Parental mental health conditions and use of healthcare services in children the first year of life – a register-based, nationwide study

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Abstract

Background

Parental mental health conditions have been associated with increased morbidity and use of healthcare services in the offspring. However, existing studies have not examined different severities of mental health conditions. Furthermore, the impact of paternal mental health has been overlooked.

We therefore examined the association between two severities of parental mental health conditions and the use of healthcare services for children the first year of life, exploring the impact of both maternal and paternal mental health conditions.

Methods

This register-based cohort study included all live-born children in Denmark 2000-2016. Information on socioeconomics, diagnoses, drug prescriptions and healthcare contacts was extracted from nationwide public registries. Parents were grouped according to severity, and thus the place of treatment, of the mental health condition. Poisson regression analyses were performed to estimate the incidence rate ratio (IRR) of contacts to general practice (GP), out-of-hour medical service, emergency room (ER) and out- and inpatient hospital contacts the first 12 months of life.

Results

The analyses included 964395 children. Twenty percent of the mothers and twelve percent of the father were identified with mental health condition. Paternal mental health conditions were independent associated with an increased risk of all kinds of infant healthcare contacts (GP IRR 1.05 (CI95% 1.04-1.05) and out-of-hour IRR 1.20 (CI95% 1.18-1.21)); however, the risks were higher for maternal mental health condition (GP IRR 1.17 (CI95% 1.17-1.18) and out-of-hour IRR 1.38 (CI95% 1.37-1.37)). The risks were even higher if both parents were classified with a mental health condition (GP IRR 1.24 (CI95% 1.23-1.25) and out-of-hour contacts IRR 1.48 (CI95% 1.45-1.51)), including minor (GP IRR 1.22 (CI95% 1.22-1.23) and out-of-hour IRR 1.37 (CI95% 1.35-1.39)). The overall pattern was the same for all types of healthcare contacts.

Conclusions

Both maternal and paternal mental health conditions, including minor mental health conditions, were associated with increased utilization of healthcare services. Focus on both parents as well as the presence of even minor mental health conditions may be warranted in planning of services.

What is already known on this subject?

Maternal depression or depressive symptoms and/or increase child use of healthcare services.

The role of different levels of mental health conditions in the mother as well as mental health conditions of the father are unknown.

What this study adds

Not only maternal but also paternal mental health conditions, including minor conditions only handled in primary healthcare, increased child use of healthcare services the first year of life.

Healthcare utilization was greatest if both parents had a mental health condition.

Introduction
Poor parental mental health has been associated with a number of negative short-term and long-term consequences for the health and well-being of the child\(^1,2\) including increased use of healthcare services\(^3-13\). Although it is generally acknowledged that fathers as well as mothers influence their children’s health and lives\(^2,14-17\), the father’s role is only sparsely examined. In most studies of child healthcare use father’s mental health is analyzed only as a control variable for which adjustments are made\(^4,8,18\), as the number of parents are examined (but not mother vs. father)\(^7,11\) or not at all included\(^3,5,6,9,10,12,13\). Thus, the separate effect of the father’s mental health as well as the combined effect of mother and father mental health has not been assessed.

Maternal depression based on either diagnoses or self-reported symptoms has been extensively examined and found to be positively associated with hospitalization of the child\(^3,6-10\) as well as emergency department utilization\(^7,8,10,11\). Moreover, children of mothers with depressive symptoms have been reported to have more visits at general practice\(^4,5,7,8,11,12\) as well as an increased risk of injuries\(^13\). Maternal anxiety has also been studied, although to a smaller extent, and the findings were in general comparable with the findings for depression\(^13\). Although mental health conditions, for example depression, includes a wide range of symptoms, severities and thus disabilities, existing literature do not distinguish between different severities of studied diagnoses or symptoms. Thus, the impact of different degrees of parental mental health conditions is unknown. This knowledge is needed to prioritize and plan services and interventions.

More studies are limited by being cross-sectional\(^5-7,9,19,20\) leading to concerns on the timing of exposure and outcome. Studies including self-reported symptoms\(^6,9,10\) are limited by recall bias. A register-based study provides control of exposure and outcome and ensures health professional evaluation of the mental health problems.

To address these gaps in the existing knowledge, this register-based study aimed to examine the association between two severities of poor parental mental health and the child’s use of healthcare services the first year of life, exploring the impact of both maternal and paternal mental health conditions.

### Methods

#### Study Design and Data Sources

We conducted a register-based cohort study using nationwide registers. Data linkages were achieved via the personal identity number, which is assigned to all Danish residents at birth or upon taking up residency\(^21\). Register keepers at Statistics Denmark carried out data collection and register linkage with all data having been anonymized before the researchers gained access to the data.

