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Bryn Evohr April 12, 2022

The Prevalence of Postpartum Depression Among Women with Physical Disabilities: A Systematic Review and Meta-Analysis

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Abstract

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By Bryn Evohr

Postpartum depression affects 10-15% of childbearing parents and has serious effects on the ongoing physical and mental health of the parent and child. Within a population of childbearing women, 12.7% report chronic physical disabilities. These mothers often face discrimination in healthcare settings and high rates of maternal and obstetric complications, as well as having higher rates of lifetime depression, factors that independently predict postpartum depression. Some studies have found higher rates of postpartum depression in mothers with physical disabilities than in able-bodied mothers, with more disabling symptoms associated with elevated postpartum depression; however, the literature is sparse, and no published review has aggregated this knowledge. This systematic review and meta-analysis investigated the association between postpartum depression and physical disability. Following PRISMA guidelines, the review started by searching PubMed and PsycInfo, with the primary inclusion criteria being that the studies had a measure of depression in women during the postpartum period and a cohort with physical disabilities. Taking a meta-analytic approach, we aggregated the prevalence of postpartum depression in women with physical disabilities and analyzed moderators including region, sample population, and measure types. The meta-analysis revealed a significant association between postpartum depression and physical disability. These findings indicate a need for greater awareness and resources for mothers with physical disabilities that have postpartum depression. Additionally, the review reveals the need for more research to investigate the experiences and causes of postpartum depression in women with physical disabilities.

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Contents

Introduction

Depression is a common morbidity after pregnancy, affecting between 10-15% of all childbearing people (O'Hara & Swain, 1996). A large U.S. survey revealed that approximately the same percentage of childbearing women, 12.7%, report chronic physical disabilities, suggesting that a significant population of women with physical disabilities may be at risk for depression after giving birth (Iezzoni et al., 2014b). However, research is limited in investigating the relationship between co-occurring physical disability and depression during the postpartum period. Self-reports from women with physical disabilities in the perinatal (prenatal or postpartum) period describe frequent discrimination and less screening for postpartum depression from clinicians, possibly because of clinicians' lack of understanding surrounding the care for this population (Hayward et al., 2017). Women with disabilities of all types are known to have higher rates of postpartum depression symptoms than nondisabled women, with an adjusted relative risk of 1.6 (Mitra et al., 2015). Several studies also found that women with chronic physical health conditions had a statistically significant higher relative risk of experiencing depression and other mental illnesses during the postpartum period than those without such conditions (Aker, 2021; Lee, 2021). However, no published review or meta-analysis was identified that describes the overall prevalence of postpartum depression among individuals with physical disabilities; thus, the extent of postpartum depression in this population has not been aggregated. Further, the results of such a review would address the dearth of understanding among clinicians and lack of formal training about the pregnancy and postpartum medical needs of women with physical disabilities (Smeltzer et al., 2018). Thus, the proposed systematic review and meta-analysis seeks to consolidate the existing knowledge about the intersection of physical disability and postpartum depression and aggregate existing empirical

data to determine the overall prevalence rate and to identify sample characteristics that are associated with the co-occurrence.

Physical disability is typically thought of as functional impairment or physical limitations – i.e., diminished ability to participate in certain activities or aspects of daily living – that result from physical conditions such as bodily injury, illness, or birth defect (Altman, 2014; Human Rights Act, 2011). A wide range of conditions can be considered physical disabilities, including but not limited to spinal cord injuries, cerebral palsy, and visual or hearing impairments. Pregnant women report a variety of chronic physical disabilities, and often more than one (Iezzoni et al., 2014a). Although some physical disabilities can limit fertility or impact reproductive risks, improvements in assistive reproduction technology and genetic risk screenings have increased the rates of pregnancy for women with physical disabilities (Chetty et al., 2011).

Childbearing-aged women with physical disabilities report pregnancies at similar or slightly lower rates as those without disabilities (Iezzoni et al., 2013). In one nationally representative sample, around 10.6% of women with physical disabilities reported pregnancy, versus 12.3% of nondisabled women; however, women with complex disabilities, which characterize 43.9% of women with physical disabilities, were significantly less likely to be pregnant, with an adjusted odds ratio of 0.69 (Horner-Johnson et al., 2016). There was no statistically significant difference in pregnancy rates between women with disabilities without complex limitations and women without disabilities. Complex disabilities were defined as self-reports of needing higher levels of assistance with activities of daily living or with more limitations in all areas of life (Horner-Johnson et al., 2016). Overall, women with physical disabilities make up a substantial group among women experiencing the transition to parenthood.

One reason to be concerned about depression during the postpartum period among women with physical disabilities is that births to women with physical disabilities have higher rates of adverse obstetric and neonatal outcomes, and such adverse obstetrical and neonatal outcomes are risk factors for postpartum depression (Ghaedrahmati et al., 2017). The overall relative risk of having any labor, delivery, or postpartum complication was found to be 1.33 for women with physical disabilities, compared to nondisabled women (Gleason et al., 2021). Specifically, these mothers had a higher risk of developing pregnancy-related illnesses like hypertensive disorders and gestational diabetes, delivery complications like Cesarean delivery, and postpartum complications like infections, with relative risks between 1.10 – 5.64 (Gleason et al., 2021). Other studies support these findings across women with many types of physical disabilities, such as women with spinal cord injuries having increased odds of Cesarean delivery (Tarasoff et al., 2020; Crane et al., 2019). In addition, pregnant women with physical disabilities may be at increased risk of adverse birth outcomes, including preterm birth and low birth weight (Signore et al., 2011; Morton et al., 2013). Overall, women with physical disabilities have higher risks of many adverse outcomes which are associated with increased rates of depression during the postpartum period (Ghaedrahmati et al., 2017).

Compounding these higher risks for adverse obstetric and birth outcomes is the failure of many providers to meet standards of accessible care during the perinatal period, despite the legal mandate from the Americans with Disabilities Act (ADA) to provide equal access to healthcare for people with disabilities (Lagu et al., 2015). Women with physical disabilities have reported a lack of sufficient accessible equipment in routine prenatal care; in an American sample, only some women's obstetricians had height-adjustable exam tables, allowing for safe transfer for women using wheelchairs or other mobility aids, and very few obstetric offices had accessible

weight scales, so none of the women in this sample reported being routinely weighed (Iezzoni et al., 2015b). This lack of accessible healthcare equipment is even more prominent in developing countries like Nigeria, where one study examining four antenatal clinics surveyed hospital administrators and found that none of the clinics had any adjustable height examination tables, chairs, or accessible weighing scales (Hart et al., 2019). During delivery, many women report physically inaccessible ultrasound tables, delivery beds and restrooms (Tarasoff, 2015). For women with physical disabilities, these negative experiences decrease their trust in healthcare, with one sample of Vietnamese women reporting that they were much less likely to attend postnatal care after experiencing these barriers during antenatal care (Nguyen et al., 2022).

Financial burdens are also placed on women with physical disabilities, as these women have extra expenses like accessible equipment and transportation, as well as personal care attendants to help with activities of daily living during pregnancy and while caring for their infants (Tarasoff, 2015) Some mothers even report these financial barriers as a disincentive to exclusive breastfeeding, since they would have to pay for transportation to bring their infants around with them for breastfeeding, due to mobility limitations (Acheampong et al., 2020). For women with physical disabilities in the perinatal period, these environmental and financial barriers interact with their physical impairments, contributing to the experience of disability as they are further limited in their ability to equally participate in society (Adams, Reiss, & Serlin, 2015).

Further complicating their experiences during delivery and the postpartum period, women with physical disabilities also have higher healthcare needs due to the particular characteristics of their disabilities. Recommendations for proactively addressing these needs include in-depth consultations with physical and occupational therapists, doctors, and lactation

consultants, among others, given the unique difficulties of this population in delivery, breastfeeding, and childcare (Byrnes & Hickey, 2016, Powell et al., 2018). However, the literature suggests that these recommendations are often not followed. In one sample of women with cerebral palsy, few reported receiving referrals for needed physical or occupational therapy (Hayward et al., 2017). Additionally, obstetric clinicians reported a lack of formal education about treatment of pregnant and postpartum patients with physical disabilities and the ensuing complications (Smeltzer et al., 2018), and 68% of resident doctors said that they would not feel comfortable with the management issues in treating women with physical disabilities, though 92% were interested in more formal education on the topic (Bekdache & Berndl, 2018). Many women with physical disabilities also report that many clinicians ignore their expertise in their own bodies (Smeltzer et al., 2016), and in one sample, 31% of women reported being refused care by a clinician due to their physical disability (Nosek et al., 2001). This lack of knowledge and appropriate care from clinicians impairs the ability of women with physical disabilities to fully heal and recover from delivery, thus exacerbating their functional limitations when it comes to coping with postpartum stressors and parenting their infants.

Additional stressors such as discrimination also contribute to negative social barriers that further impact the perinatal experience of women with physical disabilities. Women in this population are more likely to be Black, older, and in poverty, in addition to having lower levels of education and employment compared to women without physical disabilities (Iezzoni et al., 2013). There are a myriad of factors contributing to these associations; for example, the stressor of enduring racism is associated with poorer physical health, with minorities having higher risks of developing diseases at younger ages (Paradies et al., 2015; Kaholokula, 2016). Physical disability and poverty are also associated; even beyond the extra costs of disability, poverty rates

are much higher for people with disabilities (Saunders, 2007). Part of this is due to the lower employment rates for people with disabilities, who are five times more likely than nondisabled people to be involuntarily unemployed, which can lead to financial dependency on family or on government benefits that trap people with disabilities into poverty with little option for regaining employment (Turner & Turner, 2004; Dickey, 2019). These additional axes of marginalization beyond ableism – including racism, sexism, and classism – exacerbate discrimination from healthcare providers, which increases their likelihood of disability (Garland-Thompson, 2011).

Beyond these forms of discrimination, women with physical disabilities also experience ableism. During pregnancy, these women face discrimination from their family and friends, as well as the clinicians caring for them, reporting that they have been confronted with beliefs about disability being a burden to those around them and aversive reactions from those around them when they choose to have children, including some seeing them as selfish (Iezzoni et al., 2015a; Andrews & Ayers, 2016). In one Australian sample, 36% of women with physical disabilities reported receiving negative reactions to their pregnancies compared to 9% of nondisabled women, including less support from relatives or even pressure to have an abortion (Chinnery & Westbrook, 1995). Some studies even note patients' reports of gynecologists encouraging patients with physical disabilities to be sterilized, since they are seen as unable to care for children (Tarasoff et al., 2015). These and more experiences of discrimination and barriers faced by women with physical disabilities bring a unique set of functional limitations to pregnancy and motherhood (Shpigelman, 2015).

