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A comprehensive analysis of mortality-related health metrics associated with mental disorders: a nationwide, register-based cohort study

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Research in context

Evidence before this study

Systematic reviews have consistently demonstrated that people with mental disorders have an increased risk of premature mortality. Traditionally, this evidence has been based on relative risks (e.g. mortality rate ratio), or crude estimates of life expectancy that do not incorporate variation in the age of onset of the disorder. When the real age of onset has been taken into account, lower estimates of premature mortality have been found.

Added value of this study

Besides mortality rate ratios (MRRs), we report premature mortality based on Life Years Lost (LYLs) for different types of mental disorders, which incorporates precise age of onset of the disorder. We present a range of mortality-related estimates, displayed by age, sex and cause of death. We found that those with mental disorders had higher mortality rates compared to those without (MRR 2·53 [95% CI 2·52-2·54]); the largest difference was observed at age 33 years (MRR 7·25 [95% CI 7·06-7·44]). When looking at specific types of disorders, being diagnosed with all types was associated with higher mortality rates and shorter life expectancies, both in males and females. The largest reduction in remaining life expectancy after the diagnosis was observed for Substance Use Disorders (differences in LYLs of 14·84 [95% CI 14·70-14·99] years for men and 13·37 [95% CI 13·20-13·56] years for women). When we examined specific causes of death, we found that men with all types of mental disorder had fewer LYLs associated with neoplasm-related deaths compared to the general population, which indicates that the general population loses more years of life due to neoplasms than those with mental disorders. This finding relates to the ability of the LYLs to accommodate competing causes of death. While those with mental disorders had higher rates of dying from neoplasms, they had even higher rates of dying of non-cancer causes of death, which reduced the risk of them of dying from neoplasms.

Implications of all the available evidence

Mental disorders are associated with both increased mortality rates and reduced life expectancy when assessed with LYLs health metrics. Our new methods provide more accurate estimates of premature mortality and reveal previously under-appreciated features related to competing risks and specific causes of death. In order to facilitate fine-grained interrogation of the data, we have also provided an interactive data visualization website (<http://nbepi.com/mortality>).

Abstract

BACKGROUND: Systematic reviews have consistently demonstrated that those with mental disorders have an increased risk of premature mortality. Traditionally, this evidence has been based on relative risks, or crude estimates of reduced life expectancy. The aim of this study was to compile a comprehensive analysis of mortality-related health metrics associated with mental disorders, including sex- and age-specific mortality rate ratios (MRRs) and Life Years Lost (LYLs).

METHODS: We designed a population-based cohort study including all Danish residents between 1995 and 2015 (N=7,369,926). Information on mental disorders was obtained from the Danish Psychiatric Research Register, while the date and cause of death was obtained from the Danish Registry of Causes of Death. For each specific mental disorder, we estimated MRRs using Poisson regression models and excess LYLs (i.e. difference in LYLs between people with a mental disorder and the general population) for all-cause mortality, and for each specific cause of death.

FINDINGS: We found that mortality rates were higher for people with mental disorders than the general Danish population (28·70 [95% CI 28·57-28·82] vs 12·95 [95% CI 12·93-12·98] per 1000 person-years). Additionally, all types of disorders were associated with higher mortality rates (MRRs ranging from 1·92 [95%CI 1·91-1·94] for Mood Disorders to 3·91 [95%CI 3·87-3·94] for Substance Use Disorders). All types of mental disorders were associated with shorter life expectancies (LYLs ranging from 5·42 [95%CI 5·36-5·48] years for Organic Disorders in women to 14·83 [95%CI 14·70-14·99] years for Substance Use Disorders in men). When we examined specific causes of death, we found that men with any type of mental disorder lost fewer years due to neoplasm-related deaths compared to the general population, although their cancer mortality rates were higher.

INTERPRETATION: Mental disorders are associated with premature mortality. We provide a comprehensive analysis of mortality by different types of disorders, presenting both mortality rate ratios and premature mortality based on LYLs, displayed by age, sex and cause of death. We provide more accurate estimates of premature mortality and reveal previously under-appreciated features related to competing risks and specific causes of death.

FUNDING: Danish National Research Foundation

INTRODUCTION

The prevalence of mental disorders is high – it has been estimated that one in three individuals experience a mental disorder during their lifetime.¹⁻³ In addition, there is robust evidence indicating that mental disorders are associated with premature mortality.³ Many studies have reported risk ratios such as standardized mortality ratios and mortality rate ratios, which are useful for comparing the impact of different types of disorders on premature mortality, and for identifying specific causes of death.³ In addition, health metrics can provide information on the age-of-death or differential life expectancy associated with mental disorders.⁴ While previous literature has provided a range of health metrics,⁴⁻⁶ there is a need for a harmonized panel of mortality-related health metrics that includes a comprehensive range of mental disorders.

Life expectancy is widely used by the general community, and comparing the difference in average lifespan for people with mental disorders to the general population seems an intuitive way to measure premature mortality. The best known metric for premature mortality is the Years of Life Lost (YLL), which is used by the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD).⁷ Based on deaths attributable to specific causes, the YLL estimates the expected remaining life expectancy from age at death based on an ‘ideal’ standard life expectancy derived from the lowest age-specific mortality rates in any population in the world greater than 5 million. Other studies have used methods based on remaining life expectancy applying assumptions related to age-of-onset of the disorder and/or age of the cohort for follow-up. For example, an Australian study found the life expectancy gap for all mental disorders was 15.9 years for men and 12.0 years for women.⁸ A Danish study found similarly large estimates of reduced life expectancy for persons with schizophrenia (18.7 and 16.3 years for men and women, respectively).⁵ However, these studies were based on the assumption that all cases of mental disorders had onset before age 15 years.

Recent advances in health metrics can now take into account the observed age of onset (or age of first administrative onset) of the disorder of interest.^{4,9} The Life Years Lost (LYLs) method focuses on the observed age at diagnosis – compared to GBD’s YLL that focuses on age at death. Based on LYLs, it has been estimated that the average life expectancy in men and women is 10.2 and 7.3 years (respectively) shorter in those with any mental disorder.⁴ These findings, and a recent study applying these methods to schizophrenia,¹⁰ indicate that past estimates may have overestimated the actual contribution of mental disorders to premature mortality. Another advantage of using the LYL metric is that it allows to investigate the association between particular disorders and premature mortality, regardless of the main underlying cause of death. In addition, it allows the decomposition of the total reduction in life expectancy into specific types of causes of death. Given that differential life expectancy in people with mental disorders is used as a proxy indicator of the effectiveness of health care and planning input for decisions on resource allocation,¹¹ it is essential that valid metrics related to differential life expectancy are available.

The aim of this study was to undertake an investigation of mortality associated with different types of mental disorders. We used high-quality Danish registers to provide an integrated atlas of different estimates related

to premature mortality, which can be interrogated by age, sex, mental disorder type, and specific cause of death. In order to facilitate fine-grained interrogation of the data, we have also provided an interactive data visualization website (<http://nbepi.com/mortality>).

METHODS

Study population and assessment of mental disorders

We designed a population-based cohort study including all persons younger than 95 years living in Denmark at some point between January 1, 1995 and December 31, 2015 (7,369,926; 3,671,564 males and 3,698,362 females). Since 1968, the Danish Civil Registration System¹² has maintained information on all residents, including sex, date of birth, continuously updated information on vital status, and a unique personal identification number that can be used to link information from various national registries. Information on mental disorders was obtained from the Danish Psychiatric Central Research Register,¹³ which contains data on all admissions to psychiatric inpatient facilities since 1969 and visits to outpatient psychiatric departments and emergency departments since 1995. The diagnostic system used was the Danish modification of the *International Classification of Diseases, Eighth Revision* (ICD-8) from 1969 to 1993, and *Tenth Revision* (ICD-10) from 1994 onwards.¹⁴ Specific disorders were described using the ten level subchapter categories used in previous publications based on Danish registers,^{2, 15} as described in ICD-10 (e.g. F00-F09, F10-19, F20-29, etc.) and corresponding diagnoses in ICD-8. Details of the specific diagnoses included in each group of disorders are presented in Supplementary Table A1. Some disorder groups only include one specific disorder (e.g. Developmental Disorders only include Autism Spectrum Disorder). From this point onwards, we use “disorder” to describe each group of specific diagnoses, employing the short labels provided in Supplementary Table A1. For each individual in the study, the date of onset for each disorder was defined as the date of first contact (inpatient, outpatient, or emergency visit).

Mortality

Information on date and primary cause of death was obtained from the Danish Registry of Causes of Death.¹⁶ All deaths were categorized in 11 non-overlapping groups according to ICD-10 codes: infectious diseases (A00-B99), neoplasms (C00-D09), diabetes mellitus (E10-E14), diseases of the circulatory system (F03·9, I00-I25, I27, I30-I52, I60-I84, I86-I99, R54), respiratory diseases (J00-J99), digestive diseases (K00-K69, K71-K93), alcohol misuse (F10, I85, K70), suicide (X60-X84, Y87·0), homicide (X85-Y09, Y87·1), accidents (V01-X59, Y10-Y86, Y87·2, Y88-Y89), and all other causes. These causes were further categorized into two traditionally-reported categories: natural and unnatural deaths. Unnatural deaths are deaths by external causes, comprising suicide, homicide and accidents; natural deaths are deaths from diseases and medical conditions, and included all other causes.

Statistical analysis

For each specific mental disorder, follow-up started at minimum possible age of onset² (Supplementary Table A1) or on January 1, 1995, whichever came later; and it ended on date of 95th birthday, death,

emigration from Denmark, or December 31, 2015, whichever came first. All mental disorders were treated as time-varying factors. Thus, any individual was considered unexposed until the first diagnosis of a specific disorder (if it occurred); subsequently, the individual was considered to be exposed to the specific mental disorder. Hence, individuals who were diagnosed before start of follow-up were continually counted as exposed. This was dealt in the analyses by splitting the follow-up for such subjects as an unexposed part and an exposed part, and treating the parts as distinct subjects with variables that do not change with time.¹⁷ People with more than one disorder were considered as being exposed to each of the disorders (with different onsets depending on the date of first diagnosis for each disorder).

Mortality rates for the whole population and for those diagnosed with at least one disorder, as well as with each specific disorder, were calculated as the number of deaths divided by the total follow-up time in person-years. In addition, mortality rates for the whole population were calculated via direct standardization using the distribution of sex, age (5-year categories), and period (1995-1999, 2000-2004, 2005-2009, 2010-2015) of those diagnosed with each disorder and those diagnosed with at least one disorder. These standardized rates can be interpreted as the overall mortality rates in Denmark scaled to the age/sex distribution of those with the disease (and therefore avoiding confounding by these factors).¹⁷ Finally, mortality rate ratios (MRRs) with 95% confidence intervals (CIs), defined as the ratio of mortality rates among persons with and without each specific disorder (and those with at least one disorder and those without any disorder), were estimated for each specific cause of death and for all-causes combined using Poisson regression models,¹⁷ adjusting for sex, age, and calendar time. Age (in 1-year categories) and calendar time (in 5-year categories) were included in the models using cubic splines with 4 knots. Sex- and age-specific estimates were obtained by including interaction terms in the models.

Differences in average life expectancy between the group of persons with a specific mental disorder and the general population were calculated separately for men and women as excess Life Years Lost (LYLs). The technical development of this method has recently been published.^{4,9} In brief, for the group of persons with a specific mental disorder, the expected residual lifetime after the diagnosis and before a specified maximum age – set to 95 years for this study – was estimated as the area under the survival curve (which was calculated using age-specific mortality rates). LYLs quantify the average number of years lost before the specified maximum as the difference between 95 and this expected remaining life expectancy. For the general population, this measure quantifies the average number of years lost before age 95 years for a group of persons of the same sex alive at ages corresponding to the age-of-onset distribution for those with the mental disorder. The difference between LYLs between the two groups, defined as excess LYLs, can be interpreted as the average number of years that persons with a specific mental disorder lose in excess of that found in the general population of the same sex and age. The set of a maximum age is necessary for the LYLs method, and a point in which the survival probability is as low as possible provides easily-interpretable results. In this study, we chose a maximum of 95 years, which is well above the life expectancy for the Danish population.¹⁸ A sensitivity analyses for women with schizophrenia using 99 years as a

maximum age led to practically the same results. Finally, the excess LYLs were decomposed into specific causes of death using a competing risks model.¹⁹ A negative excess LYLs for a specific cause indicates that those with a mental disorder had fewer LYLs compared to the general population or, in other words, the general population lost a larger amount of life due to this specific cause than those with a mental disorder. CIs for these estimates were obtained using non-parametric bootstrap with 1,000 iterations. All analyses were performed on the secured platform of Statistics Denmark using R version 3.5.2.

Interactive data visualization website

We developed an interactive webpage to visualize all results from this study: <http://nbepi.com/mortality>.

