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Psychometric properties of the Beliefs about Medicines Questionnaire (BMQ) in Mexican adults with asthma

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Abstract

It has been identified that the treatment perception is associated with adherence behaviors and the clinical results in chronic diseases, hence the importance of having instruments to evaluate this variable. This work sought to evaluate the psychometric properties of the Spanish version of the Medication Belief Questionnaire (BMQ) in a clinical sample of 310 Mexican adults with asthma (74.2% women, *M*age= 43.98, *SD*= 14.712). Six structural models are compared, including the original and the adaptation to Spanish. The results show a better fit to a model of three correlated factors (Necessity, Concern and Harm) with an excellent fit (χ^2= 143.791. *g*= 87, *p* >.001, *CFI*= .967, *TLI*= .961, *RMSEA*= .05). Evidence of convergent and criterion validity with treatment adherence was obtained, corroborating the relationship between positive treatment perception and adherence behaviors (r= .421, *p* <.001) and negative treatment perception and non-adherence (*r*= -.223, *p* <.001). Furthermore, it was identified that patients with a positive treatment perception are more adherent than those with a negative treatment perception (χ^2= 13.645, *p* <.001, *OR*= 2.462 [*CI*= 1.518-3.991]). It is concluded that the BMQ is a reliable and valid instrument to evaluate the treatment perception in Mexican patients with asthma, in addition to being sensitive to detect adherent and non-adherent patients.
Key words: treatment perception, asthma, maintenance treatment, BMQ.

Novelty and Significance

What is already known about the topic?

- In most cross-cultural studies, the BMQ presents four relatively stable dimensions.
- The studies show limitations, for example, the use of principal component analysis (PCA) as a factor reduction method.
- Evidence indicates the possibility of improving the identification of factors, as well as the metric quality of the BMQ, especially in the case of the BMQ-General in Spanish.

What this paper adds?

- The BMQ with three related factors has a better metric fit than that of other proposed structures already analyzed in Mexican patients with asthma.
- The BMQ achieves discriminate between patients with asthma adherent and non-adherent to the maintenance treatment.

Asthma is a chronic disease involving inflammation, obstruction, sensitivity, and hyper-reactivity of the airway to various environmental elements. Genetic and environmental factors are involved in its development (Global Initiative for Asthma [GINA], 2019). The World Health Organization (WHO, 2011) reported that more than 300 million people suffer from asthma. In Mexico, about nine million people suffer this disease, with the numbers increasing (Secretaría de Salud [SSA], 2016).

One of the main problems that patients with asthma face is poor disease control, which is associated with suboptimal adherence to maintenance medication (GINA,

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2019). In the case of asthma, it has been identified that a negative treatment perception is associated with failing to adhere to treatment, as well as with adverse outcomes in disease control (Horne, Chapman, Parham, Freemantle, Forbes, & Cooper, 2013; Kosse, Koster, Kaptein, de Vries, & Bouvy, 2019; Ponieman, Wisnivesky, Leventhal, Musumeci-Szabó, & Halm, 2009; Tsianou, Giannakeas, Tsipouras, Tzallas, Skamnelos, & Christodoulou, 2017).

The negative treatment perception is conceived as an intentional cause of lack of adherence; that is, depending on treatment perception, people either choose to use or not use the drug, modify the dose, or alter the frequency of use of the treatment (Dunbar-Jacob, Schlenk, & McCall, 2012; Unni & Shiyanbola, 2016). These types of outcomes are described by the Necessity-Concerns Framework (NCF; Horne, Weinman, & Hankins, 1999). This model addresses the effects of treatment perception and conceptualizes it into two dimensions: the necessity for treatment and concern about its adverse effects. Examples of the former are believing that it is not necessary to use the maintenance medicine or that it is only necessary when symptoms are experienced. On the other hand, examples of the latter involve feelings of concern about the adverse effects that the maintenance treatment may generate (Kosse, Koster, Kaptein, de Vries, & Bouvy, 2019; Ponieman, Wisnivesky, Leventhal, Musumeci-Szabó, & Halm, 2009).

Research has shown that the NCF is one of the best models to explain and predict treatment adherence behaviors in people with asthma and other chronic diseases (Dima, Hernández, Cunillera, Ferrer, de Bruin, & ASTRO-LAB Group, 2015; Holmes, Hughes, & Morrison, 2014; Lemay, Waheedi, Al-Sharqawi, & Bayoud, 2018; Lycett, Wildman, Raebel, Sherlock, Kenny, & Chan, 2018). Specifically, it has been documented that the perception of the necessity for treatment favors adherence, while concern is a factor that decreases it (Brandstetter, Finger, Fischer, Brandl, Böhmer, Pfeifer, & Apfelbacher, 2017; Foot, La Caze, Baker, & Cottrell, 2019; Foot, La Caze, Gujral, & Cottrell, 2016). Other studies have shown that patients with a high perception of necessity and low concern for the adverse effects of treatment have a better level of adherence than in those who show both: higher levels of necessity and concern or low levels in those variables (Menckeberg, Bouvy, Bracke, Kaptein, Leufkens, Raaijmakers, & Horne, 2008; West, Borg-Theuma, & Cordina, 2018).

