Obstetric and neonatal outcomes in pregnant women with and without a history of specialist mental health care: a national population-based cohort study using linked routinely collected data in England

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Summary

Background Pregnant women with pre-existing mental illnesses have increased risks of adverse obstetric and neonatal outcomes compared with pregnant women without pre-existing mental illnesses. We aimed to estimate these differences in risks according to the highest level of pre-pregnancy specialist mental health care, defined as psychiatric hospital admission, crisis resolution team (CRT) contact, or specialist community care only, and the timing of the most recent care episode in the 7 years before pregnancy.

Methods Hospital and birth registration records of women with singleton births between April 1, 2014, and March 31, 2018 in England were linked to records of babies and records from specialist mental health services provided by the England National Health Service, a publicly funded health-care system. We compared the risks of adverse pregnancy outcomes, including fetal and neonatal death, preterm birth, and babies being born small for gestational age (SGA; birthweight <10th percentile), and composite indicators for neonatal adverse outcomes and maternal morbidity, between women with and without a history of contact with specialist mental health care. We calculated odds ratios adjusted for maternal characteristics (aORs), using logistic regression.

Findings Of 2 081 043 included women (mean age 30·0 years; range 18–55 years; 77·7% White, 11·4% South Asian, 4·7% Black, and 6·2% mixed or other ethnic background), 151 770 (7·3%) had at least one pre-pregnancy specialist mental health-care contact. 7247 (0·3%) had been admitted to a psychiatric hospital, 29 770 (1·4%) had CRT contact, and 114 753 (5·5%) had community care only. With a pre-pregnancy mental health-care contact, risk of stillbirth or neonatal death within 7 days of birth was not significantly increased (0·45–0·49%; aOR 1·11, 95% CI 0·99–1·24): risk of preterm birth (<37 weeks) increased (6·5–9·8%; aOR 1·53, 1·35–1·73), as did risk of SGA (6·2– 7·5%; aOR 1·34, 1·30–1·37) and neonatal adverse outcomes (6·4–8·4%; aOR 1·37, 1·21–1·55). With a pre-pregnancy mental health-care contact, risk of maternal morbidity increased slightly from 0·9% to 1·0% (aOR 1·18, 1·12–1·25). Overall, risks were highest for women who had a psychiatric hospital admission any time or a mental health-care contact in the year before pregnancy.

Interpretation Information about the level and timing of pre-pregnancy specialist mental health-care contacts helps to identify women at increased risk of adverse obstetric and neonatal outcomes. These women are most likely to benefit from dedicated community perinatal mental health teams working closely with maternity services to provide integrated care.

Funding National Institute for Health Research.

Introduction

There is considerable evidence that pregnant women with pre-existing mental illnesses have an increased risk of adverse birth outcomes, including preterm births and babies being small for gestational age (SGA). The risk appears greater in women with severe mental illnesses.[1] There is less consistent evidence of an increased risk of stillbirth and neonatal death. This inconsistency is potentially due to the lack of statistical power of previous studies that examine these outcomes in women with less common illnesses such as schizophrenia. A further issue is the scarcity of recording, or inconsistent recording, of the severity of symptoms in mental health-care datasets that are routinely collected.[2]

There is little evidence about the extent to which the level of specialist mental health care that women received before their pregnancy (as a proxy for severity of illness), as well as the timing of the most recent specialist mental health-care episode, is associated with adverse obstetric and neonatal outcomes. Such evidence would assist maternity and mental health professionals in identifying women at the highest risk and offering

Lancet Psychiatry 2023

Published Online
August 14, 2023
https://doi.org/10.1016/S2215-0366(23)00200-6

See Online/Comment
https://doi.org/10.1016/S2215-0366(23)00236-5

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Research in context

Evidence before this study

We searched MEDLINE from database inception to May 21, 2023, for comprehensive evidence reviews of the association between maternal prenatal mental health and adverse pregnancy outcomes, using the following search terms: ("prenatal mental health", "perinatal mental health") and ("stillbirth", "preterm", "neonatal", or "child") and "review". A 2014 *Lancet* series reviewing the evidence on the effects of maternal perinatal mental disorders on the fetus and child highlighted identification of parents and children at increased risk of adverse outcomes as an essential first step to enabling effective prevention and treatment. A narrative review published in 2020, considering more recent evidence summaries, concluded that it is well established that women with common mental disorders and severe mental illness have increased risks of adverse obstetric and neonatal outcomes, but also showed that there is little evidence at the national and international level about the extent of these increases in risk according to the nature and severity of the mental disorders or their timing in relation to pregnancy. The only comprehensive systematic review and meta-analysis to date of the association between maternal mental disorders and stillbirth and neonatal mortality, published in 2021, estimated a 60% increase in the risk of stillbirth and neonatal death in women with a prenatal mental disorder compared with women without. This review found large between-study heterogeneity, most likely explained by differences in the definition of the maternal mental health conditions recorded. This explanation is in line with a systematic review published in 2016, which shows wide variation in the recording of mental health diagnoses in large electronic health datasets.

Added value of this study

In our study of 2 million women who gave birth to a singleton baby in the England National Health Service between 2014 and 2018, to overcome the inconsistent and incomplete recording of mental health diagnoses in most administrative datasets, especially for depressive disorders and anxiety, we used the highest level of specialist mental health care as a proxy for the severity of the disorders, and the timing of the most recent pre-pregnancy specialist mental health-care contact to distinguish pregnant women's mental health-care histories. We found that approximately 1 in 14 women had at least one pre-pregnancy specialist mental health-care contact and that, in these women, the risk of adverse obstetric and neonatal outcomes was increased, even if they only had specialist mental health care in a community setting more than 5 years before the pregnancy. However, risks were higher in women with a pre-pregnancy specialist health-care contact that reflects a more severe mental illness (eg, a psychiatric hospital admission or involvement of a crisis resolution team), and in women who had a more recent pre-pregnancy specialist mental health-care contact. The risk of maternal morbidity was only slightly increased in women who had a pre-pregnancy specialist mental health-care contact.

Implications of all the available evidence

Our results show that information about the level and the timing of pre-pregnancy mental health care can support identifying women at an increased risk of adverse obstetric and neonatal outcomes. Using information about pre-pregnancy contacts in this way will help to overcome the often inconsistent and incomplete recording of mental health diagnoses. Information about the level and timing of pre-pregnancy specialist mental health care could support identifying women who are most likely to benefit from models of care, which could be provided by dedicated community perinatal mental health teams integrated with midwifery care aiming to provide continuity of care.

them appropriate care. In the UK, it is recommended that all pregnant women with a history of moderate-to-severe mental illness are referred to a specialist perinatal mental health-care team for assessment and, if needed, treatment.[3] These teams are commissioned to work closely with maternity services to provide integrated care.[4] We use the term specialist mental health care as a more generically applicable label for secondary mental health care or, in other words, the care that patients typically access either in case of a serious emergency or after a referral from a health-care professional in primary care who acts as the first line of contact.

