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The impact of education, country, race and ethnicity on the self-report of postpartum depression using the Edinburgh Postnatal Depression Scale

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Abstract

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Declaration of Interest

None.

Background—Universal screening for postpartum depression is recommended in many countries. Knowledge of whether the disclosure of depressive symptoms in the postpartum period differs across cultures could improve detection and provide new insights into the pathogenesis. Moreover, it is a necessary step to evaluate the universal use of screening instruments in research and clinical practice. In the current study we sought to assess whether the Edinburgh Postnatal Depression Scale (EPDS), the most widely used screening tool for postpartum depression, measures the same underlying construct across cultural groups in a large international dataset.

Method—Ordinal regression and measurement invariance were used to explore the association between culture, operationalized as education, ethnicity/race and continent, and endorsement of depressive symptoms using the EPDS on 8209 new mothers from Europe and the USA.

Results—Education, but not ethnicity/race, influenced the reporting of postpartum depression [difference between robust comparative fit indexes (Δ*CFI) < 0.01]. The structure of EPDS responses significantly differed between Europe and the USA (Δ*CFI > 0.01), but not between European countries (Δ*CFI < 0.01).

Conclusions—Investigators and clinicians should be aware of the potential differences in expression of phenotype of postpartum depression that women of different educational backgrounds may manifest. The increasing cultural heterogeneity of societies together with the tendency towards globalization requires a culturally sensitive approach to patients, research and policies, that takes into account, beyond rhetoric, the context of a person's experiences and the context in which the research is conducted.

Keywords

Culture; Edinburgh Postnatal Depression Scale (EPDS); education; postpartum depression; race

Introduction

> 'All happy families are alike; each unhappy family is unhappy in its own way.'
>
> *Anna Karenina* [Leo Tolstoy, 1878 (1939)]

The postpartum period is a time of elevated risk for developing major depression, with a 3-fold increased risk of hospital admission in the first 2 months after childbirth compared with 1 year after delivery (Munk-Olsen *et al.* 2006). If not promptly detected and treated, postpartum maternal depression has a negative impact on the well-being of the mother and the development of the child, with suicide a major cause of maternal death (Cantwell *et al.* 2011).

Universal screening is recommended in many countries worldwide (Meltzer-Brody, 2011) and has been most recently suggested by the US Preventative Services Task Force (O'Connor *et al.* 2016). There are, however, still significant barriers to diagnosis and treatment of postpartum depression, with about 50% of cases going undetected (Bauer *et al.* 2014). Problems with trust and acceptance are the most reported cause of undisclosed depression, with less than 20% of women admitting they are completely honest with their health care providers about their depressive symptoms (Boots Family Trust, 2013). Health professionals also report that cultural barriers, including not only language, but also fear of

incompetence, inadequate assessment tools, and the experience of cultural uncertainty (Teng *et al.* 2007), may prevent them from discussing mental health issues with the mother (Boots Family Trust, 2013).

Although there is robust evidence that the prevalence of postpartum depression varies across socio-economic levels [Postpartum Depression: Action Towards Causes and Treatment (PACT) Consortium, 2015], we do not know if and how cultural influences make an impact on the expression of depression in the postpartum period. Knowledge of whether the disclosure of depressive symptoms in new mothers differs across cultures could improve detection and provide new insights into the determinants of postpartum depression. Moreover, it is a necessary step to evaluate the universal use of screening measures in research and clinical practice.

Culture is a notoriously difficult term to define, with 164 different definitions counted by Kroeber & Kluckhohn (1952). Research about cultural variations of inner psychological experiences challenges the traditional biomedical paradigm and its methodology. Culture is a complicated matrix of interplaying elements. However, biomedical research usually identifies it with nationality and infers that differences in the rates of a disorder across countries are due to cultural differences (Chentsova-Dutton *et al.* 2014). This approach may be misleading. For example, an epidemiological survey conducted in the UK found that black Caribbean women have the same rates of above-threshold postpartum depression scores as white women (Edge & Rogers, 2005). An in-depth qualitative analysis, however, found that postpartum depression was under-reported by black Caribbean women, who rejected the concept of postpartum depression because it fails the cultural imperative of being ‘strong’ and because of their tendency to have a pragmatic approach towards problems (Edge & Rogers, 2005).

Race is the cultural factor most commonly investigated in relation to depression, especially in the perinatal period. However, other cultural factors, including education, may influence the way postpartum depressive symptoms are experienced and reported by women. The relationship between education and the expression of major depression is poorly understood. Education may influence the subjective experience, self-awareness or the acceptance, and therefore disclosure, of psychiatric symptoms and help-seeking behaviours and has been shown to contribute to a less stigmatizing view of mental health (Cook & Wang, 2010). Together with other socio-economic factors education may also modulate the maturation of specific brain regions involved in mood disorders, such as the prefrontal cortex (Shonkoff *et al.* 2009). Studies in the general adult population, however, have led to inconsistent results and highlighted the complexity of the relationship between education and depression (Gan *et al.* 2012). Moreover, there are no studies investigating the impact of education in the expression of postpartum depression.