From The National Patient Register\(^22\) information about parental diagnoses, birth-related variables of the child and child in- and outpatient hospital contacts as well as emergency department (ER) contacts were obtained. The diagnoses were encoded using the International Classification of Diseases, 10th Revision (ICD-10). The Danish Health Service Register for Primary Care\(^23\) provided information on contacts to general practitioners (GPs), private psychiatrists and psychologists. Information on reimbursed drug prescriptions were obtained from the Danish National Prescription Registry, which uses the Anatomical Therapeutic Chemical (ATC) Classification System\(^24\). Data on parity and gestational age were accessed through the Danish Medical Birth Register\(^25\) and on deaths through the Danish Death Register. Information on parental highest completed education were extracted from the Population Education Registry\(^26\). Family income were obtained from the Income Statistics Register\(^27\). Date of birth, parental civil status, child gender, country of origin and information on whether the parents lived together with each other as well as with the child were obtained from the Danish Civil Registration System\(^21\). The included Danish registers are in general considered to be of high quality with complete long-term
follow-up28.

**Settings, Study Population And Follow-up**

The Danish healthcare system is characterized by free access. Services at general practice (GP) and public hospitals are funded by the Danish tax system and free of charge. Acute medical assistance is only delivered by public services. GP serves as gatekeeper for the hospitals, and contacts to the hospitals require a referral from the GP.

All live-born Danish children born from January 1 2000 to December 31 2016 were identified and followed the first 12 months of life. Children were excluded if they died or emigrated during the first year of life or did not live with any of the parents at the time of birth.

**Parental Mental Health**

Parental mental health was categorized in three (no mental health condition, minor and moderate-severe) using The National Patient Register, The Danish Health Service Register for Primary Care and the Danish National Prescription Registry. In Denmark, minor mental health conditions are treated by GPs or psychologists in the primary healthcare sector and are thus not registered in The National Patient Register29. GPs serve as gatekeepers in the primary healthcare sector and refer more severe mental health conditions to assessment and treatment in the secondary healthcare sector (in- and outpatient wards at the hospitals or private psychiatrists). Diagnoses are not registered in The Danish Health Service Register for Primary Care; therefore, minor mental health conditions need to be identified otherwise. Talk therapy and performed psychometric tests at GP as well as contacts to psychologist are registered in The Danish Health Service Register for Primary Care and were used to identify minor mental health conditions. Furthermore, reimbursed prescriptions of antidepressant and anxiolytic medication were used. Other psychotropic medication, for example antipsychotics, were not included due to broader indications, for example nausea or analgesics.

Moderate to severe mental health conditions were identified as a registered psychiatric diagnosis (ICD-10 F00-99) at psychiatric hospital or contact to private psychiatrist. All the mental health condition indicators were measured within five years before the birth of the child. A reference group was defined as no mental health-related contacts to GP, no contacts to psychologist or private psychiatrist, no reimbursed prescriptions of antidepressants or anxiolytic medication and no registered psychiatric diagnosis within five years before the birth of the child (see Box 1).

These two groups, minor (group 1) respectively moderate-severe (group 2) mental health conditions, and the unexposed reference group generated a matrix of exposures for the child due to the combinations of the mother respectively the father in the different groups.
Box 1. Criteria for exposure. Consensus definition of groups of mental conditions.

| Exposure | Specification | Further criteria | Healthcare sector and registry |
|----------|---------------|------------------|--------------------------------|
| **Group 1**<br><i>Minor mental health conditions</i> | At least one criterion fulfilled | All criteria fulfilled |  |
| **Medication** | - At least 2 prescriptions of:<br>- antidepressant medicine (ATC N06AB, N06AX)  
- anxiolytic (benzodiazepines: ATC N03AE, N05BA, N05CD, N05CF) | No contacts to psychiatric hospital and no psychiatric hospital diagnoses | Primary healthcare sector  
The Danish Health Service Register for Primary Care  
Danish National Prescription Registry |
| **Services at general practice** | - At least two ‘talk therapy’  
- At least two psychometric tests | No records of contact to private psychiatrist | |
| **Other services** | - At least one contact to private psychologist |  |  |
| **Group 2**<br><i> Moderate to severe mental health conditions</i> |  |  |  |
| - Any registered psychiatric diagnosis (ICD-10 F00-99) at psychiatric hospital | Secondary healthcare sector  
The National Patient Register  
The Danish Health Service Register for Primary Care |  |  |
| - Mental health conditions treated at private psychiatrists (including child and adolescent psychiatrists) |  |  |  |
| **Reference group**<br><i>No mental health condition</i> | None of above |  |  |
| - No registrations of psychiatric diagnoses and no mental health condition-related contacts to GP, psychologist or private psychiatrist <b>and</b>  
- No prescriptions of antidepressants or anxiolytic drugs |  |  |  |

