Published in final edited form as:

Health Aff (Millwood). 2017 June 01; 36(6): 1024–1031. doi:10.1377/hlthaff.2017.0044.

Simulations Test Impact Of Education, Employment, And Income Improvements On Minority Patients With Mental Illness

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Abstract

Social determinants of health, such as poverty and minority background, severely disadvantage many people with mental disorders. A variety of innovative federal, state, and local programs have combined social services with mental health interventions. To explore the potential effects of such supports for addressing poverty and disadvantage on mental health outcomes, we simulated improvements in three social determinants—education, employment, and income. We used two large data sets: one from the National Institute of Mental Health that contained information about people with common mental disorders such as anxiety and depression, and another from the Social Security Administration that contained information about people who were disabled due to severe mental disorders such as schizophrenia and bipolar disorder. Our simulations showed that increasing employment was significantly correlated with improvements in mental health outcomes, while increasing education and income produced weak or nonsignificant correlations. In general, minority groups as well as the majority group of non-Latino whites improved in the desired outcomes. We recommend that health policy leaders, state and federal agencies, and insurers provide evidence-based employment services as a standard treatment for people with mental disorders.

For people with mental disorders—a severely disadvantaged and stigmatized group—social factors such as minority background,¹ poverty,² insufficient education,³ unemployment,³ lack of access to health care,³ and inadequate housing⁴ worsen mental health and result in

extremely high rates of morbidity^{2,3,5,6} and mortality related to mental illness.^{3,7} Integrating social services with mental health care may lessen the effects of these disadvantages and improve health outcomes for people with mental disorders.

Policy makers who propose to reduce health disparities for members of racial/ethnic minority groups by increasing the amount of health care in the absence of social services fail to take account of two realities. First, social factors strongly influence mental health status.^{8,9} Second, relying on health care alone to improve mental health outcomes can be expensive and inefficient.¹⁰ A visit to any inner-city psychiatric emergency department demonstrates these facts. Disadvantaged and demoralized people—often poor, homeless, unemployed, and from minority backgrounds—commonly use psychiatric emergency services to secure needed safety, housing, or basic medical care.¹¹ Like Mother Courage in Bertolt Brecht's play of the same name,¹² they know how to survive in a hostile environment. But this use of expensive health resources illustrates the larger problem of mental health care in the United States. Unlike other wealthy countries, the United States often provides expensive medical services but not less expensive social services.¹³

Our thesis is that because social determinants of health such as education, employment, and income strongly influence the lives of people with mental disorders, addressing social services within mental health care could improve their mental and physical well-being. In this article we define *health* broadly as mental and physical health, because the two aspects of overall health are inherently intertwined.¹⁴ We define *integrated care* as combined mental health and social services delivered by a single team.¹⁵

Background

INTEGRATING MENTAL HEALTH CARE AND SOCIAL SERVICES

Various integrated care models that address social determinants of health for people with psychiatric disorders are available. Some combine mental health treatments with supported education,¹⁶ supported employment,¹⁷ housing supported by case management,¹⁸ family assistance,¹⁹ or income supports.²⁰ In all of these models, integration ensures that the message, approach, and goals are consistent with treating the whole person rather than solely the illness. However, few studies have tested how these integrated services affect ethnic/racial minority populations with mental illness.

MENTAL HEALTH AMONG MINORITY POPULATIONS

According to the National Institute of Mental Health, an estimated 43.4 million adults (17.9 percent of the total population) in the United States were affected by mental illness in 2015.²¹ The prevalence of mental disorders varied significantly by race, ethnicity, and residence,^{22–26} with members of minority groups typically showing lower prevalence rates of mental illness but greater persistence and consequences of the illness, compared to non-Latino whites.²⁷ Mental health disparities between whites and members of minority groups were compounded by socioeconomic status^{28–30} and other social determinants of health.⁸ Mental disorders were also correlated with greater functional impairments and disabilities for members of racial/ethnic minorities, compared to whites.²⁴

Study Data And Methods

To examine the effects of improving social determinants on mental health outcomes among members of minority groups, we conducted simulations using two large data sets: the first from the National Institute of Mental Health's epidemiological surveys, which contained information about people with common mental disorders such as anxiety and depression, and the second from a study of Social Security Disability Insurance recipients, which contained information about people who were disabled as a result of severe mental disorders such as schizophrenia and bipolar disorder. Both data sets included members of racial/ethnic minority groups with mental health disorders.

In the first step of each simulation, we used propensity score methods developed to study racial/ethnic disparities³¹ to control for age, sex, and marital status across groups (Latinos; African Americans; non-Latino whites; and, in the epidemiological surveys, Asians). In the second step, we modified one social factor (such as annual household income), while maintaining the relationship of all other variables conditional on income. For example, if a Latino's income increased from \$10,000 to \$20,000, we changed that person's income-related variables to be consistent with those of other Latinos in the new income group. The simulations increased the proportions of people with better education, higher income, or employment by weighting people with these positive attributes more heavily. Finally, we examined the effects of improving social determinants on mental health outcomes for members of majority and minority groups. The details of the propensity score and reweighting methods are described elsewhere^{32,33} and in online Appendix Exhibit A1.³⁴

SIMULATION A: PEOPLE WITH COMMON MENTAL DISORDERS

In the first simulation, to study adults with common psychiatric disorders, we used data from the National Institute of Mental Health's Collaborative Psychiatric Epidemiology Surveys,³⁵ a national household survey of 16,423 adults conducted in 2001. We selected the 3,417 participants with common psychiatric disorders (including *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition [DSM-IV], diagnoses of social phobia, generalized anxiety disorder, post-traumatic stress disorder, alcohol dependence, alcohol abuse, drug dependence, drug abuse, anorexia, bulimia, major depressive episode, dysthymia, binge eating, agoraphobia, or panic disorder). Of the participants, 1,424 were non-Latino whites, 1,039 were African Americans, 717 were Latinos, and 237 were Asians (for sample characteristics, see Appendix Exhibit A2).³⁴