Cultural psychiatry usually focuses on ‘exotic lands’ and neglects Western nations (Cox, 1988; Kumar, 1994; Alarcón, 2009). Moreover, there is the general assumption that Western cultures are homogeneous and that there are no significant differences in psychiatric disorders across Europe and the USA. However, factors associated with maternal depression, including work and environmental demands (Dagher *et al.* 2011), access to universal

maternity leave (Dagher *et al.* 2014), health care (Kozhimannil & Kim, 2014) and financial security (Kozhimannil & Kim, 2014), are regulated and influenced by local policies that differ across countries. For example, European social policies differ from country to country, but, contrary to the USA, all countries provide some form of paid universal maternity leave and free health care (Ray *et al.* 2010).

In the current study we therefore investigated cultural aspects beyond nationality and their impact on depression beyond disease prevalence. We explored whether education, ethnicity/race and continent influenced the expression of postpartum depression. The key question was: does the Edinburgh Postnatal Depression Scale (EPDS), the most widely employed screening tool for postpartum depression, measure the same underlying construct across cultural groups?

Method

Sample

Data were gathered from the PACT consortium. The PACT consortium was created to aggregate information collected by different centres in a large, international, coherent dataset that would allow for novel investigations in the genetics and phenomenology of perinatal depression. Detailed description of data collection and aggregation across sites is provided elsewhere [Postpartum Depression: Action Towards Causes and Treatment (PACT) Consortium, 2015].

In brief, anonymous information on 17 912 parous women, both cases with postpartum depression and controls, was submitted to PACT by 19 institutions from seven countries.

Inclusion criteria for the current study were: (1) information on ethnicity/race or education or both; (2) individual item data on the EPDS available. If repeated records for a single participant were submitted, due to the longitudinal prospective design of the original study, the highest EPDS score was used, consistent with previous research [Postpartum Depression: Action Towards Causes and Treatment (PACT) Consortium, 2015].

Fig. 1 shows the sample flowchart and analytic plan. The sample used for the current analyses consisted of 1635 women living in the USA (Arkansas, Georgia, Maryland, Massachusetts, New York, North Carolina and Pennsylvania) and 6574 in Europe (103 in France, 1646 in Sweden and 4825 in two different sites in Rotterdam, the Netherlands). The English (Cox *et al.* 1987), Dutch (Pop *et al.* 1992), French (Guedeney & Fermanian, 1998) and Swedish lifetime (Meltzer-Brody *et al.* 2013) versions of the EPDS were used. Validation studies of the French and Swedish versions recommended a lower cut-off score than that of the original study (Cox *et al.* 2014).

Table 1 provides additional information on the sampling frame.

Variable definitions

The EPDS is the most widely used screening tool for postpartum depression in the world (Cox *et al.* 2014). Its 10 items are scored on an ordinal scale from 0 to 3, with higher scores

indicating worse symptomatology. There is limited consensus on the best threshold to define postpartum depression. The precision or validity of the threshold score was not problematic for this study, as we were interested in the expression of the depressive symptoms rather than in the prevalence of the disorder. Consequently, in the analyses on the different prevalence and severity of single EPDS items as a function of culture in women with significant symptomatology, we included as cases all women who had scored 10 or higher at the EPDS, consistent with the literature [Postpartum Depression: Action Towards Causes and Treatment (PACT) Consortium, 2015].

Racial/ethnic groups were reported and defined according to the US census guidelines (http://www.census.gov/topics/population/race/about.html). Women were categorized as having origin in any of the original people of:

- Europe, the Middle East or North Africa (in this paper referred as ‘white’, according to the US census guidelines)
- Black racial groups of Africa (‘black’)
- Far East, Southeast Asia or the Indian subcontinent (‘Asian’)
- Although the concept of race is separate from the concept of Hispanic origin, women were classified as ‘Latina’ if they were from Spanish-speaking countries of Central or South America, including the Dominican Republic and Cuba
- ‘Other’ if did not meet any of the criteria above or were of mixed race

Given that the educational systems differ across countries, we considered three broad ordinal categories: 12 years or fewer; 13–16 years; graduate or professional degree.

Whether the woman received money or financial aid from a government- or state-provided welfare/benefit/assistance programme or service was used as a proxy for low-income status.

Statistical analyses

Our research integrated two lines of enquiry, in which differences across ethnicities/races, education attainment and continent were explored.

First, we used ordered logistic regression to explore whether single EPDS items were expressed with greater prevalence and severity as a function of culture in a sample of 2687 women who scored 10 or above at the EPDS. Models were estimated with the *polr* command from the MASS package in R (Venables & Ripley, 2003). Proportional odds ratios (ORs) and confidence intervals (CIs) were calculated on a model using the score at each EPDS item as independent ordinal variable, ethnicity/race, education as a three-level ordinal variable, continent, EPDS total score, and study design as covariates and white race and Europe as reference categories.