This study aimed to compare the risks of adverse pregnancy outcomes, including fetal and neonatal death, preterm birth, baby born SGA, and composite indicators for neonatal adverse outcomes and maternal morbidity, between women with and those without a history of mental illness (defined as a care episode with secondary mental health-care services before pregnancy).[5,6] We used linked national datasets and differentiated risk levels according to the highest level of specialist mental health care and according to the timing of the most recent episode.[7,8]

See Online for appendix

Methods

Study design and participants

Maternity episodes for women aged 18 years and older with a recorded gestation of at least 24 completed weeks who had a singleton birth in the England National Health Service (NHS) between April 1, 2014 and March 31, 2018 were identified from Hospital Episode Statistics (HES; the administrative database of all care episodes in general NHS hospitals) and the Personal Demographics Service (PDS) birth notifications (see appendix p 2). Women who gave birth before 24 weeks

were not included because there is no legal requirement to register babies born before 24 weeks of gestation without signs of life in the UK.[9] Women who had a multiple birth were not included because their risk of adverse pregnancy outcomes is inherently increased.[10] It is also difficult to disentangle adverse events possibly linked to a pre-pregnancy specialist mental health-care history from those linked to women who have had multiple births.

Women were considered to have had a pre-existing mental illness if there was evidence in the mental health-care datasets that they had had a contact with specialist mental health care in the 7 years before pregnancy onset. These secondary care contacts typically need a referral from a general practitioner or are part of urgent or emergency care.[11] To determine the onset of pregnancy, we subtracted the gestational age at birth minus 2 weeks (or 38 weeks if gestational age was not available) from the date of birth.

Specialist mental health-care contacts were categorised by the level of care: an admission to a psychiatric ward, including generic psychiatric wards, mother–baby units, and secure wards (highest level); involvement of a specialist mental health crisis resolution team (CRT) providing intensive treatment at home (middle level); and other care contacts with specialist mental health care, including day care and outpatient or community-based care (lowest level). If women had received different levels of mental health care, they were categorised according to the highest level of care received. The timing of the most recent mental health-care contact (of any type) was categorised as more than 5 years, 1–5 years, or less than 1 year before the onset of pregnancy.

HES records provided data on maternal age, parity, previous caesarean sections, ethnicity, pre-existing hypertension, pre-existing diabetes, pre-eclampsia and eclampsia, and gestational diabetes (appendix p 2). Socioeconomic deprivation was derived from quintiles of the national ranking of the Index of Multiple Deprivation 2019 (IMD) of the women's area of residence.[12] Ethics approval was provided by the NHS Health Research Authority (19/SW/0218) and the data were provided by the NHS Data Access Request Service (DARS-NIC-376141-W5D3L-v0.9). As the data were pseudonymised, patient consent was not required.

Procedures

This study used three consecutive versions of the national dataset of specialist mental health care provided by the NHS, which together include mental health-care episodes from April 1, 2006 to the onset of pregnancy, linked at the patient level to the HES[13,14] and the birth notifications of the PDS.[15] Records on mental health-care episodes provided between December, 2015, and March, 2016 were not available for technical reasons. Data are routinely collected as part of the health service delivery. HES records include patient demographics, admission dates, diagnoses according to ICD-10 codes,[16] and procedures coded according to the OPCS Classification of Interventions and Procedures version 4 (OPCS-4) codes.[17] HES records of maternity episodes include additional information in the HES maternity tail.[9] HES and PDS records of women giving birth were linked to HES records of their babies. PDS birth records contained additional information on stillbirth, gestational age, and birthweight, which was used if HES data were missing.

Outcomes

Study outcomes were stillbirth or neonatal death within 7 days of birth, preterm birth (birth before 37 completed weeks of gestation), birth of a baby born SGA (birthweight <10th percentile using the UK–WHO gestationally corrected growth charts),[18] and two composite adverse outcome indicators that capture neonatal and maternal morbidity. The English Neonatal Adverse Outcome Indicator for liveborn babies is derived from the information on 15 ICD-10 diagnoses and seven OPCS-4 procedures present in the babies' HES records before inpatient discharge after birth (appendix p 3).[19] The English Maternal Morbidity Outcome Indicator is derived from 17 ICD-10 diagnoses (including acute psychosis, but no other mental illness

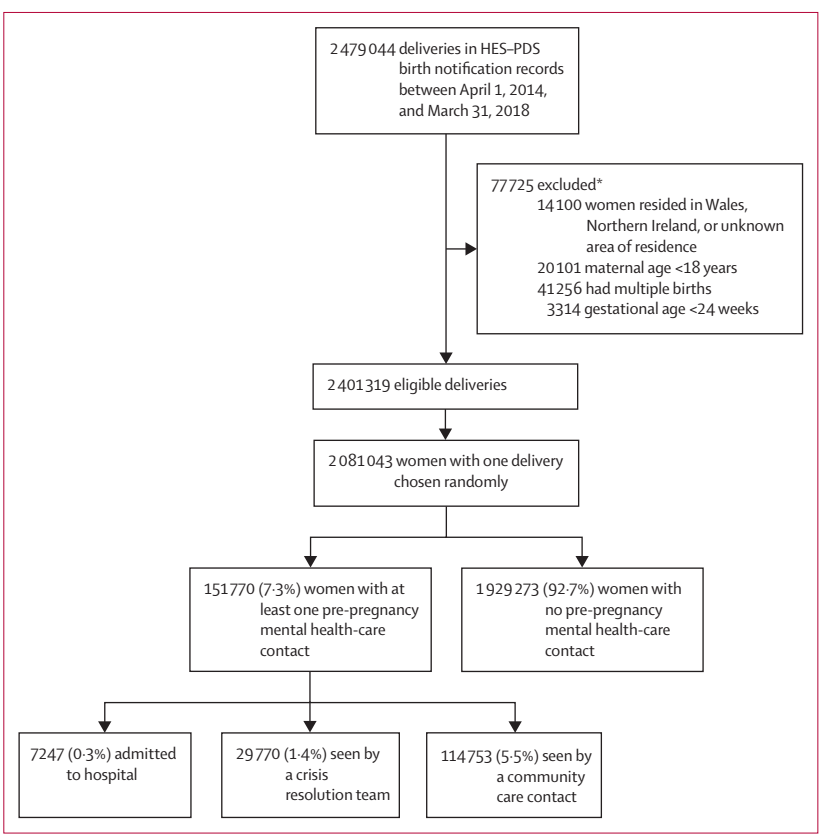

Figure: **Flow diagram**
HES=Hospital Episode Statistics. PDS=Personal Demographics Service. *Some patients were excluded for more than one criterion.

