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ADOLESCENT DEPRESSION: DIAGNOSIS, TREATMENT, AND EDUCATIONAL ATTAINMENT

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SUMMARY

In this paper, I use nationally representative longitudinal data to examine adolescent depression and educational attainment. First, I examine the individual, family, and community-level determinants of adolescent depression, diagnosis, and treatment. I find that male and minority adolescents who score high on depression scales are less likely to be diagnosed as depressed or receive treatment than female and non-Hispanic white adolescents. Additionally, I find several community-level variables to be important determinants of depression, diagnosis, and treatment. Second, I examine the importance of adolescent depression for educational attainment. Although it is uncontroversial to expect a negative relationship, most previous research uses cross-sectional data, making it difficult to adequately determine the magnitude of the effect. I find that depressive symptoms are related to educational attainment along multiple margins: dropping out of high school, college enrollment, and college type. These relationships are only found for adolescent females, and there are several interesting results across income groups. Overall, these findings suggest that further attempts to diagnose and treat adolescents with depressive symptoms are needed and that additional treatment options may be required to combat the important relationship between adolescent depression and human capital accumulation for females.

Keywords

determinants of health; economic evaluation; depression; education; adolescence

INTRODUCTION

The World Health Organization has categorized depression as among the most disabling clinical diagnoses in the world, ranking fourth, and it is predicted to climb to second place by 2020. Depression is estimated to affect nearly 340 million people worldwide, including 18 million people in the US at any one time (Murray and Lopez, 1996). Early-onset depression (before the age of 21) has been of particular concern because individuals have longer first episodes, higher rates of recurrence, longer hospitalizations, and higher overall rates of comorbid disorders, including substance use disorders (Greden, 2001). For

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adolescents, depression is associated with poor health and behavioral outcomes, including higher risks of disruptive behaviors, anxiety, substance abuse, unsafe sexual practices, and greater likelihood of being involved in fights (Saluja *et al.*, 2004). Within school settings, symptoms of depression are associated with lower achievement on tests, lower teacher-rated grades, and poorer peer relationships (Roeser *et al*, 1998). Depression during adolescence may also lead to decreased human capital accumulation, which would have negative implications for lifetime income, occupational options, and socioeconomic status (Ettner *et al.*, 1997; Hamilton *et al.*, 1997; Kessler *et al.*, 1995).[1]

Even though depression is generally highly responsive to treatment, adolescents have low rates of recognition and diagnosis (Hirschfeld *et al*, 1997). The reasons for the low rates of recognition are relatively unknown, but individual, family, and community factors are all likely to be important. Parents are thought to be particularly important because they often need to be able to recognize symptoms of mental illness in order to begin the process of attaining treatment for their child (Kuehn, 2005). Evidence from the Moving to Opportunity experiment indicates that neighborhood characteristics are important predictors of mental health (e.g. Katz *et al.*, 2001 and Leventhal and Brooks-Gunn, 2003).

This paper uses the National Longitudinal Study of Adolescent Health (Add Health) to achieve two goals. First, the associations between individual, family, and community characteristics and adolescent depressive symptoms, the probability of being diagnosed, and the probability of receiving psychological counseling (the indicator for treatment in this paper) are examined. Second, in order to explore the potential importance of depressive symptoms on human capital accumulation, the association between depression during high school and educational attainment is examined. Many previous studies rely on cross-sectional data in order to examine the links between mental illness and educational outcomes and therefore are unable to separate the effects of education on depression with the effects of depression on education. While the results in this study should not be viewed as causal estimates due to the potential for unobserved heterogeneity that could influence both depression and education, the panel nature of the data does allow a more direct estimate of the magnitude of the relationship between depression and educational attainment than previous research.

I report several findings that have policy implications. I find that male and minority adolescents who score high on depression scales are less likely to be diagnosed as depressed or receive treatment than female and non-Hispanic white adolescents. I also find a robust negative association between depression in high school and subsequent educational attainment. This association is generally found to be statistically significant and large in magnitude for females only. These findings add insights into the primary predictors of adolescent depression, treatment, and diagnosis that are informative for policymakers and clinicians interested in targeting services to particular groups of at-risk individuals as well as attempts to increase the mental health service utilization for those with mental illness. These findings also suggest that further attempts to diagnose and treat adolescents with depressive

[1]For example, Berndt *et al.* (2000) found that early-onset depression was associated with 12–18% lower earnings in women than late onset depression.

symptoms are needed and that additional research is needed to further examine the important relationship between adolescent depression and human capital accumulation for females.

THEORETICAL MOTIVATION

The association between mental health and education attainment has been discussed extensively in the social science and health science literatures. For example, Roeser *et al.* (1998) explore why academic problems and particular manifestations of emotional distress co-occur in some children. In particular, the authors stress that causality is bi-directional between mental health and academic achievement. In related work, Sandefur *et al.* (1992) find self-esteem to be positively related to high school graduation. Additionally, Kmec and Furstenberg (2002) find that depression and mental health indices are positively related to socioeconomic status. Research in the health sciences literature has also conceptualized the association between depression and educational attainment. For example, Berndt *et al.* (2000) suggest that illnesses with early age at onset that substantially reduce physical, social, or cognitive functioning decrease educational attainment. Finally, while there is much research from economists who examine some topics related to depression, such as price indices for treatment (Frank *et al.*, 1998, Berndt *et al.*, 1998a, 2001, 2002) and the effect of depression on employment (Berndt *et al.*, 1998b, Ettner *et al.*, 1997, Conti *et al.*, 2006), there are few studies on the educational effects of depression. This is an important omission because the effects of depression may be different for education outcomes than employment outcomes[2] and several researchers have documented that mental and physical illnesses can impact educational attainment.[3]

In order to motivate the link between adolescent depression and educational attainment, I utilize a simple model of human capital accumulation (Rosen, 1977). First, I assume a deterministic relationship between earnings, y, and years of schooling:

$$y = f(s\,;\,A) \tag{1}$$

where A is a person-specific variable such as ability or other mental faculties that shifts the earnings-schooling function. Ability is exogenously fixed at the time schooling decisions are made. School quality, hours of work, and non-school investments are ignored for simplicity. To simplify further, I assume that schooling is a full-time activity. As such, age-earnings profiles would be a step function with an initial phase when income is zero ($y = 0$ during the school years) followed by an earnings profile that is conditional on schooling. Assuming no tuition or other schooling fees, the discounted value of future income is

[2]The individuals in the data set used in this paper are likely too young (average age 22) to fully examine the effects of depression on labor market outcomes in this paper. The respondents are currently being re-interviewed for a fourth wave of the survey, when examining the potentially complicated effects of depression on both education and employment outcomes could be pursued.

[3]Cuttie and Stabile (2004) and Fletcher and Wolfe (forthcoming) show that attention deficit/hyperactivity disorder is associated with lower human capital accumulation. Ding *et al.* (2006) present findings that indicate that obesity as well as mental illness is associated with lower grades in school.

$$V(s) = \int_s^R y(s; A)\mathrm{e}^{-rt}\mathrm{d}t$$

(2)

where r is the interest rate and R is the age of (exogenous) retirement or death. With this setup, the only decision variable affecting human capital is years of schooling, which is chosen in order to maximize the value function. The first-order condition is

$$\frac{y'(s; A)}{y(s; A)}\left[1 - \mathrm{e}^{-r(R-s)}\right] = r$$

(3)

Equation (3) requires investments in education to be made until the ratio of the discounted return to increasing education one more year versus beginning to receive the income stream (left-hand side) is equal to the discount rate.

Even in this simple model, there are several ways that mental health can influence education. First, mental illness can affect the individual's capacity or ability to learn so that the returns to education are lower (Roeser *et al.*, 1998). For example, in the case of depression, the ability of individuals to concentrate during school or study at home might be diminished. More formally, if we interpret A as concentration during school rather than innate ability (e.g. IQ) then we would predict that concentration is a negative function of depressive symptoms, $A'(d)<0$.[4] Since optimal schooling is a function of characteristics such as 'concentration,' $s^* = s(A)$, then the first-order condition can be used to examine the predicted effects on the optimal years of schooling of an increase in depressive symptoms that operate through decreasing concentration. Rewriting Equation (3), the optimal level of schooling can be shown as an implicit function of concentration and other parameters of the model, which are suppressed for ease of exposition:

$$\frac{y'(s^*(A); A)}{y(s^*(A); A)}\left[1 - \mathrm{e}^{-r(R-s^*(A))}\right] = r$$

(4)

Differentiating Equation (4) with respect to concentration and rearranging terms yield[5]

[4]It is also possible that ability does not determine years of schooling. For example, if the earnings function is parameterized as a Cobb-Douglas technology, it is apparent from Equation (3) that concentration would not affect the marginal decision.

