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Research paper

Depression and anxiety disorders during the postpartum period in women diagnosed with attention deficit hyperactivity disorder

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ABSTRACT

Background: Attention deficit hyperactivity disorder (ADHD) is associated with an increased risk of poor mental health. However, the understanding of ADHD-related burden and impairments in women during the postpartum period is limited. The aim with the present study was to examine the risk of depression and anxiety disorders during the postpartum period among women with and without an ADHD diagnosis.

Methods: We used register-based data to identify women who gave birth to their first and/or second child between 2005 and 2013 in Sweden (n = 773,047), of which 0.5 % (n = 3515) had a diagnosis of ADHD prior to pregnancy. Diagnoses of depression and anxiety disorders up to one year after delivery were collected from the national patient register.

Results: A total of 16.76 % of the women with an ADHD diagnosis were also diagnosed with depression disorders in the postpartum period, prevalence ratio (PR) 5.09 (95 % confidence interval (CI), 4.68–5.54). A total of 24.92 % of the women with an ADHD diagnosis were also diagnosed with anxiety disorders in the postpartum period, PR 5.41 (5.06–5.78). Stratified results revealed that having a diagnosis of ADHD increased the risk for both depression and anxiety disorders postpartum, beyond other well-known risk factors.

Limitations: There is a potential risk of surveillance bias as women diagnosed with ADHD are more likely to have repeated visits to psychiatric care and might have an enhanced likelihood of also being diagnosed with depression and anxiety disorders postpartum, compared to women without ADHD.

Conclusions: ADHD is an important risk factor for both depression and anxiety disorders postpartum. Therefore, ADHD needs to be considered in the maternal care, regardless of sociodemographic factors and the presence of other psychiatric disorders.

Abbreviations: ADHD, attention deficit hyperactivity disorder; PR, prevalence ratio; CI, confidence interval.

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1. Introduction

Once thought to be a childhood disorder, attention deficit hyperactivity disorder (ADHD) is now widely recognized as a neurodevelopmental disorder that persists into adulthood in up to 70 % of cases (Kessler et al., 2006). ADHD is associated with an increased risk of poor mental and physical health (Brook et al., 2013), and frequently co-occurs with additional psychiatric disorders, such as depression and anxiety disorders (Das et al., 2012). Results from the National Comorbidity Survey demonstrated that men and women diagnosed with ADHD are three times more likely to develop major depressive disorder, and four times more likely to have co-occurring mood disorder, compared to individuals without ADHD (Kessler et al., 2006). In the general population, up to 85 % of mothers experience mood disturbances in the early postpartum period (i.e., postpartum blues). Yet only a subset of these women develops symptoms with a duration and magnitude that requires medical care (Henshaw, 2003). This supports the reproductive stress hypothesis (Wen et al., 2019), which suggests that the period related to pregnancy might be stressful for many women. The time-period surrounding pregnancy poses several challenges to women, including the risk of postpartum psychiatric disorders.

The major postpartum psychiatric disorders include postpartum depression, anxiety, and more rarely, psychosis (Meltzer-Brody et al., n.d.). Postpartum depression is one of the most frequently occurring psychiatric complications related to pregnancy and childbirth (Gaynes et al., 2005), and previous research has shown that 13 to 20 % of women (Fisher et al., 2012) suffer from postpartum depression, whereas the prevalence of postpartum anxiety is estimated to be around 10 % (Dennis et al., 2017). Previous research suggests that a diagnosis of depression or bipolar disorder prior to pregnancy is major risk factors for developing a postpartum psychiatric disorder (Silverman et al., 2017; Munk-Olsen et al., n.d.). For example, a recent population-based study found that women with a history of depression had a 21-fold increased risk of postpartum depression, compared to women without a history of depression (Silverman et al., 2017). To our knowledge, the only available study to date exploring postpartum depression symptoms (using Edinburgh Postnatal Depression Scale [EPDS]) in women with ADHD symptoms (using DSM-based criteria) included 209 women (age range 18–71 years), out of which 89 women had at least one biological child. They found that women with ADHD had an increased risk of experiencing postpartum depression symptoms, compared to women without ADHD (Dorani et al., 2021). However, these results need to be replicated in larger population-based samples, which have the possibility of also taking important risk factors into consideration, such as sociodemographic factors and a diagnosis of depression and anxiety prior to pregnancy. Extending the knowledge on maternal mental health during the postpartum period, in women diagnosed with ADHD overall (but also within specific subgroups, e.g., cohabitation status, psychiatric comorbidities), is critical as the consequences of perinatal mental health disorders increases the risk of adverse outcomes for the offspring (Field, 2011; Goodman, 2007; National Research Council and Institute of Medicine, 2009).