We first matched members of minority groups with non-Latino whites on age, sex, and marital status using propensity scores. Next, we adjusted the groups in terms of education, employment, and household income, each separately. To simulate participation in supported education programs, we increased the educational level by 30 percent for people at each level (except for those at the highest level), based on the literature about supported education.³⁶ For example, to adjust the overall effect of increasing the graduation rate by 30 percent among people who did not complete high school, the simulation changed 30 percent of those who had not completed high school to be like those who had. Overall, this procedure increased the share of people who had postsecondary education from 27 percent to 75 percent. We simulated the effect of employment by giving employment to 60 percent

of the unemployed, which is a typical gain for unemployed clients with mental illness who enter supported employment programs in the United States.¹⁷ For income, we added \$10,000 to annual household income (similar to federal disability income) for all people with common mental disorders—and as a test of sensitivity, we added \$20,000 instead (for the results of the sensitivity analysis, see Appendix Exhibits A3 and A4).³⁴

Finally, we examined the impact of improving education, employment status, or income on psychiatric symptoms (using the Kessler Screening Scale for Psychological Distress, or K6)³⁷ (for K6 scores, see Appendix Exhibit A3);³⁴ and on functional outcomes (both physical and mental health, using the World Health Organization's Disability Assessment Schedule measure of *days out of role*,³⁸ defined as the number of days a person was unable to carry out usual activities because of illness) (for scores on this measure, see Appendix Exhibit A4).³⁴

SIMULATION B: PEOPLE DISABLED BY SEVERE MENTAL DISORDERS

In the second simulation, to study adults disabled by severe psychotic or mood disorders (all of whom were currently receiving Social Security Disability Insurance based on diagnoses from Social Security Administration determinations), we used follow-up data from the Social Security Administration's Mental Health Treatment Study in the early 2000s.³⁹ Of the 1,006 control group members—who received no specific interventions—123 were Latinos, 272 were African Americans, and 611 were non-Latino whites (for clinical and demographic characteristics, see Appendix Exhibit A5).³⁴ The study surveyed too few Asians for us to include them in our analysis.

Using procedures similar to the ones described above, we matched the groups using propensity scores and simulated the impact of improving education, employment, and income for different percentages of adults with severe mental disorders. We measured functional outcomes due to mental or physical health problems using the 12-item Short Form Survey (SF-12) from the Medical Outcomes Study.⁴⁰

LIMITATIONS

Our study had several limitations. First, our analyses used different populations of adults with mental illness (those with common mental disorders in the first simulation and those with severe mental disorders in the second), outcome measures, and study group sizes. Findings from the two simulations are therefore complementary rather than redundant.

Second, our findings on adults probably are not generalizable to youths because interventions to improve socioeconomic conditions for members of minority groups—such as increasing education—may be most effective at a young age, when a person's family is often central to his or her developing motivation, cooperation, and self-esteem.⁴¹

Third, other social determinants of health, such as supported housing, were not included in the simulations because only education, employment, and income had comparable measures in the two data sets. Fourth, the simulations used cross-sectional data, self-reported outcomes, and—especially the second simulation—relatively small samples, which resulted in low power to detect subgroup differences.

Fifth, the precision of the estimates of the confidence bounds and our power to detect differences across minority groups were limited by the sample sizes. Sixth, the results might have been influenced by self-report bias. Finally, our results were based on correlational analyses, so we could not infer causation.

Study Results

SIMULATION A: PEOPLE WITH COMMON MENTAL DISORDERS

Increasing education by one level (for example, from not completing high school to completing high school) for 30 percent of the respondents at each level except the highest improved symptom scores significantly but minimally (the average impact was a change of less than 0.3 psychiatric symptom in the K6 score) for Latinos, African Americans, and non-Latino whites (Exhibit 1). Giving employment to 60 percent of the unemployed improved African Americans' mental health slightly, by an average of 1.45 symptoms (according to the Collaborative Psychiatric Epidemiology Surveys codebook, an increase—which indicates better mental health—of 1.0 symptom is an improvement of only a quarter of a standard deviation in the total score).⁴² Increasing annual household income by \$10,000 had no significant impacts on symptoms for any group (Exhibit 1), while increasing income by \$20,000 led to significant but minimal effects (the size of the average impact on symptoms was 0.4–0.5) for all groups, except Asians (see Appendix Exhibit A3).³⁴

Improving education had small but significant effects on the number of days out of role for African Americans (a decrease of 2.43 days per month) and on non-Latino whites (decrease of 1.29 days) (Exhibit 2). Giving employment to 60 percent of the unemployed participants substantially lowered the number out-of-role days for African Americans (20.9 fewer days per month), non-Latino whites (6.7 days), and Asians (8.3 days). Increasing annual household income by \$10,000 decreased the number of out-of-role days by 2.1 per month for non-Latino whites but had no significant effect for any of the minority groups. However, increasing income to \$20,000 produced significant effects for African Americans (a decrease of 5.1 out-of-role days) and for non-Latino whites (3.7 days) (see Appendix Exhibit A4).³⁴

SIMULATION B: PEOPLE DISABLED BY SEVERE MENTAL DISORDERS

Improving education or income in the sample with severe psychotic or mood disorders resulted in no significant change in functioning due to mental health (Exhibit 3) or physical health (Exhibit 4) summary scores on the Short Form Survey⁴⁰ used in the Mental Health Treatment Study.³⁹ However, changing the employment status (from unemployed to employed) resulted in significant increases in both summary scores. When 30 percent of the unemployed became employed, the mental health summary score increased by a significant 1.3 points on the score, and when 100 percent of the unemployed became employed, the score increased by a significant 4.4 points, with higher scores indicating better mental health (Exhibit 3). When 50 percent of the unemployed became employed, the physical health summary score improved by a significant 1.5 points, and when 100 percent of the unemployed became employed, the score increased by a significant 3.1 points, with higher scores indicating better physical health (Exhibit 4). The results were not significant when we

examined racial/ethnic subgroups, but this study lacked the statistical power to examine subgroups separately.

Discussion

Our simulation results suggest that increasing employment was generally correlated with improved mental health outcomes—both psychiatric symptoms and days of functioning—in adults with mental illnesses, although not all racial/ethnic subgroups showed significant changes. Both people with common mental disorders (such as anxiety and depression) and those with severe, disabling disorders (such as schizophrenia and bipolar disorder) appeared to benefit.

