21	16.40	9,350	16.11	16.14
	Weekly	154,897	37.93	37.10	19,621	34.28	33.88
Grade	8	178,874	43.02	42.84	34,548	59.77	59.65
	10	175,169	41.74	41.95	17,828	30.70	30.78
	12	63,497	15.24	15.21	5,537	9.53	9.56
Region	Northeast	89,739	19.09	21.49	18,489	28.86	31.93
	North Central	114,118	27.80	27.33	11,857	20.76	20.47
	South	160,474	39.34	38.43	21,909	39.89	37.83
	West	53,209	13.77	12.74	5,658	10.49	9.77
Urbanicity	MSA	320,004	74.60	76.64	48,273	81.54	83.35
	Non-MSA	97,536	25.40	23.36	9,640	18.46	16.65
Sex*	Male	195,995	46.95	46.94	31,006	53.86	53.54
	Female	213,326	51.09	51.09	25,158	43.12	43.44
	Missing	8,219	1.96	1.97	1,749	3.02	3.02
Race*	White	265,515	63.79	63.59	25,077	43.61	43.30
	Black	50,571	11.97	12.11	13,159	22.18	22.72
	Hispanic/ Latino	52,107	12.57	12.48	11,034	19.43	19.05
	Multi-Racial	9,053	2.15	2.17	1,052	1.91	1.82
	Other	32,518	7.62	7.79	5,487	9.35	9.47
	Missing	8,136	1.90	1.95	2,104	3.52	3.63
Highest Parental Education*	Less than High School	26,707	6.64	6.40	5,821	10.31	10.05
	High School Graduate	147,663	36.19	35.36	21,932	38.20	37.87
	College Graduate	219,286	51.40	52.52	24,139	40.96	41.68
	Missing	23,884	5.77	5.72	6,021	10.53	10.40
Academic Performance*	D's	10,694	2.55	2.56	2,732	4.70	4.72
	C's	82,791	19.89	19.83	16,774	28.88	28.96
	B's	179,289	43.00	42.94	24,481	42.47	42.27
	A's	139,983	33.41	33.53	11,645	19.99	20.11

Characteristics		Included n=417,540	Included Weighted Percent	Included Unweighted Percent	Excluded n=57,913	Excluded Weighted Percent	Excluded Unweighted Percent
	Missing	4,783	1.15	1.15	2,281	3.96	3.94
Religious Affiliation*	Baptist	77,032	19.33	18.45	11,666	20.74	20.14
	Churches of Christ	31,634	7.72	7.58	5,893	10.23	10.18
	Disciples of Christ	1,664	0.40	0.40	228	0.41	0.39
	Episcopal	4,592	1.07	1.10	477	0.81	0.82
	Lutheran	16,820	4.34	4.03	1,339	2.47	2.31
	Methodist	20,879	5.18	5.00	2,107	3.78	3.64
	Presbyterian	9,966	2.31	2.39	895	1.48	1.55
	United Churches of Christ	5,285	1.27	1.27	746	1.27	1.29
	Other Christian	23,290	5.67	5.58	2,977	5.10	5.14
	Unitarian Universalist	698	0.17	0.17	61	0.10	0.11
	Roman Catholic	93,096	20.87	22.30	11,262	18.37	19.45
	Eastern Orthodox	1,780	0.38	0.43	225	0.34	0.39
	Jewish	6,277	1.44	1.50	778	1.35	1.34
	Latter-Day Saints	5,522	1.53	1.32	453	0.92	0.78
	Muslim	3,638	0.85	0.87	797	1.30	1.38
	Buddhist	3,950	0.89	0.95	492	0.87	0.85
	Other Religion	29,722	7.20	7.12	4,959	8.54	8.56
	None	70,075	16.63	16.78	9,460	16.56	16.33
	Missing	11,620	2.75	2.76	3,098	5.36	5.35

Appendix Table 3:

Unadjusted and *Adjusted Odds Ratios for the Association between Religious Attendance and Importance with Depressive Symptoms (Score > 10; Score > 12)

