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Mortality among psychiatric patients in Taiwan—Results from a universal National Health Insurance programme

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ABSTRACT

This study investigated 6-year follow-up mortality rates and cause of death for persons younger than 45 years old with a history of hospitalisation for major psychiatric disorders after the introduction of the National Health Insurance (NHI). Linkage data combining death certificates with Taiwan NHI research claims data were used. The study cohort was comprised all patients under the age of 45 years, who had been hospitalised for major psychiatric disorders in 1998. Patients aged <45 years undergoing an appendectomy were selected as a control group. Cox proportional hazard regressions were performed to compute the adjusted 6-year hazard ratios. For patients with schizophrenia, major depression, or bipolar disorder, the adjusted risks of dying during the follow-up period were significantly 4.614, 3.707 and 3.866, respectively, times higher than that for appendectomy patients. The adjusted hazard ratios of non-natural dying during the follow-up period were significantly 16.316, 14.626 and 8.481 times for female patients with schizophrenia, major depression, and bipolar disorder, respectively, as high as for female appendectomy patients. The continuing excess mortality among psychiatric patients, from both natural and unnatural causes, still remains even after implementation of a NHI.

1. Introduction

Over the years, studies have consistently reported higher mortality rates among psychiatric patients of both genders, in various countries and ethnic groups, especially among younger patients and specifically during the first year after admission (Black et al., 1985; Casadebaig and Quemada, 1991; Chen et al., 1996; Räsänen et al., 2003). Despite some studies reporting a distinct decline in excess mortality (Sims, 1987; Casadebaig and Quemada, 1991), others have observed a persistent or even widening disparity in health outcomes between the general population and psychiatric patients (Lawrence et al., 2003; Räsänen et al., 2003).

Compared with the general population, excess mortality among psychiatric patients is attributed to both natural and unnatural causes of death (e.g., suicide and accidents). Higher risk of suicide was reported for schizophrenic, manic, and depressive patients, especially among male patients with affective disorders during the first decade after a psychiatric hospitalisation (Tsuang, 1978). Although similar patterns of death from natural causes (e.g., cardiovascular diseases and lung diseases) were reported comparing psychiatric groups and the general population, an elevated risk of mortality was documented among mentally ill people (Tsuang and Woolson, 1978; Corten et al., 1988; Mortensen and Juel, 1990, 1993).

Consistent with this picture, higher mortality, both natural and unnatural deaths, among psychiatric inpatients in Taiwan has likewise been reported (Chen et al., 1996). Using a nationwide cohort of Taiwanese psychiatric inpatients admitted between 1987 and 1988, inclusive, Chen et al. (1996) reported a higher 6-year mortality rate for psychiatric inpatients (i.e., standardized mortality ratios of 3.1 for men and 4.8 for women) compared with the general population.

Mortality studies have contributed considerably as indicators of health-care quality for inpatient and outpatient services (Tsuang and Simpson, 1985; Hewer et al., 1995). It is often asked whether equal access to health services including specialised medical procedures has been achieved for a population in general (Corten et al., 1991). Many countries with advanced economies provide universal health insurance coverage to achieve more equal health-care access and to improve the health of the general population. In Taiwan, before 1995, about 57% of the people were insured through three separate programmes, the Labor, the Government Employee, and the Farmers' Insurance Programs. In March

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1995, Taiwan initiated its National Health Insurance (NHI) programme to finance health care for all citizens. Taiwan's NHI has a unique combination of characteristics: universal coverage, a single-payer payment system with the government as the sole insurer, very low out-of-pocket copayments, comprehensive benefits, unrestricted access to any medical institution of the patient's choice and a wide variety of providers including primary care physicians. The NHI also covers the cost of medication.

Although there are limited studies available, positive effects of universal health insurance on health and health-care use have been observed (Decker and Remler, 2004). Some researchers have indicated that changes in a health-care system might contribute to a decline in the tendency to excess mortality among psychiatric patients (Tsuang and Simpson, 1985; Sims, 1987). Following the implementation of the NHI in 1995, a significant change in health-seeking behaviours and health resources use could be anticipated. It is thus of interest to re-examine the mortality rates among psychiatric patients in Taiwan following implementation of the NHI.

In this study, we investigated mortality among psychiatric patients in a universal National Health Insurance programme in Taiwan. The 6-year follow-up mortality rates and causes of death for persons younger than 45 years with a history of hospitalisation for a major psychiatric disorder following the introduction of the NHI were investigated, using data that combines death certificates with Taiwan NHI research claims data.