Ethics and data protection

The Danish Data Protection Agency and the Danish Health Data Authority approved this study. According to Danish law, informed consent is not required for register-based studies. All data were de-identified and not recognizable at an individual level.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the manuscript. The first and corresponding authors had full access to all data in the study and had final responsibility for the decision to submit for publication.

RESULTS

All-cause mortality rates

A total of 7,369,926 persons were followed-up for 111,027,389 person-years (Table 1). Overall, 762,419 persons (10.3%) were diagnosed with at least one mental disorder (347,972 males [9.5% of the total 3,671,564] and 414,447 females [11.2% of the total 3,698,362]). During the 21-year follow-up period, 1,122,351 persons (15.2%) died (564,301 males [15.4%] and 558,050 females [15.1%]). Overall, mortality rates (shown per 1,000 person-years) were higher among persons with a diagnosis of a mental disorder (28.70 [95% CI 28.57-28.82]) compared to the general Danish population after standardization to the same age-, sex-, and period-distribution as among the diagnosed (12.95 [95% CI 12.93-12.98]). Consequently, mortality due to all causes was 2.5 times higher among persons diagnosed with a mental disorder compared to those without any diagnosis (MRR was 2.53 [95% CI 2.52-2.54]). All specific types of mental disorders were associated with higher mortality rates, with MRRs ranging from 1.92 [95% CI 1.91-1.94] for Mood Disorders to 3.91 [95% CI 3.87-3.94] for Substance Use Disorders. For Schizophrenia, for example, the diagnosis was associated with a 2.6-fold increase in mortality rates (2.57 [95% CI 2.54-2.60]). Sex-specific estimates are provided in Supplementary Table A2 and showed similar results for males and females (adjusted all-cause MRRs were respectively 2.84 [95% CI 2.82-2.86] and 2.30 [95% CI 2.28-2.32]). All specific types of mental disorders were associated with higher mortality rates, both for males and females,

with MRRs higher for males for all disorders except Developmental Disorders and Intellectual Disabilities (Supplementary Figure A1).

As expected, mortality rates increased constantly with age; however, the ratio in mortality rates between those with and without a mental disorder was not constant (Figure 1). Overall, MRR peaked at age 33 years (7.25 [95% CI 7.06-7.44]), and then decreased constantly. However, even those in their eighties had MMRs of about 2. Sex-specific MRRs for people with any mental disorder showed a similar trend for males and females, although males had higher MRRs than females after age 20 years. MRRs for all specific types of disorders are available in Supplementary Figures A2-A11.

Mortality rates by specific causes of death

Mortality rates for all specific causes of death were higher for people with any mental disorder compared to those without any diagnosis of a mental disorder, with MRRs ranging from 1.40 [95% CI 1.38-1.41] for neoplasms to 11.82 [95% CI 11.43-12.22] for suicide (Supplementary Figure A12). Cause-specific MRRs were systematically higher among males; however, the association between any mental disorder and suicide was higher for females (MRR=17.52 [95% CI 16.28-18.86]) than for males (MRR=10.12 [95% CI 9.67-10.59]) (Supplementary Figure A13). Sex-specific MRRs for specific causes of death for each type of mental disorder are shown in Figure 2 (results for males and females combined are shown in Supplementary Figure A14). Overall, most mental disorders were associated with higher mortality rates for all specific causes of death. For Mood Disorders, for example, MRRs followed a similar pattern, with the lowest MRR for neoplasms (1.31 [95% CI 1.27-1.35] in men and 1.22 [95% CI 1.19-1.25] in women), and the highest MRR for suicide (12.49 [95% CI 11.79-13.22] in men and 18.22 [95% CI 16.93-19.60] in women). Some cause-specific MRRs were generally higher among males than females (e.g. digestive diseases), while others were higher among females (e.g. suicide) (Supplementary Figure A15).

Excess Life Years Lost

Excess LYLs for each specific mental disorder are shown in Figure 3. On average, remaining life expectancy after diagnosis in those with a mental disorder was 10.06 [95% CI 9.98-10.13] years shorter for males and 7.06 [95% CI 6.99-7.12] years shorter for females compared to the general population of same age. All types of mental disorders were associated with shorter remaining life expectancies. The disorder associated with a larger number of excess LYLs was Substance Use Disorders (14.84 [95% CI 14.70-14.99] years for males and 13.37 [95% CI 13.20-13.56] years for females). For Mood Disorders, for example, remaining life expectancy after diagnosis was 7.91 [95% CI 7.78-8.04] years shorter for males and 6.22 [95% CI 6.10-6.36] years shorter for females, compared to the Danish general population; while these estimates were 12.06 [95% CI 11.83-12.25] years for males and 9.37 [95% CI 9.15-9.56] years for females diagnosed with Schizophrenia. The figure shows that while most LYLs associated with mental disorders are due to natural causes (e.g. general medical conditions), external causes (e.g. suicide, homicide and accidents) also contribute substantial LYLs to most mental disorders.

Excess LYs for each type of mental disorder associated with specific causes of death are shown in Figure 4. Results for each specific type of disorder are shown separately in Supplementary Figures A16-A26. On average, those with Mood Disorders experienced a larger number of LYs than the general population for all causes of death, except for neoplasms in males for which the LYs were smaller compared to the general population, the excess LYs were therefore negative (-0.66 [95% CI $-0.78 - -0.54$] years). Interestingly, males with any type of mental disorder had negative excess LYs (i.e. smaller LYs) due to neoplasms compared to the general population, which indicates that males in the general population lose more years of life due to neoplasms than males with any type of mental disorder. Finally, we provide supplementary figures where cause-specific excess LYs and MRRs are shown side by side (Supplementary Figures A27-A37).

DISCUSSION

The study provides the most comprehensive analysis of mortality-related metrics in those with mental disorders. Our study is the first to provide estimates for each specific type of mental disorder separately; the highest MRR was found for Substance Use Disorders, however all types of mental disorders were associated with higher mortality rates. The point estimates varied by sex, with higher estimates for males compared to females for all disorders except for Developmental Disorders and Intellectual Disabilities. The sex-adjusted MRR for all mental disorders is broadly consistent with estimates from a previous Danish register study which examined excess mortality associated with any mental disorder (although not including Organic Disorders such as dementia).⁴

Besides showing age- and sex-specific MRRs, we examined differences in life expectancy after disease diagnosis for a broad range of mental disorders using Life Years Lost. All types of disorders were associated with shorter life expectancies compared to the general population; the disorder associated with a larger number of excess LYs was Substance Use Disorders. As observed in two recent papers that used the same methodology,^{4, 10} these estimates are more conservative compared to previous estimates of reduced life expectancy,^{5, 8} because we incorporated variations in age of onset into the health metric. However, as is clearly shown in Figure 3, the LYs associated with different types of mental disorder remain substantial. In particular, for prevalent disorders such as Mood, Neurotic and Substance Use Disorders, the total contribution of LYs at the population level would be substantial, given the high prevalence of these disorders.²

Our study confirms that people with mental disorders have premature mortality attributable to suicide (and other types of external causes), however most premature mortality is attributable to causes of death related to general medical conditions, including infectious diseases, neoplasms, diabetes mellitus, diseases of the circulatory system, and respiratory diseases. These findings are consistent with the very large literature based

on a wide range of methodologies and different countries.²⁰ However, our study confirms an underappreciated feature regarding cancer deaths in those with mental disorders.^{4,10} While each type of mental disorder is associated with higher rates of mortality related to neoplasms, we found that men with mental disorders had fewer years of life lost related to neoplasms (compared to the general population). This finding relates to the ability of the LYLs to accommodate competing risks (among different causes of death). While men with mental disorders had higher rates of dying from neoplasms, they had even higher rates of dying of non-cancer causes of death, which precluded them of dying from neoplasms. We provide more details of this process in the Supplementary Methods and Discussion.

The use of LYLs provides important new insights into the nature of premature mortality associated with mental disorders. It is widely appreciated that relative risks such as MRR can be misunderstood in the absence of complementary data related to absolute risks. Thus, it is important to explore a range of mortality-related health metrics, and present them together. The LYLs is an appealing metric to use alongside MRRs for a range of reasons. First, the concept of reduced life expectancy is widely understood by the general community – it is easy to communicate these findings. Second, it allows for the evaluation of the impact of particular disorders on premature mortality, regardless of how the individual died. Here, it has advantages compared to widely cited burden of disease studies that do not allow the causes of death to be directly attributed to most mental disorders.²¹ Third, it allows the total average LYLs to be partitioned into specific types of causes of death. Because only one underlying cause of death is considered, and because different causes of death are mutually exclusive and comprehensively exhaustive, the cause-specific LYLs are additive. Finally, as was demonstrated in this paper, the cause-specific LYLs reveal previous underappreciated features related to competing risks, and thus can help identify subtle but important features of the pathways between mental disorders and premature mortality.

While the study is based on a large sample, and is based on complete Danish registers, it has several limitations. Diagnosed individuals only include those with mental disorders registered in hospital, outpatient and accident/emergency settings. It does not include the many patients with milder disorders who are only treated by the general practitioner, nor those who do not seek help for their mental disorder. While it is reasonable to assume that severe disorders will eventually be registered in a hospital setting, the prevalence of untreated mild disorders is unknown. A recent study estimated that around one quarter of persons who start treatment with antidepressants in Denmark received psychiatric hospital care for depression either initially, or within five years of their first antidepressant treatment.²² These factors could lead to larger estimates of MRRs and LYLs associated with mental disorders compared to those based on community-based surveys with longitudinal follow-up. On the other hand, because we rely on age at first administrative onset, we would overestimate the actual age of onset of the mental disorder – thus the LYLs method probably slightly underestimate the actual LYLs. Furthermore, while mental disorders were identified through the psychiatric register from 1969, follow-up for mortality only started in 1995. Thus, for an unknown proportion, we were not able to observe the initial phase after the onset of the mental disorder,

when MRRs are higher. As a consequence, this issue could lead to an underestimation of MRRs. In addition, there is no information in the registers regarding remission; the group of individuals with a mental disorder can therefore be interpreted as persons who have had a diagnosis of a mental disorder, although they may have recovered afterwards. Specific types of mental disorders were considered separately; all persons with a diagnosis of a specific disorder were treated similarly, irrespective of whether they had diagnoses for other disorders. While studies have confirmed that register-based diagnoses have good validity,²³⁻²⁶ not all disorders have been validated and the mental disorders were not confirmed with structured diagnostic interviews. The validity of diagnosis may also vary within the clinical settings (e.g. because of differing skills and duration of assessments, diagnoses made in emergency room settings may be less reliable compared to outpatient or specialist inpatient units). We used broad diagnostic categories in order to allow comparisons to related publications.^{2, 15} In addition, date and cause of death was also obtained from registers. Because date is thought to be reasonably accurate, all-cause mortality is not affected by potential misclassification. However, only 5% of deaths in Denmark are examined by autopsy,²⁷ which could lead to some misclassification of the specific causes of death. Finally, while our estimates may be reflective of high-income nations in the Nordic region, we cannot assume that our findings would generalize to all countries.

There have been many editorials related to the need to improve general health outcomes in those with mental disorders.^{28, 29} Our findings highlight the need for coordinated care of general medical conditions in those with mental disorders.²⁸ For example, clinicians can be encouraged to routinely collect physical health outcomes related to comorbid general medical conditions. In addition, funders and providers can set targets to optimize the detection and assertive treatment of comorbid general medical conditions. Additionally, we hope that these estimates can provide a solid foundation for future research related to improving the life expectancy of those with mental disorders. In particular, we hope that the level of detail provided in our analyses, the range of mortality-related health estimates, and provision of an interactive website, can provide a template for the next generation of research on this topic.

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AUTHOR CONTRIBUTIONS

John McGrath, Oleguer Plana-Ripoll, Preben Bo Mortensen, Carsten Bøcker Pedersen, Esben Agerbo and Thomas Munk Laursen conceived the study and provided overall guidance. Oleguer Plana-Ripoll undertook the analyses. Oleguer Plana-Ripoll and John J. McGrath prepared the first draft. Yan Holtz prepared the associated website. All other authors reviewed results, provided guidance on methodology and reviewed the manuscript.

CONFLICT OF INTEREST

The authors declare no competing interests.

