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Validation and mode of questionnaire administration equivalence of the Edinburgh Postnatal Depression Scale (EPDS) among fathers in Brazil: Birth in Brazil study II

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Abstract

This study aimed to evaluate the psychometric properties of the Edinburgh Postnatal Depression Scale (EPDS) for measuring postnatal depression in fathers in Brazil and tested its invariance across different modes of questionnaire administration.

Method: Data were collected from the Birth in Brazil II study, a nationally representative survey of hospital births. A total of 4,600 fathers were interviewed three months after childbirth, either through telephone interviews or online self-reports. The construct validity of the EPDS was evaluated through factor analyses, and the reliability was assessed using the composite reliability coefficient (CR). Measurement invariance was tested using multi-group confirmatory factor analysis (CFA).

Results: The EPDS demonstrated a two-factor structure (anhedonia and anxiety/depression) with adequate fit (CFI = 0.969; TLI = 0.960; RMSEA = 0.032). Both factors demonstrated good reliability (CR = 0.82 and 0.90). Higher EPDS scores were positively associated with anxiety symptoms, self-reported mental health problems, and psychiatric medication use ($p < 0.001$), and

inversely associated with better self-rated health ($p < 0.001$). Measurement invariance across administration modes was supported at configural, metric, scalar, and strict levels.

Conclusions: The EPDS demonstrated adequate psychometrics properties of construct validity and reliability, and invariant two-factor structure for assessing paternal postpartum depressive symptoms, indicating its use in scientific studies and clinical screening of fathers.

Keywords: paternal depression; measurement instruments; mental health

Introduction

The Edinburgh Postnatal Depression Scale (EPDS) is a tool originally designed to evaluate symptoms of postnatal depression in mothers. Developed by Cox and colleagues in England (1), the EPDS has been adapted for use in various countries and languages. It has adequate psychometric properties and is one of the most used instruments for assessing maternal perinatal depression (2,3).

The EPDS consists of 10 items designed to assess symptoms of major depression, including anhedonia, anxiety, sadness, panic, and thoughts of self-harm. Respondents rate the frequency of each symptom they have experienced over the past seven days using an ordinal frequency scale with four response options, scored from 0 to 3. The total score ranges from 0 to 30, with higher scores indicating a greater likelihood of perinatal depression (1).

In the DSM-5-TR, perinatal depression is classified under major depressive disorder with the specifier with peripartum onset. The term perinatal depression includes both prenatal and postpartum depression. Symptoms can start during pregnancy or within the first four weeks after childbirth and may include persistent sadness, loss of interest in activities, changes in sleep and appetite, lack of energy, feelings of worthlessness or guilt, anxiety, irritability, difficulty concentrating, and suicidal thoughts (4).

Recent meta-analyses indicate that the prevalence of PPD among fathers is 8.8% within one year of childbirth, 9% within one month, 7.9% between one and three months, 9.2% between three and six months, and 8.4% between six and twelve months postpartum. Therefore, PPD is also a mental health problem among fathers (5). Untreated perinatal paternal depression

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negatively affects child development (6). In addition, the mean costs of untreated perinatal paternal depression for father-child dyad were estimated at £1103.51, £1075.06, and £945.03 (7).

Despite the EPDS being specifically designed to assess symptoms of postpartum depression in mothers, research indicates that the EPDS seems to be a valid and reliable tool for evaluating postpartum depression in fathers (8–11). In this sense, a recent systematic review indicates that the EPDS is effective for assessing symptoms of postpartum depression among fathers (12).

Most studies examining the psychometric properties of the Edinburgh Postnatal Depression Scale (EPDS) among fathers have primarily focused on criterion validity (12–14). These studies aimed to establish sensitivity and specificity values for various cut-off points. A recent meta-analysis recommended cut-off values between 7 and 10 for screening depression in men (12).

To date, there is limited research on the factor structure of the Edinburgh Postnatal Depression Scale (EPDS) among fathers (9–11,15), and none of these studies have been conducted within the Brazilian context. Some studies have suggested a two-factor structure for the EPDS among fathers (9), while others have identified a three-factor model (11,15). However, there is no study regarding the psychometric properties of the EPDS among fathers in Brazil.

