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Mental disorders and lifetime earnings

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ABSTRACT

Mental well-being of adolescents and young adults is gaining increased amount of attention. Yet little is known about lifetime labor market costs attributable to mental disorders nor the related heterogeneity by the age of onset of psychiatric conditions. This paper contributes by documenting the lifetime labor market performance deficits related to severe mental health-related problems. Using longitudinal socio-economic and health register data with a 50-year follow-up, I document that psychiatric admission history is associated with substantial losses in labor market performance which amount to 41% relative to control group. Age of first admission matters: having the first admission one year earlier than the affected controls is associated with 1% loss in lifetime earnings. Overall, results provide an economic rationale for early intervention in mental illnesses as deficits in the labor market are larger, the earlier first psychiatric admissions emerge.

JEL Classification: I10, J21, J31

Keywords: Mental disorders, Employment, Wage differentials

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1 Introduction

Mental disorders are detrimental to individuals affected but also costly for societies. Mental disorders are ranked the fourth leading cause of disability worldwide and the fifth in high-income income countries. In advanced countries, mental illnesses are increasingly becoming a greater concern for the well-being of adolescents and young adults. Mental disorders are the most common reason for disability ages below 35 and the share of disability-adjusted life years (DALY) attributable to mental and substance use disorders is increasing (GHDx database, 2019). The cost of mental ill-health in Europe is estimated to be 600 billion euro or around 4% of GDP. Around 40% of the estimated loss has been attributed to losses in work productivity (OECD, 2018). Survey-based studies have also documented negative association between depressive symptoms and educational attainment (McLeod and Kaiser, 2004), employment (Smith and Smith, 2010; Greve and Nielsen, 2013; Mousteri et al., 2019) and income (Ettner et al., 1997; Smith and Smith, 2010; Chatterji et al., 2007, 2011; Hakulinen et al., 2016, 2019a; Banerjee et al., 2017). However, there is a shortage of more elaborate estimates for the lifetime productivity losses of mental ill-health and economic consequences mental disorders by the age of onset (first psychiatric admission).

This study contributes to the prior literature by documenting the repercussions of mental disorders on labor market performance throughout the working life. The main purpose is to provide a set of estimates for work productivity losses associated with mental disorders. First, I ask how large are the deficits in labor market performance for those with a history of any psychiatric admission. As a second step, I examine more closely how much does age of first admission matter for lifetime work productivity. At this stage, I also discuss more closely to what extent premature loss in follow-up (death or emigration) affects the relationship between mental disorders and lifetime labor market performance. Additionally, I also investigate how much 'healthy" siblings, i.e. individuals who have no psychiatric admission history but one of their same-sex siblings have at least one recorded psychiatric admission, earn relative to comparable individuals with no identified family

history of psychiatric disorders.

I use rich Finnish administrative register data sources and examine how lifetime earnings differ between those that are treated for mental disorders (any mental disorders and its subcategories psychotic disorders, mood disorders and anxiety disorders) or alcohol-related problems and comparable unaffected individuals. The register-based approach using Finnish socio-economic and psychiatric admission panel data for years 1971-2019 has four major advantages. First, the dataset is large and comprises 266,000 individuals born 1951-1955 and covers their whole working age. Second, administratively collected data ensures that this study faces no considerable threat from attrition which is common in longitudinal survey studies in psychiatry (Allgulander, 1989; Haapea et al., 2008; Cheung et al., 2017) and that data consists of psychiatric admission information that has been evaluated to be high quality (Sund, 2012). Third, lifetime perspective minimizes biases related to shorter snapshots in follow-ups which might occur because association between current and lifetime earnings differ systematically by age (Haider and Solon, 2006) especially for women (Böhlmark and Lindquist, 2006) and because adolescent-onset psychiatric disorders are subject to relatively high mortality rates (Nordentoft et al., 2011) and delays in the first treatment contact since the onset of symptoms could be even decades in less severe cases (Wang et al., 2007). Thus, assuming that the expected lifetime earnings (or compensations to be exact) equal the expected lifetime worker productivity and that long psychiatric admission follow-up can capture the most severe psychiatric problems to a large extent, this study provides plausible estimates for lifetime losses in work productivity attributable to severe mental health problems.

While it is very challenging to assess the impact of mental disorders on labor market performance, it is important to learn from studies that can document the lifelong trajectories of labor market differences between mentally ill and healthier individuals. This information will help policymakers in their decisions of allocating scarce resources to psychiatric care and preventive medical care. This paper complements the scarce literature on mental disorders and long-term labor market outcomes which has mainly focused on most severe mental disorders such as schizophrenia. Hakulinen et al. (2019a) use Finnish

administrative data similar to the one used in this study. They find early-onset (ages 15-25) of severe mental disorders to have a substantial earnings deficit relative to other individuals and this tends to increase by age. Whereas the median earnings of the comparison group increase from 18 000 to 35 000 euro between ages 25 and 52, median total income of early-onset individuals is between 7 000-20 000 euro depending on diagnosis and age. Greve and Nielsen (2013) use Danish administrative records to study the link of psychiatric admission history with employment in adulthood. They find schizophrenia to severely hinder employment but also find the age of first schizophrenia admission to be negatively correlated with adulthood employment at age 35-45. The latter finding is at odds with vast psychiatric literature that documents positive correlation between the age of onset of psychiatric disorders and projected lifetime psychiatric risks. To clarify the relationship between age of onset and lifetime labor productivity, this paper provides a comprehensive documentation of age at first admission and labor market performance in different psychiatric diagnostic categories.

Relative to these studies, this paper extends the time frame and estimates the loss of work productivity related to in a wide spectrum of psychiatric disorders and thus aims to provide estimates that are relevant to policy-makers with long-sighted goals. I find that those who are treated for any mental disorder diagnosis earn about 41 percent less than individuals with psychiatric admission history. Early onset is especially damaging as those with a psychiatric admission before age 30 earn less than about 65 percent of the lifetime earnings of their unaffected peers. The labor market deficits are larger for men in both absolute and relative terms. Furthermore, the labor market deficit is not confined only to individuals with psychiatric admission, but also their ”healthy” siblings face a labor market deficit.

The rest of the paper is organized as follows. Section 2 briefly presents information on Finnish psychiatric services and the changes in the provision of the services in the recent decades. Section 3 presents the empirical framework. Section 4 describes the data and timeline of measurement and section 5 shows the main results. Section 6 discusses the results and section 7 concludes.

2 Institutional background

This paper studies the association between the age of the first psychiatric admission and lifetime earnings taking advantage of panel data from 1970 until 2019. The psychiatric admission data consists of both psychiatric hospitalizations and outpatient visits in specialized psychiatric care. To access psychiatric care, patients need a referral, typically given by a general practitioner working in a health center. Today, most of the psychiatric patients are treated in outpatient care. In 2018, less than 25 000 patients was treated in the inpatient ward for psychiatric causes, third of which involuntarily in treatment (THL, 2020). An additional 192 000 patients were treated in outpatient care. Financial barriers in seeking psychiatric treatment are non-existent or modest. In psychiatric outpatient clinics, the services are provided with free of charge but inpatient stays are accompanied with modest about 20 euro fee up to 7 days, after which the treatment is free.

The changes in the provision of psychiatric care have been dramatic since 1970. In the early 1970s, psychiatric health care system placed priority on inpatient care with almost 90% allocate to long-term care. In 1975, there were more than four mental hospital beds in Finland per 1000 inhabitants (Salokangas, 1994). Mental health acts implemented in Finland 1978 and 1991 aimed at dehospitalisation and improvements in outpatient care and rehabilitation. As a result, the majority of the mental hospital of the 1970s have been closed and the total amount mental hospital beds have decreased rapidly since early 1980s to 0.76 per 1000 inhabitants by 2000. Patients previously treated in hospitals, continued their treatment in community mental health centers (Salokangas, 1994).

In the early 1990s, psychiatry saw further changes in organization: the independent psychiatric organizations in district level ceased and psychiatric care was integrated in the general hospitals and the mental health policy was decentralized to local level. These changes were implemented during the time of deep recession in Finland. Although inpatient bed resources dropped dramatically, the number of patients did not. Treatment periods were just shortened and thus increased pressure for health service provision in the outpatient care. (Pylkkänen, 2012).

3 Empirical framework

3.1 The association between the ever-treated and never-treated

To estimate the association between severe mental disorders on lifetime earnings, I estimate the following equation

$$Y_i = \alpha D_i + \mathbf{X_{0i}}\beta + \varepsilon_i, \tag{1}$$

where Y_i is the lifetime labor market performance (earnings, income and total employment years) of an individual i observed 1970-2019 in 2019 prices. The treatment variable denoted by in D_i. D_i is a binary variable indicating whether an individual has a history of psychiatric admissions or alcohol-related admissions. X_{0i} includes a set of variables on individuals' background information from the Census 1970, at the start of follow-up. This variable set includes time-invariant characteristics (birth cohort, urban status 1970 and sex) for the study subjects and information on their parents' socio-economic background including household income (the total income of both parents) quartile within the subregion of origin and the residential subregion 1970 fixed effects. ε_i include unobserved characteristics.

History of psychiatric mental disorders is correlated with both observed and unobserved characteristics related to economically valuable traits. A body of literature suggests that mental disorders are correlated with personality traits and cognitive ability. For instance, a Swedish study exploiting conscription data finds that within-sibling differences in late adolescence (age 18) in mental conditions (assessed by Armed Forced Qualification test) are linked to 20 % decreased earnings adulthood but this is reduced by about 60% when cognitive and non-cognitive ability are controlled for (Lundborg et al., 2014). Thus it is reasonable to assume that economically valuable personality traits and cognitive ability are correlated with psychiatric symptoms and with adult labor market performance. Neglecting measures of cognitive and non-cognitive ability would produce likely

estimates that are biased downwards (away from zero). Consequently, α coefficients in equation 1 merely document the correlation between psychiatric history and lifetime labor market performance rather than providing a causal interpretation.

However, to mitigate the differences in background characteristics, I use three analytic subsamples of the full sample: i) high school (Finnish upper secondary school) sample, ii) sibling sample and iii) twin sample. In the high school sample, I use the information on the grade point average (GPA) measured at age 18 which works as a proxy for ability. However, this sample is particularly selective as schizophrenia is known to associate with cognitive deficiency especially among the ones with early-onset (Rajji et al., 2009), and thus the ones with most disabling conditions are less likely to attend high school and be included in this sample. The use of sibling and twin design aims to mitigate the confounding related to unobserved characteristics by reducing differences in genetic and growth environment between the treated and controls. Perhaps most notably, this design removes confounding related to family history with mental disorders. Although the sibling and twin fixed-effect strategies may be compelling over the usual comparison in the full sample, confounding remains nevertheless. As twins with the same treatment status (both untreated or treated pairs) are excluded, the twin fixed estimates stem from exposure-discordant pairs. The resulting comparison the discordant pairs will biased because the treatment status, here having a personal history of mental disorder, is far from random assignment. Thus focusing on siblings and twins does not remove bias but just results in a shift in the source of bias towards non-shared confounders once shared environment is leveled (Bound and Solon, 1999; Frisell et al., 2012).

Psychiatric literature has found that not only schizophrenia patients exhibit neuropsychological deficits but also their unaffected relatives. Genetic proximity to the affected individuals appears to be linked to the severity of the "healthy sibling" effect: among discordant twin pairs, the healthy monozygotic twin is more likely to be neuropsychologically impaired relative to the healthy monozygotic twin (Cannon et al., 2000). To investigate to what extent the healthy sibling phenomenon is present in this study, I use equation (1) but replace D_i with an indicator that which takes value 1 if a "healthy" indi-

vidual has at least one same-sex sibling with psychiatric admission history and value 0 if none of the same-sex siblings of a "healthy" individual have been recorded any psychiatric admissions.

3.2 The age at the first admission heterogeneity

To examine the linear association between the age at first psychiatric admission between on lifetime earnings, I add equation 1 with an interaction age at first admission and D_i and I estimate the following equation

$$Y_i = \alpha D_i + \gamma D_i \times AAFA_i + \tau AAFA_i + \mathbf{X_{0i}}\beta + \varepsilon_i, \tag{2}$$

where $AAFA_i$ is the age at the first admission of a given psychiatric diagnosis of an individual i observed 1970-2018. For the untreated the year of diagnosis is assigned randomly between the years 1971-2018. After this, the untreated are given the corresponding value of (placebo) age at first admission, $AAFA_i$ and finally this variable is centered at mean value. Here the main interest lies on the parameter γ. Psychiatric literature considers the age of onset to be related to the projected lifetime risk of a psychiatric condition (Kessler and Wang, 2008). Thus information on the age of onset has potential capturing heterogeneity in the lifetime work productivity within the group of admitted individuals. Because the information on the actual age of onset of the mental illness[1] is not available, I use the year of the first psychiatric admission as an indicative measure of the age of onset of a psychiatric disorder. Unlike the actual onset of a disorder, this measure is easily measurable but it can be preceded by years of untreated illness. Psychiatric literature suggests that the actual age of onset psychiatric disorders could occur 2-6 years before hospitalization in schizophrenia (Häfner et al., 1993). For the disorders of low severity and free of long-term disabilities, the treatment delays are longer (Narrow et al., 2002), even decades

[1]Here I refer to the age of onset as the age when the first symptoms of a disorder appear. For discussions on alternative criteria see de Girolamo et al. (2019).

(Wang et al., 2007) . Evidence suggests that treatment contact could be faster for mood disorders compared with anxiety disorders and that women seek treatment faster than men (Wang et al., 2007).

When studying the age at first admission heterogeneity, I assume that the differences in the first admission age roughly correspond to differences in the age of onset. Assuming equal timing difference between true onsets and first treatment contact and a duration of untreated illness of approximately three years, the difference in outcomes between two groups with age at the first admission 25 and 27 would then correspond roughly the differences in the outcomes of groups with the ages of onset 22 and 24. If this assumption holds, the absolute differences in age at first admissions are informative about absolute differences in the age of onset and the related differences in labor market outcomes.

