

Article

Psychometric Properties of the Online Version of the General Anxiety Disorder-7 (GAD-7): A Longitudinal Study in Pregnant and Postpartum Spanish Women

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ABSTRACT

Background: The use of online questionnaires to assess common mental disorders such as perinatal anxiety has spread due to the proliferation of Internet-based psychological interventions and research. This study analyses the validity and reliability of the online version of the Generalized Anxiety Disorder-7 (GAD-7) in a sample of pregnant and postpartum Spanish women. **Method:** A total of 3082 pregnant ($n = 1260$) and postpartum ($n = 1822$) women were recruited via the Internet and underwent three follow-up evaluations during a six-month period. **Results:** A one-factor solution was assigned by Exploratory Factor Analysis and confirmed by Confirmatory Factor Analysis for both pregnant ($CFI = 0.998$; $RMSEA = 0.035$) and postpartum ($CFI = 0.998$; $RMSEA = 0.038$) women. The one-factor model showed strict invariance across groups. Validity was confirmed by assessing correlations between GAD-7, the Edinburgh Postnatal Depression Scale, and the 10-item Posttraumatic Stress Disorder checklist at three time points. The reliability coefficient was .92 for the two groups. **Conclusions:** This study shows that the Spanish online GAD-7 version has good psychometric properties and can be used to assess anxiety symptoms during the perinatal period.

Propiedades Psicométricas de la Versión Online de la Escala de Ansiedad Generalizada (GAD-7): un Estudio Longitudinal en Mujeres Españolas Embarazadas y Puérperas

RESUMEN

Antecedentes: La proliferación de intervenciones e investigaciones psicológicas realizadas a través de internet ha fomentado la aplicación de cuestionarios online para evaluar trastornos mentales comunes como la ansiedad perinatal. Este estudio analiza la validez y fiabilidad de la versión online de la Escala de Ansiedad Generalizada (GAD-7) en una muestra de mujeres españolas embarazadas y puérperas. **Método:** 3082 mujeres embarazadas ($n = 1260$) y puérperas ($n = 1822$) fueron reclutadas por internet y seguidas durante seis meses en tres momentos de tiempo. **Resultados:** El Análisis Factorial Exploratorio aportó una solución unifactorial que se confirmó mediante Análisis Factorial Confirmatorio en embarazadas ($CFI = 0.998$; $RMSEA = 0.035$) y puérperas ($CFI = 0.998$; $RMSEA = 0.038$). Este modelo mostró invarianza estricta por grupo. La validez se confirmó evaluando las correlaciones entre GAD-7 con la Escala de Depresión Postnatal de Edimburgo y los 10 ítems de la lista de verificación del Trastorno de Estrés Postraumático en los tres momentos evaluados. El coeficiente de fiabilidad fue .92 para ambos grupos. **Conclusiones:** Este estudio muestra que la versión online en español del GAD-7 tiene buenas propiedades psicométricas y puede ser utilizada para evaluar síntomas de ansiedad durante el período perinatal.

Palabras clave:

Periodo perinatal
Evaluación online
Trastorno de ansiedad generalizada
Estudio de validez

The emergence of new technologies has opened new horizons and possibilities in the field of psychology. However, as novel digital psychological assessment tools become available, new challenges arise (Elosua et al., 2023). The use of online psychological questionnaires to assess common mental disorders, such as perinatal anxiety, has spread due to the proliferation of Internet-based psychological interventions and research (Andersson et al., 2019; Buchanan, 2003; van Ballegooijen et al., 2016). Although the application of technology-based psychological measurement tools has brought about some challenges (Elosua et al., 2023), online questionnaires have important advantages over paper-and-pencil questionnaires, as they have the potential to be low-cost, faster and less susceptible to social desirability bias (Heiervang & Goodman, 2011; Van Gelder et al., 2010). In addition, online questionnaires offer the advantage of greater perceived anonymity among respondents (Ward et al., 2014). Currently, most online psychological questionnaires have been adapted from paper-and-pencil data collection methods (van Ballegooijen et al., 2016). However, equivalence between paper-and-pencil and online questionnaires should not be assumed, and the reliability and validity of online tools need to be confirmed (American Educational Research Association; American Psychological Association; National Council on Measurement in Education, 2014; Buchanan, 2003).