We aim to examine the risk of depression and anxiety disorders during the postpartum period among women with and without an ADHD diagnosis prior to pregnancy.

2. Method

2.1. Ethics statement

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All procedures involving human subjects were approved by the Regional Ethical Review board in Stockholm, Sweden (DNR: 2013/862-31/5). Since our study was based on population-based registers, the requirement for informed consent was waived.

2.2. Study population

The Swedish Medical Birth Register was established in 1973 to collect health data on all pregnancies in Sweden (Cnattingius et al., 1990). All individuals residing in Sweden have a unique personal identification number that permits linkage between government held registers and databases. We used the medical birth register to identify all women above 15 years of age who gave birth to their first ($n = 420{,}513$) and/or second child ($n = 352{,}534$) between 2005 and 2013. Pregnancies that ended with stillbirth were excluded.

2.3. Exposure

The Swedish National Patient Register (Ludvigsson et al., 2011) provides information on psychiatric inpatient care since 1987, and outpatient care from 2001. The Swedish Prescribed Drug Register was established in 2005 and contains data on dispensed medication (Wettermark et al., 2007). ADHD was defined as having a diagnosis of ADHD according to the International Classification of Diseases (ICD), ninth or tenth edition (ICD-9: 314 or ICD-10: F90), and/or ever having been dispensed either methylphenidate, Anatomical Therapeutic Chemical (ATC) classification code N06BA04; amphetamine, ATC code N06BA01; dexamphetamine, ATC code N06BA02; atomoxetine ATC code N06BA09; or lisdexamphetamine, ATC code N06BA12, before giving birth to their first or second child. This resulted in a total of 3515 (~0.5 %) women being defined as having ADHD prior to pregnancy.

2.4. Outcomes

In line with previous research on postpartum depression based on similar data (Silverman et al., 2017), women were defined as having depression and anxiety disorders postpartum if they had received a diagnosis of depression or anxiety recorded in the patient register within 1 year after giving birth, for included ICD codes, see Table 1.

2.5. Covariates

Because previous research has demonstrated that the risk of postpartum depression is higher in younger age groups (Silverman et al., 2017), we included maternal age at delivery using 3 age categories: 15–24 years; 25–34 years; and 35+ years, retrieved from the Medical Birth Register.

We used data from the Longitudinal Integration Database for Health Insurance and Labour Market (LISA) (Ludvigsson et al., 2019) to define a proxy measure of socioeconomic status as the highest achieved maternal education at childbirth, categorized into 3 educational levels: up to 11 years; 12 to 14 years; and 15 or more years.

The Medical Birth Register was used to collect information about cohabitation status, this variable was categorized into 'Yes' = 'Lives with child's father', 'No' = includes both 'single' and 'lives together with other than child's father'.

We used the Swedish National Patient Register to retrieve

Table 1
ICD-codes included to define the presence of depression and anxiety disorders postpartum.

ICD system	Depression	Anxiety
ICD-8	790,20, 2962, 2980, 3004	300
ICD-9	296B, 298A, 311, 300E	300A, 300C, 300D, 313A
ICD-10	F32, F33, F34, F53.0	F40, F41, F42, F43

Note. Based on the Swedish version of the International Classification of Diseases (ICD) version 8, 9 and 10 codes for the identification of diagnosis.

information on a history of depression and/or anxiety disorders prior to pregnancy, as a recent population-based study found that women with a history of depression had a 21-fold increased risk of postpartum depression, compared to women without a history of depression (Silverman et al., 2017).

Similarly, we linked the index women to their biological parents and collected information on the family history of depression and/or anxiety disorders.

Because ADHD is highly comorbid with other psychiatric conditions (Kessler et al., 2006; Chen et al., 2018), we explored the role of the presence of other psychiatric disorders prior to pregnancy. We defined women as having been diagnosed with any psychiatric disorder (ICD-10 F00-F90, ICD-9 290-319) if they had been diagnosed with any non-ADHD/non-depression/non-anxiety disorder.

