

# Asthma, Depression, and Suicidality

## Results from the 2007, 2009, and 2011 Youth Risk Behavior Surveys

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**Abstract:** We assessed the association between asthma and suicidality in a nationally representative sample of US high school students. Data came from the 2007, 2009, and 2011 Youth Risk Behavioral Surveys. Weighted prevalence estimates and adjusted odds ratios were calculated. Subjects with asthma are more likely to report 2-week sadness (35.2%) compared to those without asthma (26.7%). Teens with asthma are also more likely to report suicide ideation (20.1% vs. 15%), planning (15.7% vs. 12.1%), attempt (10.1% vs. 6.9%), and treatment for attempt (3.5% vs. 2%). Although the unadjusted association between lifetime asthma and suicide attempts is statistically significant (crude odds ratio 1.5 [95% CI 1.3–1.8]), after controlling for confounders, that association is no longer statistically significant (AOR 1.2 [1–1.6]). Thus, this increase in suicidality seems to be due to the increased prevalence of sadness among teens with asthma. Similar patterns were seen in the 2007 and 2009 surveys.

**Key Words:** Asthma, sadness, suicide ideation and behavior, adolescents

(*J Nerv Ment Dis* 2015;203: 664–669)

The association between asthma and depression impacts patients' functional status (Goethe et al., 2001) and quality of life (Yonas et al., 2013), and seems associated with disease outcomes and severity (Waxmonsky et al., 2006), either through specific behaviors such as smoking (Bender, 2007; Otten et al., 2009) or by affecting adherence to treatment (Smith et al., 2006). A recent review also pointed to a vicious cycle including affective disturbances, maladaptive behavior, and dysfunctional cognition among those with asthma (Yii and Koh, 2013). Suicide is a tragic yet mostly preventable outcome at any age, and it is closely associated with depression. It remains among the top 10 causes for all ages and among the top five for adolescents (Heron, 2012). Suicidality refers to all suicide-related behaviors and thoughts which can be viewed across a spectrum of severity, from suicidal thoughts or ideation (least severity), to suicide planning, and finally to a suicide attempt. The latter can be further separated by outcomes following the attempt: no medical intervention, medical intervention required, and lethal completion of suicide. The predominant risk factors for suicide include previous suicidal behavior, history of mental illness, substance abuse, access to fire arms or deadly means, chronic illnesses, and family history of psychopathology (Bridge et al., 2006). Of these, suicidality continues to be the strongest predictor of future attempts and completion (Goldston et al., 1999), thus it is imperative to maintain vigilance and establish interventions once risk factors are identified (King et al., 2013).

According to the CDC's National Health Interview Survey of 2011, 10% of US children (under 18) currently suffer from asthma (Bloom et al., 2011), which accounts to 7.1 million children. In 2008, asthma accounted for 6.8 million doctor visits and 10.5 million missed school days (Akinbami et al., 2011; Bloom et al., 2011). There is growing evidence of an association between asthma and increased likelihood

of suicidal thoughts among adolescents that is independent of mental disorders (Bender, 2007; Goodwin et al., 2004; Kuo et al., 2010), a connection that has already been found in the adult population (Clarke et al., 2008; Goodwin, 2012; Goodwin et al., 2004, 2012; Goodwin and Eaton, 2005; Goodwin and Marušić, 2004; Iessa et al., 2011; Katon, 2010; Kuo et al., 2010; Ozek and Ekici, 2011). Most recently, it was shown an increased risk in suicide mortality among Korean adolescents between 11 and 16 years old, a result that remained significant after adjustment for potential covariates (Kuo et al., 2010). In the United States, epidemiological data from MECA study, which surveyed four sites in the United States, found, after adjustments, that adolescents with asthma were significantly more likely to have suicidal ideation (OR = 3.25 [1.04–10.1]) (Goodwin et al., 2004).