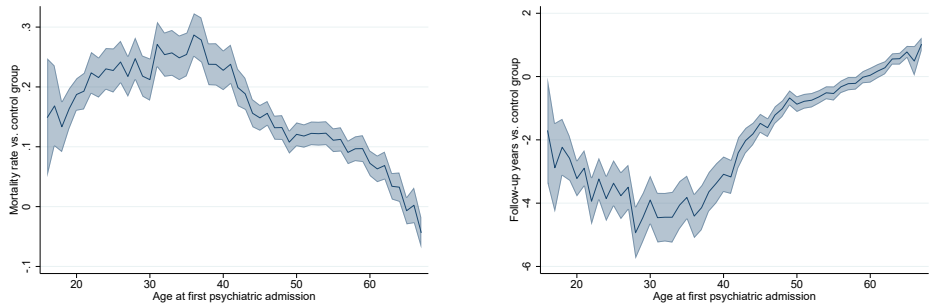
3.3 Controlling for differences in attrition

Psychiatric disorders are associated with high suicide rates especially during the first year after the first psychiatric admission (Nordentoft et al., 2011). The resulting attrition would lead upward biases in estimates of age of the first admission and lifetime labor market performance in studies that observe outcomes years or decades after the first treatment contact. This possibly explains why Greve and Nielsen (2013) find the age of first schizophrenia admission to be negatively correlated with employment at age 35-45. Another possibility is bias related to the period of measurement. If the later age admission occurs fairly near the year of measurement, the ongoing acute treatment may heavily affect current employment and thus provide a very contrasting picture between the contemporary employment and lifetime employment years. These caveats can be addressed by designing the data so that individuals could be followed from adolescence and early adulthood until their retirement age. Register-based approach is particularly useful for this data strategy because it allows larger dataset and avoids biases related to non-participation.

In this study, those who die or emigrate during the follow-up are not excluded from the study population, they just do not contribute to the income and employment measures during the years they are missing in the follow-up. This might lead to equations (1) and (2)

to produce greater differences between the treatment and group relative to contemporary comparisons that are estimated conditional on being alive and living in Finland. On the other hand, the imputation of missing data with zeros leads to upward biases for the late onset psychiatric admission cases because the first admissions at the end of the follow-up have a zero mortality rate whereas their counterparts with no psychiatric admissions have a positive mortality rate. To control for these biases, I supplement the equations (1) and (2) with control variable total years in the follow-up. Total years in follow-up is calculated by summing up the indicators of being alive and living in Finland during the measurement points.

Figure 1 visualizes the differences in all cause mortality and the total years in the follow-up by age at the first admission of the treatment group in comparison to the control group. The differences in the total follow-up years vary by the age of the first admission. Using the total follow-up years as a control variable adjusts estimates for the age of the first admission heterogeneity in both ends of the spectrum. Early-onset cases tend to be lost in follow-up early whereas the cases with their first admissions very near to the end



(A) All-cause mortality rate and age of first admission

(B) Total years in follow-up and age of first admission

Fig. 1: Visualization of differences in observed mortality and total follow-up years between the treated and control group by age of first admission (with 95% confidence intervals). Illustrations are based on estimating equation where response variable are indicator for all-cause mortality and total years in the follow-up and explanatory variables are indicators for the (placebo) age of first admission at age 16 to 67 and personal history of psychiatric admissions and their interaction.

of follow-up are by construction present near the end of follow-up. Thus individuals with a late onset of a psychiatric disorder are more likely to be present in the follow-up every year relative to controls with no psychiatric admission history.

Individuals with early-onset mental disorders are at a higher risk of premature mortality than comparable individuals with later onset. Adjusting for follow-up years provides the treated unaffected comparisons that spent an equally short period alive in Finland. The control group as a whole is less likely to die (while living in Finland) during the follow-up than the individuals with psychiatric admission history. Relative to the control group, the total length of follow-up is shorter in the early-onset group but longer for later onset (admission at age < 40) group. This is likely due to a higher rate of emigration of 'healthy individuals". This is confirmed by a casual data inspection of mortality rates in the population that is present for less than 20 years during 1971-2019: All-cause mortality rate is 90% among admitted and 53 % among the control group. On the other end of the first admission age spectrum, adjustments force the affected to be compared with "healthy individuals" that are present and alive near the end of follow-up and have never emigrated.

To sum up, the adjustment for follow-up years will provide the affected individual comparisons that have had an equal time frame to work in Finland. While this creates another type of selection problem, the benefit of this adjustment comes from the possibility of comparing lifetime estimates with the typically reported contemporary estimates which entail the condition of being alive and present in the administrative region in question.

4 Data

To document the relationship between personal psychiatric admission history and the lifetime earnings, I link three complete Finnish administrative data sets: i) census and longitudinal Employer-Employee Data covering the total population of Finland, ii) data on psychiatric hospital discharges , and iii) data on outpatient visits.

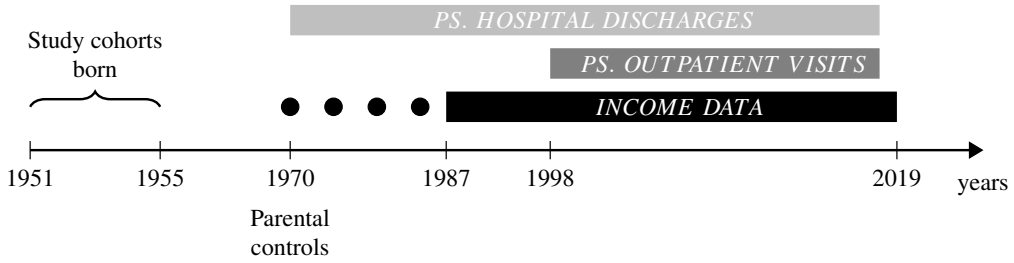


Fig. 2: Timeline of measurement

4.1 Timeline of measurement

I have access to panel data that contains socio-economic and health information on individuals born 1951-1955 from 1971 until 2019. The year 1971 is a natural starting point because high quality, population-wide Finnish administrative records on socio-economics, mortality and hospital admissions start at this stage. This study focuses on the Finnish birth cohorts of 1951-55 to ensure the good coverage of parental socio-economic information (at least 80 % rate of identification of both parents) and follow-up period that covers almost the entire working-age from late adolescence to retirement age. We focus on individuals who reside in Finland and live with their parents during Census 1970. This strategy allows for obtaining parental socioeconomic information for the study population. These conditions result in over 266,375 individuals at the start of the follow-up of which 237,442 ($\approx$ 89%) are alive and living in Finland at the end of follow-up in 2019. Individual-level socio-economic panel data is gathered from Statistics Finland and includes Finnish Census data for years 1970, 1975, 1980, 1985 and Finnish Linked Employer-Employee Data (FLEED) for years 1987-2019. I also have access to complete information on the psychiatric hospital admissions (The National Institute of Health and Welfare, THL) covering the years 1971-2018 and psychiatric outpatient visits 1998-2018. These admission data can be linked to the socio-economic information from Census and FLEED at the individual-level using personal identifiers. Figure 2 describes the timeline of measurement.

4.2 Outcome variables

Statistics Finland provides the Finnish longitudinal Census file 1970-1985 and annual Finnish Longitudinal Employer-Employee Data (FLEED) 1987-2019 which include annual taxable income (incl. labor income, entrepreneurial income, capital income, pensions, and benefits), labor income and entrepreneurial income, employment status, occupation, the municipality of residence, the highest education degree and a set of information related to family. This study focuses on earnings (the sum of labor income and entrepreneurial income) and employment as the main outcome variables which give the indication of the societal burden of mental disorders attributable to lost work input. However, there are some concerns in interpreting the earnings deficits as lost productivity. This so-called traditional "human capital approach" does not take account for the possibility of replacing an ill person with an unemployed worker. If this change would come with low "friction costs", the lost productivity would be overstated. However, mental illnesses may also cause "preseenteism", i.e. working at low productivity level while ill, which underestimate the productivity costs attributed to mental disorders (Drummond et al., 2015).

Income information comes from the Finnish Tax Administration and covers all people living in Finland during the administrative year. Annual income information has been linked to respective years of Census files and FLEED except for Census 1970 which includes income information about the year 1971. The Census was conducted every five years from 1970 to 1985. We, therefore, lack employment and income information for years 1972-74,1976-79,1981-84 and 1986. To compute estimates for lifetime labor market performance, I employ individual-level linear interpolation to cover the missing income and employment [2]. To account for inflation, I use consumer price index information from Statistics to convert all annual income in 1971 to 2019 to income to 2019 prices (euro).

The main outcome is earnings as it describes the best the difference in labor productivity. The alternative income measure, total taxable income, includes also capital

[2]This is done by imputing the missing years with an equaling the convex combination of the values from the nearest observed years. For instance, employment in the year 1977 is assigned a value $\frac{2}{5} * (employment_{1980} - employment_{1975}) + employment_{1975}$. If a person is employed in 1980 but not in 1975, year 1977 employment receives value 0.4

income, pension income, and benefits that arise from early pension schemes (e.g. disability pension) and employment and other social benefits (sickness allowance, parental leave). Analysis of taxable income will describe differences in income and thus help to explain financial differences rather than differences solely on labor productivity. The third outcome, total years employed, equals the total of annual binary employment indicators except for interpolated values that can also take values between 0 and 1.

4.3 Explanatory variables

The main explanatory variables are an indicator of any psychiatric admission (either inpatient stay or outpatient visit) and age at first admission. These variables derived from the complete psychiatric admission data and selecting first psychiatric admission and the corresponding primary diagnosis. There are a few concerns related to the choice of constructing the first psychiatric admission variable. First, psychiatric hospitalizations and outpatient visits are not substitutes. While psychiatric care in the 1970s heavily emphasized inpatient care, in the 1990s Finland shifted towards outpatient care. Therefore some of the first psychiatric admissions of lesser severity are not captured before 1998 when the register for specialized outpatient care commenced. Considering that the sample consists of individuals born in the early 1950's, their first psychiatric admissions consist of exclusively of inpatient stays until ages 43-47 after which first admission information could stem form either inpatient or outpatient care. However, focusing solely on hospitalizations would also discard many relevant psychiatric patients because the threshold of receiving psychiatric inpatient care has become substantially stricter since the 1970s. Second, both diagnostic practices and criteria have changed over time and thus evaluating trends within narrow diagnostic groups such as schizophrenia may be problematic (Salokangas et al., 2011). For instance, some retrospective re-evaluations have contested John Nash's schizophrenia diagnosis (Parker, 2015). Acknowledging the diagnostic caveats, the focus main focus in this paper will be on psychiatric disorders in general and secondly on relatively broad diagnostic subcategories.

Besides any mental disorders, I also study the labor market repercussions of three

broad psychiatric subcategories: psychotic disorders (or schizophrenia spectrum disorders), mood disorders and anxiety disorders. Alcohol-related admissions are also used as a complementary "exposure" variable although only part (i.e. alcoholic psychosis and alcoholism) of diagnosis set overlaps with any mental disorders. However, also other alcohol-related admissions, such as alcohol cirrhosis and diseases of pancreas, are relevant because alcohol abuse and dependence are often associated with other psychiatric conditions (Kessler et al., 1997). Early alcohol use initiation, alcohol-related injury, alcohol dependence are all connected (Hingson et al., 2000) and early alcohol dependence is associated with greater risk of psychiatric co-morbidity (Chen et al., 2011). This study focuses only on primary diagnoses because the quality of subsidiary diagnoses in Finnish Discharge Register has been considered poor (Sund, 2012). [3]. In determining the psychiatric subcategory of the first psychiatric admission I use the primary diagnosis of the first psychiatric admission. If an individual was given multiple psychiatric diagnoses during the first visit, I use the hierarchy of the diagnoses using the following structure: schizophrenia, mood disorder, anxiety disorder, and alcohol abuse.

Information on mental disorders is retrieved from THL (The National Institute of Health and Welfare) from a dataset that includes psychiatric hospital discharges covering the years 1971-2018 and outpatient visits in primary health care for the years 1998-2018. Because all Finnish psychiatric hospitals and outpatient facilities are public, all admissions and discharges are recorded in the registers during these periods. The admission data includes information on the dates of admission and discharge, and the diagnoses (primary and secondary) recorded by the doctor.

