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Risk of suicide according to level of psychiatric treatment: a nationwide nested case–control study

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Abstract

Purpose Knowledge of the epidemiology of suicide is a necessary prerequisite of suicide prevention. We aimed to conduct a nationwide study investigating suicide risk in relation to level of psychiatric treatment.

Methods Nationwide nested case–control study comparing individuals who died from suicide between 1996 and 2009 to age-, sex-, and year-matched controls. Psychiatric treatment in the previous year was graded as "no treatment," "medicated," "outpatient contact," "psychiatric emergency room contact," or "admitted to psychiatric hospital."

Results There were 2,429 cases and 50,323 controls. Compared with people who had not received any psychiatric treatment in the preceding year, the adjusted rate ratio (95 % confidence interval) for suicide was 5.8 (5.2–6.6) for people receiving only psychiatric medication, 8.2 (6.1–11.0) for people with at most psychiatric outpatient contact, 27.9 (19.5–40.0) for people with at most psychiatric emergency room contacts, and 44.3 (36.1–54.4) for people who had been admitted to a psychiatric hospital. The gradient was steeper for married or cohabiting people, those with higher socioeconomic position, and possibly those without a history of attempted suicide.

Conclusions Psychiatric admission in the preceding year was highly associated with risk of dying from suicide. Furthermore, even individuals who have been in contact with psychiatric treatment but who have not been admitted are at highly increased risk of suicide.

Keywords Suicide · Mental health services · Population registers · Mental disorders

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Introduction

An estimated million people die each year from suicide, accounting for approximately two percent of the global burden of disease [1]. Mental disorders are consistently and strongly associated with both suicide and deliberate self-harm [2–5]. Increased risks have been observed related to various psychiatric diagnoses, such as affective, psychotic, and personality disorders. Studies have shown that the risk of suicide and intentional self-harm is higher during admission to a psychiatric ward and immediately following discharge [6–8].

In psychiatric populations, the risk of suicide has been found to be increased for men, increasing age, higher education, people who are married or cohabiting, having a diagnosis of an affective disorder or personality disorder, and increasing number of psychiatric hospitalizations [8–11]. However, most patients even with these attributes do not die from suicide. Being further able to identify patients at increased risk of suicide is thus still important, with the ultimate goal of being able to prevent more suicide-related deaths than what is possible today.

The association between psychiatric treatment and risk of suicide has not been fully explored. On an individual level, presumably risk of suicide would be decreased by receiving psychiatric treatment. On a population level, however, inpatient psychiatric treatment is a known risk factor for suicide. At present, it is not well established to what degree patients receiving other types of psychiatric treatment are at risk of suicide. One possibility is that there exists a minimum degree of psychiatric treatment below which people are not at increased risk of suicide. Another possibility is that there exists a dose–response relationship, i.e., suicide risk differs according to a graded level of contact with mental health services. In this case, while psychiatric hospitalization may be associated with the highest risk of suicide, people receiving psychiatric emergency room or outpatient treatment would also be at increased risk of suicide. A third possibility would be that even those who are not admitted to psychiatric hospitals have as high risk of suicide as those who become hospitalized, which would probably indicate severe under-treatment of mentally ill populations. The national Danish registers provide a unique possibility to grade the population in this manner.

Aims of the study

We aimed to investigate the relative risk of suicide according to the various types of contacts with the psychiatric system, as a potential indicator of missed opportunities for suicide prevention. Secondly, we aimed to investigate whether such a dose–response relationship, if found, interacted with potential risk factors for suicide.

Methods

Population

This was a case–control study nested in nationwide Danish registers. All people with permanent residence in Denmark have been given a unique personal identification number in The Danish Central Persons Registry since 1968, including people already alive at the time of the register's inception [12]. From this dynamic cohort, a comprehensive register with a random sample of 25 % of people living in Denmark has previously been constructed. We linked this to the Cause of Death register [13] to identify all deaths from suicide from 1995 to 2009. For each case, we included approximately 20 controls (occasionally, it was difficult to match to exactly 20). Using a variable number of controls with each stratum has been shown be a valid approach [14]. Controls were matched to cases individually on sex, date of birth, but being alive at the date when the case died from suicide (match

date). We did not include people with concurrent death from other causes as controls, which would have yielded so-called proportional mortality ratios. It is well established that proportional mortality analyses might be unreliable or even seriously biased because they lack information on persons at risk [15, 16]. We selected a relatively high number of controls per case to reduce variance.

Psychiatric variables

We obtained information from the Psychiatric Central Research Register [17] regarding psychiatric contacts in the year prior to the match date, as well as previous history. This register contains information on all publically paid psychiatric treatment, amounting to the vast majority of treatment in Denmark. Information regarding visits to private psychiatrists was not available from the register. Further information was obtained from the Danish National Prescription Registry regarding redeemed prescriptions (antipsychotics, antidepressants, or lithium, henceforth termed psychiatric medication) [18].

This information was graded (1) people having no psychiatric contacts and not receiving psychiatric medication; (2) people having no psychiatric contacts, but receiving psychiatric medication; (3) people having only outpatient psychiatric contacts; (4) people having psychiatric emergency room contacts, but no psychiatric hospital admissions; and (5) people having psychiatric hospital admissions. Information regarding cohabitation status, income, and education was taken from the Integrated Database for Labor Market Research which is updated once yearly and thus retrospective to the suicide or match date [19].

