The Journal of Sociology & Social Welfare

Volume 39
Issue 3 *September*

Article 9

September 2012

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This study tests the geographic drift hypothesis that the negative SES-MI correlation results from individuals first developing conditions such as schizophrenia and then moving frequently because of their disability to low income and urban areas, and to neighborhoods with high concentrations of SMI persons. This is a secondary analysis of hospital records of 1,667,956 individuals in Massachusetts, USA, between 1994 and 2000. It employs a longitudinal cohort design and techniques of multi-level modeling. Downward geographic drift of those with schizophrenia was found to be small, but greater than other groups examined. The small level of drift was best explained by pre-existing socioeconomic conditions, and only secondarily by a diagnosis of schizophrenia, and this was true across a wide spectrum of diagnostic and demographic groups. Study hypotheses were largely supported, with downward drift confirmed, and with stronger evidence for low SES as a cause rather than a consequence of geographic drift.

Key words: *schizophrenia, residential mobility, geographic drift, socioeconomic status, social causation, social selection, population density, ghettoization*

For over 70 years now, an ongoing issue in the sociology of mental illness has been the debate between proponents of social causation and social selection explanations for the dramatically elevated rates of mental illness among those in the lowest income groups. Since the research of Faris and Dunham (1939), numerous studies have documented higher

rates of serious mental illness, especially schizophrenia, in low income, often inner city areas, and substantially lower rates in higher socioeconomic status (SES) areas. What has not been established are the primary reasons for these disparities. On one hand, proponents of social causation believe that unfavorable social conditions, such as unemployment, social stress, isolation, and lack of social support are central in the development of schizophrenia. On the other hand, advocates of social selection contend that schizophrenia is primarily an individual condition that develops as a result of genetic and other biological predispositions that only secondarily leads to low SES.

Theoretical Background

Theoretical perspectives on the selection–causation debate are rooted in and informed by an immense, yet slowly evolving body of research on the etiology of schizophrenia. Although theories that focus on strictly biological and psychosocial causes garner the most popular attention, there is continuing support for the stress-diathesis hypothesis—the idea that schizophrenia is caused by a genetic predisposition that is triggered by environmental and psychosocial stressors (Jones & Fernyhough, 2007; Portin & Alanen, 1998; Russo, Vitaliano, Brewer, Katon, & Becker, 1995). These stressors emerge at various developmental stages, and may involve such diverse conditions as prenatal environment, influenza, dysfunctional families, social labeling, and economic and social disenfranchisement. These have been alternatively hypothesized to lead to structural brain abnormalities, dysfunctions involving various neurotransmitters, and eventually a wide range of psychological and behavioral symptoms of schizophrenia such as social autism, tangential thought, hallucinations, and delusions. What have not been established are the relative salience of these conditions and the specific dynamics of their interactions.

It is recognized by many, based on genetic studies of monozygotic twins raised separately, that genes cannot account for more than 41% to 65% of the variation in susceptibility to schizophrenia (Cardno & Gottesman, 2000). Furthermore, there is no consensus on whether the inherited genetic vulnerabilities are externalized and manifested as dysfunctional

psychosocial patterns, or whether such patterns are internalized and manifested as dysfunctional psychological and neurological functioning.

The various theories of the etiology of schizophrenia, as noted above, undergird several major hypotheses regarding the negative correlation between rates of mental illness, including schizophrenia, and socioeconomic status (see Hudson, 1988, 2005). On one hand, the social stress hypothesis has several versions that involve economic stresses, e.g., unemployment (Brenner, 1973), poverty, noisome and stressful working conditions (Link, Dohrenwend, & Skodol, 1986; Link, Lennon, & Dohrenwend, 1993), etc.; cultural stress or shock (Parker, Klener, & Needelman, 1969), e.g., migration (Cantor-Graae & Selten, 2005), or family fragmentation and stresses (Kulka, Veroff, & Douvan, 1979), e.g., high levels of expressed emotion (Tanaka, Mino, & Inoue, 1995). In contrast, the social selection hypotheses propose that endogenous biological processes lead to either: (a) geographic downward drift, involving residential moves from higher to lower socioeconomic communities; (b) intergenerational social drift, typically involving the failure to attain the SES status of the family of origin; or (c) intragenerational drift, the decline from higher to lower SES status within an individual's adult years. Although evidence for the social selection hypothesis, and specifically the geographic drift version of it, is minimal for mental illness in general, there have been several studies that suggest that geographic drift may be more salient for schizophrenia (Dohrenwend et al., 1992; Loeffler & Haefner, 1999; Murphy, Olivier, Monson, & Sobol, 1991; Rodgers & Mann, 1993; Silverton & Mednick, 1984). However, even with schizophrenia there have been no consistent findings. Finally, there are some who propose that social causation and social drift may both be relevant either for the same individual in an interactive manner, or for different diagnostic or population groups.

The current study specifically focuses on geographic drift among those with schizophrenia, since it is in this arena that social selection finds some support, albeit rather weak. This study follows up on a broader test of the social causation and social selection theories that were recently conducted by Hudson (2005). The study reported here is unique in that it employs a longitudinal and multilevel design to track the

residential movement of individual patients over a seven year period between neighborhoods through a U.S. state. It is also one of the most extensive, since it uses a database of 1.7 million individuals from the state of Massachusetts in the United States, one which includes 22,810 patients diagnosed with schizophrenia in 45 different hospitals.

The purpose of this study is to test the geographic drift hypothesis for those with schizophrenia, one that suggests these individuals first develop this condition and then subsequently move frequently, ending up in low income and dense inner city areas, and in areas with high concentrations of other seriously mentally ill persons. This study aims not only to describe these patterns of movement, but to determine the degree to which they take place prior to or after the individual's first known hospitalization for schizophrenia, as well as the extent to which they can be accounted for by unfavorable pre-existing SES conditions.

Research Background

Research on residential mobility among those with schizophrenia has fallen into two broad areas. The first has been concerned with describing rates and patterns of mobility, but with little attention paid to specifically testing the geographic drift hypothesis. Related to this body of research are studies concerned with migration and immigration, and with observations about the clustering or ghettoization of seriously mentally ill (SMI) persons. The second line of research consists of more specific efforts to test the hypothesis that the negative SES-MI correlation can be accounted for by the downward social drift of people suffering from mental illness.