The stress associated with forms of discrimination like ableism and racism is associated with mental health difficulties, with people who report perceived discrimination, especially in multiple forms, having increased risk for lifetime depression (Gayman & Barragan, 2013).

Perceived discrimination during pregnancy is also prospectively linked to 2.43 times higher odds of postpartum depression among women with low education, a characteristic more prevalent among women with physical disabilities (Stepanikova & Kukla, 2017; Iezzoni et al., 2013). Physical disability itself also leads to a higher risk of depressive symptoms for women of all ages as compared to the general population (Turner & Noh, 1988). During pregnancy, women with physical disabilities have higher rates of mental health difficulties, with 67% of them experiencing some difficulties compared to 30% of those without physical disabilities (Iezzoni et al., 2015a). A systematic review and meta-analysis investigating peripartum mental illness and chronic medical conditions found that having chronic medical conditions in general, many of which often lead to physical disabilities, increases the odds of having postpartum depression with an odds ratio of 1.44 (Brown et al., 2018). A later study found that 19.5% of women with chronic physical disabilities had a mood or anxiety disorder between conception and a year after birth, compared to 15.1% without, with an adjusted odds of 1.19 for women with physical disabilities to develop a form of mood or anxiety disorder between conception and one year postpartum (Brown et al., 2019).

Although physical disability itself is not thought to cause postpartum depression, the current literature studying postpartum factors affecting women with physical disabilities suggests that the associated medical complications and social factors may contribute to a greater risk for developing postpartum depression. Postpartum depression is typically defined as either major depressive disorder that meets diagnostic criteria or elevated symptom levels that present in the postnatal period, up to a year after childbirth (O'Hara & McCabe, 2013). In addition to symptoms that characterize depression at any point in one's life, depressive features specific to postpartum women include excessive preoccupation around their baby's health and safety,

difficulty bonding with the infant, and, in extreme cases, intrusive thoughts about harming the child (Steward & Vigod, 2019). Although rates of postpartum depression in general population samples are 10 to 15%, rates are significantly higher among women with particular risk factors, such as a history of depression before and during pregnancy, obstetric and labor complications, stress, and poor social support, among others (Ghaedrahmati et al., 2017). Additional predictors of developing depression in the postpartum period include demographic factors such as being less educated, and unemployed, as well as birth outcomes like preterm birth or having an infant with a low birth weight (Katon et al., 2014). As reviewed above, these predictors of postpartum depression are seen in higher rates among women with physical disabilities.

Another important reason to investigate the association between physical disability and depression in the postpartum period is the consequences that can result if postpartum depression is underdiagnosed or undertreated. This is particularly likely in this population due to the barriers to obstetric and pediatric healthcare where screenings and treatment referrals often occur, with one group of women with cerebral palsy reporting low rates of postpartum depression screening (Hayward et al., 2017). Without proper diagnosis and treatment, postpartum depression is associated with continuing negative outcomes for both the mother and child; mothers are more likely to experience recurring episodes of depression and more relationship difficulties, including romantic breakups and less social support (Steward & Vigod, 2019; Slomian et al., 2019). They are also more likely to exhibit maladaptive parenting behaviors, including being less likely to take their child to the doctor and being less responsive to infant cues (O'Hara & McCabe, 2013). The children of mothers with postpartum depression have higher rates of internalizing and externalizing psychopathology, poorer cognitive development, and higher rates of illnesses like respiratory and gastrointestinal infections, as well as diarrhea and febrile diseases, relative to

children whose mothers do not experience postpartum depression (Moore Simas et al., 2019; Slomian et al., 2019). These consequences of postpartum depression lend all the more urgency to an investigation into the relationship between physical disability and postpartum depression.

It is crucial to better understand the relationship between physical disability and postpartum depression, given that postpartum depression leads to many consequences but physical disability in parents by itself does not. Despite the associated barriers and risks associated, having a parent with a physical disability has not been found to have a negative impact on child development (Andrews & Ayers, 2016) and it has been reported to build resilience and creative problem-solving in both the parent and child (Becker et al., 2021; Shpigelman 2015). Therefore, understanding how physical disability impacts and interacts with depression for parents in the postpartum period will improve the ability of parents and providers to maximize the benefits of having a parent with physical disabilities while mitigating the negative parent and child outcomes associated with postpartum depression.

In summary, it is important to know the associations between postpartum depression and physical disability and how this relationship works in order to improve the state of existing knowledge, to better understand the impact of negative experiences associated with physical disability, and to illuminate factors that contribute to this relationship in order to improve clinical practice and mitigate negative outcomes. Recognizing this importance, researchers have published studies investigating rates or levels of depression in the postpartum period among women with various physically disabling conditions or assessing the levels of physical impairment in relation to postpartum depression. However, many of the studies have small sample sizes, and taken together, they have significant heterogeneity across their measures of postpartum depression and physical disability, as well as participant demographics and type of

disability. With this paper, we build on this literature by reviewing it in order to make a stronger claim about the association between postpartum depression and physical disabilities. Systematically reviewing this literature and computing overall mean effect size of the relationship between postpartum depression and physical disabilities has the potential to inform researchers and practitioners in terms of the extent to which postpartum depression is present among women with physical disabilities. Advantages of a meta-analytic review over a narrative review include the generation of a more precise estimate of the true effect size of the association between postpartum depression and physical disabilities. It also statistically controls for the effects of heterogeneity between the studies and variable study quality (Lee, 2019).

In addition to the aim of generating an overall effect size for the association between postpartum depression and physical disabilities, we also sought to evaluate support for a set of theory- and empirically-driven potential moderators. The proposed meta-analysis will investigate factors that might significantly moderate the relationship between physical disability status and postpartum depression rates, including demographic characteristics like population studied and region, as well as methodological factors such as the direction of sampling (comparing cohorts of those with and without physical disabilities or those with and without postpartum depression), type of control group for comparison, and the approach to measuring depression and physical disability or impairment.

The primary hypothesis of this study is that there will be a significant association between postpartum depression and physical disability. Additionally, some of the heterogeneity in this association is hypothesized to be explained by factors such as type of disability or methodological approach measuring the variables of interest. If the hypotheses are supported by the data, this meta-analysis would provide stronger evidence that physical disability could be a

predictor of developing postpartum depression (Haidich, 2010), and thus is a key target for screening and treatment. The results could also point to a target for more financial and physical resources for people with physical disabilities during pregnancy and the postpartum period, to improve the accessibility of maternal obstetric and mental healthcare and potentially help mitigate the numerous deleterious maternal and child outcomes that result from postpartum depression in a significant population of new mothers.

Method

Protocol Registration

This review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). The protocol was submitted for registration on the prospective register of systematic reviews (PROSPERO).

Search Strategy

Two electronic databases, *PubMed* and *PsycInfo*, were searched for relevant studies on October 29th, 2021. The search strategy was comprised of terms relevant to the postpartum period, internalizing disorders, and physical disability status. The search strategy included broad terms assessing internalizing psychopathology in order to catch studies that may only mention stress or anxiety in the abstract but include a measure of postpartum depression in the full text. To determine search terms for physical disability, we reviewed the search terms for studies conducting a systematic review involving physical disability to aggregate relevant and commonly used search terms (Malouf et al., 2014; Tarasoff et al., 2020; Tough et al., 2017; Jones et al., 2012; Banks et al., 2017).

For our review, the postpartum period terms were: (postpartum or postnatal or perinatal). The depression terms were: (depression or depressed or depress* or mood or internalizing symptoms or stress or anxiety or anxious). Finally, the physical disability terms were: (disabled person* or disab* or disabled people or activity limitation* or activities of daily living or mobility limitation* or paraplegi* or quadriplegi* or physical disab* or handicap* or physical impair* or physically impair* or physical deficien* or physically deficien* or physically disab* or physical handicap* or physically handicap* or cerebral palsy or spina bifida or muscular dystrophy or chronic brain injury or traumatic brain injury or chronic traumatic encephalopathy or amputation* or amputee* or spinal cord injury or neural tube defect* or dwarfism or osteogenesis imperfecta or spinal muscular atrophy or deaf* or blind or hearing loss or hard of hearing or hearing impair* or vision loss or visually impair*). In *PubMed*, the term "blind" was searched as (blind* NOT double blind* NOT blinding NOT triple blind*) to exclude studies that included the term blind referring to study methodology, not a visual impairment. In *PubMe*d, the search was limited to studies in English and included NOT ("animals"[MeSH Terms] NOT "humans"[MeSH Terms]) in order to exclude animal studies without missing any human studies that had not yet been coded, and in *PsycInf*o, the search was limited to studies with humans and in English.

Study Selection

As described in the PRISMA flow diagram (see Figure 1), studies at the title and abstract screening phase were included if they had a reference to psychopathology in the postpartum period as well as a reference to disability of any type or a physical health condition that could be disabling. This included studies with measures of functional impairment and physical health-related quality of life. Studies were excluded if they were not peer-reviewed articles, if they did

not collect original data, or if they did not sample human subjects. At the full text review, studies were included if they had a measure of postpartum depression (e.g., a self-report questionnaire, a clinical diagnosis, or a diagnostic interview), as well as an indicator of physical disability status (e.g., a self-report questionnaire assessing physical disability-related impairment or symptomology, or a diagnosis of a chronic physical health conditions that often results in disability), and case studies were excluded. During the sequential screening process (title/abstract screening, full-text review, data extraction screening process), potential articles were selected by one reviewer. A second reviewer independently double-coded a randomly-selected 20% of the articles in the title/abstract screening for fidelity, resulting in a proportionate agreement rate of 96.8% between the reviewers, indicating high inter-rater reliability.