REFERENCES

1. Vigo D, Thornicroft G, Atun R. Estimating the true global burden of mental illness. *The Lancet Psychiatry*. 2016;3(2):171-178.
2. Pedersen CB, Mors O, Bertelsen A, Waltoft BL, Agerbo E, McGrath JJ, Mortensen PB, Eaton WW. A comprehensive nationwide study of the incidence rate and lifetime risk for treated mental disorders. *JAMA Psychiatry*. 2014;71(5):573-581.
3. Chesney E, Goodwin GM, Fazel S. Risks of all-cause and suicide mortality in mental disorders: a meta-review. *World Psychiatry*. 2014;13(2):153-160.
4. Erlangsen A, Andersen PK, Toender A, Laursen TM, Nordentoft M, Canudas-Romo V. Cause-specific life-years lost in people with mental disorders: a nationwide, register-based cohort study. *Lancet Psychiatry*. 2017;4(12):937-945.
5. Wahlbeck K, Westman J, Nordentoft M, Gissler M, Laursen TM. Outcomes of Nordic mental health systems: life expectancy of patients with mental disorders. *Br J Psychiatry*. 2011;199(6):453-458.
6. Nordentoft M, Wahlbeck K, Hallgren J, Westman J, Osby U, Alinaghizadeh H, Gissler M, Laursen TM. Excess mortality, causes of death and life expectancy in 270,770 patients with recent onset of mental disorders in Denmark, Finland and Sweden. *PLoS One*. 2013;8(1):e55176.
7. Collaborators GCoD. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet*. 2017;390(10100):1151-1210.
8. Lawrence D, Hancock KJ, Kisely S. The gap in life expectancy from preventable physical illness in psychiatric patients in Western Australia: retrospective analysis of population based registers. *BMJ*. 2013;346:f2539.
9. Andersen PK. Life years lost among patients with a given disease. *Stat Med*. 2017;36(22):3573-3582.
10. Laursen TM, Plana-Ripoll O, Andersen PK, McGrath JJ, Toender A, Nordentoft M, Canudas-Romo V, Erlangsen A. Cause-specific life years lost among persons diagnosed with schizophrenia: Is it getting better or worse? *Schizophr Res*. 2018.
11. Liu NH, Daumit GL, Dua T, Aquila R, Charlson F, Cuijpers P, Druss B, Dudek K, Freeman M, Fujii C, Gaebel W, Hegerl U, Levav I, Munk Laursen T, Ma H, Maj M, Elena Medina-Mora M, Nordentoft M, Prabhakaran D, Pratt K, Prince M, Rangaswamy T, Shiers D, Susser E, Thornicroft G, Wahlbeck K, Fekadu Wassie A, Whiteford H, Saxena S. Excess mortality in persons with severe mental disorders: a multilevel intervention framework and priorities for clinical practice, policy and research agendas. *World Psychiatry*. 2017;16(1):30-40.
12. Pedersen CB. The Danish Civil Registration System. *Scand J Public Health*. 2011;39(7 Suppl):22-25.
13. Mors O, Perto GP, Mortensen PB. The Danish Psychiatric Central Research Register. *Scand J Public Health*. 2011;39(7 Suppl):54-57.
14. Sundhedsdatastyrelsen. Klassifikation af sygdomme. <https://sundhedsdatastyrelsen.dk/da/rammer-og-retningslinjer/om-klassifikationer/sks-klassifikationer/klassifikation-sygdomme>. Accessed 07/02/2019, 2019.
15. Plana-Ripoll O, Pedersen CB, Holtz Y, Benros ME, Dalsgaard S, de Jonge P, Fan CC, Degenhardt L, Ganna A, Greve AN, Gunn J, Iburg KM, Kessing LV, Lee BK, Lim CCW, Mors O, Nordentoft M, Prior A, Roest AM, Saha S, Schork A, Scott JG, Scott KM, Stedman T, Sorensen HJ, Werge T, Whiteford HA, Laursen TM, Agerbo E, Kessler RC, Mortensen PB, McGrath JJ. Exploring Comorbidity Within Mental Disorders Among a Danish National Population. *JAMA Psychiatry*. 2019.
16. Helweg-Larsen K. The Danish Register of Causes of Death. *Scandinavian journal of public health*. 2011;39(7 Suppl):26-29.
17. Clayton D, Hills M. *Statistical Models in Epidemiology*. Oxford: Oxford University Press; 1993.
18. Denmark S. Life expectancy for new born babies by sex. 2018.
19. Andersen PK. Decomposition of number of life years lost according to causes of death. *Stat Med*. 2013;32(30):5278-5285.
20. Walker ER, McGee RE, Druss BG. Mortality in mental disorders and global disease burden implications: a systematic review and meta-analysis. *JAMA Psychiatry*. 2015;72(4):334-341.

21. Collaborators GBDCoD. Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*. 2018;392(10159):1736-1788.
22. Musliner KL, Liu X, Gasse C, Christensen KS, Wimberley T, Munk-Olsen T. Incidence of medically treated depression in Denmark among individuals 15-44 years old: a comprehensive overview based on population registers. *Acta Psychiatr Scand*. 2019;139(6):548-557.
23. Kessing L. Validity of diagnoses and other clinical register data in patients with affective disorder. *Eur Psychiatry*. 1998;13(8):392-398.
24. Phung TK, Andersen BB, Høgh P, Kessing LV, Mortensen PB, Waldemar G. Validity of dementia diagnoses in the Danish hospital registers. *Dement Geriatr Cogn Disord*. 2007;24(3):220-228.
25. Lauritsen MB, Jørgensen M, Madsen KM, Lemcke S, Toft S, Grove J, Schendel DE, Thorsen P. Validity of childhood autism in the Danish Psychiatric Central Register: findings from a cohort sample born 1990-1999. *J Autism Dev Disord*. 2010;40(2):139-148.
26. Bock C, Bukh JD, Vinberg M, Gether U, Kessing LV. Validity of the diagnosis of a single depressive episode in a case register. *Clin Pract Epidemiol Ment Health*. 2009;5:4.
27. Ylijoki-Sørensen S, Sajantila A, Lalu K, Boggild H, Boldsen JL, Boel LW. Coding ill-defined and unknown cause of death is 13 times more frequent in Denmark than in Finland. *Forensic Sci Int*. 2014;244:289-294.
28. Suetani S, Whiteford HA, McGrath JJ. An Urgent Call to Address the Deadly Consequences of Serious Mental Disorders. *JAMA Psychiatry*. 2015:1-2.
29. Thornicroft G. Physical health disparities and mental illness: the scandal of premature mortality. *Br J Psychiatry*. 2011;199(6):441-442.

Table 1. Number of persons with each diagnosis, length of the follow-up in person-years, number of observed deaths and mortality rates for all persons in Denmark and for those diagnosed with each of the mental disorders; rate ref. (i.e. mortality rates for the entire Danish population standardized to the age-, sex-, and period-distribution of those diagnosed with each specific disorder); and mortality rate ratios (MRRs) and 95% confidence intervals (CIs) comparing those with and without each disorder. Estimates were obtained with Poisson regression models adjusting for sex, age and calendar time. Age (in 1-year categories) and calendar time (in 5-year categories) were included in the models using cubic splines with 4 knots.

	N	Person-years	Deaths	Rate*	Rate ref.*	MRR (95% CI)
All persons in Denmark	7369926	111027388.7	1122351	10.11	-	-
Persons diagnosed with:						
Any Disorder	762419	7272476.4	208703	28.70	12.95	2.53 (2.52-2.54)
Organic Disorders	123695	586419.3	90144	153.72	56.83	2.94 (2.92-2.96)
Substance Use Disorders	154335	1622414.5	55844	34.42	9.42	3.91 (3.87-3.94)
Schizophrenia	103848	1152229.4	32357	28.08	11.18	2.57 (2.54-2.60)
Mood Disorders	252235	2277709.1	71156	31.24	16.88	1.92 (1.91-1.94)
Neurotic Disorders	321285	3052031.8	51206	16.78	8.13	2.14 (2.13-2.16)
Eating Disorders	23196	207593.8	623	3.00	0.97	2.87 (2.65-3.10)
Personality Disorders	141174	1738908.3	36526	21.01	9.61	2.26 (2.23-2.28)
Intellectual Disabilities	24040	218967.9	3369	15.39	4.44	3.50 (3.38-3.62)
Developmental Disorders	31251	216378.1	342	1.58	0.64	2.49 (2.24-2.77)
Behavioral Disorders	83626	656555.8	1845	2.81	1.05	2.72 (2.60-2.85)

*Rates are shown per 1,000 person-years.

Figure 1. Mortality rates per 100,000 person-years (left panels) for those with and without a diagnosis of a mental disorder for specific year 2010; and mortality rate ratios (right panels) for those with compared to those without a diagnosis of a mental disorder for ages ranging from 15 to 95 years. Mortality rate ratios were adjusted for sex and calendar time, while the sex-specific estimates included an interaction term for sex. Estimates for ages below 15 years are based on a small number of cases among the diagnosed (43 males and 25 females) and are not shown. Specific estimates for a range of ages are available in Supplementary Table A3.

Figure 2. Mortality rate ratios for specific causes of death for those with a diagnosis of each mental disorder compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Age (in 1-year categories) and calendar time (in 5-year categories) were included in the models using cubic splines with 4 knots. Estimates based on less than 3 cases are not shown. Estimates are available in Supplementary Table A4.

Figure 3. Excess Life Years Lost for those with any mental disorder and each specific type of mental disorder compared to the general Danish population of the same sex and age. Total Life Years Lost are decomposed into those attributed to natural and external causes of death. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Figure 4. Excess Life Years Lost due to specific causes of death for those with any mental disorder and each specific type of mental disorder compared to the general Danish population of the same sex and age. Estimates based on less than 3 cases are not shown. Estimates and 95% confidence intervals are available in Supplementary Table A5.

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A comprehensive analysis of mortality-related health metrics associated with mental disorders: a nationwide, register-based cohort study

SUPPLEMENTARY MATERIAL

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Supplementary Methods and Discussion

Mortality rate ratios estimate the instantaneous risk per time unit of dying – the hazard – in persons with mental disorders compared to those without mental disorders, while Life Years Lost are related to the cumulative incidence, or the survival. In the absence of competing risks (i.e. only all-cause mortality is considered), making inferences about the effect of mental disorders on the hazard permits one to make equivalent inferences about the effect of mental disorders on the incidence/survival. In the presence of competing risks, one can estimate the *cause-specific hazard*, which relates to the instantaneous risk per time unit of dying due to a specific cause among those alive at a specific time; or the *cumulative incidence*, which is the cumulative risk of dying from a specific cause over a given time interval. The latter depends not only on the cause-specific hazard for the given cause, but also on the cause-specific hazards for the other (competing) causes. Therefore, the cause-specific hazard has no direct link to the cumulative incidence and it is possible that those with mental disorders have a higher instantaneous risk (cause-specific hazard) of dying of e.g. neoplasms compared to those without mental disorders. However, they may have an even higher hazard of dying due to other causes, and experiencing these other causes precludes them from actually experiencing the death due to neoplasms. It is therefore possible that the percentage of persons who die due to neoplasms is smaller among those with mental disorders, even if the instantaneous risk of dying due to neoplasms is higher.

Supplementary Table A1. Diagnostic classification of mental disorders considered in this study according to the ICD-10 and equivalent ICD-8 diagnoses.

Mental disorders <i>Examples of diagnoses included in each group</i>	Abbreviated name used in this study	ICD-10	ICD-8 equivalency	Earliest possible age at onset (years)
Any mental disorder	Any disorder	F00 – F99	290 – 315	1
Organic, including symptomatic, mental disorders <i>Includes dementia in Alzheimer's disease, vascular dementia, etc.</i>	Organic disorders	F00 – F09	290·09, 290·10, 290·11, 290·18, 290·19, 292·x9, 293·x9, 294·x9, 309·x9	35
Mental and behavioral disorders due to psychoactive substance use <i>Includes use of alcohol, cannabis, cocaine, nicotine, opioids, sedatives, hypnotics, anxiolytics, etc.</i>	Substance use disorders	F10 – F19	291·x9, 294·39, 303·x9, 303·20, 303·28, 303·90, 304·x9	10
Schizophrenia and related disorders <i>Includes schizophrenia, schizotypal disorders, schizoaffective disorders and other psychotic disorders.</i>	Schizophrenia	F20 – F29	295·x9, 296·89, 297·x9, 298·29-298·99, 299·04, 299·05, 299·09, 301·83	10
Mood disorders <i>Includes bipolar disorder, depressive disorders, etc.</i>	Mood disorders	F30 – F39	296·x9 (excluding 296·89), 298·09, 298·19, 300·49, 301·19	10
Neurotic, stress-related, and somatoform disorders <i>Includes anxiety disorders, phobias, obsessive-compulsive disorders, etc.</i>	Neurotic disorders	F40 – F48	300·x9 (excluding 300·49), 305·x9, 305·68, 307·99	5
Eating disorders <i>Includes anorexia nervosa, bulimia nervosa, etc.</i>	Eating disorders	F50	305·60, 306·50, 306·58, 306·59	1
Specific personality disorders	Personality disorders	F60	301·x9 (excluding 301·19), 301·80, 301·81, 301·82, 301·84	10
Intellectual disabilities	Intellectual disabilities	F70 – F79	311·xx, 312·xx, 313·xx, 314·xx, 315·xx	1
Pervasive developmental disorders <i>Includes autism spectrum disorder</i>	Developmental disorders	F84	299·00, 299·01, 299·02, 299·03	1
Behavioral and emotional disorders with onset usually occurring in childhood and adolescence <i>Includes attention-deficit hyperactivity disorder, conduct disorders, childhood emotional disorders, etc.</i>	Behavioral disorders	F90 – F98	306·x9, 308·0x	1

ICD-10: International Classification of Diseases, 10th revision

ICD-8: Danish modification of the International Classification of Diseases, 8th revision

Supplementary Table A2. Number of males and females with each diagnosis, length of the follow-up in person-years, number of observed deaths and mortality rates for all people in Denmark and for those diagnosed with each of the mental disorders. Crude mortality rates are calculated as deaths divided by person-years, whereas reference mortality rates are for the entire Danish population standardized to the age, sex, and period distribution of those diagnosed with each specific disorder. MRRs, defined as the ratio of mortality rates among people with and without each specific disorder, were estimated with Poisson regression models with an interaction term for sex, adjusting for age and calendar time.

