Socioeconomic Status and the Impact of Psychiatric Care

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Abstract

Schizophrenia is severe mental disorder that contributes heavily to unemployment, homelessness, suicide, and crime. Because few psychiatric (or other) clinical trials examine impact heterogeneity by SES, clinical research findings may be inaccurate for many patients. SES may moderate the impact of care through several channels, including treatment adherence, initial illness severity, cognition, and family support. This study evaluates socioeconomic heterogeneity in the impact of an enhanced schizophrenia treatment intervention. Using data from the RAISE trial, I interact treatment with a simple SES index and assess the disparity by SES in the intervention's impact on mental health. The intervention substantially improves the mental health of patients in the highest SES quartile but does not benefit the remaining patients on average. I consider possible reasons for this pattern, including SES differences in adherence, initial mental health, cognition, and other factors but I cannot isolate a specific source of the disparity. Finally, I show similarly disparate effects on police contacts, ER visits, and suicidality, which suggests that heterogeneous clinical effects may help explain disparities in these outcomes.

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1 Introduction

Schizophrenia is a severe psychotic disorder that affects 1 percent of US adults. Symptoms include recurrent hallucinations and delusions, flat affect, and cognitive deficits. Patients usually develop the disorder during early adulthood and must manage their symptoms in perpetuity (Sawa and Snyder 2002). The standard treatment for schizophrenia combines a continuous regimen of antipsychotic medications with psychiatric counseling, family education, and supported employment.

Despite its low prevalence, schizophrenia has a large social burden. People with schizophrenia commit 11 percent of homicides and 22 percent of suicides (Fazel and Grann 2004, Osborn et al. 2008). They comprise 11 percent of the homeless population and contribute 1 percent of all emergency room visits (Folsom and Jeste 2002, Marco and Vaughan 2005). In data from 2009-2010 (when US unemployment exceeded 9 percent), 10 percent of unemployed (or "out of the labor force") adults had a serious mental illness (Luciano and Meara 2014). By reducing the incidence of these outcomes, psychiatric treatment has large and important externalities (Norton et al. 2006, Marcotte and Markowitz 2011).[1]

People with low socioeconomic status (SES) contribute disproportionately to these social costs. 17 percent of low-education schizophrenia patients (those with ≤ 9 years of schooling) commit violent crimes, compared to 11 percent of high-education patients (Fazel et al. 2009). Homeless schizophrenia patients differentially utilize hospital emergency rooms (Desai and Rosenheck 2005). While it is essential to provide low-SES patients with effective psychiatric care, these patients may respond less to care for several reasons. On average, these patients have worse adherence, more severe illnesses, worse cognition, and more common substance abuse issues (Goldman and Smith 2002, Marshall et al. 2005, Fung et al. 2008, McGurk et al. 2009, Rolnick et al. 2013). However existing clinical studies generally offer average

[1]Despite interest among economists in these social problems, only a handful of economic studies consider schizophrenia. The majority of these papers focus on the economic burden of the disorder (e.g. Cloutier et al. 2016). Other studies use schizophrenia treatment as a case study of physician prescription behavior (Drummond et al. 2011, Yang et al. 2014). Baldwin and Marcus (2014) study the impact of serious mental illness on employment transitions.

treatment effects for unrepresentative samples (Mak et al. 2007). Heterogeneity analyses primarily focus on clinical prognostic factors, age, and gender (Gabler et al. 2009). These analyses rarely examine race and ethnicity and typically only consider SES as a confound (e.g. Arnold et al. 2003). The pervasive lack of patient diversity undermines the credibility of clinical trials, particularly since trial sponsors may prefer to recruit homogeneous and highly-responsive patients to maximize statistical power (Montaner et al. 2001). Unexplored treatment effect heterogeneity makes it difficult for clinicians and policymakers to treat patients effectively.

This study examines socioeconomic heterogeneity in the impact of psychosis treatment. The RAISE initiative is an NIH-sponsored trial of an enhanced treatment program for first-episode psychosis (FEP), which precedes the onset of schizophrenia and other psychotic disorders. This 2011 trial involved 404 patients at 34 clinics throughout the US. According to Kane et al. (2016) and Rosenheck et al. (2017), the intervention modestly improved psychosis symptoms and economic outcomes compared to the typical treatment approach. I construct a socioeconomic index based on parental education, parental occupational prestige, and race.[2] A comparison to the nationally-representative sample of the 2010 General Social Survey (GSS) confirms that the trial sample exhibits meaningful socioeconomic heterogeneity. I interact patient SES with randomized treatment assignment to assess heterogeneity in the impact on mental health and several aspects of the social burden of schizophrenia.

I find that enhanced treatment only benefits high-SES patients. It improves a composite mental health index by 0.59 standard deviations for patients in the top SES quartile but does not significantly improve the mental health of other patients ($p < 0.001$ for both the absolute and differential impacts). This result is robust to several key threats to validity, including possible quality heterogeneity across sites. I show this pattern non-parametrically and assess the contributions of specific SES components. Next I consider possible causes of the disparity.

[2]Parental education and occupational prestige are standard components of the Hollingshead (1975) Index of Social Position, which is widely used in medicine. The dataset also contains own education and occupational prestige, but these variables are mechanically related to the severity of illness.

Differential adherence is unlikely to explain this pattern fully because there are only modest socioeconomic differences in adherence in this trial. I also investigate the contributions of baseline differences in mental health, employment, cognition, substance use, stigma, and family support. Regressions that control for the interaction between treatment and these covariates show that these factors do not explain the impact disparity by SES. The lack of an obvious cause of this pattern suggests that the disparity may operate through differences in stress, discrimination, or unmeasured aspects of the patient attributes above (Woolf and Braveman 2011).

Finally I consider disparities in the social impact of treatment. I follow my previous methodology to examine heterogeneous impacts on police contact, homelessness, the receipt of public assistance, earnings, psychiatric ER visits, and suicidal ideation. This exercise adjusts p-values for multiple inferences. For high-SES patients, the intervention reduces police contact by 8 percentage points (47 percent), psychiatric ER visits by 2.4 percentage points (48 percent) and suicidal ideation by 0.11 points on a three-point scale, while it increases earnings by $27.50 per week (43 percent). I do not find absolute or differential effects on homelessness or the receipt of public assistance. The intervention has no effect on any of these outcomes for patients in the bottom three SES quartiles.

This paper contributes to the literature on health disparities by showing a large socioeconomic disparity in the impact of psychiatric care. The cross-sectional comparisons that predominate in this literature make it difficult to distinguish between heterogeneity in access, quality, and the clinical effectiveness of care (Anderson et al. 2014, Tsai et al. 2014, Kuno and Rothbard 2002, Snowden 2007). By studying the heterogeneous response to a standardized intervention, my analysis isolates a disparity in the impact of enhanced treatment. This finding may explain why improved access to mental health services has not reduced the social burden of serious mental illness (Klick and Markowitz 2006). This paper also contributes to the debate about clinical trial oversight. Clinical research is a multi-billion dollar global industry and trial sponsors may wish to recruit the most responsive subjects at minimal

cost (Petryna 2009). Despite persistent doubts about the integrity of industry-sponsored research, recruiting diverse subjects does not appear to be a priority (Okike et al. 2008). My findings underscore the need to interpret average treatment effects in medical trials with caution.

2 Context

2.1 Schizophrenia and First-Episode Psychosis

Schizophrenia develops during early adulthood.[3] The disorder is characterized by "positive symptoms," such hallucinations and delusions, as well as "negative symptoms," which include flat affect and cognitive and memory impairments (Sawa and Snyder 2002). To receive this diagnosis, a patient must experience psychotic symptoms and a significant functional decline for at least six months. Schizophrenia risk is correlated with male gender, poverty, urbanicity, and latitude (McGrath et al. 2008). The leading theory is that schizophrenia is caused by a gene-environment interaction in which prenatal infection triggers the disorder among people who are genetically susceptible. Schizophrenia risk is correlated with SES because low-SES fetuses face more frequent and severe infections. Despite the genetic component of schizophrenia risk, fewer than 1 percent of people with schizophrenia have parents with the disorder (Rasic et al. 2014).

Depression is an important comorbidity that affects around half of schizophrenia patients. Psychiatric research suggests that depression may be intrinsic to schizophrenia or even represent a subtype of the illness (Upthegrove 2009). Depression is an important determinant of suicide risk among schizophrenia patients. It is also linked to poor adherence, relapse, and unemployment.

