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Psychometric Properties of the Edinburgh Postnatal Depression Scale (EPDS) for Use in Digital Perinatal Mental Health Research: A Longitudinal Study Among Spanish Pregnant and Postpartum Women

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ABSTRACT

Background: The Edinburgh Postnatal Depression Scale (EPDS) is the most frequently used paper-and-pencil instrument for assessing perinatal depression in digital perinatal mental health research. However, the psychometric properties of the EPDS to be used in this context need to be established, and more evidence is needed regarding its internal factorial structure.

Objective: To examine the psychometric properties of the EPDS for its use in digital perinatal mental health research.

Methods: The sample, recruited online, consisted of 1222 pregnant and 1772 postpartum Spanish women. Three follow-up assessments were conducted over a 6-month period. Evidence of validity based on internal structure and relationships with other variables was provided. Reliability of the EPDS was evaluated through Cronbach's alpha (α) and McDonald's Omega (ω) coefficients. In addition, EPDS item analysis was performed.

Results: Exploratory factor analysis (EFA) revealed a three-correlated-factor model (*anhedonia, depression*, and *anxiety*) that showed a good data fit by confirmatory factor analysis (CFA) for pregnant (CFI = 0.995; NNFI = 0.993; RMSEA [95% CI] = 0.047 [0.032; 0.062]) and postpartum (CFI = 0.996; NNFI = 0.994; RMSEA [95% CI] = 0.039 [0.027; 0.051]) women. The three correlated-factor model showed measurement invariance across pregnant and postpartum women. EPDS total score and the three EPDS factors showed positive ($r > 0.500$; $p < 0.001$) correlation with the GAD-7 (*anxiety symptoms*) and the PTSD-checklist (*post-traumatic stress disorder symptoms*). Reliability coefficients (α and ω) exceeded 0.87 for both the total EPDS score and its three factors.

Conclusions: The EPDS appears to be a suitable tool for assessing anhedonia, anxiety, and depression symptoms in digital perinatal mental health research. However, there is considerable variation among studies in item loadings and factors across the two- and three-factor models, indicating that more in-depth mixed-methods analyses are needed.

1 | Introduction

Perinatal depression is one of the most frequent complications during the perinatal period, which encompasses pregnancy through the first year postpartum [1]. Worldwide, it is estimated that around 12% of women meet diagnostic criteria for perinatal depression [2].

Although the prevalence is high, perinatal depression is often undetected, causing important societal costs [3]. Early detection and assessment of perinatal depression can prevent long-term complications and promote a better parent-infant bond [4–7]. In this regard, a systematic review study found that early detection of perinatal mental health problems was able to reduce the risk of experiencing depression between 18% and 59% compared to control groups, which translated into a reduction of between 2.1% and 9.1% in the prevalence of depression at follow-up [8]. Thus, universal screening is increasingly considered the best practice [9].

Digital technology-based mental health assessment instruments can offer important possibilities for the universal screening of perinatal depression. A recent systematic review concluded that digital screening for perinatal mental health was effective and feasible [10]. Digital technology-based assessment approaches can present some challenges, but digital questionnaires provide significant advantages over traditional paper-and-pencil formats [11]. They tend to improve ecological validity during assessment, be more cost-effective, quicker to administer, and more accessible [11–13]. Despite these advantages, most online mental health assessment tools have been adapted from traditional paper-and-pencil instruments [14]. Equivalence between paper-and-pencil and digital mental health assessment instruments could not be assumed, and in these cases, the reliability needs to be proven, and new validity evidence for the proposed score interpretations needs to be accumulated [15, 16].

The most frequently used paper-and-pencil instrument for assessing perinatal depression is the Edinburgh Postnatal Depression Scale (EPDS) [17–19] created by Cox et al. [20]. The EPDS is a 10-item self-reported questionnaire considered the reference tool when there are suspicions of the presence of perinatal depressive disorder [21].