	N	Person-years	Deaths	Mortality rate (1,000 person-years)		MRR
				Crude	Reference	
All males in Denmark	3671564	54951561.4	564301	10.27	10.27	
Males diagnosed with:						
Any disorder	347972	3246344.0	94929	29.24	11.59	2.84 (2.82-2.86)
Organic disorders	51400	238148.4	37999	159.56	53.27	3.15 (3.11-3.18)
Substance use disorders	97420	1001187.7	35074	35.03	9.06	4.20 (4.15-4.25)
Schizophrenia	51039	561077.0	14415	25.69	8.92	2.96 (2.91-3.02)
Mood disorders	93464	806224.1	27197	33.73	16.48	2.10 (2.07-2.13)
Neurotic disorders	126964	1130086.5	21400	18.94	8.15	2.42 (2.38-2.46)
Eating disorders	1408	11449.9	69	6.03	1.56	4.13 (3.16-5.41)
Personality disorders	53945	668405.8	16523	24.72	10.21	2.52 (2.47-2.56)
Intellectual disabilities	14305	129668.3	1788	13.79	4.17	3.37 (3.20-3.56)
Developmental disorders	23394	168701.1	240	1.42	0.66	2.25 (1.94-2.60)
Behavioral disorders	54291	439126.4	1133	2.58	0.91	2.99 (2.79-3.19)
All females in Denmark	3698362	56075827.3	558050	9.95	9.95	
Females diagnosed with:						
Any disorder	414447	4026132.4	113774	28.26	14.06	2.30 (2.28-2.32)
Organic disorders	72295	348270.9	52145	149.73	59.26	2.80 (2.77-2.83)
Substance use disorders	56915	621226.8	20770	33.43	9.99	3.50 (3.44-3.55)
Schizophrenia	52809	591152.4	17942	30.35	13.33	2.32 (2.28-2.36)
Mood disorders	158771	1471485.1	43959	29.87	17.10	1.83 (1.81-1.85)
Neurotic disorders	194321	1921945.3	29806	15.51	8.12	1.98 (1.95-2.01)
Eating disorders	21788	196143.9	554	2.82	0.94	2.76 (2.51-3.04)
Personality disorders	87229	1070502.6	20003	18.69	9.23	2.08 (2.05-2.11)
Intellectual disabilities	9735	89299.6	1581	17.70	4.83	3.66 (3.46-3.87)
Developmental disorders	7857	47677.0	102	2.14	0.59	3.36 (2.69-4.19)
Behavioral disorders	29335	217429.4	712	3.27	1.33	2.38 (2.19-2.59)

Supplementary Figure A1. Mortality rate ratios for all-cause mortality for those with a diagnosis of each mental disorder compared to those without the diagnosis for males (vertical axis) and females (horizontal axis). Estimates above the diagonal dashed line are larger for males than females, while estimates below are larger for females than males. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates are available in Supplementary Table A4.

Supplementary Figure A2. Mortality rates per 100,000 person-years (left panels) for persons with and without a diagnosis of organic disorders and mortality rate ratios (right panels) for those with compared to those without a diagnosis of organic disorders for ages ranging from 35 to 95 years. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for age, adjusting for sex and calendar time. The specific estimates are the expected values for calendar year 2010. Estimates for ages below 35 years are unavailable because 35 years is the minimum possible age at onset of organic disorders. Specific estimates for a range of ages are available in Supplementary Table A3.

Supplementary Figure A3. Mortality rates per 100,000 person-years (left panels) for those with and without a diagnosis of substance use disorders and mortality rate ratios (right panels) for those with compared to those without a diagnosis of substance use disorders for ages ranging from 15 to 95 years. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for age, adjusting for sex and calendar time. The specific estimates are the expected values for calendar year 2010. Estimates for ages below 15 years are based on a small number of cases among the diagnosed (0 males and <3 females) and are not shown. Specific estimates for a range of ages are available in Supplementary Table A3.

Mortality in persons with Substance use disorders

Supplementary Figure A4. Mortality rates per 100,000 person-years (left panels) for those with and without a diagnosis of schizophrenia and mortality rate ratios (right panels) for those with compared to those without a diagnosis of schizophrenia for ages ranging from 15 to 95 years. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for age, adjusting for sex and calendar time. The specific estimates are the expected values for calendar year 2010. Estimates for ages below 15 years are based on a small number of cases among the diagnosed (<3 males and <3 females) and are not shown. Specific estimates for a range of ages are available in Supplementary Table A3.

Mortality in persons with Schizophrenia

Supplementary Figure A5. Mortality rates per 100,000 person-years (left panels) for those with and without a diagnosis of mood disorders and mortality rate ratios (right panels) for those with compared to those without a diagnosis of mood disorders for ages ranging from 15 to 95 years. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for age, adjusting for sex and calendar time. The specific estimates are the expected values for calendar year 2010. Estimates for ages below 15 years are based on a small number of cases among the diagnosed (<3 males and <3 females) and are not shown. Specific estimates for a range of ages are available in Supplementary Table A3.

Mortality in persons with Mood disorders

Supplementary Figure A6. Mortality rates per 100,000 person-years (left panels) for those with and without a diagnosis of neurotic disorders and mortality rate ratios (right panels) for those with compared to those without a diagnosis of neurotic disorders for ages ranging from 15 to 95 years. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for age, adjusting for sex and calendar time. The specific estimates are the expected values for calendar year 2010. Estimates for ages below 15 years are based on a small number of cases among the diagnosed (<3 males and 8 females) and are not shown. Specific estimates for a range of ages are available in Supplementary Table A3.

Supplementary Figure A7. Mortality rates per 100,000 person-years (left panels) for those with and without a diagnosis of eating disorders and mortality rate ratios (right panels) for those with compared to those without a diagnosis of eating disorders for ages ranging from 20 to 95 years. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for age, adjusting for sex and calendar time. The specific estimates are the expected values for calendar year 2010. The following estimates are not shown because are based on a small number of cases among the diagnosed: ages below 20 years (<3 males and 9 females), ages above 75 years for males (<3 cases), and ages above 75 years for external causes (<3 cases). Specific estimates for a range of ages are available in Supplementary Table A3.

Mortality in persons with Eating disorders

Supplementary Figure A8. Mortality rates per 100,000 person-years (left panels) for those with and without a diagnosis of personality disorders and mortality rate ratios (right panels) for those with compared to those without a diagnosis of personality disorders for ages ranging from 15 to 95 years. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for age, adjusting for sex and calendar time. The specific estimates are the expected values for calendar year 2010. Estimates for ages below 15 years are based on a small number of cases among the diagnosed (0 males and <3 females) and are not shown. Specific estimates for a range of ages are available in Supplementary Table A3.

Supplementary Figure A9. Mortality rates per 100,000 person-years (left panels) for those with and without a diagnosis of intellectual disabilities and mortality rate ratios (right panels) for those with compared to those without a diagnosis of intellectual disabilities for ages ranging from 15 to 95 years. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for age, adjusting for sex and calendar time. The specific estimates are the expected values for calendar year 2010. The following estimates are not shown because are based on a small number of cases among the diagnosed: ages below 15 years (12 males and 6 females), ages above 85 years for external causes (6 cases). Specific estimates for a range of ages are available in Supplementary Table A3.

Supplementary Figure A10. Mortality rates per 100,000 person-years (left panels) for those with and without a diagnosis of developmental disorders and mortality rate ratios (right panels) for those with compared to those without a diagnosis of developmental disorders for ages ranging from 15 to 85 years. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for age, adjusting for sex and calendar time. The specific estimates are the expected values for calendar year 2010. The following estimates are not shown because are based on a small number of cases among the diagnosed: ages below 15 years (15 males and 5 females), ages above 85 years (<3 males and <3 females), and ages above 60 years for external causes (<3 cases). Specific estimates for a range of ages are available in Supplementary Table A3.

Supplementary Figure A11. Mortality rates per 100,000 person-years (left panels) for those with and without a diagnosis of behavioral disorders and mortality rate ratios (right panels) for those with compared to those without a diagnosis of behavioral disorders for ages ranging from 15 to 95 years. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for age, adjusting for sex and calendar time. The specific estimates are the expected values for calendar year 2010. The following estimates are not shown because are based on a small number of cases among the diagnosed: ages below 15 years (27 males and 7 females), and ages above 85 years for external causes (5 cases). Specific estimates for a range of ages are available in Supplementary Table A3.

Supplementary Figure A12. Mortality rate ratios for specific causes of death for those with a diagnosis of any mental disorder compared to those without a diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models adjusting for sex, age and calendar time. Estimates are available in Supplementary Table A4.

Supplementary Figure A13. Mortality rate ratios for specific causes of death for those with a diagnosis of any mental disorder compared to those without a diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates are available in Supplementary Table A4.

Supplementary Figure A14. Mortality rate ratios for specific causes of death for those with a diagnosis of each mental disorder compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models adjusting for sex, age and calendar time. Estimates based on less than 3 cases are not shown. Estimates are available in Supplementary Table A4.

Supplementary Figure A15. Mortality rate ratios for specific causes of death for those with a diagnosis of each mental disorder compared to those without the diagnosis for males (vertical axis) and females (horizontal axis). Estimates above the diagonal dashed line are larger for males than females, while estimates below are larger for females than males. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates based on less than 3 cases are not shown. Estimates are available in Supplementary Table A4.

Supplementary Figure A16. Excess Life Years Lost due to specific causes of death for those with a diagnosis of any mental disorder compared to the general Danish population of the same sex and age. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Supplementary Figure A17. Excess Life Years Lost due to specific causes of death for those with a diagnosis of organic disorders compared to the general Danish population of the same sex and age. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Supplementary Figure A18. Excess Life Years Lost due to specific causes of death for those with a diagnosis of substance use disorders compared to the general Danish population of the same sex and age. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Supplementary Figure A19. Excess Life Years Lost due to specific causes of death for those with a diagnosis of schizophrenia compared to the general Danish population of the same sex and age. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Supplementary Figure A20. Excess Life Years Lost due to specific causes of death for those with a diagnosis of mood disorders compared to the general Danish population of the same sex and age. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Supplementary Figure A21. Excess Life Years Lost due to specific causes of death for those with a diagnosis of neurotic disorders compared to the general Danish population of the same sex and age. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Supplementary Figure A22. Excess Life Years Lost due to specific causes of death for those with a diagnosis of eating disorders compared to the general Danish population of the same sex and age. Estimates based on less than 3 cases are not shown. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Supplementary Figure A23. Excess Life Years Lost due to specific causes of death for those with a diagnosis of personality disorders compared to the general Danish population of the same sex and age. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Supplementary Figure A24. Excess Life Years Lost due to specific causes of death for those with a diagnosis of intellectual disabilities compared to the general Danish population of the same sex and age. Estimates based on less than 3 cases are not shown. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Supplementary Figure A25. Excess Life Years Lost due to specific causes of death for those with a diagnosis of developmental disorders compared to the general Danish population of the same sex and age. Estimates based on less than 3 cases are not shown. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Supplementary Figure A26. Excess Life Years Lost due to specific causes of death for those with a diagnosis of behavioral disorders compared to the general Danish population of the same sex and age. Estimates and 95% confidence intervals are available in Supplementary Table A5.

Supplementary Figure A27. Excess Life Years Lost due to specific causes of death for those with a diagnosis of any mental disorder compared to the general Danish population of the same sex and age (left panel) and mortality rate ratios for specific causes of death for those with a diagnosis of any mental disorder compared to those without a diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates and 95% confidence intervals are available in Supplementary Tables A4 (mortality rate ratios) and A5 (Life Years Lost).

Supplementary Figure A28. Excess Life Years Lost due to specific causes of death for those with a diagnosis of organic disorders compared to the general Danish population of the same sex and age (left panel) and mortality rate ratios for specific causes of death for those with a diagnosis of organic disorders compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates and 95% confidence intervals are available in Supplementary Tables A4 (mortality rate ratios) and A5 (Life Years Lost).

Supplementary Figure A29. Excess Life Years Lost due to specific causes of death for those with a diagnosis of substance use disorders compared to the general Danish population of the same sex and age (left panel) and mortality rate ratios for specific causes of death for those with a diagnosis of substance use disorders compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates and 95% confidence intervals are available in Supplementary Tables A4 (mortality rate ratios) and A5 (Life Years Lost).