One of those paper-and-pencil questionnaires used as an online questionnaire is the Generalized Anxiety Disorder-7 (GAD-7), which is one of the most widely used paper-and-pencil self-report questionnaires used to identify probable cases of generalized anxiety disorder (Spitzer et al., 2006). The GAD-7 is a seven-item, self-report questionnaire created from the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). The psychometric properties of the GAD-7 were initially tested in the primary health care setting, showing adequate psychometric properties (GAD-7 scores ≥ 10 showed a sensitivity $\geq 79\%$ and a specificity $\geq 82\%$) and a one-factor structure (O'Connor et al., 2023; Spitzer et al., 2006). These results are congruent with the theoretical model that assumes generalized anxiety disorder as a unifactorial construct that includes anxiety and worry (apprehensive expectation) (Andrews et al., 2010). Since the development of the GAD-7 scale, a multiplicity of studies based on this tool have been conducted in different settings, with different languages and populations (Donker et al., 2011; Garcia-Campayo et al., 2010; Hinz et al., 2017; Moreno et al., 2019; Nyongesa et al., 2020; Plummer et al., 2016; Ruiz et al., 2011; Sousa et al., 2015). However, few studies have been carried out to assess the psychometric properties of the online version of the GAD-7 in assessing perinatal anxiety symptoms (Vogazianos et al., 2022).

Women in the perinatal period are a population at risk, especially for common mental disorders, since the perinatal period is a challenging and vulnerable period (Leach et al., 2017). According to previous studies, the estimated prevalence of anxiety during the perinatal period is approximately 20% (Fawcett et al., 2019), which increased to 40% during the COVID-19 pandemic (Motrico et al., 2022). Anxiety during pregnancy increases the risk for other mental health complications, such as postnatal depressive symptoms (Sutter-Dallay et al., 2004). In addition, anxiety during pregnancy may lead to adverse perinatal outcomes, such as early antibiotic use; respiratory, general, and skin diseases (Beijers et al., 2010); an increased risk for preterm birth and low birth weight (Grigoriadis

et al., 2018); smaller head circumference (Grigoriadis et al., 2018); emotional problems (Rees et al., 2019); and alterations in developmental domains (e.g., cognitive and language development) (Rogers et al., 2020), to name a few. Despite these findings, anxiety most frequently remains undetected (National Institute for Health and Care Excellence, 2015), thereby imposing a significant economic burden on society and health systems (Luca et al., 2020).

The use of the GAD-7 during the perinatal period has been recommended by the National Institute for Health and Care Excellence for further assessment when women in the perinatal period receive a score ≥ 3 on the GAD-2 (National Institute for Health and Care Excellence, 2020). However, few studies have assessed the psychometric properties of the GAD-7 in pregnant women (Gong et al., 2021; Simpson et al., 2014; Soto-Balbuena et al., 2021; Zhong et al., 2015), and only a small number included postpartum women (Simpson et al., 2014; Vogazianos et al., 2022). In those studies, the GAD-7 (both, the paper-and-pencil and online versions) showed adequate internal consistency ($\alpha \geq .84$) (Gong et al., 2021; Soto-Balbuena et al., 2021; Vogazianos et al., 2022; Zhong et al., 2015); a one-factor solution structure (Gong et al., 2021; Soto-Balbuena et al., 2021; Vogazianos et al., 2022; Zhong et al., 2015); and expected relations to other variables, such as perinatal depression.

Regarding the Spanish-speaking context, none of the published studies conducted in Spain or Latin America explored the psychometric properties of the GAD-7 in postpartum women. Also, none of these studies explored the psychometric properties of the online version of the GAD-7 in pregnant and postpartum women (Soto-Balbuena et al., 2021; Zhong et al., 2015).

Establishing the psychometric properties of the online version of the GAD-7 scale for pregnant and postpartum women would enable the early and fast detection of anxiety symptoms during the perinatal period. In addition, the use of the online version of the GAD-7 would guide clinicians when further evaluation is needed. These aspects would indeed allow the amelioration of mental and physical complications associated with perinatal anxiety and facilitate the development of primary prevention mobile-based health (mHealth) interventions. The objective of this study was to analyze the reliability and validity of the online version of the GAD-7 scale in a sample of Spanish pregnant and postpartum women. Specifically, this study was aimed at: (I) obtaining validity evidence based on the internal structure of the online version of the GAD-7; (II) obtaining validity evidence based on its correlation to other variables over time (anxiety, depression, and post-traumatic stress disorders); and (III) exploring the reliability of the online version of the GAD-7 conceptualized as internal consistency.