The effects of our simulations differed slightly between the two groups. Among people with common disorders, becoming employed improved mental health outcomes significantly for African Americans, Asians, and non-Latino whites, but not Latinos. For people with severe disorders, minority groups (including Latinos) benefited in the same pattern of results (see the online Appendix³⁴) as the majority group. Among people with severe mental disorders, becoming employed also appeared to improve physical health across all racial/ethnic groups. Improving education and income did not substantially improve mental health or physical health outcomes in any group.

Several interpretations of our data warrant consideration. Employment is undoubtedly an important social determinant of mental health. Our findings regarding employment are consistent with the results of numerous randomized controlled trials showing that supported employment helps people with severe mental illness not only work but also manage symptoms and improve quality of life.^{17,43} Our findings regarding racial/ethnic minority groups show that their members typically benefited as much from employment as did non-Latino whites. Latinos and Asians with common mental disorders were an exception.

Of course, in these relationships causality clearly goes in both directions. Treating the symptoms of mental illness helps people maintain employment,⁴⁴ and employment helps mental health. In addition, underlying third factors—such as poor economic conditions throughout society (such as a recession)—simultaneously affect employment and mental health.

While employment helps, adults with mental illness (particularly members of racial/ethnic minority groups) might not benefit from improved education and income as much as those without mental illness.²⁹ This is because taking advantage of those improvements could depend on having social mobility or access to other resources. According to the hypothesis of “minority poverty,” the combined disadvantages of being poor and having a mental illness operate differently for poor or middle-income non-Latino whites, compared to members of racial/ethnic minority groups in the same income strata.⁴⁵ Minority poverty compounds cumulative disadvantage, so increased income does not necessarily change someone’s standard of living.

Why improving employment did not help Latinos with common mental disorders as much as other groups is uncertain. Perhaps Latinos in the study samples had low-level jobs that did

not correlate with good mental health. In other words, the distribution of jobs available to Latinos might not have been as beneficial to health as the distribution of jobs obtained by whites or Blacks. Alternatively, strong family supports among Latinos may have attenuated the effects of unemployment, making the access to employment less connected to health than for other racial/ethnic groups. Previous research has shown that stronger attachment to ethnic and family identity, rather than employment, positively affects mental and physical health in Latinos. Given frequent employment instability among many Latinos, other factors could be more related to health than having employment.⁴⁶ Latinos who identify less with the dominant non-Latino culture may experience greater difficulty retaining employment and greater acculturative stress, which could lead to an unchanged or poorer mental health status.⁴⁷ Future studies of employment, unemployment, and supported employment should examine relationships to mental health across racial/ethnic groups and investigate what factors may contribute to these differences.

Another point is that the integration of employment services into mental health services makes the latter more attractive to people with mental health conditions because one of their chief goals is functional recovery.⁴⁸ When people with mental disorders receive help to address social determinants of health, they are more likely to accept mental health care, sustain their adherence to treatment, and take responsibility for their health.⁴⁹ Our findings regarding physical health improvements in people with severe mental illness who are employed are intriguing because of the high level of physical morbidity and mortality in this population.^{50,51} Integration of mental health care and vocational services has societal benefits because adults with mental disorders who are employed spend money and pay taxes; reduce their use of hospitals, emergency services, and day programs; and—especially if they receive integrated services early in the course of mental illness—may be less likely to enter the disability system and use other welfare benefits.^{52,53}

Policy Recommendations

Because employment consistently improves mental health status as well as self-esteem, community integration, and other valued outcomes for adults with mental health disorders, a variety of federal, state, and local programs are attempting to increase employment opportunities for people with mental health problems, including those from minority backgrounds.⁵⁴ A specific evidence-based model of supported employment has been developed and validated for people with severe mental disorders such as schizophrenia and bipolar disorder, but such services are poorly funded.¹⁷ No comparable model of integrated mental health care and vocational services has emerged for adults with common mental disorders such as anxiety and depression, which are more prevalent; however, research is developing in this area.⁴⁴ Research on integrated employment and mental health interventions for people with nonsevere mental health problems, particularly for members of racial/ethnic minority groups, should continue.

The larger problem for policy makers is the extreme fragmentation of health and vocational services in the United States. Integration of employment supports and health services requires the alignment of evidence-based interventions, workforce training, financing, and infrastructure. The implementation of supported employment as part of mental health care

can be funded through the Workforce Innovation and Opportunity Act of 2015, the Ticket-to-Work program of the Social Security Administration, various Medicaid options and waivers, federal block grants, state mental health dollars, and grants from the Substance Abuse and Mental Health Services Administration, the Veterans Health Administration, and philanthropic organizations.

Nevertheless, paying for integrated mental health care and employment services has been difficult because blending funds from different sources is complicated. Scaling up has not occurred in a substantial way because a simple funding mechanism is lacking.⁵⁵ How future revisions in or replacements of the Affordable Care Act will affect the combining of mental health care and social services is, of course, uncertain.

Conclusion

Combining mental health care and social services, particularly employment services, may help many Americans—particularly members of disadvantaged groups, such as the impoverished, those with more severe disorders, and those who come from minority backgrounds. Our simulation research, along with randomized controlled trials of supported employment,¹⁷ suggests that improving employment among disadvantaged groups with mental disorders is correlated with improved mental health outcomes. Because service agencies and organizations protect their funding silos, government action to combine health care and social services in ways that benefit patients and society will be necessary. Service agencies need a simple, straightforward funding mechanism to enable them to make their greatest contributions to improving the lives of those they serve by addressing health and employment simultaneously.

Acknowledgments

This study was supported by the National Institute on Minority Health and Health Disparities (NIMHD) (Research Grant No. 7R01MD009719). The content of the article is solely the responsibility of the authors and does not necessarily represent the official views of any of the funding institutions. Working with two data sets required expansive collaboration with multiple data analysts and required multiple research personnel to assemble the literature. The authors thank Thomas McGuire for providing helpful comments to guide the manuscript's development and the NIMHD for supporting the data analysis.