	Depressive Symptom Score Outcome			
Religion group (ref = 'Feels religion is important, attends weekly')	**Score>10**	***Score>10**	**Score>12**	***Score>12**
Feels religion is important, attends monthly	**1.15 (1.11, 1.18)**	**1.04 (1.01, 1.07)**	**1.15 (1.11, 1.20)**	**1.06 (1.01, 1.10)**
Feels religion is important, attends rarely	**1.46 (1.43, 1.50)**	**1.19 (1.16, 1.22)**	**1.47 (1.42, 1.52)**	**1.20 (1.16, 1.24)**
Feels religion is important, never attends	**2.21 (2.13, 2.29)**	**1.56 (1.50, 1.62)**	**2.16 (2.06, 2.26)**	**1.51 (1.43, 1.58)**
Feels religion is not important, attends weekly	**3.75 (3.45, 4.07)**	**3.10 (2.84, 3.38)**	**4.28 (3.90, 4.70)**	**3.44 (3.11, 3.79)**

	Depressive Symptom Score Outcome			
Religion group (ref = 'Feels religion is important, attends weekly')	**Score>10**	***Score>10**	**Score>12**	***Score>12**
Feels religion is not important, attends monthly	**2.87 (2.60, 3.15)**	**2.41 (2.17, 2.66)**	**3.23 (2.90, 3.61)**	**2.63 (2.34, 2.95)**
Feels religion is not important, attends rarely	**2.32 (2.23, 2.41)**	**1.78 (1.71, 1.86)**	**2.65 (2.06, 2.26)**	**1.96 (1.85, 2.06)**
Feels religion is not important, never attends	**2.86 (2.77, 2.95)**	**1.98 (1.91, 2.06)**	**3.10 (2.99, 3.22)**	**2.06 (1.96, 2.16)**

Bolding: p<.05

*Adjusted for sex, race, grade, religious affiliation, academic performance, parental education, subform, urbanicity, past two week binge drinking, past month marijuana use, and year

Appendix Table 4:

Sensitivity Analysis – Unadjusted Odds Ratios and 95% Confidence Intervals for the Associations between Religious Attendance and Depressive Symptoms for Each Level of Religious Importance

		Religious Importance			
		Not	**A Little**	**Pretty**	**Very**
Religious Attendance	Never	**5.03 (4.71, 5.37)**	**2.80 (2.56, 3.07)**	**3.03 (2.65, 3.46)**	**3.54 (3.00, 4.18)**
	Rarely	**3.69 (3.39, 4.01)**	**2.08 (1.93, 2.24)**	**1.63 (1.49, 1.78)**	**1.66 (1.49, 1.85)**
	Monthly	**4.91 (4.18, 5.77)**	**1.91 (1.71, 2.12)**	**1.26 (1.14, 1.39)**	**1.14 (1.01, 1.29)**
	Weekly	**7.38 (6.50, 8.39)**	**2.73 (2.49, 3.01)**	**1.44 (1.33, 1.56)**	Ref

Bolding: p<.05

Appendix Table 5:

Sensitivity Analysis – Adjusted* Odds Ratios and 95% Confidence Intervals for the Associations between Religious Attendance and Depressive Symptoms for Each Level of Religious Importance

		Religious Importance			
		Not	**A Little**	**Pretty**	**Very**
Religious Attendance	Never	**3.24 (3.00, 3.51)**	**1.88 (1.70, 2.07)**	**2.01 (1.75, 2.31)**	**2.48 (2.09, 2.94)**
	Rarely	**2.66 (2.42, 2.91)**	**1.65 (1.53, 1.79)**	**1.34 (1.22, 1.47)**	**1.40 (1.26, 1.56)**
	Monthly	**3.90 (3.30, 4.60)**	**1.67 (1.50, 1.86)**	**1.16 (1.05, 1.28)**	1.05 (0.93, 1.19)
	Weekly	**5.70 (4.99, 6.52)**	**2.45 (2.22, 2.70)**	**1.40 (1.29, 1.52)**	Ref

Bolding: p<.05

*Adjusted for sex, race, grade, religious affiliation, academic performance, parental education, subform, urbanicity, past two week binge drinking, past month marijuana use, and year

Appendix Table 6:

Percentages of Religious Service Attendance and Personal Importance of Religion by Region