We hypothesized that the online administered version of the GAD-7 would have a one-factor structure, would be positively associated with depression and posttraumatic stress disorder measures, and would have adequate internal consistency.

Method

Participants

A sample of Spanish pregnant and postpartum women was recruited using the following inclusion criteria: (I) age 18 years or older; (II) being pregnant or the biological mother of an infant of six months or younger; (III) living in Spain during participation in the study; and (IV) signing an informed consent to participate in

the study. All participants failing to meet the inclusion criteria were excluded from the study.

As described in the international protocol by [Motrico et al., \(2021\)](#), the representative sample size in Spain was calculated based on the number of newborns in 2020. Using G*Power program, we estimated a minimum sample size of 300 participants, considering a heterogeneity of 50%, a power of 80% to detect an effect size, and an α -level of .05. Nevertheless, a larger sample was used to improve statistical power of the analyses.

A total of 4316 participants accessed the online questionnaire and signed the informed consent form. Of them, 636 were excluded from the study because they did not fulfill inclusion criteria, and 324 because they reported erroneous pregnancy duration (> 42 weeks). All participants with missing values for the main variables studied (anxiety, depressive, and posttraumatic stress symptoms) and other errors were excluded, resulting in final sample of 3082 participants (1260 pregnant and 1822 postpartum women).

Lost to Follow-up Analyses

Of the 3082 women who participated in the study, 907 (29.4%) completed the first follow-up assessment at one month (389 pregnant; 518 postpartum women); 490 (15.9%) completed the second assessment at three months (204 pregnant; 286 postpartum women); and 336 (10.9%) completed the third follow-up assessment at six months (140 pregnant; 196 postpartum women). The main characteristics of the participants who completed each assessment are shown in Table S1 (Supplementary Material). Statistically significant differences based on age and primigravid status were observed in the characteristics of participants who completed the three-follow-up assessment, as compared to those who did not. However, no differences were found in baseline anxiety symptoms or in the level of depressive and posttraumatic stress symptoms (Table S2, Supplementary material).

Instruments

In relation to sociodemographic variables, self-report questions about age, marital status, country of birth, and primigravid status were included.

The Spanish version of the General Anxiety Disorder (GAD-7; [Spitzer et al., 2006](#)) was used ([Garcia-Campayo et al., 2010](#); [Soto-Balbuena et al., 2021](#)). This self-administered scale assesses anxiety through seven items scored on a 4-point Likert scale (from 0 = *not at all* to 3 = *nearly every day*). The total score is obtained by adding participants' responses to each item, ranging from 0 to 21 points. A high score indicates a high level of anxiety symptoms.

The Spanish version of the Edinburgh Postnatal Depression Scale (EPDS; [Cox et al., 1987](#)) was used ([Garcia-Esteve et al., 2003](#); [Vázquez & Míguez, 2019](#)). The EPDS is a 10-item self-report, 4-point Likert scale (from 0 = *not at all* to 3 = *yes, very often*). The total score ranges from 0 to 30. A high overall score indicates more depressive symptoms. Items 3, 4 and 5 of this scale form a subdimension of anxiety, with the total score ranging from 0 to 9 ([Austin et al., 2022](#)). The total score on the EPDS scale and the score on the anxiety subdimension (EPDS-3A) were considered. In relation to the total score on the EPDS scale, Cronbach's alpha coefficient (α) was .88 for the entire sample, and .89 and .88 for pregnant and postpartum women, respectively. For the EPDS-3A

score, $\alpha = .77$ for the entire sample ($\alpha = .79$ for pregnant and $\alpha = .76$ for postpartum women).

Posttraumatic Stress Disorder checklist (PTSD). A subset of 10 self-report PTSD questions included in the Coronavirus Perinatal Experiences – Impact Survey (COPE-I) ([Thomason et al., 2022](#)) were used to evaluate posttraumatic stress symptoms associated with COVID-19. This questionnaire assesses the frequency of symptoms in the last seven days, and respondents report feelings or experiences such as *feeling jumpy or easily startled* or *repeated disturbing and unwanted thoughts about the COVID-19 outbreak*. The subset of items represents each DSM-5 criterion for PTSD (two items for Cluster B, one for Cluster C, two for Cluster D, and five for Cluster E), based on a 5-point Likert scale (from 0 = *not at all* to 3 = *extremely*). The total score ranges from 0 to 40, with high scores indicating high levels of PTSD symptoms. A reliability coefficient of $\alpha = .88$ was obtained for this study ($\alpha = .88$ for pregnant and $\alpha = .88$ for postpartum women).

