Risk of Obsessive-Compulsive Disorder in Pregnant and Postpartum Women: A Meta-Analysis

Emily J. Russell, MA; Jonathan M. Fawcett, PhD; and Dwight Mazmanian, PhD

ABSTRACT

Objective: Although pregnant and postpartum women are presumed to be at greater risk of obsessive-compulsive disorder (OCD) than the general population, the evidence has been inconclusive. This meta-analysis provides an estimate of OCD prevalence in pregnant and postpartum women and synthesizes the evidence that pregnant and postpartum women are at greater risk of OCD compared to the general population.

Data Sources: An electronic search of Google Scholar, PsycINFO, PsychARTICLES, and PubMed was performed by using the search terms *OCD*, *obsessive-compulsive disorder*, *pregnancy, postpartum*, *prevalence*, and *epidemiology*. We supplemented our search with articles referenced in the obtained sources. The search was conducted until August 2012 without date restrictions.

Study Selection: We included English-language studies reporting OCD prevalence (diagnosed according to *DSM-III-R, DSM-IV,* or *ICD-10* criteria) in pregnant (12 studies) or postpartum (up to 12 months; 7 studies) women using structured diagnostic interviews. We also included a sample of regionally matched control studies (10 studies) estimating 12-month prevalence in the general female population for comparison. The control studies were limited to those conducted during the same time frame as the pregnant and postpartum studies.

Data Extraction: We extracted author name, year of publication, diagnostic measure, sample size, diagnostic criteria, country, assessment time, subject population, and the point prevalence of OCD.

Results: Mixed- and random-effects models revealed an increase in OCD prevalence across pregnancy and the postpartum period with the lowest prevalence in the general population (mean = 1.08%) followed by pregnant (mean = 2.07%) and postpartum women (mean = 2.43%). An exploratory analysis of regionally matched risk-ratios revealed both pregnant (mean = 1.45) and postpartum (mean = 2.38) women to be at greater risk of experiencing OCD compared to the general female population, with an aggregate risk ratio of 1.79.

Conclusions: Pregnant and postpartum women are more likely to experience OCD compared to the general population.

J Clin Psychiatry 2013;74(4):377–385

Submitted: *May 30, 2012; accepted October 15, 2012 (doi:10.4088/JCP.12r07917).*
Corresponding author: *Emily J. Russell, MA, Lakehead University, Department of Psychology, 955 Oliver Rd, Thunder Bay, ON, P7B 5E1 Canada (erussell@lakeheadu.ca).*

Anxiety has recently been identified as more prevalent than depression in both antenatal[1] and postnatal assessments.[2] Researchers have speculated that pregnancy and the postpartum period may be an especially vulnerable period for the development of obsessive-compulsive disorder (OCD). Retrospective reports of individuals diagnosed with OCD have shown an association between childbirth and the onset or exacerbation of symptoms.[3–7] However, retrospective designs must be interpreted cautiously because of the potential for bias in patient recall.[8,9] For this reason, researchers have begun using prospective designs to determine whether OCD is more prevalent in pregnant and postpartum women.

The clinical presentation of OCD in pregnant and postpartum women consists most frequently of obsessions concerning contamination or aggression toward the child (eg, accidental or intentional harm to the infant).[8,10,11] These obsessions often lead to compulsive cleaning, avoidance of the child, or excessive checking on the child to ensure his or her well-being. Intrusive thoughts involving fear of harm to the fetus or newborn (eg, sudden infant death syndrome) have also been found in over 80% of mothers in nonclinical samples.[9,12–16] Despite the extent of subthreshold OCD symptoms at this time, only a minority of women experience obsessive-compulsive symptoms of increased severity that cause significant distress and impairment in functioning.

Identifying the presence of clinically significant obsessive-compulsive symptoms is especially important, as untreated OCD in a caregiver can have complex and adverse effects on the physical and emotional well being of the entire family.[8,17] For example, OCD can significantly affect the provision of care and interfere with mother-infant bonding. Ritualistic behaviors performed to cope with intrusive thoughts are often very time consuming and take away from care-taking duties.[18] In a case series of 7 women with postpartum-onset OCD,[19] obsessive-compulsive symptoms resulted in dysfunctional mother-child behavior in 71% of the sample, with cases of underinvolvement (eg, avoidance) and over-involvement (eg, overprotective care). Avoidance of the infant can occur when mothers are afraid of acting upon thoughts of harming their infants.[19] For instance, Christian and Storch[20] describe the case of a woman named Sara who avoided bathing and being alone with her son due to obsessive thoughts and images of drowning him. Aggressive thoughts related to the child are obviously perceived as distressing to mothers, although women with OCD are not at increased risk of harming their infants.[15] On the opposite end of the spectrum are mothers with irrational fears of something bad happening to their infant. These fears resulted in one mother being inseparable from her infant and not allowing anyone else to help provide care, while another mother prevented her child from engaging in activities outside of school (eg, fieldtrips).[19] These

Clinical Points

- Our results indicate that pregnant or postpartum women are approximately 1.5–2 times more likely to experience obsessive-compulsive disorder compared to the general population.
- Routine prenatal screening for psychiatric disorders must extend beyond depression for both pregnant and postpartum women.
- Clinicians must be careful not to overpathologize the occurrence of adaptive anxiety in pregnant and postpartum women, given the high degree of subthreshold obsessive-compulsive symptoms at this time.

behaviors may also cause conflict within the family over division of labor and parental roles.

Given the potential impact of parental OCD on the child, it is important to understand the prevalence of this condition. Current estimates of OCD prevalence range from 0.3% to 29.0% in pregnant women and from 1.7% to 9.0% in postpartum women.[21–37] Past theorists have attributed this variability to regional differences, the use of different diagnostic measures, and the type of sample population employed (eg, community versus outpatient referrals).[8,9,11,38] Regional differences in particular have made it difficult to compare OCD prevalence in pregnant and postpartum women to the general population. The National Comorbidity Survey Replication, a large-scale nationally representative study conducted in the United States, recently reported a 12-month prevalence rate of 1.8% in female subjects.[39] In comparison, Turkey has one of the highest reported rates of OCD, with a 12-month prevalence rate of 3.3% in female subjects.[40] McGuinness et al[8] accounted for regional differences by examining the relative risk of OCD in pregnant and postpartum women compared to a separate control sample from the same country (Turkey). Although pregnant and postpartum women were at greater risk of OCD relative to the control sample, this difference was not statistically significant. Even so, their analysis included only a single comparison. Therefore, although recent reviews[8,9,11,38] recognize that pregnant and postpartum women tend to demonstrate increased rates of OCD relative to the general population, the evidence has been deemed inconclusive.[8,11] One of the major issues in this literature is the lack of appropriate baseline estimates. Prevalence estimates have been collected from the general female population in only 2 of the pregnancy or postpartum studies.[24,29]

The purpose of the current research synthesis was to provide an estimate of OCD prevalence in pregnant and postpartum women and provide converging evidence that pregnant and postpartum women are at greater risk of experiencing OCD compared to the general population. On the basis of past research, it was our expectation that OCD prevalence (and therefore the relevant risk ratios) would increase linearly as women progressed from the antenatal to postnatal period.