The development of schizophrenia proceeds in phases. According to Gardner and Nas-

[3]Psychosis is an umbrella that encompasses schizophrenia, schizoaffective disorder, schizophreniform disorder, brief psychotic disorder, delusional disorder, paraphrenia, and other subclassifications. Schizophrenia is the most common psychotic disorder.

rallah (2015, p. 34):

> The patient transitions from being "healthy" to a prodromal state characterized by: (1) non-psychotic behavioral disturbances such as depression or obsessive-compulsive disorder, (2) attenuated psychotic symptoms not requiring treatment, then converting to (3) psychotic symptoms prompting initial presentation for antipsychotic pharmacotherapy, leading to (4) a formal diagnosis of schizophreniform disorder and, subsequently, schizophrenia, requiring treatment to stabilize symptoms.

The "duration of untreated psychosis" (DUP) is the length of the interval between the arrival of symptoms and the initiation of treatment in Phase 3 above. For patients with "first episode psychosis" (FEP), research shows that early intervention that minimizes the DUP improves outcomes and facilitates long-term recovery (Marshall et al. 2005).

An antipsychotic drug regimen is the foundation of FEP treatment. Choosing the most suitable drugs and dosages is challenging and requires the clinician's ongoing attention. Antipsychotic drugs have serious side effects, including uncontrollable tics and tremors, weight gain, type-2 diabetes, and high cholesterol. Nearly everyone who takes these medications experiences at least one side effect (Fakhoury et al. 2001). Because of these side effects, clinicians may seek the smallest dose that achieves symptom control. Substance use is an important moderator of the effectiveness of treatment because recreational drugs and alcohol reduce the effectiveness of antipsychotic medications (Green et al. 2007). Several psychosocial programs complement pharmacotherapy. Patients may receive cognitive behavioral therapy, family psycho-education, and supported employment. These interventions foster life stability and help patients and their families manage the illness (Norman et al. 2017).

Schizophrenia has large personal and social costs. Fewer than 20 percent of people with schizophrenia are employed, and many patients rely on public assistance and Medicaid (Brekke et al. 2001, Marwaha and Johnson 2004). Depending on their employment histories, schizophrenia patients may either qualify for Supplemental Security Income (SSI) or Social Security Disability Insurance (SSDI). The low earnings caps in both programs create a "benefits trap" that discourages formal employment. 22 percent of schizophrenia patients are

homeless and 5 percent commit suicide (Folsom et al. 2005, Palmer et al. 2005).[4] Schizophrenia also places a burden on hospital emergency departments, contributing 1.1 percent of all admissions (Marco and Vaughan 2005). These visits often occur because the patient has become disruptive in public, which is another intangible social cost (Ascher-Svanum et al. 2010).

2.2 Disparities and Clinical Research

Clinical research is a global industry with obvious ramifications for health care practices and patient outcomes. Clinical studies include evaluations of drugs, medical devices, surgical procedures, and physical and psychotherapeutic approaches (Röhrig et al. 2009). Six pharmaceutical companies fund nearly half of all drug trials (Tungaraza and Poole 2007). Trial designers often have financial or career incentives to obtain favorable results. They may wish to recruit subjects who are homogeneous (to minimize the error variance and maximize statistical power), have large expected effects, or fewer expected complications (Okike et al. 2008). It can be difficult to recruit a sufficiently large sample, particularly in studies of rare diseases. Cost-conscious trial designers may prioritize high-SES subjects, who are easier to recruit and less likely to attrit. The extent of this phenomenon is difficult to gauge because the many studies are opaque about recruitment procedures, with fewer than half disclosing complete racial/ethnic information about trial subjects (Mak et al. 2007).

Heterogeneity analysis is a mainstay of clinical research. As in this paper, studies interact treatment with baseline covariates to assess whether impacts differ significantly across subgroups. In Gabler et al.'s (2009) review of leading medical journals, 57 percent of trials incorporated a heterogeneity or subgroup analysis. However these analyses overwhelmingly focus on prognostic factors and rarely consider race or ethnicity, much less SES.[5] This lack of focus is striking in light of the 1994 NIH policy that trials should recruit large enough

[4]Suicide has a large cost for bereaved family and friends. The children of suicide decedents face an elevated risk of depression, substance abuse, and suicide (Wilcox et al. 2010).

[5]For instance, Kane et al.'s (2016) analysis of the RAISE trial shows a heterogeneous impact by duration of untreated psychosis, which is known to moderate the impact of FEP treatment.

racial and ethnic minority subsamples to permit racial and ethnic heterogeneity analyses (Hohmann and Parron 1996).[6]

SES may moderate the impact of psychiatric care for any of several reasons. High-SES people adhere better to treatment, which means that they effectively receive more care on average (Rolnick et al. 2013). They also use and abuse fewer substances, which enhances both adherence and the impact of medication. High-SES patients have attributes that make them more responsive on average, including milder initial symptoms, shorter durations of untreated psychosis, better access to labor market and educational opportunities, less stigma related to mental illness, and more stable family environments (Marshall et al. 2005, Fung et al. 2008, McGurk et al. 2009). Since they have more education, high-SES patients may have better comprehension of their illness and may be able to communicate with health care providers more effectively (Willems et al. 2005). As I show below, SES is most strongly correlated with cognition and initial mental health in the RAISE study sample.

Despite these considerations, very little research on mental health or medical treatment more broadly evaluates socioeconomic heterogeneity in the impact of care. Without an evidence base, providers must extrapolate from published average treatment effects, which may be highly inaccurate for some patients (Lau et al. 2010).

2.3 The RAISE Trial

The RAISE trial was a prominent National Institute of Mental Health (NIMH) initiative to coordinate the psychiatric care of FEP patients. The trial evaluated the NAVIGATE intervention, which offered "coordinated specialty care" (CSC) involving four components: : individualized medication management, individual resiliency training, family psycho-education, and supported employment and education (Mueser et al. 2015). To offer individualized

[6]Gabler et al. (2009) highlight three concerns that may hamper heterogeneity analysis in practice. Sample sizes are often insufficient to detect moderate or small interactions, even though these differences may be clinically meaningful. There is the potential for data mining in search of statistically significant interactions. This criticism, which also applies to nearly all observational research, is particularly a concern for heterogeneity claims without a clear conceptual basis. Where possible, effect sizes should be adjusted for multiple inference.

medication management, providers actively monitored symptoms and side effects in order to optimize each patient's medication regimen. Individual resiliency training, a form of cognitive behavioral therapy, involved weekly or biweekly therapy sessions for as long as needed. Family psycho-education involved 10-12 sessions that attempted to help families understand psychosis, overcome stigma, and create a supportive home environment. In the supported employment and education component, counselors worked with patients to set and achieve realistic work and school goals. While each of these components is known to be beneficial, RAISE was the first evaluation of a program to coordinate these components proactively.

The control arm of the trial offered "Community Care" (CC), which consisted of "the routine treatment offered by that clinic for such patients with no additional training or supervision provided by the central team, except in relationship to retention in the research assessment and follow-up component" (Kane et al. 2016, p. 242). Although CC patients received some aspects of the intervention (e.g. antipsychotic medications), CC clinics did not necessarily offer all components or coordinate the components rigorously.

The study team advertised the trial and selected 34 sites located in 21 US states from among 63 applications to participate. They chose sites that were demographically and geographically diverse, had implementation capability, and did not have an existing FEP treatment program (Kane et al. 2015). The trial began in 2011 and lasted for two years. Researchers randomized 17 sites into CSC and recruited English-speaking patients aged 15-40 who had experienced FEP within the previous six months. These criteria led to 223 patients in the treatment arm and 181 patients in the control arm.

3 Data and Estimation

3.1 Outcome Variables

My analysis focuses on three primary mental health outcomes. Trained live interviewers conducted detailed mental health assessments every six months during the trial, for a total

of one baseline and four follow-up observations. The Positive and Negative Syndrome Scale (PANSS) is a standard and widely-used assessment of schizophrenia symptom severity (Kay et al. 1987). The instrument includes 30 items that are scored from 1 to 7, so that the total score ranges from 30 to 210. Scores of 58-74 indicate mild illness, scores of 75-94 indicate moderate illness, scores of 95-115 indicate moderately-severe illness, and scores greater than 115 indicate severe illness (Mortimer 2007). The Clinical Global Impression (CGI) is a seven-point scale of symptom severity (Haro et al. 2003). The CGI is subjective insofar as it depends on the clinician's experience, however it is easy to administer and interpret. The Calgary Depression Scale for Schizophrenia is tailored to measure depression in psychosis patient by accurately distinguishing between the symptoms of depression and psychosis (Addington et al. 1996). The scale includes nine items. Scores range from 0 to 27 and scores ≥ 6 are predictive of major depression. Lower values indicate better health for all of these measures.