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Appendix Exhibit A1: Statistical Analysis

To adjust the distributions of various covariates that differ between non-Latino whites and ethnic and racial minorities, we do propensity score matching. The adjustment consists of two steps. In Step 1, we perform a similar analysis as that in Alegria et al. (2012)¹ and Duan et al. (2008).² More precisely, there are two sets of covariates -- covariates that are justifiable in causing differences in mental and physical health (e.g., age, sex, and marital status); and covariates that are not justifiable in causing differences in mental and physical health (e.g., employment, education, income, etc.). We will call the former “allowable” covariates denoted by X_A , and the latter “non-allowable” covariates denoted by X_N . Our outcomes of interest are mental and physical health status characterized by several measurements denoted by Y . The goal in this step is to adjust for differences in health that are attributable to the allowable covariates and justifiable in causing such differences. We then investigate the impact of particular non-allowable factors one at a time (e.g., employment, education, and income).

In Step 1, we aim to estimate the potential outcome of mental and physical health if the minority group had the same characteristics as those of the non-Latino whites in the allowable variables. In particular, we consider two distributions $f_1(Y, X_A, X_N)$ for the non-Latino whites and $f_2(Y, X_A, X_N)$ for the minority groups. The joint distribution of the minority group can be composed as $f_2(Y | X_N, X_A) f_2(X_A | X_N) f_2(X_N)$. We would like to

adjust the level of allowable covariates and to keep that of the non-allowable covariates. To do so, we keep the first factor $f_2(Y | X_N, X_A)$ and the third factor $f_2(X_N)$ and adjust the second factor from that of the minority group to that of the reference group that is the non-Latino whites in the current context. More detailed discussion regarding this adjustment is given in Duan et al. (2008).² After the adjustment, the distribution becomes

$$f_2^*(Y, X_N, X_A) = f_2(Y | X_N, X_A) f_1(X_A | X_N) f_2(X_N).$$

To achieve this goal, we adopt a re-weighting method that is a common technique in the analysis of survey data. In particular, the observed minority samples of interest follow the distribution $f_2(Y, X_N, X_A)$. We observe that the observed and the target populations are

different by a factor of $R^* = \frac{f_2^*(Y, X_N, X_A)}{f_2(Y, X_N, X_A)} = \frac{f_1(X_A | X_N)}{f_2(X_A | X_N)}$. The factor R can be written as ratios of propensity scores by the Bayes' theorem. The procedure is to estimate two propensity scores of being in the non-Latino white group: one given both the allowable covariates and the non-allowable covariates and the other given the non-allowable covariates only. We estimate R^* by taking ratio of the two propensity scores. Thus, for each sample in the minority group, we obtain an estimate of the ratio, denoted by R_i^* . We adjust the original survey weight W_i to $W_i^* = W_i R_i^*$. Then, an estimated population mean for that minority

group after the adjustment is $Y^* = \frac{\sum_i Y_i W_i R_i^*}{\sum_i W_i R_i^*}$. We fit separate propensity score models for the following minority groups and the reference group.

In Step 2, we investigate the potential effect of increasing the social determinants on each of the non-allowable variables one at a time. We further split the set of non-allowable variables $X_N = (X_I, X_{-I})$, where X_I is a single variable that we would like to intervene and X_{-I} includes other non-allowable variables. In order to adjust the distribution of X_I to a prescribed level, we factorize the previously adjusted distribution f_2^* to $f_2^*(Y, X_A, X_{-I} | X_I) f_2^*(X_I)$. We keep the first factor and adjust the second factor $f_2^*(X_I)$ such that the distribution of X_I reaches a preset level (e.g. increases from less than high school education to having a high school education). More precisely, we would like to further re-weigh the minority samples to $f_2^*(Y, X_A, X_{-I}, X_I) = f_2^*(Y, X_A, X_{-I} | X_I) f_2^{**}(X_I)$. We adjust the samples by a factor

$$R^{**} = \frac{f_2^{**}}{f_2^*} = \frac{f_2^{**}(X_I)}{f_2^*(X_I)}. \text{ The survey weight is further adjusted to } W_i^{**} = W_i R_i^* R_i^{**}. \text{ Therefore,}$$

the estimated population mean of the outcome is $Y^{**} = \frac{\sum_i Y_i W_i^{**}}{\sum_i W_i^{**}}$. The effect of augmenting the social determinant (income, education or employment) on variable X_I is then the difference between Y^{**} and Y^* , that is, $E = Y^{**} - Y^*$.

The missing data are imputed by the method of multiple imputation via chain equations through the *mi* package in R.³ In particular, we create 10 imputations. The variances of the complete data estimators are estimated by the Bootstrap method described in Rust and Rao (1996).⁴ We then combine the multiplied imputed estimates via the combining rule in Little and Rubin (2002)⁵ to obtain the estimated average effect for each ethnic and racial group of augmenting each of the social determinants, one at a time.

Results of Simulation A

Supplemental Exhibit 1B presents summary statistics of the National Institute of Mental Health Collaborative Psychiatric Epidemiology Surveys (CPES).⁶ CPES data was observed for 3,495 participants who reported at least one of fourteen DSM-IV assessed psychiatric disorders. There were 1424 non-Latinos whites, 1039 African Americans, 717 Latinos, and 237 Asians. For the analysis of augmenting the social determinants, the following mental and physical health outcomes were considered: K6⁷ (i.e. scale designed to detect non-specific distress that can discriminate cases of serious mental illness from non-cases) and WHODAS days out of role⁸ (i.e. In the past 30 days, for how many days were you totally unable to carry out your usual activities or work because of any health condition?). The allowable covariates included age, gender, and marital status. The non-allowable covariates, which were considered to be contributors to mental and physical health, were employment status, education level, and household income.