	All women (n=2 081 043)	Presence of contact		Type of contact			Timing of contact		
		No contact (n=1 929 273)	At least one (n=151 770)	Community care contact (n=114 753)	Crisis resolution team (n=29 770)	Hospital admission (n=7247)	>5 years (n=22 007)	1–5 years (n=85 097)	<1 year (n=44 666)
Maternal age (missing n=28 [<0·01%])									
18–24 years	365 554 (17·6%)	323 329 (16·8%)	42 225 (27·8%)	30 640 (26·7%)	9715 (32·6%)	1870 (25·8%)	2722 (12·4%)	22 627 (26·6%)	16 876 (37·8%)
25–34 years	1 250 692 (60·1%)	1 167 627 (60·5%)	83 065 (54·7%)	63 574 (55·4%)	15 552 (52·2%)	3939 (54·4%)	14 542 (66·1%)	47 174 (55·4%)	21 349 (47·8%)
35–39 years	374 489 (18·0%)	353 674 (18·3%)	20 815 (13·7%)	16 225 (14·1%)	3477 (11·7%)	1113 (15·4%)	3703 (16·8%)	12 063 (14·2%)	5049 (11·3%)
≥40 years	90 280 (4·3%)	84 619 (4·4%)	5661 (3·7%)	4312 (3·8%)	1024 (3·4%)	325 (4·5%)	1039 (4·7%)	3232 (3·8%)	1390 (3·1%)
Parity (missing n=91 523 [4·4%])									
Nulliparous	870 661 (43·8%)	816 530 (44·3%)	54 131 (37·3%)	40 284 (36·8%)	11 226 (39·4%)	2621 (38·0%)	7067 (33·7%)	29 081 (35·8%)	17 983 (42·1%)
Multiparous no previous caesarean section	931 397 (46·8%)	856 325 (46·4%)	75 072 (51·8%)	57 113 (52·1%)	14 396 (50·5%)	3563 (51·7%)	11 370 (54·2%)	42 743 (52·6%)	20 959 (49·0%)
Multiparous with previous caesarean section	187 462 (9·4%)	171 720 (9·3%)	15 742 (10·9%)	12 137 (11·1%)	2895 (10·2%)	710 (10·3%)	2523 (12·0%)	9413 (11·6%)	3806 (8·9%)
Ethnicity (missing n=292 757 [14·1%])									
White	1 388 951 (77·7%)	1 268 938 (76·8%)	120 013 (88·1%)	91 285 (88·8%)	23 510 (87·1%)	5218 (80·8%)	17 237 (87·8%)	67 270 (88·1%)	35 506 (88·3%)
South Asian	204 298 (11·4%)	197 302 (11·9%)	6996 (5·1%)	5199 (5·1%)	1403 (5·2%)	394 (6·1%)	1038 (5·3%)	4084 (5·3%)	1874 (4·7%)
Black	84 198 (4·7%)	80 238 (4·9%)	3960 (2·9%)	2607 (2·5%)	886 (3·3%)	467 (7·2%)	601 (3·1%)	2126 (2·8%)	1233 (3·1%)
Mixed	31 957 (1·8%)	29 213 (1·8%)	2744 (2·0%)	1930 (1·9%)	618 (2·3%)	196 (3·0%)	398 (2·0%)	1481 (1·9%)	865 (2·2%)
Other stated	78 882 (4·4%)	76 399 (4·6%)	2483 (1·8%)	1724 (1·7%)	573 (2·1%)	186 (2·9%)	353 (1·8%)	1407 (1·8%)	723 (1·8%)
Socioeconomic deprivation (missing n=35 [<0·01%])									
Least deprived=quintile 1	313 034 (15·0%)	297 314 (15·4%)	15 720 (10·4%)	12 662 (11·0%)	2527 (8·5%)	531 (7·3%)	2829 (12·9%)	9108 (10·7%)	3783 (8·5%)
Quintile 2	352 242 (16·9%)	331 487 (17·2%)	20 755 (13·7%)	16 348 (14·2%)	3624 (12·2%)	783 (10·8%)	3416 (15·5%)	12 009 (14·1%)	5330 (11·9%)
Quintile 3	402 454 (19·3%)	375 299 (19·5%)	27 155 (17·9%)	20 776 (18·1%)	5185 (17·4%)	1194 (16·5%)	4097 (18·6%)	15 436 (18·1%)	7622 (17·1%)
Quintile 4	471 646 (22·7%)	435 640 (22·6%)	36 006 (23·7%)	26 834 (23·4%)	7231 (24·3%)	1941 (26·8%)	5134 (23·3%)	19 923 (23·4%)	10 949 (24·5%)
Most deprived=quintile 5	541 632 (26·0%)	489 510 (25·4%)	52 122 (34·3%)	38 124 (33·2%)	11 201 (37·6%)	2797 (38·6%)	6531 (29·7%)	28 615 (33·6%)	16 976 (38·0%)
Pregnancy risk factors (missing=91 523 [4·4%])									
Pre-existing diabetes	16 786 (0·8%)	14 839 (0·8%)	1947 (1·3%)	1395 (1·3%)	430 (1·5%)	122 (1·8%)	278 (1·3%)	1045 (1·3%)	624 (1·5%)
Pre-existing hypertensive conditions	12 467 (0·6%)	11 504 (0·6%)	963 (0·7%)	738 (0·7%)	172 (0·6%)	53 (0·8%)	158 (0·8%)	545 (0·7%)	260 (0·6%)
Gestational diabetes	112 043 (5·4%)	104 021 (5·6%)	8022 (5·5%)	5891 (5·4%)	1630 (5·7%)	501 (7·3%)	1208 (5·8%)	4415 (5·4%)	2399 (5·6%)
Pre-eclampsia or eclampsia	42 680 (2·1%)	39 618 (2·1%)	3062 (2·1%)	2279 (2·1%)	628 (2·2%)	155 (2·2%)	417 (2·0%)	1666 (2·1%)	979 (2·3%)

Table 1: **Maternal characteristics at time of birth and pre-pregnancy specialist mental health-care contact**

www.thelancet.com/psychiatry Published online August 14, 2023 https://doi.org/10.1016/S2215-0366(23)00200-6

diagnosis, suicide, or substance misuse) and nine OPCS-5 procedures in HES records of the maternity episode (appendix p 3).[6] For the purpose of this study, acute psychosis was not included. This study aimed to compare the risks of adverse pregnancy outcomes, including fetal and neonatal death, preterm birth, and babies being born SGA, as well as composite indicators for neonatal adverse outcomes and maternal morbidity between women with and without a history of mental illness.

