



Early death in those previously hospitalized for mental health care in Scotland – a nationwide follow up study, 1986 - 2010.

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Manuscripts

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Re: **Mental disorder and early death – a nationwide follow up study, 1981 - 2010.**

Tomi Ajetunmobi¹, Mark Taylor², Diane Stockton¹, and Rachael Wood¹.

	Item No	Recommendation
Title and abstract	1 Done, p1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2 Done – p2	Explain the scientific background and rationale for the investigation being reported
Objectives	3 Done – p2	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4 Done	Present key elements of study design early in the paper
Setting	5 Done	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6 Done	(a) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7 Done	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8* Done	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9 In method & discussion	Describe any efforts to address potential sources of bias
Study size	10 Done	Explain how the study size was arrived at
Quantitative variables	11 Done	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12 Done	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses
Results		
Participants	13* Done	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage

		(c) Consider use of a flow diagram
Descriptive data	14* Done	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest
Outcome data	15* Done	Report numbers of outcome events or summary measures
Main results	16 Done where applicable	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17 SMRs and YLL	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18 Done	Summarise key results with reference to study objectives
Limitations	19 Done	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20 Done	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21 Commented on	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22 Done	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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3 **Early death in those previously hospitalized for mental health care in Scotland**
4 **– a nationwide follow up study, 1986 - 2010.**
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7 'Tomi Ajetunmobi¹, Mark Taylor², Diane Stockton¹, and Rachael Wood¹.
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Contributors TA and MT conceived the study. TA and DS ascertained the data. All authors analysed the data and drafted the manuscript. RW is the study guarantor.

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Ethical approval not required as this study is covered by existing case linkage protocols. Data sharing agreed in principle.

Article Focus

- Examines whether those previously hospitalised for mental disorder die earlier than people with no overt serious mental disorder.
- Do multiple psychiatric diagnoses or comorbid disorder exacerbate any premature mortality?
- Is the apparent inequality in mortality rates between those with serious mental disorder and the general population worsening over time?

Key messages

- The average reduction in lifespan in those previously hospitalised for mental disorder compared to the general population is 17 years. People with eating disorders and personality disorder died earliest of all.
- Comorbidity or multiple psychiatric diagnoses exacerbated this effect.
- Cardiovascular and respiratory diseases were the most common causes of death, but suicides led to more years of lost life. No worsening of the 'mortality gap' over three decades was observed.

Strengths and limitations

- A large representative population studied over a long time period, which is important when examining causes of death.
- Innovative use of a diagnostic hierarchy to account for the commonly occurring comorbidity or diagnostic shift seen in psychiatry.
- People with mental disorder who never required in-patient hospital care could not be included in this study.

Objectives:

To quantify any premature mortality in those previously hospitalised for mental disorder in Scotland; attempt to separately account for the effects of multiple psychiatric diagnoses or comorbidity; and examine any trends in death rates over time.

Design:

Systematic cohort case linkage of hospital discharge and cause of death records.

Setting & participants:

Secondary care sample of all cases previously hospitalised for mental disorder in Scotland, 1986-2010.

Outcomes:

Cases with comorbidity or multiple diagnoses were hierarchically categorised, and contrasted to cases where there was no record of comorbidity. Causes of death were dichotomised into natural and non-natural causes, and time trends were analysed. Standardised mortality ratios and years of lost life were the primary outcomes.

Results

111504 people were included in the study, and 34243 had died by 31/12/2010. The average reduction in life expectancy for the whole cohort was 17 years, with eating disorders (39 year reduction) and comorbid personality disorders (27.5 year reduction) being worst affected. Non-natural deaths were 11% of the total (SMR=5.2), with these deaths occurring early, whereas physical causes of death were more common (SMR=1.7), particularly cardiovascular disease. Comorbidity elevated the risk of early death, but no worsening over time of these inequalities was observed.

Conclusions

Early death for those hospitalised with mental disorder is common, and represents a significant inequality even in well developed healthcare systems. Prevention of suicide and cardiovascular disease deserve particular attention in the mentally disordered.

Declaration of interest

All authors are employed by NHS Scotland. MT has received fees and / or hospitality from the manufacturers of various antipsychotic medications. TA, DS, and RW have no other conflicts to declare.

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3 Many of the most disabling medical conditions worldwide are mental illnesses,
4 according to the WHO¹. As well as adversely affecting day to day function, it has been
5 known for many years that people with mental illness are at increased risk of
6 premature death²⁻⁵ with schizophrenia and bipolar disorder in particular being
7 associated with an early death⁶⁻⁸. These inequalities in life expectancy have recently⁹
8 been declared a "scandal", as even the Scandinavian countries⁵, Scotland¹⁰ and
9 England⁸, despite relatively high quality and equitably distributed healthcare, have not
10 been able to demonstrate any improvement in this premature mortality for the
11 mentally ill over many years.
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17 Non-natural deaths¹¹ including suicide and accidents, account for a disproportionate
18 amount of this premature mortality in the mentally ill, particularly affecting young
19 adults. High rates of cardiovascular disease, respiratory disease and other so-called
20 natural causes also contribute^{5,12,13} to the elevated relative risk of early death in the
21 mentally ill. Precise estimates of the varying causal contributions to premature
22 mortality in the mentally disordered have been limited by the lack of large
23 representative populations being followed up over a lengthy period, and related studies
24 have usually focussed on schizophrenia and bipolar disorder^{8,14} rather than the gamut
25 of mental disorder. Additionally, the effects of comorbidity or multiple diagnoses on
26 this premature mortality have also not been quantified. Concern has also been
27 expressed that those with mental illness have not benefitted from improvements in
28 public health over the last few decades^{8,9,13} and that this mortality gap between the
29 general population and the mentally ill is widening in recent years.
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38 Using routinely collected national data, available from 1981, we set out to examine the
39 ages and causes of death in those previously hospitalised with mental disorder in
40 Scotland, and quantify any excess mortality. We also aimed to explore the relative
41 contribution of different causes of death and trends over time.
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47 **Methods**

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50 Whenever a patient is discharged from a mental ill health hospital/specialty in
51 Scotland, a Scottish Morbidity Record for Mental ill health (SMR04) is returned to the
52 Information Services Division (ISD), NHS National Services Scotland. SMR04 records
53 contain information on patient demographics such as personal identifiers, age, and
54 sex; the diagnosis that necessitated the admission; and aspects of the care given such
55 as the psychiatric subspecialty admitted to. One primary diagnosis and up to five
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3 further secondary diagnoses can be recorded. Diagnoses are coded according to the
4 International Classification of Diseases (ICD) (version 9 to 1997 and version 10 from
5 1997 to present). Statutory death records (containing demographic and ICD coded
6 cause of death information) are returned to the National Records of Scotland (NRS)
7 with copies passed to ISD for analytical purposes.
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11 For this study, SMR04 records for adults discharged from mental ill health
12 hospitals/specialities in Scotland between 1981 and 2009 were obtained. Patients
13 aged less than 15 years at the date of first admission and those admitted to the
14 learning disabilities subspecialty were excluded from the sample, in accordance with
15 the aim of studying the ages and causes of death in adults with mental illness and
16 personality disorder. Death records for the period 1986-2010 were also obtained. We
17 created a single patient record for each individual by linking all their hospital
18 admissions and their death record (if died) using a range of patient identifiers and
19 previously developed probabilistic matching algorithms. All patients who had had an
20 admission to a mental ill health specialty between 1981 and 1985 were excluded to
21 give a cohort of patients with (as close as possible to) a **first** inpatient admission
22 between 1986 and 2009 in order to clarify the issue of diagnostic shift or comorbidity.
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30 31 **Diagnostic assignment**

32 We then assigned each individual to a diagnostic category (see table 1) and excluded
33 individuals who did not have any admissions relating to a diagnostic group of interest.
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36 Table 1 here
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39 Patients with a single primary diagnosis and no other or additional diagnoses at any
40 admission were described as 'uncomplicated'. For example, an individual with five
41 hospital admissions which were all coded solely to depression would be described as
42 'uncomplicated depression'.
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46 In contrast, patients with more than one diagnosis were described as 'complicated'.
47 For patients with more than one diagnosis from the diagnostic groups of interest, a
48 hierarchical approach was used to determine the main diagnosis and hence assign a
49 patient to one group (see table 1) with schizophrenia being assigned the highest rank.
50 For example, a patient diagnosed as having bipolar disorder at their first hospital
51 admission and then admitted for depression at a later date would be assigned to the
52 'complicated bipolar' group. Conversely, someone who had three hospital admissions
53 for neurosis and then one for neurosis with depression recorded as an additional
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3 secondary diagnosis would be described as 'complicated depression' and their time at
4 risk in the cohort would be taken from their first neurosis admission.
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8 Patients may also have had other/additional diagnoses not within the diagnostic
9 groups of interest. These included other psychiatric problems (mainly dementia,
10 stress reactions and adjustment disorders); alcohol or drug misuse; or (rarely)
11 physical health problems such as pneumonia. Someone with an admission for
12 personality disorder with drug misuse recorded as an additional secondary diagnosis
13 would therefore be described as 'complicated personality disorder'.
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16 17 18 **Analysis**

19 A final record was then created for each patient within the mental ill health cohort
20 containing hierarchically defined diagnosis, complication flag, date of first admission,
21 age at first admission, sex, deprivation category at first admission, date of death and
22 (main) cause of death. Deprivation category was determined using Carstairs 1991
23 area-based deprivation quintiles¹⁵ based on postcode of residence at first admission
24 and corresponding population denominators from the Consistent Areas Through Time
25 (CATTS) classification tables¹⁶ which allows us to create a long time series of
26 deprivation-specific mortality rates.
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32 This linked dataset was used to calculate indirectly standardised mortality ratios
33 (SMRs) for the mental ill health patients using a person-years approach which took
34 account of each individual's time at risk across different age categories and time
35 periods since diagnosis. Years of Life Lost (YLL) were computed by multiplying the
36 number of deaths in the study cohort (in each period of death, sex, age band at death
37 and deprivation quintile) by the corresponding life expectancy at that age. The
38 average YLL (AYLL) was derived by dividing the total YLL by the actual number of
39 deaths within the subgroups of interest. Scottish national mortality rates split by year
40 of death (in time bands), sex, five-year age band and deprivation quintile were used
41 as the reference standard for the SMRs. Life tables were compiled based on these
42 national mortality rates following the Chiang¹⁷ methodology for the YLL analyses. To
43 examine possible trends over time in mortality rates, we chose three time period
44 cohorts each with 10 years of follow up for each cohort to capture a wide range of
45 causes of death.
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54 We looked at overall mortality; mortality by specific cause; and mortality split into
55 natural deaths (cardiovascular, cancer, respiratory, digestive, endocrine, nervous
56 system, infectious disease), non-natural deaths (accidental, suicide/undetermined,
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3 homicide), and other (all other deaths including those recorded as mental and
4 behavioural).
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8 **Results**

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11 Over the time period of study (1986-2009) there were 59,028 individuals who had a
12 consistent diagnosis within and between admissions (classified as uncomplicated) and
13 52,476 individuals who had an unstable diagnosis or additional co-morbidity within
14 and/or between admissions (classified as complicated). Women comprised 55% of the
15 cohort largely due to a higher number of cases of depression in women. Women
16 tended to be older than men at their first included admission, particularly for
17 schizophrenia and neurosis. Complicated diagnoses resulted in significantly higher
18 numbers of hospitalisations and total length of time spent in hospital as would be
19 expected (see Table 2a and 2b).
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27 Increasing deprivation was linked to mental ill health problems for both men and
28 women, with the exception of bi-polar disorder (no clear trend across deprivation
29 groups for either sex) and eating disorder in females (uncomplicated more common in
30 least deprived group; complicated no clear trend across deprivation groups).
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34 Overall, 34,243 individuals in the study cohort had died by the 31 December 2010,
35 around 80% more (SMR=1.8) than expected based on the general population (see
36 table 3). The standardised mortality ratios were generally higher for those with
37 complicated diagnoses, and highest for those with eating disorders (SMR=4.4) and
38 personality disorders complicated by comorbidity (SMR=3.1). Overall life expectancy
39 for the whole cohort of individuals with mental ill health was 17 years less than that
40 for the general population. The largest reduction in life expectancy was seen for
41 individuals with eating disorders (39 years for those with uncomplicated diagnosis) and
42 personality disorders (27.5 years for those with complicated diagnosis) however as
43 most deaths were seen in individuals with depression and schizophrenia, these
44 conditions accounted for the greatest number of years of life lost.
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50 **Relative risk of early death**

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52 The excess risk of death was extremely high for those in the youngest age group at
53 first included admission, and the excess reduced as age increased (see figure 1).
54 However, total years of life lost told a slightly different story, with a relatively constant
55 YLL for those diagnosed at ages 20-24 through to 75-79 years, with lower YLL for
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3 those aged 15-19, 80-84 and 85+ years. This reflects the fact that the absolute risk
4 of dying generally increases with age. The same age-related pattern is seen for males
5 and females, although the risk of death is higher for females compared to males at
6 every age (data not shown).
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10 **Figure 1 here**

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12 Around two thirds of deaths (22,865 deaths) in the mental ill health cohort were from
13 natural causes, 11% (3,909) from non-natural causes and the remaining 21% (7,469)
14 were from "other" deaths not coded as natural or non-natural including 'mental or
15 behavioural disorder' (36% total "other"). The excess risk of death was much higher
16 from non-natural causes (SMR=5.2) compared to natural causes (SMR=1.7) and
17 "other" deaths (SMR=1.6). On average, 31.8 years of life were lost due to every non-
18 natural death compared to 13.3 years due to every natural death and 17.4 years of life
19 lost for each "other" death, reflecting the fact that non-natural deaths tend to occur at
20 younger ages (see Table 4).
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27 There was a significant excess risk of natural, non-natural and "other" deaths for
28 patients in each diagnosis group (except uncomplicated neurotic disorders resulting in
29 "other" deaths (SMR=1.1, ns)). The highest excess risks were seen for eating
30 disorders across death groupings, although the number of deaths from eating
31 disorders was small (see Table 4). Natural deaths accounted for more years of life lost
32 than non-natural deaths in each diagnostic group. Cardiovascular disease accounted
33 for around half of all years of life lost from natural causes, with digestive disorders,
34 cancer, and respiratory disorders accounting for most of the remainder. Suicide
35 accounted for the majority of years of life lost due to non-natural causes in each
36 diagnostic group (data not shown) but Table 5 reveals the proportions of observed and
37 expected deaths for the two main natural causes of death, namely heart disease and
38 cancer, as well as suicide.
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46 **Tables 2a; 2b; 3; 4; and 5 here**

47 **Mortality trends over time**

48 Looking at individuals whose first admissions were in the periods 1986-90, 1991-95
49 and 1996-2000 and following each individual in these sub-cohorts up for 10 years from
50 their first admission, the all cause standardised mortality ratios showed no evidence of
51 a narrowing of the mortality excess over time (see Table 6).
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3 **Table 6 here**
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9 **Discussion**

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11 **Main findings**

12 This large national study provides an accurate estimate of the risk of early death
13 experienced by adults previously hospitalised for mental disorder. We showed that
14 overall life expectancy for the whole cohort of individuals previously hospitalised due to
15 mental ill health was 17 years less than that for the general population, and that the
16 excess risk of early death is greatest by far in the youngest (15-19 years old) age
17 group but that older individuals experience greater numbers of early deaths. The
18 largest reduction in life expectancy was seen for individuals with eating disorders and
19 personality disorders – namely an alarming 39 years reduction in life expectancy for
20 uncomplicated eating disorders, and 27.5 for those with a complicated personality
21 disorder.
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24 However as the greatest number of deaths were seen in individuals with depression
25 and schizophrenia, these conditions accounted for the greatest number of years of life
26 lost. The majority of these deaths in those previously hospitalised for mental disorder
27 are due to 'natural' causes such as cardiovascular and respiratory disorder, which
28 mirrors the results of a similar study from Denmark⁷ examining the life expectancy of
29 those with schizophrenia and bipolar disorder. By contrast, although only 11% of
30 deaths in our study population were attributable to 'non-natural' causes such as
31 suicide, accidents, and homicide, we found that these 'non-natural' causes carried a
32 substantially higher comparative excess risk of early death – ranging between 27
33 years of lost life for depression to a staggering 49.5 years for eating disorders,
34 emphasising that these non-natural deaths occur earlier than the more common
35 natural causes of death. For the whole cohort of mentally ill individuals, those dying
36 from non-natural causes lost, on average, almost 32 years of life, reinforcing the
37 continuing need for national suicide prevention strategies.
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41 **A stable 'mortality gap'?**

42 In addition, contrary to results elsewhere^{8,13}, we did not find any evidence that the
43 difference in risk of death between the general population and the mentally disordered
44 was worsening over time. In fact, we observed that this 'mortality gap' was stable over
45 25 years for all the common mental disorders, which offers some reassurance to
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3 claims that the mentally disordered have not benefited from improvements in public
4 health^{15,16}. Nevertheless, our data indicates that there continues to be a need for
5 monitoring the physical health of those with mental disorder, and in particular
6 screening for cardiovascular disease.
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10 **Strengths and limitations of the study**

11 Strengths of this study include the whole population coverage and the long time
12 series, along with the demonstrable high quality and completeness²⁰ of the diagnostic
13 coding and cause of death coding. We have also taken care with final diagnosis
14 assignment, using a pragmatic hierarchical approach to account for the diagnostic shift
15 and comorbidities that are commonly seen in day-to-day clinical psychiatric practice.
16 Definitive diagnosis is not always easy initially in mental health. The complicated
17 diagnoses are assigned according to a hierarchy rather than diagnosis at first
18 admission. This approach considerably increases the number of people in the higher
19 categories (eg psychoses). For example, of 17,031 individuals who were first admitted
20 with depression, 71% were assigned to depression, 17% subsequently had
21 schizophrenia and so are assigned to "complicated schizophrenia", and 11% were
22 assigned to "complicated bipolar". For some groups the hierarchy is less intuitive, for
23 example, of the 325 individuals who were first admitted with eating disorders but
24 subsequently had other mental ill health problems, 69% moved out of the eating
25 disorder group into another group higher up the hierarchy (data not shown). This will
26 lead to a conservative SMR for some complicated cases due to time at risk for
27 conditions lower down the hierarchy being assigned to a condition higher up the
28 hierarchy in the person-year analysis.
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40 **Comorbidity and early death**

41 Furthermore, we have documented that diagnostic comorbidity, whether it is comorbid
42 substance misuse, mental disorder or physical health problems, significantly elevates
43 risk of premature death and the average years of lost life in those previously
44 hospitalised due to mental illness. This adverse effect of comorbidity has not reported
45 before to our knowledge, and emphasises that comorbidity exacerbates prognosis.
46 Also, our use of the SMR and the 'years of lost life' techniques allows quantification of
47 both the relative and the absolute burden of excess death in this population. However,
48 as this is a secondary care cohort, it will only capture those most severely affected by
49 mental disorder, and hence does not allow comment on, for example, those with
50 depression managed solely in the community. Equally, those hospitalised due to eating
51 disorder are often physically unwell, so it is perhaps no surprise that this diagnostic
52 group had worrying relative and absolute mortality results in this study. Lastly, we
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3 designed a 'wash in' period of 5 years (1981-1986) in order to capture only first
4 admissions, but it is likely that some patients with psychiatric admissions prior to 1981
5 were included. The apparently old age at 'diagnosis'/first admission may suggest that
6 these are in fact not all first admissions ie the relatively short wash in period has
7 allowed us to include patients readmitted after more than 5 years as 'first admissions'.
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11 A systematic review by Saha et al¹³ found a SMR of 2.5 for risk of death in
12 schizophrenia, which is greater than our figures of 1.8 (uncomplicated) and 2.0
13 (complicated or comorbid), but the more recent study by Hoang and colleagues from
14 England⁸ found similar SMRs for both schizophrenia and bipolar disorder to our own
15 results, albeit with a shorter follow up. Large long term follow up mortality studies
16 comparing common mental disorders have not been reported elsewhere, to our
17 knowledge, and our data provide context for the literature on early death in specific
18 disorders such as schizophrenia and bipolar⁸, and depression and anxiety²¹. More
19 detailed analysis of the time trends for individual causes of death in specific diagnostic
20 groups would be valuable in the future.
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28 **Implications**

29 In previous studies of all-cause mortality in those with mental illness in Scotland,
30 behavioural risk factors such as heavy smoking and a sedentary lifestyle have been
31 linked to early death, along with social isolation and deprivation²². Policy makers in the
32 UK have also highlighted the physical health needs and premature mortality of those
33 with mental health problems which echo the worrying disparities in lifespan we have
34 identified for all the common mental disorders compared to the general population. In
35 particular, we have found that the highest risk of early death is associated with a
36 young age; eating disorders; personality disorders; and in those with multiple
37 diagnoses. A national approach across primary and secondary care tackling the
38 complex mix of factors contributing to early death in the mentally disordered is
39 required, addressing intrinsic disease related factors as well as lifestyle issues; lack of
40 help seeking; and even stigma within the healthcare professions^{15,16}. The inequity in
41 life expectancy in the mentally disordered documented here poses a considerable
42 challenge to our healthcare system.
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53 Acknowledgements. Thanks to Dr Denise Coia
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56 **References**

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Table 1: Diagnostic categories of interest (and diagnostic hierarchy)

Diagnostic group	Definition	Hierarchy
Schizophrenia	Schizophrenia and other psychotic disorders including acute psychosis, persistent delusional disorders, schizotypal and schizoaffective disorder, and drug or alcohol induced psychotic disorder	1
Bipolar disorder	Manic episodes and bipolar disorder	2
Depression	Depressive episodes and recurrent depressive disorder (excluding persistent mood disorders such as cyclothymia)	3
Neurosis	Anxiety disorders and obsessive compulsive disorder	4
Eating disorder	Anorexia and bulimia nervosa	5
Personality disorder	All types of personality disorder	6

Note: ICD9 and ICD10 codes available on request.