We then examined the factor structure of the EPDS and tested its measurement invariance to quantitatively establish whether the EPDS had similar meanings across cultures. Factor analysis assumes that the observed score on a scale is a measure of one or more latent variables, inferred through statistical analysis.

There is no consensus on the factor structure of the EPDS. We therefore explored the factor structure of EPDS on a random subsample of 1164 women. Then, informed by past research and by our exploratory factor analysis, we tested a series of baseline models by confirmatory factor analysis (CFA) (Brown, 2015). The baseline CFA models were fit using the cfa function from the package lavaan (http://lavaan.ugent.be). The diagonally weighted least-squares method was applied to estimate the model parameters and the full weight matrix to compute robust standard errors, and a mean- and variance-adjusted test statistic. We used robust fit indices [the robust standardized root mean square residual (SRMR*), the robust root mean square error of approximation (RMSEA*) and its 90% CI, and the robust comparative fit index (CFI*)] to assess how well the models captured the covariance between all the EPDS items in the model. The following cut-off values were employed: CFI* ≥0.90, RMSEA* ≤0.08, and SRMR*≤0.08 for acceptable fit and CFI* ≥0.95, RMSEA* ≤0.05, and SRMR*≤0.05 for good fit. The model with the best statistical properties and pragmatic relevance was then selected and used to test the measurement invariance of the EPDS.

In order to quantitatively test whether the EPDS items had similar meanings across cultures, we employed measurement invariance, a statistical method that allows to test whether the items of a scale measure the same underlying construct in different groups (Millsap, 2011).

Measurement equivalence (or, in statistical terms, measurement invariance) is tested within the structural equation modelling framework by using multi-group CFA (Millsap, 2011; Hirschfeld & von Brachel, 2014). It is based on the idea that a psychometric scale should work in the same way across varied conditions that are irrelevant to the measured attribute (Millsap, 2011; Hirschfeld & von Brachel, 2014). It consists of a sequence of hierarchical nested models, each defined by a more restrictive set of requirements: weak invariance (i.e. equal factor loadings); strong invariance (i.e. equal loadings and intercepts); strict invariance (equal loadings + intercepts + residuals) and allows the detection of bias related to the person's membership to a group (21) (in the current study: ethnicity, continent, education). Models were compared in pairs and measurement invariance was rejected when the difference between robust CFIs (Δ*CFI) was above the cut-off value of 0.01.

Recall bias can potentially influence the retrospective report of depressive symptoms. Therefore, we only included 6554 women assessed in prospective studies for the measurement invariance testing.

Results

Data on 8209 women meeting the inclusion criteria were available for the current analysis. Sample characteristics are presented in Table 2. The majority of the subjects were white, with no differences between studies conducted in Europe (n = 3687, 76.5%) and those conducted in the USA (n = 1226, 75.0%). Black women were equally represented across continents [17.3% (n = 832) in Europe and 18.3% (n = 299) in the USA]. However, there were statistically significant differences in the other minority groups represented across sites and between Europe [no Latinas, 6.2% (n = 300) Asian] and the USA [2.5% (n = 41) Latinas, 1.9% (n = 31) Asian, χ^2 = 269.2505, degrees of freedom (df) = 4, p < 0.001],

reflecting differences in the population structure between Europe and the USA. There were also geographical differences in education attainment, with 38.2% ($n = 2486$) of the European participants having 12 years or fewer of education, compared with 18.5% ($n = 133$) of the US counterpart ($\chi^2 = 111.295$, df = 2, $p < 0.001$).

We have previously reported EPDS item response probabilities by site [Postpartum Depression: Action Towards Causes and Treatment (PACT) Consortium, 2015].

The proportion of missing values was below 1% in all sites, with the exception of the two sites in the Netherlands, one where one out of 45 subjects did not respond to items 9 and 10 and the other where 38.5% of the sample did not have information on item 10. We therefore excluded the data from the latter centre in the analyses on thoughts of self-harm. In the ordinal logistic regression, there were no statistically significant differences in overall item non-response between women with depression and those without, and across recruitment sites, race and education level groups.

Cross-cultural differences in reporting depression

We compared responses to each EPDS item in a sub-sample of 2687 women with EPDS scores of 10 or higher examining race, educational attainment and continent. Complete information for all covariates was available for 2044 women. Specifically, there were 1502 white, 429 black, 77 Asian and 36 Latina women; 874 women with 13 years or fewer of education, 698 with 14–16 years and 327 with a graduate or professional degree; and 1254 women from Europe and 1433 from the USA. Differences were considered significant if $p < 0.005$ due to multiple comparisons.

Table 3 shows the proportional ORs obtained from the ordered regression analyses on single EPDS items.