Exposure was measured in a period of 5 years before the birth of the child

**Outcomes**

All healthcare service contacts within the first year of life were identified for every child. Vaccinations and routine childcare visits were not included in this study. A contact to GP daytime or out-of-hour service was defined as either consultation, telephone contact or visit. Due to changes in the delivery of out-of-hour service in the Capital Region in 2014, children from this region were excluded from the out-of-hour analyses from 2014–2016. An inpatient contact was defined as any admission to hospital, and an outpatient hospital contact as any registered contact to an outpatient unit. Due to changes in the registration of neonatal outpatient contacts during the study period, only outpatient contacts after the neonatal period (the first 28 days of life) were
included. Any registered contact to the emergency department was defined as an ER contact.

**Covariates**

Covariates, that potentially could confound the association between parental mental health conditions and child use of healthcare services, were identified by reviewing the literature. A directed acyclic graph\(^{30,31}\) was constructed to evaluate the identified covariates (see supplements). All covariates were extracted at the time of birth of the child, except family income, which was extracted the calendar year before.

Based on the International Standard Classification of Education (ISCED 2011)\(^ {32}\), parental education was grouped according to highest completed education in three: 1: Early childhood education, primary and lower secondary education (ISCED levels 0–2); 2: General upper secondary education, high school programs, vocational upper secondary education, vocational training and education (ISCED 3–4); and 3: Short-, medium-length or long-length higher education, first-, second- or third-cycle programs, tertiary education, bachelor or equivalent, Master’s or equivalent, Doctoral, PhD programs or equivalent (5–8).

Family income was defined as the equivalated disposable income for the family that take into account the number of children and adults in the household. We adjusted for family income, parental age at time of birth of the child and calendar year using restricted cubic splines with three knots\(^ {33}\).

Family type was classified as either living with two biological or adoptive parents or not.

Small-for-gestational-age (SGA) was defined as a birthweight for gestational age under the 2.3-percentile and large-for-gestational-age (LGA) as a birthweight for gestational age over the 97.7-percentile based on the national guidelines\(^ {34,35}\). Parity was grouped in two according to whether the child was the first child of the mother or not.

**Statistics**

Baseline information was analyzed and reported as percentages based on maternal respectively paternal mental health condition. In the following analyses, the maternal and paternal groups were combined and in total, eight exposure groups and one reference group were generated.

The median number of events for each outcome variable was calculated, and for each exposure group with an outcome above the median the total number and percentages was calculated. Poisson regression analyses\(^ {36}\), crude and adjusted, were applied to the number of outcome events for each child during follow-up to estimate the incidence rate ratio (IRR) of experiencing the outcome.

Siblings appear in the cohort and should preferably be treated in the analyses as dependent. However, a mixed effects model was not possible to apply to such a large dataset. Instead, we made sensitivity analyses including only first born children.

Non-fatal birth defects, prematurity and other significant conditions in early life might necessitate a higher number of healthcare contacts the first year of life. To examine whether such conditions affected the estimates, a sensitivity analyses excluding children admitted for at least one week during the first month of life.

Data was analyzed using Stata SE 15.1.

**Results**

The cohort included 1050385 children. Children were excluded if they died during the first year of life, were not living with either of the parents at the time of birth or emigrated the first year of life (0.9%). Due to missing parental personal identity number or if the parent were not living in the country in the exposure period 75677 children (7.2%) were excluded. Characteristics of the excluded population is presented in the supplements. In
total 964395 children were included in the analyses (Fig. 1, flow chart study population).

Educational level for both parents were lower in group 2 compared with the reference group and group 1 (table 1). Parents in group 2 tended to be younger compared with group 1 and the reference group. In 14% of the group 1 mothers, the corresponding father was also in group 1 (22% in the case of the fathers). For the mothers 11% and 8% were in group 1 and 2, respectively, and for the fathers, the percentages were 8 and 5. Number and percentages of mental healthcare service, prescriptions and diagnoses in the exposure groups are further described in the supplements.

For all outcomes, children in the exposure groups were more likely to have healthcare contacts above the median than children of parents in the reference group (Table 2).