[5]The following notation indicates the derivative with respect to the ith argument and cross partial derivative: F_i and F_{ij}

$$\frac{ds^*(A)}{dA} = \frac{(\lambda/r)y_{sa}(\cdot) + ry(\cdot)}{2y_s(\cdot) - (\lambda/r)y_{ss}(\cdot)} > 0 \text{ with } \lambda \equiv 1 - e^{-r(R-s^*)}$$

(5)

If the income function is concave in schooling ($y_{ss}(\cdot)<0$) and since $R \geq s^*(A)$, both the numerator and denominator are positive. Thus, if we assume that depressive symptoms decrease concentration, then depressive symptoms are hypothesized to decrease schooling. A second potential mechanism is that depression can affect the length of employment or life, characterized by R, which makes educational investments less valuable. With $R'(d)<0$, it can be similarly shown that depression is predicted to negatively affect schooling (see Appendix A). Therefore, from an economic point of view, there are several reasons to hypothesize an association between depression in adolescence and educational attainment, although data limitations will make it necessary to focus on the magnitude and robustness of the relationship rather than the specific causal mechanisms in this paper. In the next section, this association will be examined using the Add Health data.

EMPIRICAL MODEL

Following much of the reduced-form literature on optimal schooling (e.g. Farahati *et al.*, 2003) and the theoretical model outlined above, schooling is assumed to be a function of individual, family, and community characteristics

$$S^* = s(C, F, E, N)$$

(6)

where S^* represents optimal schooling attainment, C represents individual characteristics, F represents family characteristics, E represents exogenous environmental characteristics, and N represents neighborhood characteristics. These broad categories are chosen based on Haveman and Wolfe's (1995) review of the most important determinants of child attainment from the social sciences literature. The items of interest in this paper are characteristics in C - specifically individual mental health characteristics. In particular, the individual's depression score, self-reported diagnosis for depression, and self-reported psychological treatment will be closely examined.

DATA

The data in this study come from the restricted version of the National Longitudinal Study of Adolescent Health (Add Health). Add Health is a school-based, longitudinal study of the health-related behaviors of adolescents and their outcomes in young adulthood. Beginning with an in-school questionnaire administered to a nationally representative sample of

students in grades 7–12 in 1994–1995, the study follows up with a series of in-home interviews of students approximately one year and six years later. Add Health represents a substantial improvement in previous data for research on adolescent depression because it (1) is longitudinal (2) includes a diagnostic instrument for the full, nationally representative sample of 7–12th graders, and (3) provides links to Census data that incorporate information about the neighborhoods and communities in which students and their families reside. Other sources of data include questionnaires for parents, siblings, fellow students, and school administrators.[6]

The number of observations in the restricted Add Health data set with valid longitudinal weights and school identification codes is 14232.[7] There are 14169 observations with valid education and mental health outcomes. In order to maximize the available sample, I use single imputation techniques to estimate the missing family income and maternal education variables.[8] These variables have been shown to be the most consistent family-level predictors of educational attainment (Haveman and Wolfe, 1995). Restricting the sample to those individuals with complete data and those who are not still in high school allows a final sample of approximately 13 000 individuals.[9]

The depression scale uses 19 of the 20 items of the Center for Epidemiological Studies Depression Scale (CES-D) contained in the Add Health data set. This methodology has been used by several researchers to examine adolescent depression and has been shown to have good measurement properties (Cornwell, 2003; Radoff, 1977; Roberts *et al.*, 1991). The scale ranges from 0 to 57, and Robert *et al.* (1991) find that the optimal cut-off scores for depression are 22 for male adolescents and 24 for females. Using these cut-off scores, depression in the sample is approximately 8%.[10] Owing to the sampling methodology of the data set, many individuals who were in 12th grade during the wave 1 collection period were not interviewed during the wave 2 collection period. Therefore, I create (‘combined’) variables for being depressed and receiving counseling that represents the wave 1 measure for the 12th graders and the wave 2 measure for all other students.

As mentioned above, the restricted Add Health data allow community-level variables from the Census Bureau to be matched to the individuals in the data set. These variables are potentially important determinants of mental health outcomes, as suggested by results from the Moving to Opportunity experiment, where families were given additional resources to

[6]See Udry (2003) for full description of the Add Health data set.

[7]The public use data set is a random sample of less than half the individuals in the restricted data set and does not allow community-level variables to be used as covariates in the estimation.

[8]Dropping individuals with missing maternal education data would decrease the sample by 10% to 12 739. Dropping individuals with missing family income data would decrease the sample by 25% to 10 715. The results in this paper are largely robust to dropping individuals with missing income or maternal education data from the analysis. Results are available upon request.

[9]It is important to note that these sample restrictions could bias the results if the individuals are dropped non-randomly, in particular if individuals with mental illnesses are more likely to have missing data or leave the sample. If individuals who are dropped from the sample are the most severely mentally ill, the results of the relationship between depressive symptoms and education would presumably be downward biased. An appendix table indicates that individuals dropped from the sample are more disadvantaged, have higher rates of depression, and complete lower levels of schooling. This non-random attrition from the sample should be kept in mind when viewing the regression results.

[10]Goodman and Whitaker (2002) use Add Health and find depression rates around 8% in waves 1 and 2. Berndt *et al.* (2000) report that 15.7% of the US population has experienced an episode of major depressive disorder between ages 15 and 24. The lifetime prevalence of major depression in the National Comorbidity Survey Replication is 16.6% and the 12-month prevalence is 6.6% (Kessler *et al.*, 2003).

move to less impoverished communities. Katz *et al.* (2001) report results that improved community circumstances decreased behavioral problems for boys in Boston, and Leventhal and Brooks-Gunn (2003) find that boys in families who moved reported fewer depressive symptoms in the sample from New York City.[11] 1 include poverty and health-related county-level variables. In addition to including individual-level data that describe whether the household resides in a rural setting, I use the proportion of the county population below the poverty level, the proportion without a high school diploma, and the median and standard deviation of county-level income. Additionally, health-related variables include pediatrician density, health diagnostic practitioner density, children's hospitals with psychiatric services, and whether the county has been designated as a 'health practitioner shortage area' (HPSA).[12] These county-level variables are included to capture differences across communities in access to health care as well as differences in environments.[13] Summary statistics are given in Table I and a simple schematic of the timing of the various elements of the data is presented in Figure 1.

RESULTS

Results for mental health outcomes

In this section, I use logistic regression analysis to examine mental health and probit regression analysis to examine educational outcomes for adolescents in the Add Health survey. All results were attained using robust standard errors clustered at the school level and sample weights. First, I examine the determinants for several mental health outcomes, including depression status, being diagnosed by a doctor for depression, and getting treatment (i.e. psychological counseling). Second, I examine the extent to which mental health outcomes in high school are associated with educational attainment for the individuals.

Table II presents the results of the contemporaneous associations of mental health outcomes and individual, family, and community characteristics using the data collected during high school. In the first two columns, I examine the correlates of an individual having a CES-D score during high school above the cut-off scores suggested by Roberts *et al.* (2001) of 24 for females and 22 for males. Conforming to prior studies, females are more likely to be depressed, increasing the odds of depression by almost 70% relative to males (Saluja *et al.*, 2004; Dohrenwend *et al.*, 1992).[14] Wave 1 grade point average (GPA) is negatively related

[11]It is important to note that the interpretation of the community variables in the present (non-experimental) setting is made difficult because of the potential endogeneity of community variables. It could be the case that families with mentally ill children locate in communities with greater resources for the mentally ill. These residential decisions could bias the results toward finding higher rates of depression and utilization of services in areas with greater health resources. The results should be interpreted with this caveat in mind.