These mental health outcomes are strongly correlated. The correlated between the PANSS and CGI variables is 0.86, while the correlation between these variables and the Calgary scale is 0.42-0.46. I streamline the analysis by aggregating these variables into a mental illness (MI) index using the first principal component of these variables. I standardize the MI index in order to measure impacts in standard deviations. The PANSS and CGI scales contribute disproportionately to the MI index. The correlation between the MI index and each of these variables is at least 0.92, whereas the correlation between the MI index and the Calgary scale is 0.68.

This analysis also examines several outcomes that represent the social costs of schizophrenia. 'Law enforcement contact' is an indicator that the respondent has either been arrested or had a non-arrest interaction with police in the past month. 'Public assistance' is an indicator that the patient has received SSI, SSDI, food stamps, rent subsidies, unemployment insurance, or other social welfare benefits in the past three months. Both 'law enforcement contact' and 'public assistance' are measured quarterly, with one baseline and seven follow-

up observations in the data. 'ER visits' is an indicator that the respondent has visited the emergency room for a psychiatric purpose within the past month.[7] 'Weekly earnings' is the patient's typical gross earnings per week over the previous month, which encompasses the effects of employment, labor supply, and productivity. 'Homeless' is an indicator that the patient has been homeless or slept in a shelter during the past month. 'ER visits', 'weekly earnings', and 'homeless' are measured monthly, with one baseline and 23 follow-up observations in the data. Finally, 'suicidal ideation' uses a four-point scale to measure whether and how seriously the patient has considered suicide within the past two weeks. Although the Calgary Depression Scale and the MI index already incorporate this variable, suicidal ideation warrants independent analysis because suicide has large social costs (Wilcox et al. 2010). Like other mental health variables, 'suicidal ideation' is measured every six months.

These social cost variables are based on self reports. The reliability of these measures is an obvious concern since psychosis involves the misperception of reality. However several studies show that self-reports of psychosis patients are reliable as long as patients do not provide responses during a psychotic episode (Ready and Clark 2002, Bell et al. 2007, Nieves et al. 2000, Crisanti et al. 2003). Ready and Clark (2005) compare self-reports and informant reports of psychosis patients who are not currently psychotic. Work time differs by 0.08 standard deviations between respondents and informants and these responses are highly correlated. In a comparison with administrative records, Crisanti et al. (2005) show that self-reported arrest histories for schizophrenia patients are 90 percent accurate. These findings minimize the concern about extreme measurement error for these outcomes.

3.2 Socioeconomic Status

The baseline survey elicits the education and occupational prestige of both of the respondent's parents. Education has nine possible responses and occupational prestige has eight

[7]Patients only visit the ER more than once in 17 instances (0.003 percent of observations).

possible responses. These variables are designed to construct the Hollingshead Index of Social Position (Hollingshead 1975).[8] Social scientists have criticized this index, which remains in use in medicine and epidemiology, because it employs arbitrary weights and does not account for race or ethnicity. It is unclear how to handle people whose parents are deceased or otherwise absent (Hauser and Warren 1997, Adams and Weakliem 2011). Despite these concerns, using parental characteristics is appropriate in the context of schizophrenia because it minimizes potential feedback from mental illness into measured SES.

My analysis uses parental education, parental occupational prestige, and race/ethnicity to construct an SES index. I include categories for white, African American, Hispanic, and "other races", which include Native American, Asian, and Hawaiian or Pacific Islander. Following other analyses of race and ethnicity, I code respondents as Hispanic if they indicate Hispanic ethnicity irrespective of race. I also include indicators for missing values of parental education and occupational prestige, which primarily reflect the absence of these parents from the patient's life. I compute the first principal component of these variables, which are time-invariant and measured at baseline, and standardize the index. For patients with non-missing values for both parents, the correlation between this SES index and the Hollingshead Index is 0.97.

Much of this analysis contrasts the top quartile and the bottom three quartiles of the SES distribution. By construction, high-SES patients are more likely to be white and have better-educated parents with more prestigious occupations. 86 percent of patients in the top SES quartile are white and 73 percent have at least one parent who finished college. By contrast, 52 percent of patients in the bottom three SES quartiles are white and only 10 percent have at least one parent who finished college. Occupational prestige categories are harder to interpret, however 88 percent of patients in the top SES quartile have at least one parent with a high-prestige occupation, compared to 19 percent of patients in the bottom

[8]The Hollingshead Index assigns three points for each education increment and five points for each occupational prestige increment while weighting the contributions of both parents equally.

three SES quartiles.[9]

To provide context for the SES variation in the trial, I compare the SES distribution in the trial sample to the nationally-representative sample from the 2010 General Social Survey (GSS). The GSS measures of race, ethnicity, and parental education are directly comparable to the trial dataset. However the GSS lacks an equivalent measure of parental occupational prestige. For a like-to-like comparison, I compute an alternative SES index in both datasets that omits parental occupational prestige.

Figure 1 compares the SES density functions of the trial and GSS samples. The solid red line shows the trial SES density using my preferred construction (used in the analysis below) that includes parental occupational prestige. The dark blue and gray dashed lines show the trial and GSS densities under a common SES definition that omits occupational prestige. I normalize all three distributions so that the primary SES index (shown in red) has a mean of zero and a standard deviation of one. The similarity of the trial and GSS densities indicates that the trial sample contains meaningful socioeconomic heterogeneity, which bolsters the external validity of the SES interactions below. Secondly, a comparison of the trial SES distributions with and without occupational prestige highlights the contribution of this factor. The primary SES index has a larger variance, which suggests that incorporating occupational prestige helps the index differentiate between people with different SES levels.

3.3 Moderators

The trial data include several indices and sets of covariates that measure potential moderators. Below I control for treatment-moderator interactions to assess whether these factors contribute to the heterogeneous impact by SES.

- **Initial mental health**: patients with milder and less protracted symptoms are easier to treat (Marshall et al. 2005). The variables in this category include the baseline

[9] I define the top three prestige categories as 'high-prestige' for this calculation. These categories include (1) 'higher executive, proprietor of a large concern, major professional,' (2) 'manager of a business or large concern, proprietor of a medium-sized business, lesser professional,' and (3) 'administrative personnel, owner of a small independent business, minor professional.'

PANSS, CGI, and Calgary scores, as well as the duration of untreated psychosis. Additional estimates (available upon request) disaggregate these indices further.

- **Economic circumstances** influence recovery through their effect on life stability (McGurk et al. 2009). A job or another regular source of income promotes independence and reduces uncertainty. This category includes baseline employment status, weekly earnings, student status, receipt of SSI or SSDI, and access to private health insurance or Medicaid.

- **Cognition** may moderate the effectiveness of psychosis treatment through several channels. Cognition influences the patient's adherence propensity and ability to discuss and comprehend the treatment program (Mancuso et al. 2011). Trial participants completed the Brief Assessment of Cognition in Schizophrenia (BACS), which measures verbal memory, working memory, motor speed, verbal fluency, attention, and executive function (Keefe et al. 2004).

- **Substance abuse**: nearly half of schizophrenia patients also have a substance abuse disorder (Green et al. 2007). Alcohol and marijuana (the most commonly used substances) reduce adherence and interfere with antipsychotic medications. Baseline trial data indicate whether patients have used alcohol, marijuana, and other drugs ever in their lives and within the past 30 days, as well as the frequency of use.

- **Compliance attitudes and stigma** may also influence the receptiveness to treatment. The trial data include the seven-item Stigma Scale, which provides a standardized measure of the stigma of mental illness (King et al. 2007). The data also include the four-item Brief Evaluation of Medication Influences and Beliefs, which measures the willingness to comply with an antipsychotic treatment program (Dolder et al. 2004).

- **Family support** is an important factor that promotes life stability for FEP patients (Rabinovitch et al. 2013). I incorporate four items from the Burden Assessment Scale

for Families of the Seriously Mentally Ill that relate to family support for the patient (Reinhard et al. 1994).

3.4 Balance and Weighting

This subsection describes the baseline characteristics of study participants. Researchers cluster-randomized the intervention to 17 of the 34 trial sites, which led to a total of 223 treatment patients and 181 control patients. Table 1 reports mean baseline demographic and socioeconomic characteristics, as well as baseline mental health and social outcomes, by intervention arm. For the moderators discussed above, the table reports the standardized first principal component of the variables in each category for concision. I compute p-values in Columns 3 and 5 by regressing each covariate on a treatment indicator while clustering standard errors by site.

