Suicidal behaviour among persons with attention-deficit hyperactivity disorder

Cecilie Fitzgerald, Søren Dalsgaard, Merete Nordentoft and Annette Erlangsen

Background

Persons diagnosed with attention-deficit hyperactivity disorder (ADHD) have been found to have an increased risk of suicidal behaviour, but the pathway remains to be thoroughly explored.

Aims

To determine whether persons with ADHD are more likely to present with suicidal behaviour (i.e. suicide attempts and deaths by suicide) if they have a comorbid psychiatric disorder.

Method

Using nationwide registers covering the entire population of Denmark, this cohort study of 2.9 million individuals followed from 1 January 1995 until 31 December 2014, covers more than 46 million person-years. All persons aged ≥10 years with Danish-born parents were identified and persons with a diagnosis of ADHD were compared with persons without. Incidence rate ratios (IRRs) were calculated by Poisson regression, with adjustments for sociodemographics and parental suicidal behaviour.

Results

Persons with ADHD were followed for 164 113 person-years and 697 suicidal outcomes were observed. This group was found to have an IRR of suicidal behaviour of 4.7 (95% CI, 4.3–5.1) compared with those without ADHD. Persons with ADHD only had a 4.1-fold higher rate (95% CI, 3.5–4.7) when compared with those without any psychiatric diagnoses. For persons with ADHD and comorbid disorders the IRR was higher yet (IRR: 10.4; 95% CI, 9.5–11.4).

Conclusions

This study underlines the link between ADHD and an elevated rate of suicidal behaviour, which is significantly elevated by comorbid psychiatric disorders. In sum, these results suggest that persons with ADHD and comorbid psychiatric disorders are targets for suicide preventive interventions.

The population prevalence of attention-deficit hyperactivity disorder (ADHD) is estimated to be 7.2% worldwide and has been relatively stable over the past 40 years.[1] ADHD is a neurodevelopmental disorder with symptoms including hyperactivity, impulsivity and inattention. ADHD has a childhood onset but symptoms of ADHD and impairments often persist into adolescence and adulthood[2] and have been associated with lower educational levels, greater risk of criminal activities,[3] and early and violent death.[4] Some population-based studies have noted a higher rate of suicidal behaviour, including suicide attempts and death by suicide, among people diagnosed with or treated for ADHD, when compared with persons without ADHD.[5] It is not completely clear which mechanisms might account for this higher rate, but given that persons with ADHD also have an increased risk of developing comorbid psychiatric disorders,[6] it has been suggested that such comorbidities might act as mediating factors for suicidal outcomes.[7] To date, the relative impact of a comorbid diagnosis on the risk of suicidal behaviour has only been examined in small study samples of patients with ADHD.[8] Studies with larger samples and more rigorous analyses (i.e. adjustment for relevant social covariates, such as cohabitational, educational and socioeconomic status) are needed.

In this study, we aimed to investigate whether persons diagnosed with ADHD were more likely to present with suicidal behaviour than persons without ADHD, as well as whether the association might be mediated by psychiatric comorbidity. To our knowledge, this is the first nationwide study to examine the role of psychiatric comorbid disorders in the association between ADHD and suicidality.

Method

A cohort design was applied to nationwide register data. The Danish Civil Registration System was implemented in 1968, whereby every person living in Denmark was given a unique identification number. From then onward, the identification number was given upon live birth or immigration into the country. The Civil Registration System stores information on every person in Denmark and is considered to have a high reliability.[9] For this study, the identification number facilitated individual-level linkage to the following administrative registers: the Psychiatric Central Research Register (PCRR), the National Hospital Register (NHR), the Cause of Death Registry (CDR), the Populations Education Register, the Register on Criminal Statistics and the Income Statistics Register.

Study population

The study population comprised all persons aged 10 years or above who were recorded as living in Denmark between 1 January 1995 and 31 December 2014. Persons would enter the cohort at baseline, on their 10-year birthday or date of immigration into the country during the study period and the follow-up ended upon date of death, emigration or 31 December 2014, whichever came first. To minimise unmeasured bias among migrants related to potential traumatic events not recorded in the Danish registries, only persons for whom records of their parents being born in Denmark existed were included. This method has been used in previous studies,[10] and resulted in an exclusion of approximately 16% of the Danish population, where data was found to be insufficient.