The score interpretations of the EPDS have been worldwide validated for its use in both pregnant and postpartum women [22]. Sambrook Smith et al. [22] identified 28 reviews that included EPDS validation studies. Of those nine reviews, including 233 studies, were focused exclusively on EPDS validation studies [17, 19, 23–29]: four of these conducted meta-analytic studies to calculate pooled sensitivity and specificity (criterion validity) [14, 17, 27, 29]; two were systematic reviews aimed at evaluating the criterion validity of the EPDS [19, 28]; one systematically explored the psychometric properties of the EPDS for use in different samples from low- and lower-middle-income countries [23]; another compiled evidence on the validity of the EPDS [25]; and the final review examined qualitative validation studies of the EPDS as a screening tool [26]. Despite this, there is no consensus about its internal factorial structure [30]. The EPDS was conceptualized as a unifactorial questionnaire [20]; however, some studies have proposed alternative factorial structures composed of two factors (depression and anxiety) and three factors (anhedonia, depression, and anxiety) [30]. In addition, there appears to be variability in the item factor loadings and in the factors where items exhibit the highest factor loadings. In the Spanish context, two studies exploring the EPDS factor structure have been identified. The first one explored different internal structures of the EPDS in women at 32 weeks postpartum [31]. The authors identified that the three-factor structure—anhedonia (Items 1, 2, 10), anxiety (Items 3, 4, 5, 6), and depression (Items 7, 8, 9)—showed the best fit indices compared with the one-, two-, and four-factor structures. The second one, conducted in pregnant and postpartum women within 6 months [32] tested both the one-factor structure and the three-factor structure previously identified by Gutierrez-Zotes et al. [31]. They found that the three-factor structure previously identified by Gutiérrez-Zotes et al. [31] showed better fit indices than the one-factor structure. However, they did not explore the EPDS factorial structure using exploratory factor analysis (EFA). Two additional studies conducted in Spain were identified—one with women at 6 weeks postpartum [33] and another with pregnant women [34]—focused on examining the criterion validity of the original structure proposed by Cox et al. [20]. Those previous Spanish studies were conducted within the public health setting; however, the EPDS is frequently administered in digital format [10, 35, 36], and few studies have examined its psychometric properties for its use in this context. We identified only two studies: one conducted among Serbian pregnant and postpartum women [37] and another involving Dutch pregnant women with depressive symptoms [38]. No studies focusing on Spanish pregnant and/or postpartum women were found. Furthermore, in 2019, Cox [39] published a study reflecting on 30 years of the EPDS's history, stating that additional evidence is needed to establish the EPDS psychometric properties and pragmatic utility when administered through digital technology-based procedures.

The aim of this study was to provide validity evidence regarding the use of the EPDS in the digital perinatal mental health research context by (1) examining the internal structure of the EPDS and exploring the items' loadings onto specific factors; (2) exploring the relationships between the EPDS and other theoretically related variables; and (3) assessing the EPDS's reliability.

2 | Method

2.1 | Design

A longitudinal design was used, with assessments at baseline and at one, three, and 6 months. This study involved a secondary analysis of previously collected data [40].

2.2 | Participants

Eligibility criteria included women aged 18 years or older, residing in Spain, who were either pregnant or had a baby under 6 months of age. All participants provided informed consent. Individuals not meeting these criteria were excluded.

Based on estimates from the national birth data for 2020 and guidelines from the international protocol [40], a minimum sample of 300 women was calculated using G*Power software (heterogeneity: 50%, power: 80%, level of significance: 0.5%). A greater sample size was used to increase statistical power.

Of the 4316 women who accessed the online questionnaire and gave consent, 636 did not meet inclusion criteria, and 324 were excluded due to gestational age exceeding 42 weeks. After removing cases with missing data on depressive, anxiety, and post-traumatic stress disorder (PTSD) symptoms (primary variables of interest) or other data inconsistencies, 3082 participants remained (1260 pregnant and 1822 postpartum). Subsequently, a total of 88 participants identified as multivariate outliers on the EPDS were excluded, yielding a final sample of 2994 women (1222 pregnant women and 1772 postpartum women). Figure 1 shows the participant flow diagram.

2.2.1 | Drop-Out Rate at Follow-Up Assessments

Among the 2994 participants, follow-up completion rates were 29.3% at one month ($n = 878$; 371 pregnant and 507 postpartum women), 16.0% at three months ($n = 478$; 198 pregnant; 280 postpartum women) and 11.0% at six months ($n = 330$; 133 pregnant; 197 postpartum women).

2.3 | Instruments

Sociodemographic characteristics: Age, marital status, place of birth, and parity were assessed using a questionnaire created ad hoc.

The EPDS [20]: The Spanish version of the EPDS proposed by Garcia-Esteve et al. [33] was employed [33] to assess perinatal depression. The EPDS contains 10 items with a 4-point Likert scale ranging from 0 (not at all) to 3 (yes, very often). The EPDS total score varied from 0 to 30, with higher EPDS scores indicating more symptoms of perinatal depression.

The General Anxiety Disorder-7 scale (GAD-7) [41]: The Spanish version of the GAD-7 was employed to assess symptoms of anxiety [42]. The GAD-7 consists of 7 self-reported items rated on a 4-point Likert scale ranging from 0 (*not at all*) to 3 (*nearly every day*). The GAD-7 is used to assess anxiety in the general population [41, 42] and has also been used to assess anxiety in pregnant and postpartum women [43]. Higher scores indicate more symptoms of anxiety.

PTSD checklist: The PTSD-checklist 10-item self-report questionnaire was used to assess post-traumatic stress disorder symptoms. These 10 items are a subset of those included in the Coronavirus Perinatal Experiences—Impact Survey (COPE-I) [44]. The PTSD checklist has been designed based on each of the DSM-5 diagnostic criteria for PTSD, including two items for Cluster B, one for Cluster C, two for Cluster D, and five for Cluster E. Responses are rated on a 5-point Likert scale, with scores ranging from 0 (*not at all*) to 3 (*extremely*). Higher PTSD-checklist scores indicate high levels of PTSD symptoms.