2. Methods

2.1. Database

The hospitalisation data used in this study were obtained from the National Health Insurance Research Dataset (NHIRD) for the years 1996–98 inclusive, as published by the National Health Research Institute in Taiwan. The dataset includes all claims data from Taiwan's National Health Insurance (NHI) programme implemented as a means of financing health care for all Taiwanese citizens. As of April 2005, the NHI program had over 21 million enrollees, representing around 96% of the island's population (Chen et al., 2007).

The NHI's reimbursement system ties a hospital's reimbursement level to its patient severity profile. To deter diagnosis upcoding, the NHI Bureau implements routine sample cross-checks of each hospital's claims with its medical charts, followed by punitive measures for coding infractions. Fines for fraudulent diagnosis reporting are generally 100 times the value of the false claim. As a result, hospitals' interests are best served by accurate coding of diagnoses and services provided. It is generally believed that the NHI's checks and balances foster accurate coding, although there have not been sensitivity and specificity studies to document its coding accuracy. Since this dataset is for the purpose of claims, no missing data is likely. As one of the largest databanks of medical/health information in the world, the NHIRD offers a unique opportunity to compare mortalities among young patients admitted to psychiatric departments.

In this study, the date of death was obtained from the 1998–2004 'cause of death' data file published by the Department of Health (DOH) in Taiwan. The 'cause of death' file provides details on marital status, the dates of births and deaths, place of legal residence, underlying cause of death (ICD-9-CM code), and employment status. Given that there is mandatory registration of all deaths in Taiwan, this data should be particularly accurate and comprehensive. The NHIRD was linked to the 'cause of death' data file with the assistance of the DOH in Taiwan.

2.2. Study sample

The study cohort consisted of all patients under the age of 45 years who had been hospitalised for schizophrenia (any ICD-9-CM 295 code other than 295.7 for schizoaffective disorder), major depression (296.2X and 296.3X), or bipolar disorder (296.0X, 296.4X, 296.5X, 296.6X, 296.7X, 296.80 or 296.89) between January and December 1998, because patients younger than 45 years are at higher risk of excess mortality (Casadebaig and Quemada, 1991; Meloni et al., 2006). To avoid the potential confounding factors of institutionalisation and chronicity (Cuijpers and Smit, 2002), those who had been hospitalized for schizophrenia, bipolar disorder, or major depression or were under any psychiatric treatment for schizophrenia during the previous 2-year period (1996–97) were excluded from the study cohort. In addition, patients aged <45 years undergoing an appendectomy in 1998 with an ICD-OP code of 47.0 as the primary operative procedure were selected as a control group, since data on the general population are not available from the NHIRD. The reason for selecting appendectomy patients as the control group was that patients undergoing appendectomies are relatively indistinguishable from the general population. No statistically significant differences were found between the control cohort and the general population in Taiwan with regard to either gender ($P>0.05$) or age ($P>0.05$). Appendectomy patients were, however, excluded if they had ever been diagnosed as having any major psychiatric disorder at the time of their recruitment.

In total, 26 374 eligible patients were ultimately selected for this study, including 5515 suffering from schizophrenia, 555 from major depression, and 1581 from bipolar disorder, as well as 18 754 who had undergone an appendectomy. Follow-up of each individual patient was undertaken from recruitment until the end of 2004, with all patients identified from administrative data to determine whether any had died. Both natural and unnatural causes of deaths were examined, with unnatural causes including suicides, accidents, and homicides, while all other deaths were defined as due to natural causes (Honkonen et al., 2008).

The regression modeling also adjusted for sociodemographic variables including age (<18, 18–24, 25–34, and ≥35 years), gender, medical co-morbidities, level of urbanisation and the geographic location of the community in which the patient resided (northern, central, eastern and southern Taiwan). Details on co-morbid medical disorders, including hypertension, diabetes, renal disease, and chronic obstructive pulmonary disease (COPD), were also extracted from the claims data at the time of the index discharge, because these conditions may exacerbate the risk of mortality.

The urbanisation levels in Taiwan consist of seven strata, with level 1 referring to the 'most urbanised' communities and level 7 referring to the 'least urbanised' communities, according to standards published by the Taiwanese National Health Research Institute. However, given that there were only very small numbers of schizophrenia cases in levels 5, 6 and 7, these three levels were combined into a single group, which was thereafter referred to as level 5.