Supplementary Figure A30. Excess Life Years Lost due to specific causes of death for those with a diagnosis of schizophrenia compared to the general Danish population of the same sex and age (left panel) and mortality rate ratios for specific causes of death for those with a diagnosis of schizophrenia compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates and 95% confidence intervals are available in Supplementary Tables A4 (mortality rate ratios) and A5 (Life Years Lost).

Supplementary Figure A31. Excess Life Years Lost due to specific causes of death for those with a diagnosis of mood disorders compared to the general Danish population of the same sex and age (left panel) and mortality rate ratios for specific causes of death for those with a diagnosis of mood disorders compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates and 95% confidence intervals are available in Supplementary Tables A4 (mortality rate ratios) and A5 (Life Years Lost).

Supplementary Figure A32. Excess Life Years Lost due to specific causes of death for those with a diagnosis of neurotic disorders compared to the general Danish population of the same sex and age (left panel) and mortality rate ratios for specific causes of death for those with a diagnosis of neurotic disorders compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates and 95% confidence intervals are available in Supplementary Tables A4 (mortality rate ratios) and A5 (Life Years Lost).

Supplementary Figure A33. Excess Life Years Lost due to specific causes of death for those with a diagnosis of eating disorders compared to the general Danish population of the same sex and age (left panel) and mortality rate ratios for specific causes of death for those with a diagnosis of eating disorders compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates based on less than 3 cases are not shown. Estimates and 95% confidence intervals are available in Supplementary Tables A4 (mortality rate ratios) and A5 (Life Years Lost).

Supplementary Figure A34. Excess Life Years Lost due to specific causes of death for those with a diagnosis of personality disorders compared to the general Danish population of the same sex and age (left panel) and mortality rate ratios for specific causes of death for those with a diagnosis of personality disorders compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates and 95% confidence intervals are available in Supplementary Tables A4 (mortality rate ratios) and A5 (Life Years Lost).

Supplementary Figure A35. Excess Life Years Lost due to specific causes of death for those with a diagnosis of intellectual disabilities compared to the general Danish population of the same sex and age (left panel) and mortality rate ratios for specific causes of death for those with a diagnosis of intellectual disabilities compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates based on less than 3 cases are not shown. Estimates and 95% confidence intervals are available in Supplementary Tables A4 (mortality rate ratios) and A5 (Life Years Lost).

Supplementary Figure A36. Excess Life Years Lost due to specific causes of death for those with a diagnosis of developmental disorders compared to the general Danish population of the same sex and age (left panel) and mortality rate ratios for specific causes of death for those with a diagnosis of developmental disorders compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates based on less than 3 cases are not shown. Estimates and 95% confidence intervals are available in Supplementary Tables A4 (mortality rate ratios) and A5 (Life Years Lost).

Supplementary Figure A37. Excess Life Years Lost due to specific causes of death for those with a diagnosis of behavioral disorders compared to the general Danish population of the same sex and age (left panel) and mortality rate ratios for specific causes of death for those with a diagnosis of behavioral disorders compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for sex, adjusting for age and calendar time. Estimates and 95% confidence intervals are available in Supplementary Tables A4 (mortality rate ratios) and A5 (Life Years Lost).

Supplementary Table A3. Mortality rate ratios for those with compared to those without a diagnosis of each mental disorders at ages 20, 40, 60, and 80 years. All estimates and 95% confidence intervals were obtained with Poisson regression models with an interaction term for age, adjusting for sex and calendar time. The specific estimates are the expected values for calendar year 2010. Estimates for age 20 in those with organic disorders are not available because the minimum possible age at onset of organic disorders is 35 years. Estimates for all ages from 15 to 95 years are shown in Figure 1 and Supplementary Figures A2-A11.

Mental disorder	Sex	Cause of death	Mortality rate ratios (95% confidence intervals) at specific ages			
			20 years	40 years	60 years	80 years
Any disorder	Persons	All causes	4.24 (3.97-4.52)	6.45 (6.31-6.59)	3.27 (3.24-3.31)	2.28 (2.26-2.30)
Any disorder	Males	All causes	4.38 (4.05-4.73)	7.46 (7.27-7.66)	3.47 (3.42-3.52)	2.34 (2.31-2.37)
Any disorder	Females	All causes	4.12 (3.67-4.62)	4.98 (4.81-5.16)	3.05 (3.00-3.09)	2.24 (2.22-2.27)
Any disorder	Persons	Natural causes	2.13 (1.90-2.38)	5.07 (4.94-5.21)	3.06 (3.02-3.10)	2.25 (2.23-2.27)
Any disorder	Persons	External causes	5.81 (5.34-6.32)	12.78 (12.23-13.37)	9.66 (9.26-10.07)	3.45 (3.30-3.61)
Organic disorders	Persons	All causes	-	17.24 (15.65-18.98)	5.75 (5.62-5.88)	3.18 (3.15-3.22)
Organic disorders	Males	All causes	-	15.81 (14.08-17.75)	5.51 (5.35-5.67)	3.22 (3.17-3.27)
Organic disorders	Females	All causes	-	19.91 (16.68-23.76)	6.10 (5.89-6.33)	3.17 (3.13-3.22)
Organic disorders	Persons	Natural causes	-	18.58 (16.68-20.69)	5.60 (5.47-5.74)	3.16 (3.12-3.20)
Organic disorders	Persons	External causes	-	12.84 (10.29-16.03)	8.79 (8.06-9.60)	3.99 (3.76-4.24)
Substance use disorders	Persons	All causes	10.47 (9.14-11.98)	12.87 (12.53-13.21)	4.75 (4.68-4.82)	2.19 (2.15-2.23)
Substance use disorders	Males	All causes	8.60 (7.31-10.14)	12.51 (12.12-12.91)	4.65 (4.57-4.73)	2.14 (2.08-2.19)
Substance use disorders	Females	All causes	15.02 (11.81-19.11)	13.46 (12.81-14.14)	4.99 (4.88-5.11)	2.25 (2.20-2.31)
Substance use disorders	Persons	Natural causes	4.29 (3.11-5.91)	9.64 (9.33-9.96)	4.51 (4.45-4.59)	2.16 (2.12-2.20)
Substance use disorders	Persons	External causes	15.14 (13.00-17.63)	23.33 (22.13-24.59)	10.58 (10.06-11.12)	3.20 (2.94-3.49)
Schizophrenia	Persons	All causes	8.09 (7.00-9.35)	6.62 (6.38-6.87)	3.27 (3.20-3.34)	2.01 (1.97-2.05)
Schizophrenia	Males	All causes	7.60 (6.37-9.05)	6.62 (6.33-6.93)	3.29 (3.19-3.38)	1.97 (1.90-2.03)
Schizophrenia	Females	All causes	9.20 (7.12-11.89)	6.42 (6.02-6.84)	3.27 (3.18-3.37)	2.03 (1.98-2.08)
Schizophrenia	Persons	Natural causes	4.71 (3.54-6.26)	4.93 (4.70-5.16)	3.09 (3.02-3.16)	1.98 (1.94-2.02)
Schizophrenia	Persons	External causes	10.64 (9.00-12.58)	11.98 (11.21-12.79)	7.42 (6.95-7.93)	3.02 (2.75-3.31)
Mood disorders	Persons	All causes	3.86 (3.35-4.44)	4.72 (4.55-4.90)	2.63 (2.59-2.67)	1.75 (1.72-1.77)
Mood disorders	Males	All causes	4.48 (3.73-5.38)	5.43 (5.18-5.70)	2.65 (2.59-2.71)	1.74 (1.71-1.78)
Mood disorders	Females	All causes	4.16 (3.35-5.15)	4.09 (3.87-4.32)	2.63 (2.57-2.69)	1.75 (1.72-1.77)
Mood disorders	Persons	Natural causes	1.91 (1.44-2.54)	3.16 (3.01-3.31)	2.37 (2.33-2.42)	1.71 (1.69-1.73)
Mood disorders	Persons	External causes	6.08 (5.16-7.16)	10.76 (10.10-11.47)	9.10 (8.63-9.58)	3.15 (2.97-3.34)
Neurotic disorders	Persons	All causes	3.50 (3.18-3.85)	4.34 (4.21-4.48)	2.65 (2.60-2.69)	1.68 (1.65-1.71)
Neurotic disorders	Males	All causes	3.90 (3.44-4.43)	4.96 (4.77-5.16)	2.67 (2.61-2.73)	1.69 (1.64-1.73)
Neurotic disorders	Females	All causes	3.54 (3.03-4.12)	3.73 (3.56-3.92)	2.66 (2.61-2.72)	1.67 (1.64-1.70)
Neurotic disorders	Persons	Natural causes	2.09 (1.76-2.49)	3.21 (3.08-3.34)	2.46 (2.42-2.51)	1.64 (1.62-1.67)
Neurotic disorders	Persons	External causes	4.87 (4.31-5.50)	8.91 (8.43-9.41)	7.39 (7.02-7.78)	2.78 (2.58-2.99)
Eating disorders	Persons	All causes	2.74 (2.06-3.64)	3.07 (2.66-3.53)	3.09 (2.71-3.52)	1.98 (1.57-2.50)
Eating disorders	Males	All causes	4.03 (1.82-8.91)	4.07 (2.63-6.30)	4.26 (2.83-6.43)	1.89 (0.77-4.61)
Eating disorders	Females	All causes	3.62 (2.66-4.92)	3.33 (2.87-3.86)	3.02 (2.63-3.47)	2.00 (1.57-2.55)
Eating disorders	Persons	Natural causes	2.35 (1.49-3.70)	2.76 (2.31-3.31)	2.89 (2.51-3.32)	1.91 (1.50-2.44)
Eating disorders	Persons	External causes	3.40 (2.34-4.94)	4.98 (3.93-6.31)	9.03 (6.02-13.55)	3.38 (0.99-11.54)
Personality disorders	Persons	All causes	5.39 (4.63-6.27)	5.81 (5.61-6.02)	2.75 (2.70-2.80)	1.62 (1.59-1.65)
Personality disorders	Males	All causes	5.61 (4.45-7.08)	6.41 (6.12-6.70)	2.81 (2.74-2.88)	1.55 (1.50-1.60)
Personality disorders	Females	All causes	6.72 (5.49-8.22)	5.13 (4.86-5.42)	2.72 (2.65-2.79)	1.66 (1.62-1.70)

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Personality disorders	Persons	Natural causes	2·40 (1·69-3·42)	4·13 (3·94-4·31)	2·60 (2·55-2·65)	1·59 (1·56-1·62)
Personality disorders	Persons	External causes	8·06 (6·81-9·54)	11·74 (11·03-12·49)	6·27 (5·91-6·65)	2·53 (2·31-2·76)
Intellectual disabilities	Persons	All causes	5·70 (4·65-6·98)	6·00 (5·46-6·60)	4·14 (3·93-4·37)	2·40 (2·26-2·56)
Intellectual disabilities	Males	All causes	4·47 (3·45-5·77)	5·24 (4·64-5·91)	3·90 (3·63-4·18)	2·10 (1·90-2·31)
Intellectual disabilities	Females	All causes	9·66 (6·95-13·43)	7·45 (6·41-8·66)	4·59 (4·24-4·97)	2·63 (2·41-2·86)
Intellectual disabilities	Persons	Natural causes	8·47 (6·59-10·89)	6·72 (6·04-7·47)	4·12 (3·91-4·35)	2·37 (2·22-2·53)
Intellectual disabilities	Persons	External causes	4·04 (2·85-5·74)	4·18 (3·37-5·18)	4·85 (3·94-5·98)	3·30 (2·37-4·60)
Developmental disorders	Persons	All causes	2·81 (2·24-3·52)	3·12 (2·58-3·77)	2·13 (1·75-2·60)	2·76 (2·06-3·71)
Developmental disorders	Males	All causes	2·31 (1·79-2·99)	2·80 (2·24-3·49)	1·83 (1·43-2·33)	2·12 (1·42-3·15)
Developmental disorders	Females	All causes	4·68 (2·93-7·48)	3·83 (2·61-5·64)	3·03 (2·17-4·23)	4·19 (2·68-6·53)
Developmental disorders	Persons	Natural causes	3·34 (2·45-4·55)	3·32 (2·66-4·15)	2·16 (1·76-2·65)	2·79 (2·07-3·77)
Developmental disorders	Persons	External causes	2·61 (1·86-3·65)	2·73 (1·78-4·19)	1·65 (0·57-4·73)	1·19 (0·14-10·32)
Behavioral disorders	Persons	All causes	3·11 (2·73-3·55)	4·15 (3·82-4·51)	2·55 (2·34-2·78)	1·96 (1·77-2·18)
Behavioral disorders	Males	All causes	2·82 (2·43-3·27)	4·12 (3·74-4·53)	2·57 (2·29-2·87)	1·87 (1·58-2·23)
Behavioral disorders	Females	All causes	3·33 (2·52-4·40)	3·89 (3·31-4·57)	2·62 (2·28-3·00)	1·96 (1·72-2·24)
Behavioral disorders	Persons	Natural causes	2·34 (1·89-2·90)	3·33 (2·98-3·72)	2·52 (2·30-2·77)	1·90 (1·71-2·12)
Behavioral disorders	Persons	External causes	3·73 (3·15-4·42)	6·40 (5·59-7·33)	4·77 (3·64-6·23)	2·63 (1·61-4·29)

Supplementary Table A4. Mortality rate ratios for specific causes of death for those with a diagnosis of each mental disorder compared to those without the diagnosis. All estimates and 95% confidence intervals were obtained with Poisson regression models. Estimates for persons were adjusted for sex, age and calendar time. Estimates for males and females were obtained with an interaction term for sex, adjusting for age and calendar time. Estimates based on less than 3 cases are not shown.