Statistical analysis

The statistical analysis was not specified in a pre-published study protocol, given that there is little experience with these national mental health services datasets as a source of information about risk factors for obstetric and neonatal outcomes. However, all obstetric and neonatal outcomes follow accepted definitions. The definition of the comparison groups according to severity and timing of the pre-pregnancy mental health-care contacts was guided by creating clinically relevant groups as equal in size as possible. Odds ratios adjusted for all maternal characteristics described above (aORs) and their 95% CIs were estimated with logistic regression.

Models were fitted with robust standard errors to account for clustering of outcomes within hospitals. We estimated four models. Model 1 compared women with versus women without a pre-pregnancy specialist mental health-care contact. Model 2 compared women grouped according to the highest level of their pre-pregnancy mental health-care contact against women without a pre-pregnancy mental health-care contact (reference category) using a joint Wald test to estimate an overall p value. Model 3 is the corresponding model with women grouped according to the timing of the most recent pre-pregnancy health-care contact. Model 4 included both the groupings according to the level and the timing of the pre-pregnancy mental health-care contacts. With this model, we compared women with a community mental health-care contact more than 5 years before pregnancy against women without any mental health-care contact. We also tested the differences according to the severity and the timing of these contacts using joint Wald tests.

	n/N	Risk (%)	Unadjusted odds ratio (95% CI)	p value	Adjusted* odds ratio (95% CI)	p value
All women†	9121/2 021 289	0·45%	NA	NA	NA	NA
Model 1: any previous specialist mental health-care contact	..	..	..	0·12	..	0·078
No contact	8396/1 873 823	0·45%	1 (ref)	..	1 (ref)	..
At least one previous contact	725/147 466	0·49%	1·10 (0·98–1·24)	..	1·11 (0·99–1·24)	..
Model 2: type	..	..	..	0·0081‡	..	0·0058‡
No contact	8396/1 873 823	0·45%	1 (ref)	..	1 (ref)	..
Community care contact	526/111 434	0·47%	1·05 (0·92–1·21)	..	1·07 (0·93–1·22)	..
Crisis resolution team	153/28 992	0·53%	1·18 (1·01–1·38)	..	1·18 (1·02–1·35)	..
Hospital admission	46/7040	0·65%	1·46 (1·14–1·88)	..	1·44 (1·13–1·84)	..
Model 3: timing	..	..	..	0·077‡	..	0·048‡
No contact	8396/1 873 823	0·45%	1 (ref)	..	1 (ref)	..
>5 years	106/21 434	0·49%	1·11 (0·94–1·32)	..	1·14 (0·94–1·37)	..
1–5 years	385/8746	0·47%	1·04 (0·91–1·19)	..	1·05 (0·92–1·20)	..
<1 year	234/43 286	0·54%	1·21 (1·03–1·42)	..	1·20 (1·05–1·37)	..
Model 4: type and timing	..	..	..	0·30	..	0·23
No contact	8396/1 873 823	0·45%	1 (ref)	..	1 (ref)	..
Community care contact >5 years	87/19 119	0·46%	1·09 (0·92–1·30)	..	1·12 (0·93–1·35)	..
Type (reference: community care contact >5 years)	..	..	..	0·094‡	..	0·15‡
Crisis resolution team	153/28 992	0·53%	1·11 (0·94–1·31)	..	1·10 (0·93–1·30)	..
Hospital admission	46/7040	0·65%	1·34 (1·02–1·77)	..	1·32 (1·00–1·75)	..
Timing (reference: community care contact >5 years)	..	..	..	0·21‡	..	0·27‡
1–5 years	385/8746	0·47%	0·92 (0·76–1·11)	..	0·91 (0·76–1·09)	..
<1 year	234/43 286	0·54%	1·04 (0·83–1·30)	..	1·02 (0·83–1·25)	..
Interaction type × timing	NA	NA	NA	0·20	NA	0·20

NA=not applicable. *Adjusted for maternal age, parity and previous caesarean section, maternal ethnicity, socioeconomic deprivation, pre-existing diabetes, pre-existing hypertension, gestational diabetes, and pre-eclampsia or eclampsia. †Of the 2 081 043 included women, data on stillbirth or neonatal death were missing for 59 754 women (2·9%). ‡p value of joint test that the odds ratios are equal to 1.

Table 2: **Risk of stillbirth and neonatal mortality according to the highest level and the timing of the most recent pre-pregnancy mental health-care contact**

	n/N	Risk (%)	Unadjusted odds ratio (95% CI)	p value	Adjusted* odds ratio (95% CI)	p value
All women†	136 899/2 039 580	6·7%	NA	NA	NA	NA
Model 1: any previous specialist mental health-care contact	..	..	..	<0·0001	..	<0·0001
No contact	122 343/1 890 694	6·5%	1 (ref)	..	1 (ref)	..
At least one previous contact	14 556/148 886	9·8%	1·57 (1·36–1·81)	..	1·53 (1·35–1·73)	..
Model 2: type	..	..	..	<0·00001	..	<0·0001‡
No contact	122 343/1 890 694	6·5%	1 (ref)	..	1 (ref)	..
Community care contact	10 386/112 505	9·2%	1·47 (1·25–1·73)	..	1·44 (1·25–1·66)	..
Crisis resolution team	3219/29 262	11·0%	1·79 (1·59–2·02)	..	1·73 (1·57–1·90)	..
Hospital admission	951/7 119	13·4%	2·22 (2·03–2·43)	..	2·11 (1·96–2·28)	..
Model 3: timing	..	..	..	<0·001‡	..	<0·0001‡
No contact	122 343/1 890 694	6·5%	1 (ref)	..	1 (ref)	..
>5 years	1834/21 572	8·5%	1·35 (1·14–1·58)	..	1·33 (1·15–1·54)	..
1–5 years	7790/83 538	9·3%	1·49 (1·28–1·73)	..	1·46 (1·28–1·66)	..
<1 year	4932/43 776	11·3%	1·83 (1·59–2·11)	..	1·77 (1·58–1·97)	..
Model 4: type and timing	..	..	..	0·0013	..	<0·0001
No contact	122 343/1 890 694	6·5%	1 (ref)	..	1 (ref)	..
Community care contact >5 years	1593/19 257	8·3%	1·32 (1·11–1·56)	..	1·31 (1·12–1·52)	..
Type (reference: community care contact >5 years)	..	..	..	<0·0001‡	..	<0·0001‡
Crisis resolution team	3219/29 262	11·0%	1·18 (1·11–1·26)	..	1·16 (1·09–1·24)	..
Hospital admission	951/7 119	13·4%	1·41 (1·25–1·59)	..	1·38 (1·22–1·55)	..
Timing (reference: community care contact >5 years)	..	..	..	<0·0001‡	..	<0·0001‡
1–5 years	7790/83 538	9·3%	1·08 (1·02–1·15)	..	1·07 (1·01–1·13)	..
<1 year	4932/43 776	11·3%	1·28 (1·21–1·37)	..	1·26 (1·18–1·33)	..
Interaction type × timing	NA	NA	NA	0·75	NA	0·55