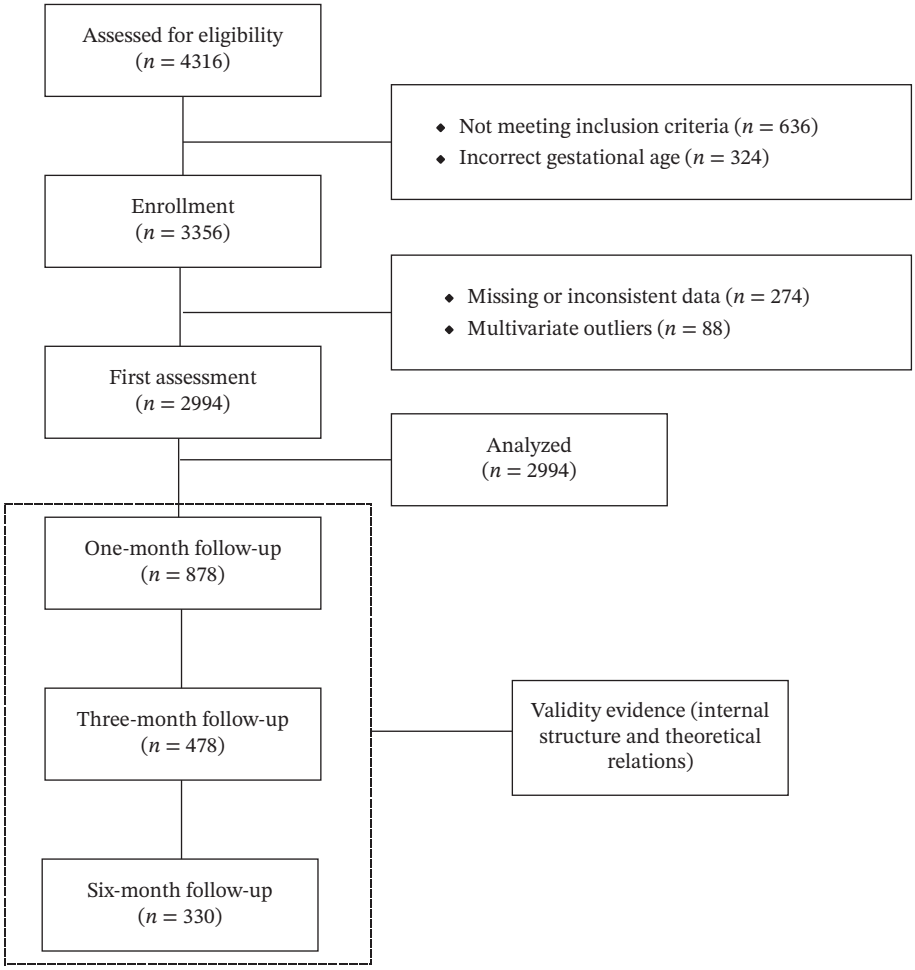

FIGURE 1 | Participants flow diagram.

2.4 | Procedure

Prior to participation in the study, participants signed the informed consent. Data were collected online between June 15 and December 31, 2020, through the Qualtrics XM survey platform. Online data collection took around 20 min. Using a snowball sampling strategy, pregnant and postpartum women were recruited through social media platforms, perinatal organizational networks, policymakers, and perinatal local organizations. Upon completion of the survey, all participants were presented with information on available mental health and support services, as well as dedicated resources for individuals experiencing gender-based violence (e.g., the 016 national hotline). In addition, participants were directed to a perinatal psychology blog offering psychoeducational resources and access to a supportive mobile application for emotional well-being during pregnancy and the postpartum period. While the study design did not allow for individualized clinical follow-up or real-time risk management, the provision of these resources was intended to ensure that participants experiencing distress, including those endorsing Item 10, had immediate access to appropriate support options. Ethical approval for the study was obtained from the Regional (Andalusia) Ethic Committee (Ethics Protocol 1257-N-20). Further details about the procedure are available in the study protocol [40].

2.5 | Data Analysis

Statistical analyses were performed using R Studio 2021.09.3. All analyses were based on complete-case data, and no imputation procedures were applied. First, through the Mahalanobis distance with $p < 0.001$, the multivariate outliers were identified. Second, violations of the normality assumption were confirmed at both the univariate and multivariate levels using Kolmogorov–Smirnov and the Mardia test, respectively. Third, sociodemographic differences between pregnant and postpartum women were analyzed using the chi-squared test and Student's *t*-test, accompanied by effect size indices (Cramer's V and Cohen's d, respectively). Fourth, a descriptive analysis of the EPDS items was carried out using mean, standard deviation, skewness, and kurtosis, as well as floor and ceiling effects. For the study of the factorial structure of the EPDS, the sample of pregnant ($n = 1222$) and postpartum women ($n = 1772$) was randomly divided into two subsamples, one of them for the EFA (n_1 pregnant = 611 and n_1 postpartum = 886) and the other for confirmatory factor analysis (CFA; n_2 pregnant = 611 and n_2 postpartum = 886). To perform EFA, the principal axis factoring extraction method and Promax rotation were used with Kaiser–Meyer–Olkin (KMO) and Bartlett's tests to determine the adequacy of the EFA. To decide the number of factors to be extracted, parallel analysis was conducted. CFA was conducted using the robust unweighted least squares (RULS) estimation method due to the ordinal and non-normal nature of the data [45]. The polychoric correlation matrix was calculated using the *lavaan R package* [46]. The following fit indices, recommended by Alavi et al. [47], were used to assess model fit: the Chi-squared statistic (χ^2), the comparative fit index (CFI), the non-normalized fit index (NNFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Values above 0.90 were indicative of an acceptable fit for CFI and NNFI [48]. Nevertheless, Hu & Bentler [49] suggest using values of 0.95 or higher. RMSEA and SRMR values close to 0.06 and 0.08, respectively, are also indicative of a good fit. To assess factorial invariance (FI) between pregnant and postpartum women, a stepwise approach was applied, testing configural, weak, strong, and strict invariance. A change in CFI value ≥ 0.01 indicated a lack of invariance [50].