Possible outcomes, or maybe confounders, that may be linking asthma with suicidality include cigarette smoking and substance use, psychiatric disorders (especially depression), childhood adversities, socioeconomic status, and ethnicity (Bandiera et al., 2013). In this study, the co-variables which the data was adjusted to were demographics (sex, age, race/ethnicity), cigarette smoking and alcohol use, and 2-week sadness, which, due to the lack of specificity of the questions, was not diagnosed as depression. Childhood adversities and stressful life events were not considered even though some questions did approach stressful events, such as bullying and physical and sexual violence. Stressful events have been shown to be an important factor on the asthmatics' lives, supporting the theory of the psyche's influences on physical manifestations (Douwes et al., 2011).

To our knowledge, no previous study has taken a nationally representative sample of US high school students to address the association between asthma, suicidality, and a possible diagnosis of depression. Because substance use disorders have been shown to be associated with suicidality (Bridge et al., 2006; Bandiera et al., 2013) and students with current and lifetime asthma reported more cigarette smoking, and alcohol use, when compared to the no asthma group, we included measures of use into the model. Therefore, we intend to expand on the current research utilizing three independent nationally represented samples to look at sadness, substance use, and risk for suicidality into four levels of severity: (1) suicidal ideation, (2) suicide plan, (3) suicide attempt, and (4) suicide attempt requiring treatment.

## METHODS

Data for the study was obtained from the Youth Risk Behavioral Survey (YRBS), which is part of the surveillance system maintained by the Centers for Disease Control and Prevention (CDC) to monitor youth behavior that influences health. Details in the YRBS methodology are available in the CDC website and have been described elsewhere (Brener et al., 2004).

In 1992 and 2000, the CDC conducted two test-retest reliability studies of the national YRBS questionnaire. In both occasions, the questionnaire was administered twice, approximately 14 days apart. In 1992, almost three fourths of the questions were rated as having a substantial or higher reliability ( $\kappa = 61\text{--}100\%$ ), and no statistically significant differences were observed between the prevalence estimates for the first and second times that the questionnaire was administered. In the second study, approximately one of five questions (22%) had significantly different prevalence estimates for the first and

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ISSN: 0022-3018/15/20309-0664

DOI: 10.1097/NMD.0000000000000349

second times that the questionnaire was administered. Questions that both kappas <61% and significantly different time-1 and time-2 prevalence estimates were considered problematic and either revised or deleted from later versions of the questionnaire.

Until today, no study has been conducted to assess the validity of all self-reported behaviors that are included on the YRBSS questionnaire. However, in 2003, CDC reviewed existing empiric literature to assess cognitive and situational factors that might affect the validity of adolescent self-reporting of behaviors measured by the YRBSS questionnaire. In this review, CDC determined that although self-reports of these types of behaviors are affected by both cognitive and situational factors, these factors do not threaten the validity of self-reports of each type of behavior equally. In addition, each type of behavior differs in the extent to which its self-report can be validated by an objective measure (Brener et al., 2004).

In summary, the YRBS is a probability sample of the United States population designed to constitute a nationally representative selection of adolescents in high school grades 9th through 12th, ages 14 to 18 years. The survey uses a three-stage cluster design, held every other year and conducted in school systems across the United States. A weighting factor was applied to each student record to adjust for non-response and the oversampling of African American and Latino students in the sample. The response rates remained above 80% for all samples utilized in this study, to include school and student completion. This survey has items suicidality dating back to its origin in 1991. The question addressing 2-week sadness was included in 1999. Despite asthma data being available since the 2003 survey, the 2007 question for identifying current asthma sufferers (item 87) was changed. Therefore, this study focuses on the latest data available, from 2011 ( $n = 14,186$ ), comparing to the last two previous years 2009 ( $n = 16,410$ ) and 2007 ( $n = 14,041$ ) samples, which showed similarity in the results.