Descriptive Studies

Although a few studies have unexpectedly found that those with schizophrenia move less frequently than other SMI groups (Lessage & Tansella, 1989; Lix et al., 2007; McCarthy, Valenstein, & Blow, 2007), others report higher than average rates of mobility (Lix et al., 2007), as well as generally high rates of mobility within neighborhoods with many such persons (Silver, Mulvery, & Swanson, 2002). Those among this group who do move frequently are more likely to be young

and living in low income neighborhoods that are located in the central city. They are also more likely to have co-occurring substance use disorders than those who move only once (Lix et al., 2007). Similarly, Lix and his colleagues (2006) found that marital status, income quintile, and use of physicians are consistent determinants of mobility among the seriously mentally ill.

There have also been several qualitative studies with very small samples that have sought to explore the dynamics of residential and institutional mobility among the seriously mentally ill, and have focused on the phenomenon of "institutional cycling" as a coping mechanism of such persons and their caretakers when confronted with the dynamics of social control (DeVerteuil, 2003; Hopper, Jost, Hay, Welber, & Haugland, 1997). Hopper et al. (1997, p. 659), for instance, conclude on the basis of interviews with 36 homeless mentally ill individuals that, "Shelters and other custodial institutions have acquired hybrid functions that effectively substitute for more stable and appropriate housing for some persons with severe mental illness." Similarily, DeVerteuil (2003, p. 361) argues, on the basis of his interviews with 25 women in a Los Angeles shelter, that such churning or institutionalized cycling is essentially a new strategy for managing indigent populations on the part of resource-strapped service providers.

A related line of research shows relatively high rates of schizophrenia among migrants, particularly those in the second generation (Cantor-Graae & Selten, 2005; Cochrane & Bal, 1987; Malzberg & Lee, 1956). Yet, more in-depth analyses reveal that rates of schizophrenia among first generation migrants in receiving contexts are comparable to those in their countries of origin (Cooper, 2005). In addition, there is no evidence of selective immigration, or that people with schizophrenia are more likely to immigrate than others. This line of research has provided evidence, at least for people of African and African Caribbean origin, that social causation, involving the stresses and lack of social supports inherent in resettlement, plays a more central role than does differential selection into low-income social strata. An early review of this research questioned the broadness of the concept of migration and the assumption of "culture shock" as being useful for explaining variations of mental illness among migrant groups (Parker et al., 1969).

In perhaps one of the most seminal studies to date, Dohrenwend et al. (1992) conclude that it is unlikely that the higher risks of schizophrenia for migrants to Israel can be explained by their low socioeconomic status. Unlike the case with anxiety and the other disorders examined, these researchers found that the association between low socioeconomic status and schizophrenia was largely attributable to social selection rather than to social causation. In a recent review of the research on migration and mental health, Bhugra (2004) concludes that migration is a multifaceted phenomenon, that critical dimensions involve whether the migration is forced or voluntary, and whether it is undertaken individually or in group, and also argues that stresses and cultural clashes that confront the second generation account for many of the elevated rates of mental disorder among these groups.

A related area of study focuses on the geographic clustering of seriously mentally ill persons. These clusters have been variously referred to as psychiatric ghettos, service dependent population ghettos (Wolch, 1980), zones of dependence (Johnston, Gregory, & Smith, 1994), or the public city (Beamish, 1981). They are typically found in some declining parts of the inner city and are characterized by: (a) service-dependent and socially-marginal populations; (b) many mental health facilities; (c) and low-cost rental accommodations (Dear & Wolch, 1987). While there has been much speculation about the negative impacts of such clustering, a study of the phenomenon in Dunedin, New Zealand, found a decidedly mixed picture (Law & Gleeson, 1998). The researchers reported that although the concentration provided some economies of scale for services and a relatively benign environment for people with serious mental illness, the most detrimental aspects included its poverty, poor housing stock, and under-funded services.

As important as is the description of residential mobility of people with schizophrenia, including ghettoization, confirmation of these patterns leaves unanswered the question about whether such concentrations are the cause or consequence of schizophrenia and similar disorders. Mobility, clustering, and downward drift, although closely related, are largely independent phenomenon, and proving or disproving one such pattern says little for the question of downward geographic drift.

Studies with Positive Findings on Geographic Drift

During recent decades, there has been continuing research that supports the notion of social selection, specifically that downward geographic drift is an important dynamic that accounts for the negative SES-MI correlation. Some positive support for this idea has come from a study by Dembling, Rovnyak, Mackey, & Blank (2002) who examined geographic migration patterns of 11,725 state psychiatric patients in Virginia over the course of 18 years. They found that one third of their sample migrated between counties over the course of the hospitalizations, more often toward lower income communities. However, the statistical effect is more modest than is portrayed in the researchers' narrative, as only somewhat over half (56% to 59%) moved to communities with less favorable SES characteristics, and by how much cannot be determined from the published report.

Another research team (Rodgers & Mann, 1993) reanalyzed data from four earlier studies on intergenerational social mobility and found evidence for downward geographic drift, and that the failure to adequately control for differences in the cohorts of mentally ill and normal populations resulted in an underestimate of such drift in prior studies. Several studies (Loefler & Haefner, 1999; Munk & Mortensen, 1992; Murphy et al., 1991; Silverton & Mednick, 1984) have also reported evidence for social drift, even prior to first known hospitalization. Loeffler and Haefner (1999, p. 93), for instance, concluded that "the biography of schizophrenics shows that ... selective processes like downward drift or nonstarting processes, lead to the migration of schizophrenics into unfavourable areas or schizophrenic residents staying in poor areas, while healthy residents leave these districts." One of the most recent studies, conducted by DeVerteuil et al. (2007), compared the residential mobility of an urban cohort with schizophrenia with a matched cohort with no mental illness using secondary data sources, and concluded that those with schizophrenia were much more likely to move from the suburb to the inner city, and less likely to move from the inner city to the suburb, compared with those without a mental illness. Much of this research has been hamstrung with inadequate samples, lack of controls, or failure to document the actual magnitude of the purported drift.

