The Impact of Depression on the Academic Productivity of University Students

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Abstract

Background: Depression is a common disorder that impacts an individual's ability to perform life activities, including those required by the workplace. Academic performance can be viewed as a direct parallel to workforce performance, with students belonging to a unique set of individuals whose ability to perform can be measured on criteria applied by an observer and by self-report. While the prevalence of depression for this group is high and preparation for entry into the workplace is critical for these individuals, this relationship has not been adequately investigated.

Aims of the Study: This study investigates the relationship between depression and its treatments and the academic performance of undergraduate students.

Methods: Data regarding academics, health and productivity for students from Western Michigan University were obtained from the University's Registrar's Office, the campus Health Center and a survey delivered to the students. The primary outcomes of interest were the student's grade point average (GPA), an objective, observer generated measure of academic productivity, and the students' self-reported academic performance.

Results: Diagnosed depression was associated with a 0.49 point, or half a letter grade, decrease in student GPA, while treatment was associated with a protective effect of approximately 0.44 points. The self-reported data regarding the impact of depression on the performance of academic tasks was consistent with these findings. Depressed students reported a pattern of increasing interference of depression symptoms with academic performance peaking in the month of diagnosis and decreasing thereafter with the lowest levels reported in months 4 through 6 post-diagnosis, each of which is significantly less than the month of diagnosis.

Discussion: The finding of a significant relationship between depression and academic performance was robust to the variety of analyses employed within this study. However, interpretation of the findings must be tempered by a number of facts. The sample was drawn from a subset of students at a single university, those willing to complete a questionnaire regarding their health and productivity. Due to non-availability of the treatment data from other health care providers, the treatment variable used within the regression models represents an imprecise proxy for the totality of treatment methods received by depressed subjects from a variety of on-campus and off-campus health care providers. Another challenge to the interpretation of this data is the interrelatedness of depression and school performance. Because of this, it was not possible to evaluate the extent to which the association between depression and academic performance is driven by causality in either direction.

Implications for Health Care Provision and Use: While depression and its effects have been studied in many different population groups and subgroups, the effect of this disease on college students has not been well documented. This research demonstrates the impact of depression and the effectiveness of its treatment on a student sample. From a public health perspective, this analysis highlights the importance of access to mental health treatment facilities among the college aged and the potential value of efforts to educate this population segment on the availability of that resource.

Introduction

Depression has a significant impact on an individual's ability to perform life activities.[1] While the ability to participate in the lives of friends and family has been widely explored in the context of quality of life, much less research has been done that investigates the impact of depression on the ability to perform the life activities related to work performance, and none have yet been published on the impact of depression on the ability of students to perform the work required for academic achievement.

Because a high proportion of its societal cost results from reductions in productivity, summary statements of these data have been featured prominently in publications focused on the total cost of depression.[1-3] Other reports have focused on a subset of the components of productivity losses such as short-term or long-term disability or absenteeism which are easily quantifiable with objective data.[4-9] In contrast to these, the impact of depression on presenteeism (reduced on-job productivity) is not as directly observable and may be largely

unrecognized by their employer.[10,11] Further work is needed to establish the validity of worker self-reports of presenteeism in order to round out our understanding of the full impact of chronic conditions such as depression on productivity and their full economic impact.

This paper reports the findings from a study of the impact of depression and its treatment on the academic productivity of undergraduate students. Academic productivity was measured using the students' undergraduate grade point average (GPA), a reasonably objective measurement of student ''on job performance'' provided by an outside evaluator based on tests of achievement and the students' (''workers'') self-reported absenteeism and presenteeism.

For this patient population, depression related reductions in academic performance are an important outcome of the disorder. It reflects a reduction in learning opportunities, a decrease in the level of information absorbed and/or a decrease in their ability to demonstrate learning. Additionally, depression can have a disruptive influence on students' future careers by delaying entry into the job market or inhibiting the job search process.

Methods

Data Sources

The sample for this study was drawn from undergraduate students of Western Michigan University (WMU). Students that had been diagnosed with depression (depressed students) between January 1998 and April 2000 at the on-campus Health Center were identified based on the ICD-9 codes 296.2x or 296.3x within their medical records. A health and productivity survey was distributed to these individuals diagnosed with depression and to a sample drawn from the student population at a ratio of approximately 1:3, respectively. The control group was developed from the pool of survey respondents. To be eligible for the control group, the students may not have reported that they had received a diagnosis of depression from a health care provider or reported more than three of six symptoms of depression (depressed mood, loss of interest or pleasure, significant weight or appetite changes, insomnia or excessive sleep, increase or decrease in activity, loss of energy, feelings of worthlessness or guilt, decreased ability to think or concentrate) where at least one of the symptoms was depressed mood or loss of interest or pleasure.