Assessment of psychiatric disorder

Information on psychiatric diagnoses was obtained from the PCRR. From 1969 onward, all psychiatric in-patient admissions have been registered in the PCRR, and from 1995, emergency room and out-patient visits were also included. Diagnoses were recorded
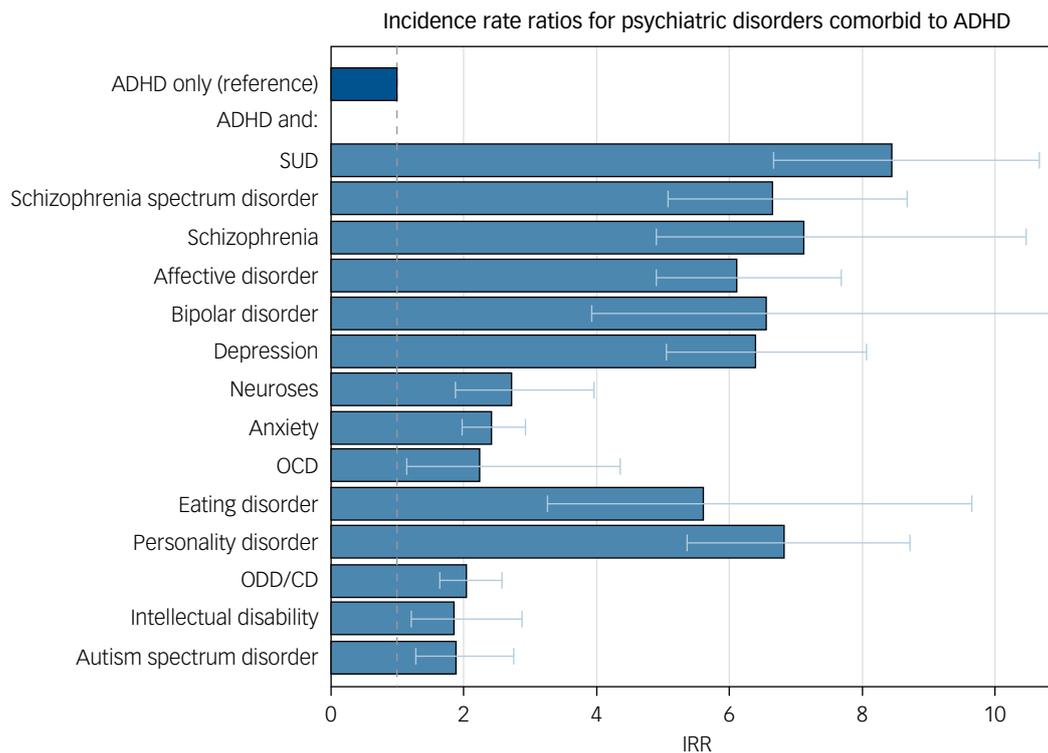
Incidence rate ratios for psychiatric disorders comorbid to ADHD

Fig. 1   The relative rates of suicidal behaviour of persons with ADHD and the specified comorbid disorder compared to persons with ADHD only

ADHD, attention-deficit hyperactivity disorder; SUD, substance use disorder; OCD, obsessive-compulsive disorder; ODD/CD, oppositional defiant disorder/conduct disorder; IRR, incidence rate ratios.

according to the ICD-8[11] and ICD-10[12]. ICD-9 was never implemented in Denmark.

Every person who had ever received a diagnosis of ADHD (ICD-8: 308.01; ICD-10: F90, F98.8) was considered as exposed from that date onward. In addition, other psychiatric diagnoses of substance use disorder (SUD); schizophrenia; schizophrenia spectrum disorders; affective disorders; bipolar disorder; depression, anxiety, dissociative, stress-related and somatoform disorders; anxiety; obsessive–compulsive disorder; post-traumatic stress disorder; eating disorders; personality disorders; intellectual disability; autism spectrum disorders (ASD) and oppositional defiant disorder/conduct disorder (ODD/CD) were identified. Detailed specifications of the ICD codes are listed in Supplementary Table 1 available at https://doi.org/10.1192/bjp.2019.128.

Outcomes

The outcome of suicidal behaviour was defined as having had a hospital contact for suicide attempt or death by suicide. In the NHR and PCRR, a diagnosis of suicidal behaivour (ICD-8: 950–959; ICD-10: X60–X84) or a reason for contact of 'suicide attempt' were considered as indicative of a suicide attempt. Records on cause of death from the CDR were assessed and persons with an ICD-code of suicidal behaivour (see above) or where suicide was recorded as the manner of death were considered as having died by suicide.