[12]It is important to note that county-level measures can be misleading because of the potential variation of the measure across different parts of the county (e.g. suburban versus urban versus rural). The results are largely robust to including measures of county population density, proportion of the county in rural areas, and proportion of the county in urban areas. Results are available upon request.

[13]Although incorporating the community-level variables have negligible impacts on the estimated individual-level coefficients, there are many instances in the results presented below that the community variables are significant predictors of mental health and education outcomes at the individual level. Results using specifications without community-level variables are available upon request.

[14]In additional results, I include a dummy variable for whether the respondent has no health insurance coverage. This variable does not appreciably change the main results, but does decrease the sample size by over 1500, and the missing responses are more likely to be from respondents with depressive symptoms. Results are available from the author.

to depression, reducing the odds of depression by nearly 40% for each point increase in GPA.[15] Additionally, being Hispanic increases the odds of being depressed by over 30% (versus white students) but the result is not statistically significant. Older individuals and individuals with lower maternal education have greater odds of being depressed, again likely indicating unmeasured characteristics of disadvantage or, in the later case, inherited depression since results in the next section indicate that depression can decrease female education attainment. Finally, individuals in high-poverty communities are more likely to be depressed. A 1% increase in the poverty rate increases the odds of depression by almost one and one-half percentage point, indicating that the poverty level of the environment is an important determinant of having depressive symptoms for adolescents.

Columns 2 and 3 examine the contemporaneous associations between being treated for mental illness and individual, family, and community characteristics. Treatment for depression is thought to be particularly difficult for early-onset depression. Saluja *et al.* (2004) report that many adolescents are untreated because depression is often attributed to normal stress of adolescence, misdiagnosed as other mental disorders or seen as a 'stage' of adolescence. In this paper, 'treatment' is a binary variable indicating whether the individual reported receiving psychological or emotional counseling in the past year. This variable is an imperfect proxy for use of mental health services for depression, since some individuals who are not depressed will also report the use of psychological or emotional counseling (e.g. individuals with schizophrenia). Additionally, individuals with depression and a co-occurring illness could be utilizing psychological counseling for the co-occurring illness (and not depression) but still be categorized as receiving 'treatment' with this variable. To the extent that this measurement error in assignment of treatment status is correlated with the control variables, the coefficients of these variables will be biased. For example, if females are more likely to have co-occurring depression and anorexia and seek psychological counseling for the anorexia but not depression, the results could incorrectly suggest that females are more likely to seek 'treatment' for depression. Unfortunately, the data set does not include information on potentially relevant co-occurring illnesses (e.g. schizophrenia, anorexia, bi-polar disorder); hence, the results of the association between depressive symptoms and seeking psychological counseling must be interpreted with caution.

In column 2, depression status during high school is included as a control variable. Controlling for previous depression status, being female increases the odds of receiving

[15]Using data containing genetic markers, Ding *et al.* (2006) show that depression likely causes large decreases in high school GPA so that GPA is an endogenous variable in my formulation. Thus, the main results in this paper likely understate the total effect of depression on education, since part of the effect operates through decreases in GPA. Unfortunately, the data contain only contemporaneous measures of GPA and depression, which does not allow a separation of the effects of depression on GPA and other educational outcomes.
It is unclear whether including GPA in the analysis is appropriate because there are two competing problems of inclusion or omission. On one hand, failing to include GPA in the analysis will cause the results to suffer from omitted ability bias, since individuals with higher GPAs presumably have higher abilities and would be predicted to attain more education. If depression and ability are correlated, then the coefficient on depression with no controls for ability will be biased upward. On the other hand, including GPA in the analysis introduces endogeneity bias into the results because depression likely affects GPA, which indirectly affects educational attainment. Therefore, the coefficient on depression will be downward bias because the 'total effect' on education is the combination of lowering GPA (which indirectly affects attainment) and the direct effects on education attainment not related to GPA. I present both sets of results (with and without controls for GPA) in the appendix as a way to bound the 'true' effect of depression on educational attainment – which likely lies in between the two sets of biased coefficients.

treatment by over 60% and being black decreases the odds by half. Additionally, individuals from intact families are less likely to receive treatment.[16] Mother's education and family income (p-value<0.15) are positively related to treatment for adolescents.[17] Community-level variables are also important determinants of receiving treatment. The density of pediatricians and health practitioners increases the odds of treatment, which suggests that access to care is an important determinant of seeking treatment. Interestingly, being designated as a 'HPSA' at the county level *increases* the odds of treatment. One potential explanation of this result is that the designation of a shortage area was followed by an increase in resources.

In column 3, the sample is restricted only to those individuals who are above the cut-off of the depression scale. In part, this restriction is used in order to focus attention on depressed individuals, since individuals in the full sample could report receiving counseling for other mental illnesses besides depression. This restriction does, however, reduce the sample size to approximately 1000 individuals and thus reduces the statistical power of the regression. The observed treatment participation for depressed adolescents is less than 30%. This is consistent with Greden (2001), who reports that 40–80% of individuals with early-onset depression do not seek treatment. Depressed females have higher odds of receiving treatment than depressed males. Being black decreases the odds of receiving treatment by nearly 60%. Interestingly, income, family structure, and maternal education are unrelated to getting treatment but the density of health practitioners substantially increases the odds of treatment. These results suggest potentially large barriers for treatment of adolescent depression, particularly for disadvantaged groups and groups with less access to health services.

In addition to being under-treated, depression is frequently under-diagnosed in adolescents (Berndt *et al.*, 2000). In columns 4 and 5, I examine the determinants of an individual reporting ever being diagnosed with depression by wave 3.[18] Again, males and minority students (even conditional on depression status) are less like to be diagnosed. Rural students are also less likely to be diagnosed. Finally, community level variables are not related to diagnosis for depression and restricting the sample to those with depression does not change the results (column 5).

Overall, several findings are robust and have policy implications. The lower probability of treatment or diagnosis for males and minority students suggests that focusing resources on assessing these individuals in high school could be warranted. Additionally, my results are

[16]Zimmerman (2005) also finds that the presence of fathers is negatively related to pursuing treatment. In contrast to the current results, Zimmerman finds that females are less likely to obtain treatment.

[17]Currie and Stabile (2004) find that the probability of treatment increases with income in the US for ADHD children but not in Canada.

[18]An important caveat to the results for diagnosis is that since this measure asks whether an individual was ever diagnosed, it could be the case that an individual was diagnosed and successfully treated before the survey collected information on depressive symptoms from the individual. These cases would bias the results toward finding no relationship between diagnosis and depressive symptoms. Additionally, since the age of onset for depression is younger for females than males, this concern with successful treatments before the data collection period could also potentially lead to biased estimates of some of the individual level variables, such as gender. There is also the potential for false reporting of diagnosis of depression for this sample. Although they do not examine depression, Baker *et al.* (2004) show systematic differences in self-reported and objective measures of health by labor market status and other characteristics. These problems with the diagnosis variable should be kept in mind by the reader and likely render the results for diagnosis of depression suggestive rather than conclusive.

consistent with the interpretation that the resources to diagnose and treat adolescent depression are lacking in disadvantaged and rural areas.

Results for educational outcomes

In this section, I investigate the relationship between education attainment and mental illness using indicators of depression during high school (waves 1 and 2) and subsequent educational attainment as measured in wave 3 of the data. There are multiple margins that depression can potentially affect educational attainment: the decision to drop out of high school, the decision to enroll in college, and the type of college to enroll in. To investigate these relationships, the primary independent variables are selected in part by the suggestions of Haveman and Wolfe (1995). They review the family and individual characteristics that have had the most robust relationships with children's educational attainment in the social science literature. These include mother's education, income level, family structure, and neighborhood characteristics. Figure 1 provides a schematic of the timing of the data collection for the independent and dependent variables. This figure indicates that difficulties with the potential for reverse causality (from educational attainment at age 22 to depressive symptoms during high school) are eliminated by the prospective design of the data collection.

First, I examine the determinants of dropping out of high school by estimating probit regressions of the probability of dropping out of high school by wave 3. Table III reports marginal effects with *p*-values in parenthesis. All results use robust standard errors clustered at the school level and sample weights.