Table 1
Baseline characteristics (total numbers and percentages) for parental mental health condition and reference group

|                      | Mother |                | Father |                |
|----------------------|--------|----------------|--------|----------------|
|                      | Reference group | Group 1 | Group 2 | Reference group | Group 1 |
| Children total N (%) | 773734 (80.2) | 111040 (11.4) | 79621 (8.3) | 843353 (87.4) | 72551 (7.5) |
| Boys, percentages   | 51.3   | 51.4           | 51.4   | 51.3           | 51.3   |
| Girls, percentages  | 48.7   | 48.6           | 48.6   | 48.7           | 48.7   |
| Small/large for gestational age, percentages |     |                |        |                |
| SGA                  | 2.2    | 2.3            | 2.9    | 2.2            | 2.5    |
| Normal               | 95.0   | 94.9           | 94.4   | 95.0           | 94.8   |
| LGA                  | 2.8    | 2.7            | 2.5    | 2.8            | 2.6    |
| Missing              | 0.1    | 0.1            | 0.1    | 0.1            | 0.1    |
| Parity, percentages  |        |                |        |                |
| First child          | 42.9   | 43.4           | 48.3   | 43.3           | 42.4   |
| Second or more       | 55.9   | 55.5           | 50.4   | 55.5           | 56.4   |
| Missing              | 1.2    | 1.0            | 1.3    | 1.2            | 1.2    |
| Age, percentages     |        |                |        |                |
| < 25                 | 10.6   | 10.4           | 23.1   | 5.2            | 4.9    |
| 25-32                | 50.3   | 45.5           | 43.8   | 38.3           | 30.8   |
### Educational level, percentages

|       | Low   | Medium | High  | Missing |
|-------|-------|--------|-------|---------|
| >32   | 39.1  | 44.0   | 33.2  | 54.2    |
| Missing | 0.0   | 0.0    | 0.0   | 2.4     |

### Household income, percentages

|       | Low   | Medium | High  | Missing |
|-------|-------|--------|-------|---------|
| >32   | 32.6  | 27.8   | 37.8  | 31.9    |
| Missing | 10.1  | 13.8   | 22.2  | 10.4    |

### Family type, percentages

|       | Living with two biological/adoptive parents | Other | Missing |
|-------|--------------------------------------------|-------|---------|
| >32   | 94.5                                       | 5.0   | 0.6     |
| Missing | 94.2                                       | 5.2   | 0.6     |

### Mental health condition of the other parent, percentages

|       | Reference group | Group 1 | Group 2 |
|-------|-----------------|---------|---------|
| >32   | 90.1            | 6.1     | 3.9     |
| Missing | 78.8            | 14.4    | 6.8     |

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Table 2
Number and percentages of children with the outcome in each group

|       | GP daytime |
|-------|------------|
| >32   |            |
| Missing |            |

9
|                                | Median number of contacts | Number and percentages of children with 1 or more contacts, N (%) |
|--------------------------------|---------------------------|---------------------------------------------------------------|
|                                |                           | Mother                                                        |
|                                |                           | Father                                                        |
| **Out-of-hour contacts**       |                           |                                                              |
|                                |                           | **Mental health group**                                        |
|                                |                           | 0                                                             |
|                                |                           | 1                                                             |
|                                |                           | 2                                                             |
|                                |                           | **Father**                                                     |
|                                |                           | 0                                                             |
|                                |                           | 160048 (53.8)                                                 |
|                                |                           | 24013 (62.0)                                                  |
|                                |                           | 17895 (62.1)                                                  |
|                                |                           | **Father**                                                     |
|                                |                           | 0                                                             |
|                                |                           | 11577 (56.8)                                                  |
|                                |                           | 3891 (63.0)                                                   |
|                                |                           | 2764 (65.7)                                                   |
|                                |                           | **Father**                                                     |
|                                |                           | 0                                                             |
|                                |                           | 7829 (55.7)                                                   |
|                                |                           | 2132 (63.0)                                                   |
|                                |                           | 2132 (63.0)                                                   |
| **ER contacts**                |                           |                                                              |
|                                |                           | **Mental health group**                                        |
|                                |                           | 0                                                             |
|                                |                           | 1                                                             |
|                                |                           | 2                                                             |
|                                |                           | **Father**                                                     |
|                                |                           | 0                                                             |
|                                |                           | 139063 (46.7)                                                 |
|                                |                           | 19506 (50.4)                                                  |
|                                |                           | 16481 (57.2)                                                  |
|                                |                           | **Father**                                                     |
|                                |                           | 0                                                             |
|                                |                           | 9769 (47.9)                                                   |
|                                |                           | 3111 (50.3)                                                   |
|                                |                           | 2475 (58.8)                                                   |
|                                |                           | **Father**                                                     |
|                                |                           | 0                                                             |
|                                |                           | 7396 (52.7)                                                   |
|                                |                           | 1879 (55.5)                                                   |
|                                |                           | 3292 (60.6)                                                   |
### Inpatient contacts

| Mental health group | 0 | 1 | 2 |
|---------------------|---|---|---|
| **Mother**          | 0 | 1 | 2 |
| **Father**          | 0 | 1622 (11.5) | 418 (12.3) | 749 (13.8) |
|                     | 1 | 7164 (35.1) | 2446 (39.6) | 1919 (45.6) |
|                     | 2 | 5133 (36.5) | 1394 (41.2) | 2522 (46.4) |