For the students of both groups (depressed students and controls), the Registrar's Office provided information consisting of: age, gender, ACT exam score (a standardized entrance exam), current class level, current college within the University, current curriculum, total credit hours attempted, total credit hours earned and, if the student had graduated, graduation date. In addition, the Registrar's Office provided GPAs, credit hours attempted and earned for each of 9 terms (from Winter 1998 to Winter 2000). The WMU academic year consists of four terms: two 16-week terms, Fall and Winter, and two eight-week terms, Spring and Summer.

For all students in the study, the campus Health Center provided information regarding their history of migraine, asthma, diabetes or allergies. For the students with a depressive disorder, additional data were obtained which included the date of their depression diagnosis, the date of last visit for depression, their depression history, the number of office visits, the number of visits that included counseling and information about their drug treatment such as name, strength, quantity dispensed and dispensing dates.

The survey completed by the participants contained 68 questions that were organized into 7 sections (details in academic experience, employment status, demographic characteristics, health care evaluation, health status and productivity impairment related to depression and other health disorders). The survey, specific to the data needs of this study, was developed with the assistance of the Health Center and was approved by WMU's Human Subjects Institutional Review Board (HSIRB). A unique identifier was generated by the Registrar's Office and used to match the information obtained from the Health Center, the Registrar's Office and the students' surveys. The anonymized data were made available to the researchers for this study.

Observed Variables

Student specific characteristics used in this analysis included the student's age and dummy variables for gender, race (white versus non-white) and living status (living with roommate/parents/partner versus alone). ACT scores, which along with high school records have been used in the education literature to predict college student GPA, were included in this analysis as a measure of student ability.[12]

A student's GPA can be affected by the course content of the classes in which they enroll. For example, a student who is doing poorly in a given academic track may elect to change to one that is less demanding. To control for this influence, a dummy variable was developed that indicates terms in which students changed their major. The number of attempted credit hours per term was included in the analyses as a proxy for the volume of academic demands on the student. A dummy variable for student level (sophomore, junior, senior and freshman-omitted category) for each term was included to control for experience in dealing with academic demands.

In addition to depression, students can experience chronic diseases (allergy, diabetes, migraine and asthma) and/or acute health conditions (e.g., flu, pneumonia, broken arm) during their college careers. A dummy variable for other health conditions was included in the analyses with the value of 1 if the student experienced any health disorders other than depression during the term.

Computed Variables

Employment Burden

Within the survey the students reported, by month, on a 0 to 100 scale the degree to which their employment, if any, impaired their ability to complete school assignments. Based

on this information, a variable was calculated for each term based on a weighted average of the scores reported for each of the months comprising that term.

Depression

According to the American Psychiatric Association, an episode of depression may cause the individual to experience depressive symptoms for a period of 4-6 months.[13] Based on this, a conservative proxy for the presence of depression within a term was constructed by assuming that the student experienced depressive symptoms for 6 months (180 days). School days falling within a 180-day period after a depression diagnosis were assigned a value of 1 and a value of zero if the school day did not fall within this period. The presence of depression within a term was then calculated as the mean value of these dummy codes during the school days comprising that term.

Treatment

Depression treatment for students participating in this study consisted of drug therapy with or without supplementation with psychotherapy, each of which was provided by on-campus or off-campus providers. Analyzable treatment data available to this study were limited to prescribed medications provided by the campus Health Center. Data from the Health Center regarding the medication name, strength, dispensing date and quantity dispensed were combined with information on daily dosage for each medication from the Physicians' Desk Reference[14] to calculate the number of months of drug therapy for depression available to each student through the Health Center. In turn, these data were used to determine the amount of drug treatment for depression within each term. Thus, the treatment variable used in this analysis was calculated as the proportion of months within a term during which the student took medication for depression. The starting date for treatment was shifted forward by 6 weeks when the treatment proxy was constructed based on the observation that drug therapy generally becomes effective approximately 6 weeks after the initiation of treatment.[15] By interacting this variable with the depression variable, a proxy of the effect of treatment on the GPA of students diagnosed with depression was obtained that reflected the delayed onset of activity and the duration of treatment use.