Statistical analyses

We calculated incidence rates based on number of events and person-days in each stratum. Poisson regression was used to calculate incidence rate ratios (IRRs) between those with ADHD and those without ADHD. Multivariate regression models were adjusted for gender (male, female), age (in years: 10–14, 15–19, 20–24, 25–29,

30–34, 35–39, 40–44, 45–49, 50–54, 55–59, ≥60) and calendar year (1995–2004, 2005–2014). A sensitivity analysis was conducted, further adjusting for cohabitational status (single adult household, cohabiting household), level of education (vocational/none, high school, university degree), socioeconomic status (within the workforce, including children and students; unemployed), as well as parents' suicide attempts (no parent, one parent, both parents) to estimate figures without the social implications associated with ADHD and the parental factors known to contribute to suicidal behaviour. All of these were treated as time-dependent variables. Interaction analyses were performed by comparing the following groups: group 1, persons with no diagnosis; group 2, persons with ADHD as their only psychiatric diagnosis; group 3, persons diagnosed with psychiatric disorders other than ADHD and group 4, persons diagnosed with one or more other psychiatric disorders comorbid to ADHD. Group 2 was chosen to include only those with no comorbid disorders to avoid comparing the effect of different comorbid disorders. The IRRs were reported with 95% CIs. The same analyses were performed with suicide as the outcome where a minimum of five suicides were observed in each category of the examined predictor. Analyses were conducted by SAS version 9.4 statistical software for Windows (SAS Institute, Inc.).

This study was approved by the Danish Data Protection Agency. In Denmark, informed consent is neither feasible nor required for register-based studies.

Results

The total study population comprised 2 924 780 persons (including 1 402 113 females) who were observed over 46 million person-years. During the 20 years of observation, 37 705 suicidal events

(4 930 suicide deaths, 32 775 suicide attempts) were observed within the total cohort (see Supplementary Table 2). In all, 32 540 persons (including 10 019 females) with an ADHD diagnosis were followed until a mean age of 21.5 (s.d. 9.6), accounting for 164 113 person-years and 697 suicidal events (35 suicide deaths, 662 suicide attempts). The incidence rates of suicidal behaviour in the total cohort and those with ADHD were 75.5 and 415.6 per 100 000 person-years, respectively.

Main analysis

Compared with persons with no ADHD diagnosis, a 4.7-fold higher rate of suicidal behaviour (95% CI, 4.34–5.06) was noted among those with ADHD (see Table 1). Males with ADHD were found to have a 3.4-fold higher rate (95% CI, 3.04–3.76), whereas a 9.1-fold higher rate was noted for females (95% CI, 8.12–10.12) when compared with males without ADHD. When stratifying by age groups, we found an excess IRR among people with ADHD for all age groups, which was particularly pronounced for those with ADHD aged 20–29 years who had an IRR of 10.07 (95% CI, 8.81–11.51) compared with those without ADHD. Persons with ADHD who had been convicted of a crime had a three-fold higher rate

compared with those with ADHD who were not convicted (IRR: 14.07; 95% CI, 12.27–16.15 v. IRR: 4.86; 95% CI, 4.44–5.33, respectively).

The sensitivity analysis resulted in a 2.6-fold higher rate of suicidal behaviour (95% CI, 2.43–2.84) among those with ADHD (see Table 2). For all analyses the resulting IRRs were smaller but significant in the same direction as the main analysis.

Parental factors

Parental psychiatric disorders or suicidal behaviour affected the rate of suicidal behaviour in children. Persons with ADHD and parents with no psychiatric disorders had an IRR of suicidal behaviour of

Table 1 Incidence rate ratios for suicidal behaviour

	No. with suicidal behaviour	%	Main analysis, IRR (95% CI)[a]
ADHD diagnosis			
No ADHD	35 058	(0.06)	1
ADHD	682	(0.23)	4.69 (4.34–5.06)***
Gender			
No ADHD			
Male	17 041	(0.06)	1
Female	18 017	(0.06)	1.13 (1.11–1.16)***
ADHD			
Male	355	(0.14)	3.38 (3.04–3.76)***
Female	327	(0.32)	9.06 (8.12–10.12)***
Age group, yr			
No ADHD			
10–19	7024	(0.04)	1
20–29	10 192	(0.08)	1.78 (1.72–1.83)***
30–39	10 334	(0.08)	1.74 (1.69–1.79)***
≥40	7508	(0.05)	1.13 (1.09–1.16)***
ADHD			
10–19	351	(0.18)	6.84 (6.14–7.62)***
20–29	222	(0.24)	10.07 (8.81–11.51)***
30–39	78	(0.18)	8.53 (6.82–10.66)***
≥40	31	(0.13)	6.39 (4.49–9.10)***
Criminal convictions			
None			
No ADHD	26 742	(0.05)	1
ADHD	474	(0.17)	4.86 (4.44–5.33)***
At least one conviction			
No ADHD	8316	(0.21)	6.82 (6.64–7.00)***
ADHD	208	(0.30)	14.07 (12.27–16.15)***
Parental psychiatric disorders			
None			
No ADHD	25 066	(0.05)	1
ADHD	409	(0.18)	4.85 (4.40–5.35)***
At least in one parent			
No ADHD	9992	(0.10)	2.35 (2.30–2.41)***
ADHD	273	(0.24)	7.32 (6.49–8.25)***
Parental suicidal behaviour			
None			
No ADHD	30 600	(0.05)	1
ADHD	576	(0.19)	2.99 (2.75–3.25)***
At least in one parent			
No ADHD	4458	(0.15)	2.44 (2.37–2.52)***
ADHD	106	(0.34)	3.87 (3.19–4.68)***