Interestingly, depression status is not statistically significantly associated with dropping out for the full sample. However, columns 2 and 3 show that the relationship between depression and high school graduation varies dramatically by gender. These results support previous research that depressive disorder only affects women's educational outcomes (Berndt *et al.*, 2000; Ding *et al.*, 2006). While there is no economically or statistically significant relationship for males, female adolescents with depression are 3.5 percentage points less likely to graduate from high school than those without depression.[19] This association is comparable to the differences in dropping out of high school for students from an intact family versus a single-parent household. Unfortunately, the data are not able to provide evidence of the mechanism behind the association between depression and dropping out of high school because many of the choices that adolescents make before dropping out of school (e.g. not doing homework, skipping school) are not adequately captured in the data set.[20] As expected, family income, maternal education, and academic achievement are

[19]The results for all education outcomes are robust to varying the cut-off + / − 2 points for females and for males. I also use the adult cut-off of 16, and the results are quite similar. Results are available upon request.

[20]In unreported results, I also examine whether the effect of depression on education is through a 'labeling effect' of being diagnosed. This idea follows from the notion that having a mental illness is stigmatizing for individuals so that a diagnosis could actually be damaging to their future outcomes. I examine this issue by adding an indicator variable of being diagnosed (as defined above) as well as an interaction between being diagnosed and being depressed. I find no evidence that being diagnosed decreases educational attainment apart from the effects of being depressed. An important caveat for these results is that the indicator of diagnosis for depression is reported at wave 3 and is a lifetime measure of whether the individual has ever been diagnosed for depression. Hence, it is a noisy measure in this analysis of the effects of diagnosis on education attainment since some of the individuals could have been diagnosed after completing their education. It is also possible that individuals could have been diagnosed and successfully treated before wave 1.

negatively associated with dropping out. Black adolescents are also less likely to drop out compared with white students, while there is no difference in dropping out between Hispanic and white students.[21] Finally, there is evidence that community variables predict dropping out behavior.[22] Students living in rural communities are less likely to drop out than urban/suburban students, although this effect is larger and only statistically significant for females. Additionally, the proportion of the county population without a high school diploma is negatively related to an individual dropping out of high school.[23],[24]

Table IV presents probit regressions of the probability of enrolling in college by wave 3 for individuals who have graduated high school.[25] Marginal effects are reported with *p*-values in parenthesis. All results use robust standard errors clustered at the school level and sample weights.

Column 1 presents the basic results. Depressed adolescents are almost six percentage points less likely to enroll in college. Males are almost six percentage points less likely than females to enroll in college. Family income, mother's education, academic achievement, and having married parents (*p*-value <0.11) increase the likelihood of enrolling in college. Black and Hispanic students are more likely to attend college than white students by over four percentage points.[26] At the community level, the proportion of the population without a high school diploma and the standard deviation of household income increase the chances of going to college. The latter result can be interpreted to represent the relationship between county-level inequality and college enrollment in that students in counties with larger income differences (keeping the mean constant) are more likely to attend college. This could represent increased access to colleges located in rich sections of the county.[27]

Columns 2 and 3 present results for the association between mental illness and college enrollment separated by gender. This is important because, as stated above, there is consistent evidence in the health literature that depressive disorder only affects women's educational outcomes (Berndt *et al.*, 2000; Ding *et al.*, 2006). Column 2 shows no statistically significant relationship between depression and college enrollment for males and

[21]The finding that black students are less likely to drop out, conditional on other observable characteristics, combined with the stylized fact that black students are (unconditionally) more likely to drop out of high school shows that white students are more advantaged along observable characteristics such as family income, parental education, and school resources than black students.
[22]The addition of the community variables does not substantively change any of the coefficients of the individual-level variables; hence, I only present the full specifications. Results without the community-level variables are available upon request.
[23]I also examined interaction effects between depression status and community-level variables. For example, including an interaction between depression and being in a rural area can be used to examine whether the effects of depression are most (or least) pronounced in rural areas. I examined interaction effects between depression and rural area, median county income level, poverty level of county, and proportion in the county who graduated high school. I found no significant effects for these interactions and do no report the results. It is possible that there is an interaction effect between depression and additional county-level variables, but I do not pursue the issue in this paper.
[24]I also experiment with including measures of physical illness and anxiety for each of the education outcomes examined in the paper. Physical illness is only statistically related to dropping out and not the other education outcomes. The association between depressive symptoms and the education outcomes is only slightly reduced. Results are available from the author.
[25]High school drop outs are not included since they are likely ineligible to enroll in college.
[26]The finding that black students are more likely to attend college, conditional on other observable characteristics, combined with the stylized fact that black students are (unconditionally) less likely to attend college shows that white students are more advantaged along observable characteristics such as family income, parental education, and school resources than black students.
[27]In unreported results, regressions that include an interaction between family income and the standard deviation of county income and picture vocabulary test score and the standard deviation of county income were not statistically significant. These results imply that having higher ability in counties with larger segments of rich and poor does not increase college enrollment nor does having higher income in counties with larger segments of rich and poor. These results call into question an interpretation of county inequality leading to increased college opportunities for richer or more able students.

the magnitude is almost half the effect for females. Additionally, family income is shown to be much more important for determining college enrollment for males than females. One interpretation of this relationship is that males from poorer families might be expected to begin employment rather than attend college, whereas there may be no similar expectation for females. Column 3 shows results for females. The mental health results are quite different from those for males. Females with depression during high school are over six percentage points less likely to enroll in college. Having married parents is also only important for females, increasing their chances of attending college by almost six percentage points. Finally, Hispanic males and black females are more likely to attend college than their white counterparts with similar characteristics. In the Appendix, I present results for males and females separately by race and income.[28] There is evidence that while depressed white and Hispanic males enroll in college at similar rates than their non-depressed counterparts, black males (and particularly black males in poor families) are negatively affected by depression, although the result is not statistically significant. In stark comparison to males, depression seems to predominantly affect the college enrollment decisions of white females from relatively rich families and non-white females from relatively poor families (not significant). These results, especially for wealthy females, are quite unexpected. It could be the case that some females in wealthy families take time off between high school and college if they have depressive symptoms. However, the differences in the results across racial groups likely do not allow a straightforward explanation until the results are corroborated in other data sets. These findings deserve to be the subject of future work.

The results in previous tables have shown that depression affects female educational attainment on multiple margins, including increasing the likelihood of dropping out and decreasing the likelihood of enrolling in any type of college. Since most two-year colleges (and even some four-year colleges) have open-enrollment policies, depression could have differential effects across college type. Table V examines this issue by presenting results from a multinomial logistic regression for three categories of educational attainment (high school, two-year college, and four-year college). High school graduation is the omitted category; hence, all coefficients are interpreted relative to this outcome. Marginal effects are reported with *p*-values presented in parentheses under the coefficients. All results use robust standard errors clustered at the school level and sample weights.

Consistent with previous results, the gender differential in the effect of depression on educational attainment is substantial. Additionally, the effect of depression on college enrollment is found to only decrease the probability of enrolling in a four-year college. While the decrease in attending a four-year college for the full sample is over six percentage points, I find no effects for males and the effect for females is 10 percentage points. Again, the magnitude of the effect for females is comparable to the difference in having an intact family versus a single-household family. Additionally, family income, maternal education, and family structure are found to increase the chances of enrolling in a four-year college and have little effect on enrolling in a two-year college (versus graduating from high school). Students from rural areas are found to be almost four percentage points more likely to attend

[28]Income is dichotomized by whether an individual is in a family with income above or below the median value for the full sample.

a two-year college and almost six percentage points less likely to attend a four-year college than students from urban/suburban areas. There is little evidence that other community variables are strong determinants of the type of college students attend.

Overall, these results suggest that indicators of depression during adolescence represent a significant obstacle for the educational attainment for females along multiple margins. One concern is that adolescent females appear to be dropping out of high school due to depression. Dropping out of school is typically predicted to significantly lower future income potential and lead to worse lifetime outcomes. New programs (perhaps school based) that target adolescent females with depressive symptoms and assist them in finishing high school might be worth considering. The ineffectiveness of current treatment (i.e. reported psychological counseling) to alleviate this association (in unreported results) suggests that alternative interventions should be examined with the explicit purpose of increasing the chances for females with depression to successfully transition into college. It is also likely that the measure of 'treatment' available in this data set does not capture the totality of treatment for depression that adolescents receive; hence, these results can be viewed as suggestive. The finding that female adolescents from relatively affluent homes are less likely to enroll in college (four-year colleges in particular) is quite curious and should be the subject of future work that further examines why the interaction between depressive symptoms and income appears to be non-linear.