DATA SOURCES AND STUDY SELECTION

Literature Search

We conducted a search of the online resources Google Scholar, PsycINFO, PsychARTICLES, and PubMed for articles in the English language using the keywords *OCD, obsessive-compulsive disorder*, *pregnancy*, *postpartum*, *prevalence*, and *epidemiology*. For each database, we began by using the Boolean search phrase (*pregnancy* OR *postpartum*) AND (*OCD* OR *obsessive compulsive disorder* OR *obsessive-compulsive disorder*) AND (*prevalence* OR *epidemiology*). For databases allowing the use of Medical Subject Heading (MeSH) search terms, we also conducted a comparable search using the MeSH keywords *postpartum period*, *pregnancy*, *pregnant women*, *obsessive-compulsive disorder*, *prevalence*, and *epidemiology*. This search was conducted until August 2012 without date restrictions and was supplemented by articles referenced in the obtained sources. Only English-language articles estimating the prevalence of OCD in pregnant or postpartum women (up to 12 months) using structured diagnostic interviews were included. Articles that reported the prevalence of obsessive and compulsive symptoms through the use of screening tools were therefore not included. The first author coded each article in consultation with the second author; in the event that any information was unclear the third author was consulted and the article was reviewed jointly until the issue was resolved unanimously.

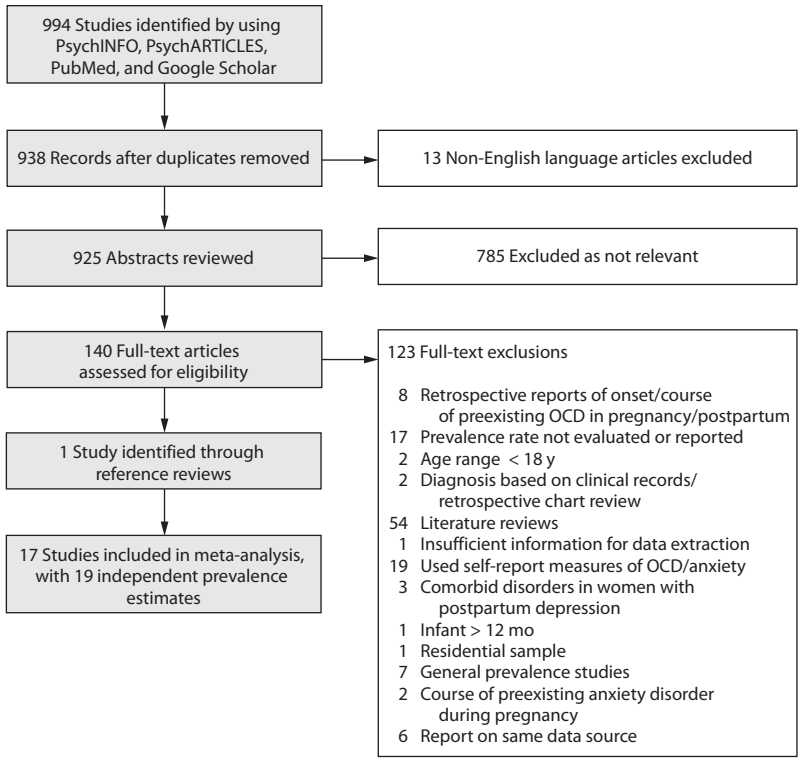
DATA EXTRACTION

The following data were extracted: author name, year of publication, diagnostic measure, sample size, diagnostic criteria, country, assessment time, subject population, and the point prevalence of OCD.

As shown in Figure 1, of the 994 studies initially identified, 17 studies were ultimately included. This process resulted in 12 independent estimates of OCD prevalence during pregnancy and 7 estimates of OCD prevalence during the postpartum period. Two studies[28,31] included independent estimates of OCD prevalence during pregnancy and the postpartum period. However, 1 study[35] included estimates of OCD prevalence during pregnancy and the postpartum period within the same sample of women. Because our models required independent effect sizes, we selected only 1 of these estimates for inclusion in our analyses (postpartum). Reformulation of our models, including the alternate estimate (pregnancy), produced the same outcome. Next, we gathered studies estimating OCD prevalence in the general population for the purpose of comparison. These studies were sampled from a larger, ongoing systematic review of the worldwide prevalence of OCD undertaken by the current authors. The search parameters for that synthesis were similar to those described above, except that the search terms included only *OCD*, *obsessive-compulsive disorder*, *prevalence*, and *epidemiology.* To match as closely as possible the characteristics of the pregnant and postpartum samples, we selected from only 12-month prevalence estimates (as opposed to lifetime prevalence) for women based on *DSM-IV* or *ICD-10* diagnostic

criteria. The countries represented within the pregnant and postpartum samples were categorized as originating from Asia (16%), Europe (32%), North America (26%), South America (5%), and the Middle East/Africa (21%). To account for regional variation in prevalence rates, we included 10 estimates in the control condition[24,29,39,41–47] that were of a similar composition (Asia, 20%; Europe, 30%; North America, 20%; South America, 10%; and the Middle East/Africa, 20%), with an effort to match the precise countries and study characteristics when possible. When multiple candidate estimates were available for a given region, preference was given to the larger sample; analyses conducted using alternate eligible control studies produced similar results. Study characteristics are summarized in Table 1.

Figure 1. Meta-Analysis Inclusion Flowchart



Quality Ratings

To assess the quality of studies included in the current meta-analysis, the first author coded each study using a 10-point scale that was created based on key methodological criteria outlined in the literature.[48] Key factors assessed included definition of the target sample, inclusion/exclusion criteria, sampling method, response rate, demographic characteristics, information on nonresponders, use of validated and clinician-administered diagnostic instruments, and reporting of prevalence estimates. The scale provides a quality rating from 0 to 10, with higher scores reflecting higher quality studies (see Table 1). The exact questions and scoring information are as follows:

1. Was the target population clearly defined? (no = 0, yes = 1)
2. Were inclusion criteria specified? (no = 0, yes = 1)
3. Were exclusion criteria specified? (no = 0, yes = 1)
4. Was the sampling method adequate? (0 = convenience/consecutive/not reported, 1 = random)
5. Was the response rate adequate? (eg, below 70%/ not reported = 0, 70% or higher = 1)
6. Were demographic characteristics of the study population given? (eg, age, ethnicity, education, marital status, employment, income; not reported/only 1 of the above listed = 0, two or more of the above = 1)
7. Was information given on nonresponders? (eg, did they differ from responders on any variables?) (no = 0, yes = 1)
8. Was a validated diagnostic instrument used during the clinical interview? (no = 0, yes = 1)
9. Who administered the diagnostic interview? (trained lay person/not reported = 0, trained clinician/researcher/mental health worker = 1)
10. Were confidence intervals or standard errors presented with the prevalence estimates? (not reported = 0, reported = 1)

The mean (SD) quality ratings were 8.1 (1.20), 6.1 (1.9), and 6.3 (1.1) for control, pregnancy, and postpartum studies, respectively. This difference was significant ($F_{2,26} = 6.62$, mean square error = 1.77, $P < .01$), with higher quality ratings for the control studies than for the pregnancy or postpartum studies.