Procedure

The methods of this study are described in the study protocol ([Motrico et al., 2021](#)). The primary study was an international, prospective, observational cohort study involving a baseline assessment and three follow-up assessments at one, three-, and six- months (Riseup-PPD-COVID-19; Trial registration NCT04595123). In this study, only data for the Spanish population were used. The methods used have been described in detail elsewhere ([Motrico et al., 2021, 2022](#)). Data were collected via an online questionnaire using the Qualtrics® XM survey platform from June 15th to December 31st, 2020. It took about 20 minutes to complete the online data collection form. Although questionnaires were completed online, the study was coordinated by single-blind reviewers from the university. Participants were recruited through social media, networks of organizations, policy-makers and local organizations using the snowball sampling method. When participants accessed the survey link, they were presented with the study information and required to give informed consent prior to accessing the questionnaire. Participants were informed on the voluntary nature of participation and the possibility to withdraw from the study at any time. This study was approved by the relevant Ethics Committee (Ethics Protocol 1257-N-20).

Data Analysis

All data analyses were carried out with JASP 0.16.4 and R Studio 2021.09.3. Prior to primary analysis, outliers and abnormal values were explored and no cases were detected. Initially both, univariate and multivariate normality was studied using the Kolmogorov–Smirnov and the Mardia test (13.37), respectively. In none of the cases could compliance with this assumption be assumed. Descriptive analysis of GAD-7 is presented as means, standard deviation, skewness, kurtosis and the existence of floor and ceiling effects. To obtain validity evidence based on internal structure of GAD-7, pregnant ($n = 1260$) and postpartum ($n = 1822$) women were randomly divided into two subgroups. Exploratory Factor Analysis was performed in one group (EFA; n_1 pregnant = 630 and n_1 postpartum = 911), whereas the other group underwent Confirmatory Factor Analysis (CFA; n_2 pregnant = 630 and n_2 postpartum = 911). EFA was performed using the principal axis

factoring extraction and varimax rotation method in JASP software. Kaiser-Meyer-Olkin (KMO) and Bartlett's tests were performed to determine EFA adequacy. Parallel analysis was conducted to determine the number of factors to be extracted. Given the ordinal and nonnormal nature of data, CFA was performed using the robust unweighted least squares (RULS) method. Using the Lavaan library (Rosseel, 2012) of R Studio, we obtained a polychoric correlation matrix and used the following goodness-of-fit indices recommended by Alavi et al. (2020): Chi-squared statistic (χ^2); Comparative Fit Index (CFI); Non-Normalized Fit Index (NNFI); Root Mean Square Error of Approximation (RMSEA); and Standardized Root Mean Square Residual (SRMR). CFI and NNFI values > 0.90 indicated an acceptable goodness of fit (McDonald & Ho, 2002). However, Hu & Bentler (1999) recommend the use of values ≥ 0.95 . RMSEA values < 0.06 also indicated a good fit. Additionally, Factorial Invariance (FI) across groups (pregnant and postpartum women) was examined in R Studio. FI was progressively tested at different levels: configural, weak, strong, and strict. A change in CFI value ≥ 0.01 was considered evidence of non-invariance (Putnick & Bornstein, 2016). If measurement invariance was confirmed, analysis of latent mean differences was performed using the group of pregnant women as the reference group. To obtain validity evidence based on relations to other variables, Pearson correlations were calculated to explore the level of agreement between GAD-7 scores and EPDS, EPDS-3A and PTSD scores. Finally, Cronbach's alpha and McDonald's omega coefficients were calculated to assess the internal consistency of the scale (Sireci & Benítez, 2023).

Results

Descriptive Statistics

The sociodemographic characteristics of the baseline sample are shown in Table 1. Mean age of participants was 33.7 years ($SD = 4.2$). The majority of participants were married/partnered or engaged (94.9%), Spanish-born (94.8%) and primigravid (62.0%). Significant differences were found between groups according to age ($p = .005$; $d = 0.10$), marital status ($p = .031$; $d = 0.04$); and being primigravid ($p = .008$; $d = 0.05$).