		Region								
		Northeast			North Central			South		
		Sample Size	Weighted Percentage	Unweighted Percentage	Sample Size	Weighted Percentage	Unweighted Percentage	Sample Size	Weighted Percentage	Unweighted Percentage
Religious Attendance	Never	19,347	22.0	21.6	19,408	16.9	17.0	20,918	12.6	13.0
	Rarely	29,376	32.7	32.7	32,950	28.5	28.9	44,475	27.3	27.7
	Monthly	14,868	16.3	16.6	18,958	16.2	16.6	26,781	16.8	16.7
	Weekly	26,148	29.0	29.1	42,802	38.4	37.5	68,300	43.4	42.6
		Sample Size	Weighted Percentage	Unweighted Percentage	Sample Size	Weighted Percentage	Unweighted Percentage	Sample Size	Weighted Percentage	Unweighted Percentage
Religious Importance	Not	20,586	23.6	22.9	20,200	17.3	17.7	19,247	11.4	12.0
	A Little	26,545	29.7	29.6	30,605	26.7	26.8	33,384	20.2	20.8
	Pretty	25,603	28.1	28.5	34,194	30.1	30.0	48,812	30.6	30.4
	Very	17,005	18.6	19.0	29,119	25.9	25.5	59,031	37.8	36.8

Appendix Table 7:

Lagged analysis of prevalence of at least monthly religious service attendance predicting mean depressive symptom score

Predictor: Prevalence of attending religious services at least monthly	Estimate predicting depressive symptom score mean	p-value
Three Years Before	−.0998	<0.001
Two Years Before	−.0854	<0.001
One Year Before	−.0736	<0.001
Same Year	−.0658	<0.001
One Year After	−.0447	0.001
Two Years After	−.0238	0.040
Three Years After	−.0067	0.509

Appendix Table 8:

Lagged analysis of prevalence of religion being personally unimportant predicting mean depressive symptom score

Predictor: Prevalence of religion being unimportant	Estimate predicting depressive symptom score mean	p-value
Three Years Before	.0854	<0.001
Two Years Before	.0735	<0.001
One Year Before	.0644	<0.001
Same Year	.0575	<0.001
One Year After	.0369	0.011

Predictor: Prevalence of religion being unimportant	Estimate predicting depressive symptom score mean	p-value
Two Years After	.0161	0.191
Three Years After	−.0012	0.907

