

# Psychometric properties of the Hospital Anxiety and Depression Scale in Mexican pregnant women

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Received: 8 November 2019

Accepted: 27 February 2020

## Citation:

Luna, D., Castañeda-Hernández, D. V., Guadarrama-Arteaga, A. L., Figuerola-Escoto, R. P., García-Arista, A., Ixtla-Pérez, M. B., ... Lezana-Fernández, M. A. (2020). Psychometric properties of the Hospital Anxiety and Depression Scale in Mexican pregnant women. *Salud Mental*, 43(3), 137-146.

DOI: [10.17711/SM.0185-3325.2020.019](https://doi.org/10.17711/SM.0185-3325.2020.019)



## ABSTRACT

**Introduction.** Anxiety and depression in pregnant women are a public health problem. Their adequate detection requires valid and reliable instruments that are also useful for prevention and treatment. **Objective.** To identify the psychometric properties of the Hospital Anxiety and Depression Scale (HADS) in a sample of Mexican pregnant women. **Method.** The HADS was applied to 716 pregnant women between 13 and 46 years old ( $M = 26.55$ ;  $SD = 6.56$ ) attended in a public hospital in Mexico City. **Results.** With a sample of 358 participants, a parallel analysis indicated a bifactorial structure for HADS, identified by exploratory factor analysis (Factor 1: anxiety, Factor 2: depression). The factors explained 53% of the variance and correlated positively ( $r = .36$ ). The global internal consistency (Cronbach's  $\alpha = .81$ ; ordinal  $\alpha = .93$ ) and by factor (anxiety: Cronbach's  $\alpha = .79$ ; ordinal  $\alpha = .88$ ; depression: Cronbach's  $\alpha = .79$ ; ordinal  $\alpha = .87$ ) was acceptable. With data from the remaining 358 participants, a confirmatory factor analysis showed an acceptable fit for the structure detected ( $\chi^2/gf = 2.72$ ; RMSEA = .06 [IC .05, .08]; GFI = .93; AGFI = .90; TLI = .90; CFI = .92). **Discussion and conclusions.** The Hospital Anxiety and Depression Scale has adequate psychometric properties to be used in pregnant Mexican women. Its use in routine pregnancy controls would be useful to prevent, detect, and timely treat these conditions.

**Keywords:** Prenatal anxiety, prenatal depression, pregnant women, validation, internal consistency, Mexico.

## RESUMEN

**Introducción.** La ansiedad y la depresión en gestantes representan un problema de salud pública. Su adecuada detección requiere de instrumentos válidos y confiables que también sirvan para su prevención y tratamiento. **Objetivo.** Identificar las propiedades psicométricas de la Escala Hospitalaria de Ansiedad y Depresión (HADS) en una muestra de mujeres embarazadas mexicanas. **Método.** Se aplicó la HADS a 716 gestantes de entre 13 y 46 años ( $M = 26.55$ ;  $DE = 6.56$ ), atendidas en un hospital público en la Ciudad de México. **Resultados.** Con una muestra de 358 participantes, un análisis paralelo indicó una estructura bifactorial para la HADS, identificada mediante análisis factorial exploratorio (Factor 1: ansiedad, Factor 2: depresión). Los factores explicaron el 53% de la varianza y correlacionaron positivamente ( $r = .36$ ). La consistencia interna global ( $\alpha$  de Cronbach = .81,  $\alpha$  ordinal = .93) y por factor (ansiedad:  $\alpha$  de Cronbach = .79,  $\alpha$  ordinal = .88; depresión:  $\alpha$  de Cronbach = .79,  $\alpha$  ordinal = .87) fue aceptable. Con los datos de las 358 participantes restantes, un análisis factorial confirmatorio mostró un ajuste aceptable para la estructura detectada ( $\chi^2/gf = 2.72$ ; RMSEA = .06 [IC .05, .08]; GFI = .93; AGFI = .90; TLI = .90; CFI = .92). **Discusión y conclusión.** La Escala Hospitalaria de Ansiedad y Depresión posee adecuadas propiedades psicométricas para su empleo en mujeres embarazadas mexicanas. Su uso en controles rutinarios del embarazo sería útil para prevenir, detectar y atender oportunamente estos padecimientos.

**Palabras clave:** Ansiedad prenatal, depresión prenatal, mujeres embarazadas, validación, consistencia interna, México.