Table 2a: Characteristics of the cohort included in the analysis (Males)

	N	%	Median age at first admission	% in most deprived quintile ¹	Admissions	
					Median number	Median total length
Uncomplicated diagnosis group:						
Schizophrenia	8,966	35	33.7	29	1	48
Bipolar disorder	1,680	7	41.1	17	1	36
Depression	12,778	49	47.5	23	1	22
Neurosis	1,129	4	40.7	26	1	14
Eating disorder	49	0	22.1	33	1	48
Personality disorder	1,221	5	30.9	30	1	8
Total uncomplicated	25,823	100	40.9	25	1	28
Complicated (hierarchical) diagnosis group:						
Schizophrenia	10,697	43	31.0	33	4	145
Bipolar disorder	2,159	9	42.4	21	3	115
Depression	9,421	38	40.1	26	2	44
Neurosis	915	4	37.1	24	2	32
Eating disorder	17	0	31.3	29	3	45
Personality disorder	1,580	6	31.3	31	2	21
Total complicated	24,789	100	35.5	28	3	73

Table 2b: Characteristics of the cohort included in the analysis (Females)

	N	%	Median age at first admission	% in most deprived quintile ¹	Admissions	
					Median number	Median total length
Uncomplicated diagnosis group:						
Schizophrenia	6,999	21	54.0	25	1	47
Bipolar disorder	2,196	7	43.4	18	1	35
Depression	20,383	61	48.5	23	1	28
Neurosis	1,946	6	48.5	26	1	18
Eating disorder	586	2	20.7	16	1	49
Personality disorder	1,095	3	31.2	27	1	9
Total uncomplicated	33,205	100	47.7	23	1	30
Complicated (hierarchical) diagnosis group:						
Schizophrenia	8,230	30	40.6	29	3	162
Bipolar disorder	3,619	13	43.0	22	3	136
Depression	13,390	48	41.1	25	2	64
Neurosis	1,136	4	42.9	21	2	38
Eating disorder	199	1	26.2	18	2	35
Personality disorder	1,113	4	29.5	28	2	27
Total complicated	27,687	100	40.6	26	3	89

1 if there had been no deprivation gradient then around 20% of cases would be in the most deprived quintile

Table 3: SMRs and years of life lost for all-cause mortality by diagnosis group (all patients diagnosed 1986-2009 and followed up until 31 December 2010)

	Observed deaths	Expected deaths	SMR ¹	Lower CI	Upper CI	Total YLL	Average YLL
Uncomplicated diagnosis group:							
Schizophrenia	5,060	2,746	1.8	1.8	1.9	78,027	15.2
Bi-polar	883	525.6	1.7	1.6	1.8	14,369	16.1
Depression	11,036	6,831.2	1.6	1.6	1.6	155,582	14.1
Neurotic disorders	838	524.7	1.6	1.5	1.7	12,373	14.9
Eating disorders	51	11.6	4.4	3.3	5.8	2,182	39.0
Personality disorders	449	234.9	1.9	1.7	2.1	10,583	22.8
Complicated (hierarchical) diagnosis group:							
Schizophrenia	5,635	2,876.9	2.0	1.9	2.0	116,775	19.6
Bi-polar	1,706	1,129.5	1.5	1.4	1.6	29,351	16.7
Depression	7,282	3,628.8	2.0	2.0	2.1	146,736	19.0
Neurotic disorders	579	272.8	2.1	2.0	2.3	12,194	19.9
Eating disorders	38	8.7	4.4	3.1	6.0	1,317	31.4
Personality disorders	686	221.9	3.1	2.9	3.3	20,894	27.5
Total	34,243	19,012.4	1.8	1.8	1.8	600,383	17.0

¹ adjusted for sex, age, period and deprivation category (Carstairs 1991 decile) at first diagnosis

Table 4: SMRs and years of life lost by diagnosis group and cause of death grouping (natural death, non-natural death, or "other" deaths) (all patients diagnosed 1986-2009 and followed up until 31 December 2010)

	Natural deaths			Non-natural deaths			Other deaths		
	N	SMR (95% CI)	AYYL	N	SMR (95% CI)	AYYL	N	SMR (95% CI)	AYYL
Uncomplicated diagnosis group:									
Schizophrenia	3,580	1.8 (1.7 - 1.8)	11.8	504	4.4 (4.0 - 4.8)	32.2	976	1.6 (1.5 - 1.7)	16.3
Bi-polar	624	1.7 (1.6 - 1.8)	13.0	97	4.7 (3.8 - 5.8)	32.0	162	1.2 (1.0 - 1.4)	16.4
Depression	7,839	1.6 (1.6 - 1.6)	12.0	1,055	4.9 (4.6 - 5.2)	27.2	2,142	1.2 (1.2 - 1.3)	13.8
Neurotic disorders	622	1.7 (1.6 - 1.9)	13.2	63	3.3 (2.6 - 4.3)	29.4	153	1.1 (0.9 - 1.3)	15.1
Eating disorders	15	2.6 (1.4 - 4.3)	23.8	12	7.2 (3.7 - 12.6)	49.5	24	5.8 (3.7 - 8.7)	39.3
Personality disorders	265	1.7 (1.5 - 1.9)	15.0	96	6.2 (5.0 - 7.6)	37.6	88	1.4 (1.2 - 1.8)	25.6
Complicated (hierarchical) diagnosis group:									
Schizophrenia	3,500	1.7 (1.7 - 1.8)	14.3	767	5.2 (4.8 - 5.5)	35.1	1,368	2.0 (1.9 - 2.1)	20.0
Bi-polar	1,139	1.4 (1.3 - 1.5)	13.7	197	5.1 (4.4 - 5.8)	30.8	370	1.3 (1.1 - 1.4)	15.7
Depression	4,525	1.8 (1.7 - 1.8)	14.8	931	6.5 (6.1 - 7.0)	32.3	1,826	1.9 (1.9 - 2.0)	18.6
Neurotic disorders	379	2.0 (1.8 - 2.3)	16.4	53	4.3 (3.2 - 5.6)	33.6	147	2.0 (1.7 - 2.3)	20.0
Eating disorders	17	3.0 (1.7 - 4.8)	24.4	5	9.0 (2.8 - 21.1)	43.2	16	6.6 (3.7 - 10.7)	32.9
Personality disorders	360	2.5 (2.2 - 2.7)	19.9	129	7.5 (6.2 - 8.9)	39.0	197	3.4 (2.9 - 3.9)	28.8
Total	22,865	1.7 (1.7 - 1.7)	13.3	3,909	5.2 (5.1 - 5.4)	31.8	7,469	1.6 (1.5 - 1.6)	17.4

¹ adjusted for sex, age, period and deprivation category (Carstairs 1991 decile) at first diagnosis

Table 5. Observed and expected number of deaths for cardiovascular disease; cancer; and suicide.

	Observed CVS ¹ deaths	Expected CVS deaths	Observed Cancer ² deaths	Expected Cancer deaths	Observed suicide ³ deaths	Expected suicide deaths
Uncomplicated diagnosis group:						
Schizophrenia	2010	1109	650	500	502	110
Bi-polar	335	199	135	105	97	19
Depression	4281	2691	1671	1358	1047	211
Neurotic disorders	313	195	136	102	60	17
Eating disorders	6	3	3	1	12	1
Personality disorders	136	84	55	41	88	14
Complicated diagnosis group						
Schizophrenia	1740	1108	476	543	771	150
Bi-polar	596	425	201	238	198	38
Depression	2219	1368	730	718	932	138
Neurotic disorders	316	99	68	51	53	12
Eating disorders	5	3	3	1	5	0
Personality disorders	129	75	49	44	123	15

¹ All cardiovascular (heart disease) deaths. ² All cancer, including lung cancer, deaths.

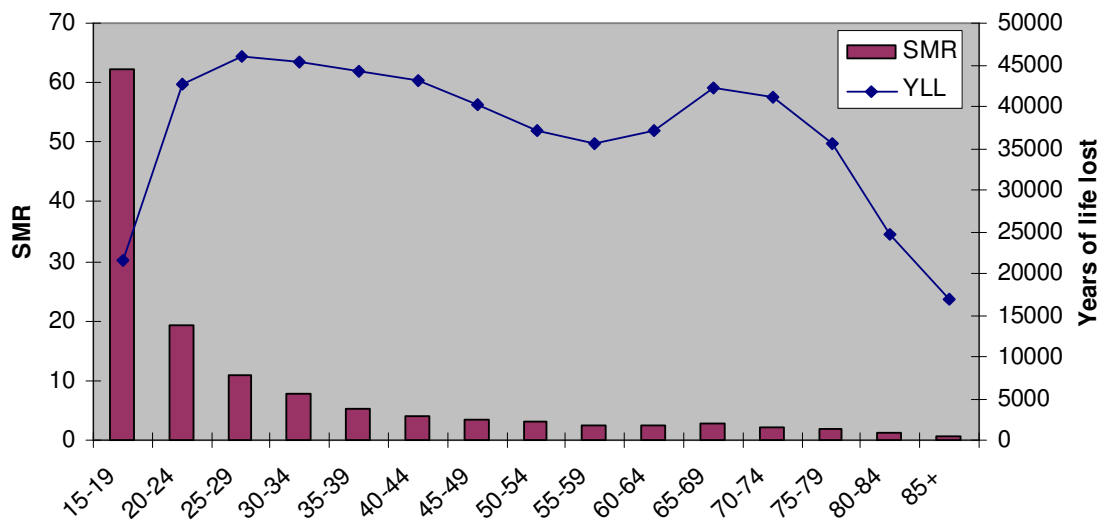
³ All deaths coded as suicides and accidents by poisoning.

Table 6: SMRs by time period of first admission (1986-2000) and followed up for 10 years from first admission (all diagnosis groups combined)

	Period of first diagnosis	Observed deaths	Expected deaths	SMR ¹	Lower CI	Upper CI
Males	1986-90	3185	1514.1	2.1	2.0	2.2
	1991-95	2878	1328.0	2.2	2.1	2.2
	1996-00	2327	1075.9	2.2	2.1	2.3
Females	1986-90	4808	2669.0	1.8	1.8	1.9
	1991-95	3882	2112.3	1.8	1.8	1.9
	1996-00	2740	1412.6	1.9	1.9	2.0

¹ adjusted for age and deprivation category (Carstairs 1991 decile) at first diagnosis

Figure 1: Age-specific all-cause SMRs and overall YLL for all patients diagnosed 1986-2009 and followed up until 31 December 2010



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Early death in those previously hospitalized for mental health care in Scotland – a nationwide follow up study, 1986 - 2010.

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3 **Early death in those previously hospitalized for mental health care in Scotland**
4 **- a nationwide follow up study, 1986 - 2010.**
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49 Contributors OA and MT conceived the study. OA and DS ascertained the data. All
50 authors analysed the data and drafted the manuscript. RW is the study guarantor.
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54

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56 for this study as no patient identifiable data were released outwith NHS National
57 Services Scotland and no new data linkages were undertaken.
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Article Focus

- Examines whether those previously hospitalised for mental disorder die earlier than people with no overt serious mental disorder.
- Do individuals with 'complicated' diagnoses (ie additional mental or physical ill health diagnoses in conjunction with their main psychiatric diagnosis) have higher excess mortality than those with 'uncomplicated' diagnoses?
- Is the apparent inequality in mortality rates between those with serious mental disorder and the general population worsening over time?

Key messages

- The average reduction in lifespan in those previously hospitalised for mental disorder compared to the general population is 17 years. People with eating disorders and personality disorder died earliest of all.
- In general, patients with 'complicated' diagnoses experience higher excess mortality than those without.
- Cardiovascular and respiratory diseases were the most common causes of death and accounted for a high proportion of the total burden of years of life lost, but suicides led to more years of lost life at the individual level due to predominantly affecting younger adults. No worsening of the 'mortality gap' over three decades was observed.

Strengths and limitations

- A large representative population studied over a long time period, which is important when examining causes of death.
- Innovative use of a diagnostic hierarchy to determine individuals' main psychiatric diagnosis.
- People with mental disorder who never required in-patient hospital care could not be included in this study.

Objectives:

To compare the mortality in those previously hospitalised for mental disorder in Scotland to that experienced by the general population.

Design:

Population based historical cohort study using routinely available psychiatric hospital discharge and death records.

Setting & participants:

Individuals with a first hospital admission for mental disorder in Scotland, 1986-2009.

Outcomes:

The main outcome measure was death from any cause, 1986-2010. Excess mortality in individuals with previous psychiatric admission was presented as standardised mortality ratios (SMR) and years of life lost (YLL). Excess mortality was assessed overall and by age, sex, main psychiatric diagnosis, whether the psychiatric diagnosis was 'complicated' (ie additional mental or physical ill health diagnoses present), cause of death, and time period of first admission.

Results

111504 people were included in the study, and 34243 had died by 31/12/2010. The average reduction in life expectancy for the whole cohort was 17 years, with eating disorders (39 year reduction) and 'complicated' personality disorders (27.5 year reduction) being worst affected. 'Natural' causes of death such as cardiovascular disease showed modestly elevated relative risk (SMR1.7) but accounted for a high proportion of all deaths (67%) and of the total burden of years of life lost (54%). Non-natural deaths such as suicide showed higher relative risk (SMR5.2) and tended to occur at a younger age but were less common overall (11% of all deaths and 22% of all YLL). Having a 'complicated' diagnosis tended to elevate the risk of early death. No worsening of the overall excess mortality experienced by individuals with previous psychiatric admission over time was observed.

Conclusions

Early death for those hospitalised with mental disorder is common, and represents a significant inequality even in well developed healthcare systems. Prevention of suicide and cardiovascular disease deserve particular attention in the mentally disordered.

Declaration of interest

All authors are employed by NHS Scotland. MT has received fees and / or hospitality from the manufacturers of various antipsychotic medications. TA, DS, and RW have no other conflicts to declare.

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3 Many of the most disabling medical conditions worldwide are mental illnesses,
4 according to the WHO¹. As well as adversely affecting day to day function, it has been
5 known for many years that people with mental illness are at increased risk of
6 premature death²⁻⁵ with schizophrenia and bipolar disorder in particular being
7 associated with an early death⁶⁻⁸. These inequalities in life expectancy have recently⁹
8 been declared a "scandal", as even the Scandinavian countries⁵, Scotland¹⁰ and
9 England⁸, despite relatively high quality and equitably distributed healthcare, have not
10 been able to demonstrate any improvement in this premature mortality for the
11 mentally ill over many years.
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18 Non-natural deaths¹¹ including suicide and accidents, account for a disproportionate
19 amount of this premature mortality in the mentally ill, particularly affecting young
20 adults. High rates of cardiovascular disease, respiratory disease and other so-called
21 natural causes also contribute^{5,12,13} to the elevated relative risk of early death in the
22 mentally ill. Precise estimates of the varying causal contributions to premature
23 mortality in the mentally disordered have been limited by the lack of large
24 representative populations being followed up over a lengthy period, and related studies
25 have usually focussed on schizophrenia and bipolar disorder^{8,14} rather than the gamut
26 of mental disorder. Additionally, the effects of comorbidity or multiple diagnoses on
27 this premature mortality have also not been quantified. Concern has also been
28 expressed that those with mental illness have not benefitted from improvements in
29 public health over the last few decades^{8,9,13} and that this mortality gap between the
30 general population and the mentally ill is widening in recent years.
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38 Using routinely collected national data, available from 1981, we set out to examine the
39 ages and causes of death in those previously hospitalised with mental disorder in
40 Scotland, and quantify any excess mortality. We also aimed to explore the relative
41 contribution of different causes of death and trends over time.
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47 **Methods**

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50 Whenever a patient is discharged from a mental ill health hospital/specialty in
51 Scotland, a Scottish Morbidity Record for Mental ill health (SMR04) is returned to the
52 NHS National Services Scotland Information Services Division (ISD).. SMR04 records
53 contain information on patient demographics such as personal identifiers, age, and
54 sex; the diagnosis that necessitated the admission; and aspects of the care given such
55 as the psychiatric subspecialty admitted to. One primary diagnosis and up to five
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3 further secondary diagnoses can be recorded. Diagnoses are coded according to the
4 International Classification of Diseases (ICD) (version 9 to 1997 and version 10 from
5 1997 to present). Statutory death records (containing demographic and ICD coded
6 cause of death information) are returned to the National Records of Scotland (NRS)
7 with copies passed to ISD for analytical purposes.
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11 For this study, SMR04 records for adults discharged from mental ill health
12 hospitals/specialities in Scotland between 1981 and 2009 were obtained. Patients
13 aged less than 15 years at the date of first admission and those admitted to the
14 learning disabilities subspecialty were excluded from the sample, in accordance with
15 the aim of studying the ages and causes of death in adults with mental illness and
16 personality disorder. Death records for the period 1986-2010 were also obtained. We
17 created a single patient record for each individual by linking all their hospital discharge
18 records and their death record (if died) using a range of patient identifiers and
19 previously developed probabilistic matching algorithms. All patients who had had an
20 admission to a mental ill health specialty between 1981 and 1985 were excluded to
21 give a cohort of patients with (as close as possible to) a **first** inpatient admission
22 between 1986 and 2009 in order to clarify the issue of diagnostic shift or comorbidity.
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31 All patient level data used in this study were held and analysed within ISD. Only
32 aggregate results, from which individual patients could not be identified, were shared
33 with members of the study team not based within ISD (MT). ISD operates strict
34 procedures to maintain patient privacy and confidentiality and no specific additional
35 permissions were required for this study. In particular, permission for linkage of
36 previously unlinked health datasets held by ISD is required from the Privacy Advisory
37 Committee. PAC approval was not required for this study however as SMR04 and
38 death records have been routinely linked within ISD for decades for purposes such as
39 monitoring patient outcomes.
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47 **Diagnostic assignation**

48 We then assigned each individual to a main psychiatric diagnosis category (see table
49 1) and excluded individuals who did not have any admissions relating to a diagnostic
50 group of interest. The diagnostic groups of interest included were schizophrenia,
51 bipolar disorder, depression, neurosis, eating disorder, and personality disorder.
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3 Patients with a single primary psychiatric diagnosis of interest recorded on all their
4 psychiatric discharge records over the period of study, and no other or additional
5 diagnoses at any admission, were described as 'uncomplicated'. For example, an
6 individual with five hospital admissions which were all coded solely to depression
7 would be described as 'uncomplicated depression'.
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11 In contrast, patients with more than one diagnosis recorded were described as
12 'complicated'. For patients with more than one diagnosis from the diagnostic groups of
13 interest, a hierarchical approach was used to determine the main diagnosis and hence
14 assign a patient to one group (see table 1) with schizophrenia being assigned the
15 highest rank. For example, a patient diagnosed as having bipolar disorder at their first
16 hospital admission and then admitted for neurosis at a later date would be assigned to
17 the 'complicated bipolar' group. Conversely, someone who had three hospital
18 admissions for neurosis and then one for neurosis with depression recorded as an
19 additional secondary diagnosis would be described as 'complicated depression' and
20 their time at risk in the cohort would be taken from their first neurosis admission.
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28 Patients may also have had other/additional diagnoses not within the diagnostic
29 groups of interest. These included other psychiatric problems (mainly dementia,
30 stress reactions and adjustment disorders); alcohol or drug misuse; or (rarely)
31 physical health problems such as pneumonia. Someone with an admission for
32 personality disorder with drug misuse recorded as an additional secondary diagnosis
33 would therefore be described as 'complicated personality disorder'.
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38 **Analysis**

39 A final record was then created for each patient within the mental ill health cohort
40 containing hierarchically defined main psychiatric diagnosis, a flag indicating whether
41 the main diagnosis was 'complicated' or not, date of first admission, age at first
42 admission, sex, deprivation category at first admission, date of death and (main)
43 cause of death. Deprivation category was determined using Carstairs 1991 area-based
44 deprivation quintiles¹⁵ based on postcode of residence at first admission and
45 corresponding population denominators from the Consistent Areas Through Time
46 (CATTS) classification tables¹⁶ which allows us to create a long time series of
47 deprivation-specific mortality rates.
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54 This linked dataset was used to calculate indirectly standardised mortality ratios
55 (SMRs) for the mental ill health patients using a person-years approach which took
56 account of each individual's time at risk (from time of first admission) across different
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3 age categories and time periods since diagnosis. Years of Life Lost (YLL) were
4 computed by multiplying the number of deaths in the study cohort (in each period of
5 death, sex, age band at death and deprivation quintile) by the corresponding life
6 expectancy at that age. The average YLL (AYLL) was derived by dividing the total YLL
7 by the actual number of deaths within the subgroups of interest. Scottish national
8 mortality rates split by year of death (in time bands), sex, five-year age band and
9 deprivation quintile were used as the reference standard for the SMRs. Life tables
10 were compiled based on these national mortality rates following the Chiang¹⁷
11 methodology for the YLL analyses. To examine possible trends over time in the excess
12 mortality experienced by individuals with previous psychiatric admission, we chose
13 three time period cohorts each with 10 years of follow up for each cohort to capture a
14 wide range of causes of death.
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22 We looked at overall mortality; mortality by specific cause; and mortality split into
23 natural deaths (cardiovascular, cancer, respiratory, digestive, endocrine, nervous
24 system, infectious disease), non-natural deaths (accidental, suicide/undetermined,
25 homicide), and other (all other deaths including those recorded as mental and
26 behavioural).
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32 Results

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35 Over the time period of study (1986-2009) there were 59,028 individuals who had a
36 consistent diagnosis within and between admissions (classified as uncomplicated) and
37 52,476 individuals who had an unstable diagnosis or additional co-morbidity within
38 and/or between admissions (classified as complicated). Women comprised 55% of the
39 cohort largely due to a higher number of cases of depression in women. Women
40 tended to be older than men at their first included admission, particularly for
41 schizophrenia and neurosis. Complicated diagnoses resulted in higher numbers of
42 hospitalisations and total length of time spent in hospital as would be expected (see
43 Table 2a and 2b).
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50 Increasing deprivation was linked to mental ill health problems for both men and
51 women, with the exception of bi-polar disorder (no clear trend across deprivation
52 groups for either sex) and eating disorder in females (uncomplicated more common in
53 least deprived group; complicated no clear trend across deprivation groups) (Table 2
54 and additional analyses available on request).
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3 Overall, 34,243 individuals in the study cohort had died by the 31 December 2010,
4 around 80% more (SMR=1.8) than expected based on the general population (see
5 table 3). The standardised mortality ratios tended to be higher for those with
6 complicated diagnoses, and overall were highest for those with eating disorders
7 (SMR=4.4) and complicated personality disorders (SMR=3.1). Overall life expectancy
8 for the whole cohort of individuals with mental ill health was 17 years less than that
9 for the general population. The largest reduction in life expectancy was seen for
10 individuals with eating disorders (39 years of life lost for those with uncomplicated
11 diagnosis) and personality disorders (27.5 YLL for those with complicated diagnosis)
12 however as most deaths were seen in individuals with depression and schizophrenia,
13 these conditions accounted for the greatest number of years of life lost.
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20 21 **Relative risk of early death**

22 The excess risk of death was extremely high for those in the youngest age group at
23 first included admission, and the excess reduced as age increased (see figure 1).
24 However, total years of life lost told a slightly different story, with a relatively constant
25 YLL for those diagnosed at ages 20-24 through to 75-79 years, with lower YLL for
26 those aged 15-19, 80-84 and 85+ years. This reflects the fact that the absolute risk
27 of dying generally increases with age. The same age-related pattern is seen for males
28 and females, although the excess risk of death is higher for females compared to
29 males at every age (data not shown).
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35 **Figure 1 here**

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38 Around two thirds of deaths (22,865 deaths) in the mental ill health cohort were from
39 natural causes, 11% (3,909) from non-natural causes and the remaining 21% (7,469)
40 were from "other" deaths not coded as natural or non-natural including 'mental or
41 behavioural disorder' (36% total "other"). The excess risk of death was much higher
42 from non-natural causes (SMR=5.2) compared to natural causes (SMR=1.7) and
43 "other" deaths (SMR=1.6). On average, 31.8 years of life were lost due to every non-
44 natural death compared to 13.3 years due to every natural death and 17.4 years of life
45 lost for each "other" death, reflecting the fact that non-natural deaths tend to occur at
46 younger ages (see Table 4).
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53 There was a significant excess risk of natural, non-natural and "other" deaths for
54 patients in each diagnosis group (except uncomplicated neurotic disorders resulting in
55 "other" deaths (SMR=1.1, ns)). The highest excess risks were seen for eating
56 disorders across death groupings, although the number of deaths in individuals with
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3 eating disorders was small (see Table 4). Natural deaths accounted for more years of
4 life lost than non-natural deaths in each diagnostic group. Cardiovascular disease
5 accounted for around half of all years of life lost from natural causes, with digestive
6 disorders, cancer, and respiratory disorders accounting for most of the remainder.
7 Suicide accounted for the majority of years of life lost due to non-natural causes in
8 each diagnostic group (data not shown). Table 5 reveals the proportions of observed
9 and expected deaths for the two main natural causes of death, namely heart disease
10 and cancer, as well as suicide.
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16 **Tables 2a; 2b; 3; 4; and 5 here**
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18 19 **Mortality trends over time**

20 Looking at individuals whose first admissions were in the periods 1986-90, 1991-95
21 and 1996-2000 and following each individual in these sub-cohorts up for 10 years from
22 their first admission, the all cause standardised mortality ratios showed no evidence of
23 a narrowing of the mortality excess over time (see Table 6).
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28 **Table 6 here**
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33 **Discussion**