Compared with white women, Latinas were significantly more likely to report higher severity of excessive self-blame and feelings of guilt (item 3: $t = 2.912$; $p = 0.004$). Analysis on self-harming thoughts (item 10) was conducted on a subsample of 2082 women, as we excluded a centre in the Netherlands, because of the high proportion (38.5%) of missing values. Black women were less likely than white women to report higher severity of self-harming thoughts (item 10: $t = -4.1911$; $p < 0.001$). There were no other statistically significant differences between races/ethnicities.

Results did not change when analyses on ethnicity/race were conducted separately on European (excluding Latinas) and US (excluding Asian women) subsamples.

Less educated women were significantly more likely to report lack of enjoyment (i.e. anhedonia, item 2: $t = -4.6982$; $p < 0.001$), while educational attainment was positively associated with crying (item 9: $t = 3.2866$; $p = 0.001$) and thoughts of self-harm (item 10: $t = 5.8802$; $p < 0.001$).

There was a strong association between EPDS items and continent even when analyses were corrected for education, study design and EPDS total score. Women from Europe reported higher scores of anhedonia (item 1: $t = -11.976$, $p < 0.001$; item 2: $t = -11.462$, $p < 0.001$),

self-blaming (item 3, $t = -7.8466$, $p < 0.001$) and anxiety (item 4: $t = -9.098$, $p < 0.001$ and item 6: $t = -8.0269$, $p < 0.001$), while women from the USA disclosed more severe insomnia (item 7: $t = 9.5428$, $p < 0.001$), depressive feelings (item 8: $t = 4.4252$, $p < 0.001$ and item 9: $t = 5.9036$, $p < 0.001$) and thoughts of self-harming (item 10, $t = 10.4617$; $p < 0.001$).

A further analysis was conducted on a subsample of women who scored 13 or higher at the EPDS with similar results.

Cross-cultural differences in the latent structure of postpartum depression

The scree plot suggested retaining three factors. After exploring the unrotated and rotated factor matrices, we opted for a varimax rotation. Two factors were highly correlated (0.87). We therefore opted for a two-factor model (Fig. 2*a*), including anhedonia (items 1–3) and depression (items 4–10). The two-factor model we obtained from our initial exploratory factor analysis had the best fit among models including all 10 EPDS items (robust indices: $\chi^2 = 3405.457$, df = 34, CFI* = 0.920, RMSEA* = 0.145, SRMR* = 0.065) and was chosen for the analyses of measurement invariance.

The EPDS did not have the same factor structure in US and European women (weak invariance Δ*CFI = 0.145, strong invariance Δ*CFI = −0.012, strict invariance Δ*CFI = 0.185). Using exploratory analysis and CFA we parsimoniously chose a one-factor model for Europe (Fig. 2*b* – robust indices: $\chi^2 = 1055.139$, df = 35, CFI* = 0.898, RMSEA* = 0.099, SRMR* = 0.060) and a three-factor model for the USA, despite the poor fit (Fig. 2*c* – robust indices: $\chi^2 = 1255.970$, df = 32, CFI* = 0.885, RMSEA = 0.154, SRMR = 0.076). When analyses by country were conducted on the three European centres in the Netherlands and in France, the EPDS showed measurement equivalence (weak invariance Δ*CFI = −0.007, strong invariance Δ*CFI = 0.011, strict invariance Δ*CFI = 0.013).

Given the differences in ethnic distribution and EPDS factor structure between Europe and the USA, we analysed measurement invariance separately for the two geographical regions. The EPDS was measurement equivalent across ethnic/racial groups (i.e. the construct measured by the EPDS was made up of the same number of factors, with equal factor loadings, intercept and variance across groups. For Europe: black *v.* white: weak invariance Δ*CFI = −0.022, strong invariance Δ*CFI = 0.006, strict invariance Δ*CFI = 0.012; Asian *v.* white: weak invariance Δ*CFI = −0.029, strong invariance Δ*CFI = 0.001, strict invariance Δ*CFI = 0.003; for the USA: black *v.* white: weak invariance Δ*CFI = 0.007, strong invariance Δ*CFI = 0.006, strict invariance Δ*CFI = 0.007; Latina *v.* white: weak invariance Δ*CFI = −0.014, strong invariance Δ*CFI < 0.001, strict invariance Δ*CFI = −0.004).

Given the evidence of differences in the factor structure between Europe and the USA, we explored the factor structure of the EPDS across levels of education by continent. The EPDS was not measurement equivalent across levels of education in Europe (low *v.* high level: weak invariance Δ*CFI = 0.028, strong invariance Δ*CFI = 0.014, strict invariance Δ*CFI = 0.012), nor in the USA (low *v.* high level: weak invariance Δ*CFI = −0.017, strong invariance Δ*CFI = 0.030, strict invariance Δ*CFI = 0.012).