Data Extraction

Relevant and available data from all included studies was extracted, including general information about the study, methods, participants, measures, demographic characteristics, and statistical outcomes. General information extracted included the lead author, the contact information for the corresponding author, the publication year, and the country the study was conducted in. For methodological information, we extracted information about the sampling direction, namely whether a study used a sample of people with physical disabilities and measuring postpartum depression, or vice versa, or presented both variables continuously. Additionally, participant information extracted included the population sampled, the inclusion and exclusion criteria, and the total number of participants. For the measures, the measure type, specific measure, and information about the measure such as translations were extracted, as well as if they used a cutoff and if so, what it was. For demographic information, we extracted and coded the maternal characteristics of age, race/ethnicity, income or socioeconomic status,

partnership status, primiparity, and education level. For maternal depression and physical disability variables, any statistics describing these variables were extracted, including means and standard deviation, median and interquartile range, odds ratio, relative risk, correlation, and percentages of groups above chosen cutoffs.

For studies with multiple effect sizes for the relationship between physical disability and postpartum depression, both effect sizes were extracted for inclusion in the meta-analytic model. Studies that did not present the variables of interest in relation to each other or that did not publish the physical disability subscale or factor of a larger measure of global disability were excluded. Studies that did not include a control group, either examining only women with physical disabilities or only women with postpartum depression, were described qualitatively, so relevant data was extracted to describe these studies, but they were not included in the final meta-analysis.

Assessment of Study Quality

Study quality was assessed using a version of the Newcastle-Ottawa Scale, a validated scale to determine the relative quality of included studies; the scale was modified to exclude questions specific to reviews of intervention studies (Wells et al., 2000). Studies were rated on three domains of quality: selection, comparability, and outcomes. Ratings were then aggregated to score studies as good, fair, or poor.

Data Analysis

The majority of studies published their data as the difference between means, i.e., the mean depressive symptom level for a group of women with physical disabilities and a group with no disabilities. Since effect sizes are a measure of association between two variables, studies that reported data using both sampling directions (cohorts with and without physical disabilities

measuring postpartum depression and cohorts with and without postpartum depression measuring physical disability) were all included in the main analysis. To account for the heterogeneity of effect size measures presented in our study pool, we converted all effect sizes to a Cohen's *d*, or standardized mean difference, and variance measure (Andrade, 2020; Cohen, 1988). For studies that presented means and confidence intervals or standard errors, these alternate measures of spread were converted to standard deviations using formulas inputted into Excel, following equations in the *Cochrane Handbook* (Higgins et al., 2021). To calculate Cohen's *d* and to convert odds ratios to Cohen's *d*, data was inputted into an online conversion website (Lenhard & Lenhard, 2016). The Cohen's *d* and standard error from Pearson's correlation were calculated in Excel (Mathur & VanderWeele, 2020). Finally, variance was calculated in Excel for all values of Cohen's *d*, following a formula from *The Handbook of Research Synthesis and Meta-Analysis* for studies (Borenstein, 2019).

Using the metafor package in R (Viechtbauer, 2010), an aggregate data random effects meta-analysis was calculated to examine the difference between standardized means, or Cohen's *d*, looking at the association between physical disability and postpartum depression. Heterogeneity was assessed using the Q test of heterogeneity and I^2 statistic, which gives a measure of the total heterogeneity/total variability. A meta-regression analyzed the proposed moderators to determine the extent to which they accounted for significant heterogeneity among effect sizes. For the moderator investigating the sampling direction of the study, we categorized studies as having compared (a) if the study compared people with and without physical disabilities and measured their rates of postpartum depression, (b) if the study compared people with and without postpartum depression and compared their levels of physical disability, or (c) if it compared both as continuous variables without any dichotomization. For the moderator

investigating the population studied, we categorized studies as having sampled (a) people with and without prior chronic physical disabilities, (b) physically disabling conditions relating to pregnancy and birth, or (c) disability ratings across the general population. Due to missing data on study demographics, region of study was analyzed as a moderator to serve as a partial proxy for race, as many of the included studies were conducted in countries that are largely racially homogenous; countries were divided up into (a) Europe, (b) South Asia, and (c) North America and Australia, as these countries are less homogenous. The comparison of the control group was analyzed as a moderator, comparing (a) samples comparing to a control group without the given exposure and (b) samples compared to a normative value from the general population sampled. The type of measure for both postpartum depression and physical disability were also analyzed as moderators, comparing (a) diagnostic interview to (b) symptom scale for postpartum depression, and (a) clinical diagnosis to (b) symptom scale for physical disability.

In addition, publication bias was assessed using a funnel plot visualization, Egger's test of funnel plot asymmetry, and Rosenthal's fail-safe *N* (Viechtbauer, 2005). Finally, additional meta-analyses were run to measure the effect size and moderators in various cases. The Cook's distances were calculated to determine which cases were significantly influential and a model was run excluding this case, to investigate the practical significance of this effect size, what significantly moderated the association, and the publication bias of the study without influential outliers. The included studies were also grouped by sampling direction and two meta-analytic models with their associated moderators were calculated to investigate the studies that compared cohorts with and without physical disabilities to those that compared to cohorts with and without postpartum depression.

Results

We analyzed our data to test our hypotheses that there is a significant association between postpartum depression and physical disability, marked by significant heterogeneity between the included studies, and that this association is moderated by demographic and methodological factors which explain some of the heterogeneity. The results are presented in seven parts: (1) tables describing the included studies, (2) the qualitative analysis describing case studies and cohort studies without control groups, as well as studies where effect sizes were not able to be calculated, (3) the quantitative meta-analysis without moderators, (4) the quantitative meta-analysis with moderator analyses, (5) the analysis of publication bias, (6) the results analyzed without the influential point, and (7) the results analyzed in two meta-analytic models separated by sampling direction.

Characteristics of Included Studies

The included studies varied in quality, as seen in Table 1, with many having fair to poor quality due to a reliance on self-reports to ascertain variables of interest and a lack of statistical control for confounding factors in the analyses of effect sizes. However, all studies were included in the meta-analysis given the small number of studies relating physical disability to postpartum depression that were identified by the screening process. The summary characteristics of the studies are presented in Table 2, the study demographics are presented in Table 3, and the study characteristics are presented in Table 4.

Qualitative Analysis

The studies that only present rates of postpartum depression among a cohort of people with physical disabilities, or rates of physical disability among a cohort of people with postpartum depression, but do not compare these rates to a control population are described in

Table 5. These studies describe varying rates of postpartum depression, many of which are higher than the average rate of the general population of 10-15% (O'Hara & Swain, 1996). Additionally, these studies describe varying rates of postpartum depression within groups of women with physical disabilities, corresponding to the level of impairment resulting from the disability. For example, women with spinal cord injuries have higher rates of postpartum depression as their injury goes higher up the spine and thus is more impairing (Lee et al., 2021). Additionally, among women with multiple sclerosis, of pregnancies that resulted in postpartum depression, 64% had higher disability ratings, as compared to 49% with higher disability ratings for pregnancies which did not result in postpartum depression, as measured by a score on the Expanded Disability Status Scale ≥ 2.0 (Krysko et al., 2021). The additional studies for which data was presented comparing an exposure to a control group, but for which an effect size of Cohen's *d* was unable to be calculated, are described in Table 6; both of these studies demonstrate a significant relationship between physical disability and postpartum depression.

Meta-Analytic Model

The second aim addressed was the association between postpartum depression and physical disabilities, analyzed through a random-effects meta-analysis and a visual inspection of the resulting forest plot (see Figure 2). The meta-analysis aggregated the standardized difference between means, or Cohen's *d*, to test the association, using a random-effects model due to the expected variance in sampling and populations between studies, since this model assumes that the true effect size may vary across the included studies. The model assessed the twelve included studies and found an overall estimate of the standardized mean difference to be 1.04, with a 95% confidence interval of [0.46, 1.63] and a standard error of 0.298 ($z = 3.50$, $p < .0001$). As expected, there was significant heterogeneity among the studies ($Q = 362.98$, $df = 11$, $p < .0001$).

The total heterogeneity of included effect sizes, or I^2 statistic, was 98.60%; the presence of significant heterogeneity supports the use of the random effects model, which assumes that the included studies may have varying underlying effect sizes, though they have a fixed relationship between the two variables. The results of this analysis support our hypothesis that there is a statistically significant association between postpartum depression and physical disability, with the summary Cohen's *d* demonstrating a large effect size, as it is above 0.8 (Cohen, 1998).

Moderator Analyses

Sampling Direction and Sample Population

To test sampling direction as a moderator, i.e., the extent to which heterogeneity was explained by whether the study (a) compared rates of postpartum depression between groups of people with and without physical disabilities, (b) compared rates of physical disability between groups of people with and without postpartum depression, or (c) was nondirectional. The meta-regression analysis was not significant ($Q_M = 2.14$, $df = 1$, $p = .143$), indicating, contrary to our hypotheses, there was not sufficient evidence to conclude that sampling direction significantly affected the heterogeneity in the summary effect size. Sample population was also tested as a moderator; however, the results of this analysis were the same as for sampling direction, as the sample population groups lined up exactly with the sampling direction groups; therefore, there was not sufficient evidence to conclude that sample population significantly affected the heterogeneity in the summary effect size, either.

Region of the World

Next, we tested the region where the study was conducted as a moderator, comparing studies conducted in Europe, in South Asia, and in North America/Australia. The meta-regression analysis was not significant ($Q_M = 2.28$, $df = 1$, $p = .320$), indicating that, contrary to

our hypotheses, there was not sufficient evidence to conclude that the region where the study was conducted significantly affected the heterogeneity in the summary effect size.

Type of Control Group for Comparison

We tested the type of control group as a moderator, comparing (a) the studies that compared their sample with the exposure to a sample without the exposure with (b) studies that compared their sample with the exposure to a normative value, taken from the general population. The meta-regression analysis was significant, ($Q_M = 4.28$, $df = 1$, $p = .039$), indicating that studies comparing to a normative value from the general population had higher effect sizes than those comparing to a population without the given exposure. If true, this finding makes intuitive sense, as, for example, the normative value of physical disability level drawn from the general population by nature includes people with and without postpartum depression. However, given that the p value was in between $\alpha = 0.05$ and $\alpha = 0.01$, and only two studies in the model compared to a normative value, one of which was an influential outlier, this finding could be due to chance alone.