34 35 **Main findings**

36 This large national study provides an accurate estimate of the risk of early death
37 experienced by adults previously hospitalised for mental disorder. We showed that
38 overall life expectancy for the whole cohort of individuals previously hospitalised due to
39 mental ill health was 17 years less than that for the general population, and that the
40 excess risk of early death is greatest by far in the youngest (15-19 years old) age
41 group but that older individuals experience greater numbers of early deaths. The
42 largest reduction in life expectancy was seen for individuals with eating disorders and
43 personality disorders – namely an alarming 39 years reduction in life expectancy for
44 uncomplicated eating disorders, and 27.5 for those with a complicated personality
45 disorder.
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54 However as the greatest number of deaths were seen in individuals with depression
55 and schizophrenia, these conditions accounted for the greatest number of years of life
56 lost. The majority of these deaths in those previously hospitalised for mental disorder
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3 are due to 'natural' causes such as cardiovascular and respiratory disorder, which
4 mirrors the results of a similar study from Denmark⁷ examining the life expectancy of
5 those with schizophrenia and bipolar disorder. By contrast, although only 11% of
6 deaths in our study population were attributable to 'non-natural' causes such as
7 suicide, accidents, and homicide, we found that these 'non-natural' causes carried a
8 substantially higher comparative excess risk of early death – ranging between 27
9 years of lost life for depression to a staggering 49.5 years for eating disorders,
10 emphasising that these non-natural deaths occur earlier than the more common
11 natural causes of death. For the whole cohort of mentally ill individuals, those dying
12 from non-natural causes lost, on average, almost 32 years of life, reinforcing the
13 continuing need for national suicide prevention strategies.
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21 **A stable 'mortality gap'?**

22 In addition, contrary to results elsewhere^{8,13}, we did not find any evidence that the
23 difference in risk of death between the general population and the mentally disordered
24 was worsening over time. In fact, we observed that this 'mortality gap' was stable over
25 25 years for all the common mental disorders, which offers some reassurance to
26 claims that the mentally disordered have not benefited from improvements in public
27 health^{15,16}. Nevertheless, our data indicates that there continues to be a need for
28 monitoring the physical health of those with mental disorder, and in particular
29 screening for cardiovascular disease.
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35 **Strengths and limitations of the study**

36 Strengths of this study include the whole population coverage and the long time
37 series, along with the demonstrable high quality and completeness²⁰ of the diagnostic
38 coding and cause of death coding. We have also taken care with main psychiatric
39 diagnosis assignment, using a pragmatic hierarchical approach to account for the
40 diagnostic shift and co-morbidities that are commonly seen in day-to-day clinical
41 psychiatric practice. Definitive diagnosis is not always easy initially in mental health.
42 Main psychiatric diagnosis has therefore been assigned using a hierarchical approach
43 and taking into account all diagnoses recorded on an individual's psychiatric discharge
44 records over the period of study rather than simply diagnosis at first admission. This
45 approach considerably increases the number of people in the higher categories (eg
46 psychoses). For example, of 17,031 individuals who were first admitted with
47 depression, 71% were assigned to depression, 17% subsequently had schizophrenia
48 recorded on a discharge record and so were assigned to "complicated schizophrenia",
49 and 11% were assigned to "complicated bipolar". For some groups the hierarchy is
50 less intuitive, for example, of the 325 individuals who were first admitted with eating
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3 disorders but subsequently had other mental ill health problems, 69% moved out of
4 the eating disorder group into another group higher up the hierarchy (data not
5 shown). This will lead to a conservative SMR for some complicated cases due to time
6 at risk for conditions lower down the hierarchy being assigned to a condition higher up
7 the hierarchy in the person-year analysis.
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10 11 **Comorbidity and early death**

12 Furthermore, we have documented that diagnostic 'complexity' (indicated by further
13 recording of other mental disorders in addition to the main psychiatric diagnosis,
14 substance misuse, or physical health problems), tends to increase the risk of
15 premature death and the average years of lost life in those previously hospitalised due
16 to mental illness. This adverse effect of complexity has not reported before to our
17 knowledge, and emphasises that comorbidity exacerbates prognosis. Also, our use of
18 the SMR and the 'years of lost life' techniques allows quantification of both the relative
19 and the absolute burden of excess death in this population. However, as this is a
20 secondary care cohort, it will only capture those most severely affected by mental
21 disorder, and hence does not allow comment on, for example, those with depression
22 managed solely in the community. Equally, those hospitalised due to eating disorder
23 are often physically unwell, so it is perhaps no surprise that this diagnostic group had
24 worrying relative and absolute mortality results in this study. Lastly, we designed a
25 'wash in' period of 5 years (1981-1986) in order to capture only first admissions, but it
26 is likely that some patients with psychiatric admissions prior to 1981 were included.
27 The apparently old age at 'diagnosis'/first admission may suggest that these are in fact
28 not all first admissions ie the relatively short wash in period has allowed us to include
29 patients readmitted after more than 5 years as 'first admissions'.
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41 A systematic review by Saha et al¹³ found a SMR of 2.5 for risk of death in
42 schizophrenia, which is greater than our figures of 1.8 (uncomplicated) and 2.0
43 (complicated), but the more recent study by Hoang and colleagues from England⁸
44 found similar SMRs for both schizophrenia and bipolar disorder to our own results,
45 albeit with a shorter follow up. Large long term follow up mortality studies comparing
46 common mental disorders have not been reported elsewhere, to our knowledge, and
47 our data provide context for the literature on early death in specific disorders such as
48 schizophrenia and bipolar disorder⁸, and depression and anxiety²¹. More detailed
49 analysis of the time trends for individual causes of death in specific diagnostic groups
50 would be valuable in the future.
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Implications

In previous studies of all-cause mortality in those with mental illness in Scotland, behavioural risk factors such as heavy smoking and a sedentary lifestyle have been linked to early death, along with social isolation and deprivation²². Policy makers in the UK have also highlighted the physical health needs and premature mortality of those with mental health problems which echo the worrying disparities in lifespan we have identified for all the common mental disorders compared to the general population. In particular, we have found that the highest risk of early death is associated with a young age; eating disorders; personality disorders; and in those with multiple diagnoses. A national approach across primary and secondary care tackling the complex mix of factors contributing to early death in the mentally disordered is required, addressing intrinsic disease related factors as well as lifestyle issues; lack of help seeking; and even stigma within the healthcare professions^{15,16}. The inequity in life expectancy in the mentally disordered documented here poses a considerable challenge to our healthcare system.

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Table 1: Main psychiatric diagnosis categories of interest (and diagnostic hierarchy)

Main psychiatric diagnosis category	Definition	Hierarchy
Schizophrenia	Schizophrenia and other psychotic disorders including acute psychosis, persistent delusional disorders, schizotypal and schizoaffective disorder, and drug or alcohol induced psychotic disorder	1
Bipolar disorder	Manic episodes and bipolar disorder	2
Depression	Depressive episodes and recurrent depressive disorder (excluding persistent mood disorders such as cyclothymia)	3
Neurosis	Anxiety disorders and obsessive compulsive disorder	4
Eating disorder	Anorexia and bulimia nervosa	5
Personality disorder	All types of personality disorder	6

Note: ICD9 and ICD10 codes available on request.

Table 2a: Characteristics of the cohort included in the analysis (Males)

	N	%	Median age at first admission (25th – 75th percentiles)	% in most deprived quintile ¹	Median total length (days) (25th – 75th percentiles)	
					Median number (25th – 75th percentiles)	Median total length (days) (25th – 75th percentiles)
Uncomplicated diagnosis group:						
Schizophrenia	8,966	35	33.7 (24.6 -50.2)	29	1.0 (1.0 -2.0)	48.0 (16.0 -161.0)
Bipolar disorder	1,680	7	41.0 (28.4 -56.2)	17	1.0 (1.0 -2.0)	36.0 (17.0 -72.0)
Depression	12,778	49	47.5 (34.2 -66.0)	23	1.0 (1.0 -1.0)	22.0 (7.0 -53.0)
Neurosis	1,129	4	40.7 (29.8 -58.5)	26	1.0 (1.0 -1.0)	14.0 (5.0 -35.0)
Eating disorder	49	<1	22.1 (19.0 -28.8)	33	1.0 (1.0 -1.0)	48.0 (12.0 -89.0)
Personality disorder	1,221	5	30.9 (23.8 -41.7)	30	1.0 (1.0 -1.0)	8.0 (3.0 -24.0)
Total uncomplicated	25,823	100	40.9 (28.4 -59.6)	25	1.0 (1.0 -2.0)	28.0 (9.0 -74.0)
Complicated (hierarchical) diagnosis group:						
Schizophrenia	10,697	43	31.0 (23.3 -44.0)	33	4.0 (2.0 -6.0)	145.0 (52.0 -429.0)
Bipolar disorder	2,159	9	42.4 (30.5 -56.6)	21	3.0 (2.0 -5.0)	115.0 (51.0 -257.0)
Depression	9,421	38	40.1 (30.0 -54.9)	26	2.0 (1.0 -4.0)	44.0 (18.0 -105.0)
Neurosis	915	4	37.0 (27.4 -48.1)	24	2.0 (1.0 -3.0)	32.0 (14.0 -71.0)
Eating disorder	17	<1	31.3 (23.5 -48.5)	29	3.0 (2.0 -4.0)	45.0 (21.0 -148.0)
Personality disorder	1,580	6	31.3 (23.8 -41.6)	31	2.0 (1.0 -3.0)	21.0 (8.0 -49.0)
Total complicated	24,789	100	35.5 (26.0 -49.9)	28	3.0(2.0-5.0)	73.0(26.0 -214.0)

Table 2b: Characteristics of the cohort included in the analysis (Females)

	N	%	Median age at first admission (25th – 75th percentiles)	% in most deprived quintile ¹	Median total length (days) (25th – 75th percentiles)	
					Median number (25th -75th percentiles)	Median total length (days) (25th – 75th percentiles)
Uncomplicated diagnosis group:						
Schizophrenia	6,999	21	53.9 (34.5 -76.0)	25	1.0 (1.0 -2.0)	47.0 (19.0 -122.0)
Bipolar disorder	2,196	7	43.4 (30.5 -61.0)	18	1.0 (1.0 -2.0)	35.0 (17.0 -74.0)
Depression	20,383	61	48.5 (33.8 -69.1)	23	1.0 (1.0 -1.0)	28.0 (10.0 -65.0)
Neurosis	1,946	6	48.5 (33.7 -68.7)	26	1.0 (1.0 -1.0)	18.0 (7.0 -39.0)
Eating disorder	586	2	20.7 (17.5 -26.5)	16	1.0 (1.0 -1.0)	49.0 (13.0 -126.0)
Personality disorder	1,095	3	31.1 (23.0 -43.5)	27	1.0 (1.0 -1.0)	9.0 (3.0 -25.0)
Total uncomplicated	33,205	100	47.6 (32.5-69.5)	23	1.0 (1.0 -1.0)	30.0 (11.0 -73.0)
Complicated (hierarchical) diagnosis group²:						
Schizophrenia	8,230	30	40.6 (27.7 -66.0)	29	3.0 (2.0 -6.0)	162.0 (68.0 -410.0)
Bipolar disorder	3,619	13	43.0 (31.2 -59.8)	22	3.0 (2.0 -5.0)	136.0 (60.0 -313.0)
Depression	13,390	48	41.1 (29.8 -61.8)	25	2.0 (2.0 -4.0)	64.0 (25.0 -163.0)
Neurosis	1,136	4	42.9 (31.2 -63.6)	21	2.0 (1.0 -3.0)	38.0 (17.0 -91.5)
Eating disorder	199	1	26.2 (20.7 -34.3)	18	2.0 (1.0 -3.0)	35.0 (10.0 -103.0)
Personality disorder	1,113	4	29.5 (22.5 -40.3)	28	2.0 (1.0 -3.0)	27.0 (10.0 -60.0)
Total complicated	27,687	100	40.6 (28.8 -61.9)	26	3.0 (2.0 -5.0)	89.0 (33.0 -237.0)

1 if there had been no deprivation gradient then around 20% of cases would be in the most deprived quintile

2 . For individuals with a complicated mental health diagnosis (hierarchical) , the age at first admission refers to the first 'ever' admission event.

Table 3: SMRs and years of life lost for all-cause mortality by diagnosis group (all patients diagnosed 1986-2009 and followed up until 31 December 2010)

	Observed deaths	Expected deaths	SMR ¹	Lower CI	Upper CI	Total YLL	Average YLL
Uncomplicated diagnosis group:							
Schizophrenia	5,060	2,746	1.8	1.8	1.9	78,027	15.2
Bi-polar	883	525.6	1.7	1.6	1.8	14,369	16.1
Depression	11,036	6,831.2	1.6	1.6	1.6	155,582	14.1
Neurotic disorders	838	524.7	1.6	1.5	1.7	12,373	14.9
Eating disorders	51	11.6	4.4	3.3	5.8	2,182	39.0
Personality disorders	449	234.9	1.9	1.7	2.1	10,583	22.8
Complicated (hierarchical) diagnosis group:							
Schizophrenia	5,635	2,876.9	2.0	1.9	2.0	116,775	19.6
Bi-polar	1,706	1,129.5	1.5	1.4	1.6	29,351	16.7
Depression	7,282	3,628.8	2.0	2.0	2.1	146,736	19.0
Neurotic disorders	579	272.8	2.1	2.0	2.3	12,194	19.9
Eating disorders	38	8.7	4.4	3.1	6.0	1,317	31.4
Personality disorders	686	221.9	3.1	2.9	3.3	20,894	27.5
Total	34,243	19,012.4	1.8	1.8	1.8	600,383	17.0

¹ adjusted for sex, age, period and deprivation category (Carstairs 1991 decile) at first diagnosis

Table 4: SMRs and years of life lost by diagnosis group and cause of death grouping (natural death, non-natural death, or "other" deaths) (all patients diagnosed 1986-2009 and followed up until 31 December 2010)

	Natural deaths			Non-natural deaths			Other deaths		
	N	SMR (95% CI)	AYYL	N	SMR (95% CI)	AYYL	N	SMR (95% CI)	AYYL
Uncomplicated diagnosis group:									
Schizophrenia	3,580	1.8 (1.7 - 1.8)	11.8	504	4.4 (4.0 - 4.8)	32.2	976	1.6 (1.5 - 1.7)	16.3
Bi-polar	624	1.7 (1.6 - 1.8)	13.0	97	4.7 (3.8 - 5.8)	32.0	162	1.2 (1.0 - 1.4)	16.4
Depression	7,839	1.6 (1.6 - 1.6)	12.0	1,055	4.9 (4.6 - 5.2)	27.2	2,142	1.2 (1.2 - 1.3)	13.8
Neurotic disorders	622	1.7 (1.6 - 1.9)	13.2	63	3.3 (2.6 - 4.3)	29.4	153	1.1 (0.9 - 1.3)	15.1
Eating disorders	15	2.6 (1.4 - 4.3)	23.8	12	7.2 (3.7 - 12.6)	49.5	24	5.8 (3.7 - 8.7)	39.3
Personality disorders	265	1.7 (1.5 - 1.9)	15.0	96	6.2 (5.0 - 7.6)	37.6	88	1.4 (1.2 - 1.8)	25.6
Complicated (hierarchical) diagnosis group:									
Schizophrenia	3,500	1.7 (1.7 - 1.8)	14.3	767	5.2 (4.8 - 5.5)	35.1	1,368	2.0 (1.9 - 2.1)	20.0
Bi-polar	1,139	1.4 (1.3 - 1.5)	13.7	197	5.1 (4.4 - 5.8)	30.8	370	1.3 (1.1 - 1.4)	15.7
Depression	4,525	1.8 (1.7 - 1.8)	14.8	931	6.5 (6.1 - 7.0)	32.3	1,826	1.9 (1.9 - 2.0)	18.6
Neurotic disorders	379	2.0 (1.8 - 2.3)	16.4	53	4.3 (3.2 - 5.6)	33.6	147	2.0 (1.7 - 2.3)	20.0
Eating disorders	17	3.0 (1.7 - 4.8)	24.4	5	9.0 (2.8 - 21.1)	43.2	16	6.6 (3.7 - 10.7)	32.9
Personality disorders	360	2.5 (2.2 - 2.7)	19.9	129	7.5 (6.2 - 8.9)	39.0	197	3.4 (2.9 - 3.9)	28.8
Total	22,865	1.7 (1.7 - 1.7)	13.3	3,909	5.2 (5.1 - 5.4)	31.8	7,469	1.6 (1.5 - 1.6)	17.4

¹ adjusted for sex, age, period and deprivation category (Carstairs 1991 decile) at first diagnosis

Table 5. Observed and expected number of deaths for cardiovascular disease; cancer; and suicide.

	Observed CVS ¹ deaths	Expected CVS deaths	Observed Cancer ² deaths	Expected Cancer deaths	Observed suicide ³ deaths	Expected suicide deaths
Uncomplicated diagnosis group:						
Schizophrenia	2010	1109	650	500	502	110
Bi-polar	335	199	135	105	97	19
Depression	4281	2691	1671	1358	1047	211
Neurotic disorders	313	195	136	102	60	17
Eating disorders	6	3	3	1	12	1
Personality disorders	136	84	55	41	88	14
Complicated diagnosis group						
Schizophrenia	1740	1108	476	543	771	150
Bi-polar	596	425	201	238	198	38
Depression	2219	1368	730	718	932	138
Neurotic disorders	316	99	68	51	53	12
Eating disorders	5	3	3	1	5	0
Personality disorders	129	75	49	44	123	15

¹ All cardiovascular (heart disease) deaths. ² All cancer, including lung cancer, deaths.

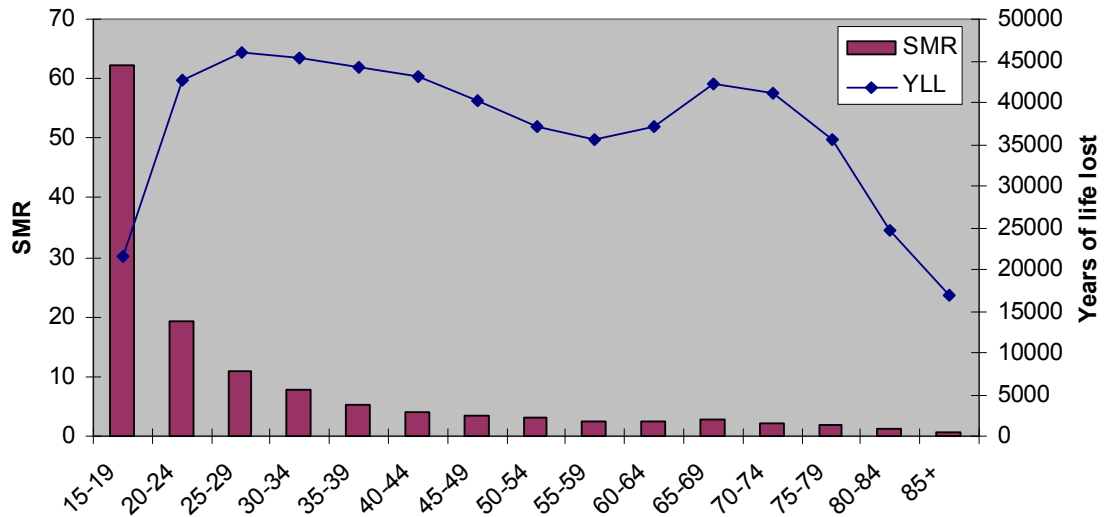
³ All deaths coded as suicides and accidents by poisoning.

Table 6: SMRs by time period of first admission (1986-2000) and followed up for 10 years from first admission (all diagnosis groups combined)

	Period of first diagnosis	Observed deaths	Expected deaths	SMR ¹	Lower CI	Upper CI
Males	1986-90	3185	1514.1	2.1	2.0	2.2
	1991-95	2878	1328.0	2.2	2.1	2.2
	1996-00	2327	1075.9	2.2	2.1	2.3
Females	1986-90	4808	2669.0	1.8	1.8	1.9
	1991-95	3882	2112.3	1.8	1.8	1.9
	1996-00	2740	1412.6	1.9	1.9	2.0

¹ adjusted for age and deprivation category (Carstairs 1991 decile) at first diagnosis

Figure 1: Age-specific all-cause SMRs and overall YLL for all patients diagnosed 1986-2009 and followed up until 31 December 2010



* The SMR for the above chart was produced from the table in Appendix A (below)

Appendix A: Age Specific all cause SMRs for all patients admitted to mental health speciality 1986 – 2009 followed up to 31st December 2010.

Age	Observed	Expected	RR	LCI	UCI
15-19	427	6.9	62.2	56.4	68.4
20-24	918	47.3	19.4	18.2	20.7
25-29	1112	101.0	11.0	10.4	11.7
30-34	1232	157.7	7.8	7.4	8.3
35-39	1357	251.4	5.4	5.1	5.7
40-44	1529	379.2	4.0	3.8	4.2
45-49	1690	515.3	3.3	3.1	3.4
50-54	1849	594.6	3.1	3.0	3.3
55-59	2162	822.4	2.6	2.5	2.7
60-64	2718	1055.7	2.6	2.5	2.7
65-69	3670	1340.3	2.7	2.7	2.8
70-74	4243	1882.2	2.3	2.2	2.3
75-79	4487	2509.9	1.8	1.7	1.8
80-84	3836	3182.7	1.2	1.2	1.2
85+	3013	6165.9	0.5	0.5	0.

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7 **Early death in those previously hospitalized for mental health care in Scotland**
8 **– a nationwide follow up study, 1986 - 2010.**
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43 | Contributors OA and MT conceived the study. OA and DS ascertained the data. All
44 authors analysed the data and drafted the manuscript. RW is the study guarantor.
45

46 *Funding* Via NHS Scotland. No specific external funding.

47 ~~Neither NHS eEthical approval not required as this study is covered by existing case~~
48 ~~linkage protocols. Data sharing agreed in principle. thical approval nor Privacy Advisory~~
49 ~~Committee approval was required for this study as no patient identifiable data were~~
50 ~~released outwith NHS National Services Scotland and no new data linkages were~~
51 ~~undertaken.~~
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Article Focus

- Examines whether those previously hospitalised for mental disorder die earlier than people with no overt serious mental disorder.
- Do [individuals with 'complicated' diagnoses \(ie additional mental or physical ill health diagnoses in conjunction with their main psychiatric diagnosis\) have higher excess mortality than those with 'uncomplicated' diagnoses? multiple psychiatric diagnoses or comorbid disorder exacerbate any premature mortality?](#)
- Is the apparent inequality in mortality rates between those with serious mental disorder and the general population worsening over time?

Key messages

- The average reduction in lifespan in those previously hospitalised for mental disorder compared to the general population is 17 years. People with eating disorders and personality disorder died earliest of all.
- [Comorbidity or multiple psychiatric diagnoses exacerbated this effect. In general, patients with 'complicated' diagnoses experience higher excess mortality than those without.](#)
- Cardiovascular and respiratory diseases were the most common causes of death [and accounted for a high proportion of the total burden of years of life lost](#), but suicides led to more years of lost life [at the individual level due to predominantly affecting younger adults](#). No worsening of the 'mortality gap' over three decades was observed.

Strengths and limitations

- A large representative population studied over a long time period, which is important when examining causes of death.
- Innovative use of a diagnostic hierarchy to [account for the commonly occurring comorbidity or diagnostic shift seen in psychiatry](#) [determine individuals' main psychiatric diagnosis](#).
- People with mental disorder who never required in-patient hospital care could not be included in this study.