Our primary interest in this analysis is in the potential improvement in the mental and physical health scores of people with last year psychiatric disorders as a result of improving participants' employment status, education level, and household income. The ensuing subsections elucidate specific augmentation levels for each of the non-allowable covariates. Note that the distributions of the variables considered in this analysis are markedly different between the disorder and non-disorder groups. We therefore stratified the samples by disorder status, that is, whether or not a participant had a last year psychiatric disorder as established by Version 3.0 of the WHO's Composite International Diagnostic Interview (CIDI).⁹ The CIDI is a structured lay administered diagnostic interview that generates diagnoses according to the definitions and criteria of DSM-IV diagnostic systems. All summarized results below focused on the groups with a selected group of assessed psychiatric disorder that were collected across the CPES.

Employment

We consider a potential effect of reducing the present unemployment rate by 60% based on the estimated effect as reported by Mueser et al.¹⁰ For instance, if the pre-effect unemployment rate of a minority group is 20%, the post-effect unemployment rate becomes $0.4 \times 20\% = 8\%$.

Exhibit 1 suggests that giving employment had little impact on the K6 scores. The differences in the outcome scores between before and after increasing the proportion of those with employment were on average generally small in magnitude. Judging by bootstrap intervals, however, we find evidence of significant improvement in K6 scores for African Americans but not for the other ethnic and racial groups. Participants with last year disorder had 1.45 (7.1%) higher scores, demonstrating better mental health.

In Exhibit 2, the intervention effect on the WHODAS *days out-of-role score* indicate that the impact of increasing the proportion with employment was most effective for African Americans, non-Latino whites, and Asians with last year disorder. African Americans had 20.91 (36.8%) lower days out of role for those with last year psychiatric disorder. Non-

Latino whites with last year disorder showed 6.68 (27.0%) lower days out of role after augmenting the proportion of those with employment. Asians with last year disorder showed significance in days out of role reduction of 8.29 (35.7%). Together these results seemed to suggest that intervening in the employment level for the unemployed group can have an appreciable impact on the WHODAS *days out-of-role score* yet little to none as evidenced in the K6 scores.

Education

Next we evaluate the effect if we increased education levels so that 30% of the people in each education category (except for the highest) receive additional education and moved up to the immediate next education category. In presenting the results, we report estimates of overall difference scores (instead of differences for each of the three education groups) to get a clearer picture of changing social determinants.

In Exhibit 1, increasing the education level was manifested mostly in Latinos, African Americans, and non-Latino whites. Participants from these groups showed significant improvements in the K6 scores for last year disorders. The size of the impact, however, was small as demonstrated by changes of less than 0.3 symptoms. The patterns relating to the role of education effects become more pronounced in the WHODAS *days out-of-role scores*. There was significant decrease in the time out-of-role scores for African Americans and non-Latino whites with last year psychiatric disorders, but not for Asians and Latinos with last year disorders. African Americans showed 2.43 day decreases in days out of role. Non-Latino whites had 1.29 differences in days out of role after augmenting education.

Household income

We consider a potential intervention of increasing the household income by \$10,000, similar to the assigned level of disability income. Overall, increasing the household income level had minimal impact on the K6 scores. The WHODAS trend on days out-of-role for non-Latino whites with last year disorders showed significant differences of 2.06 days out of role (9.2% decrease) but no significant effects for any of the minorities.

Simulation B

In a second simulation study, we used end-of-follow-up period from the control arm of the Social Security Administration's Mental Health Treatment Study¹¹ and similar procedures as above. We simulate the impact of improving education, giving employment, and increasing income on adults with serious mental disorders among Latinos, African Americans, and non-Latino whites (N = 1006). All of the participants were initially unemployed and on Social Security Disability Income. By using data from the end of follow-up, we were able to assess the effect of intervening on employment. We measured mental health and physical health functioning using the 12-item Short Form Survey (SF-12) from the Medical Outcomes Study.¹² Again, we investigate the potential improvement in the mental and physical health outcomes of people with serious mental illness as a result of intervening in participants' employment status, education level, and income. In this set of

simulations, we simulated the full range of potential improvements, from no improvement to every participant improving by one level of education, \$10,000 increase in household income, or employment, to identify the threshold required to yield significant change.

Results of Simulation B

MHTS results

As shown in Exhibit 3, intervening in the MHTS control sample to improve education and earnings did not yield significant changes, either overall or by race, in self-reported mental or physical health. Intervening to improve the employment of the unemployed yielded significant improvements overall in both SF-12 subscale measures. When at least 30% of the unemployed became employed the SF-12 Mental subscale score improved significantly; when at least 50% of the unemployed became employed the SF-12 Physical subscale score improved significantly. This sample lacked the power to discern significant changes in black and Latino groups, but we have included both overall and race-specific estimates in Exhibit 3, showing similar trends.

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Appendix Exhibit A2

Sample Characteristics of CPES respondents with psychiatric disorders included in the analyses (weighted data) by ethnic and racial groups.

		Non-Latino White (n=1424)	African American (n=1039)	Asian (n=237)	Asian (n=237)
Overall Proportion		73.26%	9.82%	2.53%	11.38%
Mean Age		40.18	38.92	37.09	35.99
	(SD)	14.77	14.33	15.53	14.17
Gender	Male	41.32%	34.91%	46.19%	45.85%
Marital status	Married/Cohabiting	47.45%	30.58%	46.80%	51.48%
	Divorced/Separated/Widowed	25.10%	29.34%	10.90%	18.14%
	Never Married	27.45%	40.08%	42.30%	30.38%
Household income		55987.20	32365.33	67129.51	43339.83
	(SD)	46966.52	36885.13	59786.94	43637.53
Employment	Employed	67.92%	60.45%	60.07%	56.37%
	Unemployed	3.79%	13.86%	10.70%	9.75%
	Not in labor force	28.30%	25.69%	29.23%	33.88%
Education	0–11 years	14.40%	30.13%	12.74%	42.42%
	12 years	31.19%	35.27%	20.05%	27.31%
	13–15 years	30.28%	22.87%	26.52%	20.53%
	16 years	24.13%	11.72%	40.69%	9.75%
Mean K6 Score		20.85	22.15	23.71	22.59
	(SD)	5.33	5.21	4.52	5.18
WHODAS	Days Out of role	20.76	31.60	14.03	19.81
	(SD)	32.02	38.98	26.72	33.10

SOURCE: National Institute of Mental Health Collaborative Psychiatric Epidemiology Surveys (2001–2003) Data available from <http://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/20240>