Measure Types of Postpartum Depression and Physical Disability

Finally, we tested the measure types of postpartum depression and physical disability as moderators. This model compared the effects of having postpartum depression measured as (a) a symptom scale or as (b) a diagnostic interview, as well as the effects of having physical disability measured as (a) a symptom scale or (b) a clinical diagnosis, to see if these moderators explained any of the heterogeneity in the model. The meta-regression analysis was significant for postpartum depression measure type ($Q_M = 42.31$, $df = 1$, $p < .0001$), and not significant for physical disability measure type ($Q_M = 1.35$, $df = 1$, $p = .245$), indicating that only the postpartum depression measure affected the model heterogeneity. The test for residual

heterogeneity was still significant after the type of postpartum depression measure was accounted for (Q_E = 157.58, df = 9, p < .0001). However, the H^2 statistic, describing unaccounted sampling variability, decreased from 71.53 to 9.18, indicating that while much of the heterogeneity in the overall model was still unaccounted for, the sampling variability was reduced with the inclusion of the postpartum depression measure moderator. Upon further examination of the data, only two studies used a diagnostic interview instead of a symptom scale to measure postpartum depression, which could indicate that there is not sufficient power for the moderator analysis. However, both studies, Kang et al., 2020 and Rahman et al., 2003, were the two studies with the largest Cook's distance, with Kang et al., 2020 having the only significant influence on the model (see Figure 3). Thus, these cases being influential in the model further supports the findings of the moderator analysis, though this finding is still preliminary (Light & Pillemer, 1984). This suggests that a measure of postpartum depression using a diagnostic interview, as opposed to a symptom scale, may detect a stronger relationship between postpartum depression and physical disability.

Publication Bias

The presence of publication bias was assessed visually through a funnel plot (see Figure 4), and statistically using Egger's test of funnel plot asymmetry and Rosenthal's fail-safe *N*. The funnel plot is not cone-shaped and does not demonstrate symmetry, as Egger's test of funnel plot asymmetry was significant (z = 3.500, p = .0005); however, the influential case (Kang et al., 2020) visually seems to skew this analysis of publication bias. The lack of an expected cone shape in the funnel plot indicates that there may be publication bias in the meta-analysis; however, the shape of the plot could also indicate other causes such as poor methodological design of the studies that leads to inflated effect sizes in small samples (Egger et al., 1977).

In another analysis of publication bias, the Rosenthal fail-safe *N* was found to be 1828 ($p < .0001$). This signifies that 1828 studies with null results would have to be missing, or in the "file drawer," for the model to not be significant (Rosenthal, 1979). Therefore, it is likely that the results of the random-effects model demonstrate a true association between postpartum depression and physical disability status.

Results Without Influential Case

To see the results of the meta-analytic model without the influence of Kang et al., 2020 pulling the results higher, we reran the analyses excluding this case ($k = 11$, see Figure 5). The model assessed the eleven other studies and found an overall estimate of the standardized mean difference to be 0.79, with a 95% confidence interval of [0.44, 1.15] and a standard error of 0.182 ($z = 4.37$, $p < .0001$). There was still significant heterogeneity among the studies ($Q = 305.60$, $df = 10$, $p < .0001$), and the total heterogeneity of included effect sizes, or I^2 statistic, was 96.20%. The meta-regressions found the largely same significant moderators, with measure type of postpartum depression being the only statistically significant moderator ($Q_M = 33.68$, $df = 1$, $p < .0001$), which decreases the H^2 statistic, describing unaccounted sampling variability, from 71.53 to 5.88. The only difference was that without the influential case, the moderator of control comparison type was no longer statistically significant ($Q_M = 0.00$, $df = 1$, $p = .998$). Therefore, the findings of the meta-analysis remain largely the same with and without the influential case: that there is a significant association between postpartum depression and physical disability, with measure type of postpartum depression being the only tested moderator that explained significant heterogeneity in the model. The only changes in our findings would be that control comparison type is no longer a significant moderator, indicating that this effect was found due to the influence of Kang, et al. (2020), and in addition a decrease in the practical significance of the

summary effect size, with the Cohen's *d* going down from a large effect size, with a value of 1.04 that is above the threshold of 0.8, to an intermediate effect size, with a value of 0.79 that is in between the thresholds of 0.5-0.8 (Cohen, 1998).

Additionally, the analysis of publication bias is changed without the influence of Kang et al. (2020), as visualized in the funnel plot (see Figure 6). Now, the funnel plot is still not cone-shaped, but it no longer has significant asymmetry ($z = 0.677$, $p = .499$). Since the funnel plot was symmetrical but demonstrated additional scatter horizontally, this indicates that the funnel plot may be displaying the effects of heterogeneity and not publication bias (Sterne et al., 2011). Funnel plots have also demonstrated high rates of Type I error in analyses of standardized mean difference and variance, particularly in the presence of high heterogeneity between studies (Pustejovsky & Rodgers, 2019). This finding is supported by the statistically significant Q statistic and high I^2 value that describe high heterogeneity in the model and a large Rosenthal fail-safe N of 1408 ($p < .0001$), indicating that it is significantly unlikely that the results are due to sampling bias (Rosenthal, 1979). Therefore, these findings support that the results of the random-effects model demonstrate a true association between postpartum depression and physical disability status with significant heterogeneity and little publication bias, with the influential case skewing the summary effect size and tests of publication bias but not changing the overall results.

Results Grouped by Sampling Direction

We also ran two additional meta-analyses to visualize the two groups of studies: (a) studies that compared postpartum depression in women with and without physical disabilities and used clinical diagnoses of physical disabilities in a population with and without specific pre-pregnancy chronic disabilities ($k = 4$), and (b) studies that compared physical disability level in

women with and without postpartum depression and used symptom scales of the level of physical disability in a general population ($k = 7$). One study was not included in either analysis, as it did not separate their sample into cohorts but instead compared continuous values of postpartum depression symptoms and physical disability level.

Sampling By Physical Disability Status

The meta-analytic model that assessed studies sampling by physical disability (see Figure 7) found an overall estimate of the standardized mean difference to be 0.50, with a 95% confidence interval of [0.20, 0.81] and a standard error of 0.155 ($z = 3.26$, $p = .0011$). There was still significant heterogeneity among the studies ($Q = 15.51$, $df = 3$, $p = .0014$), and the total heterogeneity of included effect sizes, or I^2 statistic, was 87.45%; however, though still statistically significant, this is much less heterogeneity than present in the overall meta-analysis ($Q = 362.98$, $df = 11$, $p < .0001$; $I^2 = 98.60\%$), indicating that there is less variation in study outcomes. The meta-regressions found no statistically significant moderators for this subgroup of studies, including the specific physical disability (in these studies, hearing loss and epilepsy) and region of the world; several prior moderators were not tested, as the values were the same for each study, including type of postpartum depression and physical disability measure and the type of control group comparison. Therefore, the findings of the overall meta-analysis maintain the same finding in this group of studies: that there is a significant association between postpartum depression and physical disability. The main changes in our findings would less heterogeneity and a decrease in the practical significance of the summary effect size, with the Cohen's *d* going down from a large effect size, with a value of 1.04 that is above the threshold of 0.8, to an intermediate effect size, with a value of 0.50 that is in between the thresholds of 0.5-0.8 (Cohen, 1998).

Sampling By Postpartum Depression Status

The meta-analytic model that assessed studies sampling by postpartum depression (see Figure 8) found an overall estimate of the standardized mean difference to be 1.44, with a 95% confidence interval of [0.47, 2.41] and a standard error of 0.495 ($z = 2.892$, $p = .0035$). There was still significant heterogeneity among the studies ($Q = 181.68.51$, $df = 6$, $p = .0001$), and the total heterogeneity of included effect sizes, or I^2 statistic, was 98.23%. The meta-regressions found that the specific measure assessing physical disability significantly moderated this association: the study using the WHOQOL-Bref and the studies using the BDQ have higher effect sizes than those using the SF-36 ($Q_M = 29.98$, $df = 2$, $p < .0001$) and accounting for this heterogeneity decreases the H^2 statistic, describing unaccounted sampling variability, from 71.53 to 7.87. Additionally, the type of measure for postpartum depression continues to moderate the overall association, ($Q_M = 21.06$, $df = 1$, $p < .0001$).

The prior moderator of type of disability measure was not tested, as all used a symptom scale, and the other moderators tested were not statistically significant for this subgroup of studies, including the region of the world and type of control comparison. Therefore, the findings of the meta-analysis maintain the same overall finding in this group of studies: that there is a significant association between postpartum depression and physical disability. This finding maintains a large effect size, as it is still skewed by the influential outliers previously examined, and this analysis also revealed that the specific measure used to assess physical disability level accounts for some of the variation in study outcomes between studies sampling by postpartum depression.

Discussion

The meta-analytic review found a significant association between postpartum depression and physical disability, with a large effect size and significant heterogeneity among the included studies. There was no significant effect of the sampling direction (namely, whether postpartum depression and physical disability were the exposure or the outcome, respectively, in each study); this suggests that sampling direction did not explain significant amounts of the heterogeneity in the model, though this might be affected by the small sample size as well. However, the moderator analysis of measure types revealed that, though type of physical disability measure was not a significant moderator of the relationship between postpartum depression and physical disability, postpartum depression measure was a significant moderator of this association, with diagnostic interviews having a larger effect size and accounting for some of the sampling variability. The model was unable to test the effects of many additional factors like demographic characteristics and prior depression, either before or during pregnancy, due to an insufficient sample size.

Implications

Our findings significantly contribute to the literature on postpartum depression and physical disabilities; to our knowledge, this is the first meta-analysis that investigates the association of these variables. These findings line up with those from prior studies, including a similar meta-analysis that found having chronic medical conditions increases the odds of having postpartum depression (Brown et al., 2018). Our results are congruent with our hypothesis that there is a significant relationship between postpartum depression and physical disabilities. In addition, with our analyses, we were able to generalize across a diverse set of study populations

with a variety of sampling strategies and studied populations to make a stronger claim about the association between physical disabilities and postpartum depression.

Our findings, which support our hypothesis that there is an association between postpartum depression and physical disabilities, are particularly relevant for clinical practice. There are varying degrees of prevalence of any given specific physical disability, as many conditions can lead to physical disability. However, among the roughly 11 million women in the United States between the ages of 16-64 who have disabilities, 51% of them have physical disabilities, or around 5.61 million women (Byrnes & Hickey, 2016). Though not all of these people will have children, and fewer will develop depression in the postpartum period, a much larger number of people will be seen in clinical care that have physical disabilities than any one condition causing physical disability.