Studies with Negative Findings on Geographic Drift

As weak as is the evidence that supports geographic drift, there are even fewer studies that contradict this hypothesis. One of the first was that of Lapouse et al. (1956) who examined the moves of patients with schizophrenia in a city for 20 years prior the onset of their schizophrenia. They concluded that these patients were initially concentrated in low-income neighborhoods, with negligible evidence of further downward drift. Their use of a control group revealed that others did not move up socioeconomically compared with those with schizophrenia.

More recent studies have also provided evidence for the idea that the concentration of persons with schizophrenia in the inner city is not simply a result of geographic drift, but instead reflects the socioeconomic status of their original areas of upbringing (Harrison et al., 2001). In a re-analysis of results from several earlier studies using log-linear models, Fox (1990) concluded that the earlier reported support for social drift was largely a methodological artifact. In addition, a recent Swedish study provides strong evidence that childhood social disadvantage is predictive of risk of schizophrenia (Hjern, Wicks, & Dalman, 2004).

Studies with Mixed Findings on Geographic Drift

Periodically researchers have investigated the possibility that both social causation and social selection, as manifested through downward geographic drift, best account for the observed socioeconomic disparities in the distribution of persons with schizophrenia. And it is not surprising that it is these studies that have had the most mixed findings. One of the earlier of these was that of Turner and Wagenfeld (1967, pp. 104-113) who found, using the Monroe County (NY) psychiatric register data, some evidence for minor effects of social causation, but stronger evidence that individuals with schizophrenia failed to replicate the social status of their families of origin. One of the most well-known of the early studies was that of Dauncey, Giggs, Baker, & Harrison (1993) who investigated the lifetime residential mobility of 67 patients with schizophrenia in the city of Nottingham beginning in 1978. Although they found some data suggest downward drift,

they interpreted their results to indicate that the disparate socioeconomic distribution started early in the lives of their patients and was largely set by the time of their first contact with mental health services. Other early studies with mixed findings include those of Kohn (1972), Dunham (1976), and Giggs and Cooper (1987), and as noted earlier, that of Dohrenwend et al. (1992).

Perhaps the largest study to date was one conducted by Hudson (2005), who undertook a longitudinal secondary analysis of a statewide database of patients who had been psychiatrically hospitalized in 45 psychiatric units throughout Massachusetts. Hudson tracked 34,000 patients between residential moves over the 7 years of the data collection (1993-2000) and examined changes in the socioeconomic conditions in their initial and final zipcode of residence. These data showed that within the seven years of this study there was only evidence of very slight levels of downward mobility for the psychiatric patients as a whole (14.5% experienced declines, compared with the 13.3% who saw increases), with the exception that there are data to suggest a slight tendency toward downward geographic drift among those with schizophrenia and neurosis. Of the 5,035 patients on psychiatric units with diagnoses of schizophrenia, 17.2% saw decreases in the SES of their home community (with a decreased SES z-score of .76), which was only slightly but significantly greater than the 15.2% who saw increases (with a mean increase in SES z = .68). However, because neither schizophrenia nor geographic drift were the central focus of this study, and sufficient statistical control for alternative explanations could not be used, the study leaves important questions unanswered regarding downward psychiatric drift of persons with schizophrenia.

In recent years an increasing number of researchers have introduced multilevel modeling to the effort to disaggregate neighborhood and personal predictors of the differential rates of serious mental illnesses, including schizophrenia. An initial review of this research, published by Allardyce and Boydell (2006) does, in fact, provide evidence in favor of the independent impact of impoverished community conditions over and above that of the low socioeconomic status of the afflicted individuals. The reviewers report that, "To date, there

are few examples of multilevel analyses in schizophrenia research; however, the small number of studies suggests that there may be a neighborhood social contextual effect that influences rates of schizophrenia and other psychotic disorders" (p. 592).

On the whole, research produced some support for the possibility that downward geographic drift is an important dynamic accounting for a portion of the negative SES correlation of socioeconomic status with those with the most severe mental disabilities, such as persons with schizophrenia. Yet, small samples, limited time frames, and diverse conceptualizations of mobility and downward drift, difficulties in disaggregating individual and neighborhood effects, as well as several studies that have contradicted the hypothesis, all call into serious question the salience of the geographic drift hypotheses. It is for this reason that the current study aims to address several of the limitations of past research, and to investigate the following questions and associated hypotheses:

What are the patterns of residential movement of patients with schizophrenia, in respect to the frequency and types of moves made? It is hypothesized that these moves, whether more or less frequent, will be to neighborhoods with greater population density, lower socioeconomic status, and greater concentrations of seriously mentally ill persons more often than the opposite.

To what extent does the phenomenon of geographic drift occur prior to first known psychiatric hospitalization for schizophrenia? To what extent is drift associated with age? It is hypothesized that, although downward geographic drift begins prior to first acute psychiatric hospitalization for schizophrenia, it will be accelerated following the first such hospitalization, and with advancing age.

To what extent do these moves account for socioeconomic disparities in the distribution of persons suffering from schizophrenia? It is furthermore hypothesized that downward drift will account for a portion, but not all the negative correlation between SES and MI for persons diagnosed with schizophrenia.

Can declines in residential socioeconomic conditions be attributed to characteristics of the individuals or to the communities that they live in? Finally, it is hypothesized that the extent of downward drift itself reflects pre-existing negative socioeconomic conditions to a greater extent than individual characteristics such as the diagnosis of schizophrenia.

Method

Overview

This is a longitudinal analysis of the experience of patients who were hospitalized in acute facilities during the seven year period from FY1994 to FY2000, with comparisons made between key subgroups of patients based on their ICD-9 diagnosis: (a) one or more diagnoses of schizophrenia; (b) no schizophrenic diagnoses, but other mental health diagnoses; and (c) medical diagnoses only (n = 1,667,956). A key feature of this study is that records of hospital episodes at the patient level are not duplicated, and individual patients are tracked between hospitals and communities. This is a multilevel study in that it models both levels and rates of change (slopes) of three dependent variables: (a) community socioeconomic status; (b) population density, as a proxy for urbanization; and (c) population rate of persons with serious mental illness among those with multiple hospitalizations, based on both individual predictors—particularly a diagnosis of schizophrenia —as well as characteristics of the community at first recorded hospitalization.