Appendix Exhibit A5

Sample Characteristics of MHTS control group (N=1006) at end of 2nd year follow-up period by ethnic and racial groups

		Non-Latino White (n=611)	African American (n=272)	Latino (n=123)
Mean Age		49.87	49.93	47.27
	(SD)	7.68	7.61	7.98
Gender	Male	49.87%	49.93%	47.27%
Marital status	Married/Cohabiting	19.97%	13.97%	16.26%
	Divorced/Separated/Widowed	35.19%	33.46%	34.96%
	Never Married	44.84%	52.57%	48.78%

		Non-Latino White (n=611)	African American (n=272)	Latino (n=123)
Personal Monthly Earnings, US\$		1082.84	969.00	998.70
	(SD)	589.96	415.48	596.91
Employment	Employed	15.88%	17.65%	24.39%
	Unemployed	84.12%	82.35%	75.61%
Education	0–11 years	7.86%	17.28%	16.26%
	12 years	28.81%	30.15%	33.33%
	13–15 years	40.10%	38.97%	36.59%
	16 years	23.24%	13.60%	13.82%
Mean SF-12 Mental (range 0–100)		34.91	38.02	35.46
	(SD)	12.86	14.01	12.53
Mean SF-12 Physical (range 0–100)		42.92	42.90	43.83
	(SD)	12.12	12.20	12.26

SOURCE Mental Health Treatment Study, 2006 – 2010. Westat, as contracted by Social Security Administration.

Appendix Exhibit A6

The Effect of Supported Employment, Education, and Income Interventions on Employment Rates, Educational Attainment, and Mental Health

Supported Employment			
Study	Study Design	Study Population	Impact of the Intervention
Bond, Drake, & Becker (2008)	Literature review on Randomized controlled trials that study the efficacy of the Individual Placement and Support (IPS) model for employment	Varied in the United States, including patients at community mental health centers and outpatient centers	<ul style="list-style-type: none"> The employment rate was 61% in IPS patients compared to 23% in control patients. IPS patients received their first job almost 10 weeks earlier than control patients.
Catty et al. (2008)	International randomized controlled trial that compares IPS services and traditional vocational rehabilitation (TVR)	312 adults with psychotic illness who lived in the local community and attended the vocational services centers	<ul style="list-style-type: none"> 54.5% IPS patients worked at least one day compared to 27.6% vocational service patients IPS patients worked almost four times as many hours as patient in TVR.
Tsang et al. (2009)	Randomized controlled trial that compares the employment outcomes for IPS, Integrated Supported Employment (ISE), and TVR	163 participants from community mental health programs in Hong Kong	<ul style="list-style-type: none"> The employment rate was 78.8% in ISE patients compared to 53.6% in IPS patients and 7.3% in TVR patients. ISE patients had a longer job tenure compared to IPS and TVR patients (23.84 weeks vs. 12.34 and 1.05 weeks, respectively)

Supported Employment			
Study	Study Design	Study Population	Impact of the Intervention
Howard et al. (2010)	Randomized controlled trial that compares IPS and TVR	219 participants with severe mental illness in South London	<ul style="list-style-type: none"> There was no significant difference in employment rates (13% IPS patients vs. 7% TVR patients)
Tsang et al. (2010)	Randomized controlled trial that compares ISE and TVR	189 participants with severe mental illness in Hong Kong	<ul style="list-style-type: none"> The employment rate was 82.8% in ISE patients compared to 61.5% in TVR patients. ISE patients had longer job tenure compared to TVR patients (49.64 weeks vs. 36.17 weeks).
Michon et al. (2011)	Randomized controlled trial that compares IPS and TVR	151 participants with severe mental illness in the Netherlands	<ul style="list-style-type: none"> The employment rate was 39% in IPS patients compared to 19% in TVR patients. On average, IPS patients worked significantly more days in jobs compared to TVR patients (69 days vs. 36 days).
Bond et al. (2014)	Secondary analysis on a pooled sample from four randomized controlled trials that compare IPS to a control group	109 young adults with severe mental illness in the United States	<ul style="list-style-type: none"> The employment rate was 82% in IPS patients compared to 42% in control patients. On average, IPS patients had longer employment than control patients (25 weeks vs. 7 weeks).
Williams et al. (2015)	Prospective observational design to assess the competitive employment rate of a supported employment program	114 participants with severe mental illness at three sites on the Gold Coast of Australia	<ul style="list-style-type: none"> The employment rates at the three sites were 12%, 33.3%, and 37%. The authors attributed the differences and the comparatively small percentages to deviations from evidence-based practice guidelines.
Burns et al. (2015)	Randomized controlled trial that compares traditional IPS with time-restricted IPS (IPS-LITE)	120 participants who were referred by community mental health teams in Oxfordshire, United Kingdom	<ul style="list-style-type: none"> Rates of employment were similar at 18 months (46% IPS patients vs. 41% IPS-LITE patients).
Bejerholm, Larsson, & Johanson (2017)	Randomized controlled trial that compares the newly developed Individual Enabling and Support (IES) model with TVR	61 participants with affective disorders in Sweden	<ul style="list-style-type: none"> The employment rate was 42.4% in IES patients compared to 4% in TVR patients.
Supported Education			
Hutchinson et al. (2007)	Quantitative one-group pretest-posttest survey design of combined supported education and supported employment program	61 students with psychiatric disabilities	<p>From baseline to the end of the study:</p> <ul style="list-style-type: none"> patients involved in volunteer or paid work increased from about 20% to about 60% Monthly mental health service utilization decreased from 80 hours to 40 hours