We did not have data on lifetime psychiatric diagnosis. Instead, the diagnosis at the latest psychiatric contact was categorized as psychosis (ICD-8: 295, 297, 298.29, 298.39, 298.89, 298.99, 299.05, 299.09, 301.09, and 301.29; ICD-10: Chapter F2); affective disorder (ICD-8: 296.09, 296.29, 298.09, and 300.49; ICD-10: Chapter F3); or other.

Previous suicide attempts

Information regarding previous suicide attempts was only complete until May 2007. For this reason, we also conducted analyses restricted to match dates in 2006 or earlier. This had no appreciable impact on results, and we thus present only results on the full set of cases and controls. Suicide attempts were defined as: any contact with a medical or psychiatric ward with the reason for contact given as E4 (suicide attempt), and an ICD-10 diagnostic code of S617–S619 (open wound of wrist and hand), T36x–T60x, T65 (poisoning/toxic effects by drug, substances, etc.) or X60x–X84x (intentional self-harm). Presence of an F (psychiatric) action diagnosis combined with T36x–T50x (poisoning by drugs),

Table 1 Characteristics of the study population

	Controls	Cases	Total
Level of psychiatric treatment preceding year[a]			
No psychiatric treatment	46,512 (92.4 %)	1,141 (47.0 %)	47,653 (90.3 %)
Psychiatric medication only	3,276 (6.5 %)	644 (26.5 %)	3,920 (7.4 %)
At most outpatient treatment	218 (0.4 %)	91 (3.8 %)	309 (0.6 %)
At most emergency room treatment	91 (0.2 %)	83 (3.4 %)	174 (0.3 %)
Psychiatric hospitalization	223 (0.4 %)	470 (19.4 %)	693 (1.3 %)
Lifetime history of…[b]			
Psychiatric medication[c]	6,510 (12.9 %)	1,398 (57.6 %)	7,908 (15.0 %)
Psychiatric outpatient treatment	1,546 (3.1 %)	683 (28.1 %)	2,229 (4.2 %)
Psychiatric emergency room treatment	817 (1.6 %)	498 (20.5 %)	1,315 (2.5 %)
Psychiatric hospitalization	2,475 (4.9 %)	965 (39.7 %)	3,440 (6.5 %)
Relationship status			
Married or cohabiting	33,416 (66.4 %)	1,069 (44.0 %)	34,485 (65.4 %)
Single	16,563 (32.9 %)	1,343 (55.3 %)	17,906 (34.0 %)
Unknown relationship status[d]	341 (0.7 %)	17 (0.7 %)	358 (0.7 %)
Personal income			
Highest income quartile	12,563 (25.0 %)	390 (16.1 %)	12,953 (24.6 %)
Second-highest income quartile	12.613 (25.1 %)	456 (18.8 %)	13,069 (24.8 %)
Second-lowest income quartile	12,635 (25.1 %)	558 (23.0 %)	13,193 (25.0 %)
Lowest income quartile	12,418 (24.7 %)	1,023 (42.1 %)	13,441 (25.5 %)
Unknown income[d]	91 (0.2 %)	2 (0.1 %)	93 (0.2 %)
Highest completed level of education			
Master's degree	2,728 (5.4 %)	89 (3.7 %)	2,817 (5.3 %)
Bachelor's degree	7,689 (15.3 %)	264 (10.9 %)	7,953 (15.1 %)
High school	3,000 (6,0 %)	111 (4.6 %)	3,111 (5.9 %)
Vocational education	17,991 (35.8 %)	729 (30.0 %)	18,720 (35.5 %)
Primary school only	16,152 (32.1 %)	955 (39.3 %)	17,107 (32.4 %)
Unknown education[d]	2,760 (5.5 %)	281 (11.6 %)	3,041 (5.8 %)
Country of birth			
Denmark	46,317 (92.0 %)	2,286 (94.1 %)	48,603 (92.1 %)
Greenland	102 (0.2 %)	12 (0.5 %)	114 (0.2 %)
Faroe islands	104 (0.2 %)	1 (0.0 %)	105 (0.2 %)
Other countries	3,530 (7.0 %)	118 (4.9 %)	3,648 (6.9 %)
Unknown country of birth[d]	267 (0.5 %)	12 (0.5 %)	279 (0.5 %)
Previous suicide attempts			
Attempted suicide last year	49 (0.1 %)	250 (10.3 %)	299 (0.6 %)
Ever attempted suicide	875 (1.7 %)	578 (23.8 %)	1,453 (2.8 %)

N (%). Cases are individuals who died from suicide; controls are matched on sex, age, and calendar year

[a] Variable ordered hierarchically

[b] Distinct categories meaning that a person can be in more than one category

[c] Antipsychotics, antidepressants, or lithium

[d] Undeterminable from registers

T52x–T60x (poisoning effects by substances), S51x, S55x, S59x, S61x, S65x, or S69x (forearm, wrist, or hand injuries) was also considered a previous suicide attempt, as was a diagnostic code of X60x–X84x (suicide attempt) given at a psychiatric department [20].