Unweighted summary statistics appear in Columns 1-3. Despite many similarities, treatment and control patients have several notable differences. Treatment patients are 12 percentage points more likely to be male ($p = 0.07$) and 10 percentage points less likely to be enrolled in school ($p = 0.04$). The SES index is 0.36 standard deviations higher for treatment patients ($p = 0.03$), which is primarily due to a 23-point larger share of African Americans in the control group ($p = 0.02$). Treatment patients have milder initial symptoms – the MI index is 0.18 standard deviations lower ($p = 0.06$) – although the duration of untreated psychosis does not differ significantly across arms. There are no significant baseline imbalances in the social outcomes. Finally, the bottom of the table measures attrition by reporting the number of follow-up mental health assessments (out of four). Treatment patients participate in 0.4 additional assessments ($p = 0.09$), as I discuss further below.

To quantify these discrepancies, I compute the propensity score by regressing treatment on the demographic and socioeconomic covariates in the table. The significantly higher treatment propensity in the treatment group ($p < 0.01$) at the bottom of Table 1 confirms that the covariates are systematically imbalanced. I address this issue with inverse propensity

weights (IPWs), which reweight members of the control group so that the treatment and control groups have the same treatment propensities (Hainmueller 2012). Columns 4 and 5 provide weighted summary statistics for the control group. A comparison of Columns 1 and 4 shows that weighting ameliorates the imbalances in gender, school enrollment, SES, and initial mental health. The share of respondents who are "other non-white" is the only variable that is statistically significantly different, and the magnitude of this mean difference is small. Weighting attenuates and renders insignificant the difference in attrition rates between the treatment and control arms. Most regressions below use weights, although I show that unweighted estimates are robust.

Next, Table 2 examines the association between SES and other baseline covariates. Columns 1 and 2 provide unweighted estimates and Columns 3 and 4 show estimates that use inverse propensity weights. The odd columns report the correlation between SES and each covariate, while the even columns report the mean difference in each covariate between the fourth and first SES quartiles. P-values in the even columns are based on simple regressions with site-clustered standard errors. SES is negatively correlated with all measured aspects of mental illness, including the duration of untreated psychosis. The MI index is 0.56 standard deviations lower in SES Quartile 4 than in SES Quartile 1 in Column 4. SES is strongly positively correlated with education, the use of private health insurance, and cognition. It is not strongly correlated with economic circumstances, substance use, attitudes and stigma, or family support, despite evidence of these patterns in other settings (Fung et al. 2008, McGurk et al. 2009). Without a strong correlation with SES, these moderators are unlikely to explain the differential treatment effect by SES, as I discuss further below.

4 Estimation

4.1 Approach and Main Results

I estimate heterogeneous treatment effects by patient SES with OLS. Regressions use data from the 6, 12, 18, and 24-month follow-up assessments and interact the treatment indicator with a full set of SES quartile indicators. i indexes the patient, j indexes the site, and t indexes the time period in the regression equation below.

$$Y_{ijt} = \beta_1[\ T_j \cdot SES^q_{ij}\ ] + \beta_2 SES^q_{ij} + \beta_3 X^b_{ij} + \gamma_t + \varepsilon_{ijt} \tag{1}$$

Y is the mental health outcome, T is a treatment indicator, and SES^q is the socioeconomic quartile of the patient in this expression. Regressions fully interact T with SES quartile indicators, so that each interaction coefficient provides the treatment effect for that SES quartile. γ_t is a vector of round indicators and X^b is a vector of baseline covariates that improve the precision of the estimates by reducing the error variance.[10] I cluster standard errors by site throughout the analysis to account for possibly correlated errors among participants at a common site and balance the intervention arms with inverse propensity weights.

My primary regression estimates appear in Table 3. The MI index in Column 1 is the standardized first principal component of the PANSS, CGI, and Calgary scales in Columns 2-4. Negative coefficients indicate mental health improvements for all outcomes. The quartile-specific control group means for the outcome variable appear in brackets below the coefficients and standard errors. In Column 1, the intervention reduces the MI index by 0.59 standard deviations (94 percent) for patients in the top SES quartile but does not reduce the MI index for other patients. The heterogeneity of the response is statistically significant according to a joint Wald test of the equality of the coefficients ($p < 0.01$). Columns 2-4 show a similar pattern for the three components of the MI index. The intervention reduces the PANSS score

[10] These controls include all of the covariates in Table 1. For cognition, substance use, attitudes and stigma, and family support, I control for the component indices and variables, rather than the first principal component.

by 5.01 points, the CGI by 0.43 points, and the Calgary score by 2.62 points for patients in the top SES quartile ($p < 0.01$ for all outcomes). Mental health does not improve for other SES quartiles, aside from a possible effect on depression for Quartile 2 in Column 4.[11]

The SES index is a weighted average of parental education, parental occupational prestige, and race. Figure 2 shows the heterogeneous impact for each of these components. The figure includes 83 percent confidence intervals, which provide a visual check for significant differences in means.[12] In Panel A, I identify the highest-status quartile for each parental education and occupational prestige variable. Differential impacts by parental education are particularly strong, but father's occupational prestige is also important. Panel B shows estimates by racial group. I include the 'other race' category, which contributes 4 percent of the sample, with 'white' because disaggregated estimates for these groups are similar but the 'other race' estimate is imprecise. Estimates for white/other patients are strong and statistically significant while estimates for black and Hispanic patients are close to zero. However the impact disparity by race/ethnicity is not statistically significant.

4.2 Robustness

Next I assess the robustness of this finding through several approaches. Figure 3 shows the impact disparity by SES non-parametrically using locally-weighted polynomial estimates of the MI index at follow-up for both intervention arms. The downward trajectories in the figure indicate that high-SES patients have milder symptoms (as in Table 2). The vertical distance between the red and gray lines represents the treatment effect for a particular SES quantile.[13] Below the median, there are only small differences by intervention arm in the MI index, PANSS, and CGI outcomes. Average outcomes begin to diverge at the median

[11] These results are robust under alternative parametric functional forms. Other estimates (available upon request) interact treatment the continuous SES percentile. These results show that a 10 percentage point SES improvement increases the treatment effect on the MI index by 0.08 standard deviations ($p < 0.05$).

[12] Two means are significantly different with 95 percent confidence if their 83 percent confidence intervals do not overlap.

[13] The site-clustered structure of the experiment makes it difficult to estimate confidence intervals for this figure. However Table 3 demonstrates that estimates for high-SES patients are strongly significant and estimates for other patients are insignificant.

and the difference becomes stark for high-SES patients. Results for the Calgary Depression Scale in the lower right are less clear since there appear to be effects for patients on both ends of the SES distribution. These results confirm my finding from Table 3 that the largest impacts occur in the top SES quartile and that impacts are small for other patients.

Table 4 shows that estimates are robust under several alternative specifications. I compare these results to my primary estimates in Table 3. In Column 1, which does not use inverse propensity weights to address baseline imbalance, the intervention reduces the MI index by 0.47 standard deviations (63 percent) for the top SES quartile, which is somewhat smaller than the weighted estimate above. The insensitivity of the results to weighting suggests that baseline imbalance is not a serious confound in practice. Column 2 shows that results are similar if I omit baseline covariate controls. Leaving out these variables substantially reduces statistical power, increasing the standard error for the Quartile 4 coefficient by 67 percent. However the point estimate is similar (-0.55 versus -0.59) and remains statistically significant. As before, estimates for other SES quartiles are small and insignificant.

Differential attrition by control patients may threaten validity if attriters have systematically different outcomes. Table 1 (Column 5) shows that the treatment and control arms have similar attrition rates ($p = 0.40$) once I reweight the control arm. As an additional robustness test, Column 3 of Table 4 weights respondents by the inverse probability of participation. This approach yields estimates that incorporate the missing observations of attriters into the sample (Wooldridge 2002). These weights magnify the socioeconomic disparity, with an impact of 0.65 standard deviations (127 percent) for the top SES quartile, which suggests that differential attrition is not a serious threat to validity. An additional robustness test reproduces the estimates in Table 3 for the subsample of non-attriters. Results, which are available upon request, closely resemble the reported estimates.