## INTRODUCTION

Pregnancy is a period of multiple physical and psychological changes which can cause stress (Shonkoff & Garner, 2012). When a pregnant woman fails to adapt to her condition, stress increases by enhancing the presence of mental disorders, such as anxiety and depression (Fontein-Kuipers, Nieuwenhuijze, Ausems, Budé, & de Vries, 2014), which are frequently unrecognized and therefore poorly attended (Biaggi, Conroy, Pawlby, & Pariante, 2016).

Due to the strong association between toxic stress, anxiety, and depression, some authors (Diaz et al., 2013; Brummelte & Galea, 2010), have grouped them under the maternal stress construct to refer to the spectrum of psychological problems that may occur during the pre and post-natal period (Fontein-Kuipers et al., 2014).

The maternal stress which appears during the prenatal period (PreNMS) is particularly adverse because its harmful effects occur at multiple levels, not only in the pregnant woman but also in the product. In pregnant women, PreNMS decreases the function of the immune system, which enhances the disease and the physiological changes associated with it (Coussons-Read, 2013). Likewise, it is associated with post-partum depression (Brummelte & Galea, 2010), with the increase in risk behaviors due to substance use (Bennett, Einarson, Taddio, Koren, & Einarson, 2004), the decrease in health care behaviors (Zuckerman, Amaro, Bauchner, & Cabral, 1989), and the occurrence of premature birth and spontaneous abortion (Pinto-Dussán, Aguilar-Mejía, & Gómez-Rojas, 2010). In the product, PreNMS is associated with congenital malformations and intrauterine growth restrictions (Nazer, Finschi, López-Camelo, & González, 2016), behavioral and socio-emotional disorders during childhood (Madigan et al., 2018) and adolescence (Weinstock, 2008) as are attention deficit hyperactivity disorder (Linnet et al., 2003), schizophrenia (Van Os & Selten, 1998), and depression (Watson, Mednick, Huttunen, & Wang, 1999), and the decrease in immune function, this being a condition that extends to adulthood (Entringer et al., 2008).

Given its adverse effects and frequent inattention (Aguirre, Abufhele, & Aguirre, 2016), PreNMS is considered a public health problem (Béjar-Poveda & Santiago-Vasco, 2017) and for this reason international organizations have recommended its systematic evaluation during routine pregnancy controls (Glover, 2014). In this regard, it has been observed that anxiety and prenatal depression are the most evaluated components of PreNMS (Madigan et al., 2018). International data indicate that anxiety is more frequent than depression, with a prevalence of over 27% and 13% respectively (Brunton, Dryer, Saliba, & Kohlhoff, 2015). In Mexico, the prevalence of anxiety ranges between 23% and 50% (Gómez López, Aldana Calva, Carreño Meléndez, & Sánchez Bravo, 2006; Sainz Aceves, Chávez Ureña, Díaz Contreras, Sandoval Magaña, & Robles Romero, 2013), while depres-

sion is between 6% and 67% (Sainz Aceves et al., 2013; Ceballos-Martínez et al., 2010; Berenzon, Lara, Robles, & Medina-Mora, 2013; Navarrete, Nieto, Lara, & Lara, 2019; Lara et al., 2015; Lara & Navarrete, 2012).

To assess anxiety and prenatal depression in the Mexican population, the Whooley Questions/Help Question (WQHQ) (WQHQ; Navarrete et al., 2019), the Structured Clinical Interview (SCID-I) (Lara et al., 2015), the Depression Scale of the Center for Epidemiological Studies (CES-D) (Lara & Navarrete, 2012), the Goldberg Depression and Anxiety Scale (EDAG; Sainz Aceves et al., 2013), and the Edinburgh Perinatal Depression Scale (EDPN; Ceballos-Martínez et al., 2010) have been used. Although these instruments are validated with said population, they present various inconveniences for their use. The WQHQ and the EDPN are brief, but they evaluate only depression, so it is necessary to apply another instrument to assess anxiety. SCID-I covers different psychopathological aspects in addition to depression and anxiety but requires qualified personnel for its application, which is also prolonged. CES-D and EDAG include somatic symptoms that may be confused with effects of pregnancy. In this way, the need for appropriate instruments to assess both conditions in pregnant women is evident (Aguirre et al., 2016).