A further analysis was conducted in order to determine whether the effect of continent was driven by the differences in education attainment between USA and Europe. We found that within the same level of education the structure of the EPDS differed between Europe and the USA (Δ*CFI > 0.01).

Discussion

We found that level of education and continent (Europe or USA), much more than ethnicity/race, influenced the expression of postpartum depression on the EPDS. These results have important implications for the delivery of culturally specific and sensitive clinical care and warrant careful examination with specific attention paid to education and socio-political factors.

Education

According to our findings, less educated women with postpartum depression are less likely to report crying and thoughts of self-harm and are more likely to report anhedonia. Although there is robust evidence of the association between the prevalence of postpartum depression and low socio-economic status [Wisner *et al.* 2013; Postpartum Depression: Action Towards Causes and Treatment (PACT) Consortium, 2015], we believe this is the first study to have systematically investigated the effect of education on the expression of postpartum depressive symptoms and on the psychometric properties of the EPDS. Further research is needed to replicate our findings and to understand the mechanisms by which education influences the disclosure of depressive symptoms.

Ethnicity and race

Despite the emphasis that is usually put on race/ethnicity in relation to cultural sensitivity, we did not find any major difference in the psychometric properties of the EPDS across racial/ethnic groups and only some differences in the disclosure of symptoms among depressed women. It is possible that the differences that are usually observed between white and minorities are due entirely to the differences in the socio-economic status, as suggested by the literature on disease prevalence (Comstock & Helsing, 1976; Dolbier *et al.* 2013).

Differences between European and American women

We found differences in the symptomatic manifestations of postpartum depression between European and American women. There is the general assumption that Western cultures are homogeneous and that there are no significant differences in psychiatric disorders across Europe and the USA. A recent study has corroborated this assumption and reported that the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) criteria for major depression in Europe and the USA are measurement equivalent (Kendler *et al.* 2015). However, many factors associated with postpartum depression, including work and environmental demands (Dagher *et al.* 2011), access to universal maternity leave (Dagher *et al.* 2014), health care (Kozhimannil & Kim, 2014) and financial security (Kozhimannil & Kim, 2014), are regulated and influenced by local policies that differ across countries. It is possible that the lack of universal paid maternity leave or access to health care in the USA influences the expression of psychopathology. Several studies conducted in the USA have

suggested a relationship between short maternity leave and the prevalence of depressive symptoms (Chatterji & Markowitz, 2012; Dagher *et al.* 2014), but research on the impact of maternity leave on the phenomenology of postpartum depression is lacking. Interestingly the two European countries evaluated in the measurement invariance analyses, France and the Netherlands, have similar regulations (Ray *et al.* 2010). It is also possible that issues of linguistic and cultural understandings of metaphor could explain the differences found between the USA and Europe. The Dutch and French versions of the EPDS, however, had similar factor structures, despite the linguistic differences between the two European countries.

There is a dearth of studies investigating differences in stigma towards psychiatric illness in the USA and Europe. The World Mental Health Surveys reported a wide variability (9–40%) in the prevalence of stigma associated with mood disorders in the countries included in the current study (Alonso *et al.* 2008). Differences in prescribing patterns and attitudes toward psychotropic medications between Europe and the USA may reflect stigma and are indicative of how different countries approach treatment of perinatal depression. For example, prescribing of antidepressant medication during pregnancy markedly varies between the USA and Denmark [13% (Cooper *et al.* 2007) *v.* less than 2% (Munk-Olsen *et al.* 2012), respectively]. Similarly, a population-based survey found more favourable attitudes towards psychiatric medications in the USA as compared with Germany (Schomerus *et al.* 2014).

Implications for clinicians

Our results underscore the need for clinicians to be aware of the patient's cultural perspective in the diagnostic process. Culture is a complex, multifaceted construct. Health care providers should not stereotype postpartum women on the basis of their ethnical/racial background; rather, they should explore the cultural milieu (including education) of the patient beyond ethnicity and race.

Postpartum women with lower levels of education may not disclose symptoms that usually trigger medical attention, such as crying and thoughts of self-harm. In these women, clinicians should focus on the presence of anhedonia and sensitively investigate other symptoms that may be present, but not disclosed, because they may be perceived as highly stigmatizing.

Implications for policy makers

According to our findings, the universal use of the EPDS requires careful consideration. Our results provide some preliminary evidence on the psychometric differences of the EPDS across contexts. The lack of measurement invariance can partially explain the heterogeneity in the previous validation studies of the EPDS (Eberhard-Gran *et al.* 2001; Gibson *et al.* 2009). Policy makers and clinicians should be aware that research evidence on postpartum depression may be influenced by the context in which they were obtained and that in screening for postpartum depression, one size does not necessarily fit all.