To provide evidence of validity based on relationships with other variables, Pearson correlations were calculated among the EPDS, the GAD-7, and the PTSD scores. Internal consistency was calculated using Cronbach's alpha and McDonald's omega coefficients [51].

3 | Results

3.1 | Descriptive Statistics

Table 1 shows the baseline sociodemographic characteristics of the participants. Most of the participants were married, partnered, or engaged (95%), born in Spain (95%), primigravid or primiparous (62.2%) and with a mean age of 33.78 (SD = 4.20) years. Significant differences were found in the variables analyzed ($p < 0.05$ in all cases), but with a trivial effect size.

3.2 | Items Analysis

Table 2 shows the descriptive statistics of participants' responses to the EDPS items. In the total sample and in both groups of participants, pregnant and postpartum women, Item 6 obtained the highest score and Item 10, which assesses thoughts of self-harm, the lowest. The floor effect was observed in all items except

TABLE 1 | Baseline characteristics of the participants.

Variables	Total sample ($N = 2994$) N (%)	Pregnant women ($n = 1222$) n (%)	Postpartum women ($n = 1772$) n (%)	X^2/t	p	Effect size
Sociodemographic						
Age [M (SD)]	33.78 (4.20)	33.52 (4.16)	33.96 (4.21)	−2.80	0.005	$d = 0.105$
Marital status				4.63	0.031	V = 0.040
Single/separate/divorced/widowed	148 (5.0)	48 (4.0)	100 (5.7)			
Married/partnered/engaged	2817 (95.0)	1165 (96.0)	1652 (94.3)			
Spanish-born (% yes)	2817 (95.0)	1166 (96.1)	1651 (94.2)	5.40	0.020	V = 0.043
Primigravid/primiparous (% yes)	1862 (62.2)	728 (59.6)	1134 (64.0)	6.01	0.014	V = 0.045

Note: X^2 = chi-squared test; t = Student's *t*-test; p = *p*-value; d = Cohen's d; V = Cramer's V.

TABLE 2 | Baseline descriptive statistics of the EPDS items.

Items	Min–max	*M*	SD	Skewness	Kurtosis	% of responses with a score of 0	% of responses with a score of 3
Total sample (N = 2994)							
1	0–3	0.7	0.7	0.7	−0.3	47.0	1.1
2	0–3	0.9	0.8	0.7	−0.0	36.4	3.7
3	0–3	1.3	1.0	−0.4	−1.1	26.2	10.9
4	0–3	1.4	0.9	−0.2	−1.1	24.2	7.2
5	0–3	1.1	0.9	0.2	−1.1	32.4	6.1
6	0–3	1.5	0.8	−0.2	−0.5	12.6	6.6
7	0–3	0.6	0.8	0.9	−0.3	57.2	2.2
8	0–3	0.8	0.8	0.6	−0.4	40.9	2.3
9	0–3	0.6	0.7	0.8	0.1	47.9	1.3
10	0–2	0.0	0.2	5.3	29.8	95.6	0
Pregnant women (n = 1222)							
1	0–3	0.7	0.7	0.7	−0.3	46.8	1.1
2	0–3	0.8	0.8	0.7	−0.2	37.6	2.9
3	0–3	1.2	1.0	0.1	−1.1	31.0	7.9
4	0–3	1.3	0.9	−0.2	−1.1	25.0	7.0
5	0–3	1.1	0.9	0.2	−1.0	32.5	6.1
6	0–3	1.4	0.8	−0.2	−0.6	14.2	6.3
7	0–3	0.7	0.9	0.9	−0.4	55.0	2.8
8	0–3	0.8	0.8	0.6	−0.6	41.3	1.9
9	0–3	0.6	0.7	0.9	0.3	50.0	1.5
10	0–2	0.0	0.2	5.7	35.3	96.2	0
Postpartum women (n = 1772)							
1	0–3	0.7	0.7	0.7	−0.3	47.1	1.2
2	0–3	0.9	0.8	0.7	−0.6	35.6	4.3
3	0–3	1.4	1.0	−0.1	−1.1	22.9	13.0
4	0–3	1.4	0.9	−0.3	−1.0	23.6	7.4
5	0–3	1.1	0.9	0.2	−1.1	32.4	6.2
6	0–3	1.5	0.8	−0.3	−0.4	11.5	6.8
7	0–3	0.6	0.8	1	−0.2	58.7	1.8
8	0–3	0.8	0.8	0.7	−0.2	40.7	2.7
9	0–3	0.7	0.7	0.8	−0.0	46.4	1.1
10	0–2	0.1	0.2	5.0	26.88	95.1	0

Note: Items 3, 5, 6, 7, 8, 9, and 10 have been recoded so that a higher score indicates more severe symptoms of perinatal depression.