Two items were used to address asthma, in questions worded as:

1. "Has a doctor or nurse ever told you that you have asthma?" (item 85)
2. "Do you still have asthma?" (item 86)

Lifetime asthma sufferers were identified when answered "yes" to item 85, and current asthma sufferers, a subgroup from the former, answered "yes" to item 86.

Smoking, alcohol use, and 2-week sadness was assessed in item 31, 42, and 24, respectively. Item 31 read: "During the last 30 days, on how many days did you smoke cigarettes?"; item 42 read: "During the past 30 days, on how many days did you have at least one drink of alcohol?"; and item 24 read: "During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?"

Suicidality was assessed by four separate items (25–28): (1) "During the past 12 months, did you ever seriously consider attempting suicide?"; (2) "During the past 12 months, did you make a plan about how you would attempt suicide?"; (3) "During the past 12 months, how many times did you actually attempt suicide?", recorded as "presence" or "absence" of suicide attempt; and (4) "If you attempted suicide during the past 12 months, did any attempt result in an injury, poisoning, or overdose that had to be treated by a doctor or nurse?" for an attempt requiring care. These items have been shown to have good validity (May and Klonsky, 2011).

Logistic regression models were conducted to establish the association between asthma and suicidality, with adjusted odds ratio between variables. Three models were executed: unadjusted, Model 1 (adjusted for demographic data—sex, age, and race/ethnicity), Model 2 (adjusted for demographics and substance use—tobacco and alcohol use), and Model 3 (adjustment for 2-week sadness in addition to all other covariates mentioned in above models).

Due to the anonymous database used in this project, it was determined to be exempt by University of Arkansas for Medical Sciences IRB.

## RESULTS

### Sample Description

Table 1 provides the descriptive characteristics of the 2011 sample. The total sample size was 14,186 students. Mean age was  $16 \pm 1.2$  years. There was no significant difference between males and females in the lifetime asthma group, whereas the current asthma group had a higher proportion of females (55.4% compared to 48.7% in the total sample).

The rate of lifetime and current asthma in our sample was 23% and 11.9%, respectively. Those with lifetime or current asthma had significant higher prevalence of 2-week sadness, all suicide variables (ideation, plan, attempt, and treatment), cigarette smoking, and alcohol use (see Table 1 for estimates and statistics).

### Logistic Regression Models

Table 2 presents with the odds ratio and confidence interval obtained from logistical regression model of asthma, lifetime and current, and the outcomes of 2-week sadness and all suicidality items. Subjects with asthma are at an increased risk of reporting 2-week sadness, independent of demographic and substance use confounders (see Table 2 for odds ratios, models, confidence intervals, and significance). The crude odds ratio of suicide-related items varied from 1.3 to 1.9, when not adjusted for independent variables. When adjusted for demographics, the lifetime asthma group still showed an increased odds ratio of suicidality. The current asthma group, with demographics adjustment, lost its significance for the more severe forms of suicidal behaviors (suicide attempt and requiring treatment). However, when progressively adjusted for our models (2 and 3), the results showed to be, in their vast majority, not statistically significant (see Table 2 for odds ratios, models, confidence intervals, and significance).

Results from the 2007 and 2009 years ( $n = 13,705$  and  $n = 15,542$  respectively) were mostly similar. Mean age was 16 years for all groups, and subjects were almost evenly divided between males and females. Both asthma groups presented with increased co-variables prevalence when compared to the no asthma group. Results from both years showed an association between asthma groups, 2-week sadness, and suicidality. In the unadjusted data, Models 1 and 2, all associations are shown to be significant in both groups. After adjusting for 2-week sadness though, in Model 3, the significance was lost in the lifetime asthma group. On the other hand, the current asthma group after adjustment on Model 3 remained statistically significant for the most severe form of suicide behavior ("suicide requiring treatment") (OR: 2.0–2.5 [1.2–4.2]) (tables on Appendix).