Self-Reported Academic Performance

Within the survey, students completed two questions that asked them to report the degree to which depression and other health disorders impaired their ability to conduct school activities such as attending classes, studying and preparing assignments. These data were reported as continuous variables that took values from 0 to 100 for each month covered by the survey. Self-reported academic performance, or productivity, was calculated with the equation SReport = 100 – Depression Impairment – Other Impairment, which assumed that a healthy individual had a 100% performance

level and subtracted the health related impairments associated with depression and other health conditions. These data were converted to term level data by calculating the average for the months comprising that term.

Data Analytic Procedures

GPA Regression Model

The primary analyses were conducted using regression modeling with the student's GPA for that term as the dependent variable and the independent variables as described above representing their demographics, health status and academic characteristics. The following equation represents the formulation of the GPA regression model:

$$\text{GPA} = \alpha + \beta_1 \text{ Depression} + \beta_2 \text{ (Depression * Treatment)} + \beta_3 \text{ Other} + \gamma \text{ W} + \delta \text{ Z} + \varepsilon. \tag{1}$$

Where β_1 is the impact of untreated depression on student GPA and β_2 is the impact of treated depressive disorders on student GPA. Combining these into the equation $(\beta_1 + \beta_2$ Treatment)*Depression yields the net observed effect of depression on student performance, while the total effect of diagnosed depression on student GPA in the case of full compliance with treatment is equal to $\beta_1 + \beta_2$. The coefficient β_3 represents the effect of other health disorders on student GPA. The parameter α represents individual effects not captured by any of the regressors in the GPA equation that vary across students and impact their performance. In the context of this model, they may represent student ambition to study and work hard, their academic background, social events in their life, which are difficult to be accounted for by separate variables in the structural equation. The coefficients γ and δ represent the sets of student specific characteristics and academic characteristics, respectively.

A Lagrangian Multiplier (LM) test[16,17] indicated the presence of individual effects, however a Hausman test found these not to be correlated with the depression variable.[18] The absence of selection bias in this unbalanced panel data was confirmed using the Verbeek and Nijman procedure.[19] Based on these diagnostics, a random effects estimator was selected over an ordinary least square (OLS) or a fixed effects estimator due to the increased efficiency of the model.

Self-Reported Performance Regression Model

A second regression was run using self-reported performance as the dependent variable with the remaining components of model analogous to the previous model. This resulted in the following equation:

$$\text{SReport} = u + \mu_1 \text{ Depression} + \mu_2 \text{ (Depression * Treatment)} + \mu_3 \text{ Other} + \lambda \text{ W} + \sigma \text{ Z} + v. \tag{2}$$

The presence of correlation between hidden individual effects and the regressors in the SReport equation led to the selection of a fixed effects estimator for this equation.

Table 1. Self-Reported Health and Academic Histories

Variables	Depressed Students (n = 121)	Controls (n = 209)	P-value of t-test (df)
Percent experiencing symptoms before age 18	69%	11%	< 0.0001 (181.5)[a]
Mean (SD) number of depressive symptoms reported	5.61 (0.47)	0.58 (0.31)	< 0.0001 (148.5)
Percent reporting depression symptom caused by:			
Relationship Problems	66%	13%	< 0.0001 (192.5)
Low school performance	48%	13%	< 0.0001 (183.4)
Family problems	48%	6%	< 0.0001 (150.5)
Financial problems	45%	11%	< 0.0001 (177.7)
Other problems	50%	11%	< 0.0001 (175.2)
Percent reporting a parental history of:			
Depression	59%	10%	< 0.0001 (172.6)
Anxiety	32%	3%	≤ 0.0001 (137.9)
Substance abuse	21%	7%	0.0008 (173.7)
Mean (SD) number of events in past year due to health:			
Classes missed	14.64 (23.97)	2.99 (5.37)	≤ 0.0001 (127)
Assignments missed	5.45 (8.66)	0.9 (2.78)	≤ 0.0001 (134.4)
Exams missed	1.36 (3.74)	0.1 (0.41)	0.0003 (121.7)
Courses dropped	0.74 (1.68)	0.09 (0.52)	≤ 0.0001 (133.7)
Social activities missed	4.46 (11.23)	1.14 (3.90)	0.0021 (136.9)