Statistics and analyses

We conducted conditional logistic regression using Stata MP 10.0. It is well established that the (incidence) rate ratio, i.e., the ratio between two hazard rates, can be estimated by using a conditional logistic regression stratified on the case-based risk sets [14, 21, 22]. As controls were matched on sex, age, and calendar year, analyses were automatically adjusted for these covariates. Our primary focus was the level of psychiatric contact in the year preceding the match date. Since outpatient contacts were only available from 1995, we investigated suicides from 1996 and on in order to have a full year of retrospective psychiatric assessment.

We performed both univariable and multivariable conditional logistic regression models. The latter was adjusted for marital status (married/cohabiting vs. single); income

(divided into age-, sex-, and year population-based quartiles); degree of education; and country of birth. Finally, two-way interaction terms between level of psychiatric treatment and the individual covariates were tested. When these interaction terms were statistically significant, analyses were repeated within strata of these covariates.

Ethics

Register-based studies in Denmark do not require the approval of a review board. The Danish Data Protection Agency approved the use of data for the present study. The authors did not have access to information that would allow identification of single individuals outside the registers.

Results

A total of 2,429 people who died from suicide (cases) were matched to 50,320 controls. Mean (SD) age among cases was 53.7 (18.7) years, and 71.8 % were men. Among people who died from suicide (cases), 53.0 % had received some sort of psychiatric treatment in the preceding year. The same was true for only 7.6 % of the controls. Other baseline characteristics of the sample are shown in Table 1. The prevalence of having ever (while the register existed) used antipsychotics was 5.8, 12.7 % for antidepressants, and 0.5 % for lithium.

Table 2 shows results from conditional logistic regression analyses of the association between dying from suicide and level of contact with the psychiatric system in the preceding year. The association was statistically significant ($p < 0.001$). In univariable analyses, compared with people not having received psychiatric treatment in the preceding year, the rate ratio (RR) for suicide was 7.8 (95 % confidence interval (CI) 7.0–8.8) for people receiving only psychiatric medication in the preceding year, 15.7 (95 % CI 12.0–20.6) for people receiving at most psychiatric outpatient treatment, 46.5 (95 % CI 33.6–64.5) for people receiving at most psychiatric emergency room treatment, and 94.4 (95 % CI 78.6–113.4) for people who had received psychiatric hospitalization in the preceding year. While adjustment for other risk factors decreased these rate ratios somewhat, they were still very high in the multivariable analysis.

Among people with at most psychiatric emergency room contact in the preceding year and who died from suicide, 21 % died within a week of the last emergency room visit, 28 % within 2 weeks, and 50 % within 38 days. In comparison, among people who had been admitted to a psychiatric hospital in the preceding year and who died from suicide, 31 % died within a week of discharge, 37 % within 2 weeks, and 50 % within 35 days.

Patients who had some psychiatric contact or medication but not in the previous year had a RR of 4.0 (3.4–4.6) for suicide compared to those who had never had any psychiatric contact. A total of 4,134 (8.2 %) of controls and 303 (12.5 %) of those dying from suicide fitted into this category. Compared with patients in this new category, the RR for suicide was 2.6 (2.2–3.0) for people who had only received psychiatric medication in the preceding year, 4.9 (3.7–6.6) for people with only psychiatric outpatient contacts, 14.7 (10.5–20.8) for patients with emergency room visits, and 30.1 (24.4–37.2) for patients who had been admitted at least once in the preceding year.

Table 2 also shows both associations between various potential risk factors and suicide. In univariable analyses, single people were more likely to die from suicide than those married or cohabiting [RR 2.7 (2.5–2.9), $p < 0.001$]. Rates of suicide increased as income or education decreased ($p < 0.001$), and with proximity (if any) of a previous suicide attempt ($p < 0.001$). People from Greenland had higher rates of suicide than people born in Denmark, but people born in other countries had slightly lower rates of suicide than Danes. Several variables had missing values, and these appeared to constitute special groups of individuals, as their risk of suicide was often significantly increased. In the multivariable model, educational achievement was no longer a significant predictor of dying from suicide ($p = 0.55$).

The association between increased level of psychiatric treatment and risk of suicide was found to differ between subgroups, as indicated by two-way interaction tests. Figure 1 shows, for the different subgroups, the association between level of psychiatric treatment and risk of suicide, as rate ratios. While the risk of suicide was larger for single people, the association between level of psychiatric treatment and suicide was smaller for single people than for those who were married or cohabiting ($p < 0.001$); similarly, risk of suicide was larger among people in the lowest quartile of income, but the association between psychiatric treatment and suicide was smaller in this group than in other income groups ($p < 0.001$); a similar tendency was observed for education ($p < 0.001$), where the association between level of psychiatric treatment and risk of suicide was different in those with at least high school compared to the rest of the population. A previous history of attempted suicide also interacted significantly with level of psychiatric treatment ($p < 0.001$). In other words, the dose–response association between level of psychiatric treatment and risk of dying from suicide is steeper within the subgroups at relatively lower risk of suicide (as evident in Table 2).