2.3. Statistical analysis

The SAS statistical package (SAS System for Windows, version 8.2) was used to perform the statistical analyses in this study. Pearson χ^2 tests were used to examine differences in sociodemographic characteristics, co-morbid medical disorders, and the risk of stroke development among the four cohorts (schizophrenia, major depression, bipolar disorder and appendectomy). The 6-year survival rate was then estimated using the Kaplan–Meier method, with the log-rank test used to examine differences among cohorts. Cox proportional hazard regressions were also carried out as a means of computing the adjusted 6-year hazard ratios, following adjustment for the variables above. Finally, hazard ratios (HRs) are presented along with the 95% confidence intervals (95% CIs), adopting a significance level of 0.05 ($P<0.05$) for this study.

3. Results

Of the total sample of 26 374 patients under the age of 45 years, 52.1% were male, 30.6% were aged between 25 and 34 years and 0.3% had conditions complicated by hypertension, 0.1% by cardiovascular diseases, 0.5% by diabetes, 0.1% by renal diseases and 0.3% by COPD. Details of the distribution of demographic characteristics and co-morbid medical disorders for the sampled patients are provided in Table 1 by disorder type.

Compared to the appendectomy patients, patients with major depression were more likely to be female, aged between 35 and 44 years, with conditions complicated by diabetes, residing in more-urbanized communities and in northern Taiwan at the time of the index discharge (all $P<0.001$). Table 1 also shows that there were significant differences in the distributions of gender ($P<0.001$), age ($P<0.001$), hypertension ($P<0.001$), diabetes ($P=0.009$), urbanization level ($P<0.001$), and geographic region ($P<0.001$).

The log-rank test indicated that patients with schizophrenia, major depression, and bipolar disorder had significantly lower 6-year survival rates compared with appendectomy patients ($P<0.001$). The 6-year survival rate, crude HRs, and adjusted HRs of mortality for the four cohorts are presented in Table 2, which reveals that 6.8%, 5.8%, 5.6% and 1.2% of patients with schizophrenia, major depression, bipolar disorder, and an appendectomy, respectively, died during the 6-year follow-up period. For patients with schizophrenia, major depression or bipolar disorder, the risks of dying during the follow-up period were 6.113 (95% CI = 5.169–7.230, $P<0.001$), 5.191 (95% CI = 3.580–7.526, $P<0.001$), and 4.952 (95% CI = 3.864–6.347, $P<0.001$) times that for appendectomy patients, respectively. After adjusting for patient's age, gender, co-morbidities, urbanization level, and geographic region, the relationships still remained; for patients with schizophrenia, major depression, or bipolar disorder, the risks of dying during the follow-up period were 4.614 (95% CI = 3.870–5.500, $P<0.001$), 3.707 (95% CI = 2.544–5.401, $P<0.001$), and 3.866 (95% CI = 3.003–4.978, $P<0.001$) times that for appendectomy patients,

Table 1
Demographic characteristics and comorbid medical disorders of schizophrenia, major depression, bipolar disorder, and appendectomy patients in Taiwan in 1998.

Variable	Schizophrenia (N = 5515)		Depression (N = 555)		Bipolar disorder (N = 1581)		Appendectomy (N = 18,723)		P value
	n	%	n	%	n	%	n	%	
Gender									
Male	3256	59.0	201	36.2	780	49.3	9497	50.7	<0.001
Female	2259	41.0	354	63.8	801	50.8	9226	49.3	
Age (year)									
<18	169	3.1	17	3.1	89	5.8	6029	32.2	<0.001
18–24	1032	18.7	76	13.7	348	22.0	3938	21.0	
25–34	2367	42.9	205	36.9	606	38.2	4887	26.1	
35–44	1947	35.3	257	46.3	538	34.0	3869	20.7	
Hypertension									
Yes	29	0.5	3	0.5	12	0.8	31	0.2	<0.001
No	5486	99.5	552	99.5	1569	99.3	18,692	99.8	
Cardiovascular disease									
Yes	6	0.1	2	0.4	3	0.2	15	0.1	0.118
No	5509	99.9	553	99.6	1578	99.8	18,708	99.9	
Diabetes									
Yes	41	0.7	4	0.7	10	0.6	74	0.4	0.009
No	5474	99.3	551	99.3	1571	99.4	18,649	99.6	
Renal disease									
Yes	7	0.1	0	0	1	0.1	17	0.1	
No	5508	99.9	555	100	1580	99.9	18,706	99.9	
COPD									
Yes	15	0.3	1	0.2	5	0.3	47	0.3	0.943
No	5500	99.7	554	99.8	1576	99.7	18,676	99.7	
Urbanization level									
1	1896	34.4	280	50.5	613	38.9	6589	35.2	<0.001
2	2039	37.0	238	42.9	609	38.5	7493	40.0	
3	515	9.3	7	1.3	142	9.0	1840	9.8	
4	808	14.7	30	5.4	203	12.8	2341	12.5	
5	257	4.7	0	0	14	0.9	460	2.5	
Geographic region									
Northern	2234	40.2	274	49.4	720	45.4	8450	45.1	<0.001
Central	1245	22.4	66	11.9	377	23.9	4200	22.4	
Southern	1746	31.4	199	35.9	386	24.5	5585	29.8	
Eastern	339	6.1	16	2.9	98	6.2	488	2.6	