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Objectives:

To ~~quantify any premature~~ compare the mortality in those previously hospitalised for mental disorder in Scotland ~~to that experienced by the general population; attempt to separately account for the effects of multiple psychiatric diagnoses or comorbidity; and examine any trends in death rates over time.~~

Design:

~~Systematic cohort case linkage of hospital discharge and cause of death records~~ Population based historical cohort study using routinely available psychiatric hospital discharge and death records.

Setting & participants:

~~Secondary care sample of all cases previously hospitalised~~ Individuals with a first hospital admission for mental disorder in Scotland, 1986-2009±0.

Outcomes:

~~The main outcome measure was death from any cause, 1986-2010. Excess mortality in individuals with previous psychiatric admission was presented as standardised mortality ratios (SMR) and years of life lost (YLL). Excess mortality was assessed overall and by age, sex, main psychiatric diagnosis, whether the psychiatric diagnosis was 'complicated' (ie additional mental or physical ill health diagnoses present), cause of death, and time period of first admission.~~

~~Cases with comorbidity or multiple diagnoses were hierarchically categorised, and contrasted to cases where there was no record of comorbidity. Causes of death were dichotomised into natural and non-natural causes, and time trends were analysed. Standardised mortality ratios and years of lost life were the primary outcomes.~~

Results

111504 people were included in the study, and 34243 had died by 31/12/2010. The average reduction in life expectancy for the whole cohort was 17 years, with eating disorders (39 year reduction) and 'comorbid-complicated' personality disorders (27.5 year reduction) being worst affected. 'Natural' causes of death such as cardiovascular disease showed modestly elevated relative risk (SMR1.7) but accounted for a high proportion of all deaths (67%) and of the total burden of years of life lost (54%). Non-natural deaths such as suicide showed higher relative risk (SMR5.2) and tended to occur at a younger age but were less common overall (11% of all deaths and 22% of all YLL). were 11% of the total (SMR=5.2), with these deaths occurring early, whereas physical causes of death were more common (SMR=1.7), particularly cardiovascular

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7 ~~disease. Comorbidity~~ Having a 'complicated' diagnosis tended to elevated the risk of
8 early death. No, but no-worsening over time of these inequalities of the overall
9 excess mortality experienced by individuals with previous psychiatric admission over
10 time was observed.
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12 **Conclusions**

13
14 Early death for those hospitalised with mental disorder is common, and represents a
15 significant inequality even in well developed healthcare systems. Prevention of suicide
16 and cardiovascular disease deserve particular attention in the mentally disordered.
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19 **Declaration of interest**

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21 All authors are employed by NHS Scotland. MT has received fees and / or hospitality
22 from the manufacturers of various antipsychotic medications. TA, DS, and RW have no
23 other conflicts to declare.
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7 Many of the most disabling medical conditions worldwide are mental illnesses,
8 according to the WHO¹. As well as adversely affecting day to day function, it has been
9 known for many years that people with mental illness are at increased risk of
10 premature death²⁻⁵ with schizophrenia and bipolar disorder in particular being
11 associated with an early death⁶⁻⁸. These inequalities in life expectancy have recently⁹
12 been declared a "scandal", as even the Scandinavian countries⁵, Scotland¹⁰ and
13 England⁸, despite relatively high quality and equitably distributed healthcare, have not
14 been able to demonstrate any improvement in this premature mortality for the
15 mentally ill over many years.
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19 Non-natural deaths¹¹ including suicide and accidents, account for a disproportionate
20 amount of this premature mortality in the mentally ill, particularly affecting young
21 adults. High rates of cardiovascular disease, respiratory disease and other so-called
22 natural causes also contribute^{5,12,13} to the elevated relative risk of early death in the
23 mentally ill. Precise estimates of the varying causal contributions to premature
24 mortality in the mentally disordered have been limited by the lack of large
25 representative populations being followed up over a lengthy period, and related studies
26 have usually focussed on schizophrenia and bipolar disorder^{8,14} rather than the gamut
27 of mental disorder. Additionally, the effects of comorbidity or multiple diagnoses on
28 this premature mortality have also not been quantified. Concern has also been
29 expressed that those with mental illness have not benefitted from improvements in
30 public health over the last few decades^{8,9,13} and that this mortality gap between the
31 general population and the mentally ill is widening in recent years.
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37 Using routinely collected national data, available from 1981, we set out to examine the
38 ages and causes of death in those previously hospitalised with mental disorder in
39 Scotland, and quantify any excess mortality. We also aimed to explore the relative
40 contribution of different causes of death and trends over time.
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45 **Methods**

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47 Whenever a patient is discharged from a mental ill health hospital/specialty in
48 Scotland, a Scottish Morbidity Record for Mental ill health (SMR04) is returned to the
49 [NHS National Services Scotland](#) Information Services Division (ISD), ~~NHS National~~
50 ~~Services Scotland~~. SMR04 records contain information on patient demographics such
51 as personal identifiers, age, and sex; the diagnosis that necessitated the admission;
52 and aspects of the care given such as the psychiatric subspecialty admitted to. One
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7 primary diagnosis and up to five further secondary diagnoses can be recorded.
8 Diagnoses are coded according to the International Classification of Diseases (ICD)
9 (version 9 to 1997 and version 10 from 1997 to present). Statutory death records
10 (containing demographic and ICD coded cause of death information) are returned to
11 the National Records of Scotland (NRS) with copies passed to ISD for analytical
12 purposes.
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15 For this study, SMR04 records for adults discharged from mental ill health
16 hospitals/specialities in Scotland between 1981 and 2009 were obtained. Patients
17 aged less than 15 years at the date of first admission and those admitted to the
18 learning disabilities subspecialty were excluded from the sample, in accordance with
19 the aim of studying the ages and causes of death in adults with mental illness and
20 personality disorder. Death records for the period 1986-2010 were also obtained. We
21 created a single patient record for each individual by linking all their hospital
22 [admissions-discharge records](#) and their death record (if died) using a range of patient
23 identifiers and previously developed probabilistic matching algorithms. All patients
24 who had had an admission to a mental ill health specialty between 1981 and 1985
25 were excluded to give a cohort of patients with (as close as possible to) a **first**
26 inpatient admission between 1986 and 2009 in order to clarify the issue of diagnostic
27 shift or comorbidity.
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33 [All patient level data used in this study were held and analysed within ISD. Only](#)
34 [aggregate results, from which individual patients could not be identified, were shared](#)
35 [with members of the study team not based within ISD \(MT\). ISD operates strict](#)
36 [procedures to maintain patient privacy and confidentiality and no specific additional](#)
37 [permissions were required for this study. In particular, permission for linkage of](#)
38 [previously unlinked health datasets held by ISD is required from the Privacy Advisory](#)
39 [Committee. PAC approval was not required for this study however as SMR04 and](#)
40 [death records have been routinely linked within ISD for decades for purposes such as](#)
41 [monitoring patient outcomes.](#)
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46 47 **Diagnostic assignation**

48 We then assigned each individual to a [diagnostic-main psychiatric diagnosis](#) category
49 (see table 1) and excluded individuals who did not have any admissions relating to a
50 diagnostic group of interest. [The diagnostic groups of interest included were](#)
51 [schizophrenia, bipolar disorder, depression, neurosis, eating disorder, and personality](#)
52 [disorder.](#)
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8 Table 1 here
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10 Patients with a single primary psychiatric diagnosis of interest recorded on all their
11 psychiatric discharge records over the period of study, and no other or additional
12 diagnoses at any admission, were described as 'uncomplicated'. For example, a
13 individual with five hospital admissions which were all coded solely to depression
14 would be described as 'uncomplicated depression'.
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18 In contrast, patients with more than one diagnosis recorded were described as
19 'complicated'. For patients with more than one diagnosis from the diagnostic groups of
20 interest, a hierarchical approach was used to determine the main diagnosis and hence
21 assign a patient to one group (see table 1) with schizophrenia being assigned the
22 highest rank. For example, a patient diagnosed as having bipolar disorder at their first
23 hospital admission and then admitted for depression-neurosis at a later date would be
24 assigned to the 'complicated bipolar' group. Conversely, someone who had three
25 hospital admissions for neurosis and then one for neurosis with depression recorded as
26 an additional secondary diagnosis would be described as 'complicated depression' and
27 their time at risk in the cohort would be taken from their first neurosis admission.
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32 Patients may also have had other/additional diagnoses not within the diagnostic
33 groups of interest. These included other psychiatric problems (mainly dementia,
34 stress reactions and adjustment disorders); alcohol or drug misuse; or (rarely)
35 physical health problems such as pneumonia. Someone with an admission for
36 personality disorder with drug misuse recorded as an additional secondary diagnosis
37 would therefore be described as 'complicated personality disorder'.
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41 **Analysis**

42 A final record was then created for each patient within the mental ill health cohort
43 containing hierarchically defined main psychiatric diagnosis, complication—a flag
44 indicating whether the main diagnosis was 'complicated' or not, date of first admission,
45 age at first admission, sex, deprivation category at first admission, date of death and
46 (main) cause of death. Deprivation category was determined using Carstairs 1991
47 area-based deprivation quintiles¹⁵ based on postcode of residence at first admission
48 and corresponding population denominators from the Consistent Areas Through Time
49 (CATTS) classification tables¹⁶ which allows us to create a long time series of
50 deprivation-specific mortality rates.
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7 This linked dataset was used to calculate indirectly standardised mortality ratios
8 (SMRs) for the mental ill health patients using a person-years approach which took
9 account of each individual's time at risk ([from time of first admission](#)) across different
10 age categories and time periods since diagnosis. Years of Life Lost (YLL) were
11 computed by multiplying the number of deaths in the study cohort (in each period of
12 death, sex, age band at death and deprivation quintile) by the corresponding life
13 expectancy at that age. The average YLL (AYLL) was derived by dividing the total YLL
14 by the actual number of deaths within the subgroups of interest. Scottish national
15 mortality rates split by year of death (in time bands), sex, five-year age band and
16 deprivation quintile were used as the reference standard for the SMRs. Life tables
17 were compiled based on these national mortality rates following the Chiang¹⁷
18 methodology for the YLL analyses. To examine possible trends over time in [mortality](#)
19 [rates the excess mortality experienced by individuals with previous psychiatric](#)
20 [admission](#), we chose three time period cohorts each with 10 years of follow up for each
21 cohort to capture a wide range of causes of death.
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27 We looked at overall mortality; mortality by specific cause; and mortality split into
28 natural deaths (cardiovascular, cancer, respiratory, digestive, endocrine, nervous
29 system, infectious disease), non-natural deaths (accidental, suicide/undetermined,
30 homicide), and other (all other deaths including those recorded as mental and
31 behavioural).
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36 Results

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38 Over the time period of study (1986-2009) there were 59,028 individuals who had a
39 consistent diagnosis within and between admissions (classified as uncomplicated) and
40 52,476 individuals who had an unstable diagnosis or additional co-morbidity within
41 and/or between admissions (classified as complicated). Women comprised 55% of the
42 cohort largely due to a higher number of cases of depression in women. Women
43 tended to be older than men at their first included admission, particularly for
44 schizophrenia and neurosis. Complicated diagnoses resulted in [significantly](#) higher
45 numbers of hospitalisations and total length of time spent in hospital as would be
46 expected (see Table 2a and 2b).
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51 Increasing deprivation was linked to mental ill health problems for both men and
52 women, with the exception of bi-polar disorder (no clear trend across deprivation
53 groups for either sex) and eating disorder in females (uncomplicated more common in
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7 least deprived group; complicated no clear trend across deprivation groups) [\(Table 2](#)
8 [and additional analyses available on request](#)).
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10 Overall, 34,243 individuals in the study cohort had died by the 31 December 2010,
11 around 80% more (SMR=1.8) than expected based on the general population (see
12 table 3). The standardised mortality ratios ~~were generally tended to be~~ higher for
13 those with complicated diagnoses, and ~~overall were~~ highest for those with eating
14 disorders (SMR=4.4) and ~~complicated~~ personality disorders ~~complicated by~~
15 ~~comorbidity~~ (SMR=3.1). Overall life expectancy for the whole cohort of individuals
16 with mental ill health was 17 years less than that for the general population. The
17 largest reduction in life expectancy was seen for individuals with eating disorders (39
18 years ~~of life lost~~ for those with uncomplicated diagnosis) and personality disorders
19 (27.5 ~~years-YLL~~ for those with complicated diagnosis) however as most deaths were
20 seen in individuals with depression and schizophrenia, these conditions accounted for
21 the greatest number of years of life lost.
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27 **Relative risk of early death**

28 The excess risk of death was extremely high for those in the youngest age group at
29 first included admission, and the excess reduced as age increased (see figure 1).
30 However, total years of life lost told a slightly different story, with a relatively constant
31 YLL for those diagnosed at ages 20-24 through to 75-79 years, with lower YLL for
32 those aged 15-19, 80-84 and 85+ years. This reflects the fact that the absolute risk
33 of dying generally increases with age. The same age-related pattern is seen for males
34 and females, although ~~the excess~~ risk of death is higher for females compared to
35 males at every age (data not shown).
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40 **Figure 1 here**

41 Around two thirds of deaths (22,865 deaths) in the mental ill health cohort were from
42 natural causes, 11% (3,909) from non-natural causes and the remaining 21% (7,469)
43 were from "other" deaths not coded as natural or non-natural including 'mental or
44 behavioural disorder' (36% total "other"). The excess risk of death was much higher
45 from non-natural causes (SMR=5.2) compared to natural causes (SMR=1.7) and
46 "other" deaths (SMR=1.6). On average, 31.8 years of life were lost due to every non-
47 natural death compared to 13.3 years due to every natural death and 17.4 years of life
48 lost for each "other" death, reflecting the fact that non-natural deaths tend to occur at
49 younger ages (see Table 4).
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7 There was a significant excess risk of natural, non-natural and "other" deaths for
8 patients in each diagnosis group (except uncomplicated neurotic disorders resulting in
9 "other" deaths (SMR=1.1, ns)). The highest excess risks were seen for eating
10 disorders across death groupings, although the number of deaths ~~from in individuals~~
11 ~~with~~ eating disorders was small (see Table 4). Natural deaths accounted for more
12 years of life lost than non-natural deaths in each diagnostic group. Cardiovascular
13 disease accounted for around half of all years of life lost from natural causes, with
14 digestive disorders, cancer, and respiratory disorders accounting for most of the
15 remainder. Suicide accounted for the majority of years of life lost due to non-natural
16 causes in each diagnostic group (data not shown). ~~I-but~~ Table 5 reveals the
17 proportions of observed and expected deaths for the two main natural causes of death,
18 namely heart disease and cancer, as well as suicide.
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23 **Tables 2a; 2b; 3; 4; and 5 here**

24 **Mortality trends over time**

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26 Looking at individuals whose first admissions were in the periods 1986-90, 1991-95
27 and 1996-2000 and following each individual in these sub-cohorts up for 10 years from
28 their first admission, the all cause standardised mortality ratios showed no evidence of
29 a narrowing of the mortality excess over time (see Table 6).
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33 **Table 6 here**

34 **Discussion**

35 **Main findings**

36 This large national study provides an accurate estimate of the risk of early death
37 experienced by adults previously hospitalised for mental disorder. We showed that
38 overall life expectancy for the whole cohort of individuals previously hospitalised due to
39 mental ill health was 17 years less than that for the general population, and that the
40 excess risk of early death is greatest by far in the youngest (15-19 years old) age
41 group but that older individuals experience greater numbers of early deaths. The
42 largest reduction in life expectancy was seen for individuals with eating disorders and
43 personality disorders – namely an alarming 39 years reduction in life expectancy for
44 uncomplicated eating disorders, and 27.5 for those with a complicated personality
45 disorder.
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8 However as the greatest number of deaths were seen in individuals with depression
9 and schizophrenia, these conditions accounted for the greatest number of years of life
10 lost. The majority of these deaths in those previously hospitalised for mental disorder
11 are due to 'natural' causes such as cardiovascular and respiratory disorder, which
12 mirrors the results of a similar study from Denmark⁷ examining the life expectancy of
13 those with schizophrenia and bipolar disorder. By contrast, although only 11% of
14 deaths in our study population were attributable to 'non-natural' causes such as
15 suicide, accidents, and homicide, we found that these 'non-natural' causes carried a
16 substantially higher comparative excess risk of early death – ranging between 27
17 years of lost life for depression to a staggering 49.5 years for eating disorders,
18 emphasising that these non-natural deaths occur earlier than the more common
19 natural causes of death. For the whole cohort of mentally ill individuals, those dying
20 from non-natural causes lost, on average, almost 32 years of life, reinforcing the
21 continuing need for national suicide prevention strategies.
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27 **A stable 'mortality gap'?**

28 In addition, contrary to results elsewhere^{8,13}, we did not find any evidence that the
29 difference in risk of death between the general population and the mentally disordered
30 was worsening over time. In fact, we observed that this 'mortality gap' was stable over
31 25 years for all the common mental disorders, which offers some reassurance to
32 claims that the mentally disordered have not benefited from improvements in public
33 health^{15,16}. Nevertheless, our data indicates that there continues to be a need for
34 monitoring the physical health of those with mental disorder, and in particular
35 screening for cardiovascular disease.
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40 **Strengths and limitations of the study**

41 Strengths of this study include the whole population coverage and the long time
42 series, along with the demonstrable high quality and completeness²⁰ of the diagnostic
43 coding and cause of death coding. We have also taken care with ~~final-main psychiatric~~
44 diagnosis assignment, using a pragmatic hierarchical approach to account for the
45 diagnostic shift and co-morbidities that are commonly seen in day-to-day clinical
46 psychiatric practice. Definitive diagnosis is not always easy initially in mental health.
47 ~~The complicated diagnoses are~~ Main psychiatric diagnosis has therefore been assigned
48 ~~according to a hiera~~ using a hierarchical approach and taking into account all
49 ~~diagnoses recorded on an individual's psychiatric discharge records over the period of~~
50 ~~study~~ rather than simply diagnosis at first admission. This approach considerably
51 increases the number of people in the higher categories (eg psychoses). For example,
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of 17,031 individuals who were first admitted with depression, 71% were assigned to depression, 17% subsequently had schizophrenia recorded on a discharge record and so are-were assigned to "complicated schizophrenia", and 11% were assigned to "complicated bipolar". For some groups the hierarchy is less intuitive, for example, of the 325 individuals who were first admitted with eating disorders but subsequently had other mental ill health problems, 69% moved out of the eating disorder group into another group higher up the hierarchy (data not shown). This will lead to a conservative SMR for some complicated cases due to time at risk for conditions lower down the hierarchy being assigned to a condition higher up the hierarchy in the person-year analysis.

Comorbidity and early death

Furthermore, we have documented that diagnostic comorbidity/complexity (indicated by further recording of other mental disorders in addition to the main psychiatric diagnosis, whether it is comorbid-substance misuse, mental disorder or physical health problems), significantly elevates tends to increase the risk of premature death and the average years of lost life in those previously hospitalised due to mental illness.

This adverse effect of comorbidity-complexity has not reported before to our knowledge, and emphasises that comorbidity exacerbates prognosis. Also, our use of the SMR and the 'years of lost life' techniques allows quantification of both the relative and the absolute burden of excess death in this population. However, as this is a secondary care cohort, it will only capture those most severely affected by mental disorder, and hence does not allow comment on, for example, those with depression managed solely in the community. Equally, those hospitalised due to eating disorder are often physically unwell, so it is perhaps no surprise that this diagnostic group had worrying relative and absolute mortality results in this study. Lastly, we designed a 'wash in' period of 5 years (1981-1986) in order to capture only first admissions, but it is likely that some patients with psychiatric admissions prior to 1981 were included. The apparently old age at 'diagnosis'/first admission may suggest that these are in fact not all first admissions ie the relatively short wash in period has allowed us to include patients readmitted after more than 5 years as 'first admissions'.

A systematic review by Saha et al¹³ found a SMR of 2.5 for risk of death in schizophrenia, which is greater than our figures of 1.8 (uncomplicated) and 2.0 (complicated ~~or comorbid~~), but the more recent study by Hoang and colleagues from England⁸ found similar SMRs for both schizophrenia and bipolar disorder to our own results, albeit with a shorter follow up. Large long term follow up mortality studies comparing common mental disorders have not been reported elsewhere, to our

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7 knowledge, and our data provide context for the literature on early death in specific
8 disorders such as schizophrenia and bipolar [disorder](#)⁸, and depression and anxiety²¹.
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10 More detailed analysis of the time trends for individual causes of death in specific
11 diagnostic groups would be valuable in the future.
12

13 14 **Implications**

15 In previous studies of all-cause mortality in those with mental illness in Scotland,
16 behavioural risk factors such as heavy smoking and a sedentary lifestyle have been
17 linked to early death, along with social isolation and deprivation²². Policy makers in the
18 UK have also highlighted the physical health needs and premature mortality of those
19 with mental health problems which echo the worrying disparities in lifespan we have
20 identified for all the common mental disorders compared to the general population. In
21 particular, we have found that the highest risk of early death is associated with a
22 young age; eating disorders; personality disorders; and in those with multiple
23 diagnoses. A national approach across primary and secondary care tackling the
24 complex mix of factors contributing to early death in the mentally disordered is
25 required, addressing intrinsic disease related factors as well as lifestyle issues; lack of
26 help seeking; and even stigma within the healthcare professions^{15,16}. The inequity in
27 life expectancy in the mentally disordered documented here poses a considerable
28 challenge to our healthcare system.
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Table 1: Diagnostic Main psychiatric diagnosis categories of interest (and diagnostic hierarchy)

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<u>Diagnostic group Main psychiatric diagnosis category</u>	Definition	Hierarchy
Schizophrenia	Schizophrenia and other psychotic disorders including acute psychosis, persistent delusional disorders, schizotypal and schizoaffective disorder, and drug or alcohol induced psychotic disorder	1
Bipolar disorder	Manic episodes and bipolar disorder	2
Depression	Depressive episodes and recurrent depressive disorder (excluding persistent mood disorders such as cyclothymia)	3
Neurosis	Anxiety disorders and obsessive compulsive disorder	4
Eating disorder	Anorexia and bulimia nervosa	5
Personality disorder	All types of personality disorder	6

Note: ICD9 and ICD10 codes available on request.