An important concern is that my findings may partially reflect site characteristics that moderate the impact of care. For instance, high-SES patients may respond more to treatment because they attend higher-quality clinics. The remainder of Table 4 considers this issue by

controlling for site characteristics. In Column 4, I compute the proportion of patients from each SES quartile who attend each clinic (omitting the index patient) and interact these variables with treatment. This stringent strategy controls for any differential response among patients who attend "high-SES" clinics. While standard errors more than triple in Column 4, point estimates by SES quartile resemble other estimates. Next, Column 5 controls for site fixed effects that absorb arbitrary site characteristics that are fixed across time and SES. This approach cannot identify impacts for all SES quartiles because site indicators are collinear with treatment, however it can identify the differential effect for high-SES patients. The estimate of -0.59 closely resembles my primary estimate above. Both of these results suggest that site heterogeneity does not spuriously generate the impact gradient by SES.

5 Reasons for the Heterogeneous Impact

Next I consider possible explanations for this pattern. SES is associated with many medical and non-medical inputs that could facilitate recovery. This inquiry must distinguish between explanations based on moderators and mediators. High-SES patients may have predetermined attributes (moderators) that enhance the impact of treatment, as Section 5.2 explores below. However high-SES people may also have better adherence, which mediates the impact of care (Goldman and Smith 2002, Staring et al. 2010, Rolnick et al. 2013). It is challenging to isolate the effect of adherence, which is endogenous to treatment and the patient's perceptions of its effectiveness and side effects. Despite the ubiquity of "mediation analysis" in the medical literature, it is very difficult to identify mediators credibly (Green et al. 2010). Therefore my analysis of adherence is necessarily less conclusive.

5.1 The Role of Adherence

Table 5 examines adherence by SES within the treatment group. The intervention included a regimen of antipsychotic medication and four psychosocial treatments, as Section 2.3 describes. Panel A shows the average number of tablets prescribed and consumed, as well

as the percent of prescribed tablets consumed. Panel B shows the utilization rate for each psychosocial treatment and the total number of treatments utilized. I compute all rates in the table by patient and month, and Column 5 tests whether rates differ significantly across SES quartiles.

In Panel A, there are only small differences by SES in medication adherence. Patients in Quartile 4 consume 89 percent of the prescribed drugs, compared to 85 percent in Quartile 1. High-SES patients are prescribed somewhat more medicine, which may reflect clinician perceptions that these patients can better utilize additional treatment. In Panel B, patients in Quartile 4 attend individual resiliency training (the primary psychosocial treatment) 11 percentage points more frequently than those in Quartile 1. They also utilize other intervention components somewhat more intensively. However several adherence dimensions are actually the highest in Quartile 3, which is not consistent with the modest treatment effect for this group. These patterns make it unlikely that SES differences in adherence fully explain the disparate mental health impact by SES in Table 3.

5.2 Patient Attributes that Moderate the Impact of Care

High-SES patients may respond more to treatment because they have attributes that enhance the impact of psychiatric care. High-SES patients have milder and less protracted psychosis symptoms, which make their disorders easier to treat. They have better cognition, enabling them to understand and manage their illness better. SES may also be correlated with economic circumstances, substance abuse, attitudes, stigma, and family support, all of which moderate the effectiveness of treatment. Table 2 examines these correlations in the trial sample and shows that only initial mental health and cognition are strongly correlated with SES in practice.

Next I assess further whether these factors contribute to the observed SES gradient. I augment Equation (1) by sequentially controlling for the interaction of treatment with the

baseline variables in each moderator category.[14] I demean all controls in order to create a like-to-like comparison with the estimates in Table 3. Including these controls should attenuate the differential effect for high-SES patients if these moderators partially explain the SES gradient.

Oster's (2017) proportional selection method allows me to interpret the extent of coefficient attenuation. This approach compares the coefficient of interest (for Treatment · SES Quartile 4) in regressions with and without additional controls. It computes the extent of selection on unobservables proportional to the controls, δ, that would be necessary to completely attenuate the coefficient of interest. The contribution of the controls to the regression R^2 is an important consideration since controls without explanatory power cannot possibly attenuate the coefficient of interest.[15] Large and positive values of δ indicate that selection on unobservables must be very strong to cause the observed result spuriously while small and positive values of δ indicate that weak or moderate selection on unobservables could explain the result. Negative values of δ indicate that the controls *increase* the coefficient of interest, which suggests robustness. Oster (2017) suggests that $\delta = 1$ as a threshold, however the interpretation of "large" also depends on the accuracy and comprehensiveness of the observable controls. This method does not deal with unobservables that are uncorrelated with the included controls.

Table 6 provides estimates based on this approach. Column 1 reproduces my primary regression (Table 3, Column 1) for comparison. Columns 2 and 3 control for the interaction of treatment with baseline mental health and cognition.[16] These controls attenuate the Quartile 4 impact by less than 7 percent. However δ's for these regressions are small because the covariates only slightly increase the regression R^2. It is therefore possible that unmeasured

[14]Several categories include psychiatric and psychometric scales as components. Interacting the individual items within these scales is not helpful. The resulting regressions have extreme standard errors and are difficult to interpret.

[15]This calculation requires an assumption about the maximum percent of the variation in the MI index that SES could plausibly explain. I regress the MI index on the interaction of SES percentile indicators with round indicators and obtain an R^2 of 0.52, which I use as the maximum R^2 for this exercise.

[16]Kane et al. (2016) show impact heterogeneity by the duration of untreated psychosis. Although DUP is correlated with SES, Column 2 shows that DUP heterogeneity cannot explain my findings.

aspects of initial mental health and cognition could explain the impact disparity.

Columns 4-7 control for the interaction of treatment with baseline economic circumstances, substance use, attitudes and stigma, and family support. It is less plausible that these moderators could contribute to impact heterogeneity by SES because Table 2 shows that they are not strongly correlated with SES in the trial sample. Including these controls only minimally influences my estimates. Results for high-SES patients are actually larger after I incorporate attitude/stigma and family support variables in Columns 6 and 7. These results and the lack of strong SES correlations in Table 2 suggest that these factors do not contribute to impact heterogeneity by SES.

Overall, these findings do not clarify why high-SES patients respond more to the intervention. In addition to unmeasured aspects of initial mental health and cognition, other socioeconomic factors may differentially benefit high-SES patients (Woolf and Braveman 2011). Clinicians might discriminate against low-SES patients in ways that are not obvious or measurable. These patients may have less life stability and family support in ways that are not proportional to the observables in the trial data.

6 The Social Impact of Psychiatric Treatment

This section examines the heterogeneity in the treatment effect on several social costs of schizophrenia. These outcomes, which Section 3.1 describes further, include police contact, receipt of public assistance, psychiatric emergency room visits, earnings, homelessness, and suicidal ideation. The heterogeneous mental health impact in Table 3 may suggest a heterogenous impact on these outcomes as well. Examining impacts across six outcomes creates a risk of a false-positive inference due to multiple hypothesis testing. I use the Holm (1979) multiple testing procedure to adjust p-values across outcomes. Sample sizes vary across regressions because these outcomes are measured at different intervals.

Table 7 reproduces my empirical approach above to show estimates for these outcomes. For patients in the top SES quartile, the intervention reduces the probability of police con-

tact by 8 percentage points (47 percent), the probability of an ER visit by 2.4 percentage points (48 percent) and suicidal ideation by 0.11 points on a 4-point scale. The intervention increases weekly earnings by $27.50 (43 percent). Additional results (available upon request) show that the earnings effect primarily arises through the intensive margin of additional work hours, rather than through employment. Impacts on these outcomes for the bottom three SES quartiles are small and statistically insignificant. The intervention does not have significant effects on homelessness or the receipt of public assistance for any SES quartiles.

Multiple-testing adjusted p-values for the Treatment · SES Quartile 4 coefficient and the joint test of coefficient equality appear in the bottom of the table. Quartile 4 estimates for police contact, ER visits, and suicidal ideation remain significant at the 10 percent threshold. However 'police contact' is the only outcome for which the heterogeneity by SES quartile is statistically significant after the multiple-inference correction ($p = 0.03$). Nevertheless, these findings suggest that heterogeneity in the impact of psychiatric care may contribute to heterogeneity in the incidence of these social costs of schizophrenia.

7 Conclusion

This paper provides evidence of heterogeneity by SES in the impact of psychiatric treatment. Enhanced care for first-episode psychosis has a large and significant mental health benefit for patients in the top quartile of the SES distribution but does not improve outcomes for the remaining 75 percent of patients. Figure 2 shows that this pattern is evident in all available socioeconomic indicators, but is particularly tied to parental education. The impact for high-SES patients is associated with significant declines in police contact, ER visits, and suicidality for this group. I cannot pinpoint a particular cause of this disparity with the available data. The pattern does not appear to arise through differences in any of several proximate factors, including adherence, initial mental health, cognition, economic circumstances, substance abuse, attitudes and stigma, or family support. The lack of an

obvious explanation suggests that the link between SES and the response to treatment is complex and multifaceted.