The strongest implication of the review is the demonstration, through a thorough literature search, that there are not enough studies investigating the association between postpartum depression and physical disability. More studies are needed to fully understand the mechanisms of the relationship or additional moderators such as demographic factors that would better explain this association, as well as to determine the underlying prevalence of depression in the postpartum period among people with physical disabilities. Despite the large number of people with physical disabilities that give birth, there has been very little formal research investigating the prevalence of postpartum depression in this population or its unique features and associations. Given the serious consequences of postpartum depression as well as the higher rates of several risk factors for postpartum depression in individuals with physical disabilities, such as adverse obstetric and birth outcomes, prior depression, and social and medical discrimination based on ability (Gleason et al., 2021; Turner & Noh, 1988; Tarasoff et al., 2015),

it is clear that this topic needs to be further researched in order to help mitigate, or even prevent, depression among postpartum parents with physical disabilities.

Limitations

This review was limited primarily by a lack of data to make stronger conclusions about the relationship between postpartum depression and physical disability. The systematic review found only $n = 11$ studies for inclusion in the meta-analysis, which had significant heterogeneity, only some of which is explained by the potential moderators tested. In addition, the included studies measure this association from several directions, with $n = 6$ studies comparing cohorts of women in the general population with and without postpartum depression and looking at their level of physical disabilities, $n = 4$ studies comparing cohorts of women with and without specific chronic physical disabilities and looking at their levels of postpartum depression symptoms, and $n = 1$ study comparing both variables continuously in a sample of women with varying levels of physical disability related to pregnancy pain. This difference in sampling direction limits the interpretability of the results, so that the data can suggest only an association generally between the variables but nothing more concrete about the direction of the specific relationship. However, sampling direction was not found to significantly moderate the model, which suggests that in this sample, sampling direction did not cause the heterogeneity between the studies. Additionally, aggregating the data across many types of physical disabilities into one summary measure of postpartum depression increases the generalizability of the information, so that the results can be extrapolated to a population of women with all types of physical disabilities but do not reveal information about postpartum depression within specific physical disabilities.

The included studies also had large amounts of missing data. Many studies lacked data describing their sample's demographics, so the meta-analysis was unable to compare factors such as prior history of depression, age, or race to explain some of the variance in the model. Additionally, the meta-analysis did not have sufficient power to test additional moderators such as the level of impairment from the physical disability, the type of physical disability, or history of depression to examine the effect of these factors on postpartum depression rates.

Finally, due to the wide variety of physical health conditions that can lead to physical disabilities, it was impossible to include all of them in the search terms. Since several of the studies that were included did focus on specific conditions, it is possible that some studies that examined very low base-rate physical disabilities were missed from the review.

Directions for Future Research

Our next planned steps following this paper include attempts to increase the sample size of the meta-analysis. We plan to contact the authors of the papers for which data was unable to be extracted, since these papers measured both postpartum depression and physical disability but presented their respective statistics separately; with the raw data from these studies, we will be able to calculate effect sizes of the association between these variables. In addition, we plan to reach out to the authors of papers where their effect sizes could not be calculated to attempt to use their raw data to be able to calculate the effect size Cohen's *d*. For studies that were included but did not present information about the cohorts regarding various demographic variables, authors will be contacted to see if this missing data can be used. In addition to these efforts, we plan to research normative values for postpartum depression prevalence to compare to each study for which a control group was not included, specifically finding values that are drawn from the same general population as each study sample. The data that we are able to acquire will be added

to the overall meta-analytic model in order to increase the sample size and potentially allow us to analyze more demographic factors as potential moderators. Finally, studies that also measured anxiety in the postpartum period will separately be analyzed to assess the association between postpartum anxiety and physical disability.

There are many avenues for future research building off this study, given the scarcity of research investigating the relationship between postpartum depression and physical disability. Future studies should collect further data about rates and predictors of postpartum depression in people with physical disabilities, for example examining additional moderating factors like age or race, as well as specific type of physical disability or level of impairment. In addition, these predictors should be investigated for potential mechanisms driving this association, for example, the higher rates of adverse obstetric and birth outcomes, higher rates of poverty and discrimination, and less social or financial support that are seen in people with physical disabilities (Gleason et al., 2021; Tarasoff et al., 2015).

In addition, our finding that the type of measure of postpartum depression moderated the association between postpartum depression and physical disability should be further researched, particularly since this finding needs more evidence given that it is predicated on two studies. Future research on this finding would be relevant for clinical practice, as it can investigate the effect of screening measure type on accurate diagnosis or referral for treatment. For example, if research findings support that this measure of physical disability is more strongly associated with postpartum depression, it could indicate that people with physical disabilities who meet a lower threshold on a symptom scale should be followed up with a diagnostic interview or clinical evaluation.

Specifically, future studies investigating the association between postpartum depression and physical disability can further expand the field by including clearer and stronger evidence assessing these variables as well as additional demographic information comparing cohorts with and without physical disabilities. As seen in the quality assessment of the included studies in this review, many of these initial studies were limited in quality due to their reliance on self-report for measures of postpartum depression and sometimes for physical disability, as well as due to a lack of statistical control for confounding factors. Future research should aim to improve on these points, using diagnostic interviews and confirmed clinical diagnoses to assess variables of interest to increase validity in measuring these constructs. If symptom scales are used, their data should be presented continuously and not segmented by somewhat arbitrary cutoff scores; this change will additionally improve the quality of the calculated effect sizes. Furthermore, future studies should statistically control for demographic factors like age, race and socioeconomic status, or additional confounding factors such as history of depression. These analyses, in addition to moderation analyses of such factors, will help us better understand specific variables that influence the association between postpartum depression and physical disability. Overall, studies with better-quality measures and statistics will provide stronger empirical evidence about the relationship between postpartum depression and physical disability, as well as providing cleaner contributions to future meta-analyses.

Beyond strengthening the literature, further research should also investigate the implications of the relationship between postpartum depression and physical disability in clinical practice. Currently, there are very few studies that evaluate healthcare interventions targeted at improving outcomes for women with physical disabilities throughout pregnancy, birth, and the postpartum period. One systematic review found only three randomized controlled trials that

examined such interventions targeted at women with all types of disability in general, which were small and so heterogeneous that they could not be compared (Malouf et al., 2014). A more recent literature review set guidelines for evidence-based practice in treating people with physical disabilities during and after birth, based on evaluations of evidence quality and strength (Berndl et al., 2021). The study authors recommended the following: that clinicians should be sensitive to the preferences and knowledge of their patients with regards to their disabilities, clinicians should consult with teams of doctors to make tailored plans for delivery and breastfeeding for patients with physical disabilities, and providers should screen patients with physical disabilities for postpartum depression. More research is needed to build on these findings and evaluate their efficacy, particularly in relation to mitigating risk factors, and potentially preventing some cases of postpartum depression.

In addition, future research should be conducted to evaluate psychological interventions in treating postpartum depression within this population, as this review supports that individuals with physical disabilities are likely to have higher rates of postpartum depression symptoms than women without physical disabilities. Future research should assess whether individuals with physical disabilities have different presentations of postpartum depression, or varying responses to treatment, as compared to nondisabled women. One such study explored counseling approaches for treating women with disabilities with postpartum depression and concluded that therapy can be done in general practice, as opposed to being relegated to therapists specializing in disability, given that disability itself is often not the major concern driving postpartum depression (Öksüz, 2021). Instead of a specific clinical intervention, Öksüz argues that therapists must be willing to unlearn ableism and educate themselves on disability and use a broader multicultural social justice approach in counseling that takes into account the many intersectional

factors of oppression that people with physical disabilities often face. Such an approach is likely crucial for many people with physical disabilities, as they tend to have higher rates of poverty and are more likely to be older and Black, with these experiences intersecting in unique ways for each individual (Iezzoni et al., 2013). However, more research should be done to investigate various therapeutic interventions and techniques treating postpartum depression in people with physical disabilities.

In addition to testing specific treatment options, the accessibility of therapy should be researched for postpartum patients with physical disabilities. Though little research exists on accessibility of therapy postpartum, and all its accompanying difficulties, studies on therapy for patients with physical disabilities suggest that the accessibility of attending therapy, such as physically getting to the appointment and being able to afford it, and the approachability of the therapist, such as comfort with the therapist and trust in seeking care, make a significant difference. One meta-analysis of telephone-based counseling identified eight studies that compared treatment efficacy for people with acquired physical disabilities versus controls, which together suggested moderate, statistically significant improvements in immediate coping skills and depressive symptoms, with longer-term quality of life improvements; the accessibility of virtual counseling was thus significantly more effective for patients who are more likely to have difficulty getting to a therapist's office or affording the cost of sessions (Dorstyn et al., 2011). Nosek et al., (1991), found that people from 16-68 years of age rated therapists more favorably when they were disabled themselves, especially when the therapeutic content was disability-related, and the counselors were perceived as more approachable and nonprofessionals. More research should build on these findings to examine how to make therapy more physically and financially accessible, and therapists more approachable, for people with physical disabilities

that are struggling with postpartum depression. Such research into therapeutic and health-related practice has the potential to greatly improve the lives of a marginalized population, which is likely at risk of postpartum depression at a higher rate than the general population but has less research investigating their experiences and treatment.

Conclusion

Physical disability has a strong association with postpartum depression, though it is greatly understudied, and little is known about the direct moderators of this relationship. Future research should build on the results of this review to better understand the relationship between postpartum depression and physical disabilities, with particular attention paid to potential mechanisms driving this association, to guide medical and psychological prevention and treatment efforts for the millions of people with physical disabilities at risk for, or currently experiencing, depression in the postpartum period.

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Appendix

Table 1

Quality Assessment of Included Studies Using the Modified Newcastle-Ottawa Scale

Study	Selection			Comparability	Outcome	Rating	Quality
	Representativeness of the Exposed Cohort	Selection of the Non-Exposed Cohort	Ascertainment of Exposure	Comparability of Cohorts on the Basis of Design or Analysis	Assessment of Outcome		
Akram et al., (2020)	*	*	*			3	Fair
Arrindell et al., (2006)	*			*		2	Poor
Bjørk et al., (2015)	*	*	*	* *		5	Good
Boyce et al., (2000)	*	*				2	Poor
Da Costa et al., (2006)	*					1	Poor
de Tychey et al., (2008)	*	*				2	Poor
Kang et al., (2020)	*		*			2	Poor
Patel et al., (2002)	*	*				2	Poor
Rahman et al., (2003)	*	*	*			3	Fair

Turner et al., (2006)	*	*	*	3	Fair
Turner et al., (2009)	*	*	*	3	Fair

Note. Study ratings of 1-2 are considered poor, ratings of 3-4 are considered fair, and ratings of 5-6 are considered good quality.