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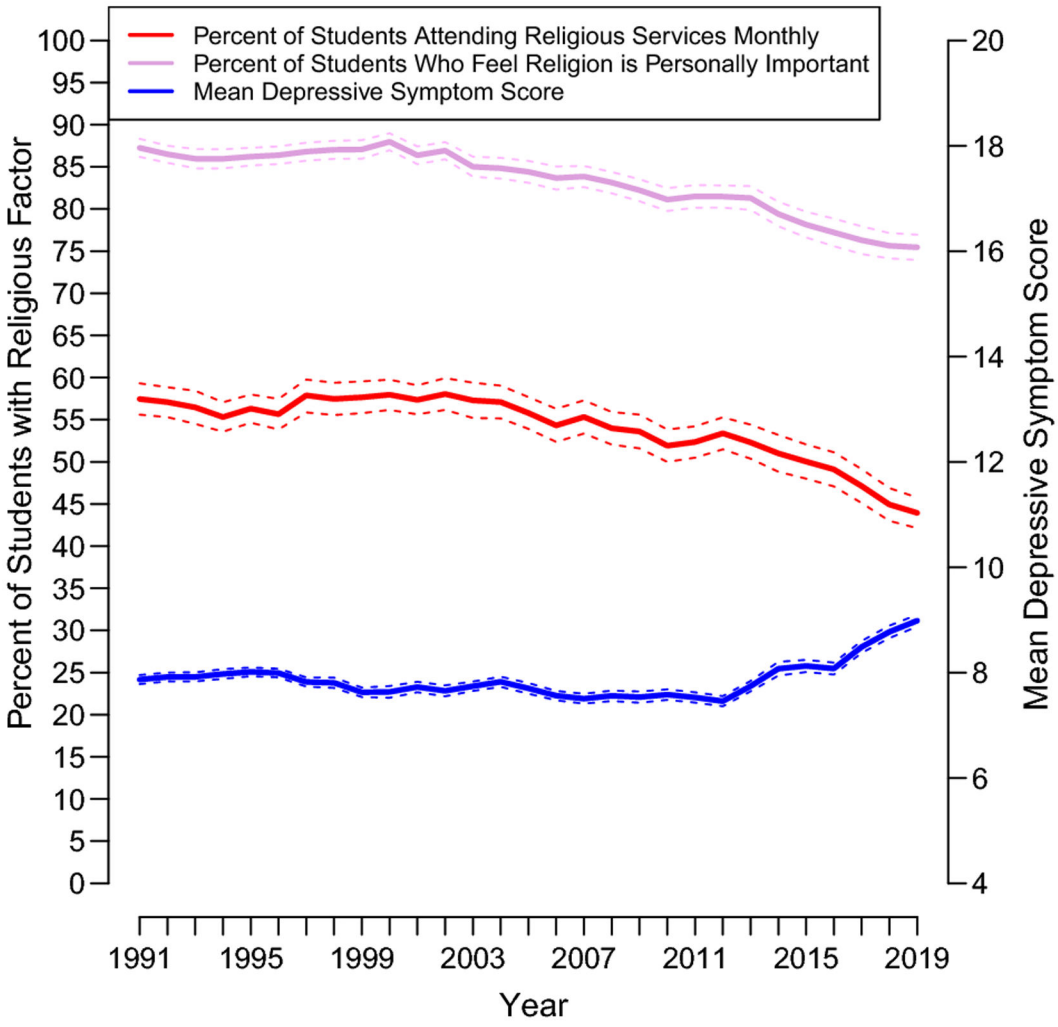

Figure 1:
Religious service attendance, importance of religion and depressive symptom scores (with 95% confidence intervals) from 1991 to 2019 among US adolescents

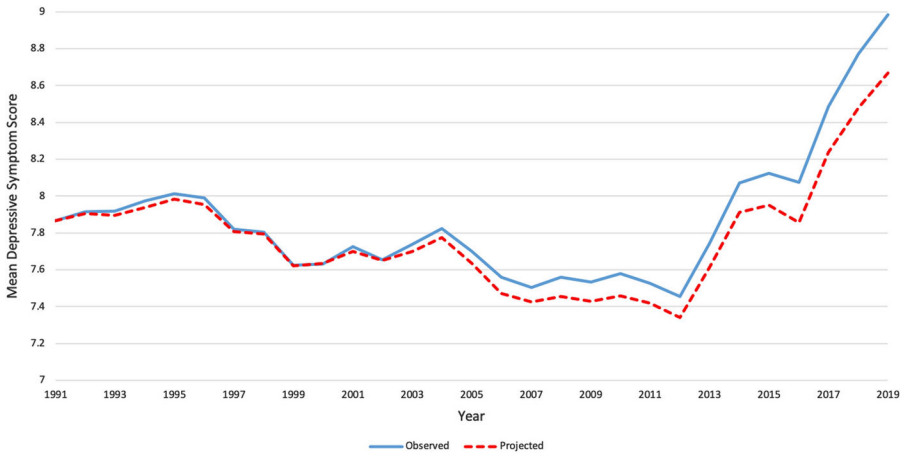

Figure 2:

Observed depressive symptom score among US adolescents from 1991 to 2019, and projected depressive symptom score if US religious service attendance and importance had remained fixed at 1991 levels

Table 1:

Unadjusted and *Adjusted Odds Ratios (and 95% Confidence Intervals) for the Association between Religious Attendance and Importance with Depressive Symptoms (Score >15)