The RAISE trial was a high-profile NIH initiative to improve schizophrenia treatment. Former NIMH director Thomas Insel (2016) has compared the RAISE findings to dramatic breakthroughs in pediatric leukemia treatment, saying that, "the results for NAVIGATE take a palpable step toward markedly better outcomes for young people following first-episode psychosis." The concentration of benefits among high-SES patients may temper this optimism. The program does not improve mental health for a substantial majority of trial participants. In the community, high-SES patients have access to more and higher-quality care, as well as better clinical outcomes (Tsai et al. 2014). Therapeutic advanced for middle and lower-class patients are urgently needed. The relative ineffectiveness of treatment for these people may contribute to the large social cost of schizophrenia in terms of crime, unemployment, and suicide.

Disparities research focuses overwhelmingly on racial and ethnic differences (Mak et al. 2007). Although whites respond better to treatment than African Americans and Hispanics, the differences are less stark than for other socioeconomic variables. A heterogeneity analysis focusing only race and ethnicity would conclude that this trial lacked the power to detect these disparities. The broader analysis of SES reveals a pattern that would not otherwise be obvious. Because clinical trials throughout medicine seldom include heterogeneity analyses by SES, many clinical findings may be inaccurate for large subpopulations (Gabler et al. 2009, Lau et al. 2010).

Table 1: Baseline Characteristics by Treatment Status

	Treatment	Unweighted Control		Weighted Control	
	Mean	Mean	P-value	Mean	P-value
	(1)	(2)	(3)	(4)	(5)
Demographics					
Male	0.78	0.66	0.07*	0.75	0.69
Age	23.2	23.1	0.88	22.5	0.41
Education	5.00	4.90	0.45	5.21	0.30
Married	0.06	0.06	0.84	0.05	0.66
Dur. Untreated Psychosis	5.5	6.6	0.40	5.2	0.80-
Receives SSI or SSDI	0.09	0.10	0.74	0.08	0.89
Private Health Insurance	0.26	0.15	0.12	0.28	0.88
Employment	0.13	0.17	0.26	0.10	0.49
School Enrollment	0.15	0.25	0.04**	0.15	0.90
Socioeconomic Status					
SES Index	0.16	-0.20	0.03**	0.28	0.61
Mother's Education	5.7	5.5	0.24	6.0	0.35
Father's Education	5.7	5.6	0.23	5.9	0.57
Mother's Occupation	4.8	4.4	0.14	5.1	0.47
Father's Occupation	4.7	4.4	0.13	4.8	0.78
African-American	0.24	0.47	0.02**	0.23	0.94
Hispanic	0.25	0.10	0.10	0.16	0.40
Other Non-White	0.05	0.04	0.34	0.02	0.03**
Absent Parent	0.18	0.28	0.05**	0.18	0.95
Mental Health Outcomes					
Mental Illness (MI) Index	0.08	-0.10	0.06*	0.17	0.55
PANSS Total Score	78.3	74.5	0.02**	79.4	0.63
Clinical Global Impression	4.12	3.96	0.06*	4.19	0.55
Calgary Depression Scale	4.65	4.65	0.98	4.89	0.63
Social Outcomes					
Police Contact	0.10	0.06	0.15	0.04	0.02
Public Assistance	0.41	0.40	0.85	0.39	0.83
Psychiatric ER Visits	0.09	0.06	0.26	0.05	0.19
Weekly Earnings	26.0	35.8	0.19	20.6	0.44
Homeless	0.05	0.05	0.99	0.08	0.54
Suicidal Ideation	0.17	0.22	0.34	0.20	0.55
Moderators					
Cognition Index	-0.01	0.01	0.89	0.27	0.21
Substance Use Index	-0.03	0.04	0.61	-0.01	0.88
Attitude/Stigma Index	0.01	-0.02	0.80	0.00	0.91
Family Support Index	-0.04	0.05	0.55	-0.19	0.32
Propensity Score	0.63	0.46	0.00***	0.63	0.99
Follow-up MH Assessments	2.6	2.2	0.09*	2.4	0.40
Patients	223	181	-	181	-

Note: The table compares the baseline means of key variables across the treatment and control arms. Columns 4 and 5 employ inverse propensity weights. All indices are standardized. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 2: Baseline Associations with Socioeconomic Status

	Unweighted		Weighted	
	ρ	$\mu^{Q4} - \mu^{Q1}$	ρ	$\mu^{Q4} - \mu^{Q1}$
	(1)	(2)	(3)	(4)
Demographics				
Male	0.07	0.08	0.08	0.10
Age	-0.07	-1.1	-0.06	-0.5
Education	0.36	0.92***	0.47	1.25***
Married	-0.06	-0.02	-0.08	-0.01
Dur. Untreated Psychosis	-0.23	-4.7***	-0.29	-5.5***
Receives SSI or SSDI	-0.03	-0.01	0.02	0.01
Private Health Insurance	0.43	0.43***	0.44	0.42***
Employment	0.02	0.04	0.02	0.05
School Enrollment	0.05	0.03	0.04	0.01
Mental Health Outcomes				
Mental Illness (MI) Index	-0.21	-0.60***	-0.23	-0.56***
PANSS Total Score	-0.20	-9.1***	-0.23	-9.2***
Clinical Global Impression	-0.20	-0.46***	-0.21	-0.40***
Calgary Depression Score	-0.12	-1.3**	-0.12	-1.1
Social Outcomes				
Police Contact	0.08	0.05	0.03	0.01
Public Assistance	-0.09	-0.08	-0.11	-0.13
Psychiatric ER Visits	0.01	0.01	0.00	-0.004
Weekly Earnings	0.02	5.9	0.00	6.1
Homeless	-0.05	-0.05	-0.13	-0.17
Suicidal Ideation	-0.11	-0.15*	-0.07	-0.08
Moderators				
Cognition Index	0.40	0.98***	0.48	1.1***
Substance Use Index	0.01	0.06	0.00	0.07
Attitude/Stigma Index	-0.02	0.06	-0.10	-0.20
Family Support Index	-0.05	-0.07	-0.02	0.14
Follow-up MH Assessments	0.08	0.43	0.09	0.30

Note: The table shows the association between SES and baseline covariates. Columns 1-2 show unweighted estimates and Columns 3-4 show estimates that employ inverse propensity weights. Odd columns report the simple correlation between the SES index and each covariate. Even columns report the mean difference between SES Quartile 4 and SES Quartile 1 for each covariate. P-values in even columns are based on simple regressions with site-clustered standard errors. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: The Impact on Mental Illness by Socioeconomic Status

	MI Index	PANSS	CGI	Calgary
	(1)	(2)	(3)	(4)
A: Estimates by SES Quartile				
Treatment · SES Quartile 4	-0.59***	-5.01***	-0.43***	-2.62***
	(0.15)	(1.70)	(0.13)	(0.66)
	[-0.63]	[65.2]	[3.55]	[4.02]
Treatment · SES Quartile 3	0.18	2.53	0.20	0.15
	(0.19)	(2.94)	(0.17)	(0.49)
	[-0.85]	[65.3]	[3.32]	[2.79]
Treatment · SES Quartile 2	-0.28	-1.54	-0.18	-1.70*
	(0.22)	(2.86)	(0.19)	(0.86)
	[-0.76]	[64.8]	[3.37]	[3.74]
Treatment · SES Quartile 1	0.26	3.17	0.31	0.19
	(0.27)	(3.36)	(0.21)	(1.11)
	[-0.18]	[74.5]	[3.83]	[4.57]
Equality of Coeffs. (p-value)	*0.00*	*0.03*	*0.02*	*0.02*
Observations	962	962	962	962

Note: The table uses a fully-interacted specification to estimate the impact of the intervention for each SES quartile. Site-clustered standard errors appear in parentheses. All regressions control for round indicators and use inverse propensity weights. Quartile-specific control means appear in brackets. The MI Index is the first first principal component of the PANSS, CGI, and Calgary scales.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Additional Robustness Estimates