Among people who died from suicide, 229 (8.6 %) had a diagnosis of psychosis at their most recent psychiatric treatment, compared with 504 (0.9 %) of controls. Corresponding figures for affective disorders were 402 (15.1 %)

Table 2 Univariable and multivariable predictors of suicide in Denmark 1996–2009

	Univariable analyses		Multivariable analysis[a]	
	Rate ratio (95 % CI)	p	Rate ratio (95 % CI)	p
Level of psychiatric treatment preceding year[b]				
No psychiatric treatment	1 (ref.)	p < 0.001	1 (ref.)	p < 0.001
Psychiatric medication only[c]	7.8 (7.0–8.8)		5.8 (5.2–6.6)	
At most outpatient treatment	15.7 (12.0–20.6)		8.2 (6.1–11.0)	
At most emergency room treatment	46.5 (33.6–64.5)		27.9 (19.5–40.0)	
Psychiatric hospitalization	94.4 (78.6–113.4)		44.3 (36.1–54.4)	
Relationship status				
Married or cohabiting	1 (ref.)	p < 0.001	1 (ref.)	p < 0.001
Single	2.7 (2.5–2.9)		1.7 (1.5–1.9)	
Unknown relationship status[d]	2.0 (1.2–3.3)		1.7 (0.91–3.2)	
Personal income				
Highest income quartile	1 (ref.)	p < 0.001	1 (ref.)	p < 0.001
Second-highest income quartile	1.2 (1.0–1.3)		1.1 (0.92–1.3)	
Second-lowest income quartile	1.4 (1.2–1.6)		1.1 (0.97-1.3)	
Lowest income quartile	2.7 (2.4–3.1)		1.5 (1.3–1.8)	
Unknown income[d]	0.5 (0.1–2.7)		0.32 (0.06–1.7)	
Highest completed level of education				
Master's degree	1 (ref.)	p < 0.001	1 (ref.)	p = 0.55
Bachelor's degree	1.1 (0.8–1.4)		0.93 (0.70–1.2)	
High school	1.2 (0.9–1.6)		0.76 (0.54–1.1)	
Vocational education	1.2 (1.0–1.5)		0.96 (0.74–1.3)	
Primary school only	1.6 (1.3–2.1)		0.94 (0.72–1.2)	
Unknown education[d]	15 (1.1–2.1)		0.91 (0.60–1.4)	
Country of birth				
Denmark	1 (ref.)	p < 0.001	1 (ref.)	p = 0.004
Greenland	2.7 (1.5–4.9)		2.2 (1.1–4.4)	
Faroe islands	0.2 (0.0–1.5)		0.11 (0.01–1.1)	
Other countries	0.8 (0.6–0.9)		0.78 (0.62–0.97)	
Unknown country of birth[d]	0.8 (0.5–1.5)		0.89 (0.47–1.7)	
Previous suicide attempts				
Attempted suicide last year	12.2 (8.6–17.2)	p < 0.001	7.1 (4.7–10.8)	p < 0.001
Attempted suicide previously	1 (ref.)		1 (ref.)	
Never attempted suicide	0.09 (0.07–0.10)		0.24 (0.20–0.29)	

[a] All variables mutually adjusted for each other

[b] Variable ordered hierarchically

[c] Antipsychotics, antidepressants, or lithium

[d] Undeterminable from registers

versus 732 (1.3 %), and for other psychiatric diagnoses 591 (22.2 %) versus 2,480 (4.5 %) (all $p < 0.001$). The level of psychiatric treatment in the preceding year interacted significantly with the last known diagnosis observed in the registers ($p < 0.001$). Figure 2 shows, within each level of psychiatric treatment, the risk of dying from suicide for different diagnostic groups. All figures are compared to the reference group of people who had not received any psychiatric treatment in the preceding year and had not received a psychiatric diagnosis while the psychiatric registers existed. For those who had not been treated in the preceding year, or had been so only with psychiatric medication, there was no differential risk of suicide according to the last known diagnosis ($p = 0.15$ or $p = 0.30$, respectively). For those receiving at most outpatient treatment, risk of suicide was elevated by nearly a factor 30 for people with a diagnosis of psychotic or affective disorders, compared to a factor 12 for people with other psychiatric diagnoses.