Mental disorder	Cause of death	Mortality rate ratios (95% confidence interval)		
		Persons	Males	Females
Any disorder	All causes of death	2.53 (2.52-2.54)	2.84 (2.82-2.86)	2.30 (2.28-2.32)
Any disorder	External causes	6.06 (5.95-6.17)	6.78 (6.60-6.97)	5.17 (5.01-5.34)
Any disorder	- Suicide	11.82 (11.43-12.22)	10.12 (9.67-10.60)	17.52 (16.28-18.86)
Any disorder	- Accidents	4.59 (4.48-4.69)	5.47 (5.29-5.67)	3.73 (3.59-3.88)
Any disorder	- Homicide	5.74 (4.96-6.64)	7.17 (5.85-8.81)	3.94 (2.97-5.23)
Any disorder	Natural causes	2.40 (2.39-2.41)	2.66 (2.64-2.68)	2.22 (2.20-2.23)
Any disorder	- Infectious diseases	2.71 (2.60-2.82)	3.35 (3.13-3.59)	2.28 (2.14-2.43)
Any disorder	- Neoplasms	1.40 (1.38-1.41)	1.51 (1.48-1.54)	1.31 (1.29-1.33)
Any disorder	- Diabetes	2.61 (2.53-2.69)	2.99 (2.85-3.14)	2.28 (2.17-2.40)
Any disorder	- Circulatory system dis.	2.45 (2.43-2.47)	2.60 (2.56-2.64)	2.34 (2.31-2.37)
Any disorder	- Respiratory diseases	2.70 (2.66-2.74)	2.95 (2.87-3.02)	2.53 (2.48-2.59)
Any disorder	- Digestive diseases	2.44 (2.38-2.51)	3.05 (2.92-3.19)	2.11 (2.03-2.19)
Any disorder	- Alcohol misuse	8.92 (8.70-9.14)	8.81 (8.53-9.10)	9.20 (8.73-9.69)
Any disorder	- Other causes	3.58 (3.54-3.62)	3.95 (3.87-4.03)	3.31 (3.26-3.37)
Organic disorders	All causes of death	2.94 (2.92-2.96)	3.15 (3.11-3.18)	2.80 (2.77-2.83)
Organic disorders	External causes	3.70 (3.57-3.84)	3.93 (3.71-4.16)	3.52 (3.33-3.72)
Organic disorders	- Suicide	3.67 (3.34-4.05)	3.71 (3.24-4.26)	3.61 (3.02-4.32)
Organic disorders	- Accidents	3.70 (3.56-3.85)	4.13 (3.88-4.41)	3.41 (3.21-3.61)
Organic disorders	- Homicide	4.98 (3.07-8.10)	4.63 (2.16-9.93)	5.42 (2.48-11.84)
Organic disorders	Natural causes	2.91 (2.89-2.93)	3.12 (3.08-3.16)	2.77 (2.75-2.80)
Organic disorders	- Infectious diseases	2.70 (2.54-2.87)	3.10 (2.79-3.45)	2.46 (2.25-2.70)
Organic disorders	- Neoplasms	1.25 (1.22-1.28)	1.45 (1.40-1.50)	1.10 (1.07-1.14)
Organic disorders	- Diabetes	2.94 (2.80-3.07)	3.32 (3.08-3.57)	2.63 (2.44-2.83)
Organic disorders	- Circulatory system dis.	3.29 (3.26-3.33)	3.36 (3.30-3.43)	3.25 (3.20-3.30)
Organic disorders	- Respiratory diseases	2.63 (2.57-2.68)	3.13 (3.02-3.24)	2.31 (2.24-2.39)
Organic disorders	- Digestive diseases	2.14 (2.05-2.23)	2.50 (2.33-2.69)	1.95 (1.84-2.07)
Organic disorders	- Alcohol misuse	7.37 (7.00-7.77)	7.34 (6.84-7.88)	7.45 (6.68-8.30)
Organic disorders	- Other causes	5.20 (5.12-5.27)	5.57 (5.43-5.72)	4.95 (4.85-5.07)
Substance use dis.	All causes of death	3.91 (3.87-3.94)	4.20 (4.15-4.25)	3.50 (3.44-3.55)
Substance use dis.	External causes	11.78 (11.49-12.07)	11.53 (11.14-11.92)	12.33 (11.74-12.95)
Substance use dis.	- Suicide	11.65 (11.16-12.16)	9.82 (9.26-10.40)	18.88 (17.29-20.61)
Substance use dis.	- Accidents	11.71 (11.35-12.07)	12.24 (11.73-12.78)	10.73 (10.10-11.40)
Substance use dis.	- Homicide	13.93 (11.75-16.53)	15.21 (12.14-19.05)	11.04 (7.52-16.21)
Substance use dis.	Natural causes	3.52 (3.49-3.56)	3.77 (3.72-3.82)	3.20 (3.14-3.25)
Substance use dis.	- Infectious diseases	5.29 (4.93-5.66)	5.94 (5.38-6.56)	4.46 (3.93-5.07)
Substance use dis.	- Neoplasms	2.05 (2.01-2.09)	2.09 (2.03-2.15)	2.00 (1.93-2.07)
Substance use dis.	- Diabetes	3.22 (3.03-3.42)	3.51 (3.23-3.81)	2.75 (2.44-3.10)
Substance use dis.	- Circulatory system dis.	2.65 (2.60-2.70)	2.87 (2.79-2.95)	2.39 (2.30-2.47)
Substance use dis.	- Respiratory diseases	4.58 (4.45-4.70)	4.40 (4.22-4.59)	4.78 (4.57-4.99)

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Substance use dis.	- Digestive diseases	5·19 (4·98-5·42)	5·99 (5·62-6·38)	4·38 (4·07-4·71)
Substance use dis.	- Alcohol misuse	21·44 (20·90-21·99)	18·63 (18·01-19·27)	31·89 (30·20-33·66)
Substance use dis.	- Other causes	3·93 (3·84-4·03)	4·25 (4·10-4·40)	3·53 (3·39-3·69)
Schizophrenia	All causes of death	2·57 (2·54-2·60)	2·96 (2·91-3·02)	2·32 (2·28-2·36)
Schizophrenia	External causes	6·89 (6·67-7·12)	7·59 (7·23-7·96)	6·04 (5·69-6·40)
Schizophrenia	- Suicide	10·76 (10·23-11·32)	9·12 (8·47-9·82)	14·85 (13·52-16·32)
Schizophrenia	- Accidents	5·39 (5·16-5·63)	6·68 (6·26-7·12)	4·17 (3·86-4·51)
Schizophrenia	- Homicide	4·39 (3·26-5·92)	5·02 (3·35-7·50)	3·34 (1·77-6·29)
Schizophrenia	Natural causes	2·36 (2·34-2·39)	2·65 (2·59-2·70)	2·19 (2·15-2·23)
Schizophrenia	- Infectious diseases	3·03 (2·76-3·32)	4·06 (3·51-4·71)	2·40 (2·07-2·78)
Schizophrenia	- Neoplasms	1·38 (1·34-1·42)	1·41 (1·34-1·48)	1·36 (1·31-1·42)
Schizophrenia	- Diabetes	3·11 (2·91-3·32)	3·54 (3·17-3·94)	2·79 (2·50-3·10)
Schizophrenia	- Circulatory system dis.	2·21 (2·17-2·26)	2·47 (2·38-2·57)	2·08 (2·01-2·14)
Schizophrenia	- Respiratory diseases	3·16 (3·06-3·27)	3·50 (3·30-3·72)	2·98 (2·84-3·12)
Schizophrenia	- Digestive diseases	2·68 (2·53-2·84)	3·60 (3·25-3·98)	2·25 (2·06-2·45)
Schizophrenia	- Alcohol misuse	3·99 (3·78-4·20)	3·89 (3·62-4·19)	4·21 (3·78-4·69)
Schizophrenia	- Other causes	3·74 (3·65-3·84)	4·44 (4·25-4·64)	3·33 (3·20-3·46)
Mood disorders	All causes of death	1·92 (1·91-1·94)	2·10 (2·07-2·13)	1·83 (1·81-1·85)
Mood disorders	External causes	5·37 (5·24-5·52)	5·99 (5·75-6·24)	4·83 (4·63-5·03)
Mood disorders	- Suicide	14·30 (13·75-14·87)	12·49 (11·79-13·22)	18·22 (16·93-19·60)
Mood disorders	- Accidents	3·16 (3·05-3·28)	3·51 (3·30-3·73)	2·92 (2·76-3·09)
Mood disorders	- Homicide	3·03 (2·27-4·03)	3·41 (2·21-5·28)	2·65 (1·63-4·30)
Mood disorders	Natural causes	1·80 (1·79-1·82)	1·92 (1·89-1·95)	1·74 (1·72-1·76)
Mood disorders	- Infectious diseases	2·18 (2·04-2·32)	2·55 (2·27-2·86)	1·98 (1·81-2·18)
Mood disorders	- Neoplasms	1·25 (1·23-1·27)	1·31 (1·27-1·35)	1·22 (1·19-1·25)
Mood disorders	- Diabetes	2·09 (1·99-2·19)	2·43 (2·24-2·64)	1·85 (1·72-2·00)
Mood disorders	- Circulatory system dis.	1·76 (1·73-1·78)	1·85 (1·80-1·90)	1·71 (1·68-1·74)
Mood disorders	- Respiratory diseases	2·29 (2·24-2·34)	2·38 (2·29-2·48)	2·23 (2·17-2·31)
Mood disorders	- Digestive diseases	2·00 (1·92-2·08)	2·22 (2·05-2·40)	1·91 (1·81-2·01)
Mood disorders	- Alcohol misuse	4·24 (4·08-4·41)	4·06 (3·84-4·30)	4·58 (4·26-4·92)
Mood disorders	- Other causes	2·25 (2·20-2·29)	2·40 (2·31-2·48)	2·17 (2·11-2·23)
Neurotic disorders	All causes of death	2·14 (2·13-2·16)	2·42 (2·38-2·46)	1·98 (1·95-2·01)
Neurotic disorders	External causes	5·91 (5·75-6·07)	6·69 (6·43-6·97)	5·11 (4·88-5·35)
Neurotic disorders	- Suicide	10·75 (10·32-11·20)	9·83 (9·27-10·42)	12·66 (11·73-13·66)
Neurotic disorders	- Accidents	4·11 (3·96-4·27)	4·91 (4·64-5·20)	3·45 (3·24-3·67)
Neurotic disorders	- Homicide	4·80 (3·91-5·89)	4·92 (3·58-6·76)	4·66 (3·32-6·55)
Neurotic disorders	Natural causes	1·97 (1·95-1·99)	2·15 (2·11-2·19)	1·86 (1·84-1·89)
Neurotic disorders	- Infectious diseases	2·36 (2·19-2·54)	2·86 (2·52-3·25)	2·07 (1·85-2·32)
Neurotic disorders	- Neoplasms	1·44 (1·41-1·47)	1·43 (1·38-1·48)	1·45 (1·41-1·49)
Neurotic disorders	- Diabetes	2·17 (2·04-2·29)	2·56 (2·33-2·82)	1·88 (1·72-2·06)
Neurotic disorders	- Circulatory system dis.	1·76 (1·73-1·79)	2·00 (1·93-2·06)	1·63 (1·59-1·68)
Neurotic disorders	- Respiratory diseases	2·76 (2·69-2·83)	2·67 (2·53-2·80)	2·80 (2·71-2·91)
Neurotic disorders	- Digestive diseases	2·39 (2·28-2·50)	2·75 (2·52-3·00)	2·22 (2·08-2·37)
Neurotic disorders	- Alcohol misuse	5·19 (5·01-5·37)	4·79 (4·56-5·04)	5·97 (5·60-6·36)
Neurotic disorders	- Other causes	2·24 (2·19-2·30)	2·56 (2·45-2·67)	2·07 (2·00-2·14)