### Outpatient contacts

| Mental health group | 0 | 1 | 2 |
|---------------------|---|---|---|
| **Mother**          | 0 | 1 | 2 |
| **Father**          | 0 | 69907 (23.5) | 11419 (29.5) | 8911 (30.9) |
|                     | 1 | 5556 (27.3) | 1875 (30.3) | 1451 (34.5) |
|                     | 2 | 3740 (26.6) | 1081 (31.9) | 1927 (35.5) |

Adjusted Poisson regression analyses (Table 3) showed a higher use of healthcare contacts if both parents were classified with mental health conditions compared to only one parent. Crude IRR are presented in the supplements.

| Table 3 |
|---------|
| Adjusted incidence rate ratio (95% confidence interval) of healthcare contacts for each exposure group |
Adjusted for calendar year, sex, parental age, parental education, family income, family type, SGA and parity

### GP contacts daytime, adjusted

| Mental health condition | Mother | Father | Reference | 1 | 2 |
|-------------------------|--------|--------|-----------|---|---|
|                         |        |        |           |   |   |
| 0                      |        |        |           |   |   |
| 1                      |        |        | 1.17 (1.17 - 1.18) | 1.18 (1.18 - 1.18) |   |
| 2                      |        |        |           |   |   |

### Out-of hour contacts, adjusted

| Mental health condition | Mother | Father | Reference | 1 | 2 |
|-------------------------|--------|--------|-----------|---|---|
|                         |        |        |           |   |   |
| 0                      |        |        |           |   |   |
| 1                      |        |        | 1.26 (1.25 - 1.27) | 1.38 (1.37 - 1.39) |   |
| 2                      |        |        |           |   |   |

### ER contacts, adjusted

| Mental health condition | Mother | Father | Reference | 1 | 2 |
|-------------------------|--------|--------|-----------|---|---|
|                         |        |        |           |   |   |
| 0                      |        |        |           |   |   |
| 1                      |        |        | 1.13 (1.11 - 1.16) | 1.34 (1.31 - 1.38) |   |
| 2                      |        |        |           |   |   |

### Inpatient contacts, adjusted

|         | Mother |         |         |         |         |
|---------|--------|---------|---------|---------|---------|
|         |        |         |         |         |         |
| Mental health condition | 0             | 1        | 2        |
|-------------------------|---------------|----------|----------|
| Father                  | Reference     | 1.25 (1.24 - 1.26) | 1.38 (1.36 - 1.40) |
|                         | 1             | 1.10 (1.09 - 1.12) | 1.32 (1.29 - 1.35) | 1.48 (1.44 - 1.52) |
|                         | 2             | 1.12 (1.10 - 1.14) | 1.26 (1.22 - 1.30) | 1.41 (1.37 - 1.45) |

**Outpatient contacts, adjusted**

| Mental health condition | 0        | 1        | 2        |
|-------------------------|----------|----------|----------|
| Father                  | Reference | 1.20 (1.19 - 1.21) | 1.29 (1.28 - 1.30) |
|                         | 1        | 1.07 (1.06 - 1.08) | 1.27 (1.25 - 1.29) | 1.58 (1.56 - 1.61) |
|                         | 2        | 1.12 (1.10 - 1.13) | 1.20 (1.18 - 1.23) | 1.48 (1.46 - 1.51) |

Notably, there was a higher use of healthcare contacts in all categories if both parents were classified in group 1 (out-of-hour contacts IRR 1.37 (CI95% 1.35–1.39) and ER IRR 1.24 (CI95% 1.18–1.30)) compared to the mother in group 1 and the father in the reference group (out-of-hour contacts IRR 1.26 (CI95% 1.25–1.27) and ER IRR 1.13 (CI95% 1.11–1.16)). The incidence rates of out-of-hour, ER, inpatient and outpatient contacts increased if the mother was classified with mental health condition group 2 compared to group 1. For GP contacts, the IRRs did not differ when comparing maternal group 1 and 2. The IRR of any of the outcomes did not differ markedly when comparing paternal group 1 and 2 mental health condition, except for ER contacts when the mother was classified as being reference (group 1 IRR 1.13 (CI95% 1.10–1.17) and group 2 IRR 1.29 (CI95% 1.25–1.33)).

For most healthcare contacts, the IRRs were highest if the mother had a mental health condition. However, the IRRs of ER contacts were similar for maternal and paternal mental health conditions.

The sensitivity analyses including only first-born children (n = 418785) did not change the estimates markedly, neither did the sensitivity analyses excluding children with at least one week of admission (940397 children included in the analyses). Results are shown in the supplements.

