Depression is pervasive in the United States. Recent data from the Centers for Disease Control and Prevention’s (CDC) Behavioral Risk Factor Surveillance Survey indicated that in 2009 9 percent of respondents met the criteria for current depression and 3.4 percent met the criteria for major depression (CDC 2010). Those same data indicated that women are more likely to report major depression (4.0 percent versus 2.7 percent). Using a human capital approach, the economic costs of depression were estimated to be $83.1 billion in 2000 with $26.1 billion (31 percent) of direct medical costs, $5.4 billion (7 percent) of suicide-related mortality costs, and $51.5 billion (62 percent) of workplace costs (Greenberg et al. 2003). One cost that has received little attention in the economics literature is the potential for depression to cause an individual to engage in risky sexual behavior. Depression may lead to risky sexual behavior as it may impair cognitive function and memory, decrease one’s ability to control impulsive behavior, increase emotional reactivity in peer relationships, reduce motivation, and increase fatalism. These effects of depression may inhibit an individual’s clear perception of the risk of contracting a sexually transmitted disease (STD) and his or her ability to prevent risky sexual behavior (Khan et al. 2009).

Despite a substantial body of research that links depression and risky sexual behavior for both males and females across a broad age range, definitively establishing the direction of causality remains elusive. Several studies present strong evidence that depression and risky sexual behaviors are positively correlated using cross-sectional data (e.g., Shrier et al. 2001 and citations within). However, such studies are not indicative of causal relationships due to the potential endogeneity of depression. For example, those who engage in sexual intercourse without a condom may become depressed as might those who contract an STD. In fact, there is a body of research that posits that risky sexual behavior itself is a cause of depression, even when the sexual behavior is not forced (Ethier et al. 2006).

Research in the medical and adolescent health fields has tried to establish the direction of causality from depression to risky sexual behaviors using the temporal ordering of events. Much of this research suggests that depressed adolescents and young adults are more likely to engage in risky sexual behaviors (Mazzaferro et al. 2006; Mota et al. 2010; Kahn et al. 2009), have an increased risk of a sexually transmitted infection (Shrier et al. 2009), and are less likely to use condoms or use them appropriately (Shrier et al. 2011; Brown et al. 2006; Lehrer et al. 2006). Yet even this research, which uses panel instead of cross-sectional data, does not definitively establish causality because there remains the possibility that a third unobservable factor could be correlated with the earlier episode of depression and the current risky sexual behavior.

In this paper, we exploit a unique opportunity in our empirical setting to identify the
causal effect of depression, measured by the Center for Epidemiologic Studies Depression Scale (CESD), on a young adult’s propensity to engage in risky sexual behaviors. Specifically, an unexpected event—the September 11 attacks (9/11) occurred during the collection of Wave III (July 2001 to April 2002) of the National Longitudinal Survey of Adolescent Health (AddHealth). Because of its unexpected nature and minimal impact on the continuation of AddHealth interviews, 9/11 can be viewed as a natural experiment which randomly assigned young adults interviewed before 9/11 into the “control” group and those after into the “treatment” group. In our data, we find that this “treatment” leads to exogenous and significant variation in the levels of depression between individuals in the “control” versus “treatment” group: the latter experienced a significant increase in CESD scores. Our results indicate that depression does lead to more engagement in risky sexual behavior.

I. Data

Our data are from the AddHealth, which is a school-based longitudinal study of a nationally representative sample of adolescents in grades 7 to 12 in the United States during the 1994–1995 school year. We use Wave III of the AddHealth for our study, with respondents having been interviewed from July 2001 to April 2002. We focus our analysis on women since we established that depression is more prevalent in women and women bear a large proportion of the costs of risky sexual activity. One in four young women is infected with at least one of the most common STDs (Alan Guttmacher Institute 2009). STDs (other than HIV/AIDS) may have more life-threatening consequences for women (e.g., Pelvic Inflammatory Disease, ectopic pregnancy and cervical cancer) than for men (Koshiol et al. 2008). Recent evidence from the CDC indicates that nearly 30 percent of women aged 20 to 24 are at high risk for the human papilloma virus (HPV) (CDC 2009), the highest risk of any age group among women. HPV, which is frequently transmitted through oral sex, has been implicated as a leading cause of throat cancer (D’Souza et al. 2007). The costs of the nine million new cases of the most prevalent STDs that occurred among 15- to 24-year-olds in 2000 amounted to $65 billion (Chesson et al. 2004). We limit our sample to unmarried women because the decisions surrounding sexual activity are likely to be different for married versus unmarried women.

Nine questions asked in Wave III are used to generate a CESD score to measure a young woman’s level of depression: How often did you feel this way during the past week? (1) You were bothered by things that usually don’t bother you; (2) You felt that you could not shake off the blues, even with help from your family and your friends; (3) You felt that you were just as good as other people; (4) You had trouble keeping your mind on what you were doing; (5) You felt depressed; (6) You were too tired to do things; (7) You enjoyed life; (8) You felt sad; (9) You felt that people disliked you. For each question, respondents chose from the following numbers as their answers: 0: never or rarely; 1: sometimes; 2: a lot of the time; 3: most of the time or all of the time. Combining all nine questions, we obtain a CESD score, ranging from 0 (least likely to be depressed) to 27 (most likely to be depressed). The CESD score is a common measure of depressive symptoms (Radloff 1977). Because this score is typically constructed using 20 questions including the nine described above and because it is usually used as a screening test rather than a diagnosis for depression, we directly use the total scores (from nine questions) in our empirical analysis instead of (arbitrarily) assigning our samples into depressed versus nondepressed groups.

Our (binary) outcome variables measuring risky sexual behaviors of single young women in a romantic relationship include: a) whether the young woman is sexually active, b) whether she engages in oral sex, c) whether she engages in anal sex, and d) whether she uses condoms during sex. Previous research has shown the

1 Wang and Yang (2010) also explore the exogeneity of 9/11 in their analysis of effects of depression on weight-related behaviors using the same dataset.

2 There is evidence that among disaster workers, 9/11 was associated with depression and Acute Stress Disorder which severely impaired their functioning (Biggs et al. 2010).
importance of examining not just vaginal intercourse but also other sexual behaviors among young adults (Averett, Corman, and Reichman forthcoming). In our analysis, we also control for these single young women’s age, race, ethnicity, years of education, self-rated health status, drinking and smoking behaviors and marijuana use, self-image, and attitudes towards risk or impulsivity.

Because Wave III of the AddHealth started gradually in July 2001 (with a few exceptions), just two months before 9/11, in order to construct comparable “control” and “treatment” groups, we focus on the young women interviewed within one month before and after 9/11. We find that there were approximately the same number of interviews one month before and one month after 9/11, consistent with what AddHealth described as an uninterrupted interview schedule.

Respondents for Wave III are asked to compile a relationship roster where they self-identify all romantic relationships they have had since 1995 (Wave I of the AddHealth). We include in our sample only those respondents currently in relationships at the time of the interview because of the unique identification method we use—the attacks of September 11. If the relationship was too far in the past we would not be identifying the effect of depression on sexual activity accurately given the temporal nature upon which our identification scheme rests. The questions about sexual activity in Wave III were asked only of women in relationships; therefore we cannot explore whether or not depression caused these women to engage in sexual activity with someone they were not in a romantic relationship with or to engage in sexual activity with strangers. We also do not have information on whether they have multiple concurrent sexual partners. Our full sample consists of 4,151 women aged 18 to 26 years. Most of our respondents are white (68 percent) or African American (25 percent). The average years of education are 13.5 and the average age is 21 years. Thirty-five percent smoked for at least 30 days in the past year, and during the year before interview 72 percent of these women drank alcohol and 31 percent used marijuana. Self-rated health averages 2.05, which is slightly worse than “very good.” The mean CESD score for the nine questions asked in the Wave III AddHealth for our sample is 8.12. More than 95 percent of these women are sexually active in their relationships. Sixty-seven percent and 11 percent of them engage in oral and anal sex, respectively. Fewer than 2 percent of the women in our sample report using condoms.