Item Analysis

Descriptive statistics of participants' responses to the GAD-7 items are shown in Table 2. Considering the total sample, the items with the highest score were Item 4 ($M = 1.3$; $SD = 1.0$) and

Item 6 ($M = 1.2$; $SD = 0.9$), whereas the items with the lowest score were Item 5 ($M = 0.7$; $SD = 0.9$) and Item 7 ($M = 0.7$; $SD = 0.9$). The same results were obtained for postpartum women (Item 4 $M = 1.3$; $SD = 1.0$; Item 6 $M = 1.3$; $SD = 0.9$; Item 5 $M = 0.7$; $SD = 0.9$). However, in pregnant women, the items with the highest scores were Items 2 ($M = 1.2$; $SD = 1.0$), 3 ($M = 1.2$; $SD = 1.0$), 4 ($M = 1.2$; $SD = 1.0$) and 6 ($M = 1.2$; $SD = 0.9$). Regarding the existence of a floor and ceiling effect, a floor effect was observed for all the items, while there was no ceiling effect for any of them (less than 15% in all cases).

Evidence of Validity Based on Internal Structure

Regarding EFA, KMO (≥ 0.92) and Bartlett's tests ($p < .001$) showed adequate values, indicating the suitability of applying EFA to the datasets (pregnant women $n_i = 630$; postpartum women $n_i = 911$). Based on parallel analysis, the one-factor solution demonstrated factor loadings > 0.68 for the two groups (Table 3).

Results of CFA of the one-factor structure are shown in Table 4. Good fit indices were obtained for pregnant (χ^2 -B (14) = 82.126; CFI = 0.998, NNFI = 0.998; RMSEA = 0.035 [0.028, 0.042]; SRMR = 0.027) and postpartum women (χ^2 -B (14) = 124.683; CFI = 0.998, NNFI = 0.997; RMSEA = 0.038 [0.032, 0.044]; SRMR = 0.029). Standardized method effect weights (Figures S1 and S2, supplementary material) ranged from 0.74 (Item 6) to 0.91 (Item 4) in pregnant women, and from 0.76 (Item 7) to 0.89 (Items 3 and 4) in postpartum women.

The results of factorial invariance analysis across groups of participants (pregnant and postpartum women) are shown in Table 5. The factorial structure of the GAD-7 scale showed strict invariance (CFI = 0.998; NNFI = 0.998; RMSEA = 0.024 [0.020, 0.028]; SRMR = 0.026) across groups. In the analysis of latent mean differences, the z-score did not show statistically significant differences between pregnant and postpartum women ($z = 0.592$; $p = .554$).

In relation to the mental health variables studied (Table 6), significant differences between pregnant and postpartum women were only observed in the anxiety subdimension of EPDS (EPDS-3A: $p < .001$; $d = 0.131$), with higher scores for postpartum women. Regarding other mental health variables, no differences were observed (PTSD: $p = .379$; $d = 0.03$; EPDS: $p = .056$; $d = 0.07$ and GAD-7: $p = .542$; $d = 0.02$).

Finally, a statistically significant positive correlation was observed among the GAD-7 scores obtained in the three follow-up assessments, with a high effect size (1st and 2nd follow-up: $r = .72$; $p < .001$; 1st and 3rd follow-up: $r = .69$; $p < .001$).

Table 1
Sociodemographic Variables of the Sample at Baseline ($N = 3082$)

Variables	Total sample ($N = 3082$)	Pregnant women ($n = 1260$)	Postpartum women ($n = 1822$)	χ^2/t	p	Effect size
	N (%)	n (%)	n (%)			
Age [M (SD)]	33.7 (4.2)	33.4 (4.2)	33.9 (4.3)	-2.79	.005	0.10
Marital status						
Single/Separate/Divorced/Widowed	156 (5.1)	51 (4.1)	105 (5.8)	4.64	.031	0.04
Married/Partnered/Engaged	2896 (94.9)	1199 (95.9)	1697 (94.2)			
Spanish-born (% yes) $n = 3052$	2893 (94.8)	1196 (95.7)	1697 (94.2)	3.39	.065	0.03
Primigravid/primiparous (% yes)	1911 (62.0)	746 (59.2)	1165 (63.9)	7.09	.008	0.05