NA=not applicable. *Adjusted for maternal age, parity and previous caesarean section, maternal ethnicity, socioeconomic deprivation, pre-existing diabetes, pre-existing hypertension, gestational diabetes, and pre-eclampsia or eclampsia. †Of the 2 081 043 included women, data on gestational age were missing for 41 463 women (2·0%). ‡p value of joint test that the odds ratios are equal to 1.

Table 3: **Risk of preterm birth according to the highest level and the timing of the most recent pre-pregnancy mental health-care contact**

Data on neonatal death were missing for maternal records not linked to neonatal records (2·9% missing); data on SGA were missing for maternal records with incomplete information on birthweight, sex of the baby, or gestational age (2·5%); data on preterm births were missing for maternal records with incomplete information on gestational age (2·0%); data on neonatal adverse outcome were missing for maternal records identified from PDS records only or for maternal records not linked to neonatal records (4·7%); and data on maternal adverse outcomes were missing for maternal records identified from PDS records only (4·4%). For regression analyses, missing values for outcomes and risk factors were imputed using chained equations to generate ten datasets.[20] Stata 17 (StataCorp, College Station, TX, USA) was used for all analyses. A p value of less than 0·05 was considered to represent statistical significance.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

Of the 2 081 043 women who were identified in the administrative hospital or birth registrations data with a singleton birth, 151 770 (7·3%) had at least one pre-pregnancy face-to-face contact with specialist mental health care: 7247 (0·3%) had at least one admission to a psychiatric hospital, 29 770 (1·4%) had at least one CRT contact (and no hospital admission), and 114 753 (5·5%) had at least one specialist community contact (and no hospital admission or CRT contact; figure).

Mean maternal age was 30·0 years (SD 5·6, IQR 26–34), with age ranging from 18 to 55 years (table 1). Women with at least one pre-pregnancy specialist mental health-care contact were more likely multiparous than women without contact, from a white ethnic background, and from more socioeconomically deprived areas; they also were more likely to have pre-existing diabetes. Women who only had a community care contact were less likely to come from deprived areas than women whose highest level of specialist mental health-care contact was a CRT contact or a psychiatric hospital admission. Women whose most recent specialist mental health-care contact

	n/N	Risk (%)	Unadjusted odds ratio (95% CI)	p value	Adjusted* odds ratio (95% CI)	p value
All women†	127 968/2 030 048	6·3%	NA	NA	NA	NA
Model 1: any previous specialist mental health-care contact	..	..	..	<0·0001	..	<0·0001
No contact	116 829/1 882 019	6·2%	1 (ref)	..	1 (ref)	..
At least one previous contact	11139/148 029	7·5%	1·23 (1·19–1·27)	..	1·34 (1·30–1·37)	..
Model 2: type	..	..	..	<0·0001‡	..	<0·0001‡
No contact	116 829/1 882 019	6·2%	1 (ref)	..	1 (ref)	..
Community care contact	8130/111 873	7·3%	1·18 (1·14–1·23)	..	1·30 (1·26–1·34)	..
Crisis resolution team	2337/29 086	8·0%	1·32 (1·26–1·39)	..	1·39 (1·32–1·46)	..
Hospital admission	672/7070	9·5%	1·58 (1·45–1·72)	..	1·64 (1·51–1·79)	..
Model 3: timing	..	..	..	<0·0001‡	..	<0·0001‡
No contact	116 829/1 882 019	6·2%	1 (ref)	..	1 (ref)	..
>5 years	1383/21 472	6·4%	1·04 (0·98–1·10)	..	1·21 (1·14–1·28)	..
1–5 years	6056/83 058	7·3%	1·19 (1·14–1·23)	..	1·31 (1·27–1·35)	..
<1 year	3700/43 499	8·5%	1·41 (1·34–1·48)	..	1·45 (1·39–1·51)	..
Model 4: type and timing	..	..	..	0·35	..	<0·0001
No contact	116 829/1 882 019	6·2%	1 (ref)	..	1 (ref)	..
Community care contact >5 years	1217/19 168	6·4%	1·03 (0·97–1·09)	..	1·20 (1·13–1·27)	..
Type (reference: community care contact >5 years)	..	..	..	<0·0001‡	..	<0·0001‡
Crisis resolution team	2337/29 086	8·0%	1·08 (1·03–1·14)	..	1·05 (1·00–1·10)	..
Hospital admission	672/7070	9·5%	1·25 (1·15–1·37)	..	1·22 (1·12–1·33)	..
Timing (reference: community care contact >5 years)	..	..	..	<0·0001‡	..	<0·0001†
1–5 years	6056/83 058	7·3%	1·13 (1·06–1·20)	..	1·07 (1·01–1·14)	..
<1 year	3700/43 499	8·5%	1·31 (1·22–1·41)	..	1·17 (1·09–1·26)	..
Interaction type × timing	NA	NA	NA	0·065	NA	0·18

NA=not applicable. *Adjusted for maternal age, parity and previous caesarean section, maternal ethnicity, socioeconomic deprivation, pre-existing diabetes, pre-existing hypertension, gestational diabetes, and pre-eclampsia or eclampsia. †Of the 2 081 043 included women, data on small for gestational age were missing for 50 995 women (2·5%). ‡p value of joint test that odds ratios are equal to 1.

Table 4: **Risk of small-for-gestational-age birth according to the highest level and the timing of the most recent pre-pregnancy mental health-care contact**

was within 1 year before the pregnancy were younger, more often nulliparous, and from more deprived areas than women whose most recent care contact occurred more than 1 year before the pregnancy.