Sample

This research uses data collected as part of the Commonwealth of Massachusetts' Case Mix database, maintained by the state's Division of Health Care Finance and Policy (MDHCFP FY1994-FY2000), and is supplemented by data from the STF-3C file of the 2000 U.S. Census. This is a state-wide health reporting system in which all acute facilities in Massachusetts are mandated to submit a report on each discharged patient. While all 1,667,956 person-level records for the 1994-2000 period are initially included (including 22,810 with schizophrenia), only those patients with a known zip code of residence, as well as a uniform health identification number

(UHIN) were used to prevent duplication of the episode records. Of these, patients with two or more hospitalizations in each of a minimum of two years were selected to permit a sufficiently stable identification of changes in conditions in community of residence as patients moved around the state. This resulted in the final selection of 571,980 patients for the testing of the final models, of whom 11,220 had received a diagnosis of schizophrenia on one or more occasions during their period of hospitalization. Although this study has examined the experience of a substantial proportion of the Massachusetts population during the designated years, because of the necessary exclusions noted above, it remains a sample study, subject to sampling error. For this reason, appropriate inferential tests are reported.

Variables: Dependent

Three dependent variables were computed to evaluate changes in patients' living circumstances based on their zip codes of residence at the time of each hospitalization. These measure three different types of geographic drift and consist of changes in: (a) socioeconomic status of the home community (zip code of residence), based on STF-3C data from the 2000 U.S. Census on the educational, occupational, and income profile of the home zip code (this is presented in detail in an earlier study by Hudson in 2005); (b) community population density (persons per sq. mile) as a proxy for urbanization; and (c) mean proportion of seriously mentally ill adults, obtained from an earlier small area estimate study based on the 2002/2003 National Comorbidity Replication data (Hudson, 2009). An equation for the linear slope of the values for each patient with two or more hospitalizations in at least two separate years was computed to characterize the direction and rate of change in community SES, population density, and concentration of seriously mentally ill (SMI) persons. Other descriptive statistics, such as frequency of moves and average distance were also computed. Distances in miles between subsequent moves were derived by computing the straight-line Euclidian distance between the centroids of the successive home zip codes.

Variables: Predictors

A key person-level predictor is the diagnostic group, which was based on primary and secondary ICD-9 diagnoses that were dichotomously recorded (*1/0*) and then grouped into the following categories: (a) those with one or more diagnoses of schizophrenia; (b) those with other psychiatric diagnoses, but no diagnosis of schizophrenia; and (c) those with only medical and no psychiatric diagnoses during any of their hospitalizations, as well as standard demographic variables such as age, gender, race (*Caucasian, African-American, Hispanic, Asian-American,* and *Other*), and veteran's status. Also included as predictors were type of insurance at first hospitalization, characterized by three dummy variables (*1/0*): Any/none, Public/private, Managed care vs. fee-for-service, HMO/Non-HMO; and also, length of period of hospitalization and total hospital episodes.

Community-level predictors were computed for each patient residence at first known hospitalization (whether psychiatric or medical), and these include community SES, population density, and rate of SMI, parallel with the above noted drift variables. Other community-level predictors examined at point of first hospitalization were rate of individual poverty, unemployment, mean household income, housing affordability, and percent of population urbanized.

Data Reliability

Analyses of administrative datasets are often confronted with questions about data reliability, especially when such data are obtained through multiple sources. In this case, several studies have been conducted, both by Hudson, Dorwart, and Wieman (1998) and by the Division of Health Care Finance and Policy (MDHCFP, 1998), which provide evidence of the data's reliability in crucial areas. The reliability of the data on age, gender, and race were assessed by this researcher through an analysis of the consistency of these fields across multiple hospitalizations of the same individuals. These analyses demonstrated very high levels of reliability or inter-rater agreement among the three different facilities of a subgroup of patients with multiple hospitalizations within any three month time span. Agreement about gender, age, and racial affiliation were all very high, at 0.93 or above (MDHCFP, 1998). A similar

procedure was used to examine agreement between separate facilities as to patients' diagnoses. The resulting Kappa reliabilities range from the slight (0 - .19) to the substantial (.60 - .79). Substantial reliabilities were found for schizophrenia (.74) and senile/pre-senile organic psychosis (.67), and moderately strong reliabilities were found for affective disorders (.54), adjustment reaction (.48), and alcohol dependence (.59).

Regarding the information on the patient's insurer, MDHCFP published an analysis of these fields, comparing their own data with that of selected facilities and insurers, including Medicaid, for 1994 (MDHCFP, 1998). This analysis indicated a good to a very good level of agreement. In the case of Medicaid, there were precise matches in 69.4% of the cases.

Analysis

Preparatory steps for the analysis included the development of SPSS data files for each of the seven years, and the merging of these files into a single master file containing 5.2 million discharge records, based on a uniform health identifier number (UHIN), an encrypted social security number that links episodes of the same individual over the multiple years. For those 3.8 million episodes with both valid identifiers and zip codes, zip code-level data were merged so as to include data on socioeconomic status and other community-level characteristics for each episode, as well as computations of distances between subsequent communities.

After computing means or percentages for key variables for individual years for each patient, a file with 1,667,989 patients was generated that included flags for the diagnostic groups, the three primary dependent variables for up to seven years of hospitalizations, as well as the other variables. From these data, best-fitting linear slopes were computed, using a SPSS syntax file for each of the three dependent variables for each patient, as well as flagging variables on patients and community characteristics for the time of initial hospitalization. This was done both for the aggregate of the seven years, and in the case of the group of people with schizophrenia, it was also done separately for the years before first psychiatric hospitalization (medical-only episodes) and for years subsequent to initial psychiatric hospitalization.

To check if the three indicators of drift are sufficiently independent, correlations were computed between the three slopes and found to range from weak to minimally strong, specifically: change in SES and Population Density, -.28 ($p = .000$); SES and SMI rate, -.548 ($p < .000$); and Density and SMI rate, .608 ($p < .000$). Thus, although these indicators of downward drift are clearly related, they cannot be treated as a unitary process; downward drift clearly has alternative interpretations.