Together with this evidence, meta-analysis studies on NCF, which included 117 studies in more than 20 countries, with more than 27,000 patients, point out the importance of treatment perception to understand and promote adherence in chronic conditions (Horne *et alia*, 2013; Mitzel & Vanable, 2020).

In order to measure levels of necessity and concern for treatment, Horne *et alia* (1999) developed the Beliefs about Medicines Questionnaire (BMQ). The BMQ has demonstrated adequate psychometric properties in its original language and in subsequent adaptations made in different countries and for different diseases. Examples are the French adaptation of the questionnaire for patients with HIV infection and diabetes (Fall, Gauchet, Izaute, Horne, & Chakroun, 2014), the Turkish version for people with COPD, asthma (Arikan, Duman, Kargın, Ergin, Horne, Karakurt, & Eryuksel, 2018) and Behçet syndrome (Çınar, Tekgöz, Çınar, & Yılmaz, 2016), Greek for patients in primary care (Komninos, Micheli, Roumeliotaki, & Horne, 2013), the Polish version for those with cardiovascular problems (Karbownik, Jankowska-Polańska, Horne, Górski, Kowalczyk, & Szemraj, 2020), the Chinese version for patients with stroke, diabetes and rheumatoid arthritis (Wei, Chapman, Li, Li, Li, Chen, Bo, Chater, Horne, 2017), and the Spanish version for patients with diabetes, hypertension (Beléndez, Hernández,

Horne, & Weinman, 2007), and psychiatric illnesses (De las Cuevas, Rivero, Perestelo, González, Pérez, & Sanz, 2011).

In their original study, Horne *et alia* (1999) used a sample of 519 individuals who suffered from asthma, diabetes, kidney or heart disease, some psychiatric disorders, or some other chronic condition. The factorial structure was explored by using a Principal Component Analysis. The final proposed scale had 18 items distributed in two dimensions: BMQ-specific and BMQ-General, which in turn are divided into two sub-dimensions. The BMQ-Specific assesses the perception of necessity (five items, ∝= .55 to .86 depending on the condition) and concern about the adverse effects of the treatment (five items, ∝= .63 to .80). On the other hand, the BMQ-General assesses the perception of drug harm (4 items, ∝= .47 to .83) and physicians' perception of drug overuse (4 items, ∝= .60 to .80). While BMQ-specific is a very stable dimension in the different adaptations (Alsous, Alhalaiqa, Abu Farha, Abdel Jalil, McElnay, & Horne, 2017; Arıkan *et alia*, 2018; Beléndez *et alia*, 2007; De las Cuevas *et alia*, 2011; Gatt, West, Calleja, Briffa, & Cordina, 2017; Komninos *et alia*, 2013; Salgado, Marques, Geraldes, Benrimoj, Horne, & Fernandez Llimos, 2013), the dimensions of the BMQ-General, show changes in item groupings across the different adaptations, especially in the Spanish version (Beléndez *et alia*, & Weinman, 2007; De las Cuevas *et alia*, 2011). Added to this, despite the BMQ being a widely used instrument for evaluating treatment perception in patients with different chronic diseases, there are no psychometric data of reliability and validity in the Mexican population.

At the same time, it is important to note that even though the BMQ presents four relatively stable dimensions in most cross-cultural studies, most of the investigations show certain limitations. One of the most important is the use of principal component analysis (PCA) as a factor reduction method (Alsous *et alia*, 2017; Beléndez *et alia*, 2007; Brett, Hulbert-Williams, Fenlon, Boulton, Walter, Donnelly, Lavery, Morgan, Morris, Horne, & Watson, 2017; De las Cuevas *et alia*, 2011; Gatt *et alia*, 2017; Komninos *et alia*, 2013; Salgado *et alia*, 2013). The PCA is not recommended for factor exploration since it can overestimate the factorial weights, the correlations, and the number of factors (Freiberg, Stover, de la Iglesia, & Fernández, 2013; Pérez & Medrano, 2010; Reise, Waller, & Comrey, 2010; Tabachnick & Fidell, 2007).

Recent evidence indicates the possibility of improving the identification of factors, as well as the metric quality of the BMQ (Fall *et alia*, 2014; Karbownik *et alia*, 2020). For example, in the case of the BMQ-General in Spanish (Beléndez *et alia*, 2007), the item "Natural remedies are safer than drugs," appears grouped in the harm subdimension, not in the overuse subdimension (to which belongs originally), so this last dimension could be weakened.

Therefore, the aim of this study was to evaluate the psychometric properties of the BMQ in Mexican adults with asthma. We analyzed the internal structure of the instrument using confirmatory factor analysis (CFA) by comparing the following models: 1) a one-dimensional model, 2) a two-dimensional model. Dimensions: general and specific, 3) the model of adaptation to Spanish (Beléndez *et alia*, 2007), 4) the original four-factor model (Horne *et alia,* 1999), 5) the three-factor model (necessity, concern, harm-overuse) and 6) a model of three factors: necessity, concern, harm (the model in which the overuse subscale is eliminated). Identifying the best model will allow us to provide evidence of construct validity, and its relationship with treatment adherence will be studied as evidence of convergent validity and its sensitivity to detect adherents and non-adherents as evidence of criterion validity.