CONCLUSIONS

This paper makes several contributions to our knowledge of the correlates and consequences of adolescent depression. I find consistent evidence that male and minority students are less likely to be diagnosed or treated, even conditional on underlying depressive symptoms. Undiagnosed and untreated depressive symptoms are problematic because individuals with a long duration of untreated mental illness have been shown to be significantly less likely to achieve remission (Marshall *et al.*, 2005). Additionally, because depression is generally highly responsive to treatment, the consequences of depression are unnecessarily exacerbated by the low rates of recognition and diagnosis for these individuals (Hirschfeld *et al.*, 1997).[29]

This paper represents one of the first attempts to establish the magnitude of the relationship between depression and educational attainment. I use a unique longitudinal data set that is able to incorporate measures of community-level characteristics as well as family variables. Most previous studies use cross-sectional data on the correlations between mental health and educational attainment. Since there is evidence that mental health and educational outcomes are inter-related, contemporaneous measures of these two variables are unable to examine the direction of causation or the magnitude of the effect (Dohrenwend *et al.*, 1992).

Although the potential presence of unobserved heterogeneity that affects both education and depression does not allow the results to be viewed as causal, I find that depressive symptoms

[29]Although in general individuals are responsive to treatment for depression, there is a substantial minority of individuals who must try several different medications before treatment is successful, and there is a small proportion of individuals who do not respond to current medications.

are significantly associated with the educational decisions of adolescents along multiple margins and appear to be confined to females. First, female adolescents with depressive symptoms are more likely to drop out of high school. Second, female adolescents with depression during high school are much less likely to enroll in college. Third, conditional on graduating high school, female adolescents with depressive symptoms are less likely to enroll in a four-year college. In additional analysis, I find that the relationship between depression and educational attainment is complicated by family resources in a non-linear manner.

The finding that males with depressive symptoms are both less likely to be diagnosed or treated for depression *and* that depression has little effect on educational attainment is puzzling. The finding is consistent with the idea that current treatments do little to dampen the effects of depression on educational attainment but are efficacious in other ways such as suicide prevention. Equally plausible is the conjecture that depression affects males and females differently due to biological differences between genders that influence their propensity to take actions necessary to succeed in high school and continue to college (e.g. homework completion, school attendance, etc.).[30] Differences in how society treats adolescents with depressive symptoms (or other social forces) are also a valid candidate for the gender differences found in this paper. Exploring these and other hypotheses should be the subject of future work.

One necessary step for research to proceed in this area is the collection of richer data. Longitudinal data that include measures of depression and educational outcomes are currently quite scarce. Additional efforts to collect such data are needed, and researchers should attempt to survey family members and friends regarding perceptions of the causes and consequences of depression to allow family and societal ideas about depression to be investigated. Also, data on types of treatment and histories of depression (number of episodes, severity, and length), measures of parental depression, and measures of comorbid conditions (both physical and mental) are also needed.

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[30]Including measures of teenage pregnancy in the regression analyses does not change the relationships reported between depression and educational attainment for females.

APPENDIX A: ADD HEALTH SCALES

How often was each of the following things true during the past week?

0 (*Never or rarely*) to 3 (*Most of the time or all of the time*)

You were bothered by things that usually don't bother you.

You didn't feel like eating, your appetite was poor.

You felt that you could not shake off the blues, even with help from your family and your friends. You felt that you were just as good as other people. (*Reverse coded.*)

You had trouble keeping your mind on what you were doing.

You felt depressed.

You felt that you were too tired to do things.

You felt hopeful about the future. (*Reverse coded.*)

You thought your life had been a failure.

You felt fearful.

You were happy. (*Reverse coded.*)

You talked less than usual.

You felt lonely.

People were unfriendly to you.

You enjoyed life. (*Reverse coded.*)

You felt sad.

You felt that people disliked you.

It was hard to get started doing things.

You felt life was not worth living.

A.1. Further comparative statics results

First, the effect of depressive symptoms that decreases the retirement age is examined. Determining the relationship of retirement age on optimal schooling (from Equation (3)) is done is several steps. First, the optimal schooling equation is

$$\frac{y'(s^*(R);A)}{y(s^*(R);A)}\left[1-e^{-r(R-s^*(R))}\right]=r \tag{A1}$$

Taking the derivative of Equation (A1) with respect to R and rearranging terms produce

$$\frac{ds^*(R)}{dR}=\frac{\delta r y_s(\cdot)}{r y_s(\cdot)(1+\delta)-y_{ss}(\cdot)(1-\delta)}>0 \quad \text{with } \delta \equiv e^{-r(R-s^*(R))} \tag{A2}$$

Assuming $y_{ss}(\cdot)<0$, $R \geq s^*$, and $R'(d)<0$ this implies that an increase in depressive symptoms that decreases the retirement age will decrease the years of schooling.

The effects of depression on education attainment are given in Table AI, while the relationship between depression and college enrollment is presented in Table AII. Table AIII gives the tests of differences in observables.

Table AI.

Effects of depression on education attainment: comparing the results with and without GPA

Outcome Sample Column	Drop out Female 1	Drop out Female 2	College Female 3	College Female 4
Individual variables				
Depressed	0.034	0.070	−0.063	−0.124
	(0.021)**	(0.000)***	(0.056)*	(0.000)**
Age	−0.009	−0.012	−0.007	−0.006
	(0.000)***	(0.000)***	(0.150)	(0.200)
Female				
GPA	−0.072		0.154	
	(0.000)***		(0.000)***	
Mother education	−0.014	−0.018	0.036	0.038
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Family income	−0.001	−0.002	0.012	0.014
	−0.43	(0.283)	(0.001)***	(0.000)***
Married	−0.03	−0.038	0.058	0.064
	(0.004)***	(0.003)***	(0.002)***	(0.001)***
Hispanic	−0.003	−0.002	0.003	0.001
	−0.804	(0.875)	(0.936)	(0.971)

Outcome Sample Column	Drop out Female 1	Drop out Female 2	College Female 3	College Female 4
Black	−0.041	−0.037	0.065	0.035
	(0.000)***	(0.001)***	(0.008)***	(0.169)
PVT score	−0.003	−0.004	0.008	0.008
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Rural	−0.028	−0.028	−0.027	−0.032
	(0.008)***	(0.012)**	(0.215)	(0.142)
Community variables				
% in poverty	0	−0.000	−0.002	−0.002
	−0.922	(0.869)	(0.644)	(0.610)
% without diploma	−0.002	−0.003	0.004	0.005
	(0.004)***	(0.000)***	(0.023)**	(0.005)***
Median HH income	−0.003	−0.003	−0.003	−0.004
	−0.198	(0.315)	(0.625)	(0.467)
Std. dev. HH income	−0.002	−0.003	0.012	0.013
	−0.421	(0.215)	(0.022)**	(0.008)***
Unemployment rate	0.006	0.008		
	(0.044)**	(0.040)**		
Constant				
Observations	6921	6921	6230	6230

Outcome Sample Column	2-Year college Female 1	4-Year college Female 2	2-Year college Female 3	4-Year college Female 4
Individual variables				
Depressed	0.005	−0.083	0.057	−0.150
	(0.829)	(0.011)**	(0.000)***	(0.000)***
Age	−0.017	0.002	−0.008	−0.002
	(0.000)***	(0.828)	(0.000)***	(0.727)
Female				
GPA	−0.059	0.289		
	(0.000)***	(0.000)***		
Mother education	−0.007	0.045	−0.013	0.041
	(0.140)	(0.000)***	(0.000)***	(0.000)***
Family income	−0.008	0.026	−0.004	0.016
	(0.002)***	(0.000)***	(0.201)	(0.002)***
Married	−0.006	0.072	−0.030	0.068
	(0.714)	(0.000)***	(0.000)***	(0.000)***
Hispanic	−0.007	0.048	−0.012	0.030
	(0.734)	(0.253)	(0.169)	(0.254)
Black	−0.057	0.164	−0.036	0.073
	(0.006)***	(0.000)***	(0.000)***	(0.001)***

Outcome Sample Column	Drop out Female 1	Drop out Female 2	College Female 3	College Female 4
PVT score	−0.002	0.011	−0.003	0.010
	(0.004)***	(0.000)***	(0.000)***	(0.000)***
Rural	0.033	−0.053	−0.005	−0.012
	(0.051)*	(0.046)**	(0.447)	(0.443)
Community variables				
% in poverty	0.003	−0.000	0.000	0.001
	(0.338)	(0.931)	(0.853)	(0.697)
% without diploma	−0.001	0.002	−0.001	0.004
	(0.674)	(0.369)	(0.008)***	(0.027)**
Median HH income	0.000	−0.002	−0.000	−0.001
	(0.999)	(0.723)	(0.843)	(0.784)
Std. dev. HH income	0.004	0.012	−0.004	0.014
	(0.202)	(0.083)*	(0.037)**	(0.005)***
Unemployment rate				
Constant	0.658	−3.100	0.722	−1.871
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Observations	5389	5389	6921	6921

*Significant at 10%

**significant at 5%

***significant at 1%. Marginal effects (*p*-values).

Table AII.