Item 6, while no ceiling effect was observed in any item (less than 15% in all cases).

3.3 | Evidence of Validity Based on Internal Structure

The adequacy of conducting the EFA with both the pregnant ($n_1 = 611$) and postpartum ($n_1 = 886$) subsample data were confirmed by using the KMO test (> 0.90) and the Bartlett's test ($p < 0.001$). The EFA revealed a three-correlated-factor solution (see Table 3). For both pregnant and postpartum women, the first factor (anhedonia) included Items 1 and 2. The second factor (anxiety) included Items 3, 4, 5, and 6 for pregnant women and Items 4, 5, and 6 for postpartum women. The third factor was composed of Items 7, 8, 9, and 10 for pregnant women and Items 3, 7, 8, 9, and 10 for postpartum women. For postpartum women, Item 3 presented high loading factors in factors 2 and 3, and thus, due to theoretical reasons, a homogenized factorial structure was proposed based on EFA for both groups of participants: Items 1 and 2 (anhedonia), Items 3–6 (anxiety), and Items 7–10 (depression).

The results of the CFA showed that the three correlated-factor solution presented a good fit of the model to the data for pregnant

TABLE 3 | EPDS loadings factors.

Items	Factor loading[†]					
	Pregnant women ($n_1 = 661$)			Postpartum women ($n_1 = 886$)		
	F1 anhedonia	F2 anxiety	F3 depression	F1 anhedonia	F2 anxiety	F3 depression
1	1.08			0.87		
2	0.70			0.92		
3		0.58			0.34	0.48
4		1.03			0.85	
5		0.94			0.89	
6		0.57			0.46	
7			0.62			0.50
8			0.92			0.74
9			0.70			0.82
10			0.79			0.59
Variance (%)	18%	28%	27%	21%	21%	24%

[†]Based on parallel analysis.

(CFI = 0.995; NNFI = 0.993; RMSEA [95% CI] = 0.047 [0.032; 0.062]) and postpartum (CFI = 0.996; NNFI = 0.994; RMSEA [95% CI] = 0.039 [0.027; 0.051]) women (see Table 4 and Figures S1 and S2 in Supporting Information). Compared with this model, the one-factor and the two-correlated-factor models presented poorer fit indexes. Also, the three correlated-factor solution of the EPDS showed strict invariance (CFI = 0.993; NNFI = 0.993; RMSEA = 0.025 [0.023, 0.027]; SRMR = 0.035) across groups (Table 5).

With respect to depression, anxiety, and PTSD symptoms (Table 6), significant differences were observed between pregnant and postpartum women in the EPDS total scores and the EPDS-Anxiety factor, with higher scores in the postpartum group.

Lastly, the correlations among EPDS scores for the three follow-up assessments were statistically significant, positive, and of a high effect size (1st and 2nd follow-up: $r = 0.774$; $p < 0.001$; 1st and 3rd follow-up: $r = 0.717$; $p < 0.001$). Similar results were obtained with the three correlated-factor model, finding significant and positive correlations that ranged from moderate to high (see Table S1, Supporting Information).

3.4 | Evidence of Validity Based on the Relationship With Other Variables

In terms of validity evidence in relation to other variables, the EPDS score as well as its factors correlated significantly, with a high effect size, with the GAD-7 and PTSD scores both in the overall sample and in pregnant and postpartum women (Table 7). Additionally, the correlations of the EPDS total score across the three time points of follow-up with the GAD-7 and the PTSD for the total sample and pregnant and postpartum women showed the same results: positive and significant correlations (see Table 7).

3.5 | Reliability of the EPDS

Item analysis is presented in Table 8. Adequate reliability coefficients (α and ω) greater than 0.70 were observed for the EPDS total score and the anxiety and depression factors for pregnant and postpartum women. For the two items that composed the anhedonia factor, a strong and significant correlation ($r \geq 0.660$; $p < 0.001$) was found between them. Overall, EPDS items demonstrated adequate discrimination indices, with values

TABLE 4 | Model fit statistics from the CFA of the EPDS.