**Discussion**

Both maternal and paternal mental health conditions were independently associated with child use of healthcare services the first year of life. These associations were found even for minor mental health condition only handled in primary care, and the risk was higher if both parents had a mental health condition.

**Interpretation**

A range of factors might explain the association between parental mental health conditions and increased use of healthcare services in infants. These factors are related to parental healthcare behavior, healthcare service-related factors and the health of the child. First, it has been argued that mothers with depression/anxiety are more likely to seek medical care for their child’s minor injuries. Furthermore, prenatal anxiety was associated...
with less parenting self-efficacy\textsuperscript{37} and higher level of stress\textsuperscript{37,38} that consequently might lead to increasing parental need of medical guidance and assessment.

Second, health professionals might be more likely to schedule extra contacts for children of vulnerable parents\textsuperscript{39}; therefore, increased use of healthcare services might not necessarily be negative. Moreover and third, children of parents with poor mental health might be more likely to have poor health which has been confirmed by a recent systematic review and meta-analysis\textsuperscript{2}. A Danish study found a higher use of primary healthcare as well as a higher rate of positive tests (C-reactive protein, Strep A test, Urinary stix) in children of mothers with depression which could be interpreted as a higher rate of infectious disease\textsuperscript{4}.

Mental health conditions of the father appeared to influence the utilization of the healthcare services, in particular if the mother was also classified with mental health conditions. Vice versa, having a parent without a mental health condition reduced the impact of mental health condition illustrating a possible protective impact of the ‘mentally healthy’ parent.

The risks of GP and inpatient contacts did not differ whether the father was classified with a group 1 or group 2 mental health condition and only minor differences were seen for outpatient contacts. This was also the case for maternal health conditions and GP contacts. These findings might indicate that the mental vulnerability in general and not the severity of the mental health condition influences the use of healthcare services.

However, increased severity of maternal mental health condition increased the risks of most healthcare contacts (out-of-hour, ER, inpatient and outpatient contacts). This points to the hypothesis that different mechanisms might explain the use of different types of healthcare services.

**Implications For Policy, Practice And Research**

This study showed an association between paternal mental health condition and the use of healthcare services of the child emphasizing the important role of the mental health of the father that is often overlooked in research\textsuperscript{2} as well as in society\textsuperscript{40}.

Minor mental health conditions are only handled in primary care and might have less public and political attention compared to more severe mental illness. However, this study revealed an association between minor mental health conditions and increased use of healthcare in infants for all categories of healthcare services. Noteworthy, the estimates for some of the outcomes did not differ whether the parent was classified with a minor or moderate/major mental health condition. These findings point to a greater focus on minor mental health conditions in mothers as well as fathers in the planning of services in the pre- and postnatal care and throughout the first year of life.

Further research is needed to explore the mechanisms behind parental mental health conditions and the use of healthcare services including examining whether the children have a greater incidence of morbidities.

**Strengths And Limitations**

The study has several strengths: The nationwide registries on an entire birth cohort in Denmark allows for powerful statistical analyses. The Danish registries are considered valid in terms of completeness, registration processes and accuracy\textsuperscript{22-24, 41}.

This study also has some limitations. There is a risk of misclassification of minor parental mental health condition (group 1) as we cannot access diagnoses, indication of prescribed medication or talk therapy or the results of the psychometric tests from The Danish Health Service Register for Primary Care. Furthermore, we only identified the parents with poor mental health who sought medical care. Thus, parents with poor mental health without any mental health condition-related contacts to GP, private psychologist, prescribed antidepressants or anxiolytic drugs or contacts to psychiatrist or psychiatric hospital were misclassified as being...
in the reference group. Moreover, parents with psychiatric disorder that have no records at psychiatric hospital within five years before birth of the child were also misclassified as being in the reference group. The above-mentioned possible misclassifications may underestimate the association between parental mental health conditions and infant healthcare use.

The cohort included births during several years hence including many calendar years in the follow-up period. This led to many structural changes during the follow-up period e.g. changes of guidelines and the procedures of registration. Both exposure groups, especially group 1, were markedly smaller in the first years of the study period increasing throughout the period (data not shown). This issue was handled in the analyses by controlling for calendar year.

**Conclusion**

Both maternal and paternal, minor as well as moderate/severe, mental health conditions were associated with an increased use of all types healthcare services for the child the first year of life. The risk was greater if both parents had a mental health condition. These findings point to a greater focus on both parents as well as minor mental health conditions in the planning and delivery of healthcare services.

**Declarations**

**Consent for publication**

Not applicable.

**Availability of data**

No data are available. It is not possible to share data according to Danish law. Access are only granted to researcher directly responsible for conducting the specific study.