Supported Employment			
Study	Study Design	Study Population	Impact of the Intervention
Gutman et al. (2009)	Randomized control trial that studies the effect of receiving educational services	38 adults with psychiatric disabilities in the United States	<ul style="list-style-type: none"> 63% of patients receiving educational services had enrolled in an educational program, obtained employment, or were applying to a program while only 6% of patients in the control group were enrolled in an educational program
Robson et al. (2010)	Implementation and outcome study of a youth-oriented supported education program modeled on IPS	20 mental health service users in New South Wales, Australia	<ul style="list-style-type: none"> 70% of service users either continued or completed their program of study
Schindler & Sauerwald (2013)	Quantitative one-group pretest-posttest survey design of an occupational therapy program that incorporates supported employment and supported education	48 adult participants with various mental health diagnoses in the United States	<ul style="list-style-type: none"> Patient employment increased from 10% to 40%. Both employment and receiving higher education increased among patients from 25% to 63%.
Fernando, King, & Loney (2014)	Case study	42 participants with mental health illness, who were enrolled in the Ontario Shores Supported Education Program	<ul style="list-style-type: none"> Self-reported improvements in reading, writing, and math skills (38.1%, 38.1%, and 31.7%, respectively)
Income Supplementation			
Rosenheck et al. (2000)	Nonequivalent control group design (comparing veterans who receive benefits with those who don't)	173 homeless veterans with serious mental illness and enrolled in the SSA-VA Joint Out-Research Initiative in the United States	<ul style="list-style-type: none"> Social Security beneficiaries had 60% more total monthly income than non-beneficiaries. Social Security beneficiaries had significantly lower interest rates, which reflected less impulsivity in spending money ($\chi^2 = 8.34$; $df = 3$; $p < .05$).
Watkins & Podus (2000)	Longitudinal survey (comparing current and discontinued beneficiaries of Social Security Insurance)	400 Social Security Insurance (SSI) beneficiaries with drug addiction or alcoholism in California, U.S.	<ul style="list-style-type: none"> At 12 months, substance use had decreased from 75% to 63% of SSI beneficiaries while substance use remained unchanged (76% to 75%) among discontinued beneficiaries (OR = 1.9; 95% CI: 1.01 to 3.02).
Ries et al. (2004)	Randomized controlled trial that compared the effect of having contingent management (changes in the type and amount of disability payment) vs. noncontingent management	41 patients with serious mental illness or substance abuse at an urban mental health center who received SSI or Social Security Disability Insurance	<ul style="list-style-type: none"> Patients with contingent management used alcohol for significantly fewer weeks ($F = 7.4$, $df = 1, 34$) and used both drugs and alcohol for significantly fewer weeks ($F = 19.27$, $df=1$).

EXHIBIT 1. Changes in psychiatric symptoms among racial/ethnic populations with mental illness after simulated improvements in education, household income, or employment

SOURCE Authors' analysis of data from ICPSR. Collaborative Psychiatric Epidemiology Surveys (CPES), 2001–2003 [United States] (ICPSR 20240) [Internet. Ann Arbor (MI): Institute for Social Research at the University of Michigan; [cited 2017 Apr 19]. Available from: <http://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/20240>. **NOTES** The exhibit, which reports the results of simulation A, shows CPES weighted data for 3,417 CPES respondents. The error bars indicate 95% confidence intervals. Kessler Screening Scale for Psychological Distress (K6) scores range from 0 to 24, with higher scores indicating better mental health (using the scoring criteria from the Collaborative Psychiatric Epidemiology Surveys codebook [see Note 43 in text]). The improvements were as follows: for annual household income, an increase of \$10,000; for education, a shift to the next-higher category (did not complete high school, completed high school, had at least some college, and completed college) for 30 percent of the respondents in each group except the last; for employment, a change to being employed for 60 percent of the unemployed respondents. * $p < 0.05$

EXHIBIT 2. Changes in number of days out of role among racial/ethnic populations with mental illness after simulated improvements in education, household income, or employment

SOURCE Authors' analysis of data from ICPSR. Collaborative Psychiatric Epidemiology Surveys (CPES), 2001–2003 [United States] (ICPSR 20240) [Internet]. Ann Arbor (MI): Institute for Social Research at the University of Michigan; [cited 2017 Apr 19]. Available from: <http://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/20240>. **NOTES** Days out of role are defined as days when a person was unable to perform his or her usual activities because of physical or mental illness. The exhibit, which reports results of simulation A, shows CPES weighted data for 3,417 CPES respondents. The error bars indicate 95% confidence intervals. The role impairment score combines four questions that ask for how many days in the past month (30 days) the respondent was impaired in his or her activities (missing responses are set to 0 days). The responses to the four questions are then weighted appropriately and summed, with the resulting sum top-coded at 30 (that is, any value higher than 30 is set to 30). The final score is then divided by 30 and multiplied by 100, so that the final scale ranges from 0 to 100. Having fewer days per month out of role (on a scale of 0 [no disability] to 100 [maximum disability]) indicates better physical or mental health. The improvements are explained in the Notes to Exhibit 1. * $p < 0.05$

EXHIBIT 3. Changes in self-reported mental health among racial/ethnic populations disabled by severe psychotic or mood disorders after simulated improvements in education, household income, or employment

SOURCE Authors' analysis of data from Frey WD, et al. Mental Health Treatment Study (Note 39 in text) (MHTS). **NOTES** The exhibit reports results from simulation B. Changes are from baseline in the twelve-item Short Form Survey (SF-12) mental health summary score in the MHTS (see Note 40 in text). Scores range from 0 to 100, with higher scores indicating a higher level of self-reported mental health. The mean score in the general population is 50 (standard deviation: 10). The improvements in education and employment are explained in the Notes to Exhibit 1. The improvement in income was a shift to the next-higher quartile of income. Improvements were applied to various shares of the control group ($N = 1,006$) in the MHTS. A solid line indicates a significant ($\alpha = 0.05$) change.

EXHIBIT 4. Changes in self-reported physical health among racial/ethnic populations disabled by severe psychotic or mood disorders after simulated improvements in education, household income, or employment

SOURCE Authors' analysis of data from Frey WD, et al. Mental Health Treatment Study (Note 39 in text) (MHTS). **NOTES** The exhibit reports results from simulation B. Changes are from baseline in the twelve-item Short Form Survey (SF-12) physical health summary score in the MHTS (see Note 40 in text). Scores range from 0 to 100, with higher scores indicating a higher level of self-reported physical health. The mean score in the general population is 50 (standard deviation: 10). The improvements in education and employment are explained in the Notes to Exhibit 1. The improvement in income is explained in the Notes to Exhibit 3. Improvements were applied to various shares of the control group ($N=1,006$) in the MHTS. A solid line indicates a significant ($\alpha = 0.05$) change.