Effect Size Calculation and Analysis

Effect sizes for prevalence estimates were calculated as logit-transformed proportions[49] by using the *escalc* function from the *metafor* package[50] within R version 2.12.1.[51] These values were back-transformed and are reported in percentages in all figures to ease their interpretation. Following McGuinness and colleagues' example,[8] log-risk ratios[49] were also calculated by comparing each sample of pregnant and postpartum women to their regionally matched "general" prevalence estimate. We calculated each risk ratio using control samples from the same study or the aggregate prevalence rate from the control studies in the same country or region, in that order of preference.

Once effect sizes were computed, separate random-effects models were fitted to the logit-transformed proportions and the log-risk ratios to generate a summary effect for each. Mixed-effects models were then fitted to the prevalence estimates to test for differences between the control, pregnant, and postpartum groups within each measure. This variable

Table 1. Studies Reporting Prevalence of Obsessive-Compulsive Disorder During Pregnancy and Postpartum as a Function of First Author, Year, Group, and Study Characteristics

First Author	Year	Group	Measure	Criteria	Assessment Time[a]	Country	N	Quality[b]	Prevalence, %
Zar[21]	2002	Pregnant	ADIS-R	*DSM-IV*	32 weeks gestation	Sweden	453	6	0.20
Andersson[22]	2003	Pregnant	PRIME-MD	*DSM-IV*	18–19 weeks gestation	Sweden	1,556	7	1.30
Sutter-Dallay[23]	2004	Pregnant	MINI	*DSM-IV*	Third trimester	France	497	7	1.20
Adewuya[24]	2006	Pregnant	MINI	*DSM-IV*	32+ weeks gestation	Nigeria	172	8	5.20
Felice[25]	2007	Pregnant	CIS-R	*ICD-10*	18.6 weeks gestation	Malta	229	6	0.40
Uguz[26]	2007	Pregnant	SCID-I/CV	*DSM-IV*	Third trimester	Turkey	434	5	3.50
Borri[27]	2008	Pregnant	SCID-I/CV	*DSM-IV*	12–15 weeks gestation	Italy	1,066	6	1.60
Yiu[28]	2009	Pregnant	Interview	*ICD-10*	Not reported	China	24	4	4.00
Uguz[29]	2010	Pregnant	SCID-I/CV	*DSM-IV*	23.26 ± 9.56 weeks gestation[c]	Turkey	309	7	5.20
Chaudron[30d]	2010	Pregnant	SCID	*DSM-IV*	30–37 weeks gestation	United States	24	7	29.00
Grigoriadis[31]	2011	Pregnant	MINI	*DSM-IV*	26.4 ± 7.9 weeks gestation[c]	Canada	62	6	1.60
Uguz[32]	2012	Pregnant	SCID-I/CV	*DSM-IV*	First trimester	Turkey	90	6	2.20
Wenzel[33]	2001	Postpartum	SCID-I/NP	*DSM-IV*	4–6 months	United States	588	6	3.90
Wenzel[34]	2005	Postpartum	SCID-I/NP	*DSM-IV*	60.8 ± 27.5 days[c]	United States	147	6	2.70
Kitamura[35]	2006	Postpartum	Interview	*DSM-III-R*	12 months	Japan	280	6	1.70
Navarro[36e]	2008	Postpartum	SCID-I/NP	*DSM-IV*	6 weeks	Spain	405	10	0.70
Zambaldi[37d]	2009	Postpartum	MINI	*DSM-IV*	2–26 weeks	Brazil	400	5	9.00
Yiu[28]	2009	Postpartum	Interview	*ICD-10*	Not reported	China	157	4	3.00
Grigoriadis[31]	2011	Postpartum	MINI	*DSM-IV*	4.8 ± 3.3 months[c]	Canada	29	6	3.50
Andrade[41d]	2002	Control	CIDI	*ICD-10*	…	Brazil	842	8	0.10
Faravelli[42]	2004	Control	MINI/FPI	*DSM-IV*	…	Italy	1,292	9	1.20
Adewuya[24]	2006	Control	MINI	*DSM-IV*	…	Nigeria	172	8	1.70
Cho[43]	2007	Control	K-CIDI	*DSM-IV*	…	South Korea	2,751	10	0.70
Himle[44]	2008	Control	CIDI-SF	*DSM-IV*	…	United States	3,155	7	1.50
Uguz[29]	2010	Control	SCID-I/CV	*DSM-IV*	…	Turkey	107	6	2.80
Serrano-Blanco[45]	2010	Control	MINI	*DSM-IV*	…	Spain	2,402	9	0.78
Cho[46]	2010	Control	K-CIDI	*DSM-IV*	…	South Korea	3,929	8	0.60
Ruscio[39f]	2010	Control	CIDI	*DSM-IV*	…	United States	1,037	9	1.80
Adam[47]	2011	Control	M-CIDI	*DSM-IV*	…	Germany	2,268	7	0.90

[a]Assessment time was measured relative to the start of pregnancy or childbirth as appropriate for the sample.
[b]Scale ranges from 0 to 10 (higher numbers = better quality).
[c]Value represents mean ± SD.
[d]This study was identified as an outlier and excluded from the reported analyses.
[e]The sample size used was for the SCID-interviewed sample as opposed to the screening results of all mothers (n = 1,453).
[f]Sample size was not reported by gender, so we assumed half the total sample was female.
Abbreviations: ADIS-R = Anxiety Disorder Interview Schedule-Revised; CIDI = Composite International Diagnostic Interview; CIDI-SF = CIDI short-form; CIS-R = Clinical Interview Schedule-Revised; FPI = Florence Psychiatric Interview; *ICD-10* = *International Classification of Diseases, Tenth Revision*; K-CIDI = Korean version of the CIDI; M-CIDI = Munich CIDI; MINI = Mini-International Neuropsychiatric Interview; PRIME-MD = Primary Care Evaluation of Mental Disorders; SCID = Structured Clinical Interview for *DSM-III-R* Disorders; SCID-I/CV = Structured Clinical Interview for *DSM-IV*, Clinical Version; SCID-I/NP = Structured Clinical Interview for *DSM-IV* Axis I Disorders, Research Version, Non-patient Edition.

was first treated as a nominal factor but then recoded as −1 (control), 0 (pregnant), and 1 (postpartum) to evaluate evidence of a linear trend across pregnancy and the postpartum period. The linear analysis is reported because it explained the greatest variance, although both analyses revealed a comparably significant pattern. As discussed later, there was insufficient heterogeneity among the estimated log-risk ratios to warrant a moderator analysis, although separate summary effects were still calculated for the pregnant and postpartum studies. Both the random- and mixed-effects models were generated using the *rma* function from the *metafor* package, and outlier analyses were carried out by using the *influence* function from the same package.[50]