Model	X^2	df	*p*	CFI	NNFI	RMSEA [95% CI]	SRMR
Pregnant women ($n_2 = 611$)							
One-factor structure	157.338	35	< 0.001	0.985	0.980	0.081 [0.068; 0.094]	0.073
Two correlated-factor solution	121.964	34	< 0.001	0.989	0.985	0.070 [0.057; 0.083]	0.065
Three correlated-factor solution	69.511	32	< 0.001	0.995	0.993	0.047 [0.032; 0.062]	0.049
Postpartum women ($n_2 = 886$)							
One-factor structure	295.183	35	< 0.001	0.974	0.967	0.092 [0.083; 0.102]	0.078
Two correlated-factor solution	238.647	34	< 0.001	0.979	0.973	0.083 [0.074; 0.093]	0.071
Three correlated-factor solution	74.136	32	< 0.001	0.996	0.994	0.039 [0.027; 0.051]	0.039

Note: χ^2 = chi-squared test; df = degrees of freedom; $p = p$ value; Three correlated-factor solution: anhedonia (Items 1 and 2), anxiety (Items 3, 4, 5, and 6), and depression (Items 7, 8, 9, and 10).
Abbreviations: CFI, comparative fit index; NNFI, nonnormalized fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual.

TABLE 5 | Factorial invariance analysis for pregnant ($n = 1222$) and postpartum ($n = 1772$) women.

Model	X^2	*df*	*p*	CFI	NNFI	RMSEA [90% CI]	SRMR	|ΔCFI|	|ΔRMSEA|
Three correlated factors solution									
Configural	442.953	64	< 0.001	0.997	0.995	0.021 [0.019, 0.022]	0.023	—	—
Weak	350.434	71	< 0.001	0.996	0.995	0.021 [0.019, 0.023]	0.025	0.001	0.000
Strong	510.467	78	< 0.001	0.994	0.993	0.025 [0.023, 0.027]	0.029	0.002	0.004
Strict	509.242	88	< 0.001	0.993	0.993	0.025 [0.023, 0.027]	0.035	0.001	0.000

Note: X^2, chi-squared test; df = degrees of freedom.
Abbreviations: CFI, comparative fit index; NNFI, nonnormalized fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual.

TABLE 6 | Baseline perinatal mental health status.

Variables	Total sample ($N = 2994$) *M* (SD)	Pregnant women ($n = 1222$) *M* (SD)	Postpartum women ($n = 1772$) *M* (SD)	*t*	*p*	*d*
GAD-7 total score	7.29 (5.24)	7.22 (5.21)	7.35 (5.25)	−0.66	0.507	0.025
EPDS total score	8.99 (5.55)	8.74 (5.67)	9.17 (5.46)	−2.04	0.042	0.078
EPDS: anhedonia	1.55 (1.41)	1.52 (1.39)	1.58 (1.43)	−1.19	0.234	0.042
EPDS: anxiety	5.28 (2.90)	5.05 (2.96)	5.44 (2.85)	−3.60	< 0.001	0.135
EPDS: depression	2.16 (2.14)	2.18 (2.20)	2.15 (2.11)	0.35	0.735	0.014
PTSD total score	9.62 (7.30)	9.48 (7.27)	9.71 (7.32)	−0.85	0.395	0.032

Note: EPDS-anhedonia: Factor 1 of the three correlated-factor solution (Items 1 and 2); EPDS-anxiety: Factor 2 of the three correlated-factor solution (Items 3, 4, 5, and 6) and EPDS-depression: Factor 3 of the three correlated-factor solution (Items 7, 8, 9, and 10).

exceeding 0.300. An exception was Item 10, which showed a discrimination index around 0.221–0.256.

4 | Discussion

This study provides robust psychometric evidence supporting the use of the EPDS in perinatal mental health research conducted in digital settings. The findings confirm that the EPDS maintains strong internal consistency, construct validity, and factorial structure, comparable to those reported for the traditional paper-based version in previous studies.

This study found that the three correlated-factor model presents better-fit indexes compared with the one-factor and the two correlated-factor models for both pregnant and postpartum women, supporting the use of the EPDS as a multidimensional tool for screening distinct but related symptom domains. The one-factor and the two correlated-factor models presented adequate fit indexes as well but worse than the three correlated-factor models. The three correlated-factor structure was composed of anhedonia (Items 1 and 2), anxiety (Items 3, 4, 5, and 6), and depression (Items 7, 8, 9, and 10). The robustness of the three-correlated factor structure identified in the present study was demonstrated through strict invariance between pregnant and postpartum women, which aligns with previous theoretical evidence indicating that antenatal depression precedes postpartum depression [52].

These findings align with prior studies evaluating the psychometric properties of the EPDS to be applied in digital perinatal mental health research in Serbian pregnant and postpartum women [37] and Dutch pregnant women with depressive symptoms [53] and with those conducted to assess the psychometric properties of the EPDS when applied in paper-and-pencil format across different cultural samples worldwide [30, 54–58].

However, it should be noted that there are significant inconsistencies in the factor structure of the EPDS across countries and studies [30]: Some studies have found that the EPDS is a unifactorial questionnaire, while other studies suggest EPDS comprises two or three factors. These inconsistencies are further evidenced by variations in item loadings across the two and three-factor structures not only in the Spanish context [32] but also in other cultural contexts [30].