Table 2a: Characteristics of the cohort included in the analysis (Males)

	N	%	Median age at first admission (25th – 75th percentiles)	% in most deprived quintile ¹	Median number (25th – 75th percentiles)	Median total length (days) (25th – 75th percentiles)
Uncomplicated diagnosis group:						
Schizophrenia	8,966	35	33.7 (24.6 -50.2)	29	1.0 (1.0 -2.0)	48.0 (16.0 -161.0)
Bipolar disorder	1,680	7	41.0 (28.4 -56.2)	17	1.0 (1.0 -2.0)	36.0 (17.0 -72.0)
Depression	12,778	49	47.5 (34.2 -66.0)	23	1.0 (1.0 -1.0)	22.0 (7.0 -53.0)
Neurosis	1,129	4	40.7 (29.8 -58.5)	26	1.0 (1.0 -1.0)	14.0 (5.0 -35.0)
Eating disorder	49	<1	22.1 (19.0 -28.8)	33	1.0 (1.0 -1.0)	48.0 (12.0 -89.0)
Personality disorder	1,221	5	30.9 (23.8 -41.7)	30	1.0 (1.0 -1.0)	8.0 (3.0 -24.0)
Total uncomplicated	25,823	100	40.9 (28.4 -59.6)	25	1.0 (1.0 -2.0)	28.0 (9.0 -74.0)
Complicated (hierarchical) diagnosis group:						
Schizophrenia	10,697	43	31.0 (23.3 -44.0)	33	4.0 (2.0 -6.0)	145.0 (52.0 -429.0)
Bipolar disorder	2,159	9	42.4 (30.5 -56.6)	21	3.0 (2.0 -5.0)	115.0 (51.0 -257.0)
Depression	9,421	38	40.1 (30.0 -54.9)	26	2.0 (1.0 -4.0)	44.0 (18.0 -105.0)
Neurosis	915	4	37.0 (27.4 -48.1)	24	2.0 (1.0 -3.0)	32.0 (14.0 -71.0)
Eating disorder	17	<1	31.3 (23.5 -48.5)	29	3.0 (2.0 -4.0)	45.0 (21.0 -148.0)
Personality disorder	1,580	6	31.3 (23.8 -41.6)	31	2.0 (1.0 -3.0)	21.0 (8.0 -49.0)
Total complicated	24,789	100	35.5 (26.0 -49.9)	28	3.0 (2.0 -5.0)	73.0 (26.0 -214.0)

Table 2b: Characteristics of the cohort included in the analysis (Females)

	N	%	Median age at first admission (25th – 75th percentiles)	% in most deprived quintile ¹	Median number (25th -75th percentiles)	Median total length (days) (25th – 75th percentiles)
Uncomplicated diagnosis group:						
Schizophrenia	6,999	21	53.9 (34.5 -76.0)	25	1.0 (1.0 -2.0)	47.0 (19.0 -122.0)
Bipolar disorder	2,196	7	43.4 (30.5 -61.0)	18	1.0 (1.0 -2.0)	35.0 (17.0 -74.0)
Depression	20,383	61	48.5 (33.8 -69.1)	23	1.0 (1.0 -1.0)	28.0 (10.0 -65.0)
Neurosis	1,946	6	48.5 (33.7 -68.7)	26	1.0 (1.0 -1.0)	18.0 (7.0 -39.0)
Eating disorder	586	2	20.7 (17.5 -26.5)	16	1.0 (1.0 -1.0)	49.0 (13.0 -126.0)
Personality disorder	1,095	3	31.1 (23.0 -43.5)	27	1.0 (1.0 -1.0)	9.0 (3.0 -25.0)
Total uncomplicated	33,205	100	47.6 (32.5 -69.5)	23	1.0 (1.0 -1.0)	30.0 (11.0 -73.0)
Complicated (hierarchical) diagnosis group²:						
Schizophrenia	8,230	30	40.6 (27.7 -66.0)	29	3.0 (2.0 -6.0)	162.0 (68.0 -410.0)
Bipolar disorder	3,619	13	43.0 (31.2 -59.8)	22	3.0 (2.0 -5.0)	136.0 (60.0 -313.0)
Depression	13,390	48	41.1 (29.8 -61.8)	25	2.0 (2.0 -4.0)	64.0 (25.0 -163.0)
Neurosis	1,136	4	42.9 (31.2 -63.6)	21	2.0 (1.0 -3.0)	38.0 (17.0 -91.5)
Eating disorder	199	1	26.2 (20.7 -34.3)	18	2.0 (1.0 -3.0)	35.0 (10.0 -103.0)
Personality disorder	1,113	4	29.5 (22.5 -40.3)	28	2.0 (1.0 -3.0)	27.0 (10.0 -60.0)
Total complicated	27,687	100	40.6 (28.8 -61.9)	26	3.0 (2.0 -5.0)	89.0 (33.0 -237.0)

¹ if there had been no deprivation gradient then around 20% of cases would be in the most deprived quintile

² . For individuals with a complicated mental health diagnosis (hierarchical) , the age at first admission refers to the first 'ever' admission event.

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Table 3: SMRs and years of life lost for all-cause mortality by diagnosis group (all patients diagnosed 1986-2009 and followed up until 31 December 2010)

	Observed deaths	Expected deaths	SMR ¹	Lower CI	Upper CI	Total YLL	Average YLL
Uncomplicated diagnosis group:							
Schizophrenia	5,060	2,746	1.8	1.8	1.9	78,027	15.2
Bi-polar	883	525.6	1.7	1.6	1.8	14,369	16.1
Depression	11,036	6,831.2	1.6	1.6	1.6	155,582	14.1
Neurotic disorders	838	524.7	1.6	1.5	1.7	12,373	14.9
Eating disorders	51	11.6	4.4	3.3	5.8	2,182	39.0
Personality disorders	449	234.9	1.9	1.7	2.1	10,583	22.8
Complicated (hierarchical) diagnosis group:							
Schizophrenia	5,635	2,876.9	2.0	1.9	2.0	116,775	19.6
Bi-polar	1,706	1,129.5	1.5	1.4	1.6	29,351	16.7
Depression	7,282	3,628.8	2.0	2.0	2.1	146,736	19.0
Neurotic disorders	579	272.8	2.1	2.0	2.3	12,194	19.9
Eating disorders	38	8.7	4.4	3.1	6.0	1,317	31.4
Personality disorders	686	221.9	3.1	2.9	3.3	20,894	27.5
Total	34,243	19,012.4	1.8	1.8	1.8	600,383	17.0

¹ adjusted for sex, age, period and deprivation category (Carstairs 1991 decile) at first diagnosis

Table 4: SMRs and years of life lost by diagnosis group and cause of death grouping (natural death, non-natural death, or "other" deaths) (all patients diagnosed 1986-2009 and followed up until 31 December 2010)

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	Natural deaths			Non-natural deaths			Other deaths		
	N	SMR (95% CI)	AYYL	N	SMR (95% CI)	AYYL	N	SMR (95% CI)	AYYL
Uncomplicated diagnosis group:									
Schizophrenia	3,580	1.8 (1.7 - 1.8)	11.8	504	4.4 (4.0 - 4.8)	32.2	976	1.6 (1.5 - 1.7)	16.3
Bi-polar	624	1.7 (1.6 - 1.8)	13.0	97	4.7 (3.8 - 5.8)	32.0	162	1.2 (1.0 - 1.4)	16.4
Depression	7,839	1.6 (1.6 - 1.6)	12.0	1,055	4.9 (4.6 - 5.2)	27.2	2,142	1.2 (1.2 - 1.3)	13.8
Neurotic disorders	622	1.7 (1.6 - 1.9)	13.2	63	3.3 (2.6 - 4.3)	29.4	153	1.1 (0.9 - 1.3)	15.1
Eating disorders	15	2.6 (1.4 - 4.3)	23.8	12	7.2 (3.7 - 12.6)	49.5	24	5.8 (3.7 - 8.7)	39.3
Personality disorders	265	1.7 (1.5 - 1.9)	15.0	96	6.2 (5.0 - 7.6)	37.6	88	1.4 (1.2 - 1.8)	25.6
Complicated (hierarchical) diagnosis group:									
Schizophrenia	3,500	1.7 (1.7 - 1.8)	14.3	767	5.2 (4.8 - 5.5)	35.1	1,368	2.0 (1.9 - 2.1)	20.0
Bi-polar	1,139	1.4 (1.3 - 1.5)	13.7	197	5.1 (4.4 - 5.8)	30.8	370	1.3 (1.1 - 1.4)	15.7
Depression	4,525	1.8 (1.7 - 1.8)	14.8	931	6.5 (6.1 - 7.0)	32.3	1,826	1.9 (1.9 - 2.0)	18.6
Neurotic disorders	379	2.0 (1.8 - 2.3)	16.4	53	4.3 (3.2 - 5.6)	33.6	147	2.0 (1.7 - 2.3)	20.0
Eating disorders	17	3.0 (1.7 - 4.8)	24.4	5	9.0 (2.8 - 21.1)	43.2	16	6.6 (3.7 - 10.7)	32.9
Personality disorders	360	2.5 (2.2 - 2.7)	19.9	129	7.5 (6.2 - 8.9)	39.0	197	3.4 (2.9 - 3.9)	28.8
Total	22,865	1.7 (1.7 - 1.7)	13.3	3,909	5.2 (5.1 - 5.4)	31.8	7,469	1.6 (1.5 - 1.6)	17.4

¹ adjusted for sex, age, period and deprivation category (Carstairs 1991 decile) at first diagnosis

Table 5. Observed and expected number of deaths for cardiovascular disease; cancer; and suicide.

	Observed CVS ¹ deaths	Expected CVS deaths	Observed Cancer ² deaths	Expected Cancer deaths	Observed suicide ³ deaths	Expected suicide deaths
Uncomplicated diagnosis group:						
Schizophrenia	2010	1109	650	500	502	110
Bi-polar	335	199	135	105	97	19
Depression	4281	2691	1671	1358	1047	211
Neurotic disorders	313	195	136	102	60	17
Eating disorders	6	3	3	1	12	1
Personality disorders	136	84	55	41	88	14
Complicated diagnosis group						
Schizophrenia	1740	1108	476	543	771	150
Bi-polar	596	425	201	238	198	38
Depression	2219	1368	730	718	932	138
Neurotic disorders	316	99	68	51	53	12
Eating disorders	5	3	3	1	5	0
Personality disorders	129	75	49	44	123	15

¹ All cardiovascular (heart disease) deaths. ² All cancer, including lung cancer, deaths.

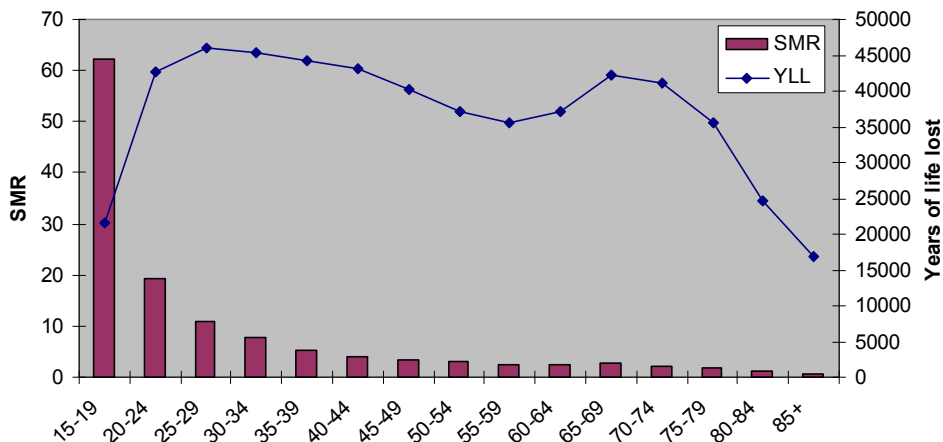
³ All deaths coded as suicides and accidents by poisoning.

Table 6: SMRs by time period of first admission (1986-2000) and followed up for 10 years from first admission (all diagnosis groups combined)

	Period of first diagnosis	Observed deaths	Expected deaths	SMR ¹	Lower CI	Upper CI
Males	1986-90	3185	1514.1	2.1	2.0	2.2
	1991-95	2878	1328.0	2.2	2.1	2.2
	1996-00	2327	1075.9	2.2	2.1	2.3
Females	1986-90	4808	2669.0	1.8	1.8	1.9
	1991-95	3882	2112.3	1.8	1.8	1.9
	1996-00	2740	1412.6	1.9	1.9	2.0

¹ adjusted for age and deprivation category (Carstairs 1991 decile) at first diagnosis

Figure 1: Age-specific all-cause SMRs and overall YLL for all patients diagnosed 1986-2009 and followed up until 31 December 2010



* The SMR for the above chart was produced from the table in Appendix A (below)

Appendix A: Age Specific all cause SMRs for all patients admitted to mental health speciality 1986 – 2009 followed up to 31st December 2010.

Age	Observed	Expected	RR	LCI	UCI
15-19	427	6.9	62.2	56.4	68.4
20-24	918	47.3	19.4	18.2	20.7
25-29	1112	101.0	11.0	10.4	11.7
30-34	1232	157.7	7.8	7.4	8.3
35-39	1357	251.4	5.4	5.1	5.7
40-44	1529	379.2	4.0	3.8	4.2
45-49	1690	515.3	3.3	3.1	3.4
50-54	1849	594.6	3.1	3.0	3.3
55-59	2162	822.4	2.6	2.5	2.7
60-64	2718	1055.7	2.6	2.5	2.7
65-69	3670	1340.3	2.7	2.7	2.8
70-74	4243	1882.2	2.3	2.2	2.3
75-79	4487	2509.9	1.8	1.7	1.8
80-84	3836	3182.7	1.2	1.2	1.2
85+	3013	6165.9	0.5	0.5	0.

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STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Re: **Mental disorder and early death – a nationwide follow up study, 1981 - 2010.**

Tomi Ajetunmobi¹, Mark Taylor², Diane Stockton¹, and Rachael Wood¹.

	Item No	Recommendation
Title and abstract	1 Done, p1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2 Done – p2	Explain the scientific background and rationale for the investigation being reported
Objectives	3 Done – p2	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4 Done	Present key elements of study design early in the paper
Setting	5 Done	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6 Done	(a) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7 Done	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8* Done	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9 In method & discussion	Describe any efforts to address potential sources of bias
Study size	10 Done	Explain how the study size was arrived at
Quantitative variables	11 Done	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12 Done	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses
Results		
Participants	13* Done	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage

		(c) Consider use of a flow diagram
Descriptive data	14* Done	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest
Outcome data	15* Done	Report numbers of outcome events or summary measures
Main results	16 Done where applicable	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17 SMRs and YLL	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18 Done	Summarise key results with reference to study objectives
Limitations	19 Done	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20 Done	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21 Commented on	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22 Done	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.



Early death in those previously hospitalized for mental health care in Scotland – a nationwide follow up study, 1986 - 2010.

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Primary Subject Heading:	Mental health
Secondary Subject Heading:	Epidemiology, Public health
Keywords:	MENTAL HEALTH, Suicide & self-harm < PSYCHIATRY, PUBLIC HEALTH

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11 **Early death in those previously hospitalized for mental health care in**
12 **Scotland – a nationwide follow up study, 1986 - 2010.**
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15 Omotomilola Ajetunmobi¹, Mark Taylor², Diane Stockton¹, and Rachael Wood¹.
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53 Contributors OA and MT conceived the study. OA and DS ascertained the data. All
54 authors analysed the data and drafted the manuscript. RW is the study guarantor.
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3 Neither NHS ethical approval nor Privacy Advisory Committee approval was required
4 for this study as no patient identifiable data were released outwith NHS National
5 Services Scotland and no new data linkages were undertaken.
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Article Focus

- Examines whether those previously hospitalised for mental disorder die earlier than people with no overt serious mental disorder.
- Do individuals with 'complicated' diagnoses (ie additional mental or physical ill health diagnoses in conjunction with their main psychiatric diagnosis) have higher excess mortality than those with 'uncomplicated' diagnoses?
- Is the apparent inequality in mortality rates between those with serious mental disorder and the general population worsening over time?

Key messages

- The average reduction in lifespan in those previously hospitalised for mental disorder compared to the general population is 17 years. People with eating disorders and personality disorder died earliest of all.
- In general, patients with 'complicated' diagnoses experience higher excess mortality than those without.
- Cardiovascular and respiratory diseases were the most common causes of death and accounted for a high proportion of the total burden of years of life lost, but suicides led to more years of lost life at the individual level due to predominantly affecting younger adults. No worsening of the 'mortality gap' over three decades was observed.

Strengths and limitations

- A large representative population studied over a long time period, which is important when examining causes of death.
- Innovative use of a diagnostic hierarchy to determine individuals' main psychiatric diagnosis.
- People with mental disorder who never required in-patient hospital care could not be included in this study.

Objectives:

To compare the mortality in those previously hospitalised for mental disorder in Scotland to that experienced by the general population.

Design:

Population based historical cohort study using routinely available psychiatric hospital discharge and death records.

Setting & participants:

Individuals with a first hospital admission for mental disorder in Scotland, 1986-2009.

Outcomes:

The main outcome measure was death from any cause, 1986-2010. Excess mortality in individuals with previous psychiatric admission was presented as standardised mortality ratios (SMR) and years of life lost (YLL). Excess mortality was assessed overall and by age, sex, main psychiatric diagnosis, whether the psychiatric diagnosis was 'complicated' (ie additional mental or physical ill health diagnoses present), cause of death, and time period of first admission.

Results

111504 people were included in the study, and 34243 had died by 31/12/2010. The average reduction in life expectancy for the whole cohort was 17 years, with eating disorders (39 year reduction) and 'complicated' personality disorders (27.5 year reduction) being worst affected. 'Natural' causes of death such as cardiovascular disease showed modestly elevated relative risk (SMR1.7) but accounted for a high proportion of all deaths (67%) and of the total burden of years of life lost (54%). Non-natural deaths such as suicide showed higher relative risk (SMR5.2) and tended to occur at a younger age but were less common overall (11% of all deaths and 22% of all YLL). Having a 'complicated' diagnosis tended to elevate the risk of early death. No worsening of the overall excess mortality experienced by individuals with previous psychiatric admission over time was observed.

Conclusions

Early death for those hospitalised with mental disorder is common, and represents a significant inequality even in well developed healthcare systems. Prevention of suicide and cardiovascular disease deserve particular attention in the mentally disordered.

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Declaration of interest

All authors are employed by NHS Scotland. MT has received fees and / or hospitality from the manufacturers of various antipsychotic medications. TA, DS, and RW have no other conflicts to declare.

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3 Many of the most disabling medical conditions worldwide are mental illnesses,
4 according to the WHO¹. As well as adversely affecting day to day function, it has been
5 known for many years that people with mental illness are at increased risk of
6 premature death²⁻⁵ with schizophrenia and bipolar disorder in particular being
7 associated with an early death⁶⁻⁸. These inequalities in life expectancy have recently⁹
8 been declared a "scandal", as even the Scandinavian countries⁵, Scotland¹⁰ and
9 England^{8,11}, despite relatively high quality and equitably distributed healthcare, have
10 not been able to demonstrate any improvement in this premature mortality for the
11 mentally ill over many years.
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17 Non-natural deaths¹² including suicide and accidents, account for a disproportionate
18 amount of this premature mortality in the mentally ill, particularly affecting young
19 adults. High rates of cardiovascular disease, respiratory disease and other so-called
20 natural causes also contribute^{5,13,14} to the elevated relative risk of early death in the
21 mentally ill. Precise estimates of the varying causal contributions to premature
22 mortality in the mentally disordered have been limited by the lack of large
23 representative populations being followed up over a lengthy period, and related studies
24 have usually focussed on schizophrenia and bipolar disorder^{8,15} rather than all major
25 mental disorders. Additionally, the effects of comorbidity or multiple diagnoses on this
26 premature mortality have also not been quantified. Concern has also been expressed
27 that those with mental illness have not benefitted from improvements in public health
28 over the last few decades^{9,14} and that this mortality gap between the general
29 population and the mentally ill is widening in recent years.
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38 Using routinely collected national data, available from 1981, we set out to examine the
39 ages and causes of death in those previously hospitalised with mental disorder in
40 Scotland, and quantify any excess mortality. We also aimed to explore the relative
41 contribution of different causes of death and trends over time.
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47 **Methods**

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49 Whenever a patient is discharged from a mental ill health hospital/specialty in
50 Scotland, a Scottish Morbidity Record for Mental ill health (SMR04) is returned to the
51 NHS National Services Scotland Information Services Division (ISD). SMR04 records
52 contain information on patient demographics such as personal identifiers, age, and
53 sex; the diagnosis that necessitated the admission; and aspects of the care given such
54 as the psychiatric subspecialty admitted to. One primary diagnosis and up to five
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3 further secondary diagnoses can be recorded. Diagnoses are coded according to the
4 International Classification of Diseases (ICD) (version 9 to 1997 and version 10 from
5 1997 to present). Statutory death records (containing demographic and ICD coded
6 cause of death information) are returned to the National Records of Scotland (NRS)
7 with copies passed to ISD for analytical purposes.
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11 For this study, SMR04 records for adults discharged from mental ill health
12 hospitals/specialities in Scotland between 1981 and 2009 were obtained. Patients
13 aged less than 15 years at the date of first admission and those admitted to the
14 learning disabilities subspecialty were excluded from the sample, in accordance with
15 the aim of studying the ages and causes of death in adults with mental illness and
16 personality disorder. Death records for the period 1986-2010 were also obtained. We
17 created a single patient record for each individual by linking all their hospital discharge
18 records and their death record (if died) using a range of patient identifiers and
19 previously developed probabilistic matching algorithms. These methods have been
20 described previously^{16, 17}. All patients who had had an admission to a mental ill health
21 specialty between 1981 and 1985 were excluded to give a cohort of patients with (as
22 close as possible to) a first inpatient admission between 1986 and 2009 in order to
23 clarify the issue of diagnostic shift or comorbidity.
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32 All patient level data used in this study were held and analysed within ISD. Only
33 aggregate results, from which individual patients could not be identified, were shared
34 with members of the study team not based within ISD (MT). ISD operates strict
35 procedures to maintain patient privacy and confidentiality and no specific additional
36 permissions were required for this study. In particular, permission for linkage of
37 previously unlinked health datasets held by ISD is required from the Privacy Advisory
38 Committee. PAC approval was not required for this study however as SMR04 and
39 death records have been routinely linked within ISD for decades for purposes such as
40 monitoring patient outcomes.
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49 **Diagnostic assignation**

50 We then assigned each individual to a main psychiatric diagnosis category (see table
51 1) and excluded individuals who did not have any admissions relating to a diagnostic
52 group of interest. The diagnostic groups of interest included were schizophrenia,
53 bipolar disorder, depression, neurosis, eating disorder, and personality disorder.
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58 Table 1 here
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Patients with a single primary psychiatric diagnosis of interest recorded on all their psychiatric discharge records over the period of study, and no other or additional diagnoses at any admission, were described as 'uncomplicated'. For example, an individual with five hospital admissions which were all coded solely to depression would be described as 'uncomplicated depression'.

In contrast, patients with more than one diagnosis recorded were described as 'complicated'. For patients with more than one diagnosis from the diagnostic groups of interest, a hierarchical approach was used to determine the main diagnosis and hence assign a patient to one group (see table 1) with schizophrenia being assigned the highest rank. For example, a patient diagnosed as having bipolar disorder at their first hospital admission and then admitted for neurosis at a later date would be assigned to the 'complicated bipolar' group. Conversely, someone who had three hospital admissions for neurosis and then one for neurosis with depression recorded as an additional secondary diagnosis would be described as 'complicated depression' and their time at risk in the cohort would be taken from their first neurosis admission.

Patients may also have had other/additional diagnoses not within the diagnostic groups of interest. These included other psychiatric problems (mainly dementia, stress reactions and adjustment disorders); alcohol or drug misuse; or (rarely) physical health problems such as pneumonia. Someone with an admission for personality disorder with drug misuse recorded as an additional secondary diagnosis would therefore be described as 'complicated personality disorder'.

Analysis

A final record was then created for each patient within the mental ill health cohort containing hierarchically defined main psychiatric diagnosis, a flag indicating whether the main diagnosis was 'complicated' or not, date of first admission, age at first admission, sex, deprivation category at first admission, date of death and (main) cause of death. Deprivation category was determined using Carstairs 1991 area-based deprivation deciles¹⁸ based on postcode of residence at first admission and corresponding population denominators from the Consistent Areas Through Time (CATTS) classification tables¹⁹ which allows us to create a long time series of deprivation-specific mortality rates.