**Ethics approval**

Ethical approval is not needed for register-based studies in Denmark. The project was approved by Statistics Denmark before gaining access to the data.

**Competing interests**

The authors declare that they have no competing interests.

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**Authors’ contributions**

SH, MNJ, CO, SPJ and KF contributed to the planning, design, analysis and interpretation of the data. MNJ performed data management. SH performed the statistical analyses and drafted the manuscript. SH, MNJ, CO, SPJ and KF revised the manuscript critically. SH, MNJ, CO, SPJ and KF gave approval for the final manuscript.

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1. Stein A, Pearson RM, Goodman SH, et al. Effects of perinatal mental disorders on the fetus and child. Lancet. 2014;384(9956):1800–19. doi:10.1016/S0140-6736(14)61277-0.

2. Pierce M, Hope HF, Kolade A, et al. Effects of parental mental illness on children’s physical health: systematic review and meta-analysis. Br J Psychiatry. 2019;1–10. doi:10.1192/bjp.2019.216.

3. Jacques N. Prenatal and postnatal maternal depression and infant hospitalization and mortality in the first year of life: A systematic review and meta-analysis. J Affect Disord. 2019;243(April 2018):201–8. doi:10.1016/j.jad.2018.09.055.

4. Lyngsøe BK, Rytter D, Munk-Olsen T, Vestergaard CH, Christensen KS, Bech BH. Maternal depression and primary healthcare use for children: a population-based cohort study in Denmark. Br J Gen Pract. 2018.

5. Chee CYI, Chong Y-S, Ng TP, Lee DTS, Tan LK, Fones CSL. The association between maternal depression and frequent non-routine visits to the infant’s doctor—a cohort study. J Affect Disord. 2008;107(1–3):247–53. doi:10.1016/j.jad.2007.08.004.

6. Guttmann A, Dick P, To T. Infant hospitalization and maternal depression, poverty and single parenthood - a population-based study. Child Care Heal Dev. 2004;30(1):67–75.

7. Dreyer K, Williamson RAP, Hargreaves DS, Rosen R, Deeny SR. Associations between parental mental health and other family factors and healthcare utilisation among children and young people: a retrospective, cross-sectional study of linked healthcare data. BMJ Paediatr Open. 2018;2(1):e000266. doi:10.1136/bmjpo-2018-000266.

8. Farr SL, Dietz PM, Rizzo JH, et al. Health care utilisation in the first year of life among infants of mothers with perinatal depression or anxiety. Paediatr Perinat Epidemiol. 2013;27(1):81–8. doi:10.1111/ppe.2012.9.117.

9. Latendresse G, Wong B, Dyer J, Wilson B, Baksh L, Hogue C. Duration of Maternal Stress and Depression: Predictors of Newborn Admission to Neonatal Intensive Care Unit and Postpartum Depression. Nurs Res. 2015;64(5):331–41. doi:10.1097/NNR.0000000000000117.

10. Minkovitz CS, Strobino D, Scharfstein D, et al. Maternal depressive symptoms and children’s receipt of health care in the first 3 years of life. Pediatrics. 2005;115(2):306-14. doi:10.1542/peds.2004-0341.

11. Sills MR, Shetterly S, Xu S, Magid D, Kempe A. Association between parental depression and children’s health care use. Pediatrics. 2007;119(4):e829-36. doi:10.1542/peds.2006-2399.

12. Ververs TF, van Wensen K, Freund MW, et al. Association between antidepressant drug use during pregnancy and child health care utilisation. BJOG. 2009;116(12):1568–77. doi:10.1111/j.1471-0528.2009.02292.x.

13. Baker R, Kendrick D, Tata LJ, Orton E. Association between maternal depression and anxiety episodes and rates of childhood injuries: A cohort study from England. Inj Prev. 2017;23(6):396–402. doi:10.1136/injuryprev-2016-042294.

14. Rehel EM. When Dad Stays Home Too: Paternity Leave, Gender, and Parenting. Gend Soc. 2014;28(1):110–32. doi:10.1177/0891243213503900.

15. Clapton G. Dad Matters - Why Fathers Should Figure In Your Work. Fathers Network Scotland. https://d3n8a8pro7vhmx.cloudfront.net/fathersnetwork/pages/84/attachments/original/1434965317/DadMatters.pdf?1434965317. Published 2014. Accessed November 21, 2019.

16. Andreasson J, Johanssen T. Becoming a half-time parent: Fatherhood after divorce. J Fam Stud. 2019;25(1):2–17. doi:10.1080/13229400.2016.1195277.

17. Bach AS. The Ambiguous Construction of Nondominant Masculinity: Configuring the “New” Man through Narratives of Choice, Involved Fatherhood, and Gender Equality. Men Masc. 2019;22(2):338-59. doi:10.1177/1097184X17715494.