Discussion

Increasing levels of psychiatric treatment in the preceding year were associated with increased rates of suicide. The risk was highest among people with at least one psychiatric
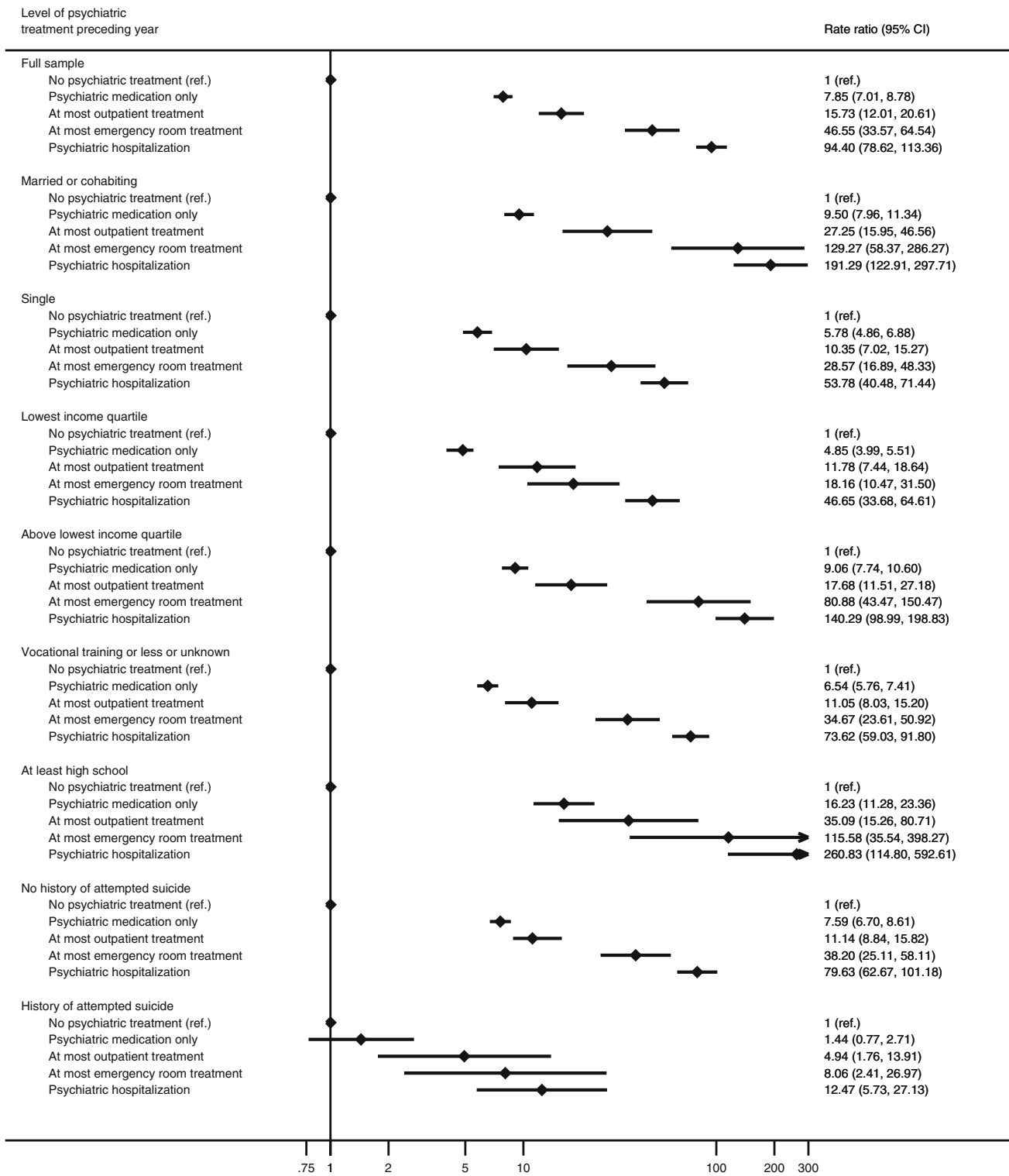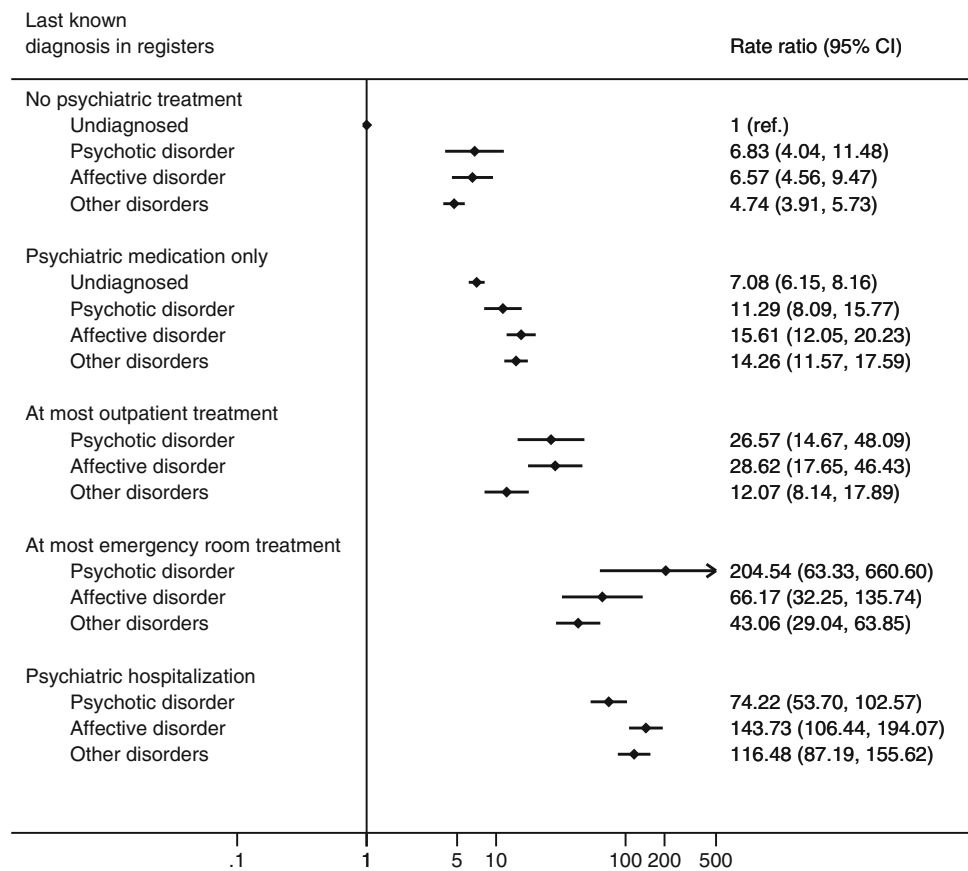
Level of psychiatric
treatment preceding year