Findings from 2007 and 2009 are in accordance with recent studies cited earlier, which show youths with asthma are significantly more likely to have suicidal behavior when compared to those without asthma. The 2011 results point to 2-week sadness being a confounder of this association.

## DISCUSSION

In this analysis of three consecutive nationally represented surveys, we demonstrated that adolescents who endorsed having asthma, regardless of present symptoms, also reported higher levels of 2-week sadness and all suicidality variables when compared to their peers with no asthma history. In the 2011 sample, after controlling for co-variables, such as smoking, alcohol use, and 2-week sadness, the first two highly correlate with suicide (Clarke et al., 2008), and the association between asthma and suicidal behavior is no longer statistically significant. Future research should be to clarify how this "2-week sadness" item correlates with sleep disturbances, loss of interest, feelings of guilt, and other depressive symptoms. It is of public health interested to have more knowledge on how asthma, sadness, and suicide

**TABLE 1.** Characteristics of the Eligible Sample in the 2011 YRSB Survey

| 2011 YRSB                           | Total      | No Asthma  | Lifetime Asthma | Current Asthma | No Asthma Versus<br>Lifetime <i>p</i> Value | No Asthma Versus<br>Current <i>p</i> Value |
|-------------------------------------|------------|------------|-----------------|----------------|---------------------------------------------|--------------------------------------------|
| Total                               | 15,425     | 11,877     | 3,548           | 1,836          | n/a                                         | n/a                                        |
| Percent of total                    | 100.0      | 77         | 23              | 11.9           | n/a                                         | n/a                                        |
| Age                                 |            |            |                 |                |                                             |                                            |
| Mean age<br>(standard deviation)    | 16.1 (1.2) | 16.1 (1.2) | 16.1 (1.2)      | 16.1 (1.2)     | n/a                                         | n/a                                        |
| Gender (%)                          |            |            |                 |                |                                             |                                            |
| Male                                | 51.3       | 51.2       | 51.7            | 44.6           | $F(1,41) = 0.2$ $p = 0.67$                  | $F(1,41) = 22.6$ $p = 0.00$                |
| Female                              | 48.7       | 48.8       | 48.3            | 55.4           | $F(1,41) = 0.2$ $p = 0.67$                  | $F(1,41) = 22.6$ $p = 0.00$                |
| Race/ethnicity (%)                  |            |            |                 |                |                                             |                                            |
| White                               | 57.3       | 57.4       | 57              | 60.2           | $F(2.67, 109.57) = 4.7$<br>$p = 0.00$       | $F(2.87, 117.65) = 4.55$<br>$p = 0.00$     |
| African American                    | 13.9       | 13.2       | 16.2            | 15.8           |                                             |                                            |
| Latino                              | 8.8        | 9.4        | 7.0             | 5.7            |                                             |                                            |
| Other <sup>a</sup>                  | 9.2        | 9.1        | 9.5             | 9.2            |                                             |                                            |
| Clinical variables (%) <sup>b</sup> |            |            |                 |                |                                             |                                            |
| 2-week sadness                      | 28.3       | 26.7       | 34.1            | 35.2           | $F(1,41) = 81.2$ $p = 0.00$                 | $F(1,41) = 41.1$ $p = 0.00$                |
| Suicidal ideation                   | 16.0       | 15.0       | 19.2            | 20.1           | $F(1,41) = 12.2$ $p = 0.00$                 | $F(1,41) = 8.1$ $p = 0.00$                 |
| Suicide planning                    | 13.0       | 12.1       | 15.7            | 15.7           | $F(1,41) = 16.0$ $p = 0.001$                | $F(1,41) = 11.5$ $p = 0.00$                |
| Suicide attempt                     | 7.6        | 6.9        | 10.2            | 10.1           | $F(1,41) = 25.3$ $p = 0.001$                | $F(1,41) = 7.6$ $p = 0.01$                 |
| Suicide requiring treatment         | 2.4        | 2.0        | 3.6             | 3.5            | $F(1,40) = 18.9$ $p = 0.00$                 | $F(1,40) = 4.9$ $p = 0.03$                 |
| Cigarette smoking (Q31)             | 18.3       | 17.5       | 21.3            | 20.2           | $F(1,41) = 14.3$ $p = 0.00$                 | $F(1,41) = 2.7$ $p = 0.11$                 |
| Alcohol use (Q42)                   | 38.8       | 37.7       | 42.7            | 42.0           | $F(1,41) = 22.6$ $p = 0.00$                 | $F(1,41) = 5.3$ $p = 0.03$                 |