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Eating disorders	All causes of death	2.87 (2.65-3.10)	4.13 (3.16-5.41)	2.76 (2.51-3.04)
Eating disorders	External causes	4.52 (3.88-5.27)	5.30 (3.17-8.86)	4.44 (3.69-5.34)
Eating disorders	- Suicide	8.77 (7.15-10.76)	8.59 (4.50-16.39)	8.80 (6.86-11.30)
Eating disorders	- Accidents	2.86 (2.26-3.62)	3.24 (1.39-7.54)	2.82 (2.13-3.75)
Eating disorders	- Homicide	-	-	-
Eating disorders	Natural causes	2.62 (2.39-2.87)	3.77 (2.75-5.18)	2.52 (2.26-2.82)
Eating disorders	- Infectious diseases	0.91 (0.34-2.43)	-	0.98 (0.32-3.00)
Eating disorders	- Neoplasms	1.44 (1.18-1.76)	1.82 (0.86-3.83)	1.41 (1.11-1.79)
Eating disorders	- Diabetes	2.92 (1.69-5.04)	12.82 (4.71-34.89)	1.97 (0.89-4.35)
Eating disorders	- Circulatory system dis.	1.97 (1.56-2.50)	2.95 (1.34-6.51)	1.89 (1.42-2.52)
Eating disorders	- Respiratory diseases	3.90 (2.90-5.25)	4.83 (1.58-14.78)	3.83 (2.69-5.46)
Eating disorders	- Digestive diseases	4.32 (2.96-6.30)	-	4.26 (2.72-6.67)
Eating disorders	- Alcohol misuse	5.12 (3.89-6.75)	6.10 (2.89-12.85)	4.95 (3.50-7.01)
Eating disorders	- Other causes	4.07 (3.46-4.78)	4.94 (2.65-9.18)	4.00 (3.30-4.84)
Personality disorders	All causes of death	2.26 (2.23-2.28)	2.52 (2.47-2.56)	2.08 (2.05-2.11)
Personality disorders	External causes	6.43 (6.24-6.63)	6.89 (6.58-7.21)	5.91 (5.61-6.23)
Personality disorders	- Suicide	9.06 (8.63-9.51)	7.37 (6.85-7.93)	12.64 (11.61-13.76)
Personality disorders	- Accidents	5.32 (5.11-5.54)	6.44 (6.06-6.84)	4.30 (4.01-4.61)
Personality disorders	- Homicide	5.58 (4.42-7.04)	7.98 (5.84-10.91)	2.99 (1.81-4.96)
Personality disorders	Natural causes	2.06 (2.04-2.09)	2.25 (2.20-2.29)	1.94 (1.91-1.97)
Personality disorders	- Infectious diseases	2.85 (2.62-3.10)	3.64 (3.17-4.18)	2.35 (2.05-2.69)
Personality disorders	- Neoplasms	1.44 (1.40-1.47)	1.46 (1.40-1.52)	1.42 (1.37-1.47)
Personality disorders	- Diabetes	2.46 (2.30-2.62)	2.77 (2.50-3.08)	2.20 (1.98-2.45)
Personality disorders	- Circulatory system dis.	1.80 (1.77-1.84)	1.99 (1.92-2.07)	1.69 (1.63-1.74)
Personality disorders	- Respiratory diseases	2.92 (2.83-3.01)	2.88 (2.73-3.05)	2.94 (2.82-3.08)
Personality disorders	- Digestive diseases	2.64 (2.50-2.78)	3.09 (2.81-3.39)	2.40 (2.22-2.59)
Personality disorders	- Alcohol misuse	5.74 (5.53-5.97)	5.49 (5.20-5.80)	6.26 (5.82-6.73)
Personality disorders	- Other causes	2.46 (2.39-2.53)	2.74 (2.61-2.87)	2.28 (2.19-2.38)
Intellectual disabilities	All causes of death	3.50 (3.38-3.62)	3.37 (3.20-3.56)	3.66 (3.46-3.87)
Intellectual disabilities	External causes	4.01 (3.55-4.52)	3.69 (3.10-4.39)	4.70 (3.74-5.90)
Intellectual disabilities	- Suicide	3.16 (2.50-3.99)	2.45 (1.74-3.47)	5.41 (3.56-8.20)
Intellectual disabilities	- Accidents	4.50 (3.90-5.19)	4.46 (3.65-5.46)	4.58 (3.47-6.03)
Intellectual disabilities	- Homicide	2.32 (0.87-6.21)	-	-
Intellectual disabilities	Natural causes	3.47 (3.35-3.59)	3.34 (3.16-3.53)	3.62 (3.42-3.84)
Intellectual disabilities	- Infectious diseases	4.63 (3.59-5.99)	4.89 (3.33-7.18)	4.33 (2.77-6.78)
Intellectual disabilities	- Neoplasms	1.42 (1.30-1.56)	1.26 (1.08-1.46)	1.61 (1.40-1.86)
Intellectual disabilities	- Diabetes	4.07 (3.32-4.98)	3.73 (2.73-5.11)	4.54 (3.24-6.36)
Intellectual disabilities	- Circulatory system dis.	3.24 (3.03-3.48)	3.04 (2.72-3.41)	3.47 (3.10-3.88)
Intellectual disabilities	- Respiratory diseases	4.84 (4.39-5.34)	5.00 (4.29-5.82)	4.68 (3.98-5.50)
Intellectual disabilities	- Digestive diseases	5.34 (4.57-6.22)	6.32 (5.01-7.97)	4.42 (3.38-5.78)
Intellectual disabilities	- Alcohol misuse	1.94 (1.57-2.41)	2.03 (1.54-2.68)	1.67 (0.99-2.84)
Intellectual disabilities	- Other causes	7.85 (7.38-8.34)	7.65 (6.94-8.42)	8.08 (7.30-8.95)
Developmental dis.	All causes of death	2.49 (2.24-2.77)	2.25 (1.94-2.60)	3.36 (2.69-4.19)
Developmental dis.	External causes	2.23 (1.79-2.79)	2.03 (1.53-2.71)	3.45 (2.00-5.94)
Developmental dis.	- Suicide	3.69 (2.70-5.05)	3.44 (2.32-5.09)	5.68 (2.44-13.25)

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Developmental dis.	- Accidents	1·60 (1·16-2·22)	1·37 (0·89-2·11)	2·93 (1·44-5·94)
Developmental dis.	- Homicide	-	-	-
Developmental dis.	Natural causes	2·65 (2·35-2·99)	2·36 (2·00-2·80)	3·55 (2·78-4·52)
Developmental dis.	- Infectious diseases	2·44 (1·09-5·44)	3·11 (1·24-7·78)	-
Developmental dis.	- Neoplasms	1·28 (0·97-1·71)	1·01 (0·66-1·54)	2·08 (1·26-3·43)
Developmental dis.	- Diabetes	1·93 (0·80-4·63)	1·48 (0·41-5·38)	-
Developmental dis.	- Circulatory system dis.	2·52 (1·89-3·37)	2·30 (1·54-3·43)	3·17 (1·78-5·65)
Developmental dis.	- Respiratory diseases	3·32 (2·16-5·10)	2·36 (1·20-4·64)	5·98 (2·95-12·13)
Developmental dis.	- Digestive diseases	8·67 (5·81-12·96)	9·79 (5·85-16·37)	6·06 (2·23-16·49)
Developmental dis.	- Alcohol misuse	1·30 (0·70-2·41)	1·22 (0·55-2·68)	-
Developmental dis.	- Other causes	4·14 (3·41-5·02)	3·68 (2·83-4·80)	5·78 (3·87-8·64)
Behavioral disorders	All causes of death	2·72 (2·60-2·85)	2·99 (2·79-3·19)	2·38 (2·19-2·59)
Behavioral disorders	External causes	4·34 (3·99-4·73)	4·38 (3·92-4·90)	4·22 (3·46-5·15)
Behavioral disorders	- Suicide	4·50 (3·87-5·23)	4·09 (3·35-4·99)	6·21 (4·47-8·63)
Behavioral disorders	- Accidents	4·29 (3·85-4·77)	4·52 (3·93-5·19)	3·64 (2·82-4·71)
Behavioral disorders	- Homicide	3·52 (2·13-5·81)	3·83 (2·03-7·23)	2·61 (0·71-9·57)
Behavioral disorders	Natural causes	2·38 (2·26-2·52)	2·52 (2·32-2·75)	2·23 (2·03-2·45)
Behavioral disorders	- Infectious diseases	2·74 (1·92-3·90)	2·41 (1·37-4·22)	3·20 (1·80-5·71)
Behavioral disorders	- Neoplasms	1·49 (1·33-1·68)	1·42 (1·17-1·71)	1·58 (1·31-1·91)
Behavioral disorders	- Diabetes	2·96 (2·18-4·02)	3·34 (2·15-5·19)	2·47 (1·39-4·41)
Behavioral disorders	- Circulatory system dis.	2·26 (2·02-2·53)	2·40 (1·99-2·88)	2·15 (1·80-2·57)
Behavioral disorders	- Respiratory diseases	3·13 (2·64-3·71)	2·94 (2·17-3·97)	3·28 (2·55-4·23)
Behavioral disorders	- Digestive diseases	3·17 (2·44-4·11)	4·64 (3·21-6·71)	2·00 (1·21-3·30)
Behavioral disorders	- Alcohol misuse	3·65 (3·04-4·39)	3·49 (2·73-4·47)	4·16 (2·78-6·22)
Behavioral disorders	- Other causes	3·01 (2·70-3·35)	3·28 (2·81-3·83)	2·64 (2·15-3·23)

Supplementary Table A5. Excess Life Years Lost due to specific causes of death for those with a diagnosis of each mental disorder compared to the general Danish population of the same sex and age. Estimates based on less than 3 cases are not shown.

Mental disorder	Cause of death	Life Years Lost (95% confidence interval)	
		Males	Females
Any disorder	All causes of death	10·06 (9·98;10·13)	7·06 (6·99;7·12)
Any disorder	External causes	3·30 (3·18;3·39)	1·45 (1·39;1·49)
Any disorder	- Suicide	1·54 (1·48;1·60)	0·74 (0·70;0·77)
Any disorder	- Accidents	1·69 (1·61;1·76)	0·68 (0·64;0·72)
Any disorder	- Homicide	0·07 (0·05;0·08)	0·02 (0·02;0·03)
Any disorder	Natural causes	6·76 (6·67;6·86)	5·61 (5·54;5·68)
Any disorder	- Infectious diseases	0·22 (0·20;0·24)	0·11 (0·10;0·13)
Any disorder	- Neoplasms	-0·43 (-0·51;-0·37)	0·16 (0·10;0·23)
Any disorder	- Diabetes	0·30 (0·27;0·33)	0·16 (0·15;0·19)
Any disorder	- Circulatory system dis.	0·90 (0·82;0·97)	1·24 (1·18;1·29)
Any disorder	- Respiratory diseases	0·68 (0·62;0·73)	0·96 (0·92;1·00)
Any disorder	- Digestive diseases	0·42 (0·39;0·46)	0·29 (0·26;0·32)
Any disorder	- Alcohol misuse	2·54 (2·49;2·62)	0·97 (0·93;1·01)
Any disorder	- Other causes	2·13 (2·05;2·19)	1·71 (1·65;1·77)
Organic disorders	All causes of death	6·95 (6·88;7·03)	5·42 (5·36;5·48)
Organic disorders	External causes	0·74 (0·66;0·83)	0·39 (0·34;0·44)
Organic disorders	- Suicide	0·20 (0·16;0·24)	0·10 (0·08;0·13)
Organic disorders	- Accidents	0·53 (0·47;0·60)	0·28 (0·25;0·32)
Organic disorders	- Homicide	0·01 (0·00;0·02)	0·01 (0·00;0·01)
Organic disorders	Natural causes	6·21 (6·09;6·32)	5·03 (4·95;5·10)
Organic disorders	- Infectious diseases	0·18 (0·15;0·23)	0·10 (0·08;0·12)
Organic disorders	- Neoplasms	-0·66 (-0·74;-0·57)	-0·20 (-0·26;-0·15)
Organic disorders	- Diabetes	0·30 (0·25;0·34)	0·11 (0·09;0·13)
Organic disorders	- Circulatory system dis.	2·09 (1·99;2·21)	1·96 (1·91;2·02)
Organic disorders	- Respiratory diseases	0·58 (0·51;0·65)	0·50 (0·45;0·55)
Organic disorders	- Digestive diseases	0·20 (0·16;0·24)	0·12 (0·10;0·16)
Organic disorders	- Alcohol misuse	0·98 (0·90;1·06)	0·33 (0·28;0·37)
Organic disorders	- Other causes	2·54 (2·45;2·64)	2·10 (2·01;2·16)
Substance use disorders	All causes of death	14·84 (14·70;14·99)	13·37 (13·20;13·56)
Substance use disorders	External causes	5·44 (5·24;5·63)	3·85 (3·66;4·02)
Substance use disorders	- Suicide	1·83 (1·72;1·92)	1·39 (1·29;1·49)
Substance use disorders	- Accidents	3·47 (3·30;3·62)	2·39 (2·24;2·53)
Substance use disorders	- Homicide	0·14 (0·11;0·17)	0·07 (0·05;0·11)
Substance use disorders	Natural causes	9·40 (9·21;9·57)	9·52 (9·36;9·72)
Substance use disorders	- Infectious diseases	0·33 (0·28;0·37)	0·28 (0·23;0·33)
Substance use disorders	- Neoplasms	-0·27 (-0·39;-0·15)	0·38 (0·24;0·51)
Substance use disorders	- Diabetes	0·22 (0·17;0·27)	0·16 (0·12;0·22)
Substance use disorders	- Circulatory system dis.	-0·19 (-0·29;-0·05)	0·51 (0·37;0·64)
Substance use disorders	- Respiratory diseases	0·87 (0·78;0·96)	1·71 (1·60;1·84)
Substance use disorders	- Digestive diseases	0·74 (0·67;0·81)	0·71 (0·61;0·79)