The risk of stillbirth or neonatal death within 7 days was 0·45% in women without a pre-pregnancy specialist mental health-care contact and 0·49% in women with a pre-pregnancy specialist mental health-care contact, but this increase was not significant (model 1: aOR 1·11, 95% CI 0·99–1·24, p=0·078; table 2). This risk varied according to the highest level of the women's mental health-care contact (model 2), and it was higher in women who had a CRT contact (0·53%, aOR 1·18, 1·02–1·35) or an admission to a psychiatric hospital (0·65%, aOR 1·44, 1·13–1·84, overall p=0·0058). Similarly, this risk varied according to the timing of the women's most recent mental health-care contact (model 3), and was highest in women with an admission within 1 year before pregnancy (0·54%, aOR 1·20, 1·05–1·37, overall p=0·048). When we used the model that included both the level and timing of the pre-pregnancy contacts (model 4), we did not find significant evidence that risks were increased in women who had a community care contact more than 5 years before the pregnancy compared with women without a pre-pregnancy contact (p=0·23). Neither did we find that the risks differed according to the level (overall p=0·15) or timing (overall p=0·27) of the pre-pregnancy contact. There was no significant interaction between the level and timing of the pre-pregnancy contacts (p=0·20).

The risk of preterm birth was 6·5% in women without a pre-pregnancy specialist mental health-care contact and 9·8% in women with a pre-pregnancy specialist mental health-care contact (model 1: aOR 1·53, 95% CI 1·35–1·73, p<0·0001; table 3). This risk gradually increased with the level of mental health-care contact (model 2) from 9·2% in women who had a community care contact only (aOR 1·44, 1·25–1·66), to 11·0% in women who had a CRT contact (aOR 1·73, 1·57–1·90), to 13·4% in women with a psychiatric hospital admission (aOR 2·11, 1·96–2·28, overall p<0·0001). We also found a gradual increase in risk inversely associated with the timing of the most recent contact (model 3), from 8·5% in women with a contact more than 5 years before the

	n/N	Risk (%)	Unadjusted odds ratio (95% CI)	p value	Adjusted* odds ratio (95% CI)	p value
All women†	129 859/1 983 950	6·5%	NA	NA	NA	NA
Model 1: any previous specialist mental health-care contact	..	..	..	<0·0001	..	<0·0001
No contact	117 688/1 839 124	6·4%	1 (ref)	..	1 (ref)	..
At least one previous contact	12 171/144 826	8·4%	1·34 (1·17–1·54)	..	1·37 (1·21–1·55)	..
Model 2: type	..	..	..	<0·0001‡	..	<0·0001‡
No contact	117 688/1 839 124	6·4%	1 (ref)	..	1 (ref)	..
Community care contact	8692/109 427	7·9%	1·26 (1·08–1·48)	..	1·29 (1·12–1·49)	..
Crisis resolution team	2647/28 486	9·3%	1·50 (1·35–1·68)	..	1·52 (1·38–1·66)	..
Hospital admission	832/6913	12·0%	2·01 (1·83–2·22)	..	1·98 (1·82–2·16)	..
Model 3: timing	..	..	..	<0·0001‡	..	<0·0001‡
No contact	117 688/1 839 124	6·4%	1 (ref)	..	1 (ref)	..
>5 years	1574/21 005	7·5%	1·18 (1·01–1·38)	..	1·21 (1·05–1·40)	..
1–5 years	6558/81 312	8·1%	1·29 (1·11–1·49)	..	1·32 (1·15–1·50)	..
<1 year	4039/42 509	9·5%	1·53 (1·35–1·75)	..	1·55 (1·39–1·72)	..
Model 4: type and timing	..	..	..	0·082	..	0·024
No contact	117 688/1 839 124	6·4%	1 (ref)	..	1 (ref)	..
Community care contact >5 years	1387/18 751	7·4%	1·16 (0·98–1·36)	..	1·19 (1·02–1·38)	..
Type (reference: community care contact >5 years)	..	..	..	<0·0001‡	..	<0·0001‡
Crisis resolution team	2647/28 486	9·3%	1·16 (1·08–1·25)	..	1·15 (1·06–1·24)	..
Hospital admission	832/6913	12·0%	1·51 (1·34–1·72)	..	1·46 (1·29–1·66)	..
Timing (reference: community care contact >5 years)	..	..	..	<0·0001‡	..	<0·0001‡
1–5 years	6558/81 312	8·1%	1·06 (1·01–1·12)	..	1·06 (1·00–1·12)	..
<1 year	4039/42 509	9·5%	1·22 (1·15–1·30)	..	1·20 (1·13–1·28)	..
Interaction type × timing	NA	NA	NA	0·097	NA	0·051

NA=not applicable. *Adjusted for maternal age, parity and previous caesarean section, maternal ethnicity, socioeconomic deprivation, pre-existing diabetes, pre-existing hypertension, gestational diabetes, and pre-eclampsia or eclampsia. †Of the 2 081 043 included women, data on a neonatal adverse outcome were missing for 97 093 (4·7%). ‡p value of joint test that odds ratios are equal to 1.

Table 5: **Risk of a neonatal adverse outcome according to the highest level and the timing of the most recent pre-pregnancy mental health-care contact**

pregnancy (aOR 1·33, 1·15–1·54), to 9·3% in women with a contact 1–5 years before the pregnancy (aOR 1·46, 1·28–1·66), to 11·3% in women with a contact less than 1 year before the pregnancy (aOR 1·77, 1·58–1·97; overall p<0·0001). This overall pattern of results was consistent with that seen when we analysed the risk of preterm birth using the model that included both the level and timing of the pre-pregnancy mental health-care contacts. There was no evidence of a statistical interaction between the level and timing of the pre-pregnancy contacts (p=0·55).

The risk of a baby being born SGA was 6·2% in women without a pre-pregnancy specialist mental health-care contact and 7·5% in women with a pre-pregnancy specialist mental health-care contact (model 1: aOR 1·34, 95% CI 1·30–1·37, p<0·0001; table 4). We found a gradual increase in risk with the highest level of the mental health-care contact (model 2), from 7·3% in women with a community care contact (aOR 1·30, 1·26–1·34), to 8·0% in women with a CRT contact (aOR 1·39, 1·32–1·46), to 9·5% in women who had a hospital admission (aOR 1·64, 1·51–1·79, overall p<0·0001). We also found a gradual increase in risk inversely associated with the timing of the most recent contact (model 3), from 6·4% in women with a contact more than 5 years before pregnancy (aOR 1·21, 1·14–1·28), to 7·3% in women who had a contact between 1 year and 5 years before pregnancy (aOR 1·31, 1·27–1·35), to 8·5% in women with a contact less than 1 year before pregnancy (aOR 1·45, 1·39–1·51, overall p<0·001). Again, this pattern of results was consistent with that seen when we modelled the risk of a baby being born SGA, including both the level and timing of the pre-pregnancy contacts (model 4). There was no evidence of a statistical interaction between the level and timing of the pre-pregnancy contacts (p=0·18).