Total sample number = 26,374. COPD, chronic obstructive pulmonary disease.

respectively. For female patients with schizophrenia, major depression, or bipolar disorder, the adjusted HRs of dying were all higher than those for male patients.

Table 2 also shows the HRs by natural and non-natural deaths. Surprisingly, the adjusted HRs of dying of non-natural causes during the 6-year follow-up period were 16 316 (95% CI = 9.877–26.952, $P<0.001$), 14 626 (95% CI = 6.909–30.962, $P<0.001$) and 8 481 (95% CI = 4.357–16.513, $P<0.001$) times for female patients with schizophrenia, major depression and bipolar disorder, respectively, as high as for female appendectomy patients.

Table 3 describes proportionate mortality by disorder type. Not surprisingly, over 25% (out of total deaths) of patients with schizophrenia, major depression, or bipolar disorder died of suicide. In comparison, only 7.9% (out of total deaths) of patients undergoing an appendectomy committed suicide. Patients with major depression or bipolar disorder did not have a significantly higher rate of death due to circulatory or respiratory diseases than those undergoing an appendectomy.

4. Discussion

This is the first report on mortality among psychiatric patients, who were fully insured, in a universal NHI programme in Taiwan. An important finding is that despite the implementation of the NHI in 1995, providing universal health-care resources to all citizens, mortality remained high and 6-year survival rates were significantly lower for psychiatric patients, with females constituting a higher risk group. Compared with appendectomy patients, the adjusted hazard ratios were significantly elevated among schizophrenic, depressive and manic patients during a 6-year follow-up period, with a higher ratio of deaths by unnatural causes.

Excess mortality among psychiatric patients has been previously reported, with overall standardized mortality ratios of psychiatric to general populations in different regions and countries, ranging from approximately 1.5–3.1 for males and 1.9–4.8 for females (Brook, 1985; Wood et al., 1985). Consistent with those reports, increased mortality, from both natural and non-natural causes, was still apparent among major psychiatric patients in the 6-year follow-up period. The prevalence of certain physical illnesses is also higher among psychiatric patients. For example, Johannessen et al. (2006) reported an elevated level of hypertension in bipolar patients, and our study also observed a higher tendency to hypertension and diabetes among patients with schizophrenia and affective disorders. As regional differences have been observed in incidence of schizophrenia (Schelin et al., 2000), we found that the distribution of psychiatric inpatients was associated with urbanisation level and geographic region, with depressive people living mainly in the most urbanised communities.

Comparing our study results with those reported before the NHI era in Taiwan, no declining mortality trend was identified. Before the introduction of the NHI, Chen et al. (1996) recruited a cohort of psychiatric inpatients from 1987 to 1988 and followed them up for 6 years to the end of 1993. Despite applying various sampling methods, our finding of excess mortality among psychiatric inpatients after the implementation of the NHI appears consistent with that from the preceding period.

Researchers have proposed that universal health insurance might increase health care use among both young and elderly populations (Card et al., 2004; Decker and Remler, 2004). Findings from the NHI in

Table 2
Six-year survival rates and hazard ratios by disorder type.