	Depressive Symptom Score Outcome	
Religion group (ref = 'Feels religion is important, attends weekly')	Score>15	*Score>15
Feels religion is important, attends monthly	1.06 (1.00, 1.13)	0.98 (0.92, 1.05)
Feels religion is important, attends rarely	**1.41 (1.34, 1.49)**	**1.15 (1.09, 1.22)**
Feels religion is important, never attends	**2.23 (2.08, 2.39)**	**1.50 (1.39, 1.61)**
Feels religion is not important, attends weekly	**5.60 (4.96, 6.31)**	**4.31 (3.79, 4.89)**
Feels religion is not important, attends monthly	**3.72 (3.19, 4.35)**	**2.94 (2.50, 3.45)**
Feels religion is not important, attends rarely	**2.80 (2.60, 3.01)**	**2.00 (1.84, 2.16)**
Feels religion is not important, never attends	**3.81 (3.62, 4.01)**	**2.43 (2.27, 2.59)**

Bolding: p<.05

*Adjusted for sex, race, grade, religious affiliation, academic performance, parental education, subform, urbanicity, past two week binge drinking, past month marijuana use, and year

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Table 2:

Odds Ratios and 95% Confidence Intervals for Depressive Symptom Score>15 by Region, Unadjusted and *Adjusted

	**Region							
Religion group (ref = 'feels religion is important, attends weekly')	**South**	***South**	**West**	***West**	**North Central**	***North Central**	**Northeast**	***Northeast**
Feels religion is important, attends monthly	1.09 (0.98, 1.20)	1.02 (0.92, 1.13)	1.27 (1.07, 1.50)	1.09 (0.91, 1.31)	0.98 (0.87, 1.11)	0.91 (0.81, 1.03)	0.98 (0.85, 1.13)	0.91 (0.78, 1.05)
Feels religion is important, attends rarely	**1.44 (1.33, 1.56)**	**1.21 (1.11, 1.32)**	**1.48 (1.28, 1.71)**	1.17 (0.99, 1.37)	**1.38 (1.25, 1.54)**	**1.12 (1.01, 1.24)**	**1.30 (1.15, 1.46)**	1.08 (0.95, 1.22)
Feels religion is important, never attends	**2.34 (2.09, 2.62)**	**1.60 (1.42, 1.81)**	**1.94 (1.62, 2.33)**	**1.31 (1.08, 1.60)**	**2.43 (2.14, 2.76)**	**1.60 (1.39, 1.84)**	**1.95 (1.69, 2.26)**	**1.36 (1.16, 1.59)**
Feels religion is not important, attends weekly	**6.67 (5.51, 8.07)**	**4.90 (3.97, 6.04)**	**5.73 (3.89, 8.45)**	**3.99 (2.72, 5.86)**	**5.24 (4.16, 6.59)**	**4.08 (3.19, 5.21)**	**4.44 (3.46, 5.68)**	**3.74 (2.90, 4.83)**
Feels religion is not important, attends monthly	**4.42 (3.41, 5.72)**	**3.27 (2.50, 4.28)**	**2.91 (1.82, 4.65)**	**2.12 (1.34, 3.35)**	**4.19 (3.15, 5.58)**	**3.40 (2.53, 4.56)**	**2.76 (2.01, 3.80)**	**2.39 (1.70, 3.35)**
Feels religion is not important, attends rarely	**3.28 (2.89, 3.72)**	**2.22 (1.93, 2.55)**	**2.71 (2.25, 3.28)**	**1.99 (1.59, 2.49)**	**2.88 (2.54, 3.27)**	**2.06 (1.79, 2.37)**	**2.19 (1.85, 2.59)**	**1.66 (1.39, 1.98)**
Feels religion is not important, never attends	**4.56 (4.19, 4.95)**	**2.78 (2.49, 3.11)**	**3.10 (2.68, 3.58)**	**2.04 (1.68, 2.47)**	**3.98 (3.61, 4.38)**	**2.56 (2.25, 2.90)**	**3.30 (2.95, 3.69)**	**2.20 (1.92, 2.53)**

Bolding: p<.05

*Adjusted for sex, race, grade, religious affiliation, academic performance, parental education, subform, urbanicity, past two week binge drinking, past month marijuana use, and year

**Region membership: Northeast – Connecticut, Massachusetts, Maine, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont; North Central – Iowa, Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, North Dakota, Nebraska, Ohio (partial), South Dakota, Wisconsin; South – Alabama, Arkansas, District of Columbia, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Ohio (partial), Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia; West – Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, Wyoming