2.6. Statistical analysis

Data management and descriptive analyses were performed with SAS software version 9.4 (SAS Institute Inc., Cary, NC), R 3.6.1 and R Studio (R Development Core Team, 2020). To deal with the non-independence of observations (some women gave birth to their first and second child between 2005 and 2013), prevalence estimates, prevalence differences (PD) and prevalence ratios (PR) with 95 % confidence intervals (CI) were calculated using log binomial regression. All analyses described below were conducted with depression and anxiety disorders as separate outcomes.

First, we estimated the prevalence, PD and PR for depression and anxiety disorders in the postpartum period, in women with versus without ADHD (total population).

Second, we estimated the prevalence, PD and PR for depression and anxiety disorders in the postpartum period, in women with versus without ADHD, while stratifying on several key-covariates (maternal age, highest achieved maternal education, cohabitation status, history of depression, history of anxiety, and the presence of psychiatric disorders prior to pregnancy).

Third, we linked the index women to their biological parents, to examine whether a family history of depression and anxiety increased the risk of depression and anxiety disorders postpartum in women diagnosed with ADHD.

Fourth, we estimated the PR (using the Poisson approximation) for depression and anxiety disorders in the postpartum period, in women with versus without ADHD while adjusting for maternal age, maternal education, cohabitation status, presence of psychiatric disorders prior to pregnancy, history of depression disorders, history of anxiety disorders, family history of depression disorders, family history of anxiety disorders.

2.7. Sensitivity analyses

First, we replicated all analyses described in *statistical analyses* and used a combined outcome including both depression and anxiety disorders. Second, based on the combined outcome, we defined depression and anxiety disorders postpartum based on both clinical diagnoses from the patient register, but also medications from the prescribed drug register (ATC codes N06A (antidepressants) and N05B (anxiolytics), for depression and anxiety respectively). Third, we conducted independent analyses for the first (n = 420,513) and second (n = 352,534) child to examine potential differences between pregnancies. Fourth, we conducted additional analyses only including women with both a diagnosis and a prescription of ADHD. This was done with the rationale that some individuals might receive ADHD medication in the treatment of other disorders (e.g., narcolepsy). Results for these sensitivity analyses are available in the Supplementary material Tables S1-S5.

In order to examine the independent association between ADHD and depression and anxiety disorders postpartum, adjustment for all risk factors included were conducted.

3. Results

A total of 773,047 unique women gave birth to a live singleton between 2005 and 2013. Most women diagnosed with ADHD were younger when giving birth to their first child (15–24 years), compared to women without ADHD (25–34 years). Women diagnosed with ADHD were also more likely to have a lower education level (up to 11 years), compared to women without ADHD (12 to 14 years). Those diagnosed with ADHD were more likely to *not* cohabit with the father of their child (~29 %), compared to women without ADHD (~5 %). A total of 59 % of the women diagnosed with ADHD had an additional psychiatric disorder compared to only 5 % of the women without ADHD, Table 2.

3.1. Risk of depression disorders in women with and without ADHD

Overall, 16.76 % (15.56–18.03) of the women diagnosed with ADHD were diagnosed with depression disorders postpartum, compared to 3.29 % (3.25–3.33) in those without ADHD, equivalent to a prevalence difference (PD) of 13.47 % (12.06–14.87), and a PR of 5.09 (4.68–5.54), Table 3.

Stratification across known risk factors for postpartum depression revealed that the prevalence estimates of depression disorders postpartum were higher in women with ADHD than among those without ADHD. All relative risks and the absolute prevalence differences remained statistically significant across the different levels of all risk factors. The increased risk of depression disorders postpartum was lower for those with a psychiatric disorder prior to pregnancy (PR = 1.50, 1.34–1.68) compared to those without (PR = 5.02, 4.39–5.76), and lower for those with a family history of depression (PR = 2.75, 2.32–3.26) compared to those without (PR = 5.55, 5.03–6.12). In contrast, the PD of depression disorders postpartum in women with versus without ADHD was substantial across these risk factors, with PDs of 6.24 % (4.22–8.26), and 10.79 % (7.95–13.63), respectively, Table 3.

Table 2
Maternal characteristics of study cohort: in ADHD and non-ADHD women.