Table 2

Summary Characteristics of Included Studies (k = 11)

Characteristic	
Total sample size	110,336
Region, *n* (%)	
Europe	5 (45.45%)
South Asia	3 (27.27%)
North America/Australia	3 (27.27%)
Method for measuring postpartum depression, *n* (%)	
Diagnostic interview	2 (18.18%)
Symptom scale	9 (81.81%)
Method for measuring physical disability, *n* (%)	
Clinical diagnosis	4 (36.36%)
Symptom scale	7 (63.63%)
Type of physical disability, *n* (%)	
Epilepsy	3 (27.27%)
Hearing loss	1 (9.09%)
Peripartum pelvic pain	1 (9.09%)
General population	6 (54.54%)

Table 3

Description of Study Demographics

Study	Country	*N*	Race/ ethnicity	Age: Mean (SD)	Income or SES	Partnership status	Percent primiparous	Education
Akram et al., (2020)	Pakistan	547	NR	[22-33]	NR	NR	NR	NR
Arrindell et al., (2006)	Netherlands	413	NR	33 (5) [23-55]	NR	NR	NR	NR
Bjørk et al., (2015)	Norway	107516	NR	29.1 (4.9) 29.8 (4.6)[a]	Low household income 10.6% 6.5%[a]	Single parent 4.6% 2.3%[a]	Mean parity 1.7(0.9) 1.7(0.8)[a]	% Low education 4.7% 2.6%[a]
Boyce et al., (2000)	Australia	504	NR	16-24: 114 (37.8%), 25-29: 126 (34.1%), 30-34: 93 (25.1%), 35+: 37 (10.0%) 16-24: 18 (33.3%), 25-29: 16 (29.6%), 30-34: 14 (25.9%), 35+: 6 (11.1%)[b]	NR	NR	31.5% 44.9%[b]	NR
Da Costa et al., (2006)	Canada	93	NR	33.17 (4.56)[b]	5.03 (1.56) on an	NR	41%[b]	NR

					income scale 1-6[b]			
de Tychey et al., (2008)	France	181	NR	NR	NR	NR	NR	NR
Kang et al., (2020)	United States		Non-Latino White 17 (74%) Latino 6 (26%)[b]	32.7 (5.3)[b]	NR	61% married[b]	35%[b]	Associate's degree or below 61%[b]
Patel et al., (2002)	India	270	NR	26 (4) [18-40]	NR	99% married	NR	NR
Rahman et al., (2003)	Pakistan	632	NR	>=30 71% 53%[b]	In poverty 73% 65%[b]	NR	NR	NR
Turner et al., (2006)	Italy	70	NR	32.5 (5.3) 31.8 (4.0)[a]	NR	Married 89%, with partner 11%, single 0% Married 83%, with partner 14%, single 3%[a]	66% 63%[a]	12.4 (3.5) 13.5 (2.9)[a]
Turner et al., (2009)	Italy	110	NR	33.0 (4.3) 31.8 (4.5)[a]	NR	Married 89%, with partner 11%, single 0% Married 82%, with partner 14%, single 4%[a]	67% 85%[a]	12.5 (3.1) 13.4 (2.9)[a]

Note. Data represents: mean (standard deviation) [range] or *n* (%).

[a] First set of numbers describes those with physical disabilities and second set describes those without physical disabilities.

[b] First set of numbers describes those with postpartum depression and second set describes those without postpartum depression. If denoted on a line with only one set of numbers, this describes those with postpartum depression only.

Table 4

Description of Study Characteristics

Study	Population	Study design	Sampling direction	Postpartum depression instrument	Physical disability instrument
Akram et al., (2020)	Hearing loss and controls	Cross-sectional	Sample of people with and without physical disabilities	EPDS (Urdu translation)	Clinical diagnosis
Arrindell et al., (2006)	Peripartum pelvic pain syndrome	Cross-sectional	Nondirectional	SCL-90-R (Dutch translation)	QBPDS (Dutch translation)
Bjørk et al., (2015)	Epilepsy and controls	Longitudinal	Sample of people with and without physical disabilities	EPDS; SCL-4d	Clinical diagnosis
Boyce et al., (2000)	General population	Cross-sectional	Sample of people with and without postpartum depression	EPDS	SF-36
Da Costa et al., (2006)	Postpartum depression and normative means	Cross-sectional	Sample of people with and without postpartum depression	EPDS	SF-36

de Tychey et al., (2008)	General population	Cross-sectional	Sample of people with and without postpartum depression	EPDS (French translation)	SF-36 (French translation)
Kang et al., (2020)	Postpartum depression with sleep problems and normative means	Longitudinal	Sample of people with and without postpartum depression	HAM-D-17; SCID-I/P	WHOQOL-Bref
Patel et al., (2002)	General population	Cross-sectional	Sample of people with and without postpartum depression	EPDS (Hindi and Konkani translations)	BDQ (Hindi and Konkani translations)
Rahman et al., (2003)	Physically healthy	Cross-sectional	Sample of people with and without postpartum depression	SCAN (translated and culturally adapted)	BDQ (translated and culturally adapted)
Turner et al., (2006)	Epilepsy and controls	Cross-sectional	Sample of people with and without physical disabilities	EPDS (Italian translation)	Clinical diagnosis
Turner et al., (2009)	Epilepsy and controls	Cross-sectional	Sample of people with and without physical disabilities	EPDS (Italian translation)	Clinical diagnosis

Note. Postpartum depression and physical disability measure abbreviations represent: Edinburgh Postnatal Depression Scale (EPDS); Symptom Checklist-90-Revised (SCL-90-R) – depression component; Hamilton Depression Rating Scale (HAM-D-17); Structured Clinical Interview for DSM Disorders (SCID-I/P) – diagnosis of major depressive disorder or an anxiety disorder; Schedule for Clinical Assessment in Neuropsychiatry (SCAN); Quebec Back Pain Disability Scale (QBPDS); Brief Disability Questionnaire (BDQ); Short Form Survey (SF-36) – physical role functioning; World Health Organization Quality of Life Assessment - Brief (WHOQOL-Bref) – physical.

Table 5

Presentation of Cohort Study Statistics without Control/Comparison

Study	***N***	**Population**	**Postpartum Depression Prevalence**	**Postpartum Depression Measure**
Anderson et al., (2021)	36	Deaf women	*M* = 5.6 (*SD* = 4.2)	EPDS (ASL translation)
Dommergues et al., (2021)	22	Motor disability due to a rare condition	*M* = 6.2 (*SD* = 4.2)	EPDS
Ghidini et al., (2008)	37	Spinal cord injury	35%	Reported diagnosis
Krysko et al., (2021)	143	Multiple sclerosis	12.6%	Clinical records
Lee et al., (2021)	30	Spinal cord injury: cervical (C1-C8)	37%	PRAMS 3-D (above cutoff score of 9)
Lee et al., (2021)	12	Spinal cord injury: upper thoracic (T1-T6)	33%	PRAMS 3-D (above cutoff score of 9)
Lee et al., (2021)	59	Spinal cord injury: lower SCI (T7 and below)	25%	PRAMS 3-D (above cutoff score of 9)
Study	***N***	**Population**	**Physical Disability Prevalence**	**Physical Disability Measure**
Husain et al., (2017)	124	Women with postpartum depression (control group from intervention)	*M* = 9.02 (*SD* = 3.51)	BDQ (Urdu translation)

Note. Postpartum depression and physical disability measure abbreviations represent: Edinburgh Postnatal Depression Scale (EPDS); Pregnancy Risk Assessment Monitoring System (PRAMS 3-D) – depression; Brief Disability Questionnaire (BDQ).

Table 6

Presentation of Study Statistics for which Relevant Effect Sizes (Cohen's d) Could Not Be Calculated

Study	***N***	**Population**	**Postpartum Depression Prevalence: With Physical Disabilities**	**Postpartum Depression Prevalence: Without Physical Disabilities**	**Notes**
Beales et al., (2016)	50	With and without pregnancy-related persistent lumbopelvic pain	Low disability: 1 (0-4.0), moderate: 2.5 (0-9.2)	1 (0-0.20)	Median (IQR) from DASS depression subscale
Crane et al., (2019)	5811	Spinal cord injury	RR 8.15 (CI 4.29-15.48)		Postpartum-depression code at rehospitalization

Study	***N***	**Population**	**Physical Disability Score: Persistent Postpartum Depression**	**Physical Disability Score: Resolved Postpartum Depression**	**Notes**
Husain et al., (2011)	763	Women with antenatal depression	9.2 (5.4)	2.7 (4.1)	BDQ + EPDS
Rahman & Creed, (2007)	129	Women with antenatal depression	7.5	5.8	BDQ + SCAN