[a] *Degrees of Freedom for the t-test using Pooled or Satterthwaite Method.*

Results

An overall response rate of 37% was obtained for the health and productivity survey. The analysis sample consisted of two groups of students drawn from the survey respondents: 121 students diagnosed with depression by a health professional at the campus Health Center and 209 controls. The two groups were statistically similar with regards to age, sex, race and student school status. However, the depressed students had a higher ACT score than the control group (23.06 versus 21.97, p = .02, df = 266). Compared to depressed students who failed to respond to the survey instrument, the depressed respondents were younger in age (22.67 versus 23.96, p = .0284, df = 288) and had a higher proportion of female students (0.85 versus 0.68, p = .0005, df = 286.8).

Although each of the 121 students diagnosed at the campus Health Center were prescribed drug therapy for their depression, only 92 students (76%) obtained at least one prescription from the center. Prescribed medications usually consisted of SSRI (selective serotonin reuptake inhibitor) products, but also included tricyclic amine medications. Sixty of the students using medication for their depression also participated in counseling sessions with psychiatrists or psychologists. Eighteen of the students with depressive disorders who did not receive medication from the center participated in some form of counseling at school or off campus, but available records indicated 11 students didn't follow any treatment.

Table 1 provides statistics on the self-reported health and academic histories of the survey respondents. On average, depressed students reported more then five symptoms of

depression during the past year and 69% of them claimed to have experienced similar symptoms before the age of 18. Generally, students with depression indicated more than one cause for their depressive symptoms. Two-thirds of them indicated that they felt a relationship problem was the cause, although low school performance, family and financial problems were also reported as causative factors. More than half of the depressed students claimed that their parents had a history of depression. A significantly larger proportion of depressed students claimed that their parents had a history of anxiety (32%) and substance abuse (21%).

Depressed students reported missing a significantly greater number of classes (14.64 vs. 2.99), exams (1.36 vs. .10) and assignments (5.45 vs. .90). Students with depression also reported dropping a significantly greater number of courses (.74 vs. .09) and missing a greater number of social activities.

GPA Equation

The first column of **Table 2** presents estimates of the coefficients of the GPA equation. The analysis controlled for age, gender, race, living status, impairment of school productivity by employment, ACT score, attempted credit hours of school, year in school and major change. As shown by these estimates, there is evidence of a negative effect imposed by depression on student GPA. The coefficient of the Depression variable indicates that the diagnosis of a depressive disorder was associated with a 0.49 point drop in GPA. An increase in student GPA of 0.44 was associated with treatment for depression, eliminating approximately 89.8% of the associated drop observed for depression. The other health disorders (mental and/or physical health

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Table 2: Regression Equation Results

Variables	GPA Equation		Self-Reported Performance Equation	
	Parameter Estimates	P-value of t-test	Parameter Estimates	P-value of t-test
Depression	−0.4854	< .0001	−5.3792	0.0295
Depression * Treatment	0.4422	0.0191	5.8108	0.1821
Other	−0.1377	0.022	−2.4927	0.0927
R-square	0.14		0.85	
Degess of Freedom for the Model	644		314	

conditions) were also associated with a significant decrease in GPA, but their impact was approximately 28% that of depression.

Self-Reported Performance Equation

In the second column of **Table 2**, the estimates of the self-rated performance equation are presented. The coefficients of the variables of interest have the expected signs, with the level of school performance significantly reduced by 5.38% due to diagnosed depression. The coefficient of the treatment variable is positive, opposite that of the depression variable and approximately equal in magnitude, but does not reach statistical significance. Other health disorders are associated with a decrease in school performance by a non-significant

percentage (2.49%) that is less than that of diagnosed depression.