Appendix Exhibit A3

Observed K6 Scores in Non-Latino Whites and Estimated Scores for Minorities (Reweight by propensity scores and sample weights)

12-Month disorder (Yes)																
	Overall	Employment			Employment adjusted			Education			Education adjusted			Household income		
		Employed	Unemployed	Unemployed	Unemployed	Difference		0–11 years	12 years	13–15 years	0–11 years	12 years	13–15 years	Scores After Adjustment (10K)	Scores After Adjustment (20K)	Difference
Asian	23.86 [23.12, 24.6]	23.78 [22.77, 24.79]	24.25 [21.97, 26.54]	23.97 [22.86, 25.08]	−0.29 [−1.77, 1.2]		23.81 [21.11, 26.5]	25.24 [24.44, 26.04]	22.53 [20.91, 24.15]	24.05 [22.7, 25.4]	24.24 [22.36, 26.12]	24.43 [23.64, 25.21]	22.98 [21.82, 24.15]	24.12 [23.41, 24.84]	24.24 [23.52, 24.96]	0.38 [−0.27, 1.03]
Latino	22.69 [22.25, 23.14]	23.18 [22.56, 23.81]	22.69 [21.65, 23.74]	22.99 [22.45, 23.52]	0.29 [−0.46, 1.05]		22.05 [21.26, 22.84]	22.86 [22.1, 23.63]	22.95 [22.15, 23.75]	24.15 [23.23, 25.07]	22.30 [21.7, 22.89]	22.89 [22.3, 23.47]	23.31 [22.67, 23.95]	22.95 [22.49, 23.4]	23.14 [22.67, 23.62]	0.45 [0.04, 0.86]
African American	22.30 [21.77, 22.84]	23.02 [22.43, 23.61]	20.60 [19.15, 22.05]	22.05 [21.36, 22.75]	1.45 [0.53, 2.38]		21.32 [20.42, 22.21]	21.86 [21.17, 22.55]	23.51 [22.49, 24.54]	23.88 [22.96, 24.8]	21.48 [20.77, 22.19]	22.36 [21.77, 22.95]	23.62 [22.81, 24.43]	22.65 [22.12, 23.18]	22.85 [22.29, 23.42]	0.55 [0.09, 1.02]
Non-Latino White	21.10 [20.74, 21.46]	21.50 [21.11, 21.89]	21.51 [20.26, 22.75]	21.50 [20.91, 22.09]	−0.01 [−0.74, 0.73]		19.77 [19, 20.55]	20.85 [20.25, 21.46]	21.23 [20.75, 21.72]	22.05 [21.59, 22.52]	20.10 [19.51, 20.68]	20.97 [20.5, 21.43]	21.48 [21.08, 21.88]	21.29 [20.95, 21.63]	21.50 [21.17, 21.83]	0.40 [0.14, 0.66]

Appendix Exhibit A4
Observed WHODAS Days Out of Role in Non-Latino Whites and Estimated Scores for Minorities (Reweighted by propensity scores and sample weights)

12-Month disorder (Yes)																
	Overall	Employment			Employment adjusted		Education			Education adjusted			Household income			
		Employed	Unemployed	Unemployed	Unemployed	Difference	0–11 years	12 years	13–15 years	Greater than or equal to 16 years	0–11 years	12 years	13–15 years	Scores After Adjustment (10K)	Scores After Adjustment (20K)	
Asian	18.41 [13.08, 23.74]	9.38 [6.69, 12.07]	23.20 [10.17, 36.22]	14.90 [9.55, 20.26]	–8.29 [–16.38, –0.21]		9.53 [2.58, 16.48]	37.24 [17.5, 56.98]	23.22 [14.4, 32.05]	12.76 [8.07, 17.45]	17.84 [10.21, 25.47]	33.03 [19.34, 46.73]	20.08 [13.95, 26.22]	18.15 [12.69, 23.61]	18.13 [12.25, 24]	–0.28 [–6.16, 5.59]
Latino	20.86 [18.01, 23.71]	13.27 [10.45, 16.09]	21.23 [12.05, 30.41]	16.45 [12.45, 20.45]	–4.78 [–10.58, 1.03]		22.12 [16.92, 27.32]	16.62 [10.64, 22.59]	25.34 [18.59, 32.09]	21.25 [11.86, 30.64]	20.47 [15.89, 25.05]	19.23 [14.98, 23.49]	24.11 [18.55, 29.67]	19.53 [16.5, 22.56]	18.97 [15.24, 22.7]	–1.88 [–5.62, 1.85]
African American	34.31 [29.32, 39.31]	22.01 [15.82, 28.21]	56.86 [45.05, 68.66]	35.95 [29.37, 42.53]	–20.91 [–28.2, –13.61]		42.40 [36.98, 47.82]	38.30 [31.82, 44.79]	27.94 [20.27, 35.61]	18.23 [11.42, 25.03]	41.17 [36.17, 46.17]	35.20 [29.22, 41.18]	25.03 [18.53, 31.52]	31.41 [25.8, 37.03]	29.25 [23.23, 35.27]	–5.06 [–8.48, –1.64]
Non-Latino White	21.10 [19.31, 22.88]	13.63 [12.19, 15.08]	24.77 [15.97, 33.56]	18.09 [14.29, 21.88]	–6.68 [–11.84, –1.51]		28.23 [22.99, 33.47]	21.60 [19.4, 23.8]	22.88 [20.21, 25.55]	13.92 [12.34, 15.5]	26.24 [22.45, 30.03]	21.98 [20.2, 23.77]	20.19 [18.21, 22.17]	19.04 [17.49, 20.58]	17.41 [16.01, 18.81]	–3.69 [–5.03, –2.35]

SOURCE National Institute of Mental Health Collaborative Psychiatric Epidemiology Surveys <http://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/20240>

NOTES * All statistics are based on 10 imputations.
* The bootstrap intervals are estimated as 2*SD of bootstrap estimates.