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Substance use disorders	- Alcohol misuse	5.70 (5.58;5.86)	3.90 (3.74;4.04)
Substance use disorders	- Other causes	2.00 (1.89;2.14)	1.87 (1.73;2.01)
Schizophrenia	All causes of death	12.06 (11.83;12.25)	9.37 (9.15;9.56)
Schizophrenia	External causes	4.84 (4.61;5.08)	2.63 (2.45;2.78)
Schizophrenia	- Suicide	2.28 (2.10;2.44)	1.48 (1.32;1.61)
Schizophrenia	- Accidents	2.49 (2.33;2.70)	1.13 (1.01;1.25)
Schizophrenia	- Homicide	0.06 (0.03;0.09)	0.02 (0.00;0.04)
Schizophrenia	Natural causes	7.22 (6.98;7.43)	6.74 (6.51;6.91)
Schizophrenia	- Infectious diseases	0.29 (0.22;0.35)	0.13 (0.09;0.16)
Schizophrenia	- Neoplasms	-0.99 (-1.17;-0.82)	-0.04 (-0.18;0.09)
Schizophrenia	- Diabetes	0.42 (0.34;0.49)	0.30 (0.24;0.36)
Schizophrenia	- Circulatory system dis.	0.90 (0.68;1.09)	1.32 (1.20;1.47)
Schizophrenia	- Respiratory diseases	1.15 (1.03;1.29)	1.42 (1.30;1.53)
Schizophrenia	- Digestive diseases	0.53 (0.44;0.61)	0.33 (0.25;0.40)
Schizophrenia	- Alcohol misuse	1.46 (1.33;1.60)	0.66 (0.56;0.74)
Schizophrenia	- Other causes	3.46 (3.25;3.66)	2.62 (2.46;2.78)
Mood disorders	All causes of death	7.91 (7.78;8.04)	6.22 (6.10;6.36)
Mood disorders	External causes	3.43 (3.28;3.56)	1.84 (1.72;1.92)
Mood disorders	- Suicide	2.31 (2.19;2.44)	1.19 (1.12;1.24)
Mood disorders	- Accidents	1.10 (1.00;1.18)	0.64 (0.58;0.71)
Mood disorders	- Homicide	0.03 (0.01;0.04)	0.01 (0.00;0.02)
Mood disorders	Natural causes	4.48 (4.33;4.63)	4.38 (4.27;4.51)
Mood disorders	- Infectious diseases	0.15 (0.11;0.18)	0.09 (0.07;0.12)
Mood disorders	- Neoplasms	-0.66 (-0.78;-0.54)	0.01 (-0.08;0.10)
Mood disorders	- Diabetes	0.33 (0.27;0.38)	0.14 (0.12;0.17)
Mood disorders	- Circulatory system dis.	0.71 (0.57;0.83)	0.88 (0.80;0.96)
Mood disorders	- Respiratory diseases	0.75 (0.65;0.82)	1.02 (0.95;1.09)
Mood disorders	- Digestive diseases	0.28 (0.23;0.34)	0.29 (0.25;0.33)
Mood disorders	- Alcohol misuse	1.50 (1.41;1.58)	0.69 (0.64;0.75)
Mood disorders	- Other causes	1.42 (1.30;1.54)	1.25 (1.17;1.32)
Neurotic disorders	All causes of death	8.59 (8.42;8.75)	6.60 (6.47;6.72)
Neurotic disorders	External causes	3.52 (3.36;3.66)	1.68 (1.60;1.75)
Neurotic disorders	- Suicide	2.01 (1.91;2.13)	0.93 (0.87;0.98)
Neurotic disorders	- Accidents	1.45 (1.34;1.55)	0.72 (0.66;0.78)
Neurotic disorders	- Homicide	0.05 (0.04;0.07)	0.03 (0.02;0.05)
Neurotic disorders	Natural causes	5.07 (4.90;5.20)	4.92 (4.80;5.04)
Neurotic disorders	- Infectious diseases	0.18 (0.13;0.22)	0.11 (0.08;0.13)
Neurotic disorders	- Neoplasms	-0.27 (-0.40;-0.15)	0.42 (0.31;0.54)
Neurotic disorders	- Diabetes	0.28 (0.20;0.33)	0.14 (0.10;0.17)
Neurotic disorders	- Circulatory system dis.	0.30 (0.18;0.41)	0.49 (0.40;0.57)
Neurotic disorders	- Respiratory diseases	0.87 (0.77;0.99)	1.33 (1.24;1.41)
Neurotic disorders	- Digestive diseases	0.34 (0.29;0.41)	0.34 (0.30;0.40)
Neurotic disorders	- Alcohol misuse	2.05 (1.95;2.18)	1.00 (0.94;1.08)
Neurotic disorders	- Other causes	1.32 (1.20;1.44)	1.10 (1.01;1.19)
Eating disorders	All causes of death	11.62 (7.34;16.05)	8.81 (7.44;10.17)

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Eating disorders	External causes	4.40 (1.72;8.39)	2.10 (1.47;2.84)
Eating disorders	- Suicide	2.85 (0.99;5.19)	1.29 (0.82;1.78)
Eating disorders	- Accidents	1.58 (-0.15;4.85)	0.79 (0.38;1.39)
Eating disorders	- Homicide	-	-
Eating disorders	Natural causes	7.23 (1.17;12.22)	6.71 (5.29;8.16)
Eating disorders	- Infectious diseases	-	0.09 (-0.15;0.38)
Eating disorders	- Neoplasms	-0.60 (-3.52;3.02)	-0.65 (-1.63;0.47)
Eating disorders	- Diabetes	0.85 (-0.13;2.40)	0.05 (-0.17;0.31)
Eating disorders	- Circulatory system dis.	-0.12 (-4.11;4.74)	0.28 (-0.97;1.46)
Eating disorders	- Respiratory diseases	0.98 (-1.51;4.94)	1.46 (0.55;2.60)
Eating disorders	- Digestive diseases	-	0.81 (0.22;1.59)
Eating disorders	- Alcohol misuse	2.13 (0.51;4.47)	1.10 (0.55;1.89)
Eating disorders	- Other causes	3.65 (0.48;7.76)	3.57 (2.61;4.61)
Personality disorders	All causes of death	10.67 (10.43;10.88)	7.97 (7.83;8.14)
Personality disorders	External causes	4.75 (4.52;4.97)	2.39 (2.25;2.50)
Personality disorders	- Suicide	1.96 (1.83;2.09)	1.25 (1.15;1.34)
Personality disorders	- Accidents	2.68 (2.49;2.86)	1.12 (1.03;1.22)
Personality disorders	- Homicide	0.12 (0.08;0.15)	0.02 (0.01;0.03)
Personality disorders	Natural causes	5.92 (5.67;6.13)	5.58 (5.47;5.76)
Personality disorders	- Infectious diseases	0.27 (0.21;0.34)	0.15 (0.11;0.19)
Personality disorders	- Neoplasms	-0.47 (-0.61;-0.28)	0.18 (0.05;0.34)
Personality disorders	- Diabetes	0.31 (0.24;0.37)	0.21 (0.17;0.27)
Personality disorders	- Circulatory system dis.	0.17 (0.00;0.34)	0.62 (0.51;0.74)
Personality disorders	- Respiratory diseases	0.95 (0.84;1.08)	1.38 (1.29;1.49)
Personality disorders	- Digestive diseases	0.46 (0.39;0.53)	0.42 (0.35;0.48)
Personality disorders	- Alcohol misuse	2.55 (2.42;2.70)	1.20 (1.12;1.29)
Personality disorders	- Other causes	1.68 (1.54;1.83)	1.40 (1.27;1.52)
Intellectual disabilities	All causes of death	13.01 (12.41;13.50)	13.66 (13.00;14.27)
Intellectual disabilities	External causes	1.97 (1.44;2.42)	1.41 (1.00;1.79)
Intellectual disabilities	- Suicide	0.37 (0.15;0.62)	0.50 (0.25;0.74)
Intellectual disabilities	- Accidents	1.58 (1.08;1.98)	0.86 (0.50;1.19)
Intellectual disabilities	- Homicide	-	-
Intellectual disabilities	Natural causes	11.04 (10.36;11.68)	12.25 (11.51;12.94)
Intellectual disabilities	- Infectious diseases	0.38 (0.18;0.64)	0.23 (0.09;0.43)
Intellectual disabilities	- Neoplasms	-1.72 (-2.24;-1.23)	-0.44 (-1.01;0.11)
Intellectual disabilities	- Diabetes	0.42 (0.19;0.67)	0.38 (0.16;0.61)
Intellectual disabilities	- Circulatory system dis.	1.18 (0.64;1.75)	2.39 (1.79;2.88)
Intellectual disabilities	- Respiratory diseases	1.88 (1.42;2.32)	1.70 (1.31;2.20)
Intellectual disabilities	- Digestive diseases	1.18 (0.87;1.50)	0.66 (0.37;0.95)
Intellectual disabilities	- Alcohol misuse	0.39 (0.08;0.62)	0.11 (-0.07;0.27)
Intellectual disabilities	- Other causes	7.32 (6.65;8.05)	7.22 (6.49;8.03)
Developmental disorders	All causes of death	6.76 (5.18;8.17)	11.76 (9.57;14.08)
Developmental disorders	External causes	0.23 (-0.30;0.98)	1.36 (0.36;2.76)
Developmental disorders	- Suicide	0.34 (-0.02;0.71)	0.34 (-0.14;0.99)
Developmental disorders	- Accidents	-0.12 (-0.56;0.39)	1.04 (0.29;2.33)

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Developmental disorders	- Homicide	-	-
Developmental disorders	Natural causes	6.52 (4.88;7.95)	10.40 (8.09;12.58)
Developmental disorders	- Infectious diseases	0.62 (-0.21;1.99)	-
Developmental disorders	- Neoplasms	-2.13 (-3.93;-0.08)	1.01 (-1.87;3.40)
Developmental disorders	- Diabetes	0.18 (-0.48;1.67)	-
Developmental disorders	- Circulatory system dis.	-0.11 (-2.03;1.92)	1.68 (-1.15;4.65)
Developmental disorders	- Respiratory diseases	0.82 (-0.75;2.25)	2.05 (0.04;4.43)
Developmental disorders	- Digestive diseases	1.89 (0.67;3.40)	0.89 (-0.36;2.25)
Developmental disorders	- Alcohol misuse	0.02 (-0.59;0.84)	-
Developmental disorders	- Other causes	5.22 (2.99;7.94)	4.49 (1.58;7.40)
Behavioral disorders	All causes of death	9.88 (8.97;10.61)	8.62 (7.90;9.50)
Behavioral disorders	External causes	3.50 (2.81;4.15)	2.03 (1.55;2.56)
Behavioral disorders	- Suicide	1.15 (0.77;1.55)	0.75 (0.46;1.23)
Behavioral disorders	- Accidents	2.25 (1.76;2.78)	1.26 (0.88;1.71)
Behavioral disorders	- Homicide	0.10 (0.00;0.24)	0.01 (-0.02;0.06)
Behavioral disorders	Natural causes	6.38 (5.44;7.36)	6.59 (5.81;7.49)
Behavioral disorders	- Infectious diseases	0.07 (-0.10;0.29)	0.34 (0.10;0.67)
Behavioral disorders	- Neoplasms	-0.23 (-1.12;0.66)	0.59 (-0.20;1.58)
Behavioral disorders	- Diabetes	0.17 (-0.11;0.54)	0.19 (-0.06;0.45)
Behavioral disorders	- Circulatory system dis.	0.50 (-0.44;1.32)	0.86 (0.15;1.61)
Behavioral disorders	- Respiratory diseases	0.87 (0.20;1.64)	1.71 (1.09;2.27)
Behavioral disorders	- Digestive diseases	0.73 (0.23;1.15)	0.23 (-0.01;0.57)
Behavioral disorders	- Alcohol misuse	1.76 (1.20;2.39)	0.88 (0.50;1.24)
Behavioral disorders	- Other causes	2.51 (1.74;3.27)	1.80 (1.20;2.46)