Table 1 displays the summary statistics of the cumulative incidence of any mental disorder in all analytic samples used in this study. Overall the incidence of any mental disorder related admissions is about 17 percent with men (18,2%) having a higher probability of psychiatric admission than women (15,4%). From the psychiatric subcategories, mood disorders (which include also bipolar and depressive disorders) is the largest cate-

[3]The ICD diagnoses used to construct the outcome measures are presented in Table S1 in the Appendix

Table 1: Cumulative incidence of mental disorder admissions by analytic sample and diagnosis

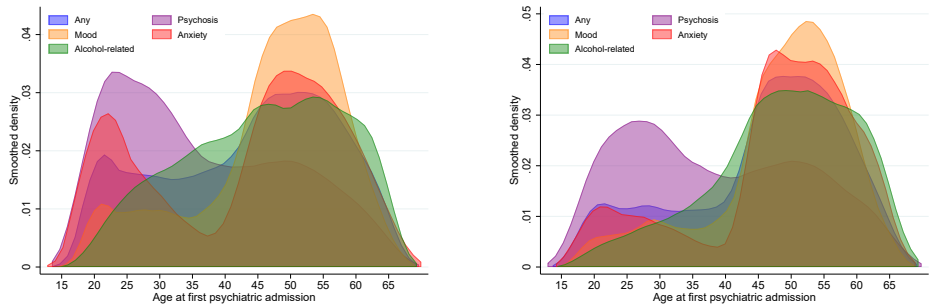
	Full sample		HS sample		Sibling sample		Twin sample	
Diagnosis	Male	Female	Male	Female	Male	Female	Male	Female
Any mental disorder	0.182	0.154	0.175	0.169	0.483	0.481	0.5	0.501
Psychotic disorder	0.0296	0.0314	0.0313	0.032	0.0802	0.101	0.0866	0.104
Mood disorder	0.0719	0.093	0.0864	0.107	0.179	0.285	0.186	0.304
Anxiety disorder	0.0379	0.0539	0.0433	0.0625	0.098	0.166	0.0887	0.175
Alcohol-related causes	0.0943	0.027	0.0668	0.0232	0.254	0.0841	0.258	0.0741
Observations	142640	123735	23009	34957	12379	8069	462	405

Notes: The table displays the cumulative incidences of mental disorder and alcohol-related admission by sex in all four analytical samples. Sibling and twin samples require within the same-sex sibling or twin pair (or other multiparity) variation in the lifetime incidence of psychiatric treatment. Inclusion to the full sample requires within-group variation in mental disorder status in cells stratified by the birth cohort, sex, subregion 1970, urban status 1970 and within subregion household income quartile. The high school (HS) sample further extends this by adding the requirement of an exact match by within subregion high school GPA quartiles.

gory in women and alcohol-related admission in men. Overall, men are more likely to be treated for mental health-related problems than women. The incidences in high school, sibling and twin samples reflect the sample inclusion criteria. In the sample where we include only individuals who graduated from upper secondary school (from now on high school), the differences between men and women are smaller. In the high school sample, the inclusion criteria of within cell variation in the full fixed effects specification (i.e. all control variables included) increases the cumulative psychiatric incidence compared with population averages. In the sibling and twin samples, it is required that the affected sibling (twin) has at least one same-sex sibling (twin) without psychiatric admission history. As I do not have access to information on the zygosity of twins, it is not possible to tell which twins are identical or which are not [4]

Mental disorders commonly emerge in adolescence and often persist into adulthood

[4]However, using the fact the monozygotic twins are always of the same-sex, one could compute indicative information on zygosity in discordant twin pairs. The share of female-male pairs within discordant twin pairs is 43,9% whereas for non-discordant (twins both unaffected or both affected) pairs sex-mix share is 39,5%. As the discordant pairs are slightly more likely to be of different sex, I presume that the analytic twin sample that includes only discordant pairs is more likely to include more dizygotic twin pairs than monozygotic twin pairs.



(A) Men (B) Women

Fig. 3: Smoothed density of first admission age by diagnosis for men and women.

(Kessler et al., 2005; Patton et al., 2014). Psychiatric research suggests that the great majority of all lifetime cases of psychiatric disorders start by age 24 (Kessler et al., 2005). For the analytic sample used in this study, however, the psychiatric admission data produces the mean age of treatment is about 44 years. There two notable reasons for the disparity between the typical age of onset and age at first admission observed in this dataset. First, it is widely acknowledged that there may be considerable delays between the actual age of onset and first admission. The duration of untreated illness is typically the shortest for the most disabling conditions, such as schizophrenia, and may be even decades in less severe cases. Second, as outpatient care data kicked in 1998, the share of the first admissions in mood and anxiety disorders increase considerably at ages 40-50 as seen in Figure 3. Furthermore, one can observe a few differences between men and women in the first admission age distributions. Psychotic disorders are relatively common in early-onset mental disorders especially for men. Psychotic disorders often treated in inpatient care patients which is why there is no substantial change in the distribution when outpatient care data is included. Inclusion of outpatient care data produces additional first admission observations especially for women in all diagnostic groups except for psychosis.

Table 2 displays background characteristics at the start of follow-up by treatment status. Treatment status is given value 1 is an individual has recorded at least one psychiatric

Table 2: Sample characteristics by lifetime psychiatric admission status sample in all analytic samples

	Full sample		HS sample		Sibling sample		Twin sample	
	Not admitted	Admitted	Not admitted	Admitted	Not admitted	Admitted	Not admitted	Admitted
Finnish-speaker (%)	94.0	96.1	93.4	96.6	97.1	96.0	94.4	96.0
Swedish-speaker (%)	5.9	3.8	6.5	3.3	2.8	3.9	5.3	3.9
Female (%)	0.473	0.423	0.605	0.594	0.395	0.394	0.467	0.468
Employed in 1970 (%)	0.289	0.33	0.303	0.359	0.359	0.366	0.356	0.369
Income in 1971	382	404	161	157	438	425	417	421
Urban status 1970 (%)	0.487	0.504	0.688	0.597	0.474	0.474	0.483	0.484
High school degree (%)	0.313	0.229	1	1	0.232	0.2	0.212	0.205
All-cause mortality 1971-2019	0.0666	0.221	0.0385	0.142	0.0949	0.237	0.115	0.24
Years in follow-up	47.7	45.9	47.9	47	47.1	45.6	46.6	45.9
Parent information 1970								
HH total income in 1971	3289	3054	5312	4667	2951	2969	2878	2870
House owner	0.782	0.751	0.74	0.739	0.766	0.762	0.792	0.793
Father's education (%)								
Primary	0.795	0.816	0.563	0.606	0.831	0.831	0.82	0.82
Upper secondary	0.0988	0.0911	0.139	0.136	0.0886	0.0872	0.102	0.101
Lower tertiary	0.0493	0.0444	0.113	0.0982	0.0366	0.0371	0.0277	0.0276
University	0.0565	0.0487	0.184	0.159	0.0437	0.0447	0.0508	0.0507
Observations	221317	45063	48013	9953	10585	9863	433	433

Notes:Sample characteristics of the treated and control group in all four analytical samples. Sibling and twin samples require discordance between same-sex siblings or twin pairs (or other multiparity) in lifetime incidence of psychiatric admissions. Inclusion to full sample requires within cell variation in mental disorder status by birth cohort, sex, subregion 1970, urban status 1970 and within subregion household income quartile. The high school (HS) sample further extends this by adding a requirement of an exact match by within subregion high school GPA quartiles.

admission during the follow-up period and value 0 otherwise. The study sample is ethnically very homogeneous: only 0.1 percent of the study sample have other than Finnish or Swedish as their mother tongue (only 0.2 percent are born abroad). This is partially due to restrictions related to birth year and being present at the start of follow-up. Among the natives, Swedish speakers are less likely to be admitted to psychiatric treatment. The treated are more likely to have been born in urban areas. They are also more likely to be men and in the working population at age 15-19, and less likely to have attended high school. The treated are more likely to die during the follow-up. The parents of the affected have lower total earnings in 1970 and the father is less likely to have a tertiary education.

Those that have a history of psychiatric admission are highly likely to have predisposed psychiatric condition years before the first contact. This is likely to show as divergence in school and labor market performance before the actual psychiatric event. The

probability of attending high school among the discordant twins highlights this. The treated twin is about 2 percentage points less likely to finish high school relative to the "healthy twin". To a large extent, sibling and twin samples balance the sample concerning parental characteristics but there are minor differences because I allow same-sex siblings and twin comparisons to include more than two siblings. The main analyses are conducted using only time-invariant background characteristics observed at the start of follow-up as the control variables. In the second sample, the high school sample, I only include those who have finished high school and for whom I have access to information on the grade point average. I use this information to compute relative grade point average (GPA) at subregion-level, and use it as a proxy for within subregion differences in cognitive ability. I use relative school performance within the region of origin is instead of absolute performance to account for region-specific grading assessment, and to account for the fact that relative performance may be more correlated with well-being within regions as opposed to performance relative to peers in more distant regions.

5 Results

5.1 Psychiatric history and labor market performance

Figure 4 reports the associations between psychiatric admissions and lifetime income in absolute and relative terms for all four analytic samples by the diagnosis category of the first admission. The first column displays the point estimates for the lifetime income differences between the treated relative and the control group without controlling for background characteristics. The individuals with no psychiatric admission history, the estimates for lifetime earnings, taxable income and employment years are 1.1 million euro, 1.4 million euro and 32.3 years. Relative to the healthy controls, those who are treated for any psychiatric reason earn 41 percent less (-0,46 million euro) during lifetime relative to the control group. Adjusting for the socio-economic background and the total years in follow-up reduces this estimate to 37 percent (-0,41 million euro). When looking at

the high school sample which adds a control variable on relative school performance, the relative deficit reduces to 33 percent. Same-sex sibling and twin fixed effect estimates that aim to mitigate the role of differences in the living environment between subjects, produce

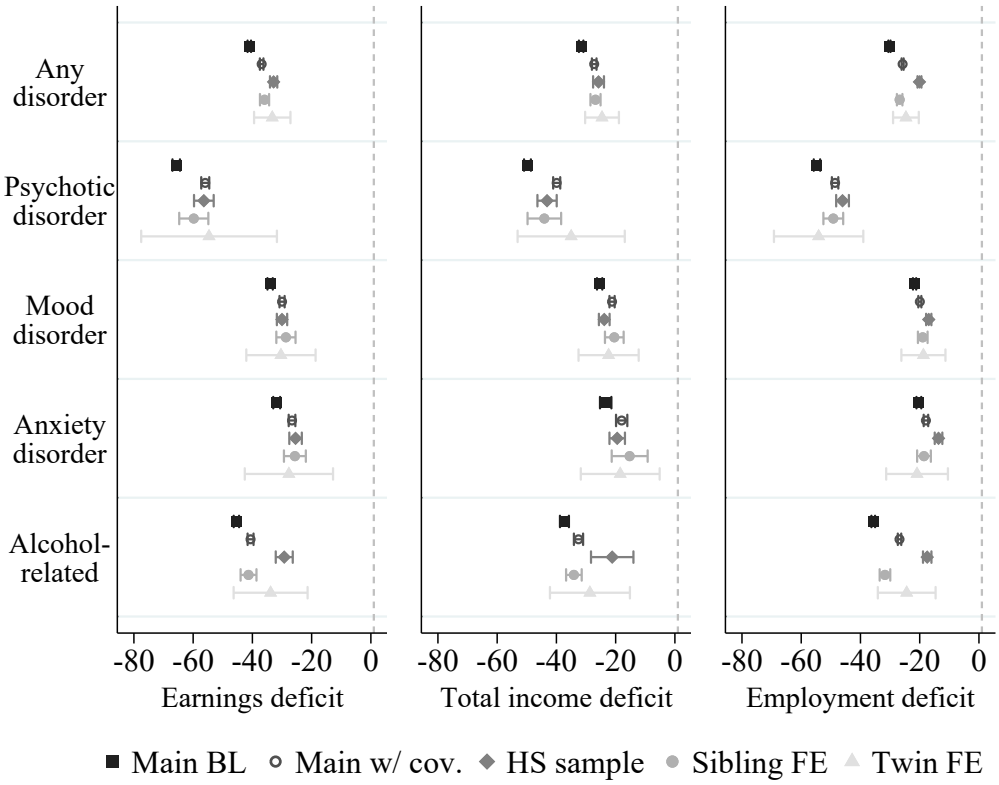


Fig. 4: Psychiatric admission history and the deficit in lifetime labor market performance. The average marginal effects (with 95% confidence intervals) of psychiatric admission on lifetime earnings, total income and years of employment converted to percentage points. The first specification uses the main sample without control variables, the second includes controls variables that include number of follow-up years, subregion 1970 fixed effects, relative household earnings in 1970 (within subregion 1970), birth cohort and sex. In the third specification the comparison is conducted between high school graduates and it includes the full set of control variables and adds local relative grade point average (standard deviations from the mean) as a control variable. Fourth and fifth specifications consist of same-sex sibling and twin fixed effect estimates. See Tables S2 to S4 for the corresponding estimates in table format.

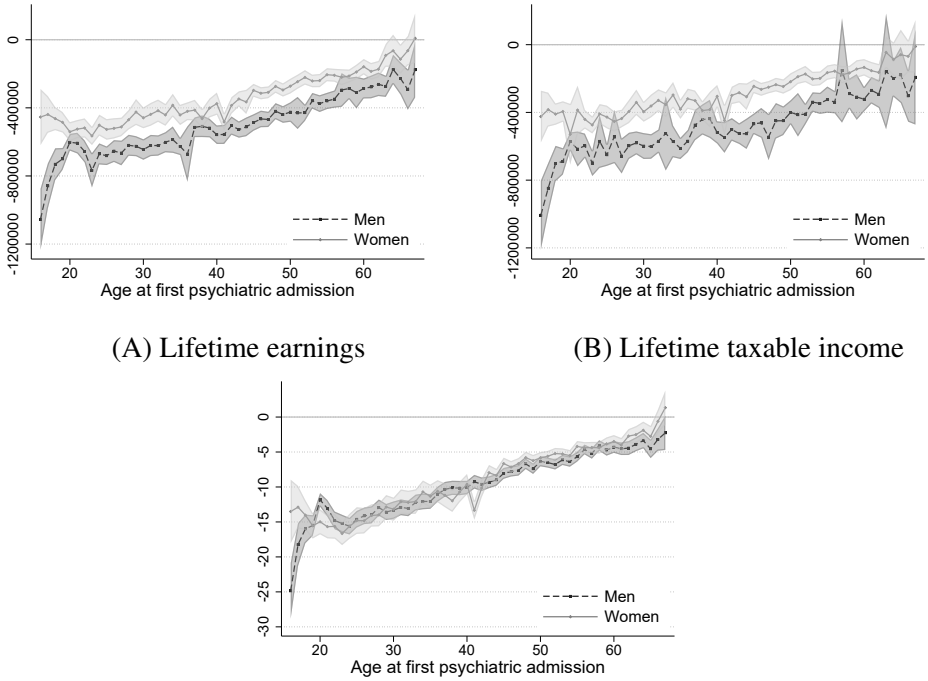
point estimates that are around the same ballpark with full sample and high school sample estimates.

Lifetime earnings disparity is the largest for the psychosis (incl. schizophrenia) admissions (unadjusted -66%, adjusted -56% in the main sample). For mood and anxiety disorders the corresponding estimates are -34 % (-30 %) and -32 % (-27 %). Earnings differences in alcohol-related admissions are larger (-45 %, -41 %) than in any mental disorders. All estimates have a p-value below 0.05.

Both in relative and absolute magnitudes, the labor market deficits are smaller in lifetime taxable income (on average 10pp. smaller deficit) than in earnings (Table S3). This is in line with recent evidence that finds that income transfers cushion against financial consequences in psychiatric admission in Finland (Hakulinen et al., 2019b). A major part of the differences in income due to decreases in employment. Those with psychiatric admission history work approximately 30% (9.8 years) less than their comparisons. When adjusted for background characteristics and length of follow-up the deficits reduces to 26% (8.3 years). In psychotic conditions, the deficit is the largest (unadj. -55%, adjusted -49%) whereas in mood (unadj. -22%, adjusted -20%) and anxiety disorders (unadj. -20%, adjusted -18%) the deficit is smaller (Table S4). The relative deficits are greater in lifetime earnings than working career length. This suggests that people with mental disorders do not only work less but also work in less lucrative occupations during their working careers. This is not surprising as a considerably smaller fraction of the treated individuals went to high school relative to "healthier" controls.

Both the relative and absolute deficits lifetime labor market outcome are greater for men (unadjusted -0,57 million euro (-44%), adjusted -0,48 million euro (-38%)) than for women (unadjusted -0,33 million euro (-35%), adjusted -0,31 million euro (-33%)). This reflects the fact women born in the 1950s worked less lucrative occupations than men and thus psychiatric conditions cause larger absolute deficit in income for men. In employment the difference are smaller: the unadjusted deficit for men is -33% (-11 years) and for women -26% (-8.4 years) whereas after covariate adjustment the estimates reduce to -27% (-8.7 years) for men and -24% (-7.6 years) for women. A more complete comparison of

the outcomes between men and women is provided in the Appendix (Tables S5-S10 and Figures S4-S6).



(A) Lifetime earnings

(B) Lifetime taxable income

(C) Lifetime employment years

Fig. 5: The age of first admission and the labor market deficits. Graphs refer to nonparametric estimates for the association of age of the first admission and the deficit in labor market performance (with 95% confidence intervals) between the treated and control group. Estimating equation departs from equation 2 by using integer-valued age at first admission ($AAFA_i$)as categorical variables instead of using continuous $AAFA_i$. Those who have no psychiatric admission history are randomly assigned with year of first admission and the corresponding age of the first admission between ages 16-67. The control variable set includes total years in follow-up, sex, urban status 1970 and childhood subregion, birth cohort and parental income quartile fixed effects.

5.2 Age at first psychiatric admission and labor market performance

Age of the first admission matters. Figure 5 visualizes of the nonparametric regression specification on the age of first admission and labor market performance for men and women. The graph indicates a roughly linear the link between the first admission age and labor market performance for both men and women. When fixing age at first admission, the employment deficits are by and large very similar between men and women with the exception of early-onset ages. In lifetime earnings and taxable income, there is a notable difference between men and women. In the following, I focus on a pooled sample with presenting the results for both men and women separately for brevity. I examine the link using linear interaction with the age of the first admission (as continuous variable) and an indicator of any mental disorder with the first admission age following equation 2. The resulting estimates suggest that a one-year reduction in the age of onset is associated with about 13 000 euro loss in lifetime earnings (Table S11). This reduces to 10 000 euro when follow-up years and other background characteristics are controlled for. In relative terms one-year reduction in the age of onset is associated with 1% deficit in lifetime earnings relative to the control group. For psychotic and mood disorders one year earlier admission is associated with the loss of 11 000 euro (adjusted estimates 10 000 and 9 000 euro). In anxiety disorders and alcohol-related causes, the losses are 9 000 euro (9 500 euro) and 16 000 euro (9 000 euro). These losses are greater for those who attended high school and fairly similar in the sibling design. Twin design suffers from low statistical power for the reliable examination of age heterogeneity in the labor market performance. To a large extent, the absolute estimates are similar for lifetime taxable income but smaller in relative terms (Table S12). For employment, one year earlier psychiatric admission is associated with the loss of 0.38 years (adj. 0.29 years). This is roughly 1% of the working career length of the control group. First admission age heterogeneity is similar in psychotic disorders and somewhat smaller mood (unadj. 0.33 , adj. 0.25) and anxiety disorders (unadj. 0.27, adj. 0.23). In alcohol-related admissions, the change in the estimates is

relatively large when controlling for background characteristics (unadj. 0.40, adj. 0.22) (Table S13).

Without adjusting for the time in follow-up, estimates for labor market deficits are larger for both men and women especially in early-onset mental disorders (see (Figures S1 to S3 in the Appendix). This is because individuals early age admissions have higher rates of mortality relative to later age admissions. On the other end of the spectrum, the non-adjustments may result in upward bias. When analyzing the age at first admission heterogeneity, the adjustments result in a more conservative estimates relative to the unadjusted specifications.

Overall, I find that earnings and employment disparity decreases by later admission age and this link roughly linear both with and without adjustments for control variables. This finding is consistent with the insight from psychiatric literature on the age of onset being a strong determinant of severity of psychiatric disorder.

5.3 Healthy sibling deficit

The risk of psychiatric disorders is correlated within families. Studies on schizophrenia have found that for the affected families the relative risk of schizophrenia can be 11 times the risk of a matched control group (Arajärvi et al., 2006). However, not all neuropsychological deficits are identified from the register data and therefore family-related risks might predict labor market performance even for those with no recorded mental disorders. Figure 6 presents the differences in the lifetime labor market performance between the healthy siblings and individuals with the similar background but without psychiatric admission history among siblings. I find that "healthy" sibling earns 8% (adj. 6%) less in both earnings over the lifetime and works about 1.5 (1.1) year less than unaffected comparison (see Table S14). Surprisingly, the disparity is about the same for psychotic disorders (earnings -10 % & -6 and employment -1.9 & -1.4 years) but larger for alcohol-related admissions in earnings (-13 % (-10)) and smaller in mood or anxiety disorders. Comparisons between same-sex twins provide similar results with one notable exception: "healthy twin" affected with a psychotic same-sex twin earns about 18 percent less (-16%)

than comparable unaffected twins. This finding is in line with the findings in psychiatric literature on healthy siblings and neuropsychological deficits which suggest that healthy sibling effect increases in genetic proximity. Since there are substantially smaller differences in lifetime employment years, results indicate that the deficit is driven mostly by selection in the job market.

As discussed above, psychotic patients often suffer from cognitive deficits that can affect labor market choices and opportunities. Besides cognitive deficits, there might be some underlying predispositions linked to personality traits that can affect career prospects. Furthermore, the parental time investments can matter. Akee et al. (2018) investigated the effects of income transfers to Indian tribal households and found that cash transfers re-

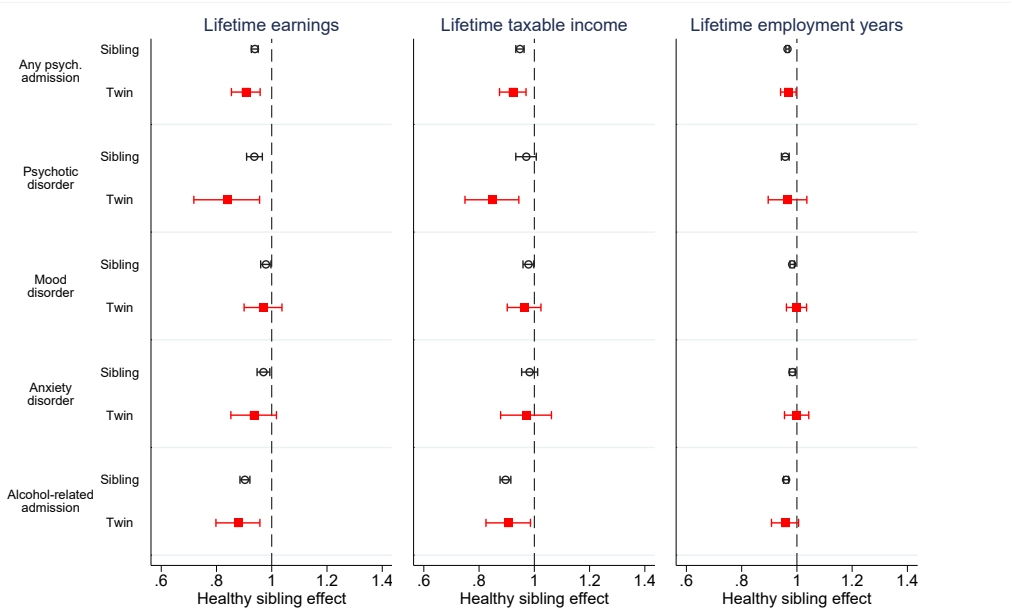


Fig. 6: Healthy sibling effects. Point estimates (with 95 % confidence intervals) refer to relative lifetime labor market performance of healthy individuals who have a sibling with psychiatric admission history vs. healthy individuals with healthy siblings. The point estimates stem from a specification that includes the full set of background characteristics: sex, birth year, subregion 1970 fixed effects, relative household earnings (parents), the urban status of residence and total years in the follow-up. Table S14 in the Appendix presents the corresponding point estimates.

sulted in increased parental investment on the children whose mental health worse than siblings'. However, Yi et al. (2015) fin that parents invest more in health of the children who experience a health shock but less educational investments relative to healthy siblings. In Finland, the education system is to a large extent free or subject to very small tuition fees and the investment that reinforce the initial differences are likely to stem from time investments. While parental investments may play a role, the differences in the healthy effects between the sibling and twin samples are supported by prior findings in psychiatry on the positive association between neuropsychological deficits and genetic proximity.

6 Discussion

This paper provides two results that should be emphasized. First, relative to healthy comparisons, the lifetime earnings differences are the greater the earlier first psychiatric admission occurs. This finding is consistent with psychiatric literature that has documented early-onset (vs late-onset) of mental disorders associated with deficiencies in cognitive processes, occupational functioning and severity of mental illness throughout the life course. This underlines the need for shifting resources to the prevention and early intervention of mental disorders to increase well-being in adulthood and decrease the societal burden linked to mental disorders. Furthermore, increased attention should be placed on securing a smooth transition of mental health services from adolescent services to adulthood, a process that is often overlooked and which is commonly creating disruption among the most severely ill individuals (Singh et al., 2010). As the age of the first admission correlates almost linearly within differential lifetime work productivity at the brink of adulthood, there is no economic rationale for concurrent discontinuities in mental health service provision.

Second, the labor market deficits are not confined to the affected individuals but also their "healthy" siblings face deficits in the labor market. Relative to unaffected comparisons that do not have siblings with psychiatric disorders, the "healthy" sibling of the af-

fected person earn 8% less and works about 1.5 year less than the unaffected comparison. Overall, this phenomenon likely suggests that the "healthy" siblings have an increased risk of less salient neuropsychological deficits and this also has labor market consequences.

While the ability of the register-based approach to capture only about half of the lifetime disorders is an obvious limitation, the lifetime perspective to mental disorders and labor market performance used in this study provide value-added in three ways. First, it is the first study to document correlations between severe mental disorders and lifetime earnings. As previously discussed, prior studies have studied some snapshots of adult outcomes and provided information on the association of depressive symptoms and labor market performance with varying periods usually between ages 20-50. Concerning the societal burden of diseases, advancing towards a lifetime perspective is important because mental disorders tend to be persistent. Estimates for the lifetime labor market performance deficit related to mental disorders work as a step in understanding the lifetime losses in work productivity associated with mental disorders.

Second, besides having access to a long history of income and employment, reliable information on severe psychiatric disorders is also crucial. The 50-year follow-up allows a profound investigation of the mental disorder and labor market performance in terms of the age of onset (first admission). As it is hard to pinpoint the age of onset of a mental disorder, the age of the first admission is adequate proxy especially when a long discontinuous study period is accessible. Many individuals suffer from mental health problems years before seeking help. This creates considerable delays between the age of onset and first psychiatric admission. While in psychotic conditions the delay may be a few years, in less severe conditions, the duration of untreated illness may be long but the vast majority of people with mental disorders seek treatment at some point during their life (Wang et al., 2007). Thus register-based research should aim to make use of complete psychiatric admission history to make an appropriate division between individuals who are mentally ill (treated for psychiatric conditions at some point in life) and healthier individuals.

Third, using high-quality administrative data with fully overlapping follow-up on psychiatric admissions and labor market performance from adolescence to retirement age,

this study provides reasonable comparisons without the burden of participation bias, attrition or biases related to self-reports that often plague survey-based studies. Departure from sound data strategy prevents from the point estimates being driven by selection to participation. In epidemiological psychiatric studies, participation bias due to premature mortality among those with psychiatric admission history becomes a concern. If a researcher observes the study sample only in late adulthood, there will be an upward bias in the labor market performance of the exposed group because the most severe psychiatric cases are more likely not to be alive. For instance, the cumulative incidence of suicide increases rapidly after the onset of illness in schizophrenia and tends to stabilize 20 years after onset (Nordentoft et al., 2011). Also if the study sample is not restricted to those present and observed at the start of follow-up at adolescence, the results might be affected by migration, notably immigration and more so in the case of rare psychiatric events such as for schizophrenia. Furthermore, while using short follow-ups one can capture the differences in present economic deficits, they may give a misleading view of the lifetime association because they do not take account for full labor market history.

This study emphasizes the importance of the age of the first admission as a predictor of relative labor market performance among the affected individuals. Indeed, knowing the age when mental illnesses emerge is important because it helps an effective organization and targeting of relevant services to reduce the detrimental impact of mental disorders (de Girolamo et al., 2019). By documenting the long-term repercussions in the labor market associated with different ages of onset of psychiatric problems, this study highlights the scale of the potential gains related to early intervention in mental disorders. Although vulnerability to mental disorders is not exogenous but is partly determined already at birth and signs of brain compromise begin years before the onset of clinical symptoms (Bearden et al., 2015), early interventions have potential reduce the damage in the long-term (Hegelstad et al., 2012). On the other hand, longer delays are associated with a reduced response to treatment (Perkins et al., 2005) which makes the recognition of the damage differentiated by the age of onset of great importance. Lifetime perspective is integral to providing policy-relevant estimates for the labor market deficits of mental disorders.

Particularly, this is important for distinguishing heterogeneity in labor market deficit estimates by the age of the first admission, information which is useful when considering age-specific treatment and intervention in psychiatry. In the future, research should focus on long-term economic evaluation of different randomized early intervention schemes to provide policymakers estimates of the long-term economic benefits of resources allocated to early intervention.

7 Conclusion

This study examined the lifetime labor market repercussions of psychiatric admissions. To provide a thorough description of the linkage between mental disorders and labor market performance, this study makes use of Finnish administrative register data that combines high-quality information on family, labor market outcomes and health for a period of almost half a century. This study highlights the economic inequality related to mental health which is particularly emphasized for the early-onset disorders. The results provide information on the scope of lifetime labor market performance losses associated with mental disorders.

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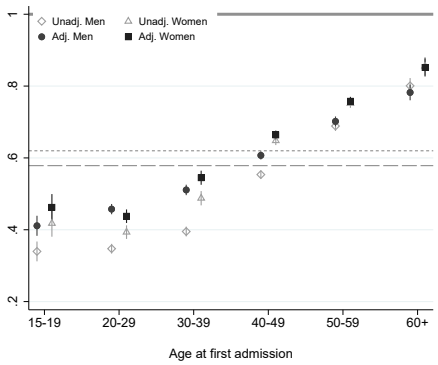
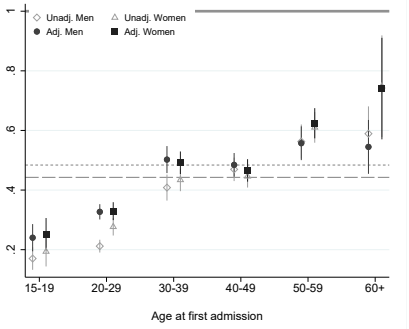
Supplementary material for *Mental disorders and life-time earnings*



(a) Any disorder



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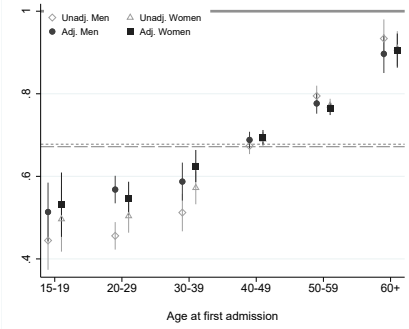

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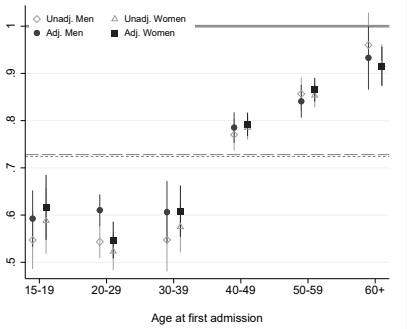

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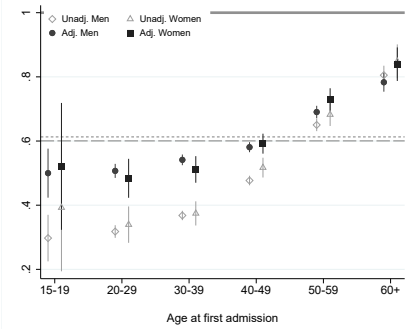
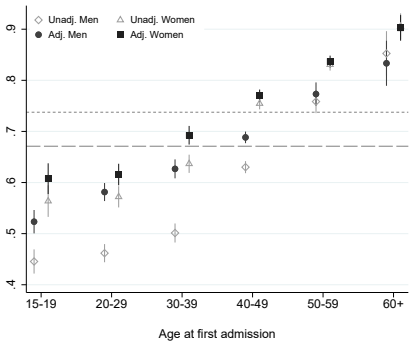
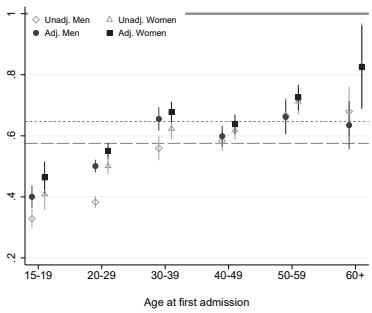


(e) Alcohol-related

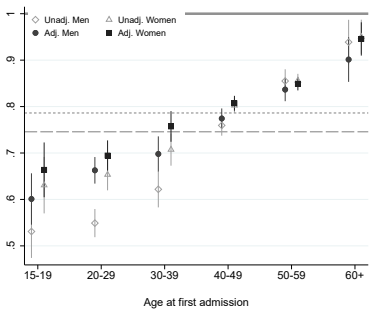
Fig. S1: Categorized age at first admission and the lifetime earnings relative to healthy controls. The percentage shares (with 95% confidence intervals) of lifetime earnings relative to the control group by the age of the first admission groups and sex. Estimates are calculated from the average marginal effects of predicted lifetime earnings. Percentage shares and confidence intervals are computed as shares of both unadjusted and adjusted (for the time in follow-up only) lifetime earnings prediction vs. the control group. All regressions include the childhood subregion, birth cohort and parental income quartile fixed effects and years in follow-up on a continuous scale. Dashed lines refer to the main effect of psychiatric admission history on the lifetime earnings of men (long dashed line) and women(short dashed line) with a continuous variable of total years in follow-up as the sole control variable.



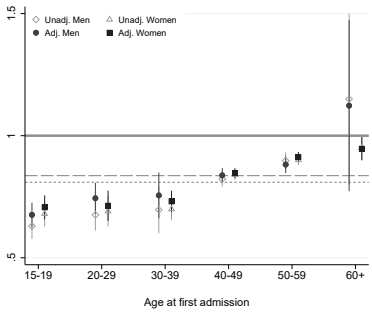
(a) Any disorder



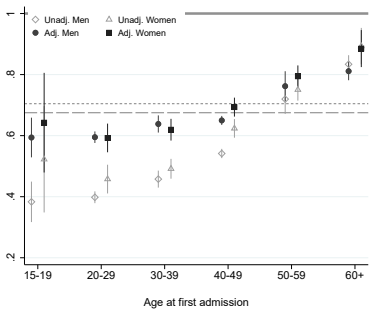
(b) Psychotic



(c) Mood

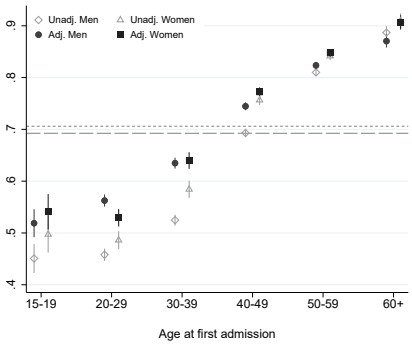


(d) Anxiety

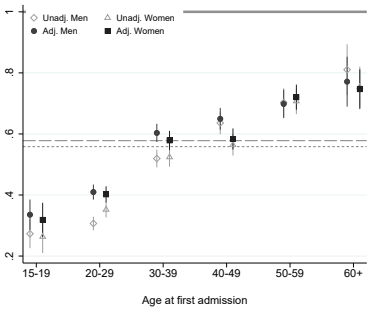


(e) Alcohol-related

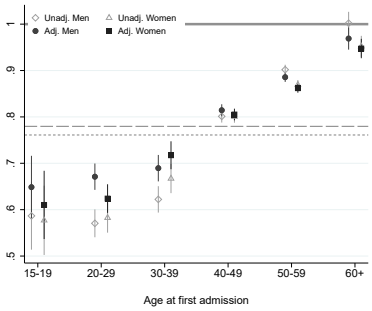
Fig. S2: Categorized age at first admission and the lifetime taxable income relative to healthy controls. The percentage shares (with 95% confidence intervals) of taxable income relative to the control group by the age of the first admission groups and sex. Estimates are calculated from the average marginal effects of predicted taxable income. Percentage shares and confidence intervals are computed as shares of both unadjusted and adjusted (for the time in follow-up only) taxable income prediction vs. the control group. All regressions include the childhood subregion, birth cohort and parental income quartile fixed effects and years in follow-up on a continuous scale. Dashed lines refer to the main effect of psychiatric admission history on the taxable income of men (long dashed line) and women(short dashed line) with a continuous variable of total years in follow-up as the sole control variable.



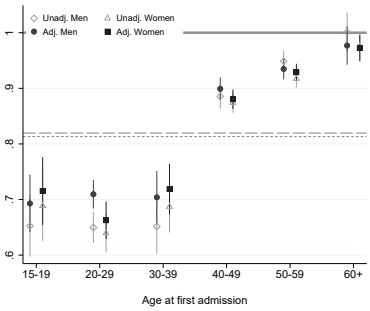
(a) Any disorder



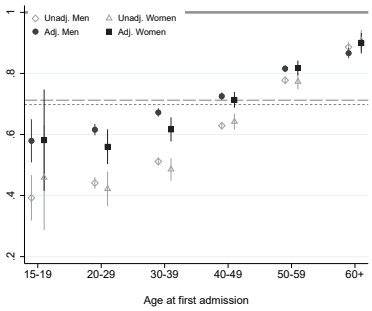
(b) Psychotic



(c) Mood



(d) Anxiety



(e) Alcohol-related

Fig. S3: Categorized age at first admission and the lifetime employment years relative to healthy controls. The percentage shares (with 95% confidence intervals) of total employment years to the control group by the age of the first admission groups and sex. Estimates are calculated from the average marginal effects of predicted total employment years. Percentage shares and confidence intervals are computed as shares of both unadjusted and adjusted (for the time in follow-up only) total employment years prediction vs. the control group. All regressions include the childhood subregion, birth cohort and parental income quartile fixed effects and years in follow-up on a continuous scale. Dashed lines refer to the main effect of psychiatric admission history on the total employment years of men (long dashed line) and women(short dashed line) with a continuous variable of total years in follow-up as the sole control variable.

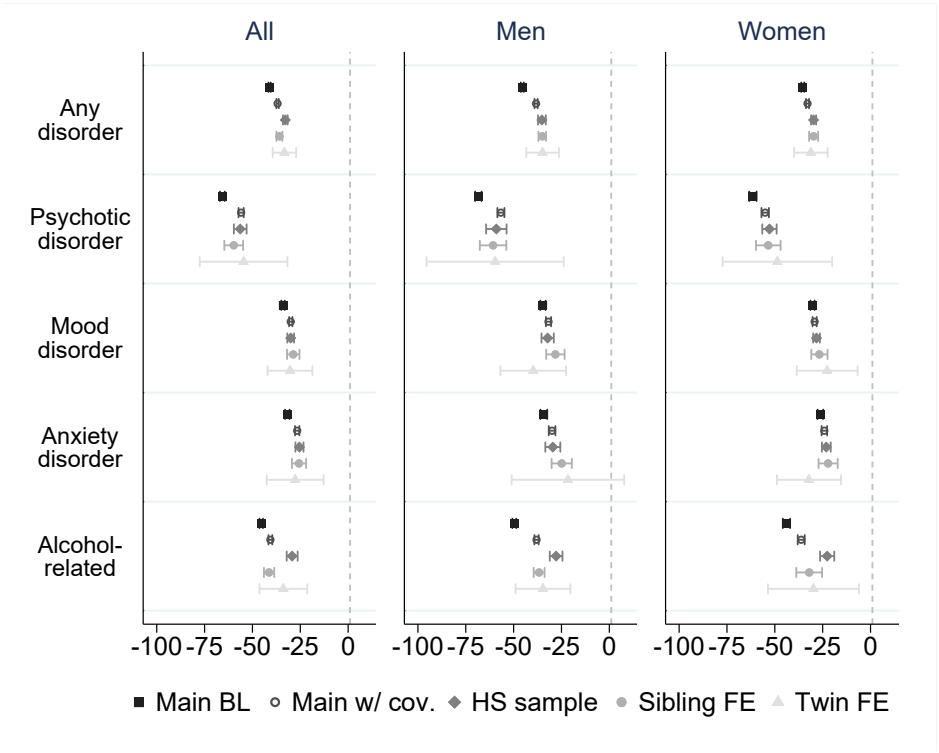


Fig. S4: Psychiatric admission history and the deficit in lifetime earnings: main results and sex-specific results. The average marginal effects (with 95% confidence intervals) of psychiatric admission on lifetime earnings is converted to percentage points. The first specification uses the main sample without control variables, the second includes controls variables that include number of follow-up years, subregion 1970 fixed effects, relative household earnings in 1970 (within subregion 1970), birth cohort and sex. In the third specification the comparison is conducted between high school graduates and it includes the full set of control variables and adds local relative grade point average (standard deviations from the mean) as a control variable. Fourth and fifth specifications consist of same-sex sibling and twin fixed effect estimates.

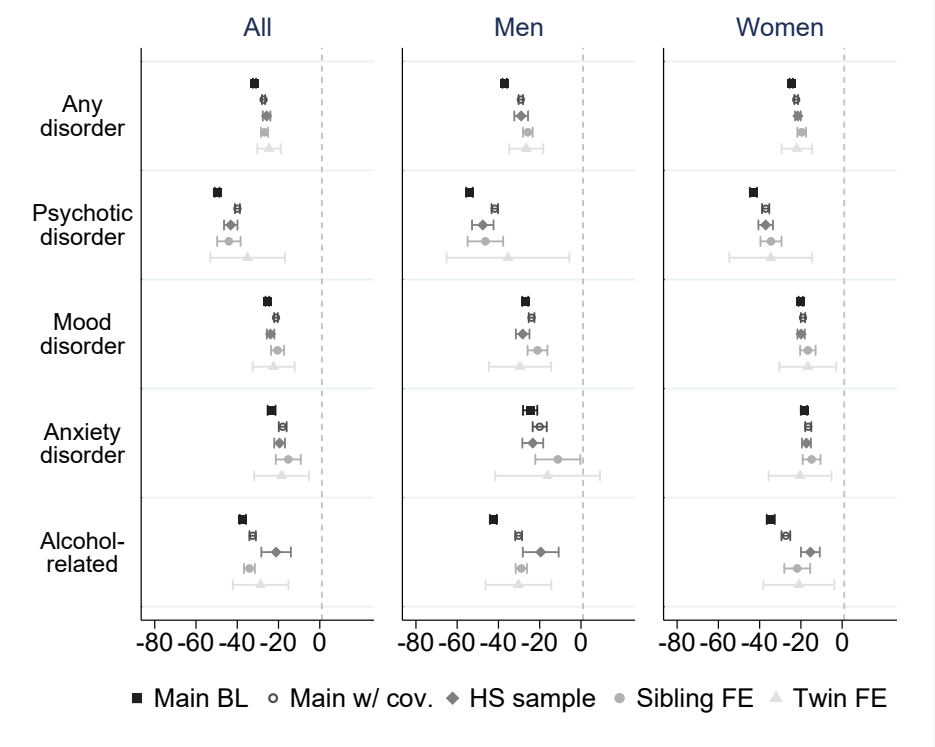


Fig. S5: Psychiatric admission history and the deficit in lifetime taxable income: main results and sex-specific results. The average marginal effects (with 95% confidence intervals) of psychiatric admission on lifetime taxable income is converted to percentage points. The first specification uses the main sample without control variables, the second includes controls variables that include number of follow-up years, subregion 1970 fixed effects, relative household taxable income in 1970 (within subregion 1970), birth cohort and sex. In the third specification the comparison is conducted between high school graduates and it includes the full set of control variables and adds local relative grade point average (standard deviations from the mean) as a control variable. Fourth and fifth specifications consist of same-sex sibling and twin fixed effect estimates.

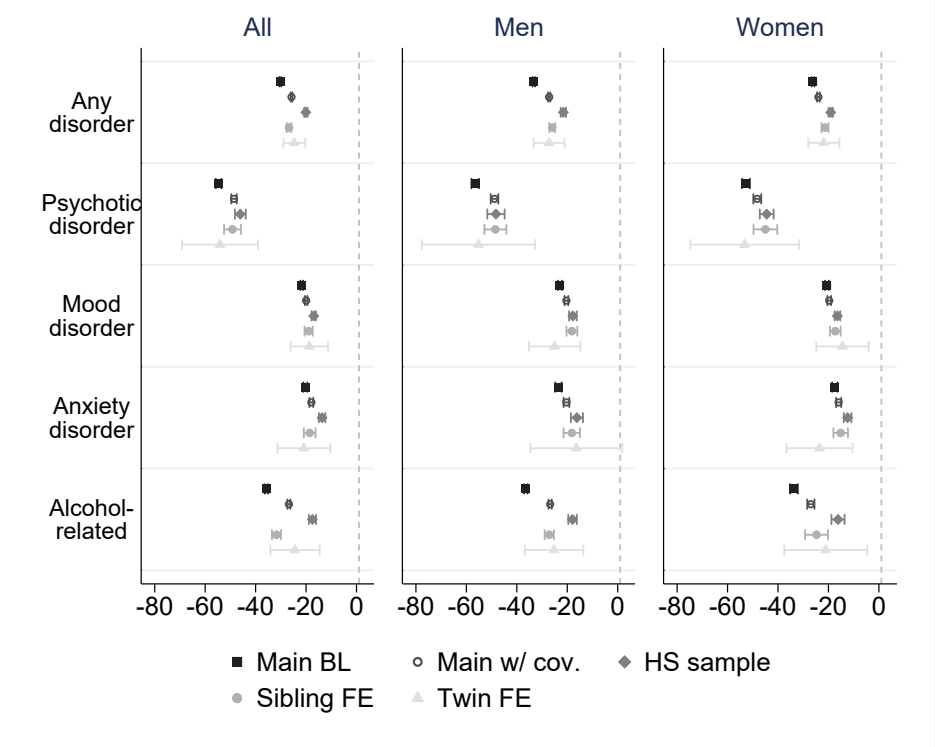


Fig. S6: Psychiatric admission history and the deficit in lifetime employment years: main results and sex-specific results. The average marginal effects (with 95% confidence intervals) of psychiatric admission on lifetime employment years is converted to percentage points. The first specification uses the main sample without control variables, the second includes controls variables that include number of follow-up years, subregion 1970 fixed effects, relative household employment years in 1970 (within subregion 1970), birth cohort and sex. In the third specification the comparison is conducted between high school graduates and it includes the full set of control variables and adds local relative grade point average (standard deviations from the mean) as a control variable. Fourth and fifth specifications consist of same-sex sibling and twin fixed effect estimates.

Table S1: Diagnosis codes used to form the first psychiatric admission information

	International Classification of Diseases, Revision		
Outcomes	ICD-8	ICD-9	ICD-10
Any mental disorder	291*-309*	291*-316*	F04*-F69*, F80*-F99*
Psychotic disorder	295*, 297*-299*	295*, 297*-299*	F20*-F29*
Mood disorder	296*, 298*,3004*	296,3004	F30*-F39
Anxiety disorder	305*, 30680, 30799, 3000-3003, 3005-3009	3000-3003	F40*-F489
Alcohol-related admissions	291,303,571,577	291, 303, 3050, 3575, 4255, 5353, 5710, 5713, 5770, 5771C, 5771D, 7607A	F10*, G312, G4051, G621, G721, I426, K860, O354, P043, Q860

Notes:Diagnoses used to form the study outcome measures. ICD-8, ICD-9 and ICD-10 refer to the International Statistical Classification of Diseases and Related Health Problems and its revision for years 1969-1986, 1987-1995, and 1996 onwards.

Table S2: Psychiatric admission history and the deficit in lifetime earnings (in 1000 euro)

Sample	Main sample		HS	Sibling	Twin
	(1)	(2)	(3)	(4)	(5)
Any disorder	-456	-406	-482	-365	-317
	[-462,-449]	[-413,-399]	[-500,-464]	[-381,-350]	[-375,-258]
Constant	1110	1102	1469	1017	951
%	0.59	0.631	0.672	0.641	0.667
N	266380	266375	57966	20448	867
Psychotic	-732	-621	-853	-580	-456
	[-746,-718]	[-636,-606]	[-903,-802]	[-627,-532]	[-647,-265]
Constant	1114	1111	1512	970	834
%	0.343	0.441	0.436	0.402	0.454
N	190486	190486	24700	3431	149
Mood	-378	-332	-441	-296	-298
	[-388,-368]	[-342,-323]	[-466,-415]	[-329,-262]	[-413,-183]
Constant	1111	1108	1468	1032	983
%	0.66	0.7	0.7	0.713	0.696
N	230200	230197	43881	8548	381
Anxiety	-353	-295	-374	-261	-263
	[-366,-340]	[-308,-283]	[-405,-343]	[-299,-224]	[-405,-122]
Constant	1111	1109	1470	1020	952
%	0.682	0.734	0.746	0.744	0.723
N	209237	209235	32787	4889	215
Alcohol-related	-513	-458	-456	-420	-313
	[-523,-503]	[-469,-446]	[-501,-411]	[-447,-393]	[-429,-198]
Constant	1131	1127	1560	1017	925
%	0.546	0.594	0.708	0.587	0.662
N	209083	209083	26838	7569	297

Notes: The average marginal effects (with 95% confidence intervals) of psychiatric admission on lifetime earnings (in €1000) in 2019 prices. The shaded rows below the predicted margin of the control group (Constant) refers to percentage shares of lifetime earnings (in 2019 prices) vs. control group computed. The first column refers to a specification that uses the full sample without control variables, the second column used controls variables that include number of follow-up years, subregion 1970 fixed effects, relative household earnings in 1970 (within subregion 1970), birth cohort and sex. The third column compares high school graduates and uses the full set of control variables and adds local relative grade point average (standard deviations from the mean) as a control variable. Fourth and fifth consist of same-sex sibling and twin fixed effect estimates.

Table S3: Psychiatric admission history and the deficit in total taxable income

Sample	Main sample		HS	Sibling	Twin
	(1)	(2)	(3)	(4)	(5)
Any disorder	-435	-372	-466	-341	-287
	[-445,-425]	[-382,-361]	[-499,-433]	[-363,-319]	[-353,-220]
Constant	1375	1364	1809	1272	1166
%	0.683	0.728	0.742	0.732	0.754
N	266380	266375	57966	20448	867
Psychotic	-686	-549	-816	-552	-355
	[-702,-671]	[-565,-533]	[-878,-755]	[-623,-481]	[-539,-172]
Constant	1379	1375	1891	1252	1015
%	0.502	0.601	0.568	0.559	0.65
N	190486	190486	24700	3431	149
Mood	-349	-291	-433	-261	-266
	[-362,-337]	[-303,-279]	[-465,-400]	[-302,-221]	[-387,-145]
Constant	1375	1371	1814	1278	1188
%	0.746	0.788	0.761	0.795	0.776
N	230200	230197	43881	8548	381
Anxiety	-321	-247	-354	-196	-217
	[-348,-295]	[-273,-221]	[-402,-307]	[-273,-118]	[-373,-60]
Constant	1376	1373	1818	1281	1175
%	0.766	0.82	0.805	0.847	0.815
N	209237	209235	32787	4889	215
Alcohol-related	-522	-454	-413	-430	-336
	[-543,-501]	[-476,-433]	[-553,-273]	[-463,-396]	[-493,-178]
Constant	1400	1396	1951	1260	1170
%	0.627	0.675	0.788	0.659	0.713
N	209083	209083	26838	7569	297

Notes: The average marginal effects of psychiatric admission on taxable income (in €1000) in 2019 prices. For further information on the econometric specification see Table S2.

Table S4: Psychiatric admission history and the deficit in total employment years

Sample	Main sample		HS	Sibling	Twin
	(1)	(2)	(3)	(4)	(5)
Any disorder	-9.8	-8.3	-6.6	-8.2	-7.5
	[-9.9,-9.6]	[-8.4,-8.1]	[-6.9,-6.4]	[-8.5,-7.9]	[-8.8,-6.2]
Constant	32.3	32	33.1	30.7	30.5
%	0.698	0.742	0.799	0.732	0.754
N	266380	266375	57966	20448	867
Psychotic	-17.6	-15.6	-15.2	-14.8	-16.3
	[-18,-17.3]	[-16,-15.3]	[-15.9,-14.5]	[-15.8,-13.8]	[-20.8,-11.8]
Constant	32.2	32.2	33	30.1	30.1
%	0.453	0.514	0.539	0.508	0.459
N	190486	190486	24700	3431	149
Mood	-7	-6.4	-5.6	-5.9	-5.9
	[-7.2,-6.8]	[-6.6,-6.3]	[-5.9,-5.3]	[-6.4,-5.4]	[-8.2,-3.5]
Constant	32.3	32.2	33.1	31.3	31.2
%	0.783	0.8	0.831	0.81	0.813
N	230200	230197	43881	8548	381
Anxiety	-6.5	-5.8	-4.5	-5.8	-6.6
	[-6.8,-6.3]	[-6,-5.5]	[-4.9,-4.1]	[-6.5,-5.1]	[-9.9,-3.3]
Constant	32.3	32.2	33.1	31.2	31.6
%	0.797	0.821	0.864	0.814	0.791
N	209237	209235	32787	4889	215
Alcohol-related	-11.5	-8.6	-5.7	-9.5	-7
	[-11.7,-11.3]	[-8.8,-8.4]	[-6.2,-5.3]	[-10,-9]	[-9.8,-4.2]
Constant	32.3	32.1	32.9	29.9	28.8
%	0.643	0.732	0.825	0.683	0.756
N	209083	209083	26838	7569	297

Notes: The average marginal effects of psychiatric admission on total employment years. For further information on the econometric specification see Table S2.

Table S5: Men's psychiatric admission history and the deficit in lifetime earnings (in 1000 euro)

Sample	Main sample		HS	Sibling	Twin
	(1)	(2)	(3)	(4)	(5)
Any disorder	-574	-476	-651	-381	-357
	[-584,-564]	[-487,-466]	[-689,-614]	[-402,-359]	[-445,-270]
Constant	1262	1245	1849	1087	1025
%	0.55	0.62	0.65	0.65	0.65
N	142640	142640	23009	12379	462
Psychotic	-864	-713	-1145	-643	-493
	[-885,-843]	[-736,-690]	[-1248,-1041]	[-716,-570]	[-789,-197]
Constant	1263	1259	1939	1059	826
%	0.32	0.43	0.41	0.39	0.4
N	101060	101060	9698	1910	78
Mood	-438	-401	-606	-328	-450
	[-456,-421]	[-418,-384]	[-667,-546]	[-384,-272]	[-644,-256]
Constant	1265	1263	1881	1164	1132
%	0.65	0.68	0.68	0.72	0.6
N	119544	119544	16159	4200	158
Anxiety	-434	-379	-563	-282	-234
	[-457,-412]	[-401,-357]	[-637,-488]	[-341,-222]	[-552,84]
Constant	1270	1268	1906	1132	1082
%	0.66	0.7	0.7	0.75	0.78
N	107350	107350	11457	2356	82
Alcohol-related	-626	-475	-515	-376	-333
	[-639,-614]	[-488,-461]	[-576,-453]	[-405,-347]	[-471,-196]
Constant	1261	1248	1852	1026	961
%	0.5	0.62	0.72	0.63	0.65
N	125084	125084	14350	6287	234

Notes: The average marginal effects (with 95% confidence intervals) of men's psychiatric admission on lifetime earnings (in €1000) in 2019 prices. The shaded rows below the predicted margin of the control group (Constant) refers to percentage shares of lifetime earnings (in 2019 prices) vs. control group computed. The first column refers to a specification that uses the full sample without control variables, the second column used controls variables that include number of follow-up years, subregion 1970 fixed effects, relative household earnings in 1970 (within subregion 1970), birth cohort and sex. The third column compares high school graduates and uses the full set of control variables and adds local relative grade point average (standard deviations from the mean) as a control variable. Fourth and fifth consist of same-sex sibling and twin fixed effect estimates.

Table S6: Men's psychiatric admission history and the deficit in total taxable income

Sample	Main sample		HS	Sibling	Twin
	(1)	(2)	(3)	(4)	(5)
Any disorder	-581	-451	-672	-351	-336
	[-598,-564]	[-468,-435]	[-749,-595]	[-383,-319]	[-440,-232]
Constant	1572	1548	2318	1363	1266
%	0.63	0.71	0.71	0.74	0.73
N	142640	142640	23009	12379	462
Psychotic	-850	-655	-1182	-647	-353
	[-874,-825]	[-679,-630]	[-1311,-1053]	[-767,-526]	[-650,-56]
Constant	1572	1567	2484	1396	996
%	0.46	0.58	0.52	0.54	0.65
N	101060	101060	9698	1910	78
Mood	-426	-377	-671	-304	-400
	[-448,-403]	[-398,-355]	[-750,-593]	[-374,-235]	[-604,-195]
Constant	1575	1572	2376	1444	1353
%	0.73	0.76	0.72	0.79	0.7
N	119544	119544	16159	4200	158
Anxiety	-389	-315	-567	-162	-227
	[-444,-335]	[-369,-262]	[-690,-444]	[-319,-4]	[-583,130]
Constant	1580	1578	2427	1443	1403
%	0.75	0.8	0.77	0.89	0.84
N	107350	107350	11457	2356	82
Alcohol-related	-668	-469	-458	-366	-367
	[-693,-642]	[-495,-444]	[-662,-253]	[-401,-332]	[-561,-174]
Constant	1570	1553	2346	1267	1211
%	0.57	0.7	0.8	0.71	0.7
N	125084	125084	14350	6287	234

Notes: The average marginal effects of men's psychiatric admission on taxable income (in €1000) in 2019 prices. For further information on the econometric specification see Table S5.

Table S7: Men's psychiatric admission history and the deficit in total employment years

Sample	Main sample		HS	Sibling	Twin
	(1)	(2)	(3)	(4)	(5)
Any disorder	-11	-8.74	-7.16	-7.77	-8.23
	[-10.98,-10.67]	[-8.88,-8.59]	[-7.51,-6.81]	[-8.11,-7.43]	[-10.08,-6.37]
Constant	32.54	32.16	33.26	29.97	30.29
%	0.67	0.73	0.78	0.74	0.73
N	142640	142640	23009	12379	462
Psychotic	-18.34	-15.82	-16.08	-14.41	-15.85
	[-18.82,-17.85]	[-16.3,-15.34]	[-17.23,-14.94]	[-15.7,-13.12]	[-22.3,-9.4]
Constant	32.46	32.39	33.32	29.71	28.72
%	0.44	0.51	0.52	0.52	0.45
N	101060	101060	9698	1910	78
Mood	-7.45	-6.61	-5.93	-5.65	-8.06
	[-7.71,-7.19]	[-6.85,-6.37]	[-6.43,-5.42]	[-6.32,-4.98]	[-11.36,-4.77]
Constant	32.54	32.49	33.38	31.13	32.29
%	0.77	0.8	0.82	0.82	0.75
N	119544	119544	16159	4200	158
Anxiety	-7.64	-6.61	-5.39	-5.59	-5.23
	[-8.05,-7.23]	[-6.98,-6.23]	[-6.19,-4.6]	[-6.59,-4.59]	[-11.04,0.58]
Constant	32.55	32.51	33.37	30.71	31.87
%	0.77	0.8	0.84	0.82	0.84
N	107350	107350	11457	2356	82
Alcohol-related	-11.83	-8.62	-5.94	-7.89	-7.27
	[-12.05,-11.61]	[-8.83,-8.42]	[-6.5,-5.38]	[-8.42,-7.36]	[-10.61,-3.93]
Constant	32.5	32.22	33.17	29.1	28.8
%	0.64	0.73	0.82	0.73	0.75
N	125084	125084	14350	6287	234

Notes: The average marginal effects of men's psychiatric admission on total employment years. For further information on the econometric specification see Table S5.

Table S8: Women's psychiatric admission history and the deficit in lifetime earnings (in 1000 euro)

Sample	Main sample		HS	Sibling	Twin
	(1)	(2)	(3)	(4)	(5)
Any disorder	-333	-308	-362	-259	-270
	[-340,-325]	[-316,-301]	[-378,-346]	[-280,-239]	[-346,-194]
Constant	940	936	1218	872	866
%	0.65	0.67	0.7	0.7	0.69
N	123735	123735	34957	8069	405
Psychotic	-581	-519	-652	-446	-411
	[-599,-563]	[-537,-501]	[-699,-606]	[-500,-392]	[-653,-169]
Constant	945	943	1236	835	845
%	0.39	0.45	0.47	0.47	0.51
N	89426	89426	15002	1521	71
Mood	-285	-275	-346	-238	-199
	[-296,-275]	[-285,-264]	[-368,-324]	[-276,-200]	[-339,-59]
Constant	941	940	1227	892	881
%	0.7	0.71	0.72	0.73	0.77
N	110653	110653	27722	4348	223
Anxiety	-247	-227	-285	-198	-280
	[-261,-233]	[-241,-214]	[-314,-257]	[-243,-154]	[-426,-134]
Constant	943	942	1236	896	871
%	0.74	0.76	0.77	0.78	0.68
N	101885	101885	21330	2533	133
Alcohol-related	-416	-342	-277	-258	-235
	[-434,-398]	[-360,-325]	[-322,-232]	[-312,-204]	[-422,-48]
Constant	948	946	1222	804	787
%	0.56	0.64	0.77	0.68	0.7
N	83999	83999	12488	1282	63

Notes: The average marginal effects (with 95% confidence intervals) of women's psychiatric admission on lifetime earnings (in €1000) in 2019 prices. The shaded rows below the predicted margin of the control group (Constant) refers to percentage shares of lifetime earnings (in 2019 prices) vs. control group computed. The first column refers to a specification that uses the full sample without control variables, the second column used controls variables that include number of follow-up years, subregion 1970 fixed effects, relative household earnings in 1970 (within subregion 1970), birth cohort and sex. The third column compares high school graduates and uses the full set of control variables and adds local relative grade point average (standard deviations from the mean) as a control variable. Fourth and fifth consist of same-sex sibling and twin fixed effect estimates.

Table S9: Women's psychiatric admission history and the deficit in total taxable income

Sample	Main sample		HS	Sibling	Twin
	(1)	(2)	(3)	(4)	(5)
Any disorder	-285	-256	-316	-212	-231
	[-295,-276]	[-266,-246]	[-336,-296]	[-234,-189]	[-309,-153]
Constant	1155	1151	1472	1079	1051
%	0.75	0.78	0.79	0.8	0.78
N	123735	123735	34957	8069	405
Psychotic	-500	-430	-559	-359	-358
	[-519,-480]	[-450,-409]	[-612,-506]	[-412,-306]	[-566,-150]
Constant	1161	1159	1507	1041	1034
%	0.57	0.63	0.63	0.65	0.65
N	89426	89426	15002	1521	71
Mood	-232	-219	-296	-183	-179
	[-244,-220]	[-231,-207]	[-322,-270]	[-224,-142]	[-327,-31]
Constant	1156	1155	1486	1101	1076
%	0.8	0.81	0.8	0.83	0.83
N	110653	110653	27722	4348	223
Anxiety	-214	-190	-258	-163	-211
	[-231,-197]	[-207,-173]	[-291,-226]	[-211,-116]	[-369,-54]
Constant	1158	1157	1492	1102	1034
%	0.82	0.84	0.83	0.85	0.8
N	101885	101885	21330	2533	133
Alcohol-related	-403	-317	-230	-216	-212
	[-425,-380]	[-341,-292]	[-299,-162]	[-278,-154]	[-385,-38]
Constant	1163	1161	1495	991	1008
%	0.65	0.73	0.85	0.78	0.79
N	83999	83999	12488	1282	63

Notes: The average marginal effects of women's psychiatric admission on taxable income (in €1000) in 2019 prices. For further information on the econometric specification see Table S8.

Table S10: Women's psychiatric admission history and the deficit in total employment years

Sample	Main sample		HS	Sibling	Twin
	(1)	(2)	(3)	(4)	(5)
Any disorder	-8	-7.64	-6.28	-6.55	-6.69
	[-8.54,-8.18]	[-7.81,-7.47]	[-6.56,-6]	[-6.97,-6.13]	[-8.58,-4.8]
Constant	31.98	31.87	32.94	30.65	30.69
%	0.74	0.76	0.81	0.79	0.78
N	123735	123735	34957	8069	405
Psychotic	-18.34	-15.82	-16.08	-14.41	-15.85
	[-18.82,-17.85]	[-16.3,-15.34]	[-17.23,-14.94]	[-15.7,-13.12]	[-22.3,-9.4]
Constant	32.46	32.39	33.32	29.71	28.72
%	0.44	0.51	0.52	0.52	0.45
N	101060	101060	9698	1910	78
Mood	-7.45	-6.61	-5.93	-5.65	-8.06
	[-7.71,-7.19]	[-6.85,-6.37]	[-6.43,-5.42]	[-6.32,-4.98]	[-11.36,-4.77]
Constant	32.54	32.49	33.38	31.13	32.29
%	0.77	0.8	0.82	0.82	0.75
N	119544	119544	16159	4200	158
Anxiety	-7.64	-6.61	-5.39	-5.59	-5.23
	[-8.05,-7.23]	[-6.98,-6.23]	[-6.19,-4.6]	[-6.59,-4.59]	[-11.04,0.58]
Constant	32.55	32.51	33.37	30.71	31.87
%	0.77	0.8	0.84	0.82	0.84
N	107350	107350	11457	2356	82
Alcohol-related	-11.83	-8.62	-5.94	-7.89	-7.27
	[-12.05,-11.61]	[-8.83,-8.42]	[-6.5,-5.38]	[-8.42,-7.36]	[-10.61,-3.93]
Constant	32.5	32.22	33.17	29.1	28.8
%	0.64	0.73	0.82	0.73	0.75
N	125084	125084	14350	6287	234

Notes: The average marginal effects of women's psychiatric admission on total employment years. For further information on the econometric specification see Table S8.

Table S11: Age of first admission and the deficit in lifetime earnings (in €1000)

Sample		Main sample		HS	Sibling	Twin
		(1)	(2)	(3)	(4)	(5)
Any mental disorder	Admitted	-486.8	-433.3	-547	-392.5	-346.1
		[-493.1,-480.6]	[-439.8,-426.7]	[-565.3,-528.8]	[-407.8,-377.1]	[-404.4,-287.7]
	Admitted*age	13.2	10.4	14.5	11	7.8
		[12.7,13.6]	[9.9,10.9]	[13,16]	[9.4,12.5]	[1.8,13.7]
	Constant	1109.8	1055.7	1774.6	1017.5	951.8
		[1105.9,1113.7]	[1044.6,1066.8]	[1743.2,1806]	[1006.7,1028.2]	[911.4,992.3]
	N	266377	266375	57966	20448	867
	R^2	0.04	0.13	0.16	0.62	0.66
Psychotic disorder	Admitted	-644.5	-548	-763.7	-488.4	-435
		[-662.1,-626.9]	[-565.9,-530.1]	[-818.4,-708.9]	[-539.8,-437]	[-678.9,-191]
	Admitted*age	11.9	9.9	14.5	13	2.3
		[10.7,13.1]	[8.7,11.1]	[10.7,18.4]	[8.5,17.5]	[-19.5,24.1]
	Constant	1113.7	1051.4	1825.4	969.4	836.5
		[1109.3,1118]	[1038,1064.9]	[1771.1,1879.7]	[942.1,996.8]	[721.8,951.2]
	N	190486	190486	24700	3431	149
	R^2	0.02	0.1	0.13	0.73	0.77
Mood disorder	Admitted	-436.5	-377.9	-508.1	-344.8	-339.1
		[-446.7,-426.3]	[-388,-367.8]	[-536,-480.2]	[-378,-311.7]	[-459.3,-219]
	Admitted*age	11.3	8.8	10.7	10	4.7
		[10.4,12.2]	[7.9,9.6]	[8.3,13.1]	[6.7,13.4]	[-6.8,16.2]
	Constant	1110.7	1059	1800.4	1032.5	987.4
		[1106.7,1114.7]	[1046.6,1071.4]	[1764.3,1836.4]	[1013,1051.9]	[919.7,1055.2]
	N	230198	230197	43881	8548	381
	R^2	0.01	0.1	0.14	0.67	0.71
Anxiety disorder	Admitted	-367.1	-309.8	-422.7	-280.3	-286.6
		[-379.8,-354.5]	[-322.1,-297.6]	[-456.2,-389.2]	[-318.1,-242.4]	[-428.2,-144.9]
	Admitted*age	9.2	9.6	11.4	9.7	11.2
		[8.2,10.1]	[8.7,10.5]	[8.8,13.9]	[6.1,13.2]	[-3.4,25.8]
	Constant	1111.2	1058.6	1838.8	1021.4	957.6
		[1107,1115.3]	[1045.4,1071.7]	[1789.9,1887.7]	[999.6,1043.2]	[872,1043.1]
	N	209236	209235	32787	4889	215
	R^2	0.01	0.09	0.14	0.72	0.81
Alcohol-related admission	Admitted	-578.2	-498.3	-573.2	-469.4	-365.8
		[-587.5,-568.9]	[-509.5,-487.2]	[-618.9,-527.5]	[-496.8,-442]	[-491.2,-240.4]
	Admitted*age	15.7	9.2	15.4	11.9	3.8
		[14.9,16.5]	[8.3,10]	[11.6,19.2]	[9,14.9]	[-9,16.6]
	Constant	1130.4	1053.4	1829.1	1017.1	921.9
		[1126.1,1134.7]	[1040.4,1066.4]	[1769.7,1888.5]	[1000.1,1034]	[849.8,994]
	N	209083	209083	26838	7569	297
	R^2	0.02	0.1	0.15	0.7	0.76

Notes: OLS estimates for the effect of psychiatric admission with interaction the age of the first admission (centered at age 42) on lifetime earnings with 95% confidence intervals. The control group consists of individuals with no psychiatric admissions. The first column refers to a specification that uses the full sample without control variables, the second column used controls variables that include subregion 1970 fixed effects, relative household earnings in 1970 (within subregion 1970), birth cohort and sex. The third column compares high school graduates and uses the full set of control variables and adds local relative grade point average (standard deviations from the mean) as a control variable. The fourth and fifth consist of the same-sex sibling and twin fixed effect estimates.

Table S12: Age of first admission and the deficit in lifetime taxable income (in €1000)

Sample		Main sample		HS	Sibling	Twin
		(1)	(2)	(3)	(4)	(5)
Any mental disorder	Admitted	-357.6	-336.6	-438.3	-263.6	-195.5
		[-364.9,-350.4]	[-343.6,-329.5]	[-460.6,-415.9]	[-282.2,-245.1]	[-292.3,-98.6]
	Admitted*age	13.9	8.9	13	9	10.3
		[13.4,14.5]	[8.3,9.4]	[11.1,15]	[7.1,11]	[-3,23.6]
	Constant	1135.5	1111	1837.3	1145.6	975.1
		[1130.9,1140.1]	[1096.3,1125.6]	[1785.9,1888.6]	[1032,1259.2]	[900.2,1050]
	N	301658	301658	71331	14653	539
	R^2	0.02	0.12	0.12	0.65	0.70
Psychotic disorder	Admitted	-473.8	-423.3	-610.2	-353.9	-290.3
		[-489.7,-457.8]	[-438.7,-407.9]	[-655.4,-565]	[-481.6,-226.2]	[-629.1,48.5]
	Admitted*age	11.6	7.1	10.8	9.1	-2.7
		[10.5,12.7]	[6,8.2]	[7.3,14.3]	[-1.1,19.2]	[-42.4,37]
	Constant	1135.5	1114.8	1849.9	1205.4	993.5
		[1130.9,1140.1]	[1098.4,1131.2]	[1794.5,1905.2]	[941,1469.7]	[928.3,1058.7]
	N	253784	253784	61244	8370	305
	R^2	0.006	0.11	0.12	0.87	0.97
Mood disorder	Admitted	-305.4	-279.1	-415.7	-232.2	-185.2
		[-315.3,-295.6]	[-288.4,-269.9]	[-442.6,-388.9]	[-291.2,-173.1]	[-356.9,-13.6]
	Admitted*age	11.8	7.2	9.9	9.9	10.9
		[11,12.6]	[6.5,8]	[7.6,12.2]	[3.6,16.1]	[-6,27.7]
	Constant	1135.5	1115.6	1849.7	1263.4	979.8
		[1130.9,1140.1]	[1099.8,1131.5]	[1796.5,1903]	[1087.2,1439.7]	[919.8,1039.8]
	N	265022	265022	64328	9737	346
	R^2	0.004	0.11	0.12	0.78	0.91
Anxiety disorder	Admitted	-249.9	-227.5	-308.1	-192.6	-125.3
		[-264.9,-234.9]	[-241.7,-213.4]	[-355,-261.2]	[-246.4,-138.8]	[-352.7,102]
	Admitted*age	8.8	7.1	8.9	8.5	-2.5
		[7.7,9.9]	[6,8.1]	[5.3,12.5]	[3.8,13.2]	[-21.1,16.1]
	Constant	1135.5	1115.4	1857.3	1207.6	966
		[1130.9,1140.1]	[1099.2,1131.6]	[1802.9,1911.7]	[980.7,1434.4]	[903.3,1028.7]
	N	258234	258234	62478	8950	331
	R^2	0.002	0.11	0.12	0.89	0.94
Alcohol-related admission	Admitted	-405.8	-407.4	-455.2	-315.2	-366.4
		[-418.3,-393.2]	[-420,-394.7]	[-509.7,-400.7]	[-359.3,-271.1]	[-735.7,2.9]
	Admitted*age	14.1	6.7	13.6	7.5	32.3
		[12.9,15.3]	[5.6,7.9]	[6.8,20.4]	[3.4,11.5]	[-44.5,109.2]
	Constant	1137.3	1120.9	1863.1	1145.4	991.2
		[1132.6,1141.9]	[1104.6,1137.2]	[1805.8,1920.4]	[976.8,1314]	[804.3,1178.1]
	N	263020	263020	61748	9606	343
	R^2	0.01	0.11	0.12	0.84	0.76

Notes: OLS estimates for the effect of psychiatric admission with interaction the age of the first admission (centered at age 42) on lifetime taxable income with 95% confidence intervals. For further information on the econometric specification see Table S11.

Table S13: Age of first admission and the deficit in lifetime employment years

Sample		Main sample		HS	Sibling	Twin
		(1)	(2)	(3)	(4)	(5)
Any mental disorder	Admitted	-10.65	-9.01	-7.84	-9	-8.44
		[-10.77,-10.54]	[-9.12,-8.9]	[-8.09,-7.59]	[-9.29,-8.71]	[-9.79,-7.09]
	Admitted*age	0.38	0.29	0.27	0.32	0.29
		[0.37,0.39]	[0.28,0.3]	[0.25,0.29]	[0.29,0.35]	[0.16,0.43]
	Constant	32.27	30.68	33.42	30.68	30.49
		[32.23,32.31]	[30.55,30.81]	[33.18,33.66]	[30.49,30.87]	[29.59,31.38]
	N	266377	266375	57966	20448	867
	R2	0.16	0.33	0.34	0.64	0.67
Psychotic disorder	Admitted	-14.68	-13.23	-13.35	-11.93	-14.66
		[-15.06,-14.31]	[-13.6,-12.86]	[-14.06,-12.64]	[-12.97,-10.88]	[-20.24,-9.09]
	Admitted*age	0.4	0.32	0.31	0.39	0.2
		[0.37,0.42]	[0.3,0.35]	[0.26,0.36]	[0.29,0.48]	[-0.37,0.77]
	Constant	32.23	30.85	33.4	30.15	30.2
		[32.19,32.28]	[30.7,31]	[33,33.81]	[29.62,30.68]	[27.38,33.01]
	N	190486	190486	24700	3431	149
	R2	0.09	0.3	0.39	0.76	0.81
Mood disorder	Admitted	-8.72	-7.74	-6.77	-7.42	-6.85
		[-8.94,-8.51]	[-7.94,-7.54]	[-7.17,-6.37]	[-8.01,-6.83]	[-9.25,-4.46]
	Admitted*age	0.33	0.25	0.19	0.3	0.2
		[0.31,0.35]	[0.23,0.26]	[0.15,0.22]	[0.24,0.36]	[-0.04,0.44]
	Constant	32.28	30.85	33.48	31.33	31.32
		[32.24,32.32]	[30.71,30.99]	[33.21,33.75]	[31.04,31.61]	[29.95,32.69]
	N	230198	230197	43881	8548	381
	R2	0.04	0.26	0.31	0.68	0.73
Anxiety disorder	Admitted	-6.96	-6.13	-5.27	-6.23	-6.99
		[-7.22,-6.71]	[-6.37,-5.88]	[-5.75,-4.78]	[-6.96,-5.51]	[-10.61,-3.37]
	Admitted*age	0.27	0.23	0.17	0.25	0.32
		[0.26,0.29]	[0.21,0.25]	[0.14,0.21]	[0.18,0.32]	[-0.01,0.65]
	Constant	32.28	30.86	33.75	31.21	31.6
		[32.24,32.32]	[30.71,31]	[33.43,34.06]	[30.8,31.61]	[29.56,33.65]
	N	209236	209235	32787	4889	215
	R2	0.02	0.25	0.3	0.7	0.8
Alcohol-related admission	Admitted	-13.17	-9.6	-7.44	-10.77	-8.8
		[-13.37,-12.97]	[-9.8,-9.41]	[-8.05,-6.82]	[-11.33,-10.21]	[-12.12,-5.48]
	Admitted*age	0.4	0.22	0.22	0.31	0.18
		[0.38,0.41]	[0.21,0.24]	[0.18,0.27]	[0.25,0.36]	[-0.15,0.5]
	Constant	32.28	30.78	33.42	29.91	28.71
		[32.24,32.32]	[30.64,30.92]	[33.06,33.78]	[29.59,30.24]	[26.99,30.44]
	N	209083	209083	26838	7569	297
	R2	0.1	0.3	0.33	0.7	0.75

Notes: OLS estimates for the effect of psychiatric admission with interaction the age of the first admission (centered at age 42) and lifetime employment years. For further information on the econometric specification see Table S11.

Table S14: "Healthy sibling" effect on lifetime labor market performance by affected sibling's diagnosis

Outcome	Any disorder		Psychosis		Mood		Anxiety		Alcohol-related	
	BL	Full	BL	Full	BL	Full	BL	Full	BL	Full
Lifetime earnings (%)										
'Healthy' sibling	0.915	0.939	0.895	0.937	0.971	0.979	0.966	0.97	0.865	0.903
95 %CI	[0.901,0.929]	[0.926,0.951]	[0.864,0.925]	[0.909,0.966]	[0.952,0.991]	[0.96,0.997]	[0.941,0.99]	[0.947,0.993]	[0.844,0.884]	[0.885,0.921]
P	<0.001	<0.001	<0.001	<0.001	0.003	0.022	0.006	0.011	<0.001	<0.001
N	60779	60779	50620	50620	58963	58963	54751	54751	54128	54128
'Healthy' twin	0.886	0.907	0.813	0.84	0.946	0.97	0.961	0.936	0.839	0.879
95 %CI	[0.829,0.94]	[0.854,0.958]	[0.689,0.931]	[0.718,0.956]	[0.871,1.017]	[0.9,1.037]	[0.876,1.042]	[0.852,1.017]	[0.747,0.925]	[0.798,0.957]
P	<0.001	<0.001	0.002	0.006	0.136	0.385	0.355	0.121	<0.001	0.002
N	2953	2953	2431	2431	2894	2894	2696	2696	2636	2636
Lifetime taxable income (%)										
'Healthy' sibling	0.925	0.948	0.929	0.971	0.972	0.979	0.98	0.983	0.857	0.896
95 %CI	[0.909,0.941]	[0.933,0.963]	[0.889,0.968]	[0.933,1.007]	[0.952,0.992]	[0.959,0.998]	[0.95,1.01]	[0.954,1.012]	[0.836,0.879]	[0.876,0.915]
P	<0.001	<0.001	<0.001	0.118	0.006	0.027	0.193	0.258	<0.001	<0.001
N	60779	60779	50620	50620	58963	58963	54751	54751	54128	54128
'Healthy' twin	0.898	0.923	0.822	0.849	0.941	0.965	0.99	0.972	0.865	0.907
95 %CI	[0.844,0.95]	[0.874,0.97]	[0.718,0.922]	[0.749,0.944]	[0.873,1.005]	[0.902,1.024]	[0.89,1.085]	[0.878,1.062]	[0.771,0.955]	[0.825,0.986]
P	<0.001	0.001	<0.001	0.002	0.072	0.25	0.837	0.543	0.003	0.02
N	2953	2953	2431	2431	2894	2894	2696	2696	2636	2636
Total employment years (%)										
'Healthy' sibling	0.951	0.966	0.942	0.958	0.98	0.983	0.977	0.984	0.933	0.961
95 %CI	[0.944,0.958]	[0.96,0.972]	[0.925,0.958]	[0.944,0.972]	[0.97,0.989]	[0.975,0.991]	[0.965,0.99]	[0.973,0.994]	[0.922,0.945]	[0.952,0.97]
P	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
N	60779	60779	50620	50620	58963	58963	54751	54751	54128	54128
'Healthy' twin	0.945	0.969	0.944	0.966	0.978	0.999	1.011	0.999	0.922	0.958
95 %CI	[0.912,0.978]	[0.941,0.997]	[0.867,1.019]	[0.896,1.036]	[0.934,1.02]	[0.962,1.035]	[0.96,1.061]	[0.955,1.043]	[0.864,0.98]	[0.908,1.006]
P	<0.001	0.033	0.146	0.346	0.31	0.959	0.677	0.98	0.008	0.087
N	2953	2953	2431	2431	2894	2894	2696	2696	2636	2636

Notes:Point estimates (with 95 % confidence intervals) refer to relative lifetime labor market performance of healthy individuals who have a sibling with psychiatric admission history vs. healthy individuals with healthy siblings. The point estimates stem from a specification that include no control variables (BL) and the full set of background characteristics: sex, birth year, subregion 1970 fixed effects, relative household earnings (parents), the urban status of residence and total years in follow-up (Full). 95 % confidence intervals and p-value are reported below the healthy sibling (twin) coefficient.

The **Aboa Centre for Economics (ACE)** is a joint initiative of the economics departments of the Turku School of Economics at the University of Turku and the School of Business and Economics at Åbo Akademi University. ACE was founded in 1998. The aim of the Centre is to coordinate research and education related to economics.

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