An alternative to assess anxiety and depression regardless of medical aspects is the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983), a brief instrument composed of two factors, which evaluates the presence and severity of anxiety and depression using a self-response format, considering their cognitive and affective dimensions. In addition, it omits somatic aspects that could be attributed to the medical condition itself. Although there is debate about the number of factors that make up this instrument and the constructs it evaluates (Terol-Cantero, Cabrera-Perona, & Martín-Aragón, 2015; Noguera, Pérez, Barrientos, Robles, & Sierra, 2013), HADS is widely used in clinical settings with a non-psychiatric population (Terol-Cantero et al., 2015).

The HADS was originally validated with an English-speaking population. However, several studies show its adequate psychometric properties with a Spanish-speaking population (Terol-Cantero et al., 2015). In Mexico, Suárez-Mendoza et al. (2019) reported, with patients with cardiovascular diseases adequate psychometric properties for the HADS scale, which also retained its original structure. Similarly, Yamamoto-Furusho et al. (2018), with patients with inflammatory bowel disease, retained the bifactorial structure of the instrument although only 10 of the 14 items remained in their original factor. For Galindo-Vázquez et al. (2015), with cancer patients maintaining the bifactorial structure of the HADS, it was required to eliminate two items that formed a third unspecified factor. In contrast, in the study of patients with HIV infection by Noguera et al. (2013), this same scale presented a unifactorial structure of 13 items that yielded a general measure of

distress rather than an evaluation of anxiety and depression. This diversity of results is consistent with the approach of Yamamoto-Furusho et al. (2018) according to which the constructs that the HADS evaluates may be different depending on the clinical population to which it is applied and therefore said instrument needs to be validated with the target population to be evaluated.

HADS is recommended for the detection of pre-natal depression and post-partum in Mexico (Secretaría de Salud, 2014). In spite of the above, there are currently no national data on their psychometric properties in pregnant women, which guarantee the certainty of the information that this instrument shows. To this must be added the reasons that Ji et al. (2011) have exposed to substantiate the need for valid and reliable instruments that assess mental health in pregnant women. These are: 1. there is abundant evidence of adverse effects that maternal stress causes in the pregnant woman and the product; 2. there is a risk that maternal stress symptoms may be confused with signs of pregnancy; 3. there is currently limited recognition of adverse conditions in the mental health of pregnant women; 4. valid and reliable instruments are a fundamental element of any intervention that addresses the mental health of pregnant women.

Due to the above, the objective of this study was to identify the psychometric properties of HADS in a sample of Mexican pregnant women. An additional objective was to identify whether the level of anxiety and depression is associated with sociodemographic and reproductive life variables of pregnant women.

## METHOD

### Design of the study

Descriptive, transversal and instrumental study.

### Participants

There were 716 pregnant women, with an age range of 13 to 46 years ( $M = 26.55$ ;  $SD = 6.56$ ), who voluntarily agreed to participate in the study. The size of the sample satisfied the criteria for exploratory (DeVon et al., 2007) and confirmatory factor analyses (Boomsma & Hoogland, 2001). Inclusion criteria were being capable of reading and writing, not presenting any terminal or psychopathological disease currently diagnose. The exclusion criteria were the inability to personally respond to the instruments, and in case of being under age, not being accompanied by an adult responsible for them.

### Place

The data collection was carried out in a public hospital in Mexico City between August and December 2018.

## Instruments

Questionnaire that collected information on sociodemographic variables (marital status, economically paid activity, education level) and related to reproductive life variables (number of children, number of abortions, trimester of pregnancy).

The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was also used. It includes 14 items with four response options with a score of 0 to 3 that are grouped into two factors (Anxiety: impairs items; Depression: pairs items). For each factor, the score from 0 to 7 indicates absence of morbidity, 8 to 10 is a borderline case, and higher than 10 indicates a probable case of anxiety/depression. The translation of Villegas (2004) for use with Mexican hospitalized women was used, which after validation showed a reliability  $\alpha = .72$  (Anxiety) and  $\alpha = .69$  (Depression) and explained 44% variance.

## Procedure

The investigation was approved by the hospital where it was conducted. Two researchers trained to carry out the process of applying the instruments, collected the information in the waiting room and the hospitalization area. Researchers asked the pregnant women individually and independently for their collaboration in the study, explained the objectives of the research, guaranteeing the confidentiality of the data and clarified doubts.

The participants who agreed to collaborate completed the printed instruments, after signing an informed consent if they were of legal age or a letter of assent if they were minors, along with the signing of the informed consent by an adult responsible for them.