Relationship between depression and college enrollment: results by gender, race, and income level

Sample	Coefficient	*p*-Value	Obs.
Male	−0.033	(0.337)	5316
Male rich	−0.033	(0.414)	3483
Male poor	−0.047	(0.427)	1833
Male white	−0.004	(0.927)	2934
Male white rich	−0.051	(0.328)	2231
Male white poor	0.167	(0.088)*	703
Male black	−0.123	(0.235)	1031
Male black rich	−0.013	(0.930)	475
Male black poor	−0.140	(0.199)	556
Male Hispanic	−0.043	(0.609)	849
Male Hispanic rich	0.052	(0.514)	406
Male Hispanic poor	−0.170	(0.168)	443
Female	−0.063	(0.056)*	6230
Female rich	−0.086	(0.016)**	3987
Female poor	−0.019	(0.051)	2243

Sample	Coefficient	*p*-Value	Obs.
Female white	−0.070	(0.100)	3421
Female white rich	−0.115	(0.009)***	2576
Female white poor	0.034	(–0.67)	845
Female black	−0.048	(0.452)	1412
Female black rich	0.024	(–0.754)	655
Female black poor	−0.095	(–0.264)	757
Female Hispanic	−0.054	(0.436)	927
Female Hispanic rich	−0.113	(–0.268)	415
Female Hispanic poor	0.012	(–0.909)	512

*Significant at 10%

**significant at 5%

***significant at 1%. *Note:* Each coefficient reflects a separate regression.

Table AIII.

Tests of differences in observables, analysis sample and dropped sample

	Analysis sample		Dropped sample			
Variable	**Mean**	**Std. dev.**	**Obs.**	**Mean**	**Std.**	**Test**
Individual variables Depression scale	11.08	7.54	1177	12.16	7.74	
Depressed (combined)	0.08	0.27	1191	0.11	0.31	—
Depressed	0.08	0.26	1177	0.10	0.30	—
Counseling (combined)	0.09	0.29	1213	0.10	0.30	NS
Counseling	0.11	0.32	1204	0.13	0.34	—
Counseling	0.09	0.28	839	0.09	0.29	NS
Counseling	0.07	0.25	1213	0.10	0.30	NS
Diagnosed	0.10	0.30	1221	0.13	0.33	—
Education level	13.28	1.94	1217	12.80	2.05	—
College	0.61	0.49	1217	0.48	0.50	—
Age	21.94	1.74	1222	22.60	1.88	—
Male	0.47	0.50	1222	0.51	0.50	—
Grade point average	2.79	0.77	815	2.77	0.77	NS
Mother education[a]	13.33	2.37	1222	12.96	2.41	—
Family income (10000's)[a]	4.72	4.27	1222	4.13	2.62	—
Married	0.63	0.48	1222	0.53	0.50	—
Hispanic	0.16	0.37	1222	0.19	0.39	—
Black	0.21	0.41	1222	0.22	0.42	NS
Picture vocabulary test score	101.0	14.25	548	93.98	19.38	—
Rural	0.27	1.00	1052	0.19	0.39	—

[a]Variable was imputed.

REFERENCES

Baker M, Stabile M, Deri C. 2004 What do self-reported, objective, measures of health measure? Journal of Human Resources 39(4): 1067–1093.

Berndt E, Busch S, Frank R. 1998a Price indexes for acute phase treatment of depression. NBER Working Paper 6799.

Berndt E et al. 1998b Workplace performance effects from chronic depression and its treatment. Journal of Health Economics 17(5): 511–535. [PubMed: 10185510]

Berndt E et al. 2000 Lost human capital from early-onset chronic depression. American Journal of Psychiatry 157(6): 940–947. [PubMed: 10831474]

Berndt E, Busch S, Frank R. 2001 Treatment price indexes for acute phase major depression In Medical Care Output and Productivity, Culter D, Berndt E (eds). NBER Studies in Income and Wealth, vol. 62 University of Chicago Press: Chicago; 462–505.

Berndt E et al. 2002 The medical treatment of depression, 1991–1996: productive inefficiency, expected outcome variations, and price indexes. Journal of Health Economics 21(3): 373–396. [PubMed: 12022264]

Conti R, Berndt E, Frank R. 2006 Early retirement and public disability insurance applications: exploring the impact of depression. NBER Working Paper 12237.

Cornwell B. 2003 The dynamic properties of social support: decay, growth, and staticity, and their effects on adolescent depression. Social Forces 81(3): 953–978.

Currie J, Stabile M. 2004 Child mental health and human capital accumulation: the case of ADHD. NBER Working Paper 10435.

Ding W, Lehrer S, Rosenquist N, Audrain-McGovern J. 2006 The impact of poor health on education: new evidence using genetic markers. NBER Working Paper 12304.

Dohrenwend B et al. 1992 Socioeconomic status and psychiatric disorders: the causation-selection issue. Science 255: 5047.

Ettner S, Frank R, Kessler R. 1997 The impact of psychiatric disorders on labor market outcomes. Industrial and Labor Relations Review 51(1): 64–81.

Farahati F, Marcotte D, Wilcox-Gok C. 2003 The effects of parents' psychiatric disorders on children's high school dropout. Economics of Education Review 22: 167–178.

Fletcher JM, Wolfe BL. In press. Child mental health and human capital accumulation: the case of ADHD revisited. Journal of Health Economics.

Frank R, Busch S, Berndt E. 1998 Measuring prices and quantities of treatment for depression. American Economic Review 88(22): 106–111.

Goodman E, Whitaker R. 2002 A prospective study of the role of depression in the development and persistence of adolescent obesity. Pediatrics 110(3): 497–504. [PubMed: 12205250]

Greden J. 2001 The burden of recurrent depression: causes consequences, and future prospects. Journal of Clinical Psychiatry 62(Suppl. 22): 5–9.

Hamilton V, Merrigan P, Dufresne E. 1997 Down and out: estimating the relationship between mental health and unemployment. Health Economics 6: 397–406. [PubMed: 9285232]

Haveman R, Wolfe B. 1995 The determinants of children's attainments: a review of methods and findings. Journal of Economic Literature 33(4): 1829–1878.

Hirschfeld R et al. 1997 The national depressive and manic-depressive association consensus statement of the undertreatment of depression. Journal of the American Medical Association 277(4): 333–340. [PubMed: 9002497]

Katz L, Kling J, Liebman J. 2001 Moving to opportunity in Boston: results of a randomized mobility experiment. Quarterly Journal of Economics 116(2): 607–654.

Kessler R, Berglund P, Demier O, Jin R, Koretz D, Merikangas K, Rush J, Walters E, Wang P. 2003 The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). Journal of the American Medical Association 289: 3095–3105. [PubMed: 12813115]

Kessler R, Foster C, Saunders W, Stang P. 1995 Social consequences of psychiatric disorders, I: educational attainment. American Journal of Psychiatry 152(7): 1026–1032. [PubMed: 7793438]

Kmec JA, Furstenberg FF Jr. 2002 Racial and gender differences in the transition to adulthood: a follow-up study of Philadelphia youth In New Perspectives in the Life Course: Socialization, vol. 7, Settersten R, Owens TJ(eds). Elsevier: UK.