This linked dataset was used to calculate indirectly standardised mortality ratios (SMRs) for the mental ill health patients using a person-years approach which took

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3 account of each individual's time at risk (from time of first admission) across different
4 age categories, time periods, sex and deprivation decile since diagnosis. All analyses
5 were carried out using Stata 11.0 (Stata Corp, College Station, Texas) using the stsplit command to
6 split age (in days) across the time periods. Age was defined in days from birth date to diagnosis
7 date, and study exit was defined in days from diagnosis date to end of follow-up interval or death,
8 whichever came first.
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13 Years of Life Lost (YLL) were computed by multiplying the number of deaths in the
14 study cohort (in each period of death, sex, age band at death and deprivation decile)
15 by the corresponding life expectancy at that age. The average YLL (AYLL) was
16 derived by dividing the total YLL by the actual number of deaths within the subgroups
17 of interest. Scottish national mortality rates split by year of death (in time bands),
18 sex, five-year age band and deprivation decile were used as the reference standard for
19 the SMRs. Life tables were compiled based on these national mortality rates following
20 the Chiang²⁰ methodology for the YLL analyses. To examine possible trends over time
21 in the excess mortality experienced by individuals with previous psychiatric admission,
22 we chose three time period cohorts each with 10 years of follow up for each cohort to
23 capture a wide range of causes of death.
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30 We looked at overall mortality; mortality by specific cause; and mortality split into
31 natural deaths (cardiovascular, cancer, respiratory, digestive, endocrine, nervous
32 system, infectious disease), non-natural deaths (accidental, suicide/undetermined,
33 homicide), and other (all other deaths including those recorded as mental and
34 behavioural).
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41 **Results**

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44 Over the time period of study (1986-2009) there were 59,028 individuals who had a
45 consistent diagnosis within and between admissions (classified as uncomplicated) and
46 52,476 individuals who had an unstable diagnosis or additional co-morbidity within
47 and/or between admissions (classified as complicated). Women comprised 55% of the
48 cohort largely due to a higher number of cases of depression in women. Women
49 tended to be older than men at their first included admission, particularly for
50 schizophrenia and neurosis. Complicated diagnoses resulted in higher numbers of
51 hospitalisations and total length of time spent in hospital as would be expected (see
52 Table 2a and 2b).
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3 Increasing deprivation was linked to mental ill health problems for both men and
4 women, with the exception of bi-polar disorder (no clear trend across deprivation
5 groups for either sex) and eating disorder in females (uncomplicated more common in
6 least deprived group; complicated no clear trend across deprivation groups) (Table 2
7 and additional analyses available on request).
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11 Overall, 34,243 individuals in the study cohort had died by the 31 December 2010,
12 around 80% more (SMR=1.8) than expected based on the general population (see
13 table 3). The standardised mortality ratios tended to be higher for those with
14 complicated diagnoses, and overall were highest for those with eating disorders
15 (SMR=4.4) and complicated personality disorders (SMR=3.1). Overall life expectancy
16 for the whole cohort of individuals with mental ill health was 17 years less than that
17 for the general population. The largest reduction in life expectancy was seen for
18 individuals with eating disorders (39 years of life lost for those with uncomplicated
19 diagnosis) and personality disorders (27.5 YLL for those with complicated diagnosis)
20 however as most deaths were seen in individuals with depression and schizophrenia,
21 these conditions accounted for the greatest number of years of life lost.
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29 **Relative risk of early death**

30 The excess risk of death was extremely high for those in the youngest age group at
31 first included admission, and the excess reduced as age at first admission increased
32 (see figure 1). However, total years of life lost told a slightly different story, with a
33 relatively constant YLL for those diagnosed at ages 20-24 through to 75-79 years, with
34 lower YLL for those aged 15-19, 80-84 and 85+ years. This reflects the fact that the
35 absolute risk of dying generally increases with age. The same age-related pattern is
36 seen for males and females, although the excess risk of death is higher for females
37 compared to males at every age (data not shown).
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44 **Figure 1 here**

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46 Around two thirds of deaths (22,865 deaths) in the mental ill health cohort were from
47 natural causes, 11% (3,909) from non-natural causes and the remaining 21% (7,469)
48 were from "other" deaths not coded as natural or non-natural including 'mental or
49 behavioural disorder' (36% of "other" causes of death). The excess risk of death was
50 much higher from non-natural causes (SMR=5.2) compared to natural causes
51 (SMR=1.7) and "other" deaths (SMR=1.6). On average, 31.8 years of life were lost
52 due to every non-natural death compared to 13.3 years due to every natural death
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3 and 17.4 years of life lost for each "other" death, reflecting the fact that non-natural
4 deaths tend to occur at younger ages (see Table 4).
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8 There was a significant excess risk of natural, non-natural and "other" deaths for
9 patients in each diagnosis group (except uncomplicated neurotic disorders resulting in
10 "other" deaths (SMR=1.1, ns). The highest excess risks were seen for eating disorders
11 across death groupings, although the number of deaths in individuals with eating
12 disorders was small (see Table 4). Natural deaths accounted for more years of life lost
13 than non-natural deaths in each diagnostic group. Cardiovascular disease accounted
14 for around half of all years of life lost from natural causes, with digestive disorders,
15 cancer, and respiratory disorders accounting for most of the remainder. Suicide
16 accounted for the majority of years of life lost due to non-natural causes in each
17 diagnostic group (data not shown). Table 5 reveals the proportions of observed ~~and~~
18 ~~expected~~ deaths for the two main natural causes of death, namely heart disease and
19 cancer, as well as suicide, the main causes of unnatural death.
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26 **Tables 2a; 2b; 3; 4; and 5 here**
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29 **Mortality trends over time**

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31 Looking at individuals whose first admissions were in the periods 1986-90, 1991-95
32 and 1996-2000 and following each individual in these sub-cohorts up for 10 years from
33 their first admission, the all cause standardised mortality ratios showed no evidence of
34 a narrowing of the mortality excess over time (see Table 6).
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38 **Table 6 here**
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44 **Discussion**

45 **Main findings**

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47 This large national study provides an accurate estimate of the risk of early death
48 experienced by adults previously hospitalised for mental disorder. We showed that
49 overall life expectancy for the whole cohort of individuals previously hospitalised due to
50 mental ill health was 17 years less than that for the general population. The excess
51 risk of early death was greatest for patients first admitted at the youngest age (15-19
52 years old) but individuals first admitted at older ages experienced greater numbers of
53 early deaths. The largest reduction in life expectancy was seen for individuals with
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3 eating disorders and personality disorders – namely an alarming 39 years reduction in
4 life expectancy for uncomplicated eating disorders, and 27.5 for those with a
5 complicated personality disorder. However as the greatest number of deaths were
6 seen in individuals with depression and schizophrenia, these conditions accounted for
7 the greatest number of years of life lost.
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11 The majority of deaths in those previously hospitalised for mental disorder are due to
12 'natural' causes such as cardiovascular and respiratory disorder, which mirrors the
13 results of a similar study from Denmark⁷ examining the life expectancy of those with
14 schizophrenia and bipolar disorder. By contrast, although only 11% of deaths in our
15 study population were attributable to 'non-natural' causes such as suicide, accidents,
16 and homicide, we found that these 'non-natural' causes carried a substantially higher
17 comparative excess risk of early death – ranging between 27 years of lost life for
18 depression to a staggering 49.5 years for eating disorders, emphasising that these
19 non-natural deaths occur earlier than the more common natural causes of death. For
20 the whole cohort of mentally ill individuals, those dying from non-natural causes lost,
21 on average, almost 32 years of life, reinforcing the continuing need for national suicide
22 prevention strategies.
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30 **A stable 'mortality gap'?**

31 In addition, contrary to results elsewhere^{8,14}, we did not find any evidence that the
32 difference in risk of death between the general population and the mentally disordered
33 was worsening over time. In fact, we observed that this 'mortality gap' was stable over
34 25 years for all the common mental disorders, which offers some reassurance to
35 claims that the mentally disordered have not benefited from improvements in public
36 health⁹. Nevertheless, our data indicates that there continues to be a need for
37 monitoring the physical health of those with mental disorder, and in particular
38 screening for cardiovascular disease.
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45 **Strengths and limitations of the study**

46 Strengths of this study include the whole population coverage and the long time
47 series, along with the demonstrable high quality and completeness²³ of the diagnostic
48 coding and cause of death coding. The reliability of a given diagnosis does not
49 necessarily imply that it is valid, however, in a specialty that lacks objective diagnostic
50 tests. We have also taken care with main psychiatric diagnosis assignment, using a
51 pragmatic hierarchical approach to account for the diagnostic shift and co-morbidities
52 that are commonly seen in day-to-day clinical psychiatric practice. Definitive diagnosis
53 is not always easy initially in mental health, and over such a long study period there
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3 may be shift in diagnostic trends. Main psychiatric diagnosis has therefore been
4 assigned using a hierarchical approach and taking into account all diagnoses recorded
5 on an individual's psychiatric discharge records over the period of study rather than
6 simply diagnosis at first admission. This approach considerably increases the number
7 of people in the higher categories (eg psychoses). For example, of 17,031 individuals
8 who were first admitted with depression, 71% were assigned to depression, 17%
9 subsequently had schizophrenia recorded on a discharge record and so were assigned
10 to "complicated schizophrenia", and 11% were assigned to "complicated bipolar". For
11 some groups the hierarchy is less intuitive, for example, of the 325 individuals who
12 were first admitted with eating disorders but subsequently had other mental ill health
13 problems, 69% moved out of the eating disorder group into another group higher up
14 the hierarchy (data not shown). This will lead to a conservative SMR for some
15 complicated cases due to time at risk for conditions lower down the hierarchy being
16 assigned to a condition higher up the hierarchy in the person-year analysis. Another
17 consideration to bear in mind is that the threshold for admission to a psychiatric
18 hospital will likely have changed over time, particularly as community based
19 alternatives became available. This unquantifiable threshold shift could complicate the
20 interpretation of the time trend data in Table 6.
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31 **Comorbidity and early death**

32 Furthermore, we have documented that diagnostic 'complexity' (indicated by further
33 recording of other mental disorders in addition to the main psychiatric diagnosis,
34 substance misuse, or physical health problems), tends to increase the risk of
35 premature death and the average years of lost life in those previously hospitalised due
36 to mental illness. This adverse effect of complexity has not reported before to our
37 knowledge, and emphasises that comorbidity exacerbates prognosis, although an
38 alternate explanation is that increased 'complexity' is in effect a proxy for lesser
39 diagnostic rigour and care, which may in turn affect mortality. Similarly, an increased
40 'complexity' in a case may be a marker of increased severity of illness, which may in
41 turn be related to early death. Also, our use of the SMR and the 'years of lost life'
42 techniques allows quantification of both the relative and the absolute burden of excess
43 death in this population. However, as this is a secondary care cohort, it will only
44 capture those most severely affected by mental disorder, and hence does not allow
45 comment on, for example, those with depression managed solely in the community.
46 Equally, those hospitalised due to eating disorder are often physically unwell, so it is
47 perhaps no surprise that this diagnostic group had worrying relative and absolute
48 mortality results in this study. Not all comorbidity (or 'complexity') will have been
49 captured here, due to the exclusion of physical ill health discharge records and
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3 probable under-recording of secondary psychiatric diagnostic codes. Lastly, we
4 designed a 'wash in' period of 5 years (1981-1986) in order to capture only first
5 admissions, but it is likely that some patients with psychiatric admissions prior to 1981
6 were included. The apparently old age at 'diagnosis'/first admission may suggest that
7 these are in fact not all first admissions ie the relatively short wash in period has
8 allowed us to include patients readmitted after more than 5 years as 'first admissions'.
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13 A systematic review by Saha et al¹⁴ found a SMR of 2.5 for risk of death in
14 schizophrenia, which is greater than our figures of 1.8 (uncomplicated) and 2.0
15 (complicated), but the more recent study by Hoang and colleagues from England⁸
16 found similar SMRs for both schizophrenia and bipolar disorder to our own results,
17 albeit with a shorter follow up. Large long term follow up mortality studies comparing
18 common mental disorders have not been reported elsewhere, to our knowledge, and
19 our data provide context for the literature on early death in specific disorders such as
20 schizophrenia and bipolar disorder⁸, and depression and anxiety²⁴. More detailed
21 analysis of the time trends for individual causes of death in specific diagnostic groups
22 would be valuable in the future.
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31 **Implications**

32 In previous studies of all-cause mortality in those with mental illness in Scotland,
33 behavioural risk factors such as heavy smoking and a sedentary lifestyle have been
34 linked to early death, along with social isolation and deprivation²⁵. Policy makers in the
35 UK have also highlighted the physical health needs and premature mortality of those
36 with mental health problems which echo the worrying disparities in lifespan we have
37 identified for all the common mental disorders compared to the general population. In
38 particular, we have found that the highest risk of early death is associated with young
39 age at first admission; eating disorders; personality disorders; and in those with
40 multiple diagnoses. A national approach across primary and secondary care tackling
41 the complex mix of factors contributing to early death in the mentally disordered is
42 required, addressing intrinsic disease related factors as well as lifestyle issues; lack of
43 help seeking; and even stigma within the healthcare professions^{21, 22, 25}. The inequity in
44 life expectancy in the mentally disordered documented here poses a considerable
45 challenge to our healthcare system.
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Table 1: Main psychiatric diagnosis categories of interest (and diagnostic hierarchy)

Main psychiatric diagnosis category	Definition	Hierarchy
Schizophrenia	Schizophrenia and other psychotic disorders including acute psychosis, persistent delusional disorders, schizotypal and schizoaffective disorder, and drug or alcohol induced psychotic disorder	1
Bipolar disorder	Manic episodes and bipolar disorder	2
Depression	Depressive episodes and recurrent depressive disorder (excluding persistent mood disorders such as cyclothymia)	3
Neurosis	Anxiety disorders and obsessive compulsive disorder	4
Eating disorder	Anorexia and bulimia nervosa	5
Personality disorder	All types of personality disorder	6

Note: ICD9 and ICD10 codes available on request.

Table 2a: Characteristics of the cohort included in the analysis (Males)

	N	%	Median age at first admission (interquartile range)	% in most deprived quintile ¹	Median number of admissions (interquartile range)	Median total length (days) on admission (interquartile range)
Uncomplicated diagnosis group:						
Schizophrenia	8,966	35	33.7 (24.6 -50.2)	29	1.0 (1.0 -2.0)	48.0 (16.0 -161.0)
Bipolar disorder	1,680	7	41.0 (28.4 -56.2)	17	1.0 (1.0 -2.0)	36.0 (17.0 -72.0)
Depression	12,778	49	47.5 (34.2 -66.0)	23	1.0 (1.0 -1.0)	22.0 (7.0 -53.0)
Neurosis	1,129	4	40.7 (29.8 -58.5)	26	1.0 (1.0 -1.0)	14.0 (5.0 -35.0)
Eating disorder	49	<1	22.1 (19.0 -28.8)	33	1.0 (1.0 -1.0)	48.0 (12.0 -89.0)
Personality disorder	1,221	5	30.9 (23.8 -41.7)	30	1.0 (1.0 -1.0)	8.0 (3.0 -24.0)
Total uncomplicated	25,823	100	40.9 (28.4 -59.6)	25	1.0 (1.0 -2.0)	28.0 (9.0 -74.0)
Complicated (hierarchical) diagnosis group:						
Schizophrenia	10,697	43	31.0 (23.3 -44.0)	33	4.0 (2.0 -6.0)	145.0 (52.0 -429.0)
Bipolar disorder	2,159	9	42.4 (30.5 -56.6)	21	3.0 (2.0 -5.0)	115.0 (51.0 -257.0)
Depression	9,421	38	40.1 (30.0 -54.9)	26	2.0 (1.0 -4.0)	44.0 (18.0 -105.0)
Neurosis	915	4	37.0 (27.4 -48.1)	24	2.0 (1.0 -3.0)	32.0 (14.0 -71.0)
Eating disorder	17	<1	31.3 (23.5 -48.5)	29	3.0 (2.0 -4.0)	45.0 (21.0 -148.0)
Personality disorder	1,580	6	31.3 (23.8 -41.6)	31	2.0 (1.0 -3.0)	21.0 (8.0 -49.0)
Total complicated	24,789	100	35.5 (26.0 -49.9)	28	3.0(2.0-5.0)	73.0(26.0 -214.0)

Table 2b: Characteristics of the cohort included in the analysis (Females)

	N	%	Median age at first admission (interquartile range)	% in most deprived quintile ¹	Median number of admissions (interquartile range)	Median total length (days) on admission (interquartile range)
Uncomplicated diagnosis group:						
Schizophrenia	6,999	21	53.9 (34.5 -76.0)	25	1.0 (1.0 -2.0)	47.0 (19.0 -122.0)
Bipolar disorder	2,196	7	43.4 (30.5 -61.0)	18	1.0 (1.0 -2.0)	35.0 (17.0 -74.0)
Depression	20,383	61	48.5 (33.8 -69.1)	23	1.0 (1.0 -1.0)	28.0 (10.0 -65.0)
Neurosis	1,946	6	48.5 (33.7 -68.7)	26	1.0 (1.0 -1.0)	18.0 (7.0 -39.0)
Eating disorder	586	2	20.7 (17.5 -26.5)	16	1.0 (1.0 -1.0)	49.0 (13.0 -126.0)
Personality disorder	1,095	3	31.1 (23.0 -43.5)	27	1.0 (1.0 -1.0)	9.0 (3.0 -25.0)
Total uncomplicated	33,205	100	47.6 (32.5 -69.5)	23	1.0 (1.0 -1.0)	30.0 (11.0 -73.0)
Complicated (hierarchical) diagnosis group²:						
Schizophrenia	8,230	30	40.6 (27.7 -66.0)	29	3.0 (2.0 -6.0)	162.0 (68.0 -410.0)
Bipolar disorder	3,619	13	43.0 (31.2 -59.8)	22	3.0 (2.0 -5.0)	136.0 (60.0 -313.0)
Depression	13,390	48	41.1 (29.8 -61.8)	25	2.0 (2.0 -4.0)	64.0 (25.0 -163.0)
Neurosis	1,136	4	42.9 (31.2 -63.6)	21	2.0 (1.0 -3.0)	38.0 (17.0 -91.5)
Eating disorder	199	1	26.2 (20.7 -34.3)	18	2.0 (1.0 -3.0)	35.0 (10.0 -103.0)
Personality disorder	1,113	4	29.5 (22.5 -40.3)	28	2.0 (1.0 -3.0)	27.0 (10.0 -60.0)
Total complicated	27,687	100	40.6 (28.8 -61.9)	26	3.0 (2.0 -5.0)	89.0 (33.0 -237.0)

1 if there had been no deprivation gradient then around 20% of cases would be in the most deprived quintile

2 . For individuals with a complicated mental health diagnosis (hierarchical) , the age at first admission refers to the first 'ever' admission event.

Table 3: SMRs and years of life lost for all-cause mortality by diagnosis group (all patients diagnosed 1986-2009 and followed up until 31 December 2010)

	Observed deaths	Expected deaths	SMR ¹ 95% CI	Total YLL	Average YLL
Uncomplicated diagnosis group:					
Schizophrenia	5,060	2,746	1.84 (1.79 - 1.89)	78,027	15.2
Bi-polar	883	525.6	1.68 (1.57 - 1.79)	14,369	16.1
Depression	11,036	6,831.2	1.62 (1.59 - 1.65)	155,582	14.1
Neurotic disorders	838	524.7	1.60 (1.49 - 1.71)	12,373	14.9
Eating disorders	51	11.6	4.39 (3.27 - 5.77)	2,182	39.0
Personality disorders	449	234.9	1.91 (1.74 - 2.10)	10,583	22.8
Complicated (hierarchical) diagnosis group:					
Schizophrenia	5,635	2,876.9	1.96 (1.91 - 2.01)	116,775	19.6
Bi-polar	1,706	1,129.5	1.51 (1.44 - 1.58)	29,351	16.7
Depression	7,282	3,628.8	2.01 (1.96 - 2.05)	146,736	19.0
Neurotic disorders	579	272.8	2.12 (1.95 - 2.30)	12,194	19.9
Eating disorders	38	8.7	4.39 (3.10 - 6.03)	1,317	31.4
Personality disorders	686	221.9	3.09 (2.86 - 3.33)	20,894	27.5
Total	34,243	19,012.4	1.80 (1.78 - 1.82)	600,383	17.0

¹ adjusted for sex, age, period and deprivation category (Carstairs 1991 decile) at first diagnosis

Table 4: SMRs and years of life lost by diagnosis group and cause of death grouping (natural death, non-natural death, or "other" deaths) (all patients diagnosed 1986-2009 and followed up until 31 December 2010)

	Natural deaths			Non-natural deaths			Other deaths		
	N	SMR (95% CI)	AYYL	N	SMR (95% CI)	AYYL	N	SMR (95% CI)	AYYL
Uncomplicated diagnosis group:									
Schizophrenia	3,580	1.78 (1.72 - 1.84)	11.8	504	4.40 (4.02 - 4.80)	32.2	976	1.58 (1.48 - 1.68)	16.3
Bi-polar	624	1.69 (1.56 - 1.83)	13.0	97	4.74 (3.84 - 5.78)	32.0	162	1.18 (1.01 - 1.38)	16.4
Depression	7,839	1.60 (1.56 - 1.63)	12.0	1,055	4.93 (4.64 - 5.24)	27.2	2,142	1.25 (1.20 - 1.30)	13.8
Neurotic disorders	622	1.71 (1.58 - 1.85)	13.2	63	3.35 (2.57 - 4.29)	29.4	153	1.07 (0.91 - 1.26)	15.1
Eating disorders	15	2.57 (1.44 - 4.26)	23.8	12	7.21 (3.71 - 12.63)	49.5	24	5.81 (3.72 - 8.66)	39.3
Personality disorders	265	1.67 (1.48 - 1.88)	15.0	96	6.21 (5.03 - 7.58)	37.6	88	1.45 (1.16 - 1.79)	25.6
Complicated (hierarchical) diagnosis group:									
Schizophrenia	3,500	1.71 (1.65 - 1.77)	14.3	767	5.17 (4.81 - 5.55)	35.1	1,368	2.02 (1.91 - 2.13)	20.0
Bi-polar	1,139	1.43 (1.34 - 1.51)	13.7	197	5.06 (4.38 - 5.82)	30.8	370	1.27 (1.14 - 1.41)	15.7
Depression	4,525	1.78 (1.72 - 1.83)	14.8	931	6.54 (6.12 - 6.97)	32.3	1,826	1.94 (1.86 - 2.04)	18.6
Neurotic disorders	379	2.04 (1.84 - 2.25)	16.4	53	4.28 (3.20 - 5.60)	33.6	147	1.98 (1.67 - 2.33)	20.0
Eating disorders	17	3.00 (1.74 - 4.82)	24.4	5	8.99 (2.84 - 21.14)	43.1	16	6.56 (3.74 - 10.68)	32.9
Personality disorders	360	2.46 (2.21 - 2.73)	19.9	129	7.47 (6.24 - 8.88)	39.0	197	3.37 (2.92 - 3.88)	28.8
Total	22,865	1.69 (1.67 - 1.71)	13.3	3,909	5.25 (5.08 - 5.41)	31.80	7,469	1.58 (1.55 - 1.62)	17.4

¹ adjusted for sex, age, period and deprivation category (Carstairs 1991 decile) at first diagnosis

Table 5. SMRs for cardiovascular disease; cancer; and suicide.