After computing descriptive statistics, including percentages, means, and zero-order correlations between key variables, and rescaling selected variables to a similar metric, predictive models of each of the three dependent variables—slope of community SES, density, and SMI rate—were estimated using the multilevel module in LISREL Version 8.8 using a randomly selected 50% calibration sample of the cases (n = 286,814). The initial step involved computing intercept-only models for each of these variables, and subsequent full models that included the fixed dichotomous predictors, and level 1 (person) and level 2 (community) predictors, including slopes. Each of these was then recomputed two to four times using a process of backward elimination of non-significant predictors. These full models were assessed by comparing their deviance statistics with the corresponding intercept-only model, as well as computing (using Excel) the intraclass correlation coefficients and the pseudo-R^2s (PRE) for both Level 1 and Level 2, based on formulae recommended by Luke (2004). In addition, each of the three full models, as well as their corresponding null models, were recomputed on the remaining validation sub-sample of 285,990 cases, with coefficients and deviance statistics reviewed for agreement between the two.

Results

The Sample

Data used in this study permit comparisons between those in Massachusetts who have been hospitalized on one or more occasions with diagnoses of schizophrenia (n = 22,810) with those hospitalized with other mental illnesses but no schizophrenia diagnoses (n = 368,408), or with no psychiatric diagnoses (n = 1,276,752), a sample that represents over a

quarter of the population of the state. Those suffering from schizophrenia have a similar mean age as the medical cohort (48.2 vs. 49.2) as the larger patient population, and are considerably younger than those with mental illness (MI), but no schizophrenia (56.6). However, variation in age among this group is substantially less, with only 1.2% under 18, compared with 5.6% of the medical population; and 22.8% were over 65, less than the 32.4% from among the latter group and the 43.3% in the MI group. Those with schizophrenia are evenly split between males and females (50.7% vs. 49.3%), in contrast to the disproportionate number of females among the regular MI population (56.6%) and especially, and those with solely medical diagnoses (65.3%). A disproportionate 9.3% of those with schizophrenia are African-American, compared with the 5.1% among the MI group and 5.4% among those with only medical hospitalizations. And not unexpectedly, those with schizophrenia live in lower SES communities (z = -.38 vs. -.31 and -.20), and more urbanized areas, with a mean population density of 6,630 persons per square mile, versus 4,954 and 4,498 for the other two groups. The communities of those with schizophrenia have a slightly higher proportion of total SMI adults (5.7%) than the communities of the MI (5.5). These diverse demographic and SES profiles could, in the end, account for differential patterns of downward drift, and for this reason results of tests for such a possibility will be reported in later sections of this article.

Hypothesis 1: Patterns of Residential Movement

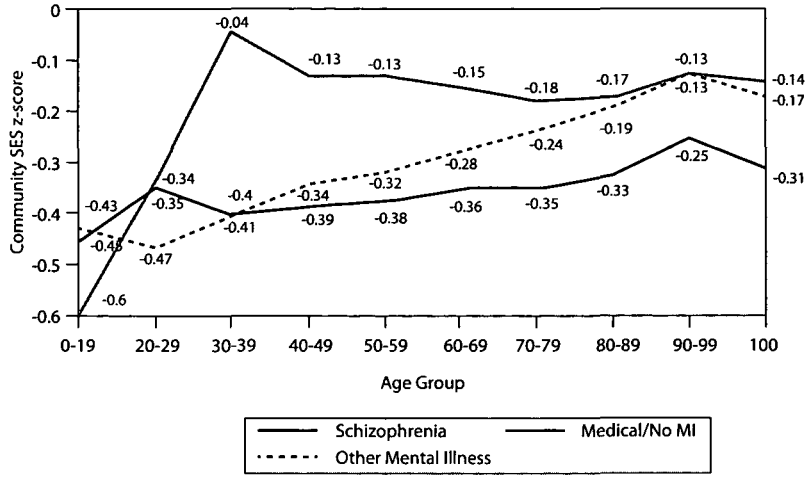
This study clearly supports the hypotheses that those with schizophrenia move more frequently and further than those with no schizophrenia, to communities with lower SES profiles, greater population density, and higher rates of seriously mentally ill persons. Those with schizophrenia moved a mean of .40 times a year, about 50% more often than other mentally ill persons (.27), and almost three times more often than those with no mental illnesses and only medical diagnoses (.15). Similarly, these moves were to locations at a mean of 3.9 miles away, compared with 2.6 and 1.5 miles for the two comparison groups.

In respect to the changes in the characteristics of these home communities, there are clear increases in the population density of their home communities, but only a slight increase in the community rate of SMI persons. For example, those with medical diagnoses only saw only a slight decline of -.016 in SES between moves; those in the MI group, about twice (-.029) the decline. Among those with schizophrenia—but prior to any hospitalization on a psychiatric unit—there was a -.035 annual decline, but after first psychiatric hospitalization, the rate peaks at -.063 per year. Because of the massive size of the sample, all of these changes are statistically significant at least the $p < .01$ level. The reader is cautioned that p-values and other inferential statistics reported in this study are used merely to assess generalizability, and should not be interpreted to imply effect sizes. Some highly 'significant' findings may possibly not represent meaningful correlations, differences, or effects simply because of the massive sample size. Thus, the reader is advised to critically consider the actual correlation or substantive effect size, independent of the p-value.

Hypothesis 2: The Question of Early Geographic Drift.

The descriptive statistics reported earlier support the second hypothesis of this study, that although downward drift begins prior to first known psychiatric hospitalization, it is accelerated subsequent to such hospitalization, in respect to declines in SES, increasing urbanization of place of residence, and increasing concentrations of seriously mentally ill persons. Whereas prior to acute psychiatric hospitalization, SES declined an average of .035 units a year, afterwards the decline accelerates to .063 units per year; similarly, the mean increase in density was 576 per year, subsequent to the first psychiatric hospitalization, the rate of increase goes up to 666 per year. The post-psychiatric hospitalization rate of increase of .006 in the SMI rate suggests that over a decade after such a hospitalization, the typical person afflicted with schizophrenia will have seen an increase of over 6% in the population rate of SMI persons in their home zip code, more than the national rate of 5.35% (Hudson, 2009). As was the case with the previous rates of change reported, each of these is significant at the $p < .01$ level or better.