The risk of neonatal adverse outcomes, defined using the composite neonatal outcome indicator, was 6·4% without a pre-pregnancy specialist mental health-care contact and 8·4% with a pre-pregnancy specialist mental health-care contact (model 1: aOR 1·37, 95% CI 1·21–1·55, p<0·0001; table 5). The pattern of results according to the level and timing of the mental health-care contacts followed that observed for the risk of preterm birth and babies born SGA. The appendix (p 4) shows the breakdown into the specific components of the neonatal adverse outcome indicator.

	n/N	Risk (%)	Unadjusted odds ratio (95% CI)	p value	Adjusted* odds ratio (95% CI)	p value
All women†	17 968/1 989 520	0·9%	NA	NA	NA	NA
Model 1: any previous specialist mental health-care contact	..	..	..	<0·0001	..	<0·0001
No contact	16 528/1 844 575	0·9%	1 (ref)	..	1 (ref)	..
At least one previous contact	1440/144 945	1·0%	1·11 (1·05–1·17)	..	1·18 (1·12–1·25)	..
Model 2: type	..	..	..	0·0006‡	..	<0·0001‡
No contact	16 528/1 844 575	0·9%	1 (ref)	..	1 (ref)	..
Community care contact	1093/109 534	1·0%	1·11 (1·05–1·19)	..	1·20 (1·13–1·28)	..
Crisis resolution team	269/28 517	0·9%	1·05 (0·93—1·19)	..	1·10 (0·97–1·25)	..
Hospital admission	78/6 894	1·1%	1·27 (1·02–1·58)	..	1·26 (1·01–1·57)	..
Model 3: timing	..	..	..	0·0001‡	..	<0·0001‡
No contact	16 528/1 844 575	0·9%	1 (ref)	..	1 (ref)	..
>5 years	186/20 960	0·9%	0·99 (0·86–1·14)	..	1·06 (0·93–1·22)	..
1–5 years	795/81 237	1·0%	1·09 (1·02–1·18)	..	1·17 (1·09–1·26)	..
<1 year	459/42 748	1·1%	1·20 (1·10 1·30)	..	1·26 (1·16–1·37)	..
Model 4: type and timing	..	..	..	0·98	..	0·31
No contact	16 528/1 844 575	0·9%	1 (ref)	..	1 (ref)	..
Community care contact >5 years	167/18 709	0·9%	1·00 (0·87–1·15)	..	1·07 (0·94–1·23)	..
Type (reference: community care contact >5 years)	..	..	..	0·37‡	..	0·29‡
Crisis resolution team	269/28 517	0·9%	0·92 (0·81–1·06)	..	0·90 (0·79–1·03)	..
Hospital admission	78/6 894	1·1%	1·09 (0·86–1·38)	..	1·01 (0·79–1·28)	..
Timing (reference: community care contact >5 years)	..	..	..	0·033‡	..	0·046‡
1–5 years	795/81 237	1·0%	1·11 (0·95–1·29)	..	1·11 (0·96–1·29)	..
<1 year	459/42 748	1·1%	1·21 (1·04–1·42)	..	1·21 (1·02–1·41)	..
Interaction type × timing	NA	NA	NA	0·43	NA	0·25

NA=not applicable. *Adjusted for maternal age, parity and previous caesarean section, maternal ethnicity, socioeconomic deprivation, pre-existing diabetes, pre-existing hypertension, gestational diabetes, and pre-eclampsia or eclampsia. †Of the 2 081 043 included women, data on a maternal adverse outcome were missing for 91 523 (4·4%). ‡p value of joint test that odds ratios are equal to 1.

Table 6: **Risk of maternal morbidity according to the highest level and the timing of the most recent pre-pregnancy mental health-care contact**

The risk of maternal morbidity, defined using the composite maternal outcome indicator, was 0·9% without a pre-pregnancy specialist mental health-care contact and 1·0% with a pre-pregnancy specialist mental health-care contact (model 1: aOR 1·18, 95% CI 1·12–1·25, p<0·0001; table 6). We also found evidence of an association of this risk with the highest level of the mental health-care contact (model 2: overall p<0·0001) or the timing of the most recent contact (model 3: overall p<0·0001). The pattern of results was less clear if we included both the level and timing of the pre-pregnancy contacts in the same model (model 4). There was no or weak evidence that the risk was especially increased in women who had a mental health-care contact that was more recent (aOR 1·11 [95% CI 0·96–1·29] for women with a contact between 1 year and 5 years before pregnancy and 1·21 [1·02–1·41] for women with a contact within 1 year before pregnancy, both compared against women with a community care contact more than 5 years before the pregnancy [overall p 0·046]). There was no evidence of an interaction between the level and timing of the pre-pregnancy contacts (overall p=0·253). See the appendix (p 5) for the breakdown into the specific components of the maternal morbidity indicator.

Discussion

This study showed that 7·3% of women giving birth in the NHS had at least one face-to-face contact with specialist mental health care before pregnancy. These women had increased risks of preterm birth, a baby born SGA, neonatal adverse outcomes, and maternal morbidity. An increase in the risk of stillbirth or neonatal death was not shown, which is probably due to the relatively low occurrence of these outcomes. The increases in risks of adverse obstetric and neonatal outcomes (including the risk of stillbirth or neonatal death) were especially marked in women who had a specialist health-care contact that reflected a more severe mental illness and in women who had a more recent pre-pregnancy mental health-care contact. These associations were also observed when potential differences in age, parity, ethnic and socioeconomic background, and other maternal conditions were considered.