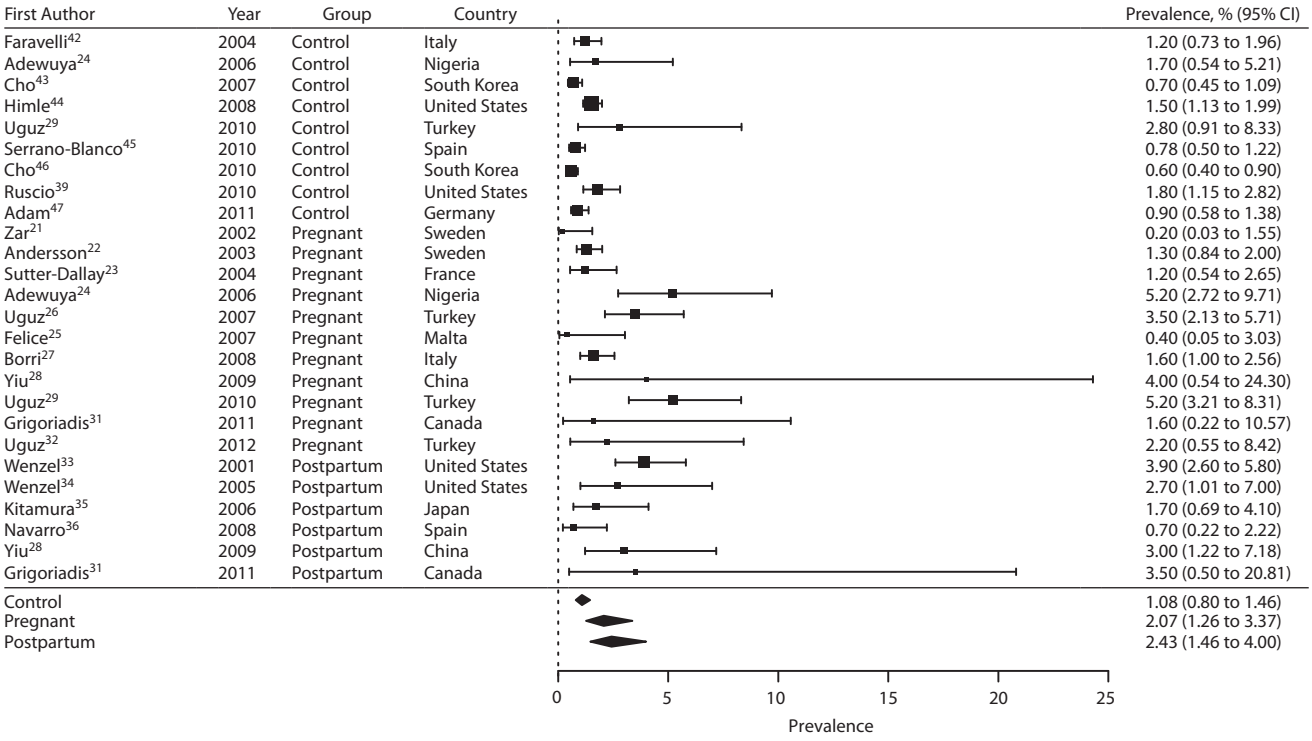
RESULTS

One control,[41] 1 pregnant,[30] and 1 postpartum[37] study were consistently identified as outliers across each of our analyses. Outliers were characterized by a studentized deleted residual of greater than 2[52] and were considered influential according to several regression deletion diagnostics (eg, Cook's distance).[53] Inspection of the variance-covariance matrix with and without these studies (ie, the covariance ratio) suggested that their inclusion reduced the precision of our estimated effects.[54] Since our goal was to provide a precise estimate of OCD prevalence (and associated risk) in pregnant and postpartum women, and also in the interest of exposition, we have reported only analyses excluding these studies. Inclusion of these outliers does not change the significance or nature of the reported effects. The back-transformed prevalence rates (95% CIs) for Andrade et al,[41] Chaudron and Nirodi,[30] and Zambaldi et al[37] were 0.10% (0.01% to 0.84%), 29.00% (14.47% to 49.66%), and 9.00% (6.56% to 12.23%). The corresponding log-risk ratios (95% CIs) for Chaudron and Nirodi[30] and Zambaldi et al[37] were 2.92 (2.25 to 3.59) and 4.50 (2.34 to 6.66). Because the relevant control study[41] underestimated OCD prevalence, whereas the relevant pregnancy[30] and postpartum[37] studies overestimated OCD prevalence (see Table 1), excluding these outliers should make our comparison between control and pregnant/postpartum populations more conservative.

Prevalence Estimates

As depicted in Figure 2, results produced an aggregate back-transformed prevalence rate of 1.64% (95% CI, 1.23%

Figure 2. Aggregate Back-Transformed Prevalence Rates and Confidence Intervals for Each Estimate Arranged Into a Forest Plot[a]



[a]Marker size represents weight within the model. Polygons are provided depicting the estimated prevalence rate per group.

Table 2. Summary of Best-Fitting Meta-Analytic Model for the Logit-Transformed Prevalence Estimates

Effect	β, (95% CI)	SE	*Z*
Intercept	−4.51 (−4.80 to −4.22)	0.15	−30.54
Group[a]	0.44 (0.28 to 0.61)	0.08	5.29
Region[b]			
Asia (reference)			
Europe	0.20 (−0.13 to 0.54)	0.17	1.20
Middle East/Africa	1.38 (0.97 to 1.78)	0.21	6.68
North America	0.81 (0.47 to 1.15)	0.17	4.65

[a]Group was coded as −1 for control, 0 for pregnant, and 1 for postpartum. There was no evidence of additional heterogeneity within the measured effect sizes, $Q_{Error21} = 18.79$, $P > .59$.

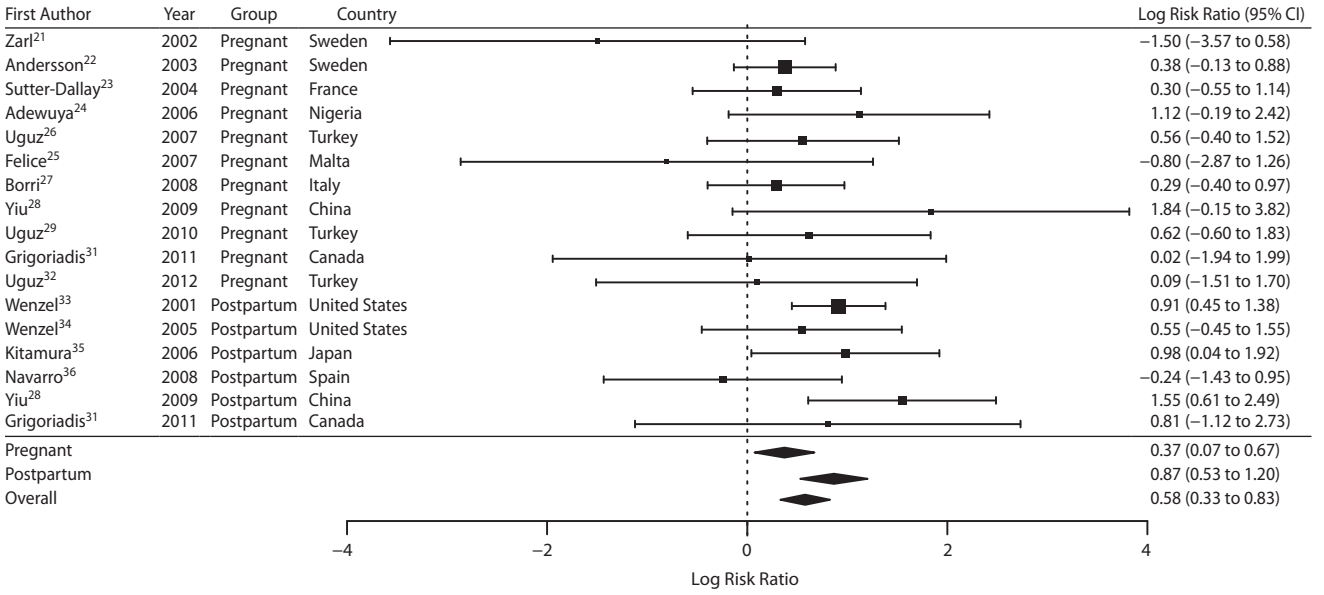
[b]Asia served as the reference condition in our analysis because it had the lowest obsessive-compulsive disorder prevalence, simplifying interpretation by making all of the regional coefficients positive. The effect of group is unchanged by altering the regional reference condition or even by recategorizing the regions. Although South America (Brazil) was originally included among the sampled regions, the studies from Brazil[37,41] were both identified as outliers and removed; see paragraph 1 of Results for further details.