Implications for clinical research

The assumption that the EPDS universally measures the same construct can potentially lead to misclassification, invalid group comparisons, and erroneous conclusions about aetiology and risk factors (Gregorich, 2006; Gibson *et al.* 2009). It is possible that differences in the EPDS symptoms reported reflect differences in the pathogenesis of depression, with certain symptoms more likely to be triggered by environmental and social factors than others (Keller *et al.* 2007; Paykel, 2008).

Our findings open opportunities for new research into the effects of the socio-cultural environment on postpartum depression. According to our results, the context influences not only the disclosure of symptoms, but also the relationship between symptoms and, therefore, how depression manifests itself. In summary, we believe our findings reinforce the need for clinicians, researchers and policy makers to pay close attention to the importance of the context in both assessment and treatment planning for women with postpartum depression.

Strengths and limitations

Our study presents several strengths: (1) the broad definition of culture including country, ethnicity/race and level of education; (2) the application of measurement invariance to the expression of depressive symptoms; and (3) the use of a large, international dataset.

To the best of our knowledge, this is the first international study on the cross-cultural differences in postpartum depression. Consequently, our findings need to be replicated and interpreted in light of the following limitations:

1. The self-reported symptoms on the EPDS do not necessary reflect the symptomatology that would be captured by a psychiatrist. Cultural bias, however, may also influence standardized measures used by clinicians (Chentsova-Dutton *et al.* 2014).
2. Because we found that the factor structure of the EPDS varies across levels of education and between continents, we could not disentangle actual differences in the psychopathology from those due to the different psychometric properties of the EPDS across groups.
3. The PACT dataset was created by aggregating data from different sites with different research protocols. Ascertainment biases and methodological differences across sites cannot be excluded. For example, it has been shown that the structure of the EPDS changes with the severity of depressive episode and responses at different time points may reflect different factor structures (Cunningham *et al.* 2014). For the factor and measurement invariance analyses we tried to minimize them by including only studies with a prospective design. Similarly, regression analyses on symptoms of depression were stratified for possible confounding factors, including study design, severity of symptomatology and country/language of administration of the EPDS. We included the EPDS total score as a covariate to capture severity of the symptomatology, and therefore partially account for possible recruitment bias

and differences among sites. Although confounders cannot be excluded, it is encouraging that the two different approaches have led to consistent conclusions.

4. Our analyses included only 41Latinas, less than 1% of the total sample. The under-representation of Latinas in biomedical research is a well-known problem (Lara-Cinisomo *et al.* 2015). Our results need to be replicated in larger samples of Latinas, as the lack of an effect, especially in the measurement invariance analyses, may be due to the low statistical power.

There are other cultural and social factors, such as religion, family support and financial situation that are likely to influence the expression of postpartum depressive symptoms and should be considered by clinicians and researchers. We pragmatically chose education and race/ethnicity as they are stable and quantifiable characteristics, easily obtainable in clinical and research settings with limited time and human resources available. Similarly, we were not able to capture differences among ethnic subgroups or the effect of immigration status. Europe is heterogeneous, with different regulations and views on family and maternity. In this research, we examined only three northwest European countries. Our findings cannot be extended to other parts of Europe.

Conclusion

Our work suggests that culture influences the expression of postpartum depression. Level of education– more than race and ethnicity – has a significant impact on symptom profiles and on the underlying construct of depression among new mothers. Our findings of significant differences between the USA and Europe contrast the general assumption that Western culture is homogeneous.

The increasing cultural heterogeneity of societies together with the tendency towards globalization requires a culturally sensitive approach to patients, research and policies, that takes into account, beyond rhetoric, the context of a person’s experiences and the context in which the research is conducted.

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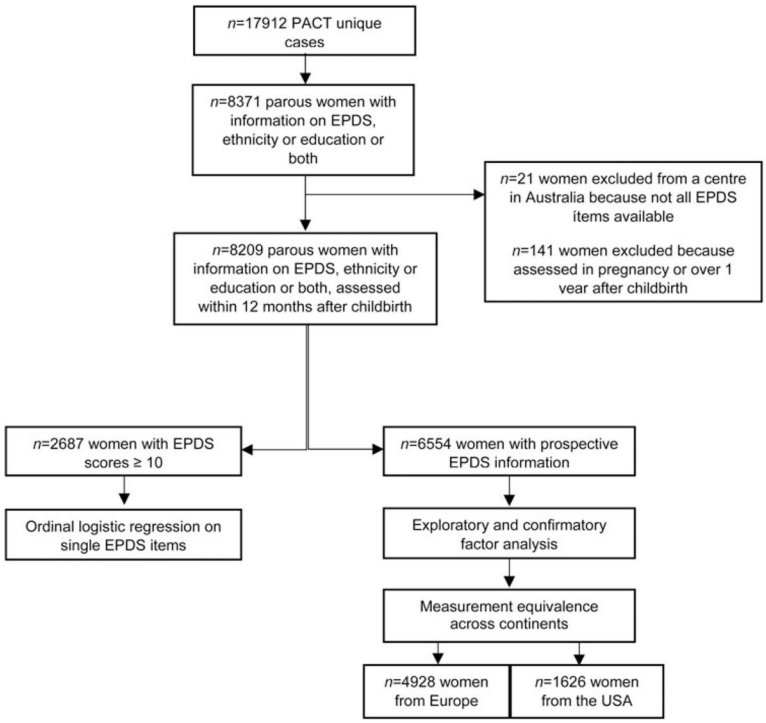

Fig. 1.