	Cardiovascular deaths ¹		Cancer deaths ²		Suicide deaths ³	
Uncomplicated diagnosis group						
	% of natural deaths	SMR (95% CI)	% of natural deaths	SMR (95% CI)	% of unnatural deaths	SMR (95% CI)
Schizophrenia	53%	1.72 (1.65 - 1.80)	12%	1.30 (1.18 - 1.43)	63%	8.05 (7.19 - 8.98)
Bi-polar	54%	1.69 (1.51 - 1.88)	15%	1.39 (1.12 - 1.69)	74%	9.70 (7.59 - 12.22)
Depression	55%	1.59 (1.54 - 1.64)	15%	1.35 (1.28 - 1.43)	75%	13.28 (12.37 - 14.24)
Neurotic disorders	50%	1.60 (1.43 - 1.79)	14%	1.37 (1.10 - 1.69)	65%	6.44 (4.62 - 8.75)
Eating disorders	40%	2.30 (0.83 - 5.04)	20%	2.92 (0.55 - 8.65)	92%	12.22 (6.07 - 21.94)
Personality disorders	51%	1.62 (1.36 - 1.91)	12%	1.17 (0.80 - 1.66)	65%	8.58 (6.57 - 11.00)
Complicated diagnosis group						
Schizophrenia	50%	1.57 (1.50 - 1.65)	9%	0.86 (0.77 - 0.96)	72%	9.05 (8.31 - 9.83)
Bi-polar	52%	1.40 (1.29 - 1.52)	12%	0.88 (0.74 - 1.05)	77%	11.57 (9.80 - 13.57)
Depression	49%	1.62 (1.56 - 1.69)	10%	1.01 (0.93 - 1.11)	74%	13.25 (12.28 - 14.27)
Neurotic disorders	44%	1.65 (1.41 - 1.92)	12%	1.34 (0.98 - 1.81)	70%	7.52 (5.29 - 10.37)
Eating disorders	29%	1.68 (0.53 - 3.95)	12%	2.06 (0.19 - 7.56)	100%	19.49 (6.15 - 45.85)
Personality disorders	43%	2.08 (1.76 - 2.43)	10%	1.32 (0.92 - 1.82)	71%	10.55 (8.49 - 12.95)

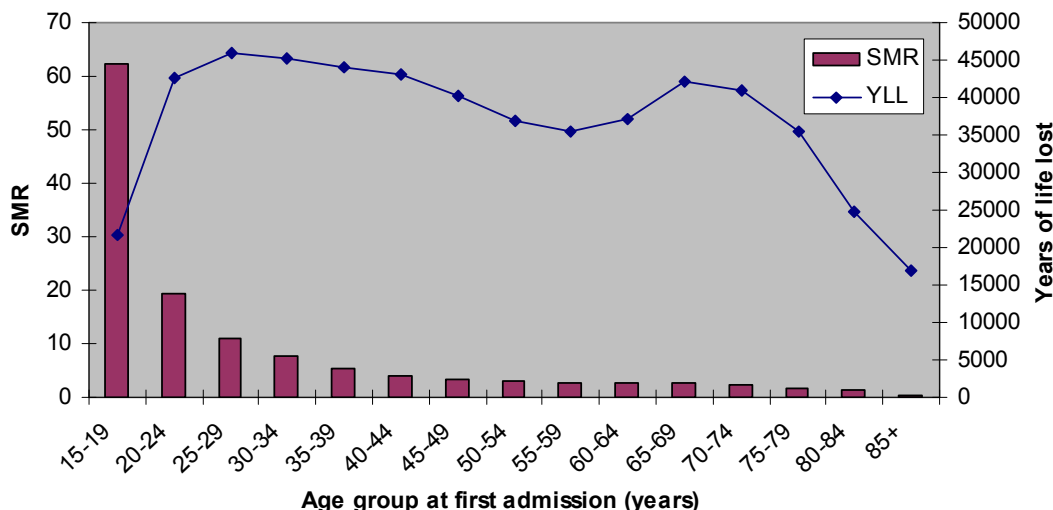
All cardiovascular deaths.¹ All cancer, including lung cancer, deaths². All deaths coded as suicides³. Cardiovascular and cancer deaths are shown as a proportion of observed natural deaths within each category and suicide is shown as a proportion of observed unnatural deaths within each category.

Table 6: SMRs by time period of first admission (1986-2000) and followed up for 10 years from first admission (all diagnosis groups combined)

	Period of first admission	Observed deaths	Expected deaths	SMR ¹ (95% CI)
Males	1986-90	3185	1514	2.10 (2.03 - 2.18)
	1991-95	2878	1328	2.17 (2.09 - 2.25)
	1996-00	2327	1076	2.16 (2.08 - 2.25)
Females	1986-90	4808	2669	1.80 (1.75 - 1.85)
	1991-95	3882	2112	1.84 (1.78 - 1.90)
	1996-00	2740	1413	1.94 (1.87 - 2.01)

¹ adjusted for age and deprivation category (Carstairs 1991 decile) at first diagnosis

Figure 1: All-cause SMRs and overall YLL for patients diagnosed 1986-2009 and followed up until 31 December 2010 by age group at first admission



* The SMR for the above chart was produced from the table in Appendix A (below)

Appendix A: All cause SMRs for patients admitted to mental health speciality 1986 – 2009 followed up to 31st December 2010, by age group at first admission

Age	Observed	Expected	SMR (95% CI)
15-19	427	6.9	62.18 (56.42 - 68.37)
20-24	918	47.3	19.39 (18.16 - 20.69)
25-29	1112	101.0	11.01 (10.37 - 11.68)
30-34	1232	157.7	7.81 (7.38 - 8.26)
35-39	1357	251.4	5.40 (5.11 - 5.69)
40-44	1529	379.2	4.03 (3.83 - 4.24)
45-49	1690	515.3	3.28 (3.13 - 3.44)
50-54	1849	594.6	3.11 (2.97 - 3.25)
55-59	2162	822.4	2.63 (2.52 - 2.74)
60-64	2718	1055.7	2.57 (2.48 - 2.67)
65-69	3670	1340.3	2.74 (2.65 - 2.83)
70-74	4243	1882.2	2.25 (2.19 - 2.32)
75-79	4487	2509.9	1.79 (1.74 - 1.84)
80-84	3836	3182.7	1.21 (1.17 - 1.24)
85+	3013	6165.9	0.49 (0.47 - 0.51)

APPENDIX B: Main psychiatric diagnoses of interest (ICD 9/10 codes)

Diagnostic Description	ICD 9 Codes	ICD 10 codes
Bipolar disorder	2960,2962, 2963,2966, 2964, 2965	F30, F31
Schizophrenia	2950, 2951, 2952, 2954, 2955,2953,2956,2958,2959 2970, 2971, 2972, 2973, 2978, 2979, 2999 2988,2989, 2981	F20, F22, F28, F29, F24X
Schizoaffective	2957	F25
Depression	311, 2966, 2961, 2980,3004, 3001	F32, F33 F38 F39
Neurotic Disorder	3000, 3002, 3003, 2968, 2969	F40, F41, F42,
Personality Disorder	3010, 3012, 3013,3014, 3015, 3016,3017, 3018,3019, 3011	F60, F61, F62
Eating disorders	3071, 3075	F50

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11 **Early death in those previously hospitalized for mental health care in**
12 **Scotland – a nationwide follow up study, 1986 - 2010.**
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53 Contributors OA and MT conceived the study. OA and DS ascertained the data. All
54 authors analysed the data and drafted the manuscript. RW is the study guarantor.
55

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3 Neither NHS ethical approval nor Privacy Advisory Committee approval was required
4 for this study as no patient identifiable data were released outwith NHS National
5 Services Scotland and no new data linkages were undertaken.
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Article Focus

- Examines whether those previously hospitalised for mental disorder die earlier than people with no overt serious mental disorder.
- Do individuals with 'complicated' diagnoses (ie additional mental or physical ill health diagnoses in conjunction with their main psychiatric diagnosis) have higher excess mortality than those with 'uncomplicated' diagnoses?
- Is the apparent inequality in mortality rates between those with serious mental disorder and the general population worsening over time?

Key messages

- The average reduction in lifespan in those previously hospitalised for mental disorder compared to the general population is 17 years. People with eating disorders and personality disorder died earliest of all.
- In general, patients with 'complicated' diagnoses experience higher excess mortality than those without.
- Cardiovascular and respiratory diseases were the most common causes of death and accounted for a high proportion of the total burden of years of life lost, but suicides led to more years of lost life at the individual level due to predominantly affecting younger adults. No worsening of the 'mortality gap' over three decades was observed.

Strengths and limitations

- A large representative population studied over a long time period, which is important when examining causes of death.
- Innovative use of a diagnostic hierarchy to determine individuals' main psychiatric diagnosis.
- People with mental disorder who never required in-patient hospital care could not be included in this study.

Objectives:

To compare the mortality in those previously hospitalised for mental disorder in Scotland to that experienced by the general population.

Design:

Population based historical cohort study using routinely available psychiatric hospital discharge and death records.

Setting & participants:

Individuals with a first hospital admission for mental disorder in Scotland, 1986-2009.

Outcomes:

The main outcome measure was death from any cause, 1986-2010. Excess mortality in individuals with previous psychiatric admission was presented as standardised mortality ratios (SMR) and years of life lost (YLL). Excess mortality was assessed overall and by age, sex, main psychiatric diagnosis, whether the psychiatric diagnosis was 'complicated' (ie additional mental or physical ill health diagnoses present), cause of death, and time period of first admission.

Results

111504 people were included in the study, and 34243 had died by 31/12/2010. The average reduction in life expectancy for the whole cohort was 17 years, with eating disorders (39 year reduction) and 'complicated' personality disorders (27.5 year reduction) being worst affected. 'Natural' causes of death such as cardiovascular disease showed modestly elevated relative risk (SMR1.7) but accounted for a high proportion of all deaths (67%) and of the total burden of years of life lost (54%). Non-natural deaths such as suicide showed higher relative risk (SMR5.2) and tended to occur at a younger age but were less common overall (11% of all deaths and 22% of all YLL). Having a 'complicated' diagnosis tended to elevate the risk of early death. No worsening of the overall excess mortality experienced by individuals with previous psychiatric admission over time was observed.

Conclusions

Early death for those hospitalised with mental disorder is common, and represents a significant inequality even in well developed healthcare systems. Prevention of suicide and cardiovascular disease deserve particular attention in the mentally disordered.

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Declaration of interest

All authors are employed by NHS Scotland. MT has received fees and / or hospitality from the manufacturers of various antipsychotic medications. TA, DS, and RW have no other conflicts to declare.

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3 Many of the most disabling medical conditions worldwide are mental illnesses,
4 according to the WHO¹. As well as adversely affecting day to day function, it has been
5 known for many years that people with mental illness are at increased risk of
6 premature death²⁻⁵ with schizophrenia and bipolar disorder in particular being
7 associated with an early death⁶⁻⁸. These inequalities in life expectancy have recently⁹
8 been declared a "scandal", as even the Scandinavian countries⁵, Scotland¹⁰ and
9 England^{8,11}, despite relatively high quality and equitably distributed healthcare, have
10 not been able to demonstrate any improvement in this premature mortality for the
11 mentally ill over many years.
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17 Non-natural deaths¹² including suicide and accidents, account for a disproportionate
18 amount of this premature mortality in the mentally ill, particularly affecting young
19 adults. High rates of cardiovascular disease, respiratory disease and other so-called
20 natural causes also contribute^{5,13,14} to the elevated relative risk of early death in the
21 mentally ill. Precise estimates of the varying causal contributions to premature
22 mortality in the mentally disordered have been limited by the lack of large
23 representative populations being followed up over a lengthy period, and related studies
24 have usually focussed on schizophrenia and bipolar disorder^{8,15} rather than all major
25 mental disorders. Additionally, the effects of comorbidity or multiple diagnoses on this
26 premature mortality have also not been quantified. Concern has also been expressed
27 that those with mental illness have not benefitted from improvements in public health
28 over the last few decades^{9,14} and that this mortality gap between the general
29 population and the mentally ill is widening in recent years.
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38 Using routinely collected national data, available from 1981, we set out to examine the
39 ages and causes of death in those previously hospitalised with mental disorder in
40 Scotland, and quantify any excess mortality. We also aimed to explore the relative
41 contribution of different causes of death and trends over time.
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47 **Methods**

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50 Whenever a patient is discharged from a mental ill health hospital/specialty in
51 Scotland, a Scottish Morbidity Record for Mental ill health (SMR04) is returned to the
52 NHS National Services Scotland Information Services Division (ISD). SMR04 records
53 contain information on patient demographics such as personal identifiers, age, and
54 sex; the diagnosis that necessitated the admission; and aspects of the care given such
55 as the psychiatric subspecialty admitted to. One primary diagnosis and up to five
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3 further secondary diagnoses can be recorded. Diagnoses are coded according to the
4 International Classification of Diseases (ICD) (version 9 to 1997 and version 10 from
5 1997 to present). Statutory death records (containing demographic and ICD coded
6 cause of death information) are returned to the National Records of Scotland (NRS)
7 with copies passed to ISD for analytical purposes.
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11 For this study, SMR04 records for adults discharged from mental ill health
12 hospitals/specialities in Scotland between 1981 and 2009 were obtained. Patients
13 aged less than 15 years at the date of first admission and those admitted to the
14 learning disabilities subspecialty were excluded from the sample, in accordance with
15 the aim of studying the ages and causes of death in adults with mental illness and
16 personality disorder. Death records for the period 1986-2010 were also obtained. We
17 created a single patient record for each individual by linking all their hospital discharge
18 records and their death record (if died) using a range of patient identifiers and
19 previously developed probabilistic matching algorithms. These methods have been
20 described previously^{16, 17}. All patients who had had an admission to a mental ill health
21 specialty between 1981 and 1985 were excluded to give a cohort of patients with (as
22 close as possible to) a first inpatient admission between 1986 and 2009 in order to
23 clarify the issue of diagnostic shift or comorbidity.
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32 All patient level data used in this study were held and analysed within ISD. Only
33 aggregate results, from which individual patients could not be identified, were shared
34 with members of the study team not based within ISD (MT). ISD operates strict
35 procedures to maintain patient privacy and confidentiality and no specific additional
36 permissions were required for this study. In particular, permission for linkage of
37 previously unlinked health datasets held by ISD is required from the Privacy Advisory
38 Committee. PAC approval was not required for this study however as SMR04 and
39 death records have been routinely linked within ISD for decades for purposes such as
40 monitoring patient outcomes.
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49 **Diagnostic assignation**

50 We then assigned each individual to a main psychiatric diagnosis category (see table
51 1) and excluded individuals who did not have any admissions relating to a diagnostic
52 group of interest. The diagnostic groups of interest included were schizophrenia,
53 bipolar disorder, depression, neurosis, eating disorder, and personality disorder.
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Patients with a single primary psychiatric diagnosis of interest recorded on all their psychiatric discharge records over the period of study, and no other or additional diagnoses at any admission, were described as 'uncomplicated'. For example, an individual with five hospital admissions which were all coded solely to depression would be described as 'uncomplicated depression'.

In contrast, patients with more than one diagnosis recorded were described as 'complicated'. For patients with more than one diagnosis from the diagnostic groups of interest, a hierarchical approach was used to determine the main diagnosis and hence assign a patient to one group (see table 1) with schizophrenia being assigned the highest rank. For example, a patient diagnosed as having bipolar disorder at their first hospital admission and then admitted for neurosis at a later date would be assigned to the 'complicated bipolar' group. Conversely, someone who had three hospital admissions for neurosis and then one for neurosis with depression recorded as an additional secondary diagnosis would be described as 'complicated depression' and their time at risk in the cohort would be taken from their first neurosis admission.

Patients may also have had other/additional diagnoses not within the diagnostic groups of interest. These included other psychiatric problems (mainly dementia, stress reactions and adjustment disorders); alcohol or drug misuse; or (rarely) physical health problems such as pneumonia. Someone with an admission for personality disorder with drug misuse recorded as an additional secondary diagnosis would therefore be described as 'complicated personality disorder'.

Analysis

A final record was then created for each patient within the mental ill health cohort containing hierarchically defined main psychiatric diagnosis, a flag indicating whether the main diagnosis was 'complicated' or not, date of first admission, age at first admission, sex, deprivation category at first admission, date of death and (main) cause of death. Deprivation category was determined using Carstairs 1991 area-based deprivation [deciles](#)¹⁸ based on postcode of residence at first admission and corresponding population denominators from the Consistent Areas Through Time (CATTS) classification tables¹⁹ which allows us to create a long time series of deprivation-specific mortality rates.

This linked dataset was used to calculate indirectly standardised mortality ratios (SMRs) for the mental ill health patients using a person-years approach which took

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3 account of each individual's time at risk (from time of first admission) across different
4 age categories, time periods, [sex and deprivation decile](#) since diagnosis. [All analyses](#)
5 [were carried out using Stata 11.0 \(Stata Corp, College Station, Texas\) using the stsplit command to](#)
6 [split age \(in days\) across the time periods. Age was defined in days from birth date to diagnosis](#)
7 [date, and study exit was defined in days from diagnosis date to end of follow-up interval or death,](#)
8 [whichever came first.](#)
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13 Years of Life Lost (YLL) were computed by multiplying the number of deaths in the
14 study cohort (in each period of death, sex, age band at death and deprivation [decile](#))
15 by the corresponding life expectancy at that age. The average YLL (AYLL) was
16 derived by dividing the total YLL by the actual number of deaths within the subgroups
17 of interest. Scottish national mortality rates split by year of death (in time bands),
18 sex, five-year age band and deprivation decile were used as the reference standard for
19 the SMRs. Life tables were compiled based on these national mortality rates following
20 the Chiang²⁰ methodology for the YLL analyses. To examine possible trends over time
21 in the excess mortality experienced by individuals with previous psychiatric admission,
22 we chose three time period cohorts each with 10 years of follow up for each cohort to
23 capture a wide range of causes of death.
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30 We looked at overall mortality; mortality by specific cause; and mortality split into
31 natural deaths (cardiovascular, cancer, respiratory, digestive, endocrine, nervous
32 system, infectious disease), non-natural deaths (accidental, suicide/undetermined,
33 homicide), and other (all other deaths including those recorded as mental and
34 behavioural).
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40 41 **Results**

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44 Over the time period of study (1986-2009) there were 59,028 individuals who had a
45 consistent diagnosis within and between admissions (classified as uncomplicated) and
46 52,476 individuals who had an unstable diagnosis or additional co-morbidity within
47 and/or between admissions (classified as complicated). Women comprised 55% of the
48 cohort largely due to a higher number of cases of depression in women. Women
49 tended to be older than men at their first included admission, particularly for
50 schizophrenia and neurosis. Complicated diagnoses resulted in higher numbers of
51 hospitalisations and total length of time spent in hospital as would be expected (see
52 Table 2a and 2b).
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3 Increasing deprivation was linked to mental ill health problems for both men and
4 women, with the exception of bi-polar disorder (no clear trend across deprivation
5 groups for either sex) and eating disorder in females (uncomplicated more common in
6 least deprived group; complicated no clear trend across deprivation groups) (Table 2
7 and additional analyses available on request).
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11 Overall, 34,243 individuals in the study cohort had died by the 31 December 2010,
12 around 80% more (SMR=1.8) than expected based on the general population (see
13 table 3). The standardised mortality ratios tended to be higher for those with
14 complicated diagnoses, and overall were highest for those with eating disorders
15 (SMR=4.4) and complicated personality disorders (SMR=3.1). Overall life expectancy
16 for the whole cohort of individuals with mental ill health was 17 years less than that
17 for the general population. The largest reduction in life expectancy was seen for
18 individuals with eating disorders (39 years of life lost for those with uncomplicated
19 diagnosis) and personality disorders (27.5 YLL for those with complicated diagnosis)
20 however as most deaths were seen in individuals with depression and schizophrenia,
21 these conditions accounted for the greatest number of years of life lost.
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29 **Relative risk of early death**

30 The excess risk of death was extremely high for those in the youngest age group at
31 first included admission, and the excess reduced as age at first admission increased
32 (see figure 1). However, total years of life lost told a slightly different story, with a
33 relatively constant YLL for those diagnosed at ages 20-24 through to 75-79 years, with
34 lower YLL for those aged 15-19, 80-84 and 85+ years. This reflects the fact that the
35 absolute risk of dying generally increases with age. The same age-related pattern is
36 seen for males and females, although the excess risk of death is higher for females
37 compared to males at every age (data not shown).
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44 **Figure 1 here**

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46 Around two thirds of deaths (22,865 deaths) in the mental ill health cohort were from
47 natural causes, 11% (3,909) from non-natural causes and the remaining 21% (7,469)
48 were from "other" deaths not coded as natural or non-natural including 'mental or
49 behavioural disorder' (36% of "other" causes of death). The excess risk of death was
50 much higher from non-natural causes (SMR=5.2) compared to natural causes
51 (SMR=1.7) and "other" deaths (SMR=1.6). On average, 31.8 years of life were lost
52 due to every non-natural death compared to 13.3 years due to every natural death
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3 and 17.4 years of life lost for each "other" death, reflecting the fact that non-natural
4 deaths tend to occur at younger ages (see Table 4).
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8 There was a significant excess risk of natural, non-natural and "other" deaths for
9 patients in each diagnosis group (except uncomplicated neurotic disorders resulting in
10 "other" deaths (SMR=1.1, ns). The highest excess risks were seen for eating disorders
11 across death groupings, although the number of deaths in individuals with eating
12 disorders was small (see Table 4). Natural deaths accounted for more years of life lost
13 than non-natural deaths in each diagnostic group. Cardiovascular disease accounted
14 for around half of all years of life lost from natural causes, with digestive disorders,
15 cancer, and respiratory disorders accounting for most of the remainder. Suicide
16 accounted for the majority of years of life lost due to non-natural causes in each
17 diagnostic group (data not shown). Table 5 reveals the proportions of ~~observed and~~
18 ~~expected~~ deaths for the two main natural causes of death, namely heart disease and
19 cancer, as well as suicide, ~~the main causes of unnatural death.~~
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26 **Tables 2a; 2b; 3; 4; and 5 here**
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29 **Mortality trends over time**

30 Looking at individuals whose first admissions were in the periods 1986-90, 1991-95
31 and 1996-2000 and following each individual in these sub-cohorts up for 10 years from
32 their first admission, the all cause standardised mortality ratios showed no evidence of
33 a narrowing of the mortality excess over time (see Table 6).
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38 **Table 6 here**
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44 **Discussion**

45 **Main findings**

46 This large national study provides an accurate estimate of the risk of early death
47 experienced by adults previously hospitalised for mental disorder. We showed that
48 overall life expectancy for the whole cohort of individuals previously hospitalised due to
49 mental ill health was 17 years less than that for the general population. The excess
50 risk of early death was greatest for patients first admitted at the youngest age (15-19
51 years old) but individuals first admitted at older ages experienced greater numbers of
52 early deaths. The largest reduction in life expectancy was seen for individuals with
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3 eating disorders and personality disorders – namely an alarming 39 years reduction in
4 life expectancy for uncomplicated eating disorders, and 27.5 for those with a
5 complicated personality disorder. However as the greatest number of deaths were
6 seen in individuals with depression and schizophrenia, these conditions accounted for
7 the greatest number of years of life lost.
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11 The majority of deaths in those previously hospitalised for mental disorder are due to
12 'natural' causes such as cardiovascular and respiratory disorder, which mirrors the
13 results of a similar study from Denmark⁷ examining the life expectancy of those with
14 schizophrenia and bipolar disorder. By contrast, although only 11% of deaths in our
15 study population were attributable to 'non-natural' causes such as suicide, accidents,
16 and homicide, we found that these 'non-natural' causes carried a substantially higher
17 comparative excess risk of early death – ranging between 27 years of lost life for
18 depression to a staggering 49.5 years for eating disorders, emphasising that these
19 non-natural deaths occur earlier than the more common natural causes of death. For
20 the whole cohort of mentally ill individuals, those dying from non-natural causes lost,
21 on average, almost 32 years of life, reinforcing the continuing need for national suicide
22 prevention strategies.
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30 31 **A stable 'mortality gap'?**

32 In addition, contrary to results elsewhere^{8,14}, we did not find any evidence that the
33 difference in risk of death between the general population and the mentally disordered
34 was worsening over time. In fact, we observed that this 'mortality gap' was stable over
35 25 years for all the common mental disorders, which offers some reassurance to
36 claims that the mentally disordered have not benefited from improvements in public
37 health⁹. Nevertheless, our data indicates that there continues to be a need for
38 monitoring the physical health of those with mental disorder, and in particular
39 screening for cardiovascular disease.
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45 46 **Strengths and limitations of the study**