Maternal characteristics	ADHD: Yes	ADHD: No
	n = 3515	n = 769,532
	n *(%)*	n *(%)*
Age		
15–24	1986 *(56.50)*	128,655 *(16.72)*
25–34	1311 *(37.30)*	510,069 *(66.28)*
35–59	218 *(6.20)*	130,808 *(17.00)*
Maternal education[a], 3 levels		
1: <9 years; 9 years; 10–11 years	2253 *(64.10)*	133,352 *(17.33)*
2: 12 years; 13–14 years	955 *(27.17)*	325,151 *(42.25)*
3: 15 years; >15 years	227 *(6.46)*	304,394 *(39.56)*
Missing	80 *(2.27)*	6635 *(0.86)*
Cohabitation with father[b]		
Yes	2310 *(65.72)*	690,887 *(89.78)*
No	1013 *(28.82)*	42,995 *(5.59)*
Missing	192 *(5.46)*	35,650 *(4.63)*
Psychiatric disorders[c]		
Present	2104 *(59.86)*	43,459 *(5.65)*
Absent	1411 *(40.14)*	726,073 *(94.35)*

Note.
[a] Maternal education refers to highest achieved maternal education at childbirth.
[b] No includes both 'single' and 'lives together with other than child's father.'
[c] Psychiatric disorders refers to any non-ADHD/non-depression/non-anxiety disorder in the national patient register, that were present prior to pregnancy.

Table 3
Prevalence, Prevalence Difference (PD), and Prevalence Ratio (PR) of depression disorders postpartum in women with versus without ADHD, across categories.

	ADHD (N = 3515)			Without ADHD (N = 769,532)			Prevalence difference (PD)	95 % CI	Prevalence ratio (PR)	95 % CI
	N	Prevalence %	95 % CI	N	Prevalence %	95 % CI				
Total population	589	16.76	15.56–18.03	25,328	3.29	3.25–3.33	13.47	12.06–14.87	5.09	4.68–5.54
Age										
15–24 years	284	14.30	12.83–15.91	5734	4.46	4.35–4.57	9.84	8.07–11.62	3.21	2.83–3.64
25–34 years	256	19.53	17.47–21.76	15,257	2.99	2.94–3.04	16.54	14.20–18.87	6.53	5.79–7.37
35+ years	49	22.48	17.44–28.47	4337	3.32	3.22–3.41	19.16	13.38–24.94	6.78	5.23–8.78
Education										
<9; 9; 10–11 years	374	16.60	15.12–18.19	7012	5.26	5.14–5.38	11.34	9.58–13.11	3.16	2.83–3.52
12; 13–14 years	162	16.96	14.72–19.47	10,459	3.22	3.16–3.28	13.74	11.10–16.39	5.27	4.50–6.17
15; >15 years	43	18.94	14.38–24.54	7758	2.55	2.49–2.61	16.39	10.85–21.94	7.43	5.54–9.97
Cohabitation with father										
Yes	385	16.67	15.20–18.24	21,343	3.09	3.05–3.13	13.58	11.89–15.27	5.40	4.87–5.98
No	166	16.39	14.24–18.79	2675	6.22	6.00–6.45	10.17	7.74–12.59	2.63	2.27–3.07
Psychiatric disorder[a]										
Present	361	18.67	16.99–20.46	4213	12.43	12.08–12.78	6.24	4.22–8.26	1.50	1.34–1.68
Absent	228	14.42	12.78–16.24	21,115	2.87	2.83–2.91	11.55	9.60–13.50	5.02	4.39–5.76
History of depression										
Present	310	24.14	21.88–26.56	5762	23.91	23.38–24.45	0.23	−2.47-2.93	1.01	0.90–1.13
Absent	279	12.51	11.20–13.94	19,566	2.62	2.59–2.66	9.89	8.30–11.46	4.76	4.20–5.41
Family history of depression										
Present	148	16.95	14.61–19.59	4249	6.16	5.98–6.34	10.79	7.95–13.63	2.75	2.32–3.26
Absent	441	16.69	15.32–18.16	21,079	3.00	2.97–3.05	13.68	12.07–15.29	5.55	5.03–6.12

Note.
[a] Psychiatric disorder refers to other psychiatric disorders prior to pregnancy.

3.2. Risk of anxiety disorders in women with and without ADHD

Overall, 24.92 % (23.52–26.38) of the women diagnosed with ADHD were diagnosed with anxiety disorders postpartum, compared to 4.61 % (4.56–4.66) in those without ADHD, equivalent to a prevalence difference (PD) of 20.31 % (18.68–21.94), and a PR of 5.41 (5.06–5.78), Table 4.