Sample flowchart and analytic plan. PACT, Postpartum Depression: Action Towards Causes and Treatment; EPDS, Edinburgh Postnatal Depression Scale.

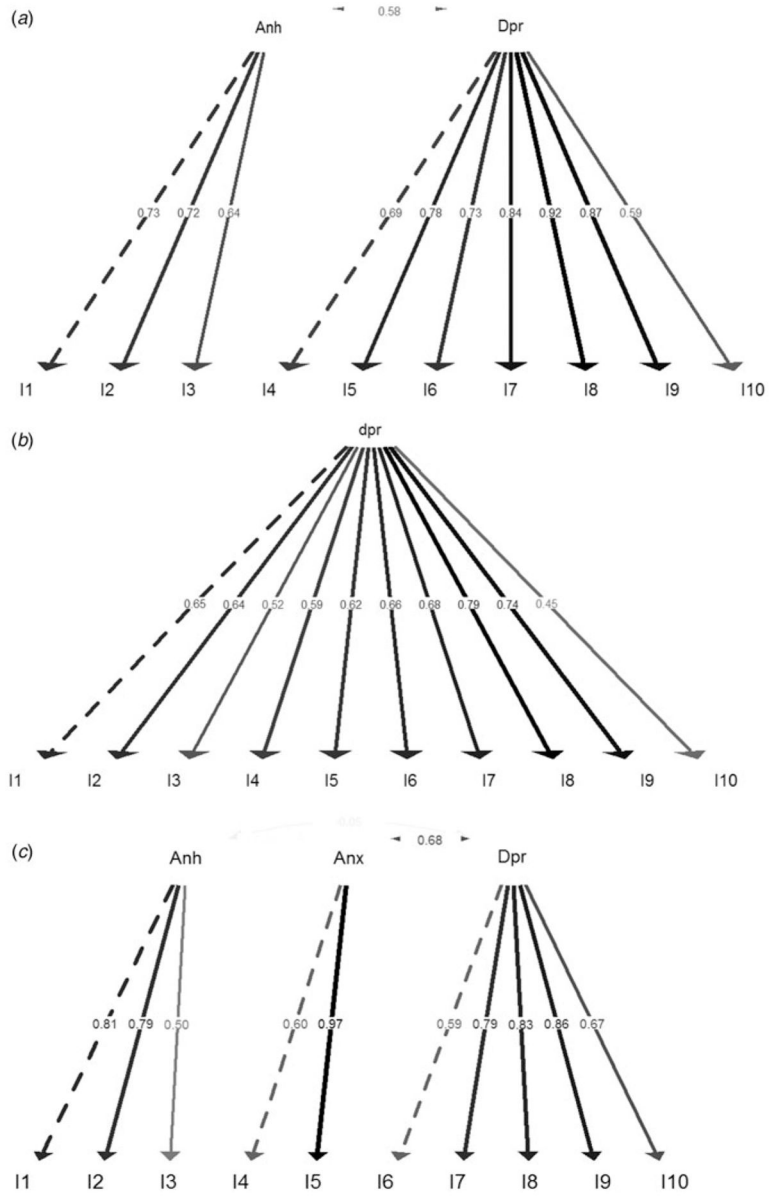

Fig. 2.

Factor models obtained from exploratory and confirmatory factor analysis: (*a*) on the whole sample of prospectively recruited women; (*b*) on prospectively recruited European women; (*c*) on prospectively recruited US women. Item 4 (I4) had loadings close to zero in the European sample. Anh, Anhedonia; Depr, depression; Anx, anxiety.

Table 1

Site location, design, enrolment period, setting and language of EPDS

Institution	Country	Assessment of postpartum symptoms	Repeated-measures design	Recruitment setting[a]	Language of EPDS
University of Rochester	USA	Prospective	Yes	Obstetric clinics	English
University of Paris	France	Prospective	Yes	Multiple	French
Johns Hopkins	USA	Prospective	Yes	Multiple	English
University of Massachussets	USA	Prospective	No	Obstetric clinics	English
University of North Carolina at Chapel Hill	USA	Prospective	Yes	Multiple	English
University of Arkansas/Emory	USA	Prospective	Yes	Multiple	English
Karolinska Institute	Sweden	Retrospective	No	Swedish Twin Community	Swedish
National Institute of Mental Health	USA	90% Prospective	No	Multiple	English
Erasmus	The Netherlands	Prospective	No	Psychiatric clinics	Dutch
Northwestern	USA	Prospective	Yes	Multiple	English
Erasmus	The Netherlands	Prospective	No	Community	Dutch

EPDS, Edinburgh Postnatal Depression Scale.