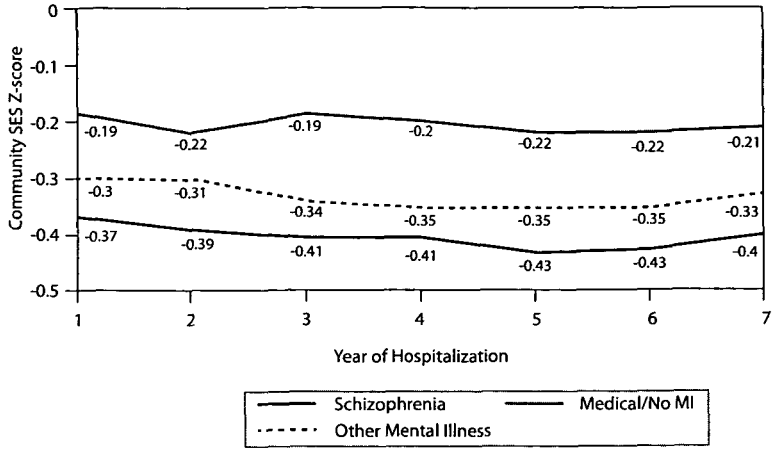
Figure 1. Changes in Initial Community SES,
By Age Decade and Diagnostic Group



Although the seven year period of the study is substantial, it is only a small portion of the typical life span. For this reason, two analyses were conducted of the relationship between age and downward drift. When mean levels of community SES, density, and SMI rates at first hospitalization are computed for the various age groups, as defined by decade, a consistent improvement is seen over the range of age cohorts in initial community of residence. Whereas the initial community SES was -.65 for those age 0-19, in the oldest group (100+) experiences a much less severe level at -.13; similarly, their mean urban population density declines from 6,335 to 4,379, and their community SMI rate declines from .061 to .051. However, due to wide variations, the zero-order correlations with age are negligible to small, although significant, with SES, at .087; density, at -.079; and SMI rate, at -.130 ($p < .000$). These analyses were then replicated separately with each of the three diagnostic subgroups, with the direction of changes and correlations found to be consistent across all three groups, including those with schizophrenia. However, the strength of the correlations between age and community characteristics for those with schizophrenia was at a negligible level, although significant (SES: $r = .022$, $p < .001$; Density: $r = -.023$, $p < .001$; SMI: $r = -.200$, $p < .003$). Figure 1 depicts increased levels of initial community SES, based on advancing age, for the three

diagnostic groups. Thus, no evidence has been uncovered for additional downward drift prior to or after the identified period of active hospitalization as captured in the primary analyses of this study.

Figure 2. Changes in Mean Community SES, By Diagnostic Group



Hypothesis 3: Impact of Geographic Drift on SES Disparities

This study examined the extent that residential moves increase the disparities in the distribution of persons with schizophrenia between low and high SES communities. Figure 2 shows a slight decline in mean community SES from an already low z score of -.37 for those with schizophrenia to a low of -.40 for those with six or more years of hospitalizations (lower line). Those with other types of mental illness—illustrated by the middle line—saw a decline from -.30 to -.33, and those with only medical causes of hospitalization lived in communities with only nominally low SES conditions (z = -.19), and saw very small declines by the end of the period examined, at -.21. Thus, although disparities in community SES increase on average the longer the period of hospitalizations, these declines only slightly increase the disparities evident at the start of the recorded history of these people's hospitalizations, beginning for many prior to any psychiatric hospitalization. These descriptive statistical indicators, thus, show that initial community conditions may play a more decisive role in accounting for the greater disparities in downward drift when the same patients are examined, more than the diagnosis of schizophrenia itself.

Table 1. Zero-order Correlations of Changes in Neighborhood Conditions (Slopes) with Selected Person and Community Predictors (N = 574,573)

Predictors	Rate of Change in Community Conditions of Patients*		
	Socio-economic Status	Population Density	Rate of SMI
Person-Level Predictors			
Gender [female = 0; male = 1]	-.011	.010	.017
Age	.041	-.020	.004
Race/Ethnicity			
Asian	-.004	.030	-.005
Black	-.081	.163[a]	.043
Caucasian	.107	-.157[a]	-.042
Hispanic/Latino	-.116[a]	.071	.043
Other	.016	.014	-.013
Diagnostic Group			
Schizophrenia	-.066	.108[a]	.145[a]
Other MI, no schizophrenia	-.056	.043	-.200[a]
Medical diagnosis only	.076	-.076	-.100[a]
Inital Community Conditions			
SES	.663[a]	-.105[a]	-.218[a]
Population density	-.119[a]	.556[a]	.097
Rate of SMI	-.588[a]	.210[a]	.242[a]
Other Inital Community Indicators			
Unemployment	-.356[a]	.225[a]	.156[a]
Percent urban	-.066	.180[a]	.032
Rent as % household income	-.107[a]	.161[a]	.061
Household income	.583[a]	-.219[a]	-.205[a]
Poverty	-.428[a]	.327[a]	.197[a]

Note: [a]non-negligible correlations (> .10). All correlations reported include all individuals who had two or more separate hospitalizations in at least two separate years; *p < .000 for all reported.

Hypothesis 4: Impact of Initial Community Conditions on Geographic Drift

Whereas the diagnosis of schizophrenia has only a negligible to weak zero-order correlation with the rate of decline in the recorded period of hospitalizations in community socioeconomic status (r = -.066; p < .000), population density (r = .108; p < .000), and rate of serious mental illness (r = -.145; p < .000), the conditions of the community that the patient lived in the first time he or she was hospitalized, had considerably stronger effects. The lower the initial SES, the more likely the patient would see further declines in SES (r = .663; p < .000), as well as increases in population density (r = -.119; p < .000) and rate of SMI (r = -.588; p < .000). Similar but somewhat less dramatic effects on SES were found when population density (r = -.105; p < .000) and rate of SMI (r = -.218; p < .000) were examined. Table 1 reports these zero-order correlations, with non-negligible coefficients (those above r = .10; p < .000) designated with superscript. A variety of other indicators of community conditions were also found to have substantial correlations with the patterns of change of the half million (n = 574,573) individuals with multiple hospitalizations over two or more separate years. However, a full test of the effects of initial conditions, along with diagnosis, requires multivariate statistical controls, and it is to these results that we will now turn.

To test for the simultaneous impact of the contributions of diagnosis and initial neighborhood conditions on the subsequent patterns of geographic drift, three multilevel models were estimated. These used patient demographics, type of insurance, and diagnosis as level 1 predictors, and initial community characteristics as level 2 predictors (see Table 2). Models were re-estimated after deletion of non-significant predictors, until all remaining coefficients were significant at the .05 level or better.