<sup>a</sup>Value corresponds to the sum of “Yes” responses.<sup>b</sup>Values indicate the percent of responders answering “Yes” to each mood question.

are related. Because the YRSB survey had only one question addressing “sadness”, it is hard to differentiate between depression, the mental disorder, and the normal feelings of sadness. The question that remains is to confirm 2-week sadness, or depression, as part of a casual pathway to suicide in teens with asthma.

Our study brings out the hypothesis that asthma might not be the cause of higher incidence of suicidality in itself, but instead be associated with higher high risk behaviors, such as substance use, and to 2-week sadness, which in turn could be a proxy for depression, increasing suicidality. There is evidence to show that an association between depression, medication non-adherence, and unhealthy behaviors, like smoking and alcohol use, may be involved in reports of current asthma symptoms in this population (Clarke et al., 2008).

It is still of extreme importance to screen asthmatics for depression, which can be done by their primary care providers (Bender, 2007). Healthcare providers and the general population should be educated about this possible association, and given tools to deal with this information, to prevent suicide behaviors.

The limitations of our approach should be kept in mind when analyzing our results. The YRSB is a large, national survey and cannot collect personal records or conduct clinical assessments. Therefore, asthma was not confirmed by medical records or clinical tests, nor was severity of symptoms or number of medications identified. Data included was based solely on self-reports from high school students willing to complete the survey which may differ from those who refused or presented incomplete data. Similarly, no data on socioeconomic status

**TABLE 2.** Association Between Asthma, 2-Week Sadness, Suicidality, and Co-Variables in the 2011 YRSB Survey

| 2011 YRSB Odds Ratio<br>(95% Confidence Interval) | Unadjusted           |                      | Model 1              |                      | Model 2              |                      | Model 3            |                   |
|---------------------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------------|-------------------|
|                                                   | Lifetime<br>Asthma   | Current<br>Asthma    | Lifetime<br>Asthma   | Current<br>Asthma    | Lifetime<br>Asthma   | Current<br>Asthma    | Lifetime<br>Asthma | Current<br>Asthma |
| 2-week sadness                                    | <b>1.4 (1.3–1.5)</b> | <b>1.5 (1.3–1.7)</b> | <b>1.4 (1.3–1.6)</b> | <b>1.4 (1.3–1.7)</b> | <b>1.4 (1.2–1.5)</b> | <b>1.4 (1.2–1.6)</b> | —                  | —                 |
| Suicidal ideation                                 | <b>1.3 (1.1–1.6)</b> | <b>1.4 (1.1–1.7)</b> | <b>1.4 (1.1–1.6)</b> | <b>1.3 (1.1–1.6)</b> | <b>1.2 (1.0–1.4)</b> | <b>1.3 (1.0–1.6)</b> | 1.0 (0.9–1.3)      | 1.1 (0.9–1.4)     |
| Suicidal planning                                 | <b>1.4 (1.2–1.6)</b> | <b>1.3 (1.1–1.5)</b> | <b>1.4 (1.2–1.6)</b> | <b>1.3 (1.1–1.5)</b> | <b>1.2 (1.0–1.5)</b> | <b>1.2 (1.0–1.4)</b> | 1.1 (0.9–1.3)      | 1.0 (0.8–1.3)     |
| Suicidal attempt                                  | <b>1.5 (1.3–1.8)</b> | <b>1.4 (1.1–1.9)</b> | <b>1.6 (1.3–1.9)</b> | <b>1.4 (1.0–1.8)</b> | <b>1.4 (1.2–1.8)</b> | <b>1.4 (1.0–1.9)</b> | 1.2 (1.0–1.6)      | 1.2 (0.8–1.7)     |
| Suicide requiring treatment                       | <b>1.9 (1.4–2.5)</b> | <b>1.6 (1.0–2.4)</b> | <b>1.8 (1.3–2.4)</b> | 1.5 (0.9–2.3)        | <b>1.6 (1.1–2.2)</b> | 1.4 (0.8–2.2)        | 1.4 (0.9–2.0)      | 1.2 (0.7–2.0)     |