ADHD, attention-deficit hyperactivity disorder; IRR, incidence rate ratio.
a. Adjusted for age, gender and calendar year.
***P < 0.001.

Table 2 Sensitivity analyses with incidence rate ratios for suicidal behaviour and for death by suicide, with additional adjustments

	Suicidal behaviour, IRR (95% CI)[a]	Death by suicide, IRR (95% CI)[a]
ADHD diagnosis		
No ADHD	1	1
ADHD	2.63 (2.43–2.84)***	1.61 (1.15–2.25)**
Gender		
No ADHD		
Male	1	1
Female	1.23 (1.20–1.26)***	0.33 (0.31–0.35)***
ADHD		
Male	2.01 (1.80–2.23)***	1.52 (1.05–2.20)*
Female	4.85 (4.34–5.41)***	0.73 (0.33–1.63)
Age group, yr		
No ADHD		
10–19	1	1
20–29	2.19 (2.12–2.27)***	0.16 (0.14–0.19)***
30–39	1.65 (1.60–1.70)***	0.42 (0.38–0.45)***
≥40	1.19 (1.15–1.23)***	0.72 (0.67–0.77)***
ADHD		
10–19	6.81 (6.11–7.59)***	0.34 (0.16–0.71)**
20–29	3.86 (3.38–4.42)***	0.63 (0.36–1.11)
30–39	2.71 (2.17–3.39)***	1.16 (0.64–2.09)
≥40	2.15 (1.51–3.06)***	1.05 (0.44–2.53)
Previous suicide attempt		
None		
No ADHD		1
ADHD		5.28 (4.90–5.70)***
At least one attempt		
No ADHD		0.62 (0.40–0.98)**
ADHD		3.61 (2.17–6.01)***
Criminal convictions		
None		
No ADHD	1	1
ADHD	3.17 (2.89–3.47)***	1.93 (1.18–3.16)**
At least one conviction		
No ADHD	3.98 (3.87–4.09)***	3.47 (3.25–3.71)***
ADHD	5.76 (5.01–6.61)***	3.78 (2.40–5.95)***
Parental psychiatric disorders[b]		
None		
No ADHD	1	1
ADHD	3.04 (2.75–3.35)***	1.75 (1.12–2.72)***
At least one parent		
No ADHD	1.95 (1.91–2.00)***	1.76 (1.65–1.87)**
ADHD	4.01 (3.56–4.52)***	2.49 (1.50–4.14)*
Parental suicidal behaviour[b]		
None		
No ADHD	1	1
ADHD	2.99 (2.75–3.25)***	1.74 (1.20–2.53)***
At least one parent		
No ADHD	2.44 (2.37–2.52)***	2.21 (2.02–2.41)**
ADHD	3.87 (3.19–4.68)***	2.71 (1.29–5.70)*

ADHD, attention-deficit hyperactivity disorder; IRR, incidence rate ratio; SES, socio-economic status.
a. Adjusted for age, gender, year, cohabitational status, SES, educational level and parents' suicide attempts.
b. Adjusted for age, gender, year, cohabitational status, SES and educational level.
* P < 0.05, **P < 0.01, ***P < 0.001.

4.85 (95% CI, 4.40–5.35). In comparison, among those with ADHD where at least one parent had a psychiatric disorder, an IRR of 7.32 (95% CI, 6.49–8.25) was noted. Having ADHD and a parent with suicidal behaviour was associated with an IRR of 3.87 (95% CI, 3.19–4.68), whereas those whose parents did not have suicidal behaviour had an IRR of 2.99 (95% CI, 2.75–3.25) compared with those without ADHD.

Psychiatric comorbidity

Individuals who had only been diagnosed with ADHD had an IRR of 4.09 (95% CI, 3.53–4.73), whereas those diagnosed with additional psychiatric disorders had an IRR of 10.43 (95% CI, 9.53–11.41) when compared with those without ADHD (see Supplementary Table 3). The IRR was highest among persons with psychiatric disorders other than ADHD (IRR: 14.84; 95% CI, 14.52–15.17). The largest difference was noted for SUD: those who only had ADHD had an IRR of 2.90 (95% CI, 2.51–3.36), whereas those with ADHD and SUD had an IRR of 21.55 (95% CI, 17.98–25.83), which was comparable with those with SUD but without ADHD (IRR: 25.12; 95% CI, 24.32–25.95). A comorbid diagnosis of ASD was associated with a two-fold higher rate of suicidal behaviour, from an IRR of 2.63 (95% CI, 2.27–3.05) for people with ADHD to 4.65 (95% CI, 3.25–6.66) among those with both disorders; those with autism alone had an IRR of 2.31 (95% CI, 1.98–2.71).

Having an increasing number of different comorbid disorders was linked to increasing rates of suicidal behaviour. Having one, two and three or more comorbid disorders resulted in IRRs of 4.76 (95% CI, 3.88–5.84), 4.41 (95% CI, 3.47–5.61) and 8.20 (95% CI, 7.36–9.13) when compared with those without ADHD.

Death by suicide

With regard to death by suicide, persons with ADHD had an IRR of 3.20 (95% CI, 2.29–4.47) (see Table 3). Males with ADHD had an IRR of 2.98 (95% CI, 2.06–4.30), but the estimate for females failed to reach significance (IRR 1.47; 95% CI, 0.66–3.27). Persons with ADHD who were aged 30–39 years had a higher suicide rate (IRR: 3.01; 95% CI, 1.66–5.44) than age-matched persons without ADHD.

Discussion

Our analysis confirmed that persons diagnosed with ADHD have higher rates of suicidal behaviour, including death by suicide, when compared with those without ADHD. Specific risk factors for suicidal behaviour in persons with ADHD suggested by this study were female gender, young age, psychiatric comorbidity, previous suicidal behaviour, a criminal record and parental history of psychiatric disorder. This is the first study to give a comprehensive overview of the relation between ADHD, suicidal behaviour and comorbid psychiatric disorders, and we noted a significantly higher rate among those with comorbidity, which was comparable with that of the comorbid disorder.

In line with previous studies,[4,5] we found an excess rate of suicidal behaviour among people with ADHD. Our findings suggest that this association cannot be fully explained by parental psychiatric disorders. Children with ADHD without parental psychiatric disorders also had a substantially higher frequency of suicidal behaviour. There are several possible explanations for the observed association. First, impulsivity, a recognised trait of ADHD, has also been linked genetically to suicidal behaviour,[13] and so it is possible that some of the association might be thus explained.[5] Second, other characteristics of ADHD, such as impaired decision-making,[14] low

Table 3 Incidence rate ratios for death by suicide

	No. of deaths by suicide	(%)	Main analysis, IRR (95% CI)[a]
ADHD diagnosis			
No ADHD	4895	(0.01)	1
ADHD	35	(0.01)	3.20 (2.29–4.47)***
Gender			
No ADHD			
Male	3871	(0.01)	1
Female	1024	(0.00)	0.29 (0.27–0.32)***
ADHD			
Male	29	(0.01)	2.98 (2.06–4.30)***
Female	6	(0.01)	1.47 (0.66–3.27)
Age group, yr			
No ADHD			
10–19	2197	(0.01)	1
20–29	259	(0.00)	0.14 (0.13–0.16)***
30–39	950	(0.01)	0.50 (0.46–0.54)***
≥40	1489	(0.01)	0.70 (0.65–0.74)***
ADHD			
10–19	7	(0.00)	0.35 (0.17–0.74)**
20–29	12	(0.01)	1.40 (0.79–2.47)
30–39	11	(0.03)	3.01 (1.66–5.44)***
≥40	5	(0.02)	2.68 (1.11–6.45)*
Previous suicide attempt			
None			
No ADHD	3711	(0.01)	1
ADHD	1185	(0.01)	20.73 (19.41–22.14)***
At least one attempt			
No ADHD	19	(0.09)	2.59 (1.65–4.07)***
ADHD	15	(0.05)	22.20 (13.36–36.88)***
Criminal convictions			
None			
No ADHD	3212	(0.01)	1
ADHD	16	(0.01)	3.06 (1.86–5.01)***
At least one conviction			
No ADHD	1683	(0.04)	5.60 (5.26–5.96)***
ADHD	19	(0.03)	8.21 (5.22–12.91)***
Parental psychiatric disorders			
None			
No ADHD	3528	(0.01)	1
ADHD	20	(0.01)	3.15 (2.03–4.90)***
At least one parent			
No ADHD	1367	(0.01)	2.04 (1.91–2.17)***
ADHD	15	(0.01)	4.89 (2.94–8.12)***
Parental suicidal behaviour			
None			
No ADHD	4325	(0.01)	1
ADHD	28	(0.01)	3.17 (2.18–4.61)***
At least one parent			
No ADHD	570	(0.02)	2.67 (2.44–2.91)***
ADHD	7	(0.02)	5.55 (2.64–11.67)***

ADHD, attention-deficit hyperactivity disorder; IRR, incidence rate ratio.
a. Adjusted for age, gender and calendar year.
* $P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

peer preference[15] and high risk-willingness,[16] have been suggested to contribute to the increased rate. Finally, low educational attainment[17] and high levels of stress[18] have been noted as risk factors for suicidal behaviour.[19] Our sensitivity analysis confirmed that ADHD was associated with suicidal behaviour also when adjusting for several relevant covariates that might act as confounders.

Although an association with suicidal behaviour was confirmed for both males and females separately, the hazard for females was found to be twice that of males, supporting previous findings.[5] ADHD has also been found to have a more pronounced effect in females on a number of other adverse outcomes,[4,10,20] which might indicate that the social implications of having ADHD are more extensive for females, who are traditionally expected to be calmer and less physical than males. It has, to our knowledge, not previously been shown that ADHD might have a more pronounced impact on suicidal behaviour in younger persons. This could be

related to attenuation of social effects especially important in this age group, such as starting a family or adjusting to the educational system. The higher rate related to having parents with a psychiatric disorder might indicate an increased emotional vulnerability in persons exposed to a more turbulent childhood, but could also be explained through genetically transmitted vulnerability.[5] Having a parent with suicidal behaviour did not result in a significantly higher IRR for persons with ADHD as it did for persons without ADHD. This suggests that a parent's suicidal behaviour is not relevant for the outcome of their child if they are also affected by an ADHD diagnosis. This might be owing to the already elevated distress that seems to be present in these individuals. It has been suggested that persons with ADHD are more likely to carry out criminal activities,[3] and criminal behaviour has been linked to suicidal behaviour.[21] It is therefore highly relevant to explore the mechanisms making persons with ADHD at risk for criminal activities.

Psychiatric comorbidity

Although the association was particularly strong for SUD, schizophrenia spectrum disorders and affective disorders, almost all comorbid diagnoses resulted in an increased rate of suicidal behaviour for persons with ADHD, suggesting that the association is partly mediated by comorbid psychiatric disorders. Nevertheless, a 2.5- to 3.0-fold higher rate was noted among persons with ADHD only across all analyses, clearly showing the unexplained effect of the diagnosis. The excess ratio associated with a comorbid disorder was generally of the same magnitude as in persons diagnosed only with the other disorder, suggesting that ADHD does not further increase risk in persons who are already at high risk *via* their other diagnosis. This contrasts with previous findings related to comorbid bipolar disorder, albeit from a smaller sample size.[22] The importance of addressing comorbid SUD is well known and yet particularly relevant.[10] For persons with anxiety, an additional ADHD diagnosis seemed to have a protective effect, possibly because persons with both disorders might represent a select group. A similar finding was observed for overall comorbid diagnoses. Further analyses would be needed to elucidate these findings. ASD stood out with an elevated rate for persons with comorbid ADHD compared with those without, which could suggest that the increased risk of suicidality in individuals with ASD[23] may be partly mediated through ADHD. This would, however, need further examination. A higher rate of suicidal behaviour in relation to higher numbers of comorbid disorders is well established.[24]

Strengths and limitations

The strengths of this study are related to the use of longitudinal data from highly reliable nationwide registers with very little missing data. The large sample includes all persons diagnosed with ADHD and has virtually no loss to follow-up and a low risk of mortality and selection bias. Furthermore, it was possible to examine associations with a wide spectrum of comorbid disorders. As Danish registers allow for linkage of family members, it was possible to adjust for predisposing factors related to parents' mental health, with an almost complete coverage for people born after 1952. The long study period was yet another strength of this study.

We also acknowledge several limitations of this study. Although the registration of suicide deaths is evaluated to be reliable in Denmark, suicide attempts might be under-recorded by as much as 30%.[25] It is possible that a small fraction of individuals with ADHD might only be diagnosed by psychiatrists in private practices and so are not identified by the registers and not included in our ADHD population. Furthermore, misclassification might have occurred, particularly in early years; however, these circumstances would likely render our estimates as conservative. Indeed, those diagnosed at hospital clinics may represent more severe cases, which means that our findings might not generalise to the broad ADHD spectrum. This limitation also applies to other psychiatric disorders analysed. Furthermore, as only few events of death by suicide were observed for some psychiatric diagnoses, the main outcome was chosen to be a combination of attempted suicide and death by suicide. The results may therefore only be partially representative of the relation between ADHD and suicide deaths. Also, by excluding children whose parents were not born in Denmark, our findings might not be fully representative of the entire nation.

Clinical implications

Given that ADHD is correlated with an increased risk of developing other and often more disabling psychiatric disorders later in life,[20] the findings of this study underscores the importance of diagnosis and treatment of ADHD. An awareness regarding suicidality among persons with ADHD, especially among those with comorbid disorders, is needed. Long-term effects of ADHD might persist into adulthood, and there is a need for preventive measures and interventions throughout a patient's lifetime, to reduce the risk of suicides and suicide attempts.

To our knowledge, no interventions have specifically targeted suicide in persons with ADHD. General interventions addressing suicide among children and adolescents have been implemented in many countries, but the evidence base is limited.[26] However, previous cohort studies suggest that pharmacotherapy for ADHD may have beneficial effects on the risk of suicidal behaviour.[5,27] In addition, our findings suggest that interventions focused on comorbid disorders, particularly on SUD, schizophrenia spectrum disorders and affective disorders, might be indicated. When assessing risk of suicidal behaviour, clinicians might consider other risk factors, such as juvenile delinquency and/or a history of psychiatric disorders or suicidal behaviour in parents. Also, clinicians could provide increased clinical attention for females with ADHD,[4,10] including assessing for risk of suicidal behaviour.

Cecilie Fitzgerald, Research Year Student, Danish Research Institute for Suicide Prevention, Mental Health Centre Copenhagen, Denmark; **Søren Dalsgaard**, PhD, Professor, National Centre for Register-based Research, Department of Economics and Business, School of Business and Social Sciences, Aarhus University, Denmark; **Merete Nordentoft**, DM Sc, Professor, Danish Research Institute for Suicide Prevention, Mental Health Centre Copenhagen; The Lundbeck Foundation Initiative for Integrative Psychiatric Research, iPSYCH; and Mental Health Centre Copenhagen, Copenhagen University Hospital, Denmark; **Annette Erlangsen**, PhD, Senior Researcher, Danish Research Institute for Suicide Prevention, Mental Health Centre Copenhagen, Denmark; Department of Mental Health, Johns Hopkins Bloomberg School of Public Health, USA; and Centre for Mental Health Research, Australian National University, Australia

Correspondence: Cecilie Fitzgerald, Research Unit, Mental Health Centre Copenhagen, Kildegaardsvej 28, DK-2900 Hellerup, Denmark. Email: cecilie.aalling.husballe.01@regionh.dk

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Supplementary material

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References

1 Thomas R, Sanders S, Doust J, Beller E, Glasziou P. Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics* 2015; **135**(4): e994–1001.

2 Riglin L, Collishaw S, Thapar AK, Dalsgaard S, Langley K, Smith GD, et al. Association of genetic risk variants with attention-deficit/hyperactivity disorder trajectories in the general population. *JAMA Psychiatry* 2016; **73**(12): 1285–92.

3 Dalsgaard S, Mortensen PB, Frydenberg M, Thomsen PH. Long-term criminal outcome of children with attention deficit hyperactivity disorder. *Crim Behav Ment Health* 2013; **23**(2): 86–98.

4 Dalsgaard S, Ostergaard SD, Leckman JF, Mortensen PB, Pedersen MG. Mortality in children, adolescents, and adults with attention deficit hyperactivity disorder: a nationwide cohort study. *Lancet* 2015; **385**(9983): 2190–6.

5 Ljung T, Chen Q, Lichtenstein P, Larsson H. Common etiological factors of attention-deficit/hyperactivity disorder and suicidal behavior: a population-based study in Sweden. *JAMA Psychiatry* 2014; **71**(8): 958–64.

6 Ottosen C LJ, Faraone SV, Chen Q, Hartman C, Larsson H, Petersen L, et al. Sex differences in comorbidity patterns of attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry* 2019; **58**(4): 412–22.e3.

7 James A, Lai FH, Dahl C. Attention deficit hyperactivity disorder and suicide: a review of possible associations. *Acta Psychiatr Scand* 2004; **110**(6): 408–15.

8 Yoshimasu K, Barbaresi WJ, Colligan RC, Voigt RG, Killian JM, Weaver AL, et al. Psychiatric comorbidities modify the association between childhood ADHD and risk for suicidality: a population-based longitudinal study. *J Atten Disord* 2019; **23**(8): 777–86.

9 Pedersen CB. The Danish Civil Registration System. *Scand J Public Health* 2011; **39**(suppl 7): 22–5.

10 Ottosen C, Petersen L, Larsen JT, Dalsgaard S. Gender differences in associations between attention-deficit/hyperactivity disorder and substance use disorder. *J Am Acad Child Adolesc Psychiatry* 2016; **55**(3): 227–34 e4.

11 World Health Organisation. *International Statistical Classification of Diseases and Related Health Problems 8th revision*. WHO, 1965.

12 World Health Organisation. *International Statistical Classification of Diseases and Related Health Problems 10th revision*. WHO, 2007.

13 Hawton K, van Heeringen K. Suicide. *Lancet* 2009; **373**(9672): 1372–81.

14 Miller M, Sheridan M, Cardoos SL, Hinshaw SP. Impaired decision-making as a young adult outcome of girls diagnosed with attention-deficit/hyperactivity disorder in childhood. *J Int Neuropsychol Soc* 2013; **19**(1): 110–4.

15 Meza JI, Owens EB, Hinshaw SP. Response inhibition, peer preference and victimization, and self-harm: longitudinal associations in young adult women with and without ADHD. *J Abnorm Child Psychol* 2016; **44**(2): 323–34.

16 Humphreys KL, Lee SS. Risk taking and sensitivity to punishment in children with ADHD, ODD, ADHD + ODD, and controls. *J Psychopathol Behav Assess* 2011; **33**(3): 299–307.

17 Barry TD, Lyman RD, Klinger LG. Academic underachievement and attention-deficit/hyperactivity disorder: the negative impact of symptom severity on school performance. *J Sch Psychol* 2002; **40**(3): 259–83.

18 Lackschewitz H, Hüther G, Kröner-Herwig B. Physiological and psychological stress responses in adults with attention-deficit/hyperactivity disorder (ADHD). *Psychoneuroendocrinology* 2008; **33**(5): 612–24.

19 Jablonska B, Lindblad F, Ostberg V, Lindberg L, Rasmussen F, Hjern A. A national cohort study of parental socioeconomic status and non-fatal suicidal behaviour–the mediating role of school performance. *BMC Public Health* 2012; **12**: 17.

20 Dalsgaard S, Mortensen PB, Frydenberg M, Thomsen PH. Conduct problems, gender and adult psychiatric outcome of children with attention-deficit hyperactivity disorder. *Br J Psychiatry* 2002; **181**: 416–21.

21 Webb RT, Qin P, Stevens H, Mortensen PB, Appleby L, Shaw J. National study of suicide in all people with a criminal justice history. *Arch Gen Psychiatry* 2011; **68**(6): 591–9.

22 Lan WH, Bai YM, Hsu JW, Huang KL, Su TP, Li CT, et al. Comorbidity of ADHD and suicide attempts among adolescents and young adults with bipolar disorder: a nationwide longitudinal study. *J Affect Disord* 2015; **176**: 171–5.

23 Culpin I, Mars B, Pearson RM, Golding J, Heron J, Bubak I, et al. Autistic traits and suicidal thoughts, plans, and self-harm in late adolescence: population-based cohort study. *J Am Acad Child Adolesc Psychiatry* 2018; **57**(5): 313–20.e6.

24 Qin P, Nordentoft M. Suicide risk in relation to psychiatric hospitalization: evidence based on longitudinal registers. *Arch Gen Psychiatry* 2005; **62**(4): 427–32.

25 Helweg-Larsen K, Kjøller M, Juel K, Sundaram V, Laursen B, Kruse M, et al. *Selvmord i Danmark: Markant fald, men stigende antal selvmordsforsøg - hvorfor?* [Suicide in Denmark: Marked decrease but increasing number of suicide attempts – why?] Statens Institut for Folkesundhed, 2006.

26 Hawton K, Witt KG, Taylor Salisbury TL, Arensman E, Gunnell D, Townsend E, et al. Interventions for self-harm in children and adolescents. *Cochrane Database Syst Rev* 2015; **12**: CD012013.

27 Chen Q, Sjolander A, Runeson B, D'Onofrio BM, Lichtenstein P, Larsson H. Drug treatment for attention-deficit/hyperactivity disorder and suicidal behaviour: register based study. *BMJ* 2014; **348**: g3769.

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