A consideration when using a scale is its effectiveness according to the mode of application. This is because studies may use different modes of data collection, such as telephone interviews or self-administered questionnaires (16). To accommodate multiple application methods and ensure the equivalence of measurement properties, it is important to test the invariance of the Edinburgh Postnatal Depression Scale (EPDS) across different modes of application. However, to date, there are no studies available that examine the measurement invariance EPDS for fathers based on the mode of application.

Given the absence of studies evaluating the validity and reliability of the EPDS among fathers in Brazil, the aim of this study was to assess whether the EPDS is a valid and reliable tool for screening symptoms of paternal postpartum depression (PPD) in the Brazilian context. To achieve this, the psychometric properties of the EPDS were examined, focusing on its construct validity and

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reliability. Additionally, the measurement invariance of the scale across different modes of administration was evaluated.

Methods

This article analyzed data from the Birth in Brazil II survey, a study with a nationally and regionally representative sample of hospital births in Brazil, with data collection from 2021 to 2025. A total of 22,209 postpartum women were interviewed in maternity hospitals and two follow-up interviews by phone or online.

At the time of the maternity interview and at the 2-month postpartum follow-up, the woman was asked to provide contact phone numbers for the partners/fathers of the babies. These men were invited to participate in a telephone or online interview three months after childbirth. Eligible participants were those whose contact phone numbers had been provided by the postpartum women and whose babies were alive at the time of the interview (abortions, stillbirths, and neonatal deaths were excluded). Men who reported at the time of the interview that they were no longer the woman's partner were considered ineligible. At the end, this study interviewed 4,600 fathers.

Instruments

Edinburgh Postnatal Depression Scale (EPDS) was used to measure paternal PPD symptoms. The EPDS was originally developed to assess maternal PPD symptoms in the United Kingdom. It consists of 10 items, each one with a scale response with four possible options ranging from 0 to 3, resulting in a total score between 0 and 30 (1). The Brazilian Portuguese version used in this study was developed by Santos and colleagues (17).

State-Trait Anxiety Inventory-S (STAI-S) was used to assess symptoms of paternal anxiety. The State-Trait Anxiety Inventory – State Subscale (STAI-S) is a self-report questionnaire developed to measure state anxiety, which refers to a temporary emotional condition characterized by subjective feelings of tension, apprehension, nervousness, and heightened autonomic nervous system activity. It consists of 6 items, each describing how the respondent feels "right now, at this moment." Participants rate the intensity of each statement on

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a 4-point Likert scale. Higher scores indicate greater levels of state anxiety (18). This study uses a version of the STAI-S validated in Brazil (19)

The sociodemographic characteristics (macro-region, age, schooling, race, marital status), health self-assessment, mental health problems ("Do you have any chronic emotional or psychiatric problems that require medical follow-up/hospitalization?"), use of psychiatric medication ("Are you currently taking any medication for psychological or psychiatric problems?") were obtained via a structured questionnaire.

Analyses

Descriptive analyses were conducted to describe the characteristics of the sample. The construct validity and reliability of the EPDS were tested through the following steps: first, the unidimensional factor structure of the EPDS, which is the original proposed (1), was verified by confirmatory factor analysis (CFA). For this purpose, robust weighted least squares estimator (weighted least squares mean and variance - WLSMV) for parameter estimation (recommended for categorical data) and oblique rotation were used. The comparative fit index (CFI), Tucker-Lewis index (TLI) and root mean square error of approximation (RMSEA) were used to assess the adequacy of the model. The values of CFI and TLI > 0.95, and RMSEA < 0.06 were considered well-fitting models. In addition, the 90% confidence interval (90%CI) for the RMSEA was calculated and a lower limit close to 0 and an upper limit lower than 0.08 were considered appropriate (20,21).

Second, the total sample was randomly split into two groups. In one subsample, Exploratory structural equation models (ESEM) were conducted to analyze the factor structure of EPDS (22). The number of factors to be initially retained in the model was determined by parallel analysis (PA) with a random permutation of the observed data (23). The estimator, the type of rotation, and the adjustment indices used were the same as the first CFA. In addition, the item with standardized factor loads > 0.40 and not presenting a cross-load was retained in the factor model (24).

Third, the factorial model adjusted by ESEM was tested via CFA in the other subsample. In this step, the composite reliability coefficient (CR) was performed to assess the reliability of each factor of EPDS. In addition,

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convergent and discriminant factor validities were analyzed. CR and average variance extracted (AVE) are two measures of reliability that can estimate the convergent factor validity. Thus, CR and AVE per factor were estimated using the standardized factor loads of the items and their measurement errors to verify convergent factor validity. Values for CR ≥ 0.7 indicate good reliability and values between 0.6 and 0.7 are acceptable. Values for AVE ≥ 0.5 were considered adequate for convergent validity. The factor discriminant validity analysis was performed by comparing the correlation between the factors and the square root of the AVE. To be considered a good discriminant validity, the square root estimates of the AVE should be higher than the correlation between the factors (24,25). It is important to highlight that dividing the sample into exploratory and confirmatory subsamples reduces overfitting and provides more robust evidence of the stability and generalizability of the instrument's factor structure (24).

Fourth, the construct validity of the EPDS was also verified based on external variables. For this purpose, hypotheses testing (26) analyses between EPDS and anxiety symptoms (STAI-S), health self-assessment, mental health problems and use of psychiatric medication was performed by generalized linear model (GLM).. Model assumptions, including independence of observations, absence of substantial multicollinearity, and adequacy of model specification, were assessed. Generalized linear models (GLMs) were fitted using the Poisson family with a log link and robust variance estimation. To test the association between the variables, regression coefficients (β), their respective standard deviations, and p-values obtained were used. A p-value ≤ 0.05 associated with β was considered significant.

To investigate the measurement invariance of the proposed two-factor model of the Edinburgh Postnatal Depression Scale (EPDS) across different modes of questionnaire administration, a multi-group confirmatory factor analysis (MG-CFA) was performed (20). The analysis followed a stepwise procedure to test various levels of invariance, adhering to established guidelines (27,28). The process included the following sequential steps: First, we assessed configural invariance, which is the baseline model that tests whether the same factor structure is applicable across groups without imposing any equality constraints on the parameters. A good model fit at this stage

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suggests that participants in different groups understand the constructs in a similar way. Next, we analyzed metric invariance (also known as weak invariance), where factor loadings were constrained to be equal across groups. After that, we assessed scalar invariance (strong invariance), where we constrained the intercepts of the observed variables to be equal across groups, in addition to the factor loadings. Scalar invariance is essential for making meaningful comparisons of latent means between groups. Finally, we verified strict invariance by constraining the residual variances of the observed indicators to be equal across groups. This step further supports the equivalence of the measurement model (27,28).

To evaluate the adequacy of the model fit, we used several fit indices, including Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Changes in CFI (ΔCFI ≤ .01) and RMSEA (ΔRMSEA ≤ .015) served as criteria for determining invariance between nested models (29,30).

Survey weights were not incorporated into the analyses, as the study used a convenience sample. In addition, missing data were handled using the Full Information Maximum Likelihood (FIML) method. Statistical analyses were performed using MPlus version 8 and R version 3.5.1.

AI use declaration

During the preparation of this work the author(s) used a Grammarly program in order to Review the English writing of the text. After using this tool/service, the author(s) reviewed and edited the content as needed and took full responsibility for the content of the publication.

Ethics committee

The NBII study was approved by the National Research Ethics Committee (CONEP) under number 3,909,299, on March 11, 2020. The study involving the partners/fathers of the babies was submitted to the Research Ethics Committee of the National School of Public Health and approved on November 30, 2021, under number 5,136,883.

Before the start of the telephone interviews, the informed consent form was read aloud, and a copy was sent to the participant via the WhatsApp

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messaging app. In the online interviews, the informed consent form appeared before the start of the questionnaire, and completion of the questionnaire indicated the participant's agreement to take part.

Results

The sample included 4,600 participants, with the highest proportion residing in the Southeast region of Brazil (39.0%). Most participants were between 20 and 34 years old (61.9%), had secondary education (55.5%), self-identified as Mixed color (47.9%) and were employed (86.8%). Concerning health status, the most frequent self-assessment was "good" (53.8%). Most participants reported no mental health problems (96.6%) and did not use psychiatric medication (97.6%). The mean score for depressive symptoms measured by the EPDS was 3.6 (SD = 3.6), while the mean score for anxiety symptoms measured by the STAI-S was 10.7 (SD = 3.0) (Supplementary Table S1).

The original factor model (unidimensional) of the EPDS did not present adequate fit indices in CFA (RMSEA = 0.074 (90%CI = 0.069- 0.080), CFI= 0.921; TLI= 0.898). Since the original model of the EPDS did not achieve adequate fit indices, ESEM analysis was performed. The ESEM started with a 2-factor dimensional structure suggested by parallel analysis. The 2-factor model showed adequate fit indices in ESEM analysis (CFI = 0.973, TLI = 0.953 and RMSEA = 0.051; 90%CI: 0.044-0.058). Two items (Q1, Q2) showed loads >0.40 in factor 1 and eight items (Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10) in factor 2 (Table 1).

Table 1. Exploratory analyses of the paternal *EPDS* using exploratory structural equation models (ESEM): standardized loads and general adjustment estimate of the model

Item	λi1	λi2
EPDS1 - I have been able to laugh and see the funny side of things.	**0.823**	0.016
EPDS2 - I have looked forward with enjoyment to things.	**0.824**	0.015
EPDS3 - I have blamed myself unnecessarily when things went wrong.	-0.082	**0.693**

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EPDS4 - I have been anxious or worried for no good reason.	-0.092	**0.747**
EPDS5 - I have felt scared or panicky for no very good reason	0.013	**0.770**
EPDS6 - Things have been getting on top of me.	0.119	**0.500**
EPDS7 - I have been so unhappy that I have had difficulty sleeping	0.132	**0.628**
EPDS8 - I have felt sad or miserable	0.146	**0.745**
EPDS9 - I have been so unhappy that I have been crying	0.002	**0.836**
EPDS10 - The thought of harming myself has occurred to me	-0.063	**0.771**
CFI/TLI	0.973/0.953	
RMSEA (90%CI)	0.051 (0.044-0.058)	

90%CI: 90% confidence interval; λ: factor load; Φ: correlation coefficient; CFI: comparative fit index; RMSEA: root mean square error of approximation; TLI: Tucker-Lewis index.
Note: bold loads are greater than 0.40.

The 2-factor model obtained via ESEM showed adequate fit indices in CFA analysis (CFI = 0.969, TLI = 0.960 and RMSEA = 0.032; 90%CI: 0.012-0.048). Two items (Q1, Q2) comprise factor 1 and eight items (Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10) were included in factor 2. The factorial loads varied from 0.589 (item 6) to 0.853 (item 8) and the correlation between the two factors was 0.658 (F1-F2) (Table 2).

Regarding EPDS reliability, factors 1 and 2 showed adequate values of CR (0.82 and 0.90). In addition, factors 1 and 2 presented an AVE > 0.50 (0.696 and 0.533, respectively). AVE square root of factor 1 (0.834) and factor 2 (0.733) were greater than the correlation between them (0.658), indicating good discriminant validity between factors (Table 2).

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Table 2 Confirmatory factor analysis (CFA) and reliability of EPDS: standardized loads, measurement errors, and general adjustment estimates

Item	λi1	λi2	δi
Factor 1 – Anhedonia			
EPDS1 - I have been able to laugh and see the funny side of things.	0.836	-	0.302
EPDS2 - I have looked forward with enjoyment to things.	0.834	-	0.305
Factor 2 – Anxiety and depression			
EPDS3 - I have blamed myself unnecessarily when things went wrong.	-	0.628	0.606
EPDS4 - I have been anxious or worried for no good reason.	-	0.673	0.547
EPDS5 - I have felt scared or panicky for no very good reason	-	0.776	0.397
EPDS6 - Things have been getting on top of me.	-	0.589	0.653
EPDS7 - I have been so unhappy that I have had difficulty sleeping	-	0.724	0.476
EPDS8 - I have felt sad or miserable	-	0.853	0.273
EPDS9 - I have been so unhappy that I have been crying	-	0.833	0.306
EPDS10 - The thought of harming myself has occurred to me	-	0.723	0.478
AVE	-	0.696	0.533
RQ (AVE)	-	0.834	0.733
CR	-	0.82	0.90
Φ (F1-F2)		0.658	
CFI/TLI		0.978/0.971	
RMSEA (90%CI)		0.041 (0.032-0.051)	

90%CI: 90% confidence interval; δ: measurement errors; λ: factor load; Φ: correlation coefficient; AVE: average variance extracted; CFA: confirmatory factor analysis; CFI: comparative fit index; CR: composite reliability; RMSEA: root mean square error of approximation; RQ (AVE): square root of the extracted average variance; TLI: Tucker-Lewis index.

Concerning the hypothesis test (construct validity), the scores on the EPDS scale were positively correlated with paternal anxiety symptoms (STAI-S) ($\beta = 0.003$; p-value < 0.001). Fathers that declared having mental health showed higher scores on the EPDS ($\beta = 0.997$; p-value < 0.001) compared with those that did not have. In addition, the use of psychiatric medication showed association with the EPDS ($\beta = 0.807$; p-value < 0.001), fathers that use have higher scores on the EPDS compared with those who did not use it. Regarding

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health self-assessment, the better the health self-assessment (β = 0.405; p-value < 0.001), the lower the EPDS scores (Table 3).

Table 3. Hypothesis testing: associations between EPDS and anxiety symptoms, self-reported mental health problems, psychiatric medication use, and self-rated health

	EPDS	
	β	**p-value**
STAI-S	0.003	**<0.001**
Mental health problems	0.997	**<0.001**
Use of psychiatric medication	0.807	**<0.001**
Health self-assessment	0.405	**<0.001**

β: regression coefficient obtained from generalized linear model (Poisson);
EPDS: *Edinburg Postpartum Depression Scale*; STAI-S: *State-Trait Anxiety Inventory-S*
Note: in bold, p-value < 0.05

Measurement invariance was examined across modes of questionnaire administration in accordance with a sequential procedure. The configural model showed good fit, supporting equivalence of the factor structure (CFI = 0.979, TLI = 0.972, SRMR= 0.042 and RMSEA = 0.043; IC= (0.038-0.047)). Metric invariance was supported (ΔCFI = -0.008, ΔTLI =-0.006, ΔRMSEA= 0.004 ΔSRMR=0.000), indicating equality of factor loadings. Scalar invariance was also sustained (ΔCFI = 0.003, ΔTLI =0.007, ΔRMSEA= -0.005, ΔSRMR=0.000), suggesting that item thresholds are equal across groups. Finally, strict invariance was supported (ΔCFI = - 0.003, ΔTLI =0.000, ΔRMSEA= 0.000, ΔSRMR=0.003), confirming equivalence of residual variances. These results indicate that the instrument may function equivalently across groups, allowing for meaningful comparisons of both latent means and observed scores (Table 4).

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Table 4. Measurement invariance across mode of questionnaire administration of the EPDS

Models	S-Bχ 2	df	p	CFI	TLI	RMSEA (90%-CI)	SRMR	ΔCFI	ΔTLI	ΔRMSEA	ΔSRMR
Configural invariance (no constraints imposed)	346.300	68	0	0.979	0.972	0.043 (0.038-0.047)	0.042	-	-	-	-
Metric invariance (thresholds equal)	461.951	78	0	0.970	0.966	0.047 (0.043-0.051)	0.042	-0.008	-0.006	0.004	0.000
Scalar invariance (thresholds/loadings equal)	426.442	86	0	0.974	0.973	0.042 (0.038-0.046)	0.042	0.003	0.007	-0.005	0.000
Strict invariance (residual or uniqueness equal)	470.929	94	0	0.971	0.972	0.042 (0.039-0.046)	0.045	-0.003	0.000	0.000	0.003

S-Bχ2 = Satorra–Bentler scaled χ2; df = degrees of freedom; p= p-value; CFI = comparative fit index; TLI= Tucker–Lewis Index; RMSEA= root-mean-square error of approximation; SRMR= Standardized Root Mean Square Residual; ΔCFI = difference in CFI between the compared models; ΔTLI = difference in TLI between the compared models; ΔRMSEA= difference in RMSEA between the compared models; ΔSRMR = difference in SRMR between the compared models.

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Discussion

The results of this study suggest that the Edinburgh Postnatal Depression Scale (EPDS) may be a valid and reliable tool for assessing symptoms of postpartum depression (PPD) among fathers in Brazil. The analysis of construct validity revealed a factor model with two dimensions: factor 1, "anhedonia," and factor 2, "depression and anxiety." Additionally, hypothesis testing showed that the total scores of the EPDS were associated with other constructs, consistent with existing literature (31–34). Furthermore, all tested classes of measurement invariance — including configural, metric, scalar, and strict — were confirmed, indicating that the EPDS performs equally well across different methods of questionnaire administration.

The two-factor model identified in this study aligns with previous research (9,10), where the factors and their corresponding items were similar with those observed in the EPDS Italian version. Factor 1 compromises symptoms of anhedonia, which includes items 1 (laugh) and 2 (enjoyment). Anhedonia refers to the inability to experience joy or pleasure and is commonly defined as a lack of enjoyment from activities that are typically pleasurable. It is a core symptom of major depressive disorder and is often used as a criterion for diagnosing the condition. In the EPDS Italian version, this factor is analogous to factor 2 and was named “depression” (9).

The factor 2 identified comprised items 3 through 10 of the EPDS. This factor includes symptoms of anxiety, represented by items 3, 4, and 5, as well as feelings of sadness and thoughts of self-harm found in items 6 through 10. Therefore, it has been labeled “depression and anxiety.” In the Italian version, this corresponds to the first factor, which is referred to as 'distress' (9).

Factors 1 and 2 demonstrated adequate reliability (0.82 and 0.90). In addition, the AVE square root of factor 1 (0.834) and factor 2 (0.733) were greater than the correlation between them (0.658), indicating good discriminant validity between them. In other hands, this means that while both dimensions are correlated, they remain independent of each other, which supports the existence of two separate dimensions.

Although some studies have supported a two-factor structure, others have identified a three-factor solution. Studies conducted in Turkey (15) and the UK (11) identified three factors: anhedonia (items 1–2), anxiety (items 3–6), and

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depression (items 7–10), distinguishing anxiety and depression symptoms as separate dimensions. However, these studies also reported a substantial correlation between the anxiety and depression factors (11), consistent with the findings of the present study. In our sample, the three-factor model was not empirically supported, potentially because the high correlation between anxiety and depression symptoms did not support their distinction as separate factors.

Regarding the hypothesis testing, the results observed of the correlations between EPDS, and other constructs support the construct validity of the EPDS applied to fathers. In this sense, anxiety symptoms among fathers measured by the STAI-S showed a positive and significant association with the EPDS scores, indicating that higher anxiety symptoms were associated with increased levels of symptoms of depression. This aligns with previous literature showing a strong comorbidity between depression and anxiety in the perinatal period, even among fathers (34,35). Additionally, fathers with a history of mental health issues or currently using psychiatric medication scored higher on the EPDS compared to those without such a history or medication use, as reported in the literature (34). Finally, the inverse relationship observed between self-rated health and EPDS scores suggests that worse perceived health is associated with greater depressive symptomatology, further reinforcing the expected patterns of association (31). Concurrently, these results may indicate the ability of the EPDS instrument to differentiate between these groups, reinforcing the validity of the EPDS.