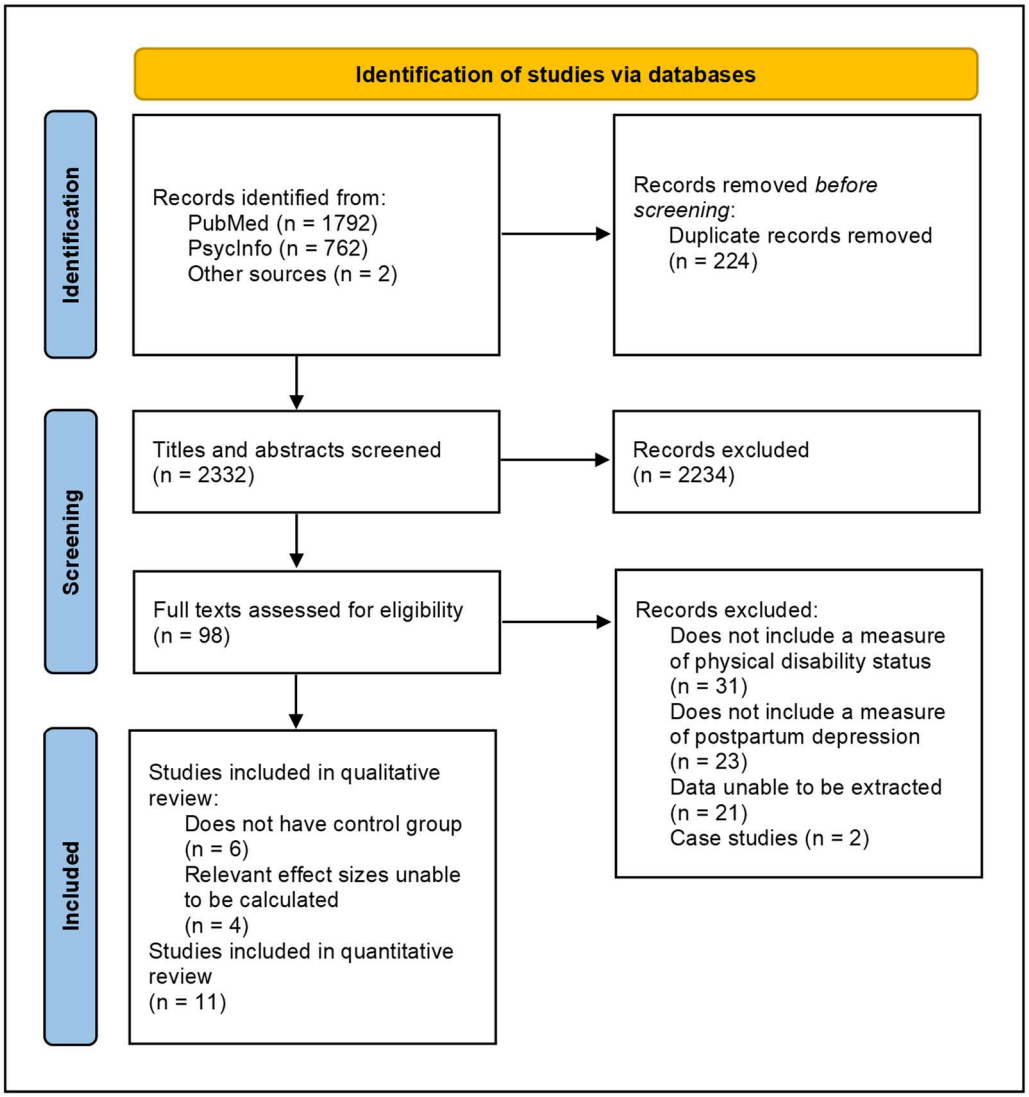

Figure 1. PRISMA flow diagram of the of study selection process for the systematic review and meta-analysis.

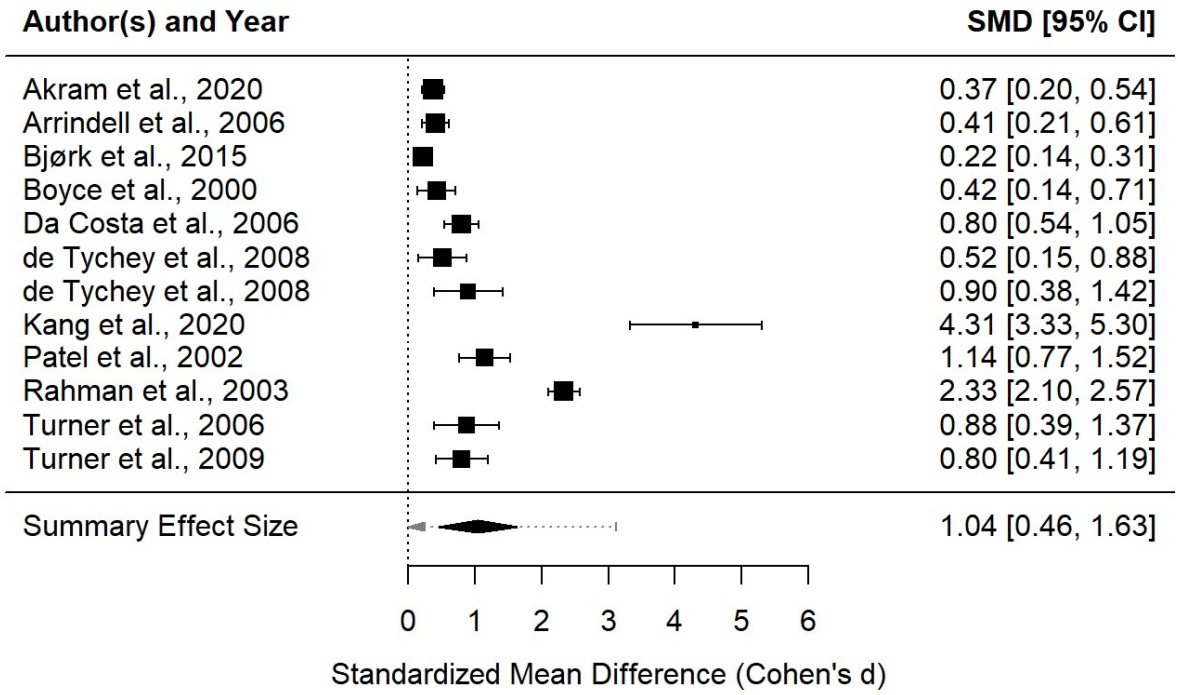

Figure 2. Forest plot displaying summary effect size of Cohen's *d*.

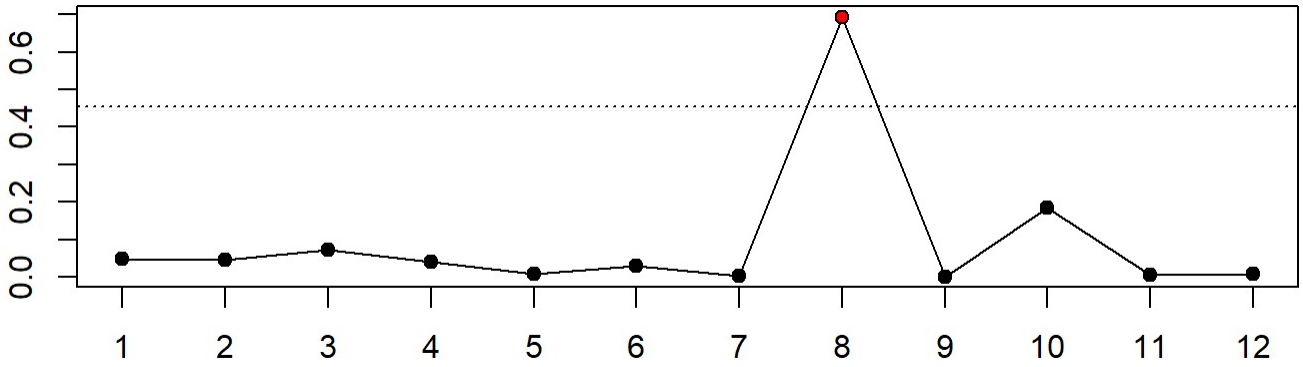

Figure 3. Graph of the Cook's Distances of each study in the model, with the influential case shown in red at point 8 (Kang et al., 2020) and the next most influential case, though shown in black as it is not statistically significant, shown at point 10 (Rahman et al., 2003).

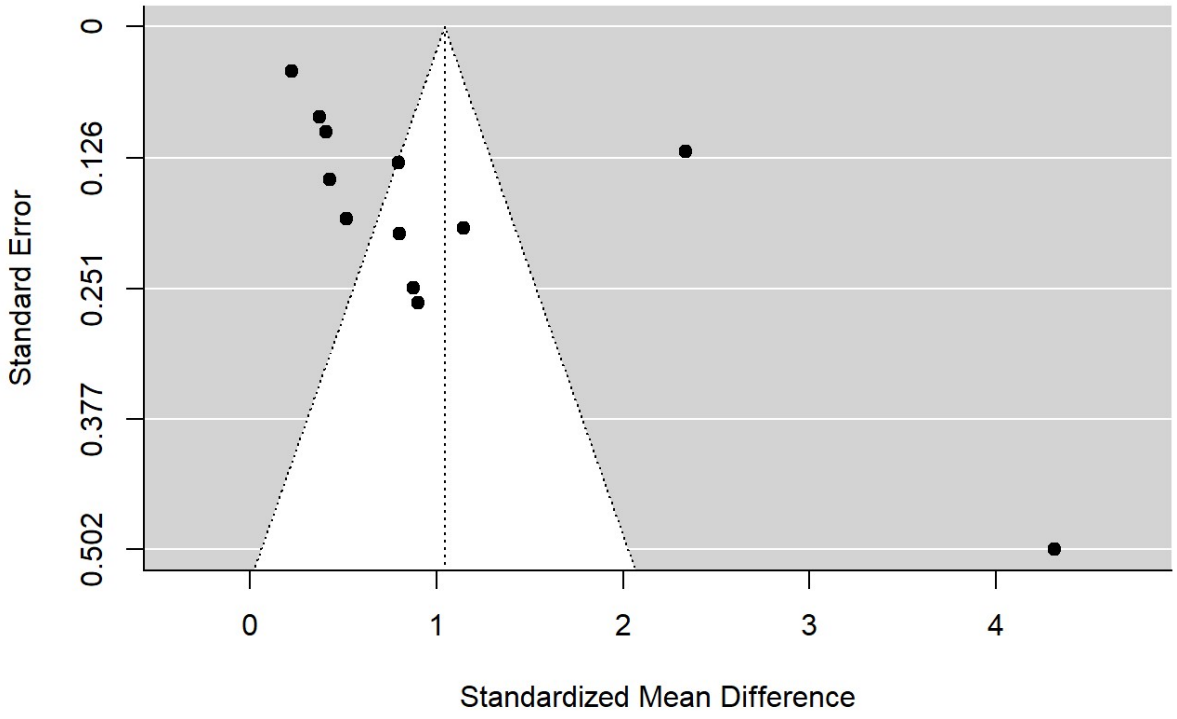

Figure 4. Funnel plot depicting publication bias in the random-effects model.