Pattern of Self-Reported Performance

The pattern of impairment of school performance reported by depressed students in the six months before and after the index month (i.e., the month in which depression was diagnosed) is displayed in **Figure 1**. The means exhibit elevated and generally increasing impairment in the months preceding the diagnosis, with each month having a mean of 28% or above. The pre-diagnosis means peak in the month prior to diagnosis, followed by a mean of 46.3% impairment in the month of diagnosis. After diagnosis, impairment of school performance begins a steady decrease of
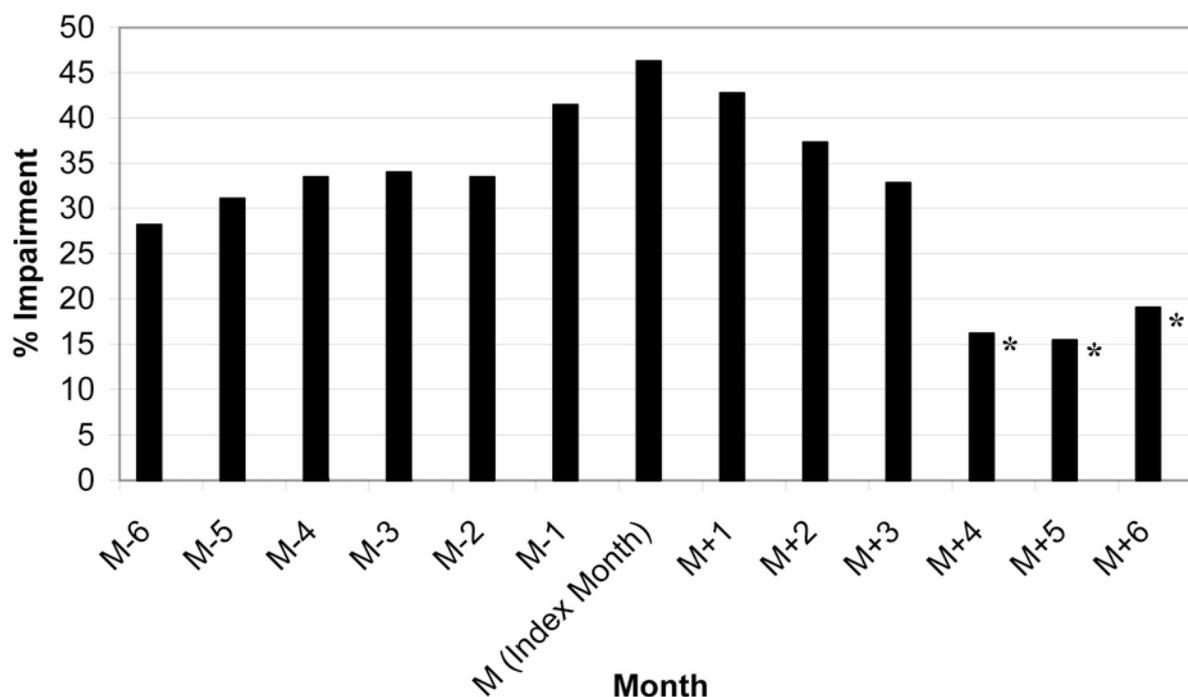

Figure 1. Self-Reported Impairment of School Performance Caused by Depression
in the 6 Month Before and After a Diagnosis of Depression

* Significantly different from the Index Month at p ≤ .05

approximately 11% per month through 3 months post-diagnosis. All monthly impairment means during this three-month span exceed 32% impairment. In months 4 through 6 post-diagnosis, the mean impairment ranges from 15 to 19%, just less than half the impairment observed in months 4 through 6 pre-diagnosis and significantly less than the index month.

Matched Pairs

As a further test of the relationships observed within the regression models, 75 matched student pairs were developed which were comprised of a diagnosed subject and a control matched on gender, curriculum, class level, and their GPA (± 0.25) for the term prior to the date of the first visit for depression of the depressed students (baseline term). The change in mean GPA for both groups from the baseline term to the index term (the term in which the diagnosed students had their first visit for depression) was evaluated. Within the group composed of depressed students, a mean decrease in GPA of .25 (SD = 0.8619) was observed based on a change from a 3.21 GPA in the baseline term to 2.96 in the index term. Over the same period, the matched controls were observed to have an average .03 increase (SD = 0.7497) in GPA reflecting a change from a baseline 3.06 GPA to 3.09 during the index term. A t-test of the mean differences for the two groups was significant (p = .0398, df = 148).

Discussion

Depression is a prevalent and serious mental disorder among adolescents and young adults. It is associated with an increase in family problems, school failure and particularly in adolescents, suicide, substance abuse and absenteeism.[20] The subjects of this study were college undergraduates with the focus of the research being the impact of depression on academic achievement, a proxy for the larger body of productivity impacts which extends to the workplace and the home.