Rate ratio (95% CI)

Full sample
No psychiatric treatment (ref.)   1 (ref.)
Psychiatric medication only   7.85 (7.01, 8.78)
At most outpatient treatment   15.73 (12.01, 20.61)
At most emergency room treatment   46.55 (33.57, 64.54)
Psychiatric hospitalization   94.40 (78.62, 113.36)

Married or cohabiting
No psychiatric treatment (ref.)   1 (ref.)
Psychiatric medication only   9.50 (7.96, 11.34)
At most outpatient treatment   27.25 (15.95, 46.56)
At most emergency room treatment   129.27 (58.37, 286.27)
Psychiatric hospitalization   191.29 (122.91, 297.71)

Single
No psychiatric treatment (ref.)   1 (ref.)
Psychiatric medication only   5.78 (4.86, 6.88)
At most outpatient treatment   10.35 (7.02, 15.27)
At most emergency room treatment   28.57 (16.89, 48.33)
Psychiatric hospitalization   53.78 (40.48, 71.44)

Lowest income quartile
No psychiatric treatment (ref.)   1 (ref.)
Psychiatric medication only   4.85 (3.99, 5.51)
At most outpatient treatment   11.78 (7.44, 18.64)
At most emergency room treatment   18.16 (10.47, 31.50)
Psychiatric hospitalization   46.65 (33.68, 64.61)

Above lowest income quartile
No psychiatric treatment (ref.)   1 (ref.)
Psychiatric medication only   9.06 (7.74, 10.60)
At most outpatient treatment   17.68 (11.51, 27.18)
At most emergency room treatment   80.88 (43.47, 150.47)
Psychiatric hospitalization   140.29 (98.99, 198.83)

Vocational training or less or unknown
No psychiatric treatment (ref.)   1 (ref.)
Psychiatric medication only   6.54 (5.76, 7.41)
At most outpatient treatment   11.05 (8.03, 15.20)
At most emergency room treatment   34.67 (23.61, 50.92)
Psychiatric hospitalization   73.62 (59.03, 91.80)

At least high school
No psychiatric treatment (ref.)   1 (ref.)
Psychiatric medication only   16.23 (11.28, 23.36)
At most outpatient treatment   35.09 (15.26, 80.71)
At most emergency room treatment   115.58 (35.54, 398.27)
Psychiatric hospitalization   260.83 (114.80, 592.61)

No history of attempted suicide
No psychiatric treatment (ref.)   1 (ref.)
Psychiatric medication only   7.59 (6.70, 8.61)
At most outpatient treatment   11.14 (8.84, 15.82)
At most emergency room treatment   38.20 (25.11, 58.11)
Psychiatric hospitalization   79.63 (62.67, 101.18)

History of attempted suicide
No psychiatric treatment (ref.)   1 (ref.)
Psychiatric medication only   1.44 (0.77, 2.71)
At most outpatient treatment   4.94 (1.76, 13.91)
At most emergency room treatment   8.06 (2.41, 26.97)
Psychiatric hospitalization   12.47 (5.73, 27.13)

.75   1   2   5   10   100 200 300

Fig. 1 Risk of suicide according to level of psychiatric treatment: overall and within subgroups

admission in the preceding year. However, even people receiving only psychiatric medication, psychiatric outpatient treatment, or psychiatric emergency room treatment were at a severely increased risk of dying from suicide compared with the background population. The public health significance of this finding may be considerable.

Fig. 2 Risk of suicide according to diagnosis within hierarchical groups of psychiatric treatment

Last known diagnosis in registers		Rate ratio (95% CI)
No psychiatric treatment		
Undiagnosed		1 (ref.)
Psychotic disorder		6.83 (4.04, 11.48)
Affective disorder		6.57 (4.56, 9.47)
Other disorders		4.74 (3.91, 5.73)
Psychiatric medication only		
Undiagnosed		7.08 (6.15, 8.16)
Psychotic disorder		11.29 (8.09, 15.77)
Affective disorder		15.61 (12.05, 20.23)
Other disorders		14.26 (11.57, 17.59)
At most outpatient treatment		
Psychotic disorder		26.57 (14.67, 48.09)
Affective disorder		28.62 (17.65, 46.43)
Other disorders		12.07 (8.14, 17.89)
At most emergency room treatment		
Psychotic disorder		204.54 (63.33, 660.60)
Affective disorder		66.17 (32.25, 135.74)
Other disorders		43.06 (29.04, 63.85)
Psychiatric hospitalization		
Psychotic disorder		74.22 (53.70, 102.57)
Affective disorder		143.73 (106.44, 194.07)
Other disorders		116.48 (87.19, 155.62)

.1   1   5   10   100 200   500

Presumably, although at a population level, psychiatric hospitalization increases risk of suicide, at the individual level, risk of suicide must be reduced by such treatment. It is thus possible that the very high rates of suicide among individuals who have received only, e.g., psychiatric outpatient treatment could be reduced by outpatient identification of this risk with subsequent hospitalization. This potential is further underlined by the apparent vicinity of outpatient psychiatric treatment to the suicide. In the group of people who died from suicide and had received psychiatric emergency room treatment in the preceding year without being hospitalized, one in five died from suicide within a week of discharge from the psychiatric emergency room, and half within 38 days.