Kuehn B. 2005 Mental illness takes heavy toll on youth. Journal of the American Medical Association 294(3): 293–295. [PubMed: 16030265]

Leventhal T, Brooks-Gunn J. 2003 Moving to opportunity: an experimental study of neighborhood effects on mental health. American Journal of Public Health 93(9): 1576–1582. [PubMed: 12948983]

Marshall M, Lewis S, Lockwood A, Drake R, Jones P, Croudace T. 2005 Association between duration of untreated psychosis and outcomes in cohorts of first-episode patients: a systematic review. Archives of General Psychiatry 62: 975–983. [PubMed: 16143729]

Murray CJ, Lopez AD. 1996 The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability from Disease, Injuries, and Risk Factors in 1990 and Projected to 2020, vol. 1 World Health Organization Harvard University Press: Cambridge, MA.

Radoff L. 1977 The CES-D Scale: a self report depression scale for research in the general population. Applied Psychological Measurement 1: 385–401.

Roberts R, Lewinsohn P, Seeley J. 1991 Screening for adolescent depression: a comparison of depression scales. Journal of the American Academy for Child Adolescent Psychiatry 30(1): 58–66.

Roeser R, Eccles J, Strobel K. 1998 Linking the study of schooling and mental health: selected issues and empirical illustrations at the level of the individual. Educational Psychologist 33(4): 153–176.

Rosen S. 1977 Human capital: a survey of empirical research. Research in Labor Economics 1: 3–40.

Saluja G et al. 2004 Prevalence of and risk factors for depressive symptoms among young adolescents. Archives of Pediatrics and Adolescent Medicine 158: 760–765. [PubMed: 15289248]

Sandefur G, McLanahan S, Wojtkiewicz R. 1992 The effects of parental marital status during adolescence on high school graduation. Social Forces 71(1): 103–121.

Udry JR. 2003 The National Longitudinal Study of Adolescent Health (Add Health), Waves I and II, 1994–1996; Wave III, 2001–2002 [machine-readable data file and documentation]. Carolina Population Center, University of North Carolina at Chapel Hill, Chapel Hill, NC.

Zimmerman F. 2005 Social and economic determinants of disparities in professional help-seeking for child mental health problems: evidence from a national sample. Health Services Research 40(5): 1514–1533. [PubMed: 16174145]

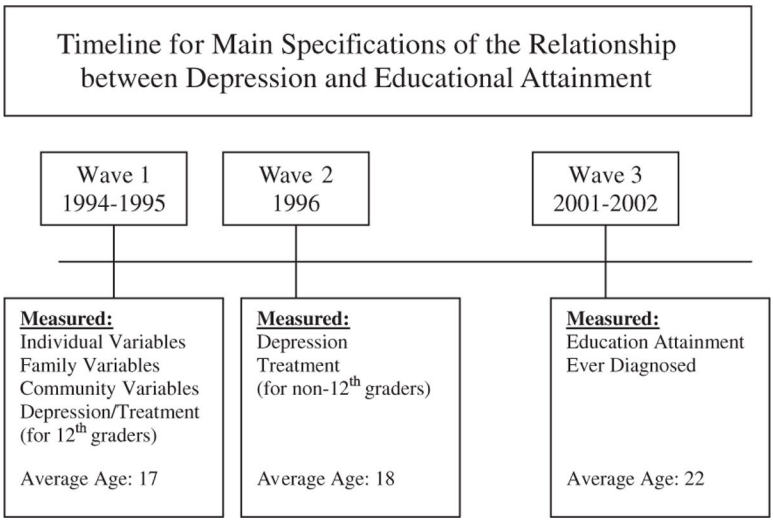

Figure 1.
Timeline for main specifications of the relationship between depression and education attainment

Table I.

Summary statistics, Add Health Data (unweighted, 12 890 observations)

Variable	Time Wave	Mean	Std. dev.	Min	Max
Individual variables					
Depression scale	1	11.08	7.54	0	56
Depressed (combined)	1.2	0.08	0.27	0	1
Depressed (male) (6036 obs.)	1.2	0.06	0.24	0	1
Depressed (female) (6854 obs.)	1.2	0.09	0.29	0	1
Depressed	1	0.08	0.26	0	1
Counseling (combined)	1.2	0.09	0.29	0	1
Counseling	1	0.11	0.32	0	1
Counseling	2	0.09	0.28	0	1
Diagnosed	3	0.10	0.30	0	1
Education level	3	13.28	1.94	6	22
College	3	0.61	0.49	0	1
Age	3	21.94	1.74	18	27
Male	All	0.47	0.50	0	1
Grade point average	1	2.79	0.77	1	4
Mother education[a]	1	13.33	2.37	8	21
Family income (10000's)[a]	1	4.72	4.27	0	99
Married	1	0.63	0.48	0	1
Hispanic	All	0.16	0.37	0	1
Black	All	0.21	0.41	0	1
Picture vocabulary test score	1	101.0	14.25	14	139
Rural	1	0.27	0.44	0	1
	Year	**Mean**	**Std. dev.**	**Min**	**Max**
Community variables					
% in poverty	1990	14.0	7.03	2.6	40.2
% without high school diploma	1990	25.7	9.09	5.2	61.1
Median income (1000's)	1990	30.3	7.86	12.7	54.6
Std. dev. income (1000's)	1990	30.4	5.94	18.3	49.7
Pediatricians (per 10M)	1993	0.14	0.10	0.0	0.5
Diagnostic pract. (per 10M)	1993	0.19	0.21	0.0	1.9
Hospitals with Psych. (per 10M)	1993	0.26	0.38	0.0	2.7
Health shortage area (part of county)	1995	0.62	0.49	0	1
Health shortage area (all of county)	1995	0.07	0.25	0	1

[a]Variable was imputed.

Table II.

Logistic regression analysis of mental illness characteristics: individual, family, and environmental associations[a]

Outcome Sample Columns	Depressed Full 1	Counseling Full 2	Counseling Depressed 3	Diagnosed Full 4	Diagnosed Depressed 5
Individual variables					
Depressed		4.000		3.162	
		(3.157–5.068) **		(2.389–4.184) **	
Age	1.150	0.951	0.898	0.971	0.934
	(1.097–1.206) **	(0.908–0.995) *	(0.806–1.001)	(0.930–1.014)	(0.831–1.051)
Female	1.688	1.641	1.674	2.647	2.225
	(1.380–2.064) **	(1.387–1.940) **	(1.102–2.545) *	(2.275–3.080) **	(1.496–3.309) **
GPA	0.602	0.612	0.819	0.717	0.659
	(0.529–0.684) **	(0.517–0.724) **	(0.618–1.086)	(0.648–0.794) **	(0.500–0.869) **
Mother education	0.954	1.058	1.046	1.041	1.070
	(0.914–0.997) *	(1.011–1.106) *	(0.940–1.163)	(0.999–1.085)	(0.962–1.192)
Family income	1.005	1.012	0.989	1.004	1.027
	(0.984–1.026)	(0.996–1.029)	(0.948–1.031)	(0.987–1.022)	(0.973–1.085)
Married	0.770	0.731	1.011	0.959	1.089
	(0.635–0.935) **	(0.617–0.866) **	(0.666–1.533)	(0.815–1.128)	(0.695–1.707)
Hispanic	1.308	0.768	0.603	0.523	0.384
	(0.955–1.792)	(0.562–1.048)	(0.349–1.042)	(0.382–0.716) **	(0.175–0.845) *
Black	0.956	0.515	0.404	0.396	0.265
	(0.718–1.273)	(0.383–0.693) **	(0.240–0.681) **	(0.301–0.520) **	(0.148–0.474) **
PVT score	0.985	1.005	1.015	1.015	1.012
	(0.978–0.993) **	(0.996–1.015)	(0.999–1.031)	(1.007–1.022) **	(0.993–1.031)
Rural	1.082	0.851	0.627	0.792	0.732
	(0.888–1.319)	(0.688–1.054)	(0.383–1.028)	(0.638–0.984) *	(0.429–1.246)
Community variables					
% in poverty	1.014	0.993	1.014	1.007	1.030
	(1.001–1.027) *	(0.975–1.012)	(0.982–1.048)	(0.994–1.021)	(0.987–1.075)
Pediatricians	0.698	4.898	4.812	0.967	2.228
	(0.225–2.169)	(1.508–15.905) **	(0.277–83.683)	(0.321–2.912)	(0.092–54.019)
Practitioners	1.301	1.723	3.303	1.230	1.103
	(0.981–1.726)	(1.246–2.381) **	(2.002–5.450) **	(0.752–2.010)	(0.393–3.098)
Hospitals	1.023	0.975	0.898	1.120	1.030
	(0.805–1.298)	(0.758–1.255)	(0.474–1.701)	(0.828–1.515)	(0.500–2.122)
Health shortage (whole)	1.006	1.366	1.171	0.980	0.891
	(0.811–1.249)	(1.081–1.725) **	(0.724–1.896)	(0.813–1.181)	(0.499–1.594)