Model 1: Odds ratio adjusted for demographic data to include age, sex, and race/ethnicity.

Model 2: Adjusted for Model 1 covariates as well as alcohol and smoking.

Model 3: Adjusted for all above covariates and 2-week sadness.

Bold type identifies statistical significance.

was collected, which has been shown to be associated to both asthma and having depression (Wissow et al., 1988). Finally, cross-sectional studies cannot present any casual relations or directionality between asthma and suicidality.

Our results strengthen the existing evidence linking asthma and 2-week sadness, a proxy for depression, as well as the higher prevalence of suicidality in this group. We believe that more detailed research to explore the possible causal paths for this association is needed looking towards prevention and early treatment of depression and suicidality among teens with asthma.

## CONCLUSION

Our findings confirm the increased prevalence of 2-week sadness, a proxy for depression, in a nationally representative sample of US high-school students. Those teens are also at increased risk for suicidal thoughts, plans, attempts, and attempts requiring treatment, but that increase in suicidality seems to be caused by the increase in depressive symptoms.

## Clinical Implications

Teens with asthma are at increased risk for depression, and those with depression are at increased risk for suicidal behavior. These findings support the need for regular mood screenings in this population, and if screened positive, those teens should be referred to treatment to prevent the tragedy of teen suicide. Specific interventions to decrease depression in this population will likely have a significant impact in the suicide risk. Clinicians should be aware to assess and inquire about the degree of sadness, and the potential presence of a depressive disorder, in this specific population.

## DISCLOSURE

The authors declare no conflict of interest.

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APPENDIX: RESULTS

2009/2007

Because results from both years are similar and led us to draw same conclusions, they will be presented together.

Demographic Characteristics: in both samples, the mean age of students who participated was 16 years and did not differ significantly among asthma groups. In regards to gender, only the current asthma group was significant in that 52.8% and 57.2%, respectively, of the participants were female. This significance was not seen in the lifetime asthma group, the no asthma group, or the total sample population.

Identification of Students with Asthma: a total of 15,542 and 13,705 students, respectively, completed the questionnaire for the items included in this study. Of these, 3,457 and 2,820 responded (22.2% and 20.3%, respectively) that at one time in their life a healthcare professional told them they had asthma (lifetime asthma group). A total of 1,661 and 1,432 self-reported having current asthma (10.4% and 10.9%, respectively), indicating that they have had asthma symptoms over the course of the past 12 months in the presence of an asthma diagnosis. Comparing both years, the only significant difference was an increase in the overall prevalence of asthma (from 20.3% to 22.2%).

Depression Indicators and Substance Use Behaviors: 2-week sadness was reported with significantly increased frequency among the current asthma (32.8% and 37.2%) and the lifetime asthma (31.4% and 33.9%) when compared to the no asthma group (24.2% and 27%). Endorsement of cigarette smoking was also significant for both asthma groups (current asthma 21.5%; lifetime asthma 22.6%) when compared to the no asthma group (18.2%) in 2009, but not significant between asthma groups on the 2007 survey. On the other hand, 46.1% and 48.6% of the lifetime asthma group endorsed alcohol use, a significant finding ( $p < 0.005$ ) for both years. When the current asthma group was compared to the no asthma group, in 2009, it did not reach

significance with 43.7% vs. 40.6% ( $p = 0.23$ ). In 2007, it approached significance with 49.1% of the current asthma group vs. 43.8% of the no asthma group ( $p = 0.07$ ).