We analyzed data regarding academic performance derived from two sources. One of these was from the perspective of outside observers who assign tasks to a group of subjects and evaluate their performance relative to other subjects in the group, or to an external standard. The evaluations of a set of these external observers were summarized in the calculation of the GPA for that term. The subjects themselves provided the second perspective. They reported the number of academic activities they were unable to complete and provided a summary measure of the degree to which depression had decreased their effectiveness as students.

An important issue in the measurement of an individual's performance, whether in academics or the work environment, is the amount of agreement between an observer's objective measures of performance and the subject's own perception of their performance. As Berndt et al.[21] pointed out, subjective measures may be better than objective measures in registering changes in interpersonal communication skills,

ability to generate team enthusiasm and cognition. Differences in the extent to which activities of these types comprise the work output of an individual may account for some disparities between the observations of external evaluators and the individual performing the activities.

Within the random effects estimate model, a diagnosis of depression was associated with a decrease in student GPA of 0.49 points, or approximately half of a letter grade. Depression treatment aims to shorten the episode of depression, to prevent recurrence and to decrease the negative consequences of episodes.[20] Full compliance with drug treatment, which was often used in combination with psychotherapy within this patient sample, was associated with a protective effect for student GPA, with the estimate for that effect being 0.44 points.

In many respects the self-reported data mirrored the objective assessments provided by the outside observers, with highly significant differences in the number of missed classes, assignments and exams and the number of courses dropped, between the depressed students and the controls. Within the self-reported performance regression model, depression was found to be associated with significantly lower performance. The impact of treatment and other health conditions, while of the anticipated sign and roughly similar magnitude in relation to depression to those observed in the GPA model, failed to reach significance.

Point estimates for the variables of interest, the depression and treatment variables, were very similar across the alternative estimators that were investigated (OLS, random effects, fixed effects), providing evidence regarding the robustness of these results. In contrast, and not surprisingly, the coefficients of the demographic variables that were included to control for their hypothesized impact on the variables of interest based on the academic literature, are rather sensitive to the estimation method. Further evidence in support of the findings is provided by the sub-analysis conducted on matched pairs within the sample with a finding of a significant negative change in GPA within the group of depressed students.

Despite the consistent findings across a number of alternative analytical methods, there are a number of limitations that impact the interpretation of the data from this study. The sample was drawn from a subset of students at a single university, those willing to complete a questionnaire regarding their health and productivity. The higher proportion of female students within the respondent population may have influenced the magnitude of the reported effects to the extent that gender differences exist in the willingness to acknowledge decreased abilities due to poor health or to allow poor health to influence their behavior. Differences between the two groups within the analyzed sample with regard to GPA, with GPA being highest among the depressed students, does not allow us to rule out regression to the mean as accounting for at least some of the observed difference associated with the depression diagnosis.

As the identification of depression cases and the treatment data were generated from information provided by the on-campus Health Center, it is reasonable to assume that some

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proportion of the control patients may have been diagnosed and/or treated for depression by off-campus practitioners during the course of the study, however the criteria for identification of the control group, which included a list of depression symptoms, should have kept this number to a minimum. It is perhaps more likely that the depressed students sought and received treatment from a variety of off-campus providers, with that influence unaccounted for within the data. This potential compounds an evident issue regarding the lack of counseling data in sufficient detail for analysis. As a result, the treatment variable used within the regression models represents an imprecise proxy for the totality of treatment methods received by depressed subjects from a variety of on-campus and off-campus health care providers.

Another challenge to the interpretation of this data is the interrelatedness of depression and school performance. Among the 121 students diagnosed with depression, 58 students claimed low school performance as one of the causes of their depressive symptoms. None of the depressed students reported school performance as the only cause of depression and, on average, these students claimed an additional two causes. It appears that the causes of depression in this student sample were multiple and, within this analysis, it is not possible to evaluate the extent to which the association between depression and academic performance is driven by causality in either direction.

This analysis yields results that address a number of issues. It is consistent with the results obtained from studies regarding the impact of depression and treatment for depression on the productivity of workers. In this study, the subjects were college students whose performance at academic tasks was measured on both external criteria applied by an observer and by self-report. Significant areas of agreement were found between the external criteria and the self-report, lending credence to worker productivity investigations that must rely upon self-report as the only data source. Lastly, from a public health perspective, this analysis highlights the importance of access to mental health treatment facilities among the college aged and the potential value of efforts to educate this population segment on the availability of that resource.

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