## Statistical analyses

The sample was randomly divided into two subsamples of 358 participants. With the first subsample, the mean, standard deviation, coefficient of asymmetry, and kurtosis of each item were calculated, and the Shapiro-Wilk univariate normality test was conducted. The sample adequacy was evaluated by calculating the KMO index, the Bartlett test of sphericity, and the determinant of the correlation matrix.

To avoid overestimation of factors, a parallel analysis was performed (Hayton, Allen, & Scarpello, 2004). An exploratory factorial analysis was conducted with the method of unweighted least squares with promax rotation on the polychoric correlation matrix and the corrected item-total correlation was estimated. To form the factors, at least three items were considered per factor, each item with a saturation  $\geq .40$  in a single factor (simple factor structure), corrected item-total correlation  $\geq .20$  (Cortada de Kohan, 2004), conceptual congruence item-factor, and internal consistency by factor  $\geq .70$  calculated by Cronbach's  $\alpha$  and ordinal  $\alpha$  (George

& Mallery, 2003). The global internal consistency was also evaluated with these last two coefficients. Ordinal  $\alpha$  was used because it is a measure of internal consistency suitable for ordinal response scales with five or fewer options, and because there is evidence that Cronbach's  $\alpha$  tends to underestimate the value of this measure (Elosua & Zumbo, 2008).

With the second subsample, the sample adequacy tests and a confirmatory factor analysis (maximum likelihood) were performed. It was considered as criteria to verify the goodness of fit of the model: absolute adjustment indexes, Chi-square test ( $\chi^2$ ), Chi-square ratio ( $\chi^2/df$ ); adjustments of parsimonious character, Root Mean Square Error of Approximation (RMSEA) with its confidence interval (CI); partial adjustments of absolute character, Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI); indexes of incremental adjustment, Tucker-Lewis Index (TLI), Comparative Goodness Index (CFI). Acceptable adjustment values were considered:  $\chi^2/df \leq 5$ , RMSEA  $\leq .08$ , GFI  $\geq .90$ , AGFI  $\geq .90$ , TLI  $\geq .90$ , CFI  $\geq .90$ ; and excellent fit:  $\chi^2/df \leq 2$ , RMSEA  $\leq .05$ , GFI  $\geq .95$ , AGFI  $\geq .95$ , TLI  $\geq .95$ , CFI  $\geq .95$  (Steppan, Piontek, & Kraus, 2014). With unsatisfactory adjustments, the appropriate re-specifications were made to the model that considered statistical criteria (indexes of modification and factor saturation of each item) and theoretical criteria (conceptual coherence item-factor) in order to maintain the conceptual value of the instrument (Pérez, Medrano, & Sánchez Rosas, 2013). The elaborated re-specifications were evaluated sequentially. The fit of the data to the original model of Zigmond and Snaith was also evaluated.

With the total of the sample, the prevalence of anxiety and depression in the target population was reported, according to the structure of the HADS detected. Finally, Pearson product-moment correlation tests were performed to identify the association between the score obtained by factor with age, number of children, previous pregnancies, abortions, and weeks of gestation. Similarly,  $\chi^2$  tests of independence were conducted to identify the association between the presence of anxiety and depression with the level of education, marital status, economically remunerated activity, and trimester of pregnancy. For this case, with a significant result, Pearson's standardized residuals were calculated as a post hoc test and Cramer's V as an index of the strength of association. The strength of association between variables detected by Pearson's product-moment correlation and  $\chi^2$  test was interpreted trivial with absolute values less than .10, .11-.29 low, .30-.49 medium, and  $\geq .50$  high (Ellis, 2010). The programs FACTOR v.10.8.02, SPSS v.20, and AMOS v.21 were used. A result was considered significant with a  $p \leq .05$ .

### Ethical considerations

This study was approved by the Research Committee and the Research Ethics Committee of the Hospital de la Mujer (registration HM-INV/2018:04.03) and was conducted

following the ethical standards of the Helsinki Declaration (updated to 2013) and guidelines national (SMP, 2010) and international (APA, 2002) psychological research with humans. Additionally, participants identified with risk or presence of anxiety and/or depression were referred to the hospital's clinical psychology department.