The two most powerful effects predictive of subsequent SES decline were the diagnosis of schizophrenia, associated with a -.0166 decline per year in SES, and initial community SES, a .0059 annual decline. Those with a diagnosis of schizophrenia had an average annual rate of decline of .017, greater than others during the period of their hospitalizations. This positive relationship with initial SES indicates that those who started out in well-to-do communities saw increases in SES,

Table 2. Full Multilevel Models of Changes in Community SES, Population Density, and SMI Rate (n=286,814)

Model Parameters	Rates of Change		
	Community SES	Population Density	SMI Adults
Fixed Coefficients			
Intercept[3]	0.0124	0.0159	0.0009
Diagnosis: Schizophrenia	-0.0166	-0.0039	-0.0002
Diagnosis: Other mental illness		-0.0311	-0.0026
Diagnosis: Medical prob. only		-0.0315	-0.0026
Insurance: Public		0.0006	0.0000
Insurance: None	-0.0007	0.0004	
Race: African American	-0.0022	0.0021	0.0001
Race: White		-0.0004	
Race: Hispanic	-0.0031	0.0015	0.0001
Number of Episodes	-0.0013	0.0025	0.0002
Span of Hospitalizations	-0.0020	0.0036	0.0005
Age	0.1200	-0.0600	-0.0100
Initial SES	0.0059		
Initial Population Density	21	619	
Initial SMI Rate			0.0061
Household Income	1,200	110	
*Random Coefficients** Level 1: Person Level (n=286,749)*			
Intercept[2,3]	0.0028	2.18E-03	7.67E-06
Number of Episodes[2]	0.0001	-1.40E-04	-3.94E-07
Span of Hospitalizations[2]	0.0001	6.00E-05	4.06E-07
Age[2]	0.0400	.0040	3.86E-05
Level 2: Community Level (n=497)			
Intercept[2,3]	0.0002	7.51E-07	2.43E-08
Initial SES[2]	0.0002		
Initial Density[2]	0.0000	.0290	
Initial SMI Rate[2]			5.86E-08
Household Income[2]	50	113	

NOTES: See table 6 for goodness-of-fit statistics. All solutions converged within 12 iterations. Predictors without any significant coefficient for any of the models were dropped, and model recomputed. These consisted of: Gender, Race (Asian/P.I. & Other), Insurance (HMO, Private, None), Housing Affordability, Vet Status, Poverty, and Unemployment. After estimation, coefficients for rescaled variables are reported in original scale.

[1] $p < .05$. All other parameters are significant at $p < .001$.

[2] Only variances, not covariances, of predictors are reported here for brevity.

[3] For the intercept only models, the following coefficients were computed for the intercept: Rate of Change in Community SES—fixed -0.0010; Person Level 0.0054, Community Level 0.0044; Rate of Change in Population Density—Fixed 0.0241, Person Level 0.0049; Community Level 0.0018; Rate of Change in Rate of SMI Adults—Fixed 0.0041, Person Level .0000, Community Level 1.2039E-06.

Table 3. Goodness-of-Fit Indices for Multilevel Models of Changes in Community SES, Population Density, and SMI Rate (n=286,814)

Model Parameters	Rates of Change		
	Community SES	Population Density	SMI Adults
Random Coefficients Level 1: Person Level			
Intraclass Correlation	.992	.995	.998
Pseudo-R^2 *	.871	.856	.774
Intercept Only Model			
Intraclass Correlation	.549	.735	.945
Level 2: Community Level			
Intraclass Correlation	.008	.005	.002
Pseudo-R^2 *	.995	.994	.997
Intercept Only Model			
Intraclass Correlation	.451	.265	.057
Goodness-of-Fit			
Deviance (-2LL): Calibration	-1,251,466	-1,354,125	-3,058,753
Deviance (-2LL): Test Data	-1,260,088	-1,350,948	-3,102,163
Free Parameters	30	30	24
Intercept Only Model			
Deviance (-2LL): Calibration	-680,455	-704,645	-2,291,563
Deviance (-2LL): Test Data	-689,118	-709,331	-2,299,035
Free Parameters	8	8	8

Notes: See table 5 for parameter estimates. All solutions converged within 12 iterations. Predictors without any significant coefficient for any of the models were dropped, and model recomputed. These consisted of: Gender, Race (Asian/P.I.), Insurance (HMO, Private, None), Vet Status, Poverty, Unemployment.
*Computed as a proportional reduction of error measure, comparing each full model to its corresponding null or intercept only model, based on formulas from: D.A. Luke. (2004). *Multilevel modeling* (pp. 35-37). [Sage University Paper 143].Thousand Oaks, CA: Sage Publications, . The n used in these formulae was the harmonic mean n for all second level units.

and those who came from poor areas saw further decreases in SES, an effect that adds to the tendency of a diagnosis of schizophrenia to be associated with declines.

For each standard deviation (z = 1.0) less in initial community SES, the patient would experienced about a 6% decline in SES over the course of a decade, with other factors held constant. In addition, the greater the patient's age, the more likely were they to see increases in community SES (***b*** = .12), a finding consistent with the previous bivariate analyses (see Figure 1). Contributions of a variety of other predictors were significant, but had negligible to minimal effects, indicating

that the pattern involving the simultaneous effects of SES and schizophrenia is generalizable across a variety of demographic groups.

Changes in levels of population density—a proxy indicator of urbanization—were most powerfully predicted by medical diagnosis (b = -.0315; $p < .000$) or by a non-schizophrenic mental illness (b = -.0311; $p < .000$). Movements to less urbanized areas are associated with non-medical diagnosis, more likely not involving schizophrenia, whereas there was only a slight effect of schizophrenia on causing movement to more urbanized areas (b = -.0039; $p < .000$). The single most powerful predictor was the patient's initial communities' level of urbanization (b = =619; $p < .000$), associated with moves to even more urbanized areas. Similarly, the most significant predictor of the tendency to move to areas with greater concentrations of SMI persons was also initial urbanization (b = .0061; $p < .000$), but neither this nor other predictors had substantial effects in explaining such patterns.