18. Raitasalo K, Holmila M, Autili-Rämö I, Notkola IL, Tapanainen H. Hospitalisations and out-of-home placements of children of substance-abusing mothers: A register-based cohort study. Drug Alcohol Rev. 2015;34(1):38-45. doi:10.1111/dar.12121.

19. Lagerberg D, Magnusson M. Utilization of child health services, stress, social support and child characteristics in primiparous and multiparous mothers of 18-month-old children. Scand J Public Health. 2013;41(4):374–83. doi:10.1177/1403494813484397.
20. Raphael JL, Zhang Y, Liu H, Giardino AP. Parenting stress in US families: Implications for paediatric healthcare utilization. Child Care Health Dev. 2010;36(2):216–24. doi:10.1111/j.1365-2214.2009.01052.x.

21. Pedersen CB. The Danish civil registration system. Scand J Public Health. 2011;39(7):22–5. doi:10.1177/1403494810387965.

22. Schmidt M, Schmidt SAJ, Sandegaard JL, Ehrenstein V, Pedersen L, Toft Sørensen H. The Danish National Patient Registry: a review of content, data quality, and research potential. Clin Epidemiol. 2015;7:449–90. doi:10.2147/CLEP.S91125.

23. Sahl Andersen J, De Fine Olivarius N, Krasnik A. The Danish national health service register. Scand J Public Health. 2011;39(7):34–7. doi:10.1177/1403494810394718.

24. Wallach Kildemoes H, Toft Sørensen H, Hallas J. The Danish national prescription registry. Scand J Public Health. 2011;39(7):38–41. doi:10.1177/1403494810394717.

25. Bliddal M, Broe A, Pottegård A, Olsen J, Langhoff-Roos J. The Danish Medical Birth Register. Eur J Epidemiol. 2018;33(1):27–36. doi:10.1007/s10654-018-0356-1.

26. Jensen VM, Rasmussen AW. Danish education registers. Scand J Public Health. 2011;39(7):91–4. doi:10.1177/1403494810394715.

27. Baadsgaard M, Quitzau J. Danish registers on personal income and transfer payments. Scand J Public Health. 2011;39(7):103–5. doi:10.1177/1403494811405098.

28. Schmidt M, Schmidt SAJ, Adelborg K, et al. The Danish health care system and epidemiological research: from health care contacts to database records. Clin Epidemiol. 2019;11:563–91. doi:10.2147/CLEP.S179083.

29. Shrier I, Platt RW. Reducing bias through directed acyclic graphs. BMC Med Res Methodol. 2008;8(1):70. doi:10.1186/1471-2288-8-70.

30. Greenland S, Pearl J, Robins JM. Causal Diagrams for Epidemiologic Research. Epidemiology. 1999;10(1):37–48. doi:10.1097/00001648-199901000-00008.

31. United Nation Educational Scientific an Cultural Organisation (UNESCO). International Standard Classification of Education. http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf.

32. Desquiblet L, Mariotti F. Dose-response analyses using restricted cubic spline functions in public health research. Stat Med. 2010;29(9):1037–57. doi:10.1002/sim.3841.

33. Barker DJP. Fetal programming of coronary heart disease. Trends Endocrinol Metab. 2002;13(9):364–8. doi:10.1016/S1043-2760(02)00689-6.

34. Westergaard HB, Zingenberg H, Gjerris AC, et al. IUGR - Sandbjerg Guideline 2014.; 2014.

35. Huizink AC, Menting B, De Moor MHM, et al. From prenatal anxiety to parenting stress: a longitudinal study. Arch Womens Ment Health. 2017;20(5):663–72. doi:10.1007/s00737-017-0746-5.

36. Glahder Lindberg L, Thorsen T, Reventlow S [The Work with Vulnerable Patients and Social Inequality in General Practice. A Focus Group Examination with GPs] in Danish. København; 2011.

37. Foreningen Far [Fathers' Association]. [Catalogue of Equality 2017 (in Danish)].; 2017. https://files.site.surftown.com/f2/8a/f28a1aa0-1416-43ae-a68c-a5a6ee4860a8.pdf.

38. Schmidt M, Pedersen L, Sørensen HT. The Danish Civil Registration System as a tool in epidemiology. Eur J Epidemiol. 2014;29(8):541–9. doi:10.1007/s10654-014-9930-3.
1,050,385 children in the population

- Child died during the study
- Child not living with parents, n=1,769 (0.2%)
- Child emigrated from the country, n=1,769 (0.4%)
- Missing parental permission
- Parent not living in the country during the period prior to the study

964,395 children included in the study (91.8%)

Figure 1
Flow chart study population

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