Variable	Six-year survival rate	Crude hazard ratio/95% confidence interval (CI)	Adjusted hazard ratio[a]/95% CI
All deaths			
Total			
Disorder type			
Schizophrenia	93.2	6.113 (5.169–7.230)***	4.614 (3.870–5.500)***
Major depression	94.2	5.191 (3.580–7.526)***	3.707 (2.544–5.401)***
Bipolar disorder	94.5	4.952 (3.864–6.347)***	3.866 (3.003–4.978)***
Appendectomy	98.9	1.000	1.000
Male			
Disorder type			
Schizophrenia	93.2	4.807 (3.890–5.940)***	3.477 (2.791–4.329)***
Major depression	92.0	5.664 (3.376–9.501)***	3.786 (2.245–6.385)***
Bipolar disorder	93.1	4.844 (3.538–6.633)***	3.733 (2.713–5.135)***
Appendectomy	98.5	1.000	1.000
Female			
Disorder type			
Schizophrenia	93.3	8.504 (6.451–11.210)***	6.925 (5.158–9.299)***
Major depression	95.5	5.687 (3.315–9.757)***	4.619 (2.659–8.023)***
Bipolar disorder	95.8	5.275 (3.517–7.910)***	4.406 (2.905–6.681)***
Appendectomy	99.2	1.000	1.000
Natural deaths			
Total			
Disorder type			
Schizophrenia	96.2	4.977 (4.018–6.166)***	3.457 (2.780–4.342)***
Major depression	97.7	2.975 (1.651–5.361)***	1.897 (1.048–3.434)*
Bipolar disorder	97.1	3.843 (2.749–5.373)***	2.844 (2.025–3.996)***
Appendectomy	99.2	1.000	1.000
Male			
Disorder type			
Schizophrenia	96.6	4.105 (3.112–5.416)***	2.802 (2.109–3.722)***
Major depression	96.8	3.496 (1.529–7.997)***	2.145 (0.933–4.932)
Bipolar disorder	97.2	3.647 (2.338–5.690)***	2.710 (1.729–4.247)***
Appendectomy	99.1	1.000	1.000
Female			
Disorder type			
Schizophrenia	96.9	6.353 (4.530–8.909)***	4.584 (3.194–6.577)***
Major depression	98.5	2.901 (1.250–6.732)*	1.980 (0.843–4.652)
Bipolar disorder	97.7	4.200 (2.520–6.997)***	3.220 (1.906–5.439)***
Appendectomy	99.4	1.000	1.000
Non-natural deaths			
Total			
Disorder type			
Schizophrenia	96.3	9.444 (7.244–12.312)***	7.945 (6.007–10.509)***
Major depression	96.1	9.827 (6.057–15.943)***	8.276 (5.050–13.563)***
Bipolar disorder	96.8	7.934 (5.535–11.372)***	6.737 (4.658–9.743)***
Appendectomy	99.6	1.000	1.000
Male			
Disorder type			
Schizophrenia	96.3	6.558 (4.750–9.053)***	5.129 (3.653–7.201)***
Major depression	94.8	9.322 (4.747–18.304)***	7.050 (3.554–13.988)***
Bipolar disorder	95.7	7.682 (4.982–11.846)***	6.263 (4.019–9.760)***
Appendectomy	99.4	1.000	1.000
Female			
Disorder type			
Schizophrenia	96.2	16.974 (10.505–27.337)***	16.316 (9.877–26.952)***
Major depression	96.9	14.029 (6.764–29.096)***	14.626 (6.909–30.962)***
Bipolar disorder	98.0	8.941 (4.666–17.134)***	8.481 (4.357–16.513)***
Appendectomy	99.8	1.000	1.000

*$P<0.05$; ***$P<0.001$.
[a] Hazard ratios were adjusted for patient's age, gender, medical comorbidity (including hypertension, diabetes, renal disease, and chronic obstructive pulmonary disease), urbanization, and geographical location.

Taiwan also indicated that discrepancies in access to health care were indeed significantly reduced after a National Health Insurance programme with comprehensive coverage was initiated (Chen et al., 2007). Although we anticipated that higher health-care use would be associated with better health outcomes, our study was unable to find evidence of reduced mortality among psychiatric patients. Some prior studies have obtained similar results, finding that although health insurance coverage might improve self-reported health status (Card et al., 2004), mortality remained intact (Card et al., 2004; Chen et al., 2007).

Several plausible reasons might explain this finding. First, 6-year mortality might not be a sufficiently sensitive index for assessing the effects of a health-care system on health outcomes. The NHI program has only recently been implemented for that long, and mortality rates are established based upon lifetime investment in health.