All three estimated models were evaluated through comparison with their corresponding null or intercept only equivalents, and in each case substantial decreases in the deviance statistic indicates improved fit with the combination of level one and level two predictors (see Table 3). Pseudo-R^2 (PRE) measures for levels 1 (individual) and 2 (community), for each of the three models indicate that the full model, which includes slopes of key predictors, as well as the fixed effects of dichotomous predictors, all brought about a very substantial proportionate reduction of error (PRE), compared with the corresponding null model, ranging from .77 to over .99.

Discussion

The results of this study confirm a modest level of downward geographic drift, but paradoxically minimize its origins in social selection. Specifically, these results show that the nominal level of geographic drift is primarily the result of low SES to begin with and is only minimally influenced by the diagnosis of schizophrenia. On one hand, downward geographic drift clearly takes place during periods of active hospitalization, more so for those with schizophrenia than for others. Yet, even for this population, downward drift is modest, such that

it does not substantially increase disparities in community socioeconomic conditions as schizophrenia progresses. But more important, the extent and speed of decline in socioeconomic circumstances is predicted more powerfully by the patients' initially poor community conditions than by the diagnosis of schizophrenia itself. Most important is the combination of the two that best explains the extent of downward geographic drift across a very wide spectrum of diagnostic, age, racial, gender, and other demographic groups in Massachusetts. In short, the rich grow richer and are able to move to higher SES areas; the poor are forced into even poorer areas, and this is particularly the case for those who suffer from schizophrenia.

One of the unique features of this study is that it has examined downward drift, not only in terms of socioeconomic conditions, but also in respect to urbanization and the geographic clustering of seriously mentally ill persons. Not unexpectedly, the study provides clear evidence of the propensity of persons with schizophrenia to move to denser or more urbanized areas. These are not necessarily poorer areas, but a positive correlation was found between moves to low SES and to urbanized areas. It may be that a greater availability of services in dense urban areas stimulates such moves, however, this interpretation is not supported by a negligible to slight tendency of this population to move areas of higher concentration of seriously mentally ill persons. It may be that the gentrification of many inner city areas, along with policies in Massachusetts aimed at dispersing group homes for the psychiatrically disabled, have in recent years minimized the ghettoization of the mentally ill as has been documented in previous decades.

Although this study examined the pre-psychiatric hospitalization period of those with schizophrenia, a limitation of this research which continues to be relevant here is that it has been only able to examine a maximum of seven years of hospitalizations for the same individuals. It could be that prior to any recorded hospitalization that the patients saw much more substantial downward drift. Yet, unexpectedly, controls for age show that the older the patient, the higher their community SES, the less urbanized their home community, and lower the concentration of SMI persons. In addition, the older the patient the greater was the rate of improvement for each of these characteristics of their home community, suggesting that the experience of the seven year period examined is most

likely not generalizable across the life span, and even that over the long run, there are improvements in community circumstances. However, this cannot be concluded definitively since the analyses of the impact of age covered different cohorts of individuals who have lived in varying historical periods.

As extensive as this study is, it nevertheless has a few additional limitations. It necessarily leaves out the experience of all those who have had fewer than two years of hospitalizations and the experience of those who move out of the state. Although it is possible that those who have been minimally hospitalized could experience greater socioeconomic declines than those who have been hospitalized more frequently, the assumption of this study has been that if downward geographic drift exists, it is most likely found among the most disabled who are generally hospitalized the most often. The sample employed in this study does not include those without zipcodes, specifically, the homeless, thus extreme changes in neighborhood SES involving homelessness in poor communities, as a beginning or ending 'residence,' will be underestimated.

Another limitation is that the full power of multi-level analytical algorithms could not be utilized in the current modeling. The two levels analyzed here—persons and communities —leave out the episodes level. Rates of change or slopes based on episodes were computed as a preparatory step to multilevel modeling, rather than as an integral part of it. This was done to minimize the intractability of modeling variations in changes in the 1.5 million episodes over the many individuals and communities involved. However, this is not a serious limitation since inferential tests based on the smaller sample sizes of individuals and communities, as was done in this study, make it less rather than more likely to detect significant effects. Even with the exclusion of the episode level, the study has more than sufficient statistical power to test the hypotheses of interest.

Another limitation is that this is a retrospective study that does not allow for experimental controls (e.g., random assignment of patients to diverse communities). Thus, it is entirely possible that unmeasured conditions may account for the effects that have been detected. Finally, it needs to be noted that the database used did not include direct measures for SES on the individual level, but only indirect proxy measures, such as type of insurance (i.e., none vs. some, public vs. private). These

are insufficiently reliable measures to permit examination of individual SES, and thus, the focus of this study has been on community SES, which in prior studies has often proven more salient than the individual indicators of SES (Allardyce & Boydell, 2006).

Perhaps the most important implication of these findings is that the socio-economic disadvantages of those with serious mental illnesses, such as schizophrenia, are not so much secondary complications of biologically-rooted disease processes, but instead, are integral in the early development of such conditions. It is not so much that people with schizophrenia are selectively excluded from favorable communities, but that the disadvantages inherent in low SES communities aggravates schizophrenia as well as the future residential opportunities for people with and without schizophrenia or other mental illnesses. This study shows that although geographic drift is commonly assumed to be a mechanism of social selection, its existence is actually more closely associated with processes of social causation. Unfavorable socioeconomic conditions are causally implicated in both the early stages of schizophrenia, as well as downward geographic drift, and thus, of processes of social disintegration.

Although the details of the dynamic processes in the early course of schizophrenia are yet to be fully elucidated, these findings highlight the importance of interventions on multiple systemic levels. Traditional mental health services, such as psychiatric hospitalization, psychotropic medications, and counseling, need to be carefully linked or integrated with socioeconomic supports, whether these involve supported housing, assisted employment, assisted education, or psychiatric and vocational rehabilitation. Community building, especially in low income areas with high concentrations of SMI persons, needs to supplement competency building efforts targeted to persons in need. Community building needs to happen in locales and programs of maximum need, such as inner city neighborhoods and psychiatric clubhouses, but attention also needs to be paid to community building in institutions such as middle and secondary schools and general hospitals where many persons exhibit the early manifestations of serious mental illnesses.

Acknowledgement: The Office of Academic Affairs, at Salem State University, kindly provided partial financial support for this project.

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