to 2.20%) across conditions—although there was a substantial amount of heterogeneity in the measured effects ($I^2 = 80.69\%$). The presence of heterogeneity permitted exploration of potential moderators, resulting in a model including both region and group. Asia and Europe had the lowest prevalence rates and the Middle East/Africa had the highest prevalence rates. The effect of group indicated a significant linear increase from control to pregnancy and from pregnancy to postpartum (β = 0.44; 95% CI, 0.28 to 0.61). Separate random-effects models were fit to each group to produce back-transformed prevalence rates of 1.08% (95% CI, 0.80% to 1.46%) for the control group, 2.07% (95% CI, 1.26% to 3.37%) for the pregnant group, and 2.43% (95% CI, 1.46% to 4.00%) for the postpartum group. This analysis suggests a substantial increase in OCD prevalence in pregnant or postpartum populations, although these groups are more similar in their relative prevalence. The full model is summarized in Table 2 and explains almost all (>99%) of the heterogeneity within the calculated effect sizes. Measure (Composite International Diagnostic Interview, Structured Clinical Interview for *DSM-III-R*, Mini-International Neuropsychiatric Interview, other), sample population (community, outpatient referrals), and study quality (score of 0–10) were also considered, but none explained a significant amount of variance and so were removed from our final model. This finding should not be taken as strong evidence that those factors have *no* impact on OCD prevalence. The current analyses focused on prevalence estimates within pregnancy and the postpartum period, resulting in a relatively small number of studies and limited variability within predictors such as measure or sample population. Future research focusing on the relative contributions of these factors could include a larger number of studies and therefore a more robust estimate of the relevant effects.

Risk Analysis

As depicted in Figure 3, analysis of the log-risk ratios comparing the pregnant and postpartum groups to

Figure 3. Aggregate Log Risk Ratios and Confidence Intervals for Each Estimate Arranged Into a Forest Plot



regionally matched control groups produced an aggregate back-transformed risk ratio of 1.79 (95% CI, 1.39 to 2.29). The-log risk ratio for this analysis was 0.58 (95% CI, 0.33 to 0.83), the standard error was 0.13, and the relevant *z* score was 5.11. There was no evidence of residual heterogeneity within the model ($Q_{\text{Error16}} = 18.84$, $P > .27$). Unlike the prevalence analyses reported in the previous section, there was minimal evidence of heterogeneity among our measures ($I^2 = 10.00\%$). Therefore, a moderator analysis was not warranted.[55] Nonetheless, estimates of the relative risk calculated separately for each group suggested a back-transformed risk ratio of 1.45 (95% CI, 1.07 to 1.96) for the pregnant group and a back-transformed risk ratio of 2.38 (95% CI, 1.70 to 3.33) for the postpartum group. Put differently, women are approximately 1.5–2 times more likely to experience OCD during or following pregnancy.

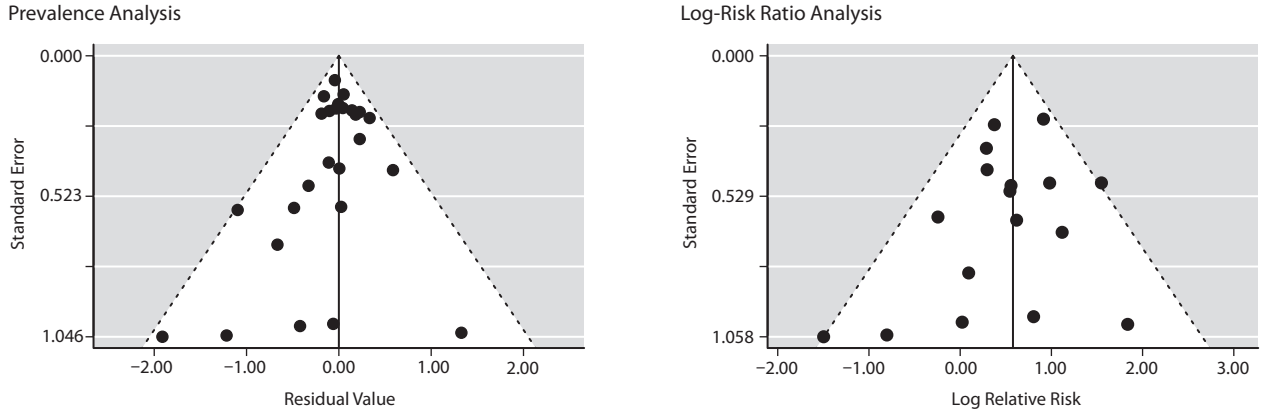
Given that pregnant or postpartum women are at greater risk of experiencing OCD, we then calculated a fail-safe N to estimate the number of additional, unpublished findings averaging to null (mean = 0) needed for this effect to become nonsignificant.[56] The outcome of this analysis suggests that 625 additional comparisons averaging to 0 (no increased risk) would need to be included in our analysis to change the outcome from significant to nonsignificant. Inspection of the relevant funnel plots (Figure 4) suggests that the existence of such a large number of missing studies averaging to null is unlikely in either the prevalence or the risk analyses presented above.

DISCUSSION

We applied modern meta-analytic techniques to address OCD prevalence in pregnant and postpartum women and to provide converging evidence that pregnant and postpartum women are at greater risk of OCD. The overall prevalence estimates obtained were 1.08% for women in the general population, 2.07% during pregnancy, and 2.43% during the postpartum period. We had expected to find a linear increase in OCD prevalence from the control group to the pregnant group and ultimately to the postpartum group. Inspection of Figure 2 supports this hypothesis—prevalence increases as women progress from pregnancy to the postpartum period. However, our analysis of the regionally matched log-risk ratios suggests that this trend should be interpreted more conservatively. The risk analysis revealed that pregnant or postpartum women are approximately 1.5–2 times more likely to experience OCD compared to the general population. Inspection of the separate group estimates appears to support an even greater risk for postpartum compared to pregnant women. However, there was insufficient heterogeneity within our measures to warrant a moderator analysis, so this potential difference should be viewed with caution. It appears reasonable to conclude at this stage that the risk of OCD is greater when women are pregnant *or* postpartum—whether that risk is greater for postpartum compared to pregnant women requires further research.