Method

Participants

Considering a non-probabilistic sampling of volunteer subjects, 310 patients with a confirmed diagnosis of asthma and indication of maintenance treatment participated in the present study (74.2% women, *M*age= 43.98 years, *SD*= 14.712, *Time* of diagnosis= 13.67 years, *SD*= 12.46) of the Instituto Nacional de Enfermedades Respiratorias (INER) located in Mexico City. The majority resided in the center of the country (91.3%; Mexico City and the State of Mexico) and 8.3% in other states of the Mexican Republic. 51.2% were married or lived with a partner, 70.32% had a basic or higher educational level, 29% were dedicated to the home, 25.5% were employees, and 22.9% were engaged in commerce or were professionals (22.9%).

Measures and Instruments

Sociodemographic and Clinical Data Card. We designed a set of questions to gather information on personal, family, educational, occupational data and variables related to the disease (time of evolution of the disease).

Beliefs about Medicines Questionnaire (BMQ; Horne *et alia*, 1999). BMQ Spanish version of Beléndez *et alia* (2007) was used for people with diabetes and hypertension. To adapt the BMQ for people with asthma, we changed the words insulin/pills for maintenance medication. The BMQ has 18 items distributed in two dimensions: BMQ-General and BMQ-specific. The response options for each item are defined on a five-point Likert-type scale (1= totally disagree, 5= totally agree). The internal consistency of the dimensions was acceptable (Cronbach's alpha of .66 [overuse], .72 [harm], .82 [necessity] and .73 [concern]). According to Horne *et alia* (1999), with the BMQ-Specific scores, a differential score of necessity-concern (DNP) is obtained by subtracting the result of concern from that of necessity to generate a variable where both forms of perception about the treatment are weighted (positive scores reflect a greater necessity and negative scores a greater concern). Furthermore, it is suggested that the respondents can be classified into four groups of patients using the theoretical mean score of necessity and concern: a) accepting: high necessity-low concern; b) ambivalent: high necessity and concern; c) skeptics: low necessity-high concern; and d) indifferent: low necessity and concern. It is specified that the version of the BMQ used for this study have a four-point Likert-type scale to respond to each item and not a five-point scale like the Spanish version (Beléndez *et alia*, 2007). For this, the recommendations of Hernández Baeza, Tort, Romá, and Benito (2001) were followed.

Medication Adherence-Asthma Reporting Scale (MARS-A; Horne & Hankins, 2008): Mexican version of MARS-A adapted by Lugo González and Vega Valero (2020) was used in patients with asthma based on the original version. It contains seven items that measure the frequency of intentional behaviors of non-adherence to the maintenance medication. The responses are defined on a four-point Likert-type scale (1= I always do it this way, 4= I never do it this way) with scores ranging between seven and 28. The cut-off points are seven to 25 for non-adherence and from 26 to 28 for adherence. The scale obtained a Cronbach's alpha of .85.

Design and Procedure

According to the classification of Ato, López García, and Benavente (2013) we conducted an instrumental study. Once the project was approved by the INER Research Ethics Committee, with code C47-18, the patients were captured in the waiting room of the Asthma Clinic. The instruments were applied individually, each participant was exposed to the objectives of the investigation, and instructions were provided to respond

to the evaluation instruments, emphasizing her voluntary, anonymous, and confidential participation, a prior signature of consent under information.

Data Analysis

The normality of the data was evaluated with the Kolmogorov-Smirnov-Lilliefors statistic (*KSL*, Pedrosa, Juarros, Robles, Basteiro, & García, 2015), the correlations between the items and the total test were obtained to evaluate the behavior of the items (using as cut-off point correlations greater than .20 as a good indicator; Ferrando & Anguiano, 2010).

For construct validity evidence a Confirmatory Factor Analysis (CFA) was performed with a WLSMV (Weighted Least Squares Mean and Variance Adjusted) estimation method, which is appropriate for CFA with categorical data and which is more appropriate in cases in which it is not observed multivariate normality (Muthén, 1983). In all cases where the items were the indicators, their categorical nature was taken into account by making factor analyses on the polychoric correlation matrix. The analyses were carried out using the MPlus 7.1 program (Muthén & Muthén, 2012).

The following models are compared: 1) The simplest one-factor or one-dimensional model, 2) the two-factor model: general and specific, 3) A three-factor model (necessity, concern, and specific aspects), 4) The original four-dimensional model (Horne *et alia*, 1999), 5) The four-dimensional model in its Spanish version (Beléndez *et alia*, 2007), and 6) The three-factor model: necessity, concern, harm). To evaluate the goodness of fit, the indicators with the cut-off points in parentheses that indicate an adequate fit were taken into account, namely: the chi-square statistic (χ^2, p >.05), gl, Comparative Fit Index (*CFI* >.90), the Tucker-Lewis Index (*TLI* >.90) and the root mean square error of approximation (*RMSEