



Mortality in persons with mental disorders is substantially overestimated using inpatient psychiatric diagnoses



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ABSTRACT

Mental disorders are associated with premature mortality, and the magnitudes of risk have commonly been estimated using hospital data. However, psychiatric patients who are hospitalized have more severe illness and do not adequately represent mental disorders in the general population. We conducted a national cohort study using outpatient and inpatient diagnoses for the entire Swedish adult population ($N = 7,253,516$) to examine the extent to which mortality risks are overestimated using inpatient diagnoses only. Outcomes were all-cause and suicide mortality during 8 years of follow-up (2001–2008). There were 377,339 (5.2%) persons with any inpatient psychiatric diagnosis, vs. 680,596 (9.4%) with any inpatient or outpatient diagnosis, hence 44.6% of diagnoses were missed using inpatient data only. When including and accounting for prevalent psychiatric cases, all-cause mortality risk among persons with any mental disorder was overestimated by 15.3% using only inpatient diagnoses (adjusted hazard ratio [aHR], 5.89; 95% CI, 5.85–5.92) vs. both inpatient and outpatient diagnoses (aHR, 5.11; 95% CI, 5.08–5.14). Suicide risk was overestimated by 18.5% (aHRs, 23.91 vs. 20.18), but this varied widely by specific disorders, from 4.4% for substance use to 49.1% for anxiety disorders. The sole use of inpatient diagnoses resulted in even greater overestimation of all-cause or suicide mortality risks when prevalent cases were unidentified (~20–30%) or excluded (~25–40%). However, different methods for handling prevalent cases resulted in only modest variation in risk estimates when using both inpatient and outpatient diagnoses. These findings have important implications for the interpretation of hospital-based studies and the design of future studies.

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1. Introduction

Research from the past 20 years has shown that mental disorders are associated with increased all-cause (Harris and Barraclough, 1998) and suicide (Harris and Barraclough, 1997) mortality. Most large, highly cited studies have ascertained mental disorders using hospital discharge data, which are more commonly available than outpatient data (Hamer et al., 2008; Hiroeh et al., 2001; Hiroeh et al., 2008; Hoang et al., 2011; Laursen et al., 2007; Politi et al., 2002; Qin et al., 2003; Wahlbeck et al., 2011). However, persons with mental disorders who are hospitalized typically have more severe illness and do not adequately represent mental disorders in the general population. This is increasingly the case as

more mental disorders are now treated in outpatient settings (Narrow et al., 2000; Wahlbeck et al., 2011). Studies that ascertain mental disorders solely using inpatient diagnoses will miss many milder cases, likely resulting in overestimation of mortality risks for the general population, (Gale et al., 2012) although to what extent is unclear. Furthermore, studies have used different methods for handling prevalent psychiatric cases, which may either be identified and included, identified and excluded, or unidentified (counted as a case only if a new diagnosis). Although inclusion of prevalent cases may result in underestimation of mortality risks due to survivor bias, such bias may potentially be avoided if properly accounting for variable time at risk after diagnosis (left truncation), (Azzato et al., 2009; Brookmeyer, 2005) with the additional advantage of improved statistical power due to a larger sample size. The extent to which mortality risks are overestimated using only inpatient diagnoses, and the relative effects of different methods

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for handling prevalent cases, are unknown. Such information would have important implications for the interpretation of the large number of hospital-based studies, health policy planning based on such studies, and the design of future studies.

We used nationwide outpatient and inpatient data in Sweden to examine 1) the extent to which all-cause and suicide mortality risks in the general population are overestimated when mental disorders are ascertained using only inpatient compared with both inpatient and outpatient diagnoses, and 2) the extent to which risk estimates are influenced by different methods for handling prevalent psychiatric cases.

2. Materials and methods

2.1. Study population and outcomes

The study population consisted of all persons aged 17 years or older who were living in Sweden on January 1, 2001 ($N = 7,253,516$). The outcomes were all-cause mortality and suicide mortality (*International Classification of Diseases*, version 10 [ICD-10] codes X60–X84) during 8 years of follow-up (January 1, 2001 through December 31, 2008). These outcomes were identified using the Swedish Death Registry, which includes ~99.5% of all deaths nationwide (*National Board of Health and Welfare*, 2010). Suicide was examined because it is the most widely studied cause of death among psychiatric patients (*Harris and Barraclough*, 1997). This study was approved by the Regional Ethical Review Board of Lund University in Sweden.

2.2. Mental disorder ascertainment

Mental disorders were identified by any primary or secondary diagnosis in the Swedish Outpatient Registry or the Swedish Hospital Registry during the same follow-up period (January 1, 2001 through December 31, 2008). The Swedish Outpatient Registry contains all primary and secondary outpatient diagnoses nationwide starting in 2001; and the Swedish Hospital Registry contains all primary and secondary inpatient psychiatric diagnoses starting in 1973 (non-psychiatric diagnoses in 1964) for six counties in southern Sweden, and with nationwide coverage since 1987. These registries were recently estimated to be >99% complete (*Ludvigsson et al.*, 2011). “Prevalent” mental disorders were identified by any primary or secondary diagnosis in the Swedish Hospital Registry from 1973 through 2000 (before nationwide outpatient data were available). Mental disorders were classified according to ICD-10 codes and examined in the following categories: any mental disorder (F00–F69), substance use disorders (F10–F19), schizophrenia (F20), bipolar disorder (F31), depression (F32–F33), anxiety disorders (F40–F41), and personality disorders (F60–F61). Other less common mental disorders (and specifically those with <100 suicides) were not examined separately. To evaluate excess mortality risks associated with having more than one psychiatric condition, we also examined “any second mental disorder” among those specified above, while adjusting for any first mental disorder.

2.3. Statistical analysis

Cox proportional hazards regression was used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for the association between mental disorders and either all-cause or suicide mortality. Each model was performed alternatively using only inpatient or both inpatient and outpatient diagnoses during the follow-up period (2001–2008). Prevalent psychiatric cases (diagnosed in 1973–2000) were alternatively: 1) identified and

included, accounting for left truncation (variable time at risk after diagnosis) in the Cox model (*Brookmeyer*, 2005); 2) unidentified, i.e., diagnoses prior to 2001 were disregarded, so that persons were counted as cases only if they received a diagnosis during 2001–2008; or 3) identified and excluded from the model. Mental disorders were modeled as time-dependent variables in each model, so that persons contributed to “non-exposed” person-time before and “exposed” person-time after the earliest diagnosis of the respective mental disorder. Persons with multiple psychiatric diagnoses were included in multiple categories so that they contributed to the risk estimate for each respective disorder. All hazard ratios were adjusted for age (modeled as a time-dependent continuous variable) and sex. Analyses of “any second mental disorder” were also adjusted for any first mental disorder by modeling these simultaneously as separate time-dependent variables, in order to estimate the excess mortality risk associated with a second disorder above and beyond that of a first disorder. Individuals were censored at the time of emigration, as determined by the absence of a Swedish residential address in census data ($n = 202,769$; 2.8%); and, in analyses of suicide, at the time of death from any other cause ($n = 724,350$, 10.0%). The proportional hazards assumption was evaluated by graphical assessment of log–log plots (*Garrett*, 1997) and was met in each of the models. All statistical tests were two-sided and used an α -level of 0.05. All analyses were conducted using Stata statistical software, version 11.2 (*StataCorp*, 2010).

3. Results

In the entire population of 7,253,516 Swedish adults, 377,339 (5.2%) persons had an inpatient diagnosis of any mental disorder in 2001–2008, compared with 680,596 (9.4%) who had an inpatient or outpatient diagnosis of any mental disorder, hence 44.6% of diagnoses were missed using inpatient data only (*Table 1*). The proportion of diagnoses missed was highest for anxiety disorders (71.3%), and lowest for substance use disorders (27.3%) and schizophrenia (36.0%). Among cases identified using only inpatient diagnoses, 71,570 (19.0%) were prevalent (i.e., diagnosed in 1973–2000) which had an average follow-up of 9.6 years (maximum 21.4 years); whereas using both inpatient and outpatient diagnoses, there were 90,289 (13.3%) prevalent cases with an average follow-up of 9.8 years (maximum 22.0 years).

3.1. All-cause mortality

When prevalent cases were included and left truncation accounted for, the adjusted hazard ratio (aHR) for association

Table 1

Number and prevalence of Swedish adults ($N = 7,253,516$) with mental disorders ascertained alternatively using only inpatient or both inpatient and outpatient diagnoses (2001–2008).^a

Mental disorders (ICD-10 codes)	Inpatient diagnoses only <i>n</i> (%)	Inpatient and outpatient diagnoses <i>n</i> (%)	Cases missed using inpatient diagnoses only
Any mental disorder (F00–F69)	377,339 (5.2)	680,596 (9.4)	44.6%
Substance use disorders (F10–F19)	116,924 (1.6)	160,762 (2.2)	27.3%
Schizophrenia (F20)	16,620 (0.2)	25,970 (0.4)	36.0%
Bipolar disorder (F31)	14,855 (0.2)	30,895 (0.4)	51.9%
Depression (F32–F33)	95,492 (1.3)	214,830 (3.0)	55.5%
Anxiety disorders (F40–F41)	42,633 (0.6)	148,498 (2.0)	71.3%
Personality disorders (F60–F61)	12,952 (0.2)	32,330 (0.4)	59.9%
At least 2 mental disorders	44,824 (0.6)	115,206 (1.6)	61.1%

^a These comparisons are based on psychiatric diagnoses from all inpatient and outpatient settings during 2001–2008, and do not include diagnoses prior to 2001 when nationwide outpatient data were unavailable.

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