47 Strengths of this study include the whole population coverage and the long time
48 series, along with the demonstrable high quality and completeness²³ of the diagnostic
49 coding and cause of death coding. The reliability of a given diagnosis does not
50 necessarily imply that it is valid, however, in a specialty that lacks objective diagnostic
51 tests. We have also taken care with main psychiatric diagnosis assignment, using a
52 pragmatic hierarchical approach to account for the diagnostic shift and co-morbidities
53 that are commonly seen in day-to-day clinical psychiatric practice. Definitive diagnosis
54 is not always easy initially in mental health, and over such a long study period there
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3 may be shift in diagnostic trends. Main psychiatric diagnosis has therefore been
4 assigned using a hierarchical approach and taking into account all diagnoses recorded
5 on an individual's psychiatric discharge records over the period of study rather than
6 simply diagnosis at first admission. This approach considerably increases the number
7 of people in the higher categories (eg psychoses). For example, of 17,031 individuals
8 who were first admitted with depression, 71% were assigned to depression, 17%
9 subsequently had schizophrenia recorded on a discharge record and so were assigned
10 to "complicated schizophrenia", and 11% were assigned to "complicated bipolar". For
11 some groups the hierarchy is less intuitive, for example, of the 325 individuals who
12 were first admitted with eating disorders but subsequently had other mental ill health
13 problems, 69% moved out of the eating disorder group into another group higher up
14 the hierarchy (data not shown). This will lead to a conservative SMR for some
15 complicated cases due to time at risk for conditions lower down the hierarchy being
16 assigned to a condition higher up the hierarchy in the person-year analysis. Another
17 consideration to bear in mind is that the threshold for admission to a psychiatric
18 hospital will likely have changed over time, particularly as community based
19 alternatives became available. This unquantifiable threshold shift could complicate the
20 interpretation of the time trend data in Table 6.
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31 **Comorbidity and early death**

32 Furthermore, we have documented that diagnostic 'complexity' (indicated by further
33 recording of other mental disorders in addition to the main psychiatric diagnosis,
34 substance misuse, or physical health problems), tends to increase the risk of
35 premature death and the average years of lost life in those previously hospitalised due
36 to mental illness. This adverse effect of complexity has not reported before to our
37 knowledge, and emphasises that comorbidity exacerbates prognosis, although an
38 alternate explanation is that increased 'complexity' is in effect a proxy for lesser
39 diagnostic rigour and care, which may in turn affect mortality. Similarly, an increased
40 'complexity' in a case may be a marker of increased severity of illness, which may in
41 turn be related to early death. Also, our use of the SMR and the 'years of lost life'
42 techniques allows quantification of both the relative and the absolute burden of excess
43 death in this population. However, as this is a secondary care cohort, it will only
44 capture those most severely affected by mental disorder, and hence does not allow
45 comment on, for example, those with depression managed solely in the community.
46 Equally, those hospitalised due to eating disorder are often physically unwell, so it is
47 perhaps no surprise that this diagnostic group had worrying relative and absolute
48 mortality results in this study. Not all comorbidity (or 'complexity') will have been
49 captured here, due to the exclusion of physical ill health discharge records and
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3 probable under-recording of secondary psychiatric diagnostic codes. Lastly, we
4 designed a 'wash in' period of 5 years (1981-1986) in order to capture only first
5 admissions, but it is likely that some patients with psychiatric admissions prior to 1981
6 were included. The apparently old age at 'diagnosis'/first admission may suggest that
7 these are in fact not all first admissions ie the relatively short wash in period has
8 allowed us to include patients readmitted after more than 5 years as 'first admissions'.
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13 A systematic review by Saha et al¹⁴ found a SMR of 2.5 for risk of death in
14 schizophrenia, which is greater than our figures of 1.8 (uncomplicated) and 2.0
15 (complicated), but the more recent study by Hoang and colleagues from England⁸
16 found similar SMRs for both schizophrenia and bipolar disorder to our own results,
17 albeit with a shorter follow up. Large long term follow up mortality studies comparing
18 common mental disorders have not been reported elsewhere, to our knowledge, and
19 our data provide context for the literature on early death in specific disorders such as
20 schizophrenia and bipolar disorder⁸, and depression and anxiety²⁴. More detailed
21 analysis of the time trends for individual causes of death in specific diagnostic groups
22 would be valuable in the future.
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31 **Implications**

32 In previous studies of all-cause mortality in those with mental illness in Scotland,
33 behavioural risk factors such as heavy smoking and a sedentary lifestyle have been
34 linked to early death, along with social isolation and deprivation²⁵. Policy makers in the
35 UK have also highlighted the physical health needs and premature mortality of those
36 with mental health problems which echo the worrying disparities in lifespan we have
37 identified for all the common mental disorders compared to the general population. In
38 particular, we have found that the highest risk of early death is associated with young
39 age at first admission; eating disorders; personality disorders; and in those with
40 multiple diagnoses. A national approach across primary and secondary care tackling
41 the complex mix of factors contributing to early death in the mentally disordered is
42 required, addressing intrinsic disease related factors as well as lifestyle issues; lack of
43 help seeking; and even stigma within the healthcare professions^{21, 22, 25}. The inequity in
44 life expectancy in the mentally disordered documented here poses a considerable
45 challenge to our healthcare system.
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Table 1: Main psychiatric diagnosis categories of interest (and diagnostic hierarchy)

Main psychiatric diagnosis category	Definition	Hierarchy
Schizophrenia	Schizophrenia and other psychotic disorders including acute psychosis, persistent delusional disorders, schizotypal and schizoaffective disorder, and drug or alcohol induced psychotic disorder	1
Bipolar disorder	Manic episodes and bipolar disorder	2
Depression	Depressive episodes and recurrent depressive disorder (excluding persistent mood disorders such as cyclothymia)	3
Neurosis	Anxiety disorders and obsessive compulsive disorder	4
Eating disorder	Anorexia and bulimia nervosa	5
Personality disorder	All types of personality disorder	6

Note: ICD9 and ICD10 codes available on request.

Table 2a: Characteristics of the cohort included in the analysis (Males)

	N	%	Median age at first admission (interquartile range)	% in most deprived quintile ¹	Median number of admissions (interquartile range)	Median total length (days) on admission (interquartile range)
Uncomplicated diagnosis group:						
Schizophrenia	8,966	35	33.7 (24.6 -50.2)	29	1.0 (1.0 -2.0)	48.0 (16.0 -161.0)
Bipolar disorder	1,680	7	41.0 (28.4 -56.2)	17	1.0 (1.0 -2.0)	36.0 (17.0 -72.0)
Depression	12,778	49	47.5 (34.2 -66.0)	23	1.0 (1.0 -1.0)	22.0 (7.0 -53.0)
Neurosis	1,129	4	40.7 (29.8 -58.5)	26	1.0 (1.0 -1.0)	14.0 (5.0 -35.0)
Eating disorder	49	<1	22.1 (19.0 -28.8)	33	1.0 (1.0 -1.0)	48.0 (12.0 -89.0)
Personality disorder	1,221	5	30.9 (23.8 -41.7)	30	1.0 (1.0 -1.0)	8.0 (3.0 -24.0)
Total uncomplicated	25,823	100	40.9 (28.4 -59.6)	25	1.0 (1.0 -2.0)	28.0 (9.0 -74.0)
Complicated (hierarchical) diagnosis group:						
Schizophrenia	10,697	43	31.0 (23.3 -44.0)	33	4.0 (2.0 -6.0)	145.0 (52.0 -429.0)
Bipolar disorder	2,159	9	42.4 (30.5 -56.6)	21	3.0 (2.0 -5.0)	115.0 (51.0 -257.0)
Depression	9,421	38	40.1 (30.0 -54.9)	26	2.0 (1.0 -4.0)	44.0 (18.0 -105.0)
Neurosis	915	4	37.0 (27.4 -48.1)	24	2.0 (1.0 -3.0)	32.0 (14.0 -71.0)
Eating disorder	17	<1	31.3 (23.5 -48.5)	29	3.0 (2.0 -4.0)	45.0 (21.0 -148.0)
Personality disorder	1,580	6	31.3 (23.8 -41.6)	31	2.0 (1.0 -3.0)	21.0 (8.0 -49.0)
Total complicated	24,789	100	35.5 (26.0 -49.9)	28	3.0(2.0-5.0)	73.0(26.0 -214.0)

Table 2b: Characteristics of the cohort included in the analysis (Females)

	N	%	Median age at first admission (interquartile range)	% in most deprived quintile ¹	Median number of admissions (interquartile range)	Median total length (days) on admission (interquartile range)
Uncomplicated diagnosis group:						
Schizophrenia	6,999	21	53.9 (34.5 -76.0)	25	1.0 (1.0 -2.0)	47.0 (19.0 -122.0)
Bipolar disorder	2,196	7	43.4 (30.5 -61.0)	18	1.0 (1.0 -2.0)	35.0 (17.0 -74.0)
Depression	20,383	61	48.5 (33.8 -69.1)	23	1.0 (1.0 -1.0)	28.0 (10.0 -65.0)
Neurosis	1,946	6	48.5 (33.7 -68.7)	26	1.0 (1.0 -1.0)	18.0 (7.0 -39.0)
Eating disorder	586	2	20.7 (17.5 -26.5)	16	1.0 (1.0 -1.0)	49.0 (13.0 -126.0)
Personality disorder	1,095	3	31.1 (23.0 -43.5)	27	1.0 (1.0 -1.0)	9.0 (3.0 -25.0)
Total uncomplicated	33,205	100	47.6 (32.5 -69.5)	23	1.0 (1.0 -1.0)	30.0 (11.0 -73.0)
Complicated (hierarchical) diagnosis group²:						
Schizophrenia	8,230	30	40.6 (27.7 -66.0)	29	3.0 (2.0 -6.0)	162.0 (68.0 -410.0)
Bipolar disorder	3,619	13	43.0 (31.2 -59.8)	22	3.0 (2.0 -5.0)	136.0 (60.0 -313.0)
Depression	13,390	48	41.1 (29.8 -61.8)	25	2.0 (2.0 -4.0)	64.0 (25.0 -163.0)
Neurosis	1,136	4	42.9 (31.2 -63.6)	21	2.0 (1.0 -3.0)	38.0 (17.0 -91.5)
Eating disorder	199	1	26.2 (20.7 -34.3)	18	2.0 (1.0 -3.0)	35.0 (10.0 -103.0)
Personality disorder	1,113	4	29.5 (22.5 -40.3)	28	2.0 (1.0 -3.0)	27.0 (10.0 -60.0)
Total complicated	27,687	100	40.6 (28.8 -61.9)	26	3.0 (2.0 -5.0)	89.0 (33.0 -237.0)

1 if there had been no deprivation gradient then around 20% of cases would be in the most deprived quintile

2 . For individuals with a complicated mental health diagnosis (hierarchical) , the age at first admission refers to the first 'ever' admission event.

Table 3: SMRs and years of life lost for all-cause mortality by diagnosis group (all patients diagnosed 1986-2009 and followed up until 31 December 2010)

	Observed deaths	Expected deaths	SMR ¹ 95% CI	Total YLL	Average YLL
Uncomplicated diagnosis group:					
Schizophrenia	5,060	2,746	1.84 (1.79 - 1.89)	78,027	15.2
Bi-polar	883	525.6	1.68 (1.57 - 1.79)	14,369	16.1
Depression	11,036	6,831.2	1.62 (1.59 - 1.65)	155,582	14.1
Neurotic disorders	838	524.7	1.60 (1.49 - 1.71)	12,373	14.9
Eating disorders	51	11.6	4.39 (3.27 - 5.77)	2,182	39.0
Personality disorders	449	234.9	1.91 (1.74 - 2.10)	10,583	22.8
Complicated (hierarchical) diagnosis group:					
Schizophrenia	5,635	2,876.9	1.96 (1.91 - 2.01)	116,775	19.6
Bi-polar	1,706	1,129.5	1.51 (1.44 - 1.58)	29,351	16.7
Depression	7,282	3,628.8	2.01 (1.96 - 2.05)	146,736	19.0
Neurotic disorders	579	272.8	2.12 (1.95 - 2.30)	12,194	19.9
Eating disorders	38	8.7	4.39 (3.10 - 6.03)	1,317	31.4
Personality disorders	686	221.9	3.09 (2.86 - 3.33)	20,894	27.5
Total	34,243	19,012.4	1.80 (1.78 - 1.82)	600,383	17.0

¹ adjusted for sex, age, period and deprivation category (Carstairs 1991 decile) at first diagnosis

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Table 4: SMRs and years of life lost by diagnosis group and cause of death grouping (natural death, non-natural death, or "other" deaths) (all patients diagnosed 1986-2009 and followed up until 31 December 2010)

	Natural deaths			Non-natural deaths			Other deaths		
	N	SMR (95% CI)	AYYL	N	SMR (95% CI)	AYYL	N	SMR (95% CI)	AYYL
Uncomplicated diagnosis group:									
Schizophrenia	3,580	1.78 (1.72 - 1.84)	11.8	504	4.40 (4.02 - 4.80)	32.2	976	1.58 (1.48 - 1.68)	16.3
Bi-polar	624	1.69 (1.56 - 1.83)	13.0	97	4.74 (3.84 - 5.78)	32.0	162	1.18 (1.01 - 1.38)	16.4
Depression	7,839	1.60 (1.56 - 1.63)	12.0	1,055	4.93 (4.64 - 5.24)	27.2	2,142	1.25 (1.20 - 1.30)	13.8
Neurotic disorders	622	1.71 (1.58 - 1.85)	13.2	63	3.35 (2.57 - 4.29)	29.4	153	1.07 (0.91 - 1.26)	15.1
Eating disorders	15	2.57 (1.44 - 4.26)	23.8	12	7.21 (3.71 - 12.63)	49.5	24	5.81 (3.72 - 8.66)	39.3
Personality disorders	265	1.67 (1.48 - 1.88)	15.0	96	6.21 (5.03 - 7.58)	37.6	88	1.45 (1.16 - 1.79)	25.6
Complicated (hierarchical) diagnosis group:									
Schizophrenia	3,500	1.71 (1.65 - 1.77)	14.3	767	5.17 (4.81 - 5.55)	35.1	1,368	2.02 (1.91 - 2.13)	20.0
Bi-polar	1,139	1.43 (1.34 - 1.51)	13.7	197	5.06 (4.38 - 5.82)	30.8	370	1.27 (1.14 - 1.41)	15.7
Depression	4,525	1.78 (1.72 - 1.83)	14.8	931	6.54 (6.12 - 6.97)	32.3	1,826	1.94 (1.86 - 2.04)	18.6
Neurotic disorders	379	2.04 (1.84 - 2.25)	16.4	53	4.28 (3.20 - 5.60)	33.6	147	1.98 (1.67 - 2.33)	20.0
Eating disorders	17	3.00 (1.74 - 4.82)	24.4	5	8.99 (2.84 - 21.14)	43.1	16	6.56 (3.74 - 10.68)	32.9
Personality disorders	360	2.46 (2.21 - 2.73)	19.9	129	7.47 (6.24 - 8.88)	39.0	197	3.37 (2.92 - 3.88)	28.8
Total	22,865	1.69 (1.67 - 1.71)	13.3	3,909	5.25 (5.08 - 5.41)	31.80	7,469	1.58 (1.55 - 1.62)	17.4

¹ adjusted for sex, age, period and deprivation category (Carstairs 1991 decile) at first diagnosis

Table 5. SMRs for cardiovascular disease; cancer; and suicide.

	Cardiovascular deaths ¹		Cancer deaths ²		Suicide deaths ³	
Uncomplicated diagnosis group						
	% of natural deaths	SMR (95% CI)	% of natural deaths	SMR (95% CI)	% of unnatural deaths	SMR (95% CI)
Schizophrenia	53%	1.72 (1.65 - 1.80)	12%	1.30 (1.18 - 1.43)	63%	8.05 (7.19 - 8.98)
Bi-polar	54%	1.69 (1.51 - 1.88)	15%	1.39 (1.12 - 1.69)	74%	9.70 (7.59 - 12.22)
Depression	55%	1.59 (1.54 - 1.64)	15%	1.35 (1.28 - 1.43)	75%	13.28 (12.37 - 14.24)
Neurotic disorders	50%	1.60 (1.43 - 1.79)	14%	1.37 (1.10 - 1.69)	65%	6.44 (4.62 - 8.75)
Eating disorders	40%	2.30 (0.83 - 5.04)	20%	2.92 (0.55 - 8.65)	92%	12.22 (6.07 - 21.94)
Personality disorders	51%	1.62 (1.36 - 1.91)	12%	1.17 (0.80 - 1.66)	65%	8.58 (6.57 - 11.00)
Complicated diagnosis group						
Schizophrenia	50%	1.57 (1.50 - 1.65)	9%	0.86 (0.77 - 0.96)	72%	9.05 (8.31 - 9.83)
Bi-polar	52%	1.40 (1.29 - 1.52)	12%	0.88 (0.74 - 1.05)	77%	11.57 (9.80 - 13.57)
Depression	49%	1.62 (1.56 - 1.69)	10%	1.01 (0.93 - 1.11)	74%	13.25 (12.28 - 14.27)
Neurotic disorders	44%	1.65 (1.41 - 1.92)	12%	1.34 (0.98 - 1.81)	70%	7.52 (5.29 - 10.37)
Eating disorders	29%	1.68 (0.53 - 3.95)	12%	2.06 (0.19 - 7.56)	100%	19.49 (6.15 - 45.85)
Personality disorders	43%	2.08 (1.76 - 2.43)	10%	1.32 (0.92 - 1.82)	71%	10.55 (8.49 - 12.95)

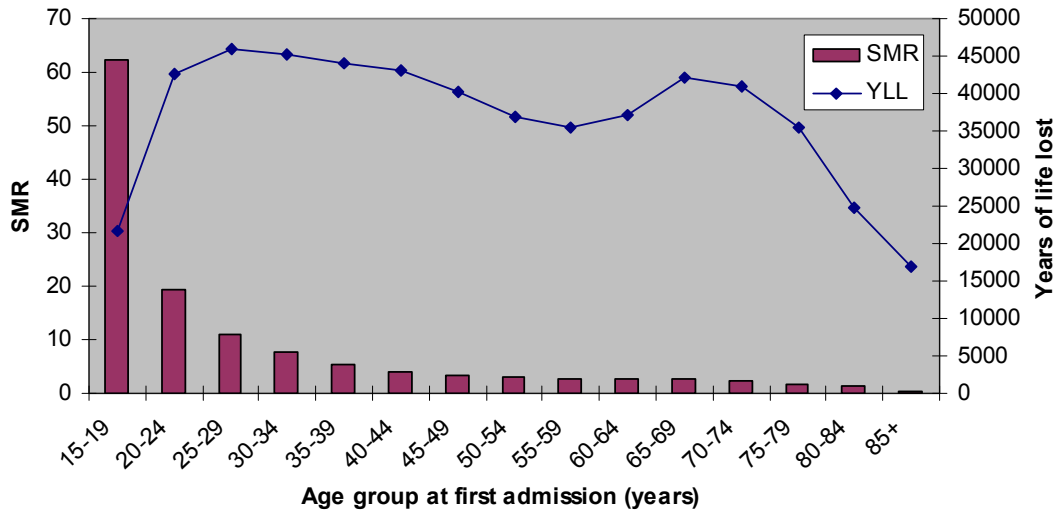
All cardiovascular deaths.¹ All cancer, including lung cancer, deaths². All deaths coded as suicides³. Cardiovascular and cancer deaths are shown as a proportion of observed natural deaths within each category and suicide is shown as a proportion of observed unnatural deaths within each category.

Table 6: SMRs by time period of first admission (1986-2000) and followed up for 10 years from first admission (all diagnosis groups combined)

	Period of first admission	Observed deaths	Expected deaths	SMR ¹ (95% CI)
Males	1986-90	3185	1514	2.10 (2.03 - 2.18)
	1991-95	2878	1328	2.17 (2.09 - 2.25)
	1996-00	2327	1076	2.16 (2.08 - 2.25)
Females	1986-90	4808	2669	1.80 (1.75 - 1.85)
	1991-95	3882	2112	1.84 (1.78 - 1.90)
	1996-00	2740	1413	1.94 (1.87 - 2.01)

¹ adjusted for age and deprivation category (Carstairs 1991 decile) at first diagnosis

Figure 1: All-cause SMRs and overall YLL for patients diagnosed 1986-2009 and followed up until 31 December 2010 by age group at first admission



* The SMR for the above chart was produced from the table in Appendix A (below)

Appendix A: All cause SMRs for patients admitted to mental health speciality 1986 – 2009 followed up to 31st December 2010, by age group at first admission

Age	Observed	Expected	SMR (95% CI)
15-19	427	6.9	62.18 (56.42 - 68.37)
20-24	918	47.3	19.39 (18.16 - 20.69)
25-29	1112	101.0	11.01 (10.37 - 11.68)
30-34	1232	157.7	7.81 (7.38 - 8.26)
35-39	1357	251.4	5.40 (5.11 - 5.69)
40-44	1529	379.2	4.03 (3.83 - 4.24)
45-49	1690	515.3	3.28 (3.13 - 3.44)
50-54	1849	594.6	3.11 (2.97 - 3.25)
55-59	2162	822.4	2.63 (2.52 - 2.74)
60-64	2718	1055.7	2.57 (2.48 - 2.67)
65-69	3670	1340.3	2.74 (2.65 - 2.83)
70-74	4243	1882.2	2.25 (2.19 - 2.32)
75-79	4487	2509.9	1.79 (1.74 - 1.84)
80-84	3836	3182.7	1.21 (1.17 - 1.24)
85+	3013	6165.9	0.49 (0.47 - 0.51)

APPENDIX B: Main psychiatric diagnoses of interest (ICD 9/10 codes)

Diagnostic Description	ICD 9 Codes	ICD 10 codes
Bipolar disorder	2960,2962, 2963,2966, 2964, 2965	F30, F31
Schizophrenia	2950, 2951, 2952, 2954, 2955,2953,2956,2958,2959 2970, 2971, 2972, 2973, 2978, 2979, 2999 2988,2989, 2981	F20, F22, F28, F29, F24X
Schizoaffective	2957	F25
Depression	311, 2966, 2961, 2980,3004, 3001	F32, F33 F38 F39
Neurotic Disorder	3000, 3002, 3003, 2968, 2969	F40, F41, F42,
Personality Disorder	3010, 3012, 3013,3014, 3015, 3016,3017, 3018,3019, 3011	F60, F61, F62
Eating disorders	3071, 3075	F50

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Re: **Mental disorder and early death – a nationwide follow up study, 1981 - 2010.**

Tomi Ajetunmobi¹, Mark Taylor², Diane Stockton¹, and Rachael Wood¹.

	Item No	Recommendation
Title and abstract	1 Done, p1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2 Done – p2	Explain the scientific background and rationale for the investigation being reported
Objectives	3 Done – p2	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4 Done	Present key elements of study design early in the paper
Setting	5 Done	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6 Done	(a) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7 Done	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8* Done	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9 In method & discussion	Describe any efforts to address potential sources of bias
Study size	10 Done	Explain how the study size was arrived at
Quantitative variables	11 Done	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12 Done	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses
Results		
Participants	13* Done	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage

		(c) Consider use of a flow diagram
Descriptive data	14* Done	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest
Outcome data	15* Done	Report numbers of outcome events or summary measures
Main results	16 Done where applicable	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17 SMRs and YLL	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18 Done	Summarise key results with reference to study objectives
Limitations	19 Done	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20 Done	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21 Commented on	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22 Done	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.