## RESULTS

### Description of the sample

Of the total sample, the highest percentage was married or in free union ( $n = 552$ ; 77.1%) followed by single women ( $n = 139$ ; 19.4%), divorced ( $n = 22$ ; 3.1%) and widows ( $n = 2$ ; .3%) represented the lowest percentage of the sample. Out of all them, 77.8% ( $n = 557$ ) had economically remunerated activities and 62.7% ( $n = 449$ ) had university studies or higher average level. 242 (33.8%) were primigravidas, the number of children at the time of completing the instruments had a range of 0 to 6 ( $Mdn = 1$ ) and that of abortions a range of 0 to 4 ( $Mdn = 0$ ). Most of them ( $n = 538$ ; 75.1%) were in the third trimester of pregnancy, while the remaining were in the second ( $n = 146$ ; 20.4%) or first ( $n = 32$ ; 4.5%).

### Exploratory factor analysis

The analysis of the HADS items is shown in Table 1. The mean and standard deviation per item ranged between .65 and 1.28, and .72 and .99 respectively, without evidence of univariate normality ( $p < .05$ ). The data were adequate to perform factor analysis, KMO index = .84, Bartlett's sphericity test = 1349.8 ( $p < .001$ ), determinant of the correlation matrix = .02. The parallel analysis indicated the presence of two factors whose explained variance was greater than the variance explained by random factors. The exploratory factor analysis showed a simple solution in which the items met the requirements of quantity, saturation, and corrected item-total correlation to conform the factors, which at the same time were adapted to the requirements of internal consistency (Table 1). The factors showed a significant positive correlation ( $p < .001$ ), and together they explained 53% of the variance. The overall internal consistency was Cronbach's  $\alpha = .81$  and ordinal  $\alpha = .93$ .

### Confirmatory factor analysis

The data were adequate to perform factor analysis, KMO index = .85, Bartlett's sphericity test = 1718.9 ( $p < .01$ ), determinant of the correlation matrix = .007. The initial model was acceptable only in some adjustment criteria (Table 2). A revision to the modification indexes indicated that the re-specification could improve the parameters evaluated. The analysis focused on the covariation of the error

Table 1

*Analysis of the items and the factor structure of the Hospital Anxiety and Depression Scale (HADS) in a sample of Mexican pregnant women*

Item	M	SD	A	K	F1	F2	$r_{(r-ic)}$
1 Me siento tensa o nerviosa	1.28	.97	.12	-1.04	.77		.57
3 Tengo una sensación de miedo, como si algo horrible fuera a suceder	.76	.93	1	-.01	.81		.59
5 Tengo mi mente llena de preocupaciones	1.08	.94	.41	-.83	.69		.54
8 Me siento como si cada día estuviera más lenta	1.13	.97	.27	-1.06	.66		.49
9 Tengo una sensación extraña, como de aleteo en el estomago	.87	.90	.68	-.53	.80		.47
10 He perdido interés en mi aspecto personal	.81	.95	.89	-.29	.51		.41
11 Me siento inquieta, como si no pudiera parar de moverme	.65	.80	.98	.13	.66		.40
13 Me asaltan sentimientos repentinos de pánico	.95	.99	.63	-.79	.74		.56
2 Todavía disfruto con lo que antes me gustaba	.75	.85	.95	.17		.76	.54
4 Puedo reírme y ver el lado divertido de las cosas	.74	.87	1.12	.60		.78	.56
6 Me siento alegre	.68	.72	.94	.89		.50	.44
7 Puedo estar sentada tranquilamente y sentirme relajada	.73	.79	.97	.54		.72	.62
12 Me siento optimista respecto al futuro	.76	.80	.94	.54		.74	.50
14 Me divierto con un buen libro, la radio o un programa de TV	.65	.82	1.29	1.21		.87	.61
<b>Properties of the factors</b>							
Autovalue					5.11	2.46	
% Explained variance					36	17	
Cronbach's $\alpha$					.79	.79	
Ordinal $\alpha$					.88	.87	
F1: Anxiety	7.57	4.84					
F2: Depression	4.34	3.44					
<b>Correlation between factors</b>							
F1: Anxiety					1		
F2: Depression					.36	1	

Notes: M = mean; SD = standard deviation; A = asymmetry; K = kurtosis; F = factor;  $r_{(r-ic)}$  = corrected item-total correlation.

terms of the items belonging to the same factor. The conceptual review of the items suggested a similarity between two pairs of them, which could have caused a sensation of redundancy in the reader. After two re-specifications performed sequentially, a model was obtained (Figure 1) with an acceptable fit (Table 2).

The evaluation of the original model of Zigmond and Snaitsh showed no acceptable adjustments (Table 2).