The major strength of this study is that we could use linked national datasets of care provided by the NHS. The NHS provides more than 98% of all specialist mental health care,[21,22] and more than 97% of all maternity care is

provided in NHS hospitals in England.[9] We included only singleton births after 24 weeks of gestation, aiming to create a cohort that is clinically meaningful. Of the women giving birth in England and Wales between April 1, 2014 and March 31, 2018, 1·4% had a multiple pregnancy. These women were not included because their pregnancies are associated with increased risks of adverse pregnancy outcomes that are unrelated to their pre-pregnancy mental health-care history, and it is recommended that they are offered care from a consultant in a tertiary-level fetal medicine centre.[23] Women giving birth before 24 weeks were not included for a number of reasons. First, only babies born before 24 weeks who show signs of life are registered in the UK, and it is accepted that the assessment of signs of life is difficult to standardise, which in turn affects recording of neonatal mortality.[24] Second, only 0·12% of livebirths occurred before 24 weeks of gestation in 2016 in England and Wales, and it is unlikely that this percentage will differ between women with and without a specialist mental health-care history.[9]

We traced all face-to-face contacts with specialist mental health services between April 1, 2006 and the onset of pregnancy so that we had a 7-year look-back period for the pre-pregnancy mental health history of all women. However, it should be acknowledged that this look-back period was shorter in younger women because we did not have access to adolescent mental health records. Another strength is the inclusion of both obstetric and neonatal outcomes. Studying only obstetric outcomes would have ignored that interventions, including induction of labour or caesarean section, could have changed the timing of birth without preventing a baby from dying in utero or at a later stage.[26]

A key characteristic of our study is that we used the highest level and the timing of the most recent specialist mental health-care contact to distinguish women's mental health-care histories. We opted for this approach rather than using recorded diagnoses of mental illness because of the recognised inconsistency and lack of completeness in the recording of mental health diagnoses in administrative datasets, especially for depressive disorders and anxiety.[27] Mental health-care contacts in primary care were not available.

Limitations of our study include that, because of technical issues with the national data provider, we did not have access to records of specialist mental health-care episodes for a 4-month period between December 1, 2015 and March 31, 2016. Therefore, we will have misclassified a proportion of women whose highest level of specialist mental health-care contact occurred during that period. It is estimated that one in three included women had (at most) 4 months of their mental health-care history missing in the most recent year, and approximately one in two included women had (at most) 4 months of their mental health-care history missing between 1 year and 5 years. It is unlikely that this period without access to mental health-care records will have had a major effect, given that the number of women whose mental health-care history was affected in the year immediately before pregnancy is relatively low. Moreover, the 4-month duration is relatively short for those whose mental health history was affected between 1 year and 5 years before the onset of the pregnancy, and most women with pre-pregnancy mental illness will have had multiple contacts. The misclassification is non-differential and could therefore have led to a slight underestimation of the association between pre-pregnancy mental health-care history and adverse outcomes.[28]

Finally, unmeasured confounding factors cannot be excluded. However, it is important to note that we adjusted for age, parity, ethnicity, and socioeconomic deprivation, which are recognised as key risk factors for adverse pregnancy outcomes.[7,8]

Previous studies have described the prevalence of common and severe mental illness during pregnancy and the year after birth,[1,29] but there is little systematic evidence on the prevalence of mental illness before the onset of pregnancy. Other new key findings are that the risks of preterm birth and a baby born SGA were increased for all women who had a pre-pregnancy contact with specialist mental health care, even if they had only experienced a community contact more than 5 years before the pregnancy. However, the risk of maternal morbidity seems to be only slightly increased in women who had a pre-pregnancy specialist mental health-care contact.

A recent meta-analysis of 28 studies reported increases of 40–50% in the risk of stillbirth and neonatal mortality, irrespective of the type of mental disorder that was studied and the perinatal outcomes considered, but with considerable heterogeneity between studies.[30] We did not find an overall increase in the risk of stillbirth and neonatal mortality considering all women with a pre-pregnancy specialist mental health-care contact, but we did find an increase in women who had been admitted to a psychiatric hospital. The overall increases in the risk of other adverse outcomes, including preterm and SGA births, were found to be in a similar range as reported in the meta-analysis.[30]

Our results suggest the importance of adding questions to the initial obstetric risk assessment (which already includes questions about current medication, smoking, alcohol use, illicit drug use, and other adverse conditions) asking women who are planning a pregnancy or who have recently learned they are pregnant whether they have ever had contact with specialist mental health-care services. Of note, questions about the highest level of the mental health care and the timing of the most recent contact provide an opportunity to identify women at the highest risk.

In the NHS, specialist community perinatal mental health teams have been set up to provide advice and care for women with severe mental illnesses in the pre-conception phase, during pregnancy, and in the postnatal

period.[4] A national study of the clinical and cost-effectiveness of these community perinatal mental health teams, ESMI-II, is currently under way.[31] In many countries, new maternity care models (such as the midwifery caseload model) have been introduced to improve continuity of carer, especially for women with complex medical and social needs. These models present opportunities for risk assessment and referral, for example to pregnancy smoking cessation services.[32–34]

To guide the prevention of adverse obstetric and neonatal outcomes, we need a detailed causal mediation analysis to get a better understanding of the complex pathways that explain the increases in the risks in the women who had a specialist mental health-care contact before the onset of pregnancy.[29] Such analysis should also consider more detailed biological mechanisms and the wider range of circumstances that mediate and modify these risks, including the women's overall health, health-related behaviour, and wider aspects of adversity (eg, socioeconomic deprivation, substance misuse, and intimate partner violence).[8]

For more on **ESMI-II** see http://www.esmi2.org.uk/

Contributors

LMH, HAO'M, JvdM, SB, and HS conceived the study. All authors were involved in the design. JL, PM, and IG-U had access to the data and carried out the analyses. JL, IG-U, and JvdM wrote the report with contributions from all other authors. JL and IG-U are joint first authors and LMH, HAO'M, and JvdM are joint senior authors. JL and IG-U accessed and verified the underlying data. LMH, HAO'M, and JvdM had final responsibility for the decision to submit for publication.

Declaration of interests

LMH, HAO'M, JvdM, SB, DP, and HS declare funding from the National Institute of Health Research to deliver a study on the effectiveness of community perinatal mental health services (17/49/38). AK, TH, IG-U, and JvdM also declare funding from the Healthcare Quality Improvement Partnership to deliver the National Maternity and Perinatal Audit. All other authors declare no competing interests.

Data sharing

This work uses data that has been provided by patients as part of their care and support. The data are collated, maintained, and quality assured by National Health Service (NHS) Digital, now part of NHS England. Requests for access to these data should be directed to the Data Access Request Service, which is part of NHS England (https://digital.nhs.uk/services/data-access-request-service-dars).

Acknowledgments

We thank Alissa Frémeaux, Amar Karia, Alessandra Morelli, Fran Caroll, and the Royal College of Obstestricians and Gynaecologists, UK.
The study was funded by the National Institute for Health and Care Research (17/49/38).

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