Second, although the NHI in Taiwan was reported to promote greater healthcare use of both inpatient and outpatient services significantly among low- and middle-income groups, more than among the higher-income class, whether similar patterns can be observed for discrepancies between psychiatric and general populations remains a question. As reported by Kisely et al. (2007), mentally ill persons with circulatory disease (including ischaemic heart disease and stroke), especially those who had been psychiatric inpatients, were significantly less likely to undergo specialised or revascularisation procedures. Psychiatric illness was associated with reduced access to some medically necessary procedures, even in a universal health-care system aimed at producing equality in service delivery. Furthermore, psychiatric patients' motivation towards recovery and compliance with treatment might be involved in the quality of healthcare they receive.

Third, access to or use of health-care services might not be the main determinant of health. Other factors, including environment, lifestyle, or health behaviors are also substantial in influencing a person's health status (Marmot and Wilkinson, 1999). These factors cannot be directly modified by the introduction of the NHI.

Aside from implementation of the NHI, various factors might help explain the reasons why psychiatric patients possess higher mortality risk from both natural and unnatural causes of deaths. Psychiatric patients may receive poorer quality health care (Hewer et al., 1995), including insufficient diagnosis or treatment of their physical illnesses (Corten et al., 1991). Patients might be limited in their ability to recognize and communicate physical disturbances to others. Some demographic, urbanisation, or hazardous health behaviours might contribute to these differences. For example, higher cardiovascular morbidity and mortality among depressive patients might possibly be due their looser control of hypertension (Davidson et al., 2000). Lifestyle, such as alcohol or tobacco use, less physical activity, and unhealthy eating habits may play a part in the proportionately higher numbers of deaths (Brown et al., 2000; Cuijpers and Smit, 2002). Factors associated with patients' specific psychiatric symptoms or side-effects of psychotropic drugs might also be involved in the excess mortality among persons with mental illness (Appleby et al., 2000; Zarate and Patel, 2001).

Further, higher suicides rates and incidence of accidental deaths due to hazardous activities were considered to be responsible for increased numbers of death by unnatural causes. Approximately, 28% of the excess mortality might be attributed to suicide and 12% to accidents among schizophrenic patients (Brown, 1997). Proportionate mortality from suicide in our sample was high. Based upon reports from Department of Health, Executive Yuan, Taiwan, suicide rates rose from 9.97 (per 100 000) in 1998 to 15.31 (per 100 000) in 2004 among the general population in Taiwan, with an even higher rise among psychiatric patients. Further, previous studies have shown that underreporting of suicide is commonplace (Dijkhuis et al., 1994; Wang and Chou, 1997). Possible reasons for the growing trend might include increased economic burdens, psychological distress, unemployment rates, psychiatric problems (e.g., alcohol use, major depression) and other psychosocial situations (e.g., high divorce rate) (Yip, 1996; Wang and Chou, 1997).

Several limitations of this study merit attention. First, typical concerns associated with mortality analysis include the quality, extensiveness, and accuracy of death certificates and death registries

Table 3
Proportionate mortality by disorder type ($N = 34,157$).