The association or gradient between level of psychiatric treatment and risk of suicide was lower among single people, those with lower incomes or levels of education, and those with a history of attempted suicide. These are generally the groups at higher overall risk of suicide. One explanation for this could be that in groups with higher risk of suicide, the association with psychiatric treatment becomes limited by a ceiling effect.

Suicide rates among people born in Greenland were higher than among people born in Denmark. People from Greenland living in Denmark are known to have adverse health outcomes on a number of important measures, including suicide [23–25]. As such, this secondary finding is not unexpected, but highlights the need of giving special attention to ethnic minorities.

Several other studies have shown that suicide risk is increased in people with a history of mental illness and psychiatric hospitalizations [2–7]. It would probably be wrong to conclude that the treatment causally increases risk of suicide—presumably, effective treatment would decrease the risk of an individual dying from suicide compared to a scenario in which that person did not receive treatment. Rather, the association is likely one of selection, in that people with increasing levels of psychiatric contact also are more severely at risk of dying from suicide. As such, our results could indicate that the psychiatric treatment system successfully identifies people who require treatment. While this would imply that people who have been psychiatrically hospitalized are an important group for suicide prevention, the gradient also reveals that other groups of people require attention in order to prevent suicide. This indicates a need to focus on suicidal behavior both within outpatient clinics and general practitioners. While affective disorders appeared to be slightly more linked to risk of suicide than other disorders, our results indicate that all diagnostic groups should be considered for

risk of suicide. Finally, it should be noted that risk of suicide is also extremely elevated among people receiving only psychiatric emergency room or outpatient treatment. This indicates that an important area of focus should be to ensure proper treatment for patients at risk of suicide being treated at psychiatric emergency rooms and outpatient clinics. The structure of the data used for this study did not allow us to estimate the proportion of psychiatric emergency room contacts that do not immediately result in psychiatric hospitalizations, but other studies have shown that more than 50 percent of patients in psychiatric emergency rooms are discharged to outpatient care or no further care, even in patients presenting with attempted suicide [26–28].

Strengths and limitations

The present investigation holds both important strengths and limitations. Perhaps the most important advantage of the present study lies in the use of unselected Danish registries, ensuring complete follow-up until emigration, as well as validated measurements of suicide and use of psychiatric services. Unfortunately, this does not allow for identification of untreated psychiatric symptoms and illness. As such, using psychiatric treatment contact as a proxy for symptom severity is not completely valid. If this represents a bias, it would probably be that the more severely ill yet untreated people are at a relatively higher risk of suicide, biasing our results toward the null hypothesis. A further limitation lies in establishing previous psychiatric contact for those born outside Denmark. This limitation appears acceptable, however, since our primarily investigated risk factor was contact in the preceding year, on which we had full information on all cases and controls.

A further limitation lies in the fact that observational studies such as the present one cannot establish causality, but merely associations. Furthermore, the retrospective nature of certain secondary variables opens up the possibility for both residual confounding and differential information bias. An example of such would be a person classified as being married, but then became separated or divorced and as a consequence died from suicide. The direction by which this would influence the dose–response relationship between level of psychiatric treatment and suicide is not evident. Also, we did not obtain information on all types of psychiatric medications; for instance, prescription of anxiolytics was not registered in the present study. With the gradient used in our investigation, this means that people in the un-treated category may actually have received such medication; this is likely to bias our results toward the null hypothesis.

We did not have access to information on whether patients have received treatment from privately practicing psychiatrists or general practitioners. While the coverage of severe mental illness in the Psychiatric Central Research Register is nearly completely, mild to moderate disorders may still have been treated by privately practicing psychiatrists or general practitioners [17]. As such, there is a risk that some people classified in this study as having received only psychiatric medication or no treatment at all have in fact received this kind of outpatient treatment. While we believe that this is unlikely to have any noticeable impact on the observed gradient that we report, if anything it would presumably indicate that our findings are conservative.

It may be difficult to be certain that our results can be generalized to other countries and populations. Certainly, variations exist between in the definitions of suicide, e.g., according to death certification procedures [29–31]. This is unlikely to introduce systematic differences regarding the associations investigated in the present study. Rather, differences in casemix and in organizational features of the psychiatric treatment may influence the extent to which our results can be generalized to other countries. For instance, although socioeconomic differences in treatment-seeking behavior do exist in Denmark, psychiatric treatment (except, in part, medication) is almost completely publically funded. In countries where this is not the case, it may thus well be that even more disadvantaged groups exist than in the present investigation. It still seems likely, however, that the finding that suicide rates are elevated in nonadmitted psychiatric emergency room patients will also be valid in countries with other welfare systems than in Denmark.

In conclusion, the public health implications of the observed dose–response relationship would be that not only people with a history of psychiatric hospitalization but also those receiving only psychiatric medication, outpatient treatment, or psychiatric emergency room treatment should be monitored more closely.