### Prevalence of anxiety and depression

Table 3 indicates the mean and standard deviation of the Anxiety and Depression factors for the total sample, as well

as the prevalence of these conditions according to the original cut points.

### Association of anxiety and depression with socio-demographic and reproductive life variables

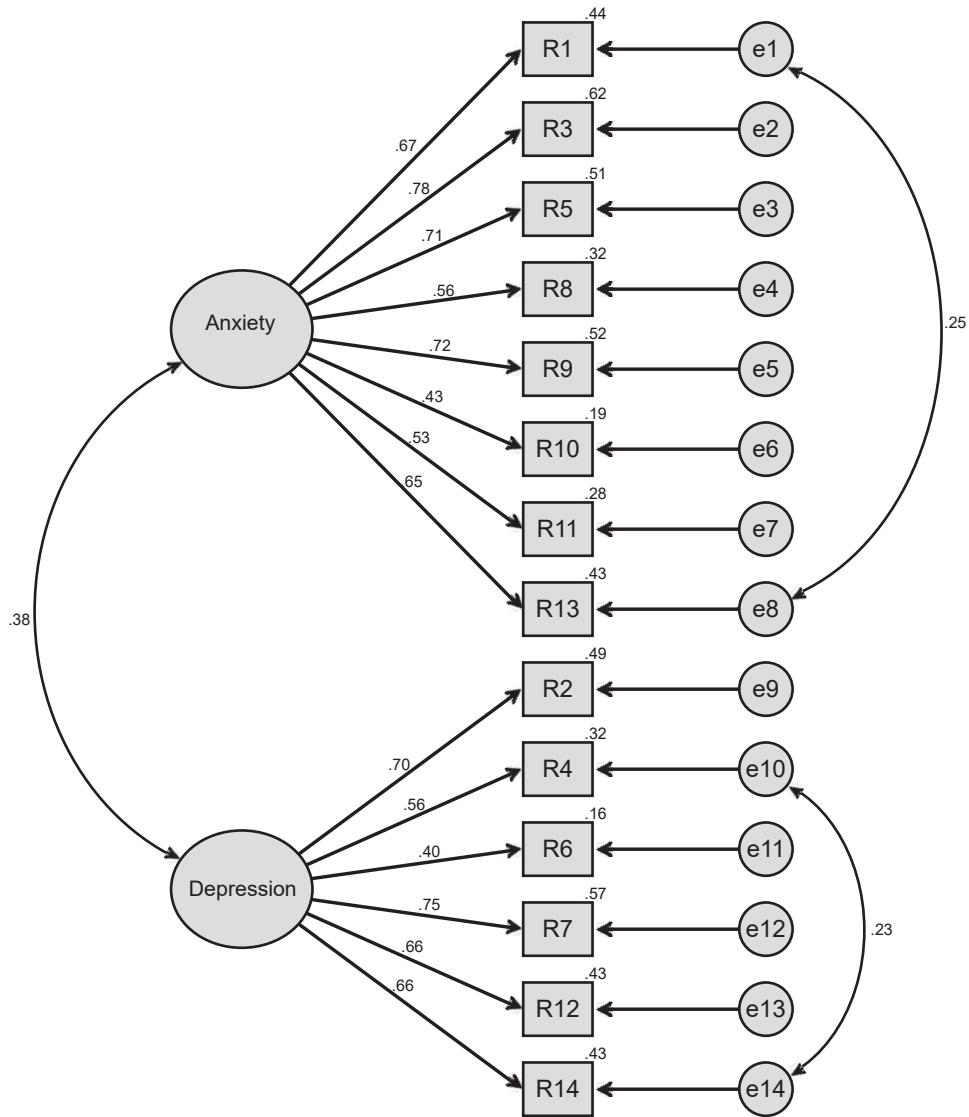
A correlation was detected between the score obtained in the Depression factor and the number of previous pregnancies ( $r = .12$ ;  $p < .01$ ). No other correlation was significant. The presence of Depression was also associated with the level of studies of the pregnant woman ( $\chi^2 = 11.87$ ;  $V = .12$ ;  $p = .01$ ). Although these associations are significant, the strength of association between variables was low in all cases.