II. Econometric Model

The following econometric model is brought to our data:

\[ y_i = \beta_0 + \beta_1 \text{CESD}_i + x_i \beta_2 + \varepsilon_i, \]

where is \( \varepsilon_i \) the disturbance term for individual \( i \), CESD\(_i\) is her CESD score which could be potentially endogenous, \( x_i \) is a vector of her characteristics, and \( y_i \), as we mentioned in the Data section, includes four binary outcomes for each respondent to measure whether she engages in: (i) vaginal sex, (ii) oral sex, (iii) anal sex, and/or (iv) uses condoms during sex. Our instrumental variable (IV), not shown in equation (1) but used in our two-stage least squares (2SLS) estimation, is a binary variable set to 1 if the young woman was interviewed on or after the occurrence of 9/11 and 0 otherwise. When we graph the weekly average CESD scores against interview dates, there is a jump in the CESD scores right after 9/11 indicating that this IV is very likely to be strong; our “treatment” group is indeed treated in this “natural experiment.” The strength of our IV is also confirmed by our estimation results, which we discuss below.

III. Empirical Results

Table 1 presents the OLS and 2SLS estimates of the effect of depressed mood on our four outcome variables. We show only the results from the model that includes the full set of controls discussed above, although we do not show the coefficients from our control variables in this table due to space limitations. The OLS results reveal a positive and significant coefficient only on the probability of engaging in sexual intercourse. This finding that depression is positively related to sexual activity has been reported by others as summarized earlier.

Moving to the 2SLS estimates in column 2 of Table 1, it is clear that our instrument is strong as indicated by the F-statistics (shown in square brackets) from the first stage all exceeding 10 (The complete set of all results are available in
Specifically, our 2SLS results indicate that not only are young women with elevated depressed mood more likely to be sexually active, they are also more likely to engage in oral sex and to have sex without a condom, even after controlling for our rich set of covariates. Our 2SLS results are larger than our OLS results, suggesting that OLS underestimates the effect of depression on having sex. We ran two additional specification checks. First, we ran a model to determine if 9/11 was a statistically significant determinant of relationship status, and we found that it was not. Finally, we also included the 9/11 variable in the fully specified OLS equation and found that it was never statistically significant. Thus, we feel confident that our instrument is legitimately excluded from the second stage.

<table>
<thead>
<tr>
<th>Table 1—Coefficients on CESD Score</th>
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<tbody>
<tr>
<td>Outcome</td>
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<tr>
<td>Vaginal sex ($N = 4,003$)</td>
</tr>
<tr>
<td>(0.001)</td>
</tr>
<tr>
<td>Oral sex ($N = 3,751$)</td>
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<tr>
<td>(0.003)</td>
</tr>
<tr>
<td>Anal sex ($N = 3,700$)</td>
</tr>
<tr>
<td>(0.002)</td>
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<tr>
<td>Condom use ($N = 3,747$)</td>
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<tr>
<td>(0.001)</td>
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</tbody>
</table>

Notes: Robust standard errors in parentheses. First-stage $F$-statistics in square brackets. All models include controls for race, ethnicity, years of education, age, self-rated health, whether the respondent drinks, smokes, or uses marijuana, self-image, and attitudes towards risk.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

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IV. Conclusion

In this paper we have added to the existing literature by exploiting the timing of 9/11 coincident with the data collection of Wave III of the AddHealth survey to identify the effect of depression on risky sexual activity among young adult women. We focus on contemporary measures of sexual activity because these are indicative of current sexual practices, and they are often performed without barrier protection, making them particularly risky. Given the high probability and substantial costs of a young adult woman contracting an STD, it is also important to understand the risk factors underlying an STD diagnosis so policymakers can make appropriate policy recommendations.

Our findings indicate that higher CESD scores are significantly associated with having vaginal sex and with two risky sexual behaviors that are relatively common among young women (oral sex and failure to use a condom). These findings indicate that initiatives to make mental health care more available to a wider array of the population may also have the benefit of reducing risky sexual activity. As of January 2010, only 22 states plus the District of Columbia mandated mental health care (Kaiser Foundation 2010).

REFERENCES