Regarding certain specific items, Item 10 showed inconsistent findings across studies. In the present study, Item 10 was part of the depression factor, which aligns with previous validation studies conducted in different cultural contexts [54–56, 58–61] and with the diagnostic criteria for major depression according to DSM-V. However, studies involving Spanish-speaking pregnant and postpartum women found that Item 10 was associated with the anhedonia factor, although with low factor loadings [31, 32]. Additionally, congruent with prior studies conducted in different cultural settings, including the Spanish context, Item 10 exhibited low discrimination and a significant floor effect [30–32].

Item 10 assesses thoughts of self-harm, which may or may not reflect suicidal ideation. Therefore, its primary purpose is to serve as an alert rather than to contribute directly to diagnosis. Consequently, in both clinical practice and research, any response other than "never" should be interpreted with

TABLE 7 | Correlations of the EPDS scores with anxiety (GAD-7) and post-traumatic stress symptoms (PTSD) at baseline and the three time points of follow-up.

	Baseline					
	Total sample ($N = 2994$)		Pregnant women ($n = 1222$)		Postpartum women ($n = 1772$)	
Variables	**GAD-7**	**PTSD**	**GAD-7**	**PTSD**	**GAD-7**	**PTSD**
EPDS total score	0.791*	0.774*	0.799*	0.777*	0.787*	0.772*
EPDS: anhedonia	0.587*	0.584*	0.586*	0.572*	0.587*	0.591*
EPDS: anxiety	0.729*	0.706*	0.740*	0.713*	0.723*	0.702*
EPDS: depression	0.674*	0.663*	0.695*	0.685*	0.660*	0.648*
	Follow-ups					
	Total sample		**Pregnant women**		**Postpartum women**	
Variables	**GAD-7**	**PTSD**	**GAD-7**	**PTSD**	**GAD-7**	**PTSD**
1st follow-up						
EPDS total score	0.680*	0.672*	0.671*	0.663*	0.681*	0.675*
EPDS: anhedonia	0.490*	0.525*	0.513*	0.586*	0.474*	0.489*
EPDS: anxiety	0.669*	0.637*	0.654*	0.628*	0.675*	0.640*
EPDS: depression	0.525*	0.528*	0.502*	0.472*	0.535*	0.559*
2nd follow-up						
EPDS total score	0.657*	0.676*	0.630*	0.678*	0.671*	0.671*
EPDS: anhedonia	0.485*	0.508*	0.480*	0.528*	0.484*	0.490*
EPDS: anxiety	0.638*	0.643*	0.581*	0.617*	0.671*	0.656*
EPDS: depression	0.548*	0.576*	0.545*	0.588*	0.547*	0.563*
3rd follow-up						
EPDS total score	0.638*	0.633*	0.644*	0.661*	0.631*	0.611*
EPDS: anhedonia	0.445*	0.459*	0.465*	0.484*	0.426*	0.438*
EPDS: anxiety	0.617*	0.606*	0.619*	0.628*	0.613*	0.588*
EPDS: depression	0.552*	0.543*	0.554*	0.572*	0.550*	0.523*

*$p < 0.001$.

TABLE 8 | Item-total correlations and reliability coefficients (Cronbach's alpha and McDonald's omega).

Variables	Total sample ($N = 2994$)	Pregnant women ($n = 1222$)	Postpartum women ($n = 1772$)
Cronbach's alpha/McDonald's omega			
EPDS total score	0.878/.886	0.889/.897	0.871/.879
EPDS: anhedonia	$r = 0.663^{*}/rho = 0.672^{*}$	$r = 0.668^{*}/rho = 0.671^{*}$	$r = 0.660^{*}/rho = 0.672^{*}$
EPDS: anxiety	0.806/0.811	0.827/0.831	0.792/0.797
EPDS: depression	0.776/0.848	0.791/0.866	0.766/0.835
Item—test correlation			
1	0.605	0.611	0.602
2	0.597	0.607	0.591
3	0.569	0.586	0.561
4	0.664	0.687	0.647
5	0.634	0.642	0.629
6	0.633	0.677	0.599
7	0.665	0.708	0.640
8	0.735	0.755	0.723
9	0.680	0.711	0.657
10	0.234	0.256	0.221
Cronbach's alpha if item is deleted/McDonald's omega if item is deleted			
1	0.867/0.876	0.879/0.889	0.858/0.867
2	0.867/0.877	0.879/0.889	0.859/0.868
3	0.871/0.881	0.882/0.892	0.863/0.873
4	0.862/0.871	0.873/0.883	0.854/0.863
5	0.865/0.874	0.877/0.887	0.856/0.865
6	0.864/0.873	0.874/0.883	0.858/0.867
7	0.862/0.872	0.872/0.882	0.855/0.866
8	0.856/0.869	0.868/0.881	0.848/0.860
9	0.862/0.873	0.872/0.885	0.854/0.866
10	0.886/0.885	0.897/0.896	0.879/0.879

$^{*}p < 0.001$.

appropriate caution. In addition, a prior individual participant data meta-analysis showed that when Item 10 (self-harm) is removed, the EPDS-9 demonstrates a screening performance comparable to that of the full EPDS for the detection of depression [62]. From a clinical practice perspective, the complementary use of a targeted, well-validated suicidality screener within digital workflows should be considered.