Table 2

*Criteria of goodness of fit of the factor structure of the Hospital Anxiety and Depression Scale (HADS) in a sample of Mexican pregnant women*

	$\chi^2$	$\chi^2/gf$	RMSEA (IC)	GFI	AGFI	TLI	CFI
Originally estimated model	321.71**	3.04	.07 (.06-.08)	.92	.89	.88	.90
Re-specified model	201.27**	2.72	.06 (.05-.08)	.93	.90	.90	.92
Original model of Zigmond and Snaitsh	516.49**	6.79	.12 (.11-.13)	.82	.76	.67	.73

Note: \*\* $p < .05$



**Figure 1.** Factorial structure of the Hospital Anxiety and Depression Scale in a sample of Mexican pregnant women.

**Table 3**  
*Descriptive statistics and interpretation of the total score by factor of the Anxiety and Hospital Depression Scale (HADS) in a sample of Mexican pregnant women*

	M	SD	Absence of morbidity		Border case		Identified case	
			F	%	F	%	F	%
Anxiety	7.39	5.04	377	(52.7)	152	(21.2)	187	(26.1)
Depression	4.19	3.35	622	(86.9)	63	(8.8)	31	(4.3)

Notes: M = mean; SD = standart desviation; F = frequency.

## DISCUSSION AND CONCLUSION

The validation of the HADS scale with pregnant Mexican women shows a structure with the factors “Anxiety” and “Depression” that is consistent with its original form (Zigmond & Snaith, 1983) and with several previous versions validated with a Mexican population (c.f. Galindo-Vázquez et al., 2015; Suárez-Mendoza et al., 2019; Yamamoto-Furussho et al., 2018).

However, the factors demonstrated by the exploratory factor analysis are partially different from those of the original version. Item 8 (“Me siento como si cada día estuviera más lenta”) and item 10 (“He perdido interés en mi aspecto personal”) were placed in the Anxiety factor, even though originally both correspond to the Depression factor. In contrast, item 7 (“Puedo estar sentada tranquilamente y sentirme relajada”) originally from the Anxiety factor, was placed in the Depression factor. This conformation is similar to that obtained by Yamamoto-Furussho et al. (2018) who suggested that the difficulty in mobility (item 8) and in personal care attention (item 10) could generate anxiety in the population studied by them. This interpretation is plausible for the population reported here since there is evidence that changes in the body’s shape and the weight of the pregnant woman can lead to a negative assessment of her body image which is associated with high levels of anxiety (Nagl, Jepsen, Linde, & Kersting, 2019). On the tranquility and relaxation described in item 7, according to Yamamoto-Furussho et al. (2018) it is possible that both are associated with an emotional response of sadness. This interpretation is also consistent with the population analyzed here since there is evidence that indicates that during pregnancy the rate of physical inactivity ranges between 64.5% and 91.5% (Aguilar Cordero et al., 2014) and that there is an inverse relationship between physical activity and depressive symptoms in pregnant women (Salazar Martínez, 2016).

The foregoing suggests that the exploratory structure reported with pregnant women for the HADS scale is conceptually and empirically consistent. Additionally, the confirmatory factor analysis showed an acceptable adjustment of the structure identified. This last result is novel with respect to the validations currently available for HADS in the Mexican population. The internal consistency and the percentage of variance explained here are also acceptable and similar to those described in other validations of the HADS scale in the Mexican population (c.f., Galindo-Vázquez et al., 2015; Suárez-Mendoza et al., 2019; Yamamoto-Furussho et al., 2018). All these results provide evidence that the HADS scale is an instrument with adequate psychometric properties to assess anxiety and depression during pregnancy in the Mexican population.

The results obtained here are the opposite of those reported by Karimova and Martin (2003) and Jomeen and Martin (2004) who concluded that the HADS scale is not

an adequate instrument to assess the level of anxiety and depression in pregnant women. In the first study (Karimova & Martin, 2003), the HADS scale was applied at 12 and 34 weeks gestation to a sample of English and Uzbek primigravida women from 18 to 22 years old. Internal consistency was acceptable for both nationalities, at each time interval. However, the exploratory factor structure extracted for the total of the sample or by nationality revealed between four and five factors depending on the gestation week analyzed. In the second study (Jomeen & Martin, 2004), the HADS scale was applied to 101 English women of at least 18 years, the majority primigravida and with an average of 13.57 weeks of gestation. Although internal consistency was acceptable, the exploratory factor structure included three factors, which were not subjected to confirmatory analysis. In contrast, confirmatory factor analysis revealed that two models of three factors previously identified, one with a healthy population (Caci et al., 2003) and the other with a population with major depression (Friedman, Samuelian, Lancrenon, Even, & Chiarelli, 2001), that presented the best fit.