Table 2
Descriptive Statistics for the GAD-7 Items at Baseline

Items	Min-Max	M	SD	Skewness	Kurtosis	% of responses with a score of 0	% of responses with a score of 3
Total Sample (N = 3082)							
1	0-3	1.1	0.9	0.6	-0.4	27.7	9.0
2	0-3	1.2	1.0	0.4	-0.8	26.1	13.6
3	0-3	1.2	1.0	0.3	-0.9	26.5	12.9
4	0-3	1.3	1.0	0.3	-0.9	24.7	13.4
5	0-3	0.7	0.9	1.1	0.4	54.7	5.2
6	0-3	1.3	0.9	0.3	-0.7	20.8	11.6
7	0-3	0.7	0.9	1.1	0.1	53.0	6.2
Pregnant Women (n = 1260)							
1	0-3	1.1	0.9	0.6	-0.4	26.6	8.9
2	0-3	1.2	1.0	0.4	-0.8	24.8	13.5
3	0-3	1.2	1.0	0.3	-0.9	27.0	12.8
4	0-3	1.2	1.0	0.4	-0.8	25.0	12.3
5	0-3	0.7	0.9	1.1	0.3	54.0	4.8
6	0-3	1.2	0.9	0.4	-0.6	22.4	10.5
7	0-3	0.7	0.9	1.1	0.1	53.2	5.8
Postpartum Women (n = 1822)							
1	0-3	1.1	0.9	0.6	-0.4	28.5	9.1
2	0-3	1.2	1.0	0.4	-0.8	26.9	13.7
3	0-3	1.2	1.0	0.3	-0.9	26.2	13.0
4	0-3	1.3	1.0	0.3	-0.9	24.5	14.1
5	0-3	0.7	0.9	1.2	0.4	55.2	5.4
6	0-3	1.3	0.9	0.3	-0.7	19.6	12.4
7	0-3	0.7	0.9	1.1	0.1	52.9	6.5

Evidence of Validity Based on the Relationship With Other Variables

Concerning validity evidence for relations to other variables, a significant correlation was observed, with a high effect size,

between GAD-7 scores for the total sample and EDPS ($r = .79; p < .001$); EPDS-3A ($r = .70; p < .001$); and PTSD scores ($r = .81; p < .001$). Additionally, a strong correlation was found between GAD-7 scores at the three time points and EPDS (1st follow-up: $r = .65; p < .001$; 2nd follow-up: $r = .63; p < .001$; and 3rd follow-up: $r = .66; p < .001$); EPDS-3A (1st follow-up: $r = .59; p < .001$; 2nd follow-up: $r = .55; p < .001$; and 3rd follow-up: $r = .57; p < .001$); and PTSD score (1st follow-up: $r = .66; p < .001$; 2nd follow-up: $r = .66; p < .001$; and 3rd follow-up: $r = .66; p < .001$).

Table 3
Factor Loadings Derived from EFA for the GAD-7

Items	Factor loading†	
	Pregnant Women (n ₁ = 630)	Postpartum Women (n ₁ = 911)
1	0.85	0.77
2	0.86	0.75
3	0.87	0.80
4	0.85	0.81
5	0.74	0.75
6	0.78	0.73
7	0.70	0.68

Note. †Based on parallel analysis

Table 4
Fit Indices Derived from the CFA for the GAD-7

Model	χ^2 -B	df	p	CFI	NNFI	RMSEA [95% CI]	SRMR
Pregnant women (n₂ = 630)							
One-factor solution	82.126	14	<.001	0.998	0.998	0.035 [0.028, 0.042]	0.027
Postpartum women (n₂ = 911)							
One-factor solution	124.683	14	<.001	0.998	0.997	0.038 [0.032, 0.044]	0.029

Table 5
Test of Factorial Invariance Between Pregnant (n = 1260) and Postpartum (n = 1822) Women

Model	X ²	df	CFI	NNFI	RMSEA [90% CI]	SRMR	ACFI	ARMSEA
One-factor solution								
Configural	239.680	28	0.998	0.998	0.027 [0.024, 0.030]	0.021	-	-
Weak	149.702	34	0.998	0.998	0.026 [0.022, 0.030]	0.023	0.000	0.001
Strong	173.438	40	0.998	0.998	0.026 [0.022, 0.030]	0.025	0.000	0.000
Strict	160.484	47	0.998	0.998	0.024 [0.020, 0.028]	0.026	0.000	0.002

Table 6
Perinatal Mental Health Variables of the Sample at Baseline (N = 3082)

Variables	Total sample (N = 3082)	Pregnant women (n = 1260)	Postpartum women (n = 1822)	t	p	d
	M (SD)	M (SD)	M (SD)			
GAD-7 scores	7.46 (5.36)	7.39 (5.35)	7.51 (5.36)	-0.61	.542	0.022
EPDS-10 scores	9.24 (5.75)	9.00 (5.89)	9.40 (5.66)	-1.91	.056	0.070
EPDS-3A score	3.86 (2.38)	3.68 (2.39)	3.99 (2.36)	-3.57	<.001	0.131
PTSD scores	9.86 (7.51)	9.71 (4.47)	9.96 (7.53)	-0.88	.379	0.032