Regarding Item 3, our analysis revealed different loading patterns depending on the group. For postpartum women, Item 3 cross-loaded onto both depression (0.48) and anxiety (0.34) factors, whereas for pregnant women, it showed a high loading exclusively on the anxiety factor. This pattern aligns with findings from a previous study conducted with English postpartum women, which reported similar results for this item [57]. Additionally, studies involving Latin and European Spanish-speaking samples have consistently classified Item 3 within the anxiety factor for both pregnant and postpartum women [31, 32, 58]. These converging lines of evidence support our decision to assign Item 3 to the anxiety factor for both groups.

The inconsistency observed in Item 3 may be explained by clinical considerations. Self-blame could be associated with excessive worry—a hallmark of anxiety during pregnancy and the postpartum period [63]. Additionally, self-blame may be associated with feelings of guilt related to motherhood during the postpartum period. Guilt has been shown to be significantly associated with postnatal depression [64]. Thus, the dual relevance of self-blame to both anxiety and depression may account for its variable loading across groups.

The high correlations with well-established measures of anxiety (GAD-7) and post-traumatic stress symptoms further support the convergent validity of the EPDS to be applied in digital perinatal mental health research. The results remained robust at the one-, three-, and 6-month follow-up assessments.

Regarding reliability, the EPDS and its factors appear to accurately assess depression both as a global construct and as a multidimensional construct. These findings are consistent with previous studies conducted in diverse cultural samples worldwide [30, 54–57].

The results of this study can have important implications for using the EPDS in future digital research and clinical practice on perinatal mental health. They enable the exploration of specific EPDS factors without necessarily administering the entire instrument. They support large-scale studies conducted online and enhance the assessment of perinatal mental health in crisis situations, such as the COVID-19 pandemic, where quarantine restrictions prevent leaving home. Additionally, these results could contribute to increasing access to early perinatal depression screening and the development of transdiagnostic digital technology-based tools, which may play a crucial role in preventing perinatal mental health problems [8]. Reliable digital technology-based questionnaires can also help evaluate women who are hard to access through in-person methods, thereby saving time and lowering costs [65], as well as supporting the development of digital mental health interventions [66].

This study has four main limitations. First, it does not provide definitive conclusions regarding the factorial structure of the EPDS; more in-depth mixed-methods analyses are needed. Second, inherent biases associated with digital data collection methods [11] may have influenced the results of the present study. Future research should further examine the utility of the EPDS across diverse populations and digital delivery formats to maximize its impact on perinatal mental healthcare and prevention. Third, the use of digital snowball sampling methods to recruit participants may introduce selection bias and limit the representativeness of the sample. Women with limited internet access or lower digital literacy could be underrepresented, which may affect the external validity of the findings. However, it is important to note that, according to the 2024 Survey on Equipment and Use of Information and Communication Technologies in Households conducted in Spain, 95.8% of respondents reported having used the internet in the previous three months, and 81.4% reported using e-health services [67]. Additionally, data collection took place during the COVID-19 pandemic, and the sample was demographically skewed (predominantly Spain-born and partnered women), which may have influenced EPDS score distributions and limits the generalizability of the findings to more diverse, clinically referred, or non-pandemic populations. Fourth, although previous research has reported comparable psychometric properties for paper-based and digital administrations of the EPDS, the equivalence between these two formats was not directly tested in the present study. Consequently, potential effects of digital administration on response patterns or psychometric characteristics cannot be fully ruled out and should be examined in future comparative research.

5 | Conclusion

The EPDS appears to be an adequate tool for assessing anhedonia, depression, and anxiety in digital perinatal mental health research. The three-correlated factor structure demonstrated strict invariance between pregnant and postpartum women. Additionally, both the one-factor and two-factor (depression and anhedonia) structures demonstrated acceptable fit indices, although these were somewhat inferior to the three-factor structure. There is considerable variation among studies in item loadings across the two- and three-factor models, indicating that more in-depth mixed-methods analyses are needed. Reliability and convergent validity based on relationships with other variables supports the appropriateness of the EPDS as a suitable tool for large-scale screening, longitudinal monitoring, and evaluation of digital mental health interventions. However, there is considerable variation among studies in item loadings and factors across the two- and three-factor models, indicating that more in-depth mixed-methods analyses are needed.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding authors upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. *(Supporting Information)*

Supporting 1. Figure S1: This figure shows the path diagram of the three correlated factors solution for pregnant women.

Supporting 2. Figure S2: This figure shows the path diagram of the three correlated factors solution for postpartum women.

Supporting 3. Table S1: This table shows the correlations between EPDS dimension scores in the three follow-up assessments (at one, three, and six months postbaseline) in the total sample and in the groups of pregnant women and postpartum women.