Stratification across known risk factors revealed that the prevalence estimates of anxiety disorders postpartum was higher in women with ADHD than among those without ADHD. All relative risks and the absolute prevalence differences remained statistically significant across the different levels of all risk factors. The increased risk of anxiety disorders postpartum was lower for those with a psychiatric disorder prior to pregnancy (PR = 1.75, 1.61–1.91) compared to those without (PR = 5.18, 4.65–5.78), and lower for those with a family history of anxiety (PR = 3.09, 2.57–3.71) compared to those without (PR = 5.22, 4.74–5.75). In contrast, the PD of depression disorders postpartum in women with versus without ADHD was substantial across these risk factors, with PDs of 11.99 % (9.66–14.32), and 12.52 % (9.22–15.83), respectively, Table 4.

3.3. Sensitivity analyses

When using a combined outcome including both depression and anxiety disorders, results revealed similar estimates as the analyses examining depression and anxiety disorders separately, Table S1 in the Supplementary material.

Including both diagnoses from the patient register and medications from the prescribed drug register to define depression and anxiety disorders, the associations between ADHD and depression and anxiety disorders postpartum revealed similar results as in the main analyses, Table S2 in the Supplementary material.

When the first and second pregnancy was analyzed separately, it suggested no differences between pregnancies in the risk of being diagnosed with depression and/or anxiety postpartum in women diagnosed with ADHD, Tables S3-S4 in the Supplementary material.

In a sensitivity analysis, we defined that women needed to have both a clinical diagnosis in the NPR, and a prescription of ADHD medication from the PDR. These analyses revealed similar estimates, suggesting that the potential influence from misclassification, that is, some might have received ADHD medication in the treatment of other disorders, did not influence the results, Table S5 in the Supplementary material.

After adjusting for all risk factors, estimates showed an independent association between ADHD and depression and anxiety disorders postpartum, with a PR of 1.13 (1.06–1.20).

4. Discussion

In the present population-based study, we demonstrated that ADHD was associated with an increased risk of both depression and anxiety disorders in the postpartum period, after considering different subgroups of mothers (i.e., based on age, educational status, current social support, presence of psychiatric disorders prior to pregnancy, a prior history of depression or anxiety disorders, or the presence of a family history of depression or anxiety disorders). Adjusted estimates further showed an independent association between ADHD and depression and anxiety disorders postpartum emphasizing that ADHD is an important risk factor to consider in the perinatal maternal care. Primary health care providers should assess women with ADHD for the risk of depression and anxiety disorders postpartum, from the first antenatal visit. Parental education prior to conception, and psychological surveillance during, and social support after childbirth should be provided to women

Table 4
Prevalence, Prevalence Difference (PD), and Prevalence Ratio (PR) of anxiety disorders postpartum in women with versus without ADHD, across categories.

	ADHD (N = 3515)			Without ADHD (N = 769,532)			Prevalence difference (PD)	95 % CI	Prevalence ratio (PR)	95 % CI
	N	Prevalence %	95 % CI	N	Prevalence %	95 % CI				
Total population	876	24.92	23.52–26.38	35,480	4.61	4.56–4.66	20.31	18.68–21.94	5.41	5.06–5.78
Age										
15–24 years	446	22.46	20.68–24.34	8768	6.82	6.68–6.95	15.64	13.53–17.75	3.30	2.99–3.63
25–34 years	370	28.22	25.85–30.72	21,136	4.14	4.09–4.20	24.08	21.42–26.74	6.81	6.19–7.49
35+ years	60	27.52	22.02–33.80	5576	4.26	4.15–4.37	23.26	17.16–29.36	6.46	5.16–8.07
Education										
<9; 9; 10–11 years	609	27.03	25.24–28.90	10,926	8.19	8.05–8.34	18.84	16.73–20.94	3.30	3.04–3.58
12; 13–14 years	201	21.05	18.58–23.75	14,624	4.50	4.43–4.57	16.55	13.67–19.43	4.68	4.08–5.37
15; >15 years	43	18.94	14.38–24.54	9767	3.21	3.15–3.27	15.73	9.94–21.52	5.90	4.34–8.02
Cohabitation with father										
Yes	539	23.33	21.65–25.10	29,805	4.31	4.27–4.36	19.02	17.09–20.95	5.41	4.97–5.88
No	288	28.43	25.74–31.29	3861	8.98	8.71–9.25	19.45	16.48–22.42	3.17	2.84–3.53
Psychiatric disorder[a]										
Present	541	27.97	26.02–30.02	5417	15.98	15.59–16.37	11.99	9.66–14.32	1.75	1.61–1.91
Absent	335	21.19	19.25–23.27	30,063	4.09	4.04–4.13	17.10	14.81–19.39	5.18	4.65–5.78
History of anxiety										
Present	528	33.19	30.92–35.54	8252	24.44	23.99–24.90	8.75	6.06–11.43	1.36	1.25–1.47
Absent	348	18.09	16.43–19.87	27,228	3.70	3.66–3.74	14.39	12.42–16.35	4.89	4.38–5.45
Family history of anxiety										
Present	129	18.51	15.80–21.56	2666	5.99	5.77–6.21	12.52	9.22–15.83	3.09	2.57–3.71
Absent	460	16.32	15.01–17.73	22,662	3.13	3.09–3.17	13.20	11.65–14.74	5.22	4.74–5.75

Note.
[a] Psychiatric disorder refers to other psychiatric disorders prior to pregnancy.

diagnosed with ADHD.

Previous studies have shown that a prior history of depression or bipolar disorder increased the risk of postpartum depression and postpartum readmissions (Silverman et al., 2017; Munk-Olsen et al., n.d.). For example, women with a history of depression had a 21-fold increased risk of postpartum depression compared to women without a history of depression (Silverman et al., 2017). In addition, women with bipolar affective disorder had a 37-fold increased risk of postpartum readmissions compared to women without bipolar affective disorder (Munk-Olsen et al., n.d.). Our results indicate that ADHD is an important risk factor for depression and anxiety disorders during the postpartum period, although the effect size is probably lower compared to having a history of depression and bipolar disorder (Silverman et al., 2017; Munk-Olsen et al., n.d.). Importantly, we found that women diagnosed with ADHD, with and without a psychiatric disorder prior to pregnancy, were considerably more likely to be diagnosed with depression and anxiety disorders postpartum compared to women without ADHD. This emphasizes the importance of extra surveillance and support during and after pregnancy in women diagnosed not only with depression and bipolar disorder but also in those diagnosed with ADHD.

Known risk factors for postpartum depression are younger age, lower educational attainment, low levels of social support, history of depression, and depression or anxiety during pregnancy (Beck, 2001; Beck, 1996; Robertson et al., 2004; Dagher and Shenassa, 2012; Darcy et al., 2011; Nakku et al., 2006). In the present study, the relative risk (i.e., PR) of depression and anxiety disorders postpartum in women diagnosed with ADHD was consistently lower when ADHD co-occurred with these risk factors. In particular, the relative risk for depression and anxiety disorders postpartum in women diagnosed with ADHD was weaker in those with a psychiatric disorder prior to pregnancy, with a history of depression or anxiety disorders, and with a family-history of depression or anxiety disorders. One potential explanation is that women diagnosed with both ADHD and depression prior to pregnancy, or with both ADHD and anxiety disorders prior to pregnancy, might have a different type of support and treatment during and after pregnancy compared to women diagnosed with ADHD alone. This in turn could result in fewer readmissions, and therefore lower estimates in this subgroup. It is also possible that in individuals with multiple diagnoses it is more difficult to pinpoint a specific diagnosis, i.e., depression and anxiety disorders, as some symptoms could be assumed to be due to the already existing disorders (e.g., bipolar disorder). Still, all relative risks remained robust and the absolute prevalence differences were substantial across all risk factors. Further, after taking all covariates into consideration, results indicate that ADHD independently increased the risk for depression and anxiety disorders postpartum, beyond other well-established risk factors, such as of sociodemographic factors and other psychiatric disorders.

In the present study, cohabitation status did not seem to be a protective factor in individuals diagnosed with ADHD. One plausible explanation is that social support might also increase the likelihood of seeking help, leading to stronger associations in women living together with the father of the child. It is also important to highlight that ADHD is associated with an increased risk of being a teenage parent (Østergaard et al., 2017; Skoglund et al., 2019), which is mirrored in our cohort (Table 2). Therefore, some of the included pregnancies in the lowest age category might reflect unplanned pregnancies. The combination of being diagnosed with ADHD and being pregnant at a young age, could increase the vulnerability and therefore the risk of being diagnosed with a psychiatric disorder postpartum, such as depression and anxiety. However, results from the present study also show that women diagnosed with ADHD have an increased risk of depression and anxiety disorders regardless of age. This highlights the importance of health care

providers to evaluate women diagnosed with ADHD across the lifespan.