Similar results were obtained for pregnant and postpartum women. In all cases, higher anxiety scores (baseline assessment) were associated with higher EPDS ($r = .80$; $p < .001$ and $r = .79$; $p < .001$ in pregnant and postpartum women, respectively); EPDS-3A ($r = .71$; $p < .001$ in pregnant women and $r = .69$; $p < .001$ in postpartum women); and PTSD scores ($r = .82$; $p < .001$ in pregnant women and $r = .80$; $p < .001$ in postpartum women). In the same line, there was a significant, positive correlation between the GAD-7 scores obtained in the three follow-up assessments and EPDS, EPDS-3A and PTSD in the two groups of participants (see Table S3, Supplementary Material).

Reliability

The reliability of test scores, estimated through Cronbach's alpha and McDonald's Omega coefficients (Table 7), showed a value of .92 for the total scale ($\alpha = .92$ and $\omega = .92$ for the total sample and for pregnant and postpartum women). Item-test correlation ranged from .68 (Item 7) to .81 (Item 3) in the total sample, and from .70 (Item 7) to .82 (Item 3) and .67 (Item 7) and .80 (Item 3) in pregnant and postpartum women, respectively. In no case did the removal of an item lead to an increase in reliability coefficients.

Table 7
Item-Test Correlations and Cronbach's Alpha and McDonald's Omega Coefficients

Variables	Total sample (N = 3082)	Pregnant women (n = 1260)	Postpartum women (n = 1822)
Cronbach's alpha/McDonald's omega			
GAD Total score	.92/.92	.92/.92	.92/.92
Item – test correlation			
1	.77	.78	.76
2	.76	.78	.74
3	.81	.82	.80
4	.80	.81	.79
5	.70	.69	.71
6	.69	.68	.71
7	.68	.70	.67
Cronbach's alpha if item is deleted/McDonald's omega if item is deleted			
1	.90/.90	.91/.91	.90/.90
2	.90/.91	.91/.91	.90/.90
3	.90/.90	.90/.90	.90/.90
4	.90/.90	.90/.90	.90/.90
5	.91/.91	.92/.92	.91/.91
6	.91/.91	.92/.92	.91/.90
7	.91/.91	.91/.92	.91/.91

Discussion

To our knowledge, this is the first study to obtain different sources of validity evidence and explore the reliability of the online version of the GAD-7 in a sample of Spanish pregnant and postpartum women. The present study suggests that the online version of the GAD-7 is a valid and reliable instrument for use in Spanish pregnant and postpartum women. The results of this study were based on responses from 1260 pregnant women and 1822 postpartum women who were followed-up for six months.

In terms of psychometric properties, a one-factor solution was found through EFA and confirmed by CFA. Although studies aiming

to test the psychometric properties of the GAD-7 in pregnant and/or postpartum women are scarce, our results were consistent with those of previous studies (Soto-Balbuena et al., 2021; Vogazianos et al., 2022; Zhong et al., 2015); more specifically, the one-factor structure was found to be more suitable for the online version of the GAD-7 in Cypriot pregnant and postpartum women (Vogazianos et al., 2022) and the paper-and-pencil GAD-7 version in Spanish (Soto-Balbuena et al., 2021) and Peruvian (Zhong et al., 2015) pregnant women. In addition, our results are congruent with previous studies aimed at testing the psychometric properties of the online version of the GAD-7 in the Dutch general population (Donker et al., 2011) and Spanish primary care patients (Muñoz-Navarro et al., 2017) and with those testing the psychometric properties of the paper-and-pencil version of the GAD-7 in different settings, languages and populations (García-Campayo et al., 2010; Hinz et al., 2017; Nyongesa et al., 2020; Spitzer et al., 2006). In addition, these results are in agreement with theoretical models assuming that generalized anxiety disorder during the perinatal period is a unifactorial construct that includes anxiety and worry (apprehensive expectation) about multiple future activities or events, which are extreme or disproportionate to those events (Andrews et al., 2010). Anxiety per se, worries, and psychosomatic aspects seem to be linked. As Matthey (2016) pointed out, anxiety during the perinatal period is an “acute adjustment disorder with anxiety”.