	MI Index				
	(1)	(2)	(3)	(4)	(5)
Treatment · SES Quartile 4	-0.47***	-0.55**	-0.65***	-0.68	-0.58***
	(0.16)	(0.25)	(0.16)	(0.53)	(0.20)
	[-0.75]	[-0.63]	[-0.51]	[-0.63]	[-0.63]
Treatment · SES Quartile 3	0.089	0.12	0.19	0.15	–
	(0.18)	(0.22)	(0.19)	(0.48)	
	[-0.81]	[-0.85]	[-0.85]	[-0.85]	
Treatment · SES Quartile 2	-0.28	0.090	-0.31	-0.38	–
	(0.19)	(0.24)	(0.23)	(0.56)	
	[-0.69]	[-0.76]	[-0.60]	[-0.76]	
Treatment · SES Quartile 1	0.16	-0.0046	0.27	0.22	–
	(0.27)	(0.31)	(0.27)	(0.60)	
	[-0.33]	[-0.18]	[-0.18]	[-0.18]	
Equality of Coeffs. (p-value)	*0.12*	*0.16*	*0.01*	*0.01*	–
Weights	None	IPW	IPW/Attrit	IPW	IPW
Individual Covariates	Yes	No	Yes	Yes	Yes
Site Controls	No	No	No	SES	FE
Observations	962	962	962	962	962
R^2	0.37	0.09	0.40	0.39	0.41

Note: The table shows that estimates are robust under several alternative specifications. Estimates follow the specification in Panel B of Table 3. Column 1 omits inverse propensity weights. Column 2 does not control for baseline covariates. Column 3 weights by the attrition probability, as the text explains. Column 4 controls for patient shares by SES quartile and clinic and the interaction of patient shares with treatment. Column 5 controls for site fixed effects. Regressions include round indicators and site-clustered standard errors. The MI Index is the first first principal component of the PANSS, CGI, and Calgary outcomes. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Adherence for Treatment Patients by SES Quartile

	Quartile 1	Quartile 2	Quartile 3	Quartile 4	P-value
	(1)	(2)	(3)	(4)	(5)
A: Medication Adherence					
Tablets prescribed	28.3	26.5	38.5	32.8	0.06
Tablets consumed	24.6	22.8	33.9	29.7	0.10
Percent of medications consumed	*0.85*	*0.83*	*0.89*	*0.89*	*0.40*
B: Intervention Utilization					
Individual resiliency training	0.53	0.57	0.67	0.64	0.02
Individualized medication management	0.53	0.54	0.55	0.57	0.99
Supported education and employment	0.14	0.20	0.18	0.22	0.54
Family psycho-education	0.25	0.32	0.37	0.29	0.09
Percent of services utilized	*0.36*	*0.41*	*0.44*	*0.43*	*0.25*

Note: The table shows the use of antipsychotic medications and the utilization of intervention components by SES quartile within the treatment group. I compute rates by individual and month. Column 5 tests whether rates differ significantly across SES quartiles. P-values are based on weighted regressions with site-clustered standard errors.

Table 6: Sensitivity to Controlling for Treatment · Baseline Covariates

	MI Index						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment · SES Quartile 4	-0.59***	-0.56***	-0.55***	-0.59***	-0.55***	-0.64***	-0.63***
	(0.15)	(0.16)	(0.18)	(0.14)	(0.14)	(0.14)	(0.16)
Treatment · SES Quartile 3	0.18	0.18	0.17	0.18	0.24	0.15	0.17
	(0.19)	(0.18)	(0.18)	(0.19)	(0.19)	(0.18)	(0.18)
Treatment · SES Quartile 2	-0.28	-0.31	-0.21	-0.35	-0.31	-0.22	-0.28
	(0.22)	(0.24)	(0.21)	(0.21)	(0.21)	(0.19)	(0.24)
Treatment · SES Quartile 1	0.26	0.23	0.24	0.26	0.19	0.35	0.31
	(0.27)	(0.27)	(0.29)	(0.26)	(0.29)	(0.25)	(0.26)
Equality of Coeffs. (p-value)	*0.00*	*0.01*	*0.03*	*0.00*	*0.00*	*0.00*	*0.00*
Control for Treatment · Baseline:	–	MH	Cog	Econ	Subs	Att/Stig	Family
R^2	0.38	0.38	0.39	0.39	0.40	0.40	0.38
Proportional Selection δ	–	0.23	0.48	0.63	1.7	-851	-0.19
Observations	962	962	962	962	962	962	962

Note: The table shows the impact of treatment by SES quartile after controlling for the interaction of treatment and five baseline moderators, which Section 3.3 describes in more detail. Site-clustered standard errors appear in parentheses. Column 2 controls for initial mental health, Column 3 controls for cognition, Column 4 controls for economic circumstances, Column 5 controls for substance use, Column 6 controls for attitudes and stigma, and Column 7 controls for family support. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Social Impacts of Psychiatric Care, by SES Quartile

	Police Contact	Public Assistance	Psychiatric ER Visits	Weekly Earnings	Homeless	Suicidal Ideation
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment · SES Quartile 4	-0.080***	0.0046	-0.024***	27.5**	0.013	-0.11**
	(0.018)	(0.064)	(0.0086)	(13.0)	(0.047)	(0.045)
	[0.17]	[0.48]	[0.05]	[64.0]	[0.03]	[0.14]
Treatment · SES Quartile 3	0.024	-0.080	-0.011	-8.21	-0.076	-0.056
	(0.029)	(0.097)	(0.015)	(25.2)	(0.050)	(0.047)
	[0.08]	[0.56]	[0.02]	[70.4]	[0.13]	[0.11]
Treatment · SES Quartile 2	-0.0091	-0.037	-0.0075	0.40	-0.014	-0.046
	(0.040)	(0.073)	(0.0099)	(14.2)	(0.042)	(0.058)
	[0.06]	[0.57]	[0.02]	[47.8]	[0.02]	[0.10]
Treatment · SES Quartile 1	0.039	-0.14	0.0052	-14.3	-0.14	0.10
	(0.058)	(0.11)	(0.012)	(12.1)	(0.11)	(0.086)
	[0.15]	[0.83]	[0.02]	[26.3]	[0.36]	[0.10]
Treatment · Q4 (adj. p-value)	0.00	0.99	0.04	0.12	0.99	0.10
Equality of Coeffs. (adj. p-value)	0.03	0.99	0.98	0.84	0.99	0.91
Baseline Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Weights	IPW	IPW	IPW	IPW	IPW	IPW
Observations	1987	1987	5780	5780	5780	962

Note: The table shows treatment effects by SES quartile on six outcomes with large social costs. 'Police contact' is an indicator that the respondent has been arrested or otherwise interacted with police in the past month. 'Public Assistance' is an indicator that the patient has received any of several forms of public assistance in the past three months. 'Psychiatric ER Visits' is an indicator that the respondent has visited the emergency room for a psychiatric purpose in the past month. 'Weekly earnings' the usual gross weekly earnings for the respondent in the past month. 'Homeless' is an indicator that the patient has been homeless or slept in a shelter during the past month. 'Suicidal ideation' uses a four-point scale to measure whether and how seriously the patient has considered suicide within the past two weeks. Site-clustered standard errors appear in parentheses and quartile-specific control means appear in brackets. All estimates control for round indicators. Multiple-inference adjusted p-values based on the Holm (1979) procedure appear at the bottom of the table. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