References

1. World Health Organization. Suicide prevention (SUPRE). http://www.whoint/mental_health/prevention/suicide/suicideprevent/en/2012. Cited 2013 Aug 26. http://www.who.int/mental_health/prevention/suicide/suicideprevent/en/
2. Mortensen PB, Agerbo E, Erikson T, Qin P, Westergaard-Nielsen N (2000) Psychiatric illness and risk factors for suicide in Denmark. Lancet 355(9197):9–12

3. Bostwick JM, Pankratz VS (2000) Affective disorders and suicide risk: a reexamination. Am J Psychiatry 157(12):1925–1932
4. Palmer BA, Pankratz VS, Bostwick JM (2005) The lifetime risk of suicide in schizophrenia: a reexamination. Arch Gen Psychiatry 62(3):247–253
5. Harris EC, Barraclough B (1997) Suicide as an outcome for mental disorders. A meta-analysis. Br J Psychiatry 170:205–228
6. Goldacre M, Seagroatt V, Hawton K (1993) Suicide after discharge from psychiatric inpatient care. Lancet 342(8866):283–286
7. Pirkis J, Burgess P (1998) Suicide and recency of health care contacts. A systematic review. Br J Psychiatry 173:462–474
8. Qin P, Nordentoft M (2005) Suicide risk in relation to psychiatric hospitalization: evidence based on longitudinal registers. Arch Gen Psychiatry 62(4):427–432
9. Madsen T, Agerbo E, Mortensen PB, Nordentoft M (2011) Predictors of psychiatric inpatient suicide: a national prospective register-based study. J Clin Psychiatry 73(2):144–151
10. Agerbo E (2007) High income, employment, postgraduate education, and marriage: a suicidal cocktail among psychiatric patients. Arch Gen Psychiatry 64(12):1377–1384
11. Hunt IM, Kapur N, Webb R, Robinson J, Burns J, Turnbull P et al (2007) Suicide in current psychiatric in-patients: a case-control study. The National Confidential Inquiry into Suicide and Homicide. Psychol Med 37(6):831–837
12. Pedersen CB (2011) The Danish civil registration system. Scand J Public Health 39(7 suppl):22–25
13. Helweg-Larsen K (2011) The Danish register of causes of death. Scand J Public Health 39(7 Suppl):26–29
14. Borgan O, Goldstein L, Langholz B (1995) Methods for the analysis of sampled cohort data in the Cox proportional hazards model. Ann Stat 23(5):1749–1778
15. McDowall M (1983) Adjusting proportional mortality ratios for the influence of extraneous causes of death. Stat Med 2(4):467–475
16. Roman E, Beral V, Inskip H, McDowall M, Adelstein A (1984) A comparison of standardized and proportional mortality ratios. Stat Med 3(1):7–14
17. Mors O, Perto GP, Mortensen PB (2011) The Danish psychiatric central research register. Scand J Public Health 39(7 Suppl):54–57
18. Kildemoes HW, Sorensen HT, Hallas J (2011) The Danish national prescription registry. Scand J Public Health 39(7 Suppl):38–41
19. Statistics Denmark (2007) Integrated database for labour market research (IDA). Statistics Denmark. Cited 2013 Aug 26. http://www.dst.dk/en/Statistik/dokumentation/Declarations/integrated-database-for-labour-market-research-ida-.aspx
20. Christiansen E, Larsen KJ, Agerbo E, Bilenberg N, Stenager E (2012) Incidence and risk factors for suicide attempts in a general population of young people: a Danish register-based study. Aust N Z J Psychiatry
21. Borgan O, Langholz B (1993) Nonparametric estimation of relative mortality from nested case-control studies. Biometrics 49(2):593–602
22. King G, Zeng L (2002) Estimating risk and rate levels, ratios and differences in case-control studies. Stat Med 21(10):1409–1427
23. Bjerregaard P, Curtis T (2002) Cultural change and mental health in Greenland: the association of childhood conditions, language, and urbanization with mental health and suicidal thoughts among the Inuit of Greenland. Soc Sci Med 54(1):33–48
24. Moustgaard H, Bjerregaard P, Borch-Johnsen K, Jorgensen ME (2005) Diabetes among Inuit migrants in Denmark. Int J Circumpolar Health 64(4):354–364
25. Boysen T, Friborg J, Andersen A, Nilsson Poulsen G, Wohlfahrt J, Melbye M (2008) The Inuit cancer pattern—the influence of migration. Int J Cancer 122(11):2568–2572
26. Hugo M, Smout M, Bannister J (2002) A comparison in hospitalization rates between a community-based mobile emergency service and a hospital-based emergency service. Aust N Z J Psychiatry 36(4):504–508
27. Schnyder U, Klaghofer R, Leuthold A, Buddeberg C (1999) Characteristics of psychiatric emergencies and the choice of intervention strategies. Acta Psychiatr Scand 99(3):179–187
28. Baca-Garcia E, Diaz-Sastre C, Resa EG, Blasco H, Conesa DB, Saiz-Ruiz J et al (2004) Variables associated with hospitalization decisions by emergency psychiatrists after a patient's suicide attempt. Psychiatr Serv 55(7):792–797
29. Kapusta ND, Tran US, Rockett IR, De LD, Naylor CP, Niederkrotenthaler T et al (2011) Declining autopsy rates and suicide misclassification: a cross-national analysis of 35 countries. Arch Gen Psychiatry 68(10):1050–1057
30. Atkinson MW, Kessel N, Dalgaard JB (1975) The comparability of suicide rates. Br J Psychiatry 127:247–256
31. De Leo D, Evans R (2003) International suicide rates: recent trends and implications for Australia. Australian Institute for Suicide Research and Prevention, Canberra