Prevalence of Suicidality in Students with Asthma: In the total samples, all four suicidality variables were endorsed significantly more frequently by both asthma groups when compared to the no asthma controls ( $p < 0.005$  for all results). Between asthma groups, the current asthma students endorsed all suicidality variables more often than the lifetime asthma group. Specifically, “suicidal ideation” was endorsed by 18.7% and 20.4%, 16.9% and 17.8%, and 12.7% and 13.6% in the current asthma, lifetime, and no asthma groups, respectively. “Suicide planning” was endorsed in 13.6% and 15.7% of the current asthma, 13.8% and 14.0% of the lifetime asthma group, whereas the no asthma group was 9.9% and 10.5%. “Suicide attempts” were reported 9.9% and 11.9% in the current asthma group, 8.4% and 9.3% in the lifetime asthma group, and 5.5% and 6.3% in the no asthma group. Finally, “suicide requiring treatment” was endorsed in 4.0% and 4.2% of the current asthma group, 3.2% and 3.3% of the lifetime asthma group, and 1.6% of the no asthma group for both years.

Association Between Suicidality and Asthma: results from both years show association between asthma groups, sadness, and suicidality. In the unadjusted data, all associations are shown to be significant. This significance was maintained after adjustments in Model 1 and 2. After adjusting for all confounders to include sadness in Model 3, the significance was lost with all variables associations in the lifetime asthma group, with exception for the “suicidal planning” in 2009. On the other hand, the current asthma group survived all adjustments and maintained statistically significant associations in regards to “suicide attempt” (OR = 1.5 [1.0–2.1] and 1.6 [1.2–2.1]) and “suicide requiring treatment” (OR = 2.5 [1.5–4.2] and 2.0 [1.2–3.2]), the two most severe variables of suicidality.

These finding are in accordance with recent studies cited earlier which show youths with asthma are significantly more likely to have suicidal ideation when compared to those without asthma.

TABLE 2A. Association Between Asthma, 2-Week Sadness, Suicidality, and Co-Variables in the 2007 YRSB Survey

| 2007 YRBS Odds Ratio<br>(95% Confidence Interval) | Unadjusted         |                   | Model 1            |                   | Model 2            |                   | Model 3            |                   |
|---------------------------------------------------|--------------------|-------------------|--------------------|-------------------|--------------------|-------------------|--------------------|-------------------|
|                                                   | Lifetime<br>Asthma | Current<br>Asthma | Lifetime<br>Asthma | Current<br>Asthma | Lifetime<br>Asthma | Current<br>Asthma | Lifetime<br>Asthma | Current<br>Asthma |
| 2-week sadness                                    | 1.4 (1.3–1.5)      | 1.5 (1.3–1.7)     | 1.5 (1.3–1.6)      | 1.4 (1.2–1.6)     | 1.4 (1.2–1.6)      | 1.4 (1.2–1.6)     | —                  | —                 |
| Suicidal ideation                                 | 1.3 (1.1–1.6)      | 1.4 (1.1–1.7)     | 1.4 (1.1–1.6)      | 1.3 (1.1–1.6)     | 1.2 (1.0–1.4)      | 1.3 (1.0–1.6)     | 1.0 (0.9–1.3)      | 1.1 (0.9–1.4)     |
| Suicidal planning                                 | 1.4 (1.2–1.6)      | 1.3 (1.1–1.5)     | 1.4 (1.2–1.6)      | 1.3 (1.1–1.5)     | 1.2 (1.0–1.5)      | 1.2 (1.0–1.4)     | 1.1 (0.9–1.3)      | 1.0 (0.8–1.3)     |
| Suicidal attempt                                  | 1.5 (1.3–1.8)      | 1.4 (1.1–1.9)     | 1.6 (1.3–1.9)      | 1.4 (1.0–1.8)     | 1.4 (1.2–1.8)      | 1.4 (1.0–1.9)     | 1.2 (1.0–1.6)      | 1.2 (0.8–1.7)     |
| Suicide requiring treatment                       | 1.9 (1.4–2.5)      | 1.6 (1.0–2.4)     | 1.8 (1.3–2.4)      | 1.5 (0.9–2.3)     | 1.6 (1.1–2.2)      | 1.4 (0.8–2.2)     | 1.4 (0.9–2.0)      | 1.2 (0.7–2.0)     |