Cause of deaths (ICD-9-CM codes 001-999)	Schizophrenia ($n = 377$)	Depression ($n = 32$)	Bipolar disorder ($n = 88$)	Appendectomy ($n = 216$)	Total ($n = 713$)
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Infectious and parasitic diseases (001–139)	8 (2.1)	0 (0.0)	2 (2.3)	1 (0.5)	11 (1.5)
Neoplasms (140–239)	26 (6.9)	0 (0.0)	12 (13.6)	56 (25.9)	94 (13.2)
Endocrine, nutritional and metabolic disease and immunity disorders (240–279)	11 (2.9)	0 (0.0)	3 (3.4)	10 (4.6)	24 (3.4)
Diseases of blood and blood-forming organs (280–289)	0 (0.0)	0 (0.0)	1 (1.1)	0 (0.0)	1 (0.1)
Diseases of the nervous system and sense organs (320–389)	3 (0.8)	0 (0.0)	1 (1.1)	8 (3.7)	12 (1.7)
Disease of the circulatory system (390–459)	30 (8.0)	1 (3.1)	1 (1.1)	18 (8.3)	50 (7.0)
Diseases of the respiratory system (460–519)	15 (4.0)	1 (3.1)	2 (2.3)	5 (2.3)	23 (3.2)
Disease of the digestive system (520–579)	26 (6.9)	5 (15.6)	10 (11.4)	26 (12.0)	67 (9.4)
Diseases of the genitourinary system (580–629)	1 (0.3)	0 (0.0)	1 (1.1)	3 (1.4)	5 (0.7)
Disease of the skin and subcutaneous tissue (680–709)	3 (0.8)	0 (0.0)	1 (1.1)	1 (0.5)	5 (0.7)
Disease of the musculoskeletal system and connective tissue (710–739)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.5)	1 (0.1)
Congenital anomalies (740–759)	3 (0.8)	0 (0.0)	0 (0.0)	0 (0.0)	3 (0.4)
Symptoms, signs, and ill-defined conditions (780–799)	33 (8.8)	3 (9.4)	4 (4.6)	10 (4.6)	50 (7.0)
Injury and poisoning (800–999)	69 (18.3)	6 (18.8)	17 (19.3)	50 (23.2)	142 (19.9)
Suicide (E950–E959)	101 (26.8)	11 (34.4)	24 (27.3)	17 (7.9)	153 (21.5)
Complications of pregnancy, childbirth, and the puerperium (630–679)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.5)	1 (0.1)
Certain conditions originating in the perinatal period (760–779)	48 (12.7)	5 (15.6)	9 (10.2)	9 (4.2)	71 (10.0)

(Martin, 1985; Flanders, 1992). Because of the mandatory registration of all deaths in Taiwan, data from the death registry should be particularly accurate and comprehensive and are thus the most appropriate data available for mortality analysis. Meanwhile, although ICD-9-CM codes were used consistently throughout our study period, the possibility of changes in coding practices on death certificates should be considered when interpreting trends in natural and non-natural deaths. In spite of the fluctuation of non-natural deaths by various methods, there has been a steady rise in natural deaths which may reflect no obvious attitudinal changes in coding practices on death certificates over the study period. However, because of the fact that claims and death certificates were used to define the diagnosis in this study, the potential bias related to the reliability of diagnoses existed. Second, the reliability and validity of the NHI claims data and over- and under-diagnoses should be considered. To deter upcoding, the NHI Bureau routinely performs sample cross-checks of each hospital's claims with its medical charts, followed by punitive measures for coding infractions. It generally accepted that the NHI's checks and balances promote appropriate coding. However, the reliability of diagnoses might vary among different psychiatric disorders, with diagnostic accuracy being higher for schizophrenia than for major depression (Chien et al., 2007). Lower diagnostic accuracy might attenuate the mortality gap slightly between patients with major depression and the general population.

Third, social stigmas might lead some patients to deny symptoms. Because of possible under-representation of psychiatric inpatients in this study, excess mortality among psychiatric patients might slightly be under-estimated. Further, the use of psychiatric inpatients might favour the recruitment of more physically vulnerable persons, because psychiatric patients with physical illness might be more likely to be hospitalised than those with mental disorders alone. Finally, this study was unable to investigate the effects of such risk factors as patients' socioeconomic status, marital status, education, and family history of psychiatric conditions related to mortality. Data regarding concurrent use alcohol, tobacco or other substances were not available.

The continuing excess mortality among psychiatric patients from both natural and unnatural causes and across different categories of mental illnesses highlights the ongoing significance of this problem. Even after implementation of a universal health-care system in Taiwan that is free at the point of delivery, this issue remains. Thus, a significant next step would be to evaluate the quality of medical care received by psychiatric patients, ascertaining its weaknesses so that further improvements can be made. Whether inequitable access to some medically necessary procedures exists for psychiatric patients under the NHI and developing strategies to reduce these disparities warrant future investigation. Consistently high rates of unnatural deaths, especially for female patients, are warning signals of deficiencies in psychiatric services. More deaths from unnatural causes occur particularly during or shortly after a psychiatric hospitalisation, reinforcing the need for more intensive care or follow-up during this period. Routine monitoring of the side effects of different types and doses of psychotropic prescriptions, compliance with the medication regimen, and encouraging healthier behaviors and lifestyles deserve special and constant attention.

Our study supports the continuing development of strategies to efficiently reduce death rates, such as improvements in health-care quality, promoting use of medical services, and keeping track of disturbing psychotic or physical symptoms among psychiatric patients. Regular monitoring of mortality trends among psychiatric patients and the effect of the NHI program on death rates should continue.

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