5. Strengths and limitations

This is to our knowledge the first population-based study to examine the association between clinically diagnosed ADHD and depression and anxiety disorders during the postpartum period. In addition, by using population-based registers, the present study was able to stratify on and adjust for several important risk factors for postpartum depression and anxiety disorders to see whether women with ADHD are at an increased risk of developing depression and anxiety disorders postpartum.

Some limitations need to be mentioned in relation to our findings. By using information from the Swedish Prescribed Drug Register and the National Patient Register, we do not have information about ADHD subtypes (i.e., impulsive/hyperactive, inattentive, or combined), and therefore cannot distinguish whether it is ADHD overall, or if there is a specific subtype within ADHD that increases the risk of being diagnosed with depression and anxiety disorders during the postpartum period. There is also a potential risk of surveillance bias as women diagnosed with ADHD are more likely to have repeated visits to psychiatric care and might therefore have an enhanced likelihood of also being screened/diagnosed with depression and anxiety disorders postpartum, compared to those women without ADHD. Further, even though antidepressants and anxiolytics are mainly used for depression and anxiety disorders, they are also used for some eating disorders (e.g., bulimia nervosa) (Wilson and Fairburn, 2002), and pain disorders (e.g., fibromyalgia) (Häuser et al., 2012). To minimize the risk of misclassifying the outcome of interest, the present study only included clinical diagnoses of depression and anxiety disorders from the National Patient Register in the main analyses. However, since many individuals with depression and anxiety disorders are managed in primary health care, and not in specialized healthcare, using clinical diagnoses could reflect more severe cases. The sensitivity analysis (including both medications and diagnoses) suggested no differences in the association between ADHD and depression and anxiety disorders during the postpartum period. In addition, because many women had a diagnosis of depression and anxiety prior to pregnancy, some of the diagnoses postpartum are likely to reflect readmissions.

In line with previous research (Silverman et al., 2017), the present study defined the postpartum period to be from the day of delivery to 1 year after giving birth. However, it is important to mention that the postpartum period could be divided into three distinct phases: the acute period (6–12 h postpartum), the subacute postpartum period (2–6 weeks), and the delayed postpartum period (up to 6 months) (Romano et al., 2010). The inclusion of 1 year postpartum was based on the importance of maintaining sufficient statistical power (number of women being diagnosed with ADHD and having an outcome event), and consequently, potential risk differences in the association between ADHD and depression and anxiety disorders across more specific postpartum periods were not possible to investigate.

6. Conclusions

ADHD is an important risk factor for both depression and anxiety disorders in the postpartum period and should be considered in the postpregnancy maternal care, regardless of sociodemographic factors and the presence of other psychiatric disorders. Parental education prior to conception, psychological surveillance during, and social support after childbirth should be provided to women diagnosed with ADHD.

CRediT authorship contribution statement

A.A., and H.L., were responsible for the study concept and design. A. A., and M.G.A., were responsible for statistical analysis. A.A., M.G.A., S. O., A.V., L.G., A.G., C.S., K.B.M., B.M.D., P.L., C.T., AND H.L., analyzed and/or interpreted the data. A.A., C.T., and H.L., drafted the manuscript. A.A., M.G.A., S.O., A.V., L.G., A.G., C.S., K.B.M., B.M.D., P.L., C.T., AND H.L., provided critical revision of the manuscript for important intellectual content.

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Conflict of interest

Henrik Larsson has served as a speaker for Medice, Evolan Pharma and Shire/Takeda and has received research grants from Shire/Takeda; all outside the submitted work. No other authors report any conflicts of interest.

Data availability

Data cannot be shared publicly because of the Swedish Secrecy Act. Data from the Medical Birth Register, the Multi-Generation Register and the National Patient Register were used for this study and made available by ethical approval. Researchers may apply for access through the Swedish Research Ethics Boards (www.etikprovningsmyndigheten.se) and from the primary data owners Statistics Sweden (www.scb.se) and the National Board of Health and Welfare (www.socialstyrelsen.se), in accordance with Swedish law.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2023.01.069.

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