Model 1: Odds ratio adjusted for demographic data to include age, sex, and race/ethnicity.  
Model 2: Adjusted for Model 1 covariates as well as alcohol and smoking.  
Model 3: Adjusted for all above covariates and sadness.  
Bold type identifies statistical significance.

**TABLE 2B.** Association Between Asthma, 2-Week Sadness, Suicidality, and Co-Variables in the 2009 YRSB Survey

| 2009 YRBS Odds Ratio<br>(95% Confidence Interval) | Unadjusted           |                      | Model 1              |                      | Model 2              |                      | Model 3              |                      |
|---------------------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                                   | Lifetime<br>Asthma   | Current<br>Asthma    | Lifetime<br>Asthma   | Current<br>Asthma    | Lifetime<br>Asthma   | Current<br>Asthma    | Lifetime<br>Asthma   | Current<br>Asthma    |
| 2-week sadness                                    | <b>1.4 (1.3–1.5)</b> | <b>1.4 (1.3–1.6)</b> | <b>1.5 (1.3–1.6)</b> | <b>1.4 (1.3–1.6)</b> | <b>1.4 (1.3–1.5)</b> | <b>1.4 (1.2–1.6)</b> | —                    | —                    |
| Suicidal ideation                                 | <b>1.4 (1.2–1.6)</b> | <b>1.5 (1.3–1.8)</b> | <b>1.4 (1.2–1.6)</b> | <b>1.5 (1.2–1.8)</b> | <b>1.3 (1.1–1.5)</b> | <b>1.4 (1.2–1.7)</b> | 1.1 (0.9–1.3)        | 1.2 (1.0–1.5)        |
| Suicidal planning                                 | <b>1.5 (1.3–1.7)</b> | <b>1.3 (1.1–1.6)</b> | <b>1.5 (1.3–1.8)</b> | <b>1.3 (1.1–1.6)</b> | <b>1.4 (1.2–1.7)</b> | <b>1.3 (1.0–1.6)</b> | <b>1.2 (1.1–1.5)</b> | 1.1 (0.9–1.4)        |
| Suicidal attempt                                  | <b>1.6 (1.3–1.9)</b> | <b>1.4 (1.4–2.3)</b> | <b>1.6 (1.3–2.0)</b> | <b>1.7 (1.3–2.2)</b> | <b>1.4 (1.2–1.8)</b> | <b>1.7 (1.3–2.3)</b> | 1.2 (0.9–1.5)        | 1.5 (1.0–2.1)        |
| Suicide requiring treatment                       | <b>2.0 (1.5–2.8)</b> | <b>2.3 (1.5–3.6)</b> | <b>2.0 (1.5–2.9)</b> | <b>2.3 (1.4–3.6)</b> | <b>1.8 (1.2–2.7)</b> | <b>2.0 (1.1–3.5)</b> | 1.4 (1.0–2.1)        | <b>2.5 (1.5–4.2)</b> |

Model 1: Odds ratio adjusted for demographic data to include age, sex, and race/ethnicity.

Model 2: Adjusted for Model 1 covariates as well as alcohol and smoking.

Model 3: Adjusted for all above covariates and sadness.

Bold type identifies statistical significance.