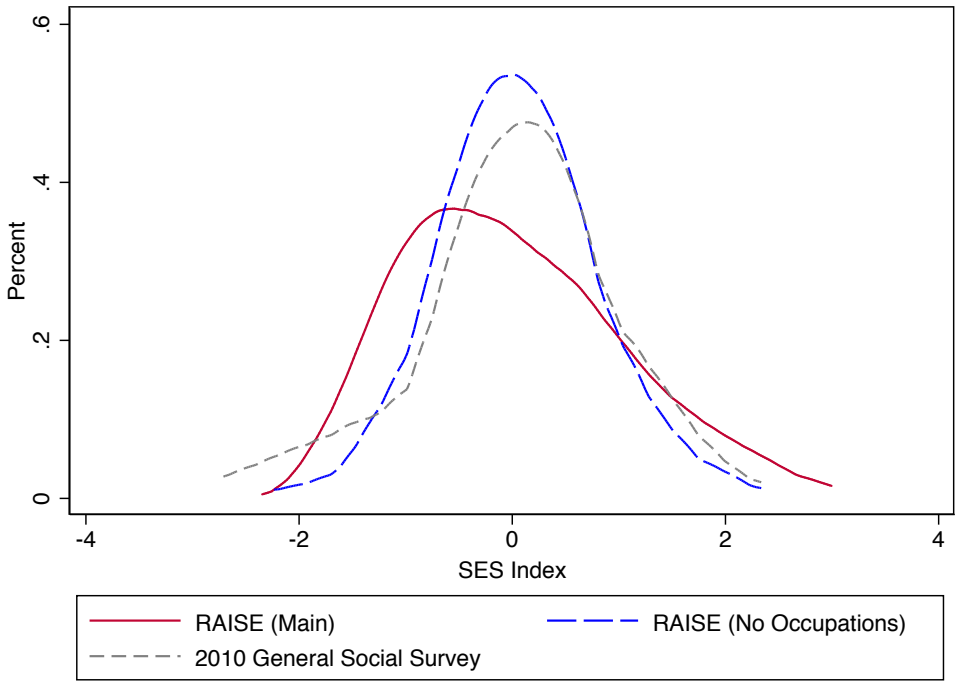


Figure 1: Density of the SES Index

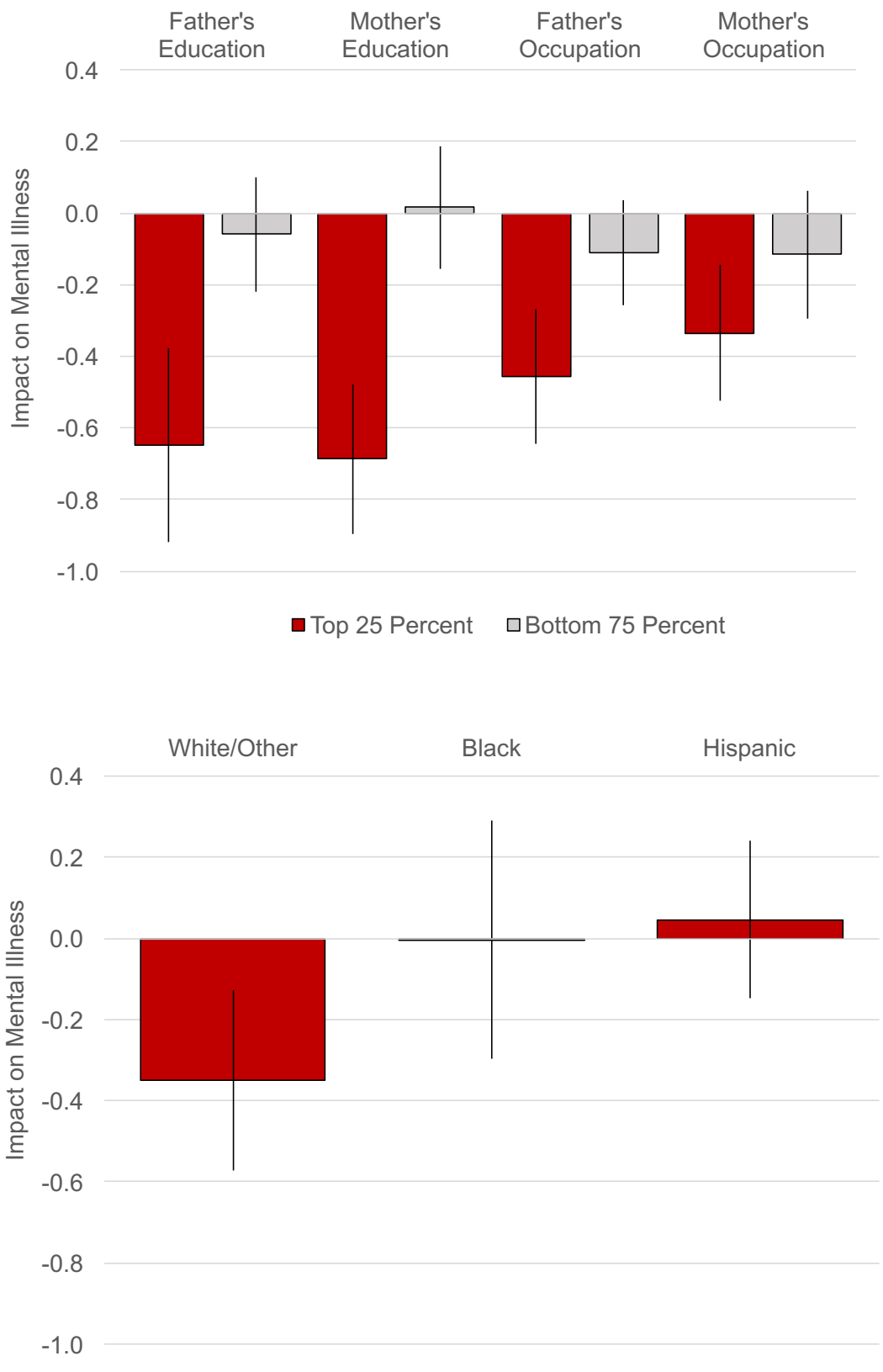


Figure 2: The Impact on Mental Illness by SES Component
(with 83% Confidence Intervals)

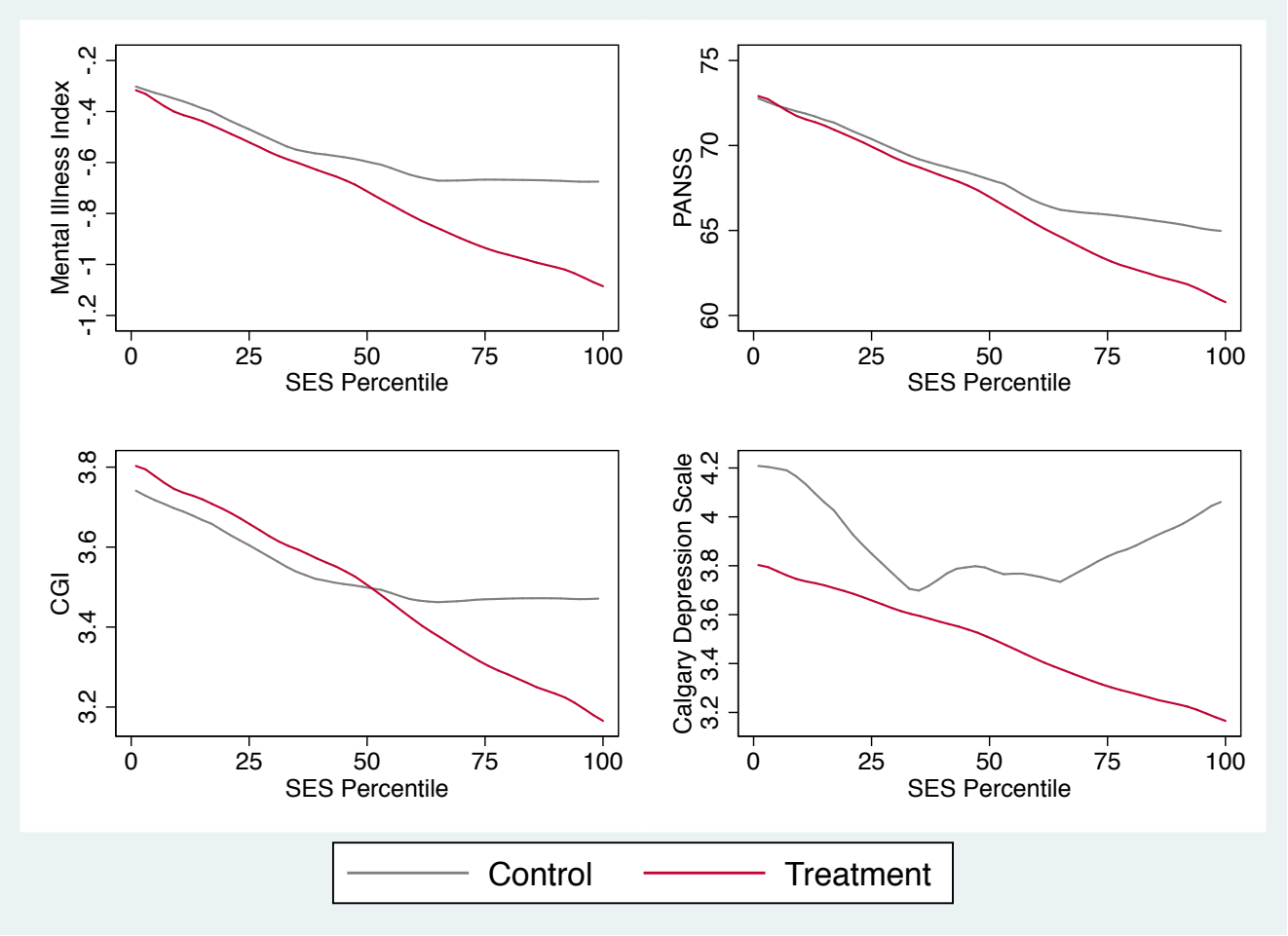


Figure 3: Heterogeneity by SES in the Impact of the Intervention

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