Outcome **Sample** **Columns**	**Depressed** **Full** **1**	**Counseling** **Full** **2**	**Counseling** **Depressed** **3**	**Diagnosed** **Full** **4**	**Diagnosed** **Depressed** **5**
Health shortage (part)	1.245	1.317	1.051	1.018	0.587
	(0.881–1.761)	(0.911–1.904)	(0.575–1.924)	(0.710–1.460)	(0.258–1.337)
Observations	12958	12957	1028	12 940	1024

*Significant at 5%;

**significant at 1%. Odds ratios (95% confidence intervals).

[a]Results in this table are the same qualitatively if the individuals with missing maternal education and income are dropped rather than imputed.

Table III.

Probit regression analysis of associations between dropping out and mental health

Outcome Sample Column	Drop out Full 1	Drop out Male 2	Drop out Female 3
Individual variables			
Depressed	0.019	−0.006	0.035
	(0.127)	(0.748)	(0.022)**
Age	−0.016	−0.019	−0.013
	(0.000)***	(0.000)***	(0.000)***
Female	(0.001)***		
GPA	−0.085	−0.097	−0.069
	(0.000)***	(0.000)***	(0.000)***
Mother education	−0.011	−0.007	−0.013
	(0.000)***	(0.022)**	(0.000)***
Family income	−0.005	−0.015	−0.001
	(0.032)**	(0.000)***	(0.540)
Married	−0.033	−0.032	−0.025
	(0.000)***	(0.007)***	(0.011)**
Hispanic	−0.010	−0.014	−0.005
	(0.366)	(0.360)	(0.687)
Black	−0.036	−0.040	−0.033
	(0.000)***	(0.003)***	(0.001)***
PVT score	−0.003	−0.003	−0.002
	(0.000)***	(0.000)***	(0.000)***
Rural	−0.016	−0.007	−0.021
	(0.097)*	(0.606)	(0.034)**
Community variables			
% in poverty	−0.000	0.000	−0.000
	(0.854)	(0.910)	(0.823)
% without diploma	−0.003	−0.003	−0.002
	(0.000)***	(0.001)***	(0.002)***
Median HH income	−0.004	−0.003	−0.003
	(0.064)*	(0.241)	(0.161)
Std. dev. HH income	−0.000	0.000	−0.002
	(0.869)	(0.853)	(0.404)
Unemployment rate	0.006	0.006	0.006
	(0.010)***	(0.090)*	(0.028)**
Observations	12 950	6066	6884

*Significant at 10%

** significant at 5%

*** significant at 1%. Marginal effects (*p*-values).

Table IV.

Probit regression analysis of associations between college enrollment and mental health

Outcome Sample Column	College Full 1	College Male 2	College Female 3
Individual variables			
Depressed	−0.058	−0.037	−0.065
	(0.019)**	(0.278)	(0.051)*
Age	−0.000	−0.002	0.001
	(0.986)	(0.818)	(0.917)
Female	0.056		
	(0.000)***		
GPA	0.175	0.176	0.173
	(0.000)***	(0.000)***	(0.000)***
Mother education	0.036	0.036	0.035
	(0.000)***	(0.000)***	(0.000)***
Family income	0.019	0.030	0.012
	(0.000)***	(0.000)***	(0.001)***
Married	0.023	−0.012	0.054
	(0.104)	(0.573)	(0.003)***
Hispanic	0.041	0.085	−0.001
	(0.112)	(0.016)**	(0.973)
Black	0.046	0.026	0.062
	(0.055)*	(0.453)	(0.010)**
PVT score	0.007	0.007	0.006
	(0.000)***	(0.000)***	(0.000)***
Rural	−0.021	−0.015	−0.030
	(0.298)	(0.606)	(0.163)
Community variables			
% in poverty	−0.004	−0.006	−0.003
	(0.344)	(0.291)	(0.503)
% without diploma	0.004	0.004	0.005
	(0.020)**	(0.096)*	(0.009)***
Median HH income	−0.006	−0.009	−0.003
	(0.294)	(0.188)	(0.541)
Std. dev. HH income	0.016	0.019	0.012
	(0.001)***	(0.001)***	(0.015)**
Observations	11 512	5296	6216

*Significant at 10%

**significant at 5%

*** significant at 1%. Marginal effects (*p*-values).

Table V.

Associations between college enrollment type and mental health, multinomial logit regression (omitted category = high school graduation)

Outcome Sample Column	2-Year college Full 1	4-Year college Full 2	2-Year college Male 3	4-Year college Male 4	2-Year college Female 5	4-Year college Female 6
Individual variables						
Depressed	0.004	−0.069	0.008	−0.012	0.006	−0.101
	(0.832)	(0.004)***	(0.760)	(0.750)	(0.785)	(0.002)***
Age	−0.021	0.013	−0.025	0.012	−0.019	0.013
	(0.000)***	(0.029)**	(0.000)***	(0.079)*	(0.000)***	(0.054)*
Female	0.028	0.046				
	(0.002)***	(0.000)***				
GPA	−0.052	0.301	−0.038	0.300	−0.066	0.299
	(0.000)***	(0.000)***	(0.001)***	(0.000)***	(0.000)***	(0.000)***
Mother education	−0.001	0.038	0.005	0.031	−0.007	0.043
	(0.722)	(0.000)***	(0.174)	(0.000)***	(0.117)	(0.000)***
Family income	−0.004	0.028	0.001	0.030	−0.008	0.026
	(0.109)	(0.000)***	(0.748)	(0.000)***	(0.001)***	(0.000)***
Married	0.010	0.036	0.028	−0.002	−0.003	0.063
	(0.388)	(0.028)**	(0.054)*	(0.942)	(0.849)	(0.001)***
Hispanic	0.028	0.030	0.061	−0.020	−0.004	0.069
	(0.158)	(0.348)	(0.032)**	(0.550)	(0.834)	(0.113)
Black	−0.052	0.145	−0.053	0.114	−0.057	0.169
	(0.001)***	(0.000)***	(0.003)***	(0.002)***	(0.006)***	(0.000)***
PVT score	−0.001	0.009	−0.001	0.008	−0.001	0.010
	(0.010)***	(0.000)***	(0.133)	(0.000)***	(0.011)**	(0.000)***
Rural	0.036	−0.053	0.044	−0.058	0.029	−0.047
	(0.004)***	(0.018)**	(0.011)**	(0.031)**	(0.082)*	(0.076)*
Community variables						
% in poverty	0.004	−0.002	0.002	−0.000	0.005	−0.003
	(0.169)	(0.659)	(0.639)	(0.933)	(0.109)	(0.539)
% without diploma	−0.001	0.002	0.000	−0.000	−0.001	0.004
	(0.591)	(0.407)	(0.969)	(0.917)	(0.377)	(0.121)
Median HH income	0.001	−0.003	0.001	−0.004	0.001	−0.003
	(0.634)	(0.570)	(0.814)	(0.566)	(0.706)	(0.658)
Std. dev. HH income	0.004	0.012	0.006	0.011	0.002	0.013
	(0.197)	(0.046)**	(0.107)	(0.086)*	(0.376)	(0.043)**
Constant	0.480	−3.015	0.321	−2.687	0.666	−3.193
	(0.002)***	(0.000)***	(0.091)*	(0.000)***	(0.000)***	(0.000)***

Outcome Sample Column	2-Year college Full 1	4-Year college Full 2	2-Year college Male 3	4-Year college Male 4	2-Year college Female 5	4-Year college Female 6
Observations	10 390	10 390	4721	4721	5669	5669

*
Significant at 10%

**
significant at 5%

***
significant at 1%. Marginal effects (p-values).