The results derived from factorial invariance analysis across groups of participants (pregnant and postpartum women) showed strict invariance across groups. To our knowledge, previous studies did not explore factorial invariance of GAD-7 between pregnant and postpartum women.

In line with the study of Vogazianos et al. (2022), validity evidence based on relations to other variables confirmed the expected results: high levels of anxiety were associated with higher levels of depression and posttraumatic stress symptoms in pregnant and postpartum women. In addition, a significant and positive correlation was found between anxiety and the EPDS-3A score. These correlations remained stable across the three time points.

In terms of reliability evaluated as internal consistency, the Spanish online GAD-7 version showed adequate and high internal consistency for both, pregnant ($\alpha = .92$ and $\omega = .92$) and postpartum women ($\alpha = .92$ and $\omega = .92$). Thus, these results demonstrate the good reliability of the online GAD-7 version for use in Spanish pregnant and postpartum women. These indices are high, as compared to previous studies testing the psychometric properties of the online GAD-7 version in pregnant and postpartum women (Vogazianos et al., 2022) and the paper-and-pencil GAD-7 version in pregnant woman (Gong et al., 2021; Soto-Balbuena et al., 2021; Zhong et al., 2015).

This study has several strengths. The sample was composed of a large cohort of pregnant and postpartum women from different regions of Spain who were followed-up for six months and had heterogeneous sociodemographic characteristics, which contributed to its validity. In addition, the study methodology was conducted following the Standards for Educational and Psychological Testing (American Educational Research Association; American Psychological Association; National Council on Measurement in Education, 2014).

Despite its strengths, this study has some limitations. Firstly, since this study was part of a larger study by Motrico et al., (2022),

no complementary questionnaires were used to assess anxiety. Secondly, this study did not explore the utility of the online version of the GAD-7 to detect anxiety using adequate standardized cutoff values as gold standard to assess anxiety was not used. Thus, the sensitivity and specificity of the Spanish online GAD-7 version were not explored in this study. Additionally, this study may contain biases inherent to online-based psychological data collection methods (Elosua et al., 2023). Finally, as a non-probability sampling method was used for patient inclusion, the external validity of this study could be limited.

The results of this study have some implications for practice. They demonstrate that the Spanish online GAD-7 version is a useful and valuable instrument to rapidly assess anxiety symptoms in pregnant and postpartum women via the Internet. These results could have practical implications for clinical practice and research. In the clinical setting, the lack of time and limited resources available may reduce opportunities to detect anxiety during diagnostic clinical interviews. Therefore, the online GAD-7 version emerges as a useful prescreening tool for clinicians to determine whether further in-depth screening or diagnosis assessments are needed (van Ballegooijen et al., 2016). In addition, this instrument may contribute to the development of mobile-based and web-based interventions that, in turn, can contribute to creating more accessible interventions to prevent anxiety (Muñoz et al., 2018). In the field of research, the use of the online version of the GAD-7 could facilitate assessment and access to women during the perinatal period when women are difficult to reach due to other procedures or circumstances (such as during the COVID-19 pandemic). The use of this questionnaire could help save time and reduce costs (Wright, 2006).

In conclusion, the Spanish online version of the GAD-7 is a useful tool for assessing anxiety symptoms during the perinatal period. Having an adequate online instrument to assess anxiety might contribute to the rapid and early detection of anxiety; thus, it might contribute to reducing the disease burden associated with anxiety during the perinatal period and facilitate the development of mobile-based and web-based interventions. It is necessary that further studies involving the use of standardized cut-off values and comparison with a gold standard are performed. These studies should be aimed at exploring the efficacy of the online GAD-7 version in detecting anxiety in Spanish pregnant and postpartum women. In addition, future studies could use mixed methods to obtain qualitative evidence about whether the GAD-7 captures specific aspects of anxiety experienced by women during the perinatal period.

Author Contributions

Irene Gómez-Gómez: Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Writing - Review & Editing; **Sara Domínguez-Salas:** Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Writing - Review & Editing; **María F. Rodríguez-Muñoz:** Conceptualization and Writing - Review & Editing; **Carmen Rodríguez-Domínguez:** Writing - Review & Editing; **Diego Gómez-Baya:** Writing - Review & Editing; **Emma Motrico:** Conceptualization; Supervision; Funding Acquisition; Writing - Review & Editing.

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Declaration of Interests

The authors declare that there is no conflict of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author, [Sara Domínguez-Salas], upon reasonable request.

Supplementary Material

The supplementary material for this study is available online: <https://osf.io/vbu3n/>

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