The measurement of configural, metric, scalar, and strict invariance according to the mode of questionnaire administration equivalence of the Edinburgh Postnatal Depression Scale (EPDS) among fathers in Brazil were supported, indicating that the instrument may operate equivalently across mode application by telephone interview and self-rated. These findings indicate that the instrument may function equivalently whether administered via telephone interview or self-report. This supports the conclusion that the underlying construct of PPD symptoms is interpreted and measured consistently across both groups, with equivalent factor structures, factor loadings, item intercepts, and residual variances. From a methodological standpoint, these results provide evidence for the validity of cross-group comparisons based on mode of administration.

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In this sense, administration-mode invariance has clinical implications, as the EPDS can be administered either through self-report or interviewer-assisted formats without compromising the comparability of scores. It also has important implications for research, where different data collection modes may be necessary across settings, populations, or study designs.

Although this study contributes to scientific research and clinical practice by indicating the effectiveness of the EPDS for assessing PPD symptoms in fathers in Brazil, it has some limitations. Since this study uses a cross-sectional design, its ability to draw causal inferences from the hypothesis test is limited. This limitation arises from the possibility of reverse causality. In addition, although the study collected data from a large national cohort, the sample may not accurately represent all Brazilian fathers; nor can the findings be generalized beyond the Brazilian population.Furthermore, participants were not randomly assigned to either the telephone interview or the self-administered mode of administration, which could introduce selection bias. Differences in participant characteristics across these groups may still affect responses, even though the findings showed measurement invariance. Another limitation is the absence of criterion validity assessment against structured clinical diagnostic interviews, which limits the extent to which the EPDS's scores can be interpreted in relation to clinical diagnoses. In addition, the use of self-report measures, which may be subject to reporting and social desirability biases, may affect the accuracy of responses. While the EPDS has been adapted for use in Brazil, its original development primarily focused on mothers. As a result, there may be gender-specific aspects of paternal PPD that the instrument does not fully capture.

This study demonstrated that the Edinburgh Postnatal Depression Scale (EPDS) may be an effective tool for measuring postnatal depression among fathers in Brazil, as it showed adequate validity and reliability. However, future research should continue to evaluate other psychometric properties of the EPDS, particularly its sensitivity and specificity for screening postpartum depression (PPD). In addition, future studies should prioritize longitudinal and cross-cultural validation to assess the stability, temporal validity, and generalizability of the instrument across different populations and contexts. This instrument could assist health professionals in identifying fathers who may be

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experiencing postpartum depression and could also contribute to future research on fathers' mental health.

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Conflicts of interest/Competing interests

The authors declare that they have no conflicts of interest.

Availability of data and material (data transparency)

Data will be available upon request to the authors.

Code availability (software application or custom code)

Code will be available upon request to the authors.

Author statement

M. Baldisserotto and M. Theme-Filha participated in the study design, data collection, statistical analyses, discussion of results, writing and revising the manuscript. Fraga, A. and Papaterra M. participated in the data analysis and discussion, writing, and reviewing the manuscript.

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Supplementary Table S1 Sociodemographic characteristics and physical and mental health condition of the participants included in the study Birth in Brazil II

Variables	Sample (n = 4600)	
	n (*)	%
Region		
North	439	9,8
Northeast	1228	27,5
Southeast	1747	39,0
South	668	14,9
Midwest	393	8,8
Age		
<20	79	1,8
20-34	2772	61,9
>35	1628	36,3
Schooling		
Primary education	870	19,4
Secondary education	2497	55,5
Higher education	1131	25,1
Race/color		
White	1465	32,6
Black	754	16,8
Brown	2154	47,9
Other	121	2,7
Employment situation		
Unemployed	593	13,2
Employee	3887	86,8
Health self-assessment		
Excellent	1543	33,6
Good	2467	53,8
Moderate/poor/very poor	580	12,6
Mental health problems		
No	4443	96,6
Yes	141	3,1
Uses psychiatric medication		
No	4470	97,6
Yes	108	2,4
	Average	**SD**
Symptoms of depression (EPDS)	3,6	3,6
Anxiety Symptoms (STAI-S)	10,7	3,0

(*) the differences in the totals of the variables are due to missing data

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