[a]Multiple: psychiatric clinics, obstetric clinics, community, advertisements.

Table 2

Sample characteristics ($n = 8209$)

	Europe				USA			
	n	**Median**	**Min**	**Max**	***n***	**Median**	**Min**	**Max**
Age at interview, years	6575	33	15	68	1635	31	18	46
Date of completion of EPDS, days after childbirth[a]	4535	85	9	294	1625	37	0	365
Race or ethnicity, *n* (%)								
Asian	300	(6.2)			31	(1.9)		
Black	832	(17.3)			299	(18.3)		
Latina-Hispanic	0				41	(2.5)		
White	3687	(76.5)			1226	(75.0)		
Other	2	(<0.1)			38	(2.3)		
Education attainment, *n* (%)								
12 years or fewer	2486	(38.2)			133	(18.5)		
13–16 years	2548	(39.1)			351	(48.9)		
Graduate or professional degree	1475	(22.7)			234	(32.6)		
Marital status, *n* (%)								
Married or live as married	5648	(87.5)			1108	(69.0)		
Lives alone: single, divorced, separated, widowed	806	(12.5)			498	(31.0)		
Design of the study in which the woman was recruited, *n* (%)								
Prospective	4928	(75.0)			1626	(99.4)		
Retrospective	1646	(25.0)			9	(0.6)		
Low-income status, *n* (%)								
Yes	531	(12.8)			22	(19.8)		
No	3631	(87.2)			89	(80.2)		

Min, Minimum; max, maximum; EPDS, Edinburgh Postnatal Depression Scale.

[a]Includes only prospectively evaluated women.

Table 3

Association between scores of single EPDS items and ethnicity/race, education and continent in 2687 women with postnatal depression[a]

		Black	Hispanic-Latina	Asian	Education	USA
	Item	**OR (0.5–99.5% CI)**	**OR (0.5–99.5% CI)**	**OR (0.5–99.5% CI)**	**OR (0.5–99.5% CI)**	**OR (0.5–99.5% CI)**
1	I have been able to laugh and see the funny side of things[b]	1.04 (0.715–1.500)	2.33 (0.845–6.452) *	0.85 (0.461–1.558)	0.76 (0.560–1.027) *	0.19 (0.130–0.268) ***
2	I have looked forward with enjoyment to things[b]	1.11 (0.772–1.598)	1.81 (0.634–5.166)	0.93 (0.509–1.693)	0.58 (0.426–0.780) ***	0.21 (0.146–0.295) ***
3	I have blamed myself unnecessarily when things went wrong	1.31 (0.916–1.890)	3.15 (1.142–8.685) ***	1.26 (0.687–2.304)	0.79 (0.592–1.060) *	0.36 (0.259–0.505) ***
4	I have been anxious or worried for no good reason	0.92 (0.632–1.333)	0.71 (0.258–1.938)	1.00 (0.531–1.889)	0.78 (0.574–1.051)	0.27 (0.184–0.388) ***
5	I have felt scared or panicky for no very good reason	0.86 (0.594–1.239)	1.09 (0.353–3.376)	1.23 (0.652–2.315)	1.37 (1.016–1.860) **	1.00 (0.701–1.414)
6	Things have been getting on top of me	0.97 (0.659–1.425)	0.93 (0.320–2.693)	0.96 (0.494–1.874)	1.27 (0.929–1.749)	0.32 (0.221–0.460) ***
7	I have been so unhappy that I have had difficulty sleeping	1.25 (0.846–1.831)	0.56 (0.169–1.839)	0.75 (0.392–1.427)	1.03 (0.745–1.432)	3.82 (2.665–5.501) ***
8	I have felt sad or miserable	0.99 (0.654–1.500)	0.80 (0.236–2.730)	1.01 (0.497–2.041)	1.21 (0.863–1.690)	1.89 (1.305–2.741) ***
9	I have been so unhappy that I have been crying	0.81 (0.545–1.214)	0.52 (0.169–1.621)	0.59 (0.196–1.620)	1.53 (1.097–2.143) ***	2.34 (1.615–3.394) ***
10	The thought of harming myself has occurred to me	0.34 (0.174–0.680) ***	0.32 (0.093–1.110) *	0.84 (0.174–4.019)	3.21 (1.926–5.348) ***	49.45 (18.915–129.285) ***

EPDS, Edinburgh Postnatal Depression Scale; OR, odds ratio; CI, confidence interval.

[a]Proportional OR and CIs were calculated on a model using ethnicity/race, education, EPDS total score, and study design as covariates. White race and Europe were the reference categories; education was treated as an ordinal variable.

[b]Reverse-scored items.

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.005$.