The etiology of OCD in pregnant and postpartum women is not yet fully understood. Biological models point to the extreme changes in gonadal hormones that coincide with pregnancy and the postpartum period. In the last trimester of pregnancy, progesterone and estrogen rise 10- and 50-fold over maximum menstrual cycle levels and return to follicular levels within the first 1 to 7 days following childbirth.[57] Gonadal hormones have been shown to influence mood through the interaction with multiple neurotransmitter pathways (ie, serotonin, dopamine, γ-aminobutyric acid, glutamate, and acetylcholine).[58] According to the hormonal sensitivity hypothesis, some women are especially vulnerable to fluctuating hormone levels across reproductive events such as menarche, the premenstrual period, pregnancy/postpartum, and perimenopause.[59,60]

Figure 4. Funnel Plots Depicting the Relationship Between Standard Error (plotted down) and Residuals in the Final Models for the Logit-Transformed Prevalence and Log-Risk Ratio Analyses[a]



[a]Relatively good estimates are expected for studies with low variability (low standard error; top of the figure) and relatively poor estimates are expected for studies with high variability (high standard error; bottom of the figure) producing a pyramidal shape in the residuals. Publication bias is often diagnosed by the relative absence of points on the side of the funnel disconfirming the predicted relationship (left-hand side); this occurs because nonsignificant results are less likely to be published. Both visual inspection and statistical tests of symmetry (the regression and rank tests for asymmetry both produce $P > .15$ for each plot) reveal minimal evidence of publication bias.

Reproductive events have also been linked to the onset and exacerbation of OCD. For instance, retrospective studies have found that 21%–22% of outpatients report the onset of OCD within a year of menarche.[3,61] In outpatients who have had children, retrospective reports estimate that 5.7%–39% of women experienced the new onset of OCD in pregnancy compared to 0%–50% in the postpartum period.[3–5,7,17,61] Preexisting OCD was exacerbated in 8%–46.1% of women during pregnancy compared to 29%–50% in the postpartum period.[3,6,7,17,26,62] Premenstrual exacerbation of obsessive-compulsive symptoms has been observed in 20%–49% of women.[3,6,7] Individuals who experience premenstrual syndrome or exacerbation of preexisting OCD symptoms premenstrually are more likely to experience a worsening of OCD symptoms during pregnancy and the postpartum period.[3,17] These findings highlight that for at least some women, reproductive events represent periods of vulnerability for the onset or exacerbation of symptoms. Although these biological explanations are congruent with known hormonal changes surrounding birth, they rely heavily on retrospective reports and correlational analyses and do not explain the onset of obsessive-compulsive symptoms in new fathers.[16,63]

Recent theorists have argued that psychological factors must also be considered to understand the increased prevalence of OCD in pregnant and postpartum women, such as the empirically based model proposed by Fairbrother and Abramowitz.[64] Although intrusive thoughts commonly occur in new parents, psychological factors such as inflated responsibility beliefs, overestimation of threat, and faulty appraisals of intrusive thoughts can increase vulnerability for the development or exacerbation of OCD. Especially for first-time parents, having a baby represents a sudden shift in focus from oneself or partner to fulfilling the immediate needs and safety concerns of an infant. Even the task of "baby proofing" a house conveys the message that harm is literally at every turn. This environment can create an increased responsibility in parents for preventing harm to their infant. Fairbrother and Abramowitz[64] propose that a heightened sense of responsibility and increased perception of threat in the postpartum period result in a greater likelihood of misinterpreting benign thoughts as threatening.

Cognitive-behavioral models assert that the significance and meaning attributed to intrusive thoughts rather than the mere presence of these thoughts is the contributing factor in the development of obsessional behavior.[65] Thus, although intrusive thoughts have been found to be common in pregnancy and the postpartum period, women are more likely to be at risk for OCD if they believe these thoughts increase the likelihood of the behavior occurring and exaggerate the consequences of such an event. For instance, picking up a knife while in the kitchen may evoke an intrusive image of stabbing one's child. Instead of interpreting this image as just a fleeting thought and resuming supper, a woman at risk of developing OCD may interpret the event as revealing her "true" feelings for her infant and may begin avoiding her infant for fear of inflicting actual harm.[15] Obsessional thoughts can trigger avoidance behavior, attempts to suppress the thought, as well as overt or covert repetitive behavior aimed at reducing distress (eg, checking the baby's pulse every 15 minutes to ensure he or she is still breathing in response to intrusive thoughts about sudden infant death syndrome).[64] Although a full review of the etiology of OCD in pregnancy and the postpartum period is beyond the scope of this article, it is important that both biological and psychological factors be considered.

Upon reviewing the main findings of this study, several limitations must be considered. First, few studies have examined OCD prevalence in pregnant or postpartum women, and they tend to have smaller sample sizes compared to control studies. Nonetheless, the fail-safe N of over 600 for the log-risk ratio analysis suggests our findings to be stable.

Second, the present study was unable to obtain unpublished manuscripts that examined OCD prevalence in pregnant or postpartum women, suggesting the potential for the "file drawer problem." However, given the strong need for studies in this area and the resources required for such large-scale investigations, the likelihood of a large number of unpublished prevalence studies existing is low. Further, inspection of the funnel plots provided in Figure 4 does not implicate the absence of any large number of disconfirming studies. Third, the control studies could not be perfectly matched for all relevant factors (eg, age, country). Fourth, although study quality was not found to be a significant predictor of prevalence in the analyses reported above, the control studies were of significantly greater quality than either of the remaining groups. Finally, most of the control studies selected to represent OCD prevalence in the general population most likely included pregnant or postpartum women, resulting in the overestimation of OCD prevalence in nonpregnant women to some degree. Importantly, this overestimation should work against the comparison between control and pregnant/postpartum populations; ie, the estimates in the current analyses could be described as conservative.

Future prospective research should examine OCD prevalence at each trimester of pregnancy and into the postpartum period. To date, most studies vary in the selected time points measured throughout pregnancy and the postpartum period, a limitation that makes cross-study comparisons difficult. Longitudinal research may be especially beneficial for examining biological determinants such as hormonal sensitivity. For instance, hormonal sensitivity could be measured in individuals with OCD prior to key reproductive events as a means of predicting the degree of symptom exacerbation. Women with obsessive-compulsive spectrum disorders (eg, trichotillomania) may also show the same exacerbation of symptoms across reproductive events as seen in OCD. Broadening the area of focus may reveal a greater number of women who would benefit from monitoring across pregnancy and the postpartum period. Finally, although the current study focused on prevalence, continuing investigations of the incidence of OCD and course of preexisting OCD across reproductive events are also needed.

In conclusion, the current study finds that pregnant and postpartum women are at greater risk for OCD compared to the general population. These findings highlight the importance of screening for psychiatric disorders beyond depression in both pregnant and postpartum women. However, given the high degree of endorsement of maternal preoccupations at this time, health care practitioners must be careful not to overpathologize the occurrence of anxiety at a time when it is adaptive for infant well-being. The implementation of prevention programs that target women at risk for developing postpartum OCD is an important area for future exploration. For instance, in a randomized controlled trial, Timpano et al[66] assessed the efficacy of a 6-week cognitive-behavioral prevention program aimed at vulnerable pregnant women with risk factors for developing postpartum OCD. Compared to the control group, women in the prevention program had significantly lower obsessions, compulsions, and cognitive distortions throughout the first 6 months postpartum. The addition of a prevention program to already ongoing prenatal education classes may be cost-effective and especially appealing to women who are reticent to take psychotropic medication during pregnancy or when breast-feeding.[66]

Author affiliations: Department of Psychology, Dalhousie University, Halifax, Nova Scotia (Dr Fawcett); and Department of Psychology, Lakehead University, Thunder Bay, Ontario (Dr Mazmanian and Ms Russell), Canada. Dr Fawcett is now with the MRC Cognition and Brain Sciences Unit, Cambridge, United Kingdom.
Potential conflicts of interest: The authors report no potential conflicts of interest.
Funding/support: This research received no direct financial support from any granting agency.

REFERENCES

1. Lee AM, Lam SK, Sze Mun Lau SM, et al. Prevalence, course, and risk factors for antenatal anxiety and depression. *Obstet Gynecol*. 2007;110(5):1102–1112.
2. Reck C, Struben K, Backenstrass M, et al. Prevalence, onset and comorbidity of postpartum anxiety and depressive disorders. *Acta Psychiatr Scand*. 2008; 118(6):459–468.
3. Labad J, Menchón JM, Alonso P, et al. Female reproductive cycle and obsessive-compulsive disorder. *J Clin Psychiatry*. 2005;66(4):428–435, quiz 546.
4. Maina G, Albert U, Bogetto F, et al. Recent life events and obsessive-compulsive disorder (OCD): the role of pregnancy/delivery. *Psychiatry Res*. 1999;89(1): 49–58.
5. Neziroglu F, Anemone R, Yaryura-Tobias JA. Onset of obsessive-compulsive disorder in pregnancy. *Am J Psychiatry*. 1992;149(7):947–950.
6. Vulink NC, Denys D, Bus L, et al. Female hormones affect symptom severity in obsessive-compulsive disorder. *Int Clin Psychopharmacol*. 2006;21(3):171–175.
7. Williams KE, Koran LM. Obsessive-compulsive disorder in pregnancy, the puerperium, and the premenstruum. *J Clin Psychiatry*. 1997;58(7):330–334, quiz 335–336.
8. McGuinness M, Blissett J, Jones C. OCD in the perinatal period: is postpartum OCD (ppOCD) a distinct subtype? a review of the literature. *Behav Cogn Psychother*. 2011;39(3):285–310.
9. Speisman BB, Storch EA, Abramowitz JS. Postpartum obsessive-compulsive disorder. *J Obstet Gynecol Neonatal Nurs*. 2011;40(6):680–690.
10. Misri S, Kendrick K. Obsessive-compulsive disorder in the perinatal period: a review of the literature. *Curr Psychiatry Rev*. 2007;3(4):265–270.
11. Uguz F, Ayhan MG. Epidemiology and clinical features of obsessive-compulsive disorder during pregnancy and postpartum period: a review. *JMOOD*. 2011; 1(4):178–186.
12. Abramowitz JS, Meltzer-Brody S, Leserman J, et al. Obsessional thoughts and compulsive behaviors in a sample of women with postpartum mood symptoms. *Arch Women Ment Health*. 2010;13(6):523–530.
13. Brockington IF, Macdonald E, Wainscott G. Anxiety, obsessions and morbid preoccupations in pregnancy and the puerperium. *Arch Women Ment Health*. 2006;9(5):253–263.
14. Leckman JF, Mayes LC, Feldman R, et al. Early parental preoccupations and behaviors and their possible relationship to the symptoms of obsessive-compulsive disorder. *Acta Psychiatr Scand suppl*. 1999;100(suppl S396)1–26.
15. Abramowitz JS, Schwartz SA, Moore KM, et al. Obsessive-compulsive symptoms in pregnancy and the puerperium: a review of the literature. *J Anxiety Disord*. 2003;17(4):461–478.
16. Abramowitz JS, Khandker M, Nelson CA, et al. The role of cognitive factors in the pathogenesis of obsessive-compulsive symptoms: a prospective study. *Behav Res Ther*. 2006;44(9):1361–1374.
17. Forray A, Focseneanu M, Pittman B, et al. Onset and exacerbation of obsessive-compulsive disorder in pregnancy and the postpartum period. *J Clin Psychiatry*. 2010;71(8):1061–1068.
18. Miller LJ, Shah A. Major mental illness during pregnancy. *Prim Care Update Ob Gyns*. 1999;6(5):163–168.
19. Arnold LM. A case series of women with postpartum-onset obsessive-compulsive disorder. *Prim Care Companion J Clin Psychiatry*. 1999;1(4): 103–108.
20. Christian LM, Storch EA. Cognitive behavioral treatment of postpartum onset: obsessive compulsive disorder with aggressive obsessions. *Clin Case Stud*. 2009;8(1):72–83.
21. Zar M, Wijma K, Wijma B. Relations between anxiety disorders and fear of

childbirth during late pregnancy. *Clin Psychol Psychother*. 2002;9(2):122–130.
22. Andersson L, Sundström-Poromaa I, Bixo M, et al. Point prevalence of psychiatric disorders during the second trimester of pregnancy: a population-based study. *Am J Obstet Gynecol*. 2003;189(1):148–154.
23. Sutter-Dallay AL, Giaconne-Marcesche V, Glatigny-Dallay E, et al. Women with anxiety disorders during pregnancy are at increased risk of intense postnatal depressive symptoms: a prospective survey of the MATQUID cohort. *Eur Psychiatry*. 2004;19(8):459–463.
24. Adewuya AO, Ola BA, Aloba OO, et al. Anxiety disorders among Nigerian women in late pregnancy: a controlled study. *Arch Women Ment Health*. 2006;9(6):325–328.
25. Felice E, Saliba J, Grech V, et al. Antenatal psychiatric morbidity in Maltese women. *Gen Hosp Psychiatry*. 2007;29(6):501–505.
26. Uguz F, Gezginc K, Zeytinci IE, et al. Obsessive-compulsive disorder in pregnant women during the third trimester of pregnancy. *Compr Psychiatry*. 2007;48(5):441–445.
27. Borri C, Mauri M, Oppo A, et al. Axis I psychopathology and functional impairment at the third month of pregnancy: results from the Perinatal Depression-Research and Screening Unit (PND-ReScU) study. *J Clin Psychiatry*. 2008;69(10):1617–1624.
28. Yiu MG, Szeto WL, Wong GP, et al. Symptoms of anxiety and depression in the perinatal period: referrals to the comprehensive child development service in a Hong Kong regional hospital. *Hong Kong J Psychiatry*. 2009;19(3):112–116.
29. Uguz F, Gezginc K, Kayhan F, et al. Is pregnancy associated with mood and anxiety disorders? a cross-sectional study. *Gen Hosp Psychiatry*. 2010;32(2):213–215.
30. Chaudron LH, Nirodi N. The obsessive-compulsive spectrum in the perinatal period: a prospective pilot study. *Arch Women Ment Health*. 2010;13(5):403–410.
31. Grigoriadis S, de Camps Meschino D, Barrons E, et al. Mood and anxiety disorders in a sample of Canadian perinatal women referred for psychiatric care. *Arch Women Ment Health*. 2011;14(4):325–333.
32. Uguz F, Gezginc K, Kayhan F, et al. Is hyperemesis gravidarum associated with mood, anxiety and personality disorders: a case-control study. *Gen Hosp Psychiatry*. 2012;34(4):398–402.
33. Wenzel A, Gorman LL, O'Hara MW, et al. The occurrence of panic and obsessive-compulsive symptoms in women with postpartum dysphoria: a prospective study. *Arch Women Ment Health*. 2001;4(1):5–12.
34. Wenzel A, Haugen EN, Jackson LC, et al. Anxiety symptoms and disorders at eight weeks postpartum. *J Anxiety Disord*. 2005;19(3):295–311.
35. Kitamura T, Yoshida K, Okano T, et al. Multicentre prospective study of perinatal depression in Japan: incidence and correlates of antenatal and postnatal depression. *Arch Women Ment Health*. 2006;9(3):121–130.
36. Navarro P, García-Esteve L, Ascaso C, et al. Non-psychotic psychiatric disorders after childbirth: prevalence and comorbidity in a community sample. *J Affect Disord*. 2008;109(1–2):171–176.
37. Zambaldi CF, Cantilino A, Montenegro AC, et al. Postpartum obsessive-compulsive disorder: prevalence and clinical characteristics. *Compr Psychiatry*. 2009;50(6):503–509.
38. Ross LE, McLean LM. Anxiety disorders during pregnancy and the postpartum period: a systematic review. *J Clin Psychiatry*. 2006;67(8):1285–1298.
39. Ruscio AM, Stein DJ, Chiu WT, et al. The epidemiology of obsessive-compulsive disorder in the National Comorbidity Survey Replication. *Mol Psychiatry*. 2010;15(1):53–63.
40. Cilliçilli AS, Telcioğlu M, Aşkin R, et al. Twelve-month prevalence of obsessive-compulsive disorder in Konya, Turkey. *Compr Psychiatry*. 2004;45(5):367–374.
41. Andrade L, Walters EE, Gentil V, et al. Prevalence of ICD-10 mental disorders in a catchment area in the city of São Paulo, Brazil. *Soc Psychiatry Psychiatr Epidemiol*. 2002;37(7):316–325.
42. Faravelli C, Abrardi L, Bartolozzi D, et al. The Sesto Fiorentino study: point and one-year prevalences of psychiatric disorders in an Italian community sample using clinical interviewers. *Psychother Psychosom*. 2004;73(4):226–234.
43. Cho MJ, Kim JK, Jeon HJ, et al. Lifetime and 12-month prevalence of *DSM-IV* psychiatric disorders among Korean adults. *J Nerv Ment Dis*. 2007;195(3):203–210.
44. Himle JA, Muroff JR, Taylor RJ, et al. Obsessive-compulsive disorder among African Americans and blacks of Caribbean descent: results from the National Survey of American Life. *Depress Anxiety*. 2008;25(12):993–1005.
45. Serrano-Blanco A, Palao DJ, Luciano JV, et al. Prevalence of mental disorders in primary care: results from the diagnosis and treatment of mental disorders in primary care study (DASMAP). *Soc Psychiatry Psychiatr Epidemiol*. 2010;45(2):201–210.
46. Cho MJ, Chang SM, Lee YM, et al. Prevalence of *DSM*-IV major mental disorders among Korean adults: a 2006 National Epidemiologic Survey (KECA-R). *Asian J Psychiatr*. 2010;3(1):26–30.
47. Adam Y, Meinlschmidt G, Gloster AT, et al. Obsessive-compulsive disorder in the community: 12-month prevalence, comorbidity and impairment. *Soc Psychiatry Psychiatr Epidemiol*. 2012;47(3):339–349.
48. Giannakopoulos NN, Rammelsberg P, Eberhard L, et al. A new instrument for assessing the quality of studies on prevalence. *Clin Oral Investig*. 2012;16(3):781–788.
49. Cooper H, Hedges LV, Valetine JC. *The Handbook of Research Synthesis and Meta-Analysis*. 2nd ed. New York, NY: Russell Sage Foundation; 2009.
50. Viechtbauer W. Conducting meta-analyses in R with the metafor package. *J Stat Softw*. 2010;36(3):1–48.
51. R Development Core Team. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing; 2010.
52. Hedges LV, Olkin I. *Statistical Methods for Meta-Analysis*. New York, NY: Academic Press; 1985.
53. Cook RD, Weisberg S. *Residuals and Influence in Regression*. New York, NY: Chapman and Hall; 1982.
54. Viechtbauer W, Cheung MWL. Outlier and influence diagnostics for meta-analysis. *Res Syn Meth*. 2010;1(2):112–125.
55. Higgins JP, Thompson SG, Deeks JJ, et al. Measuring inconsistency in meta-analyses. *BMJ*. 2003;327(7414):557–560.
56. Rosenthal R. Combining results of independent studies. *Psychol Bull*. 1978;85(1):185–193.
57. Bloch M, Daly RC, Rubinow DR. Endocrine factors in the etiology of postpartum depression. *Compr Psychiatry*. 2003;44(3):234–246.
58. Douma SL, Husband C, O'Donnell ME, et al. Estrogen-related mood disorders: reproductive life cycle factors. *ANS Adv Nurs Sci*. 2005;28(4):364–375.
59. Deecher D, Andree TH, Sloan D, et al. From menarche to menopause: exploring the underlying biology of depression in women experiencing hormonal changes. *Psychoneuroendocrinology*. 2008;33(1):3–17.
60. Soares CN. *DSM-V* and reproductive-related psychiatric disorders: a closer look at windows of vulnerability. *Arch Women Ment Health*. 2010;13(1):15–16.
61. Labad J, Alonso P, Segalas C, et al. Distinct correlates of hoarding and cleaning symptom dimensions in relation to onset of obsessive-compulsive disorder at menarche or the perinatal period. *Arch Women Ment Health*. 2010;13(1):75–81.
62. Uguz F, Kaya V, Gezginc K, et al. Clinical correlates of worsening in obsessive-compulsive symptoms during pregnancy. *Gen Hosp Psychiatry*. 2011;33(2):197–199.
63. Abramowitz JS, Schwartz SA, Moore KM. Obsessional thoughts in postpartum females and their partners: content, severity and relationship with depression. *J Clin Psychol Med S*. 2003;10(3):157–164.
64. Fairbrother N, Abramowitz JS. New parenthood as a risk factor for the development of obsessional problems. *Behav Res Ther*. 2007;45(9):2155–2163.
65. Salkovskis PM. Understanding and treating obsessive-compulsive disorder. *Behav Res Ther*. 1999;37(suppl 1):S29–S52.
66. Timpano KR, Abramowitz JS, Mahaffey BL, et al. Efficacy of a prevention program for postpartum obsessive-compulsive symptoms. *J Psychiatr Res*. 2011;45(11):1511–1517.

Editor's Note: We encourage authors to submit papers for consideration as a part of our Focus on Women's Mental Health section. Please contact Marlene P. Freeman, MD, at mfreeman@psychiatrist.com.