In the present work, most of the participants were multigravida, a characteristic associated with greater and more severe anxiety (Sujita, Shinde, Shaikh, & Khole, 2018) and a predictor of prenatal depression (Ajinkya, Jadhav, & Srivastava, 2013). The majority were in the third trimester of pregnancy, during which the occurrence of anxiety is more frequent (Silva, Nogueira, Clapis, & Leite, 2017). In addition, older gestational age has been identified as a predictor of anxiety and prenatal depression (Rezaee & Farmarzi, 2014). On the other hand, the aforementioned works included exclusively (Karimova & Martin, 2003) or mostly (Jomeen & Martin, 2004) primigravidas that were evaluated at two specific moments of the first and third trimester of pregnancy or mostly in the upper limit of the first trimester. It is possible that these variables are associated with differences in exploratory structures reported for HADS when applied in pregnant women.

It is likely that differences in the validation process, particularly during the exploratory factor analysis, are also responsible for the inconsistency between results. The studies by Karimova and Martin (2003) and Jomeen and Martin (2004) used Kaiser’s criteria (i.e., self-assessment greater than 1 to decide the number of factors to retain) instead a parallel analysis was used in this work. While with the first method there is a risk of overestimating the number of factors, with the use of the second one it is possible to identify factors whose explained variance is not higher than randomly formed factors, even if their eigenvalue is  $> 1$  and then discard them (Ledesma & Valero-Mora, 2007). In this sense, it is not currently possible to determine whether in the previous validations of the HADS scale with pregnant women, irrelevant factors were identified that caused an incongruity between said validation and the original structure of the instrument.

Using the structure detected and the cut-off points originally proposed by (Zigmond & Snaith, 1983), the prevalence of anxiety was greater than that of depression. This result is consistent with international data (Brunton et al., 2015), and national data (Gómez López et al., 2006; Sainz Aceves et al., 2013; Ceballos-Martínez et al., 2010; Berenzon et al., 2013; Navarrete et al., 2019; Lara et al., 2015; Lara & Navarrete, 2012). However, this result should be treated with caution since in the original scale there is an equivalent number of items for each condition evaluated. The results of the current validation show an imbalance in which there is one more item in the Anxiety factor and one less in the Depression factor. Under this circumstance, the absence of adjustment at the cut-off points can cause an increase in false positives for anxiety accompanied by an increase in false negatives for depression.

Although the level of studies, the number of previous pregnancies and the perception of health showed an association with the presence of anxiety or depression, the strength of association between variables was low so that this result has very limited practical implications. However, future studies must identify associated and predictive variables of these conditions whose manipulation allows them to be prevented or addressed through intervention programs.

An aspect pending investigation is whether the intensity of anxiety and prenatal depression vary depending on the moment in which the pregnant woman is (Aguirre et al., 2016). Although our data do not indicate such fluctuation, systematic studies aimed at this end have yet to be performed.

Among the strengths of this study are the heterogeneity in the age of the target population, the use of parallel analysis that increases the certainty in the number of factors that make up the HADS, and the use of confirmatory factor analysis that allows a more stringent evaluation of the identified structure. The main limitation is the absence of certainty about the cut-off point to identify cases of anxiety and depression that due to the change in the composition of the factors may not be those originally proposed. Other limitations include the absence of an external criterion for the presence of anxiety and depression in the participants, additional validation procedures, such as convergent or predictive validity, and the identification of the sensitivity and specificity of the structure detected for HADS. These limitations should be corrected in future studies.

The HADS scale has adequate psychometric properties to be used as an instrument for the evaluation of anxiety and depression in Mexican pregnant women. Its use will be useful for the adequate detection of these conditions, which will allow carrying out the pertinent actions in order to reduce or avoid the adverse effects that the pregnancy and the product cause anxiety and prenatal depression. In this regard, the routine evaluation of these conditions through

out pregnancy controls is recommended, as well as their use in combination with other evaluation strategies and subsequently intervention.

### Funding

None

### Conflicts of interest

The authors declare they have no conflicts of interest.

### Acknowledgment

We thank the Hospital de la Mujer for all their support in carrying out this study. Also to Liliana Osorio Bautista for her comments in the elaboration of this manuscript. To the anonymous reviewers for the comments made to this manuscript.

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