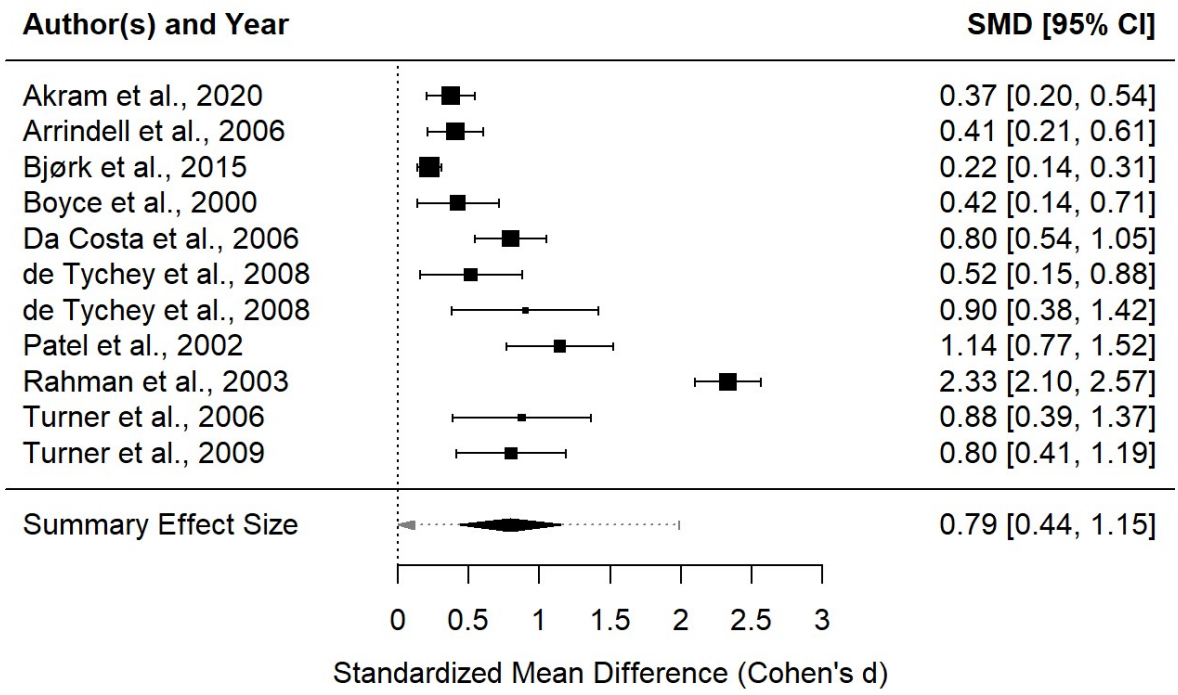

Figure 5. Forest plot displaying summary effect size of Cohen's *d* excluding the influential case.

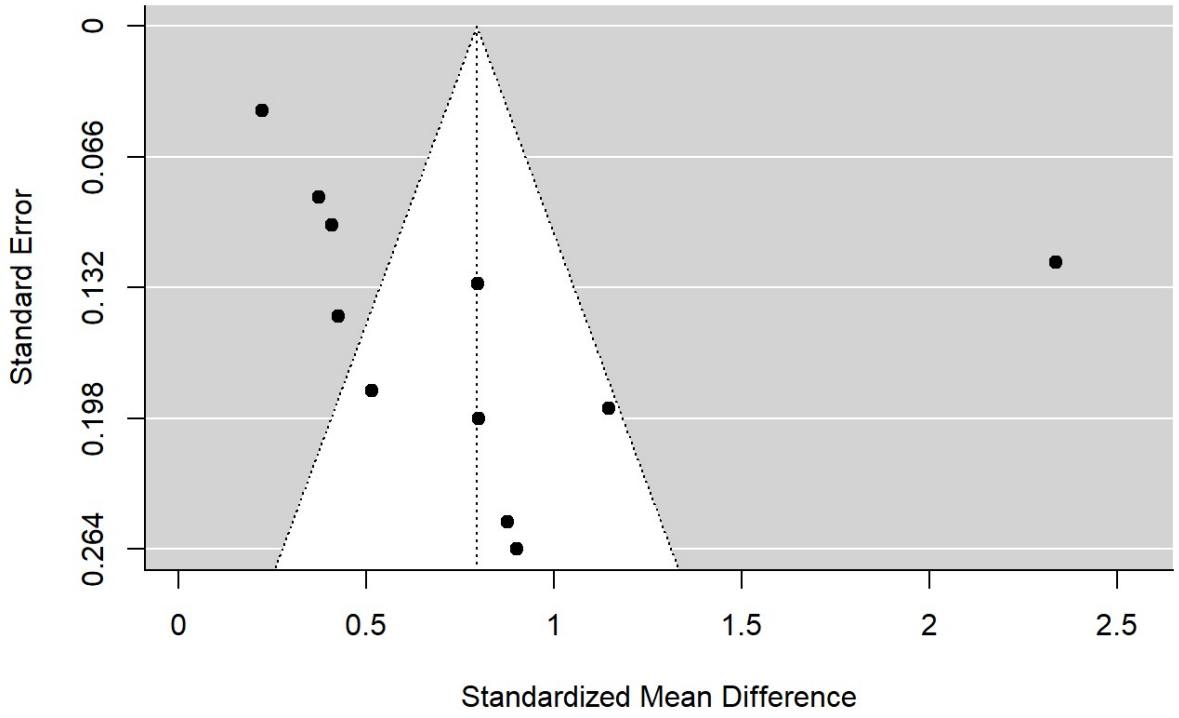

Figure 6. Funnel plot depicting publication bias in the random-effect model excluding the influential case.

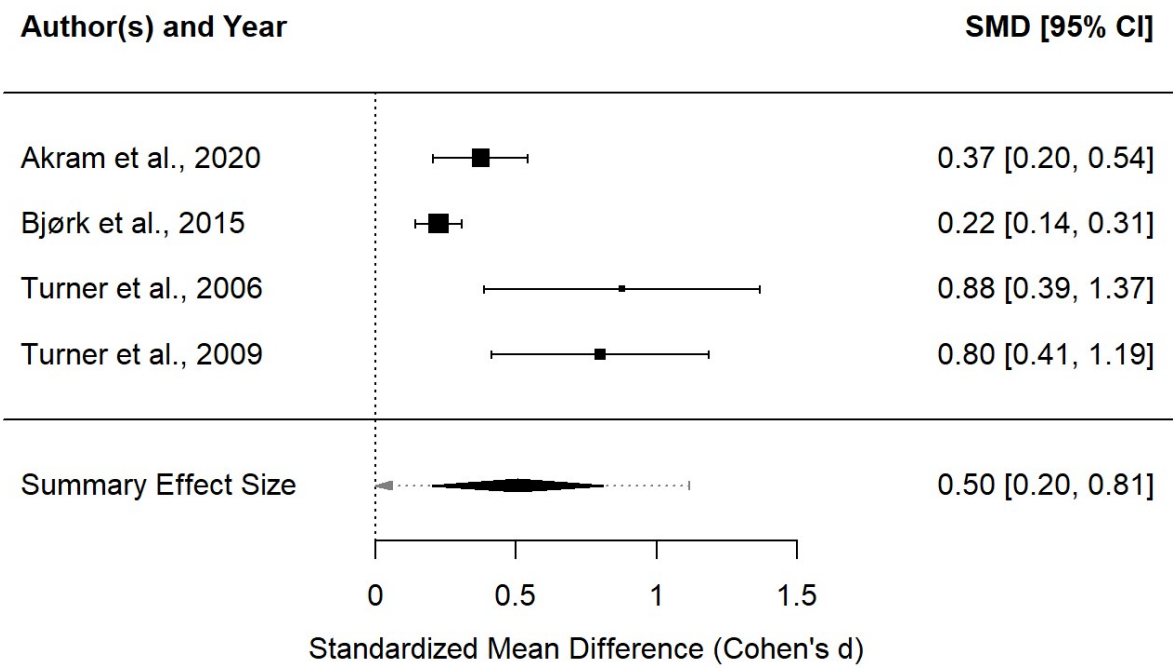

Figure 7. Forest plot displaying summary effect size of Cohen's *d* sampling by physical disability.

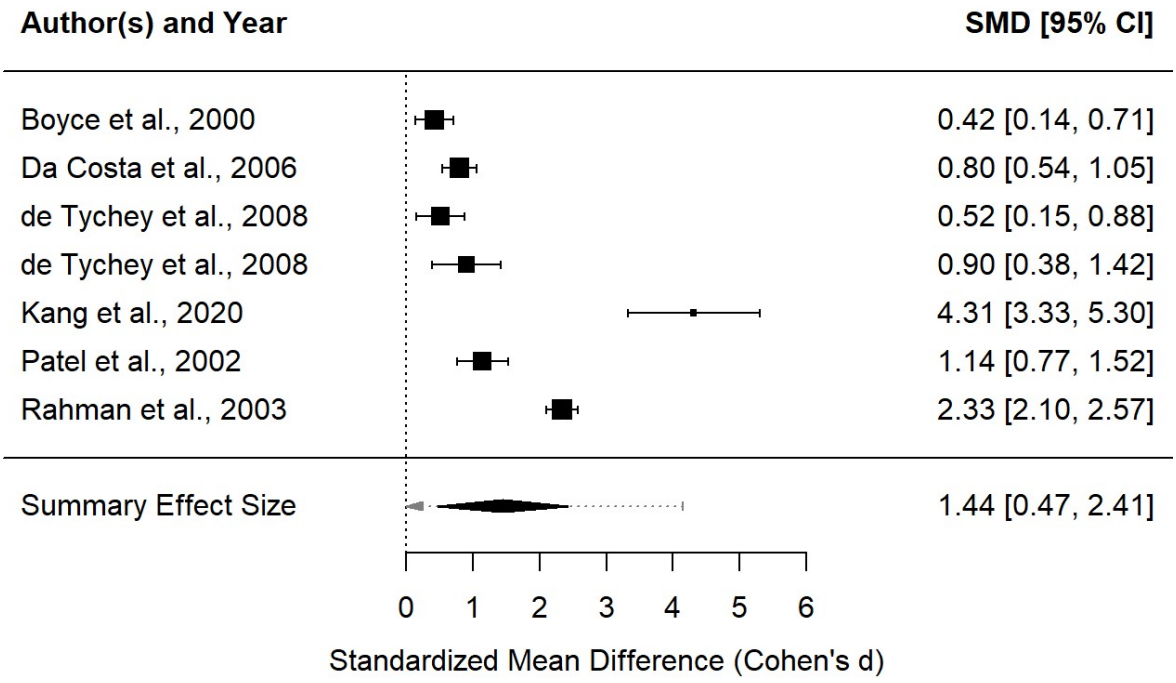

Figure 8. Forest plot displaying summary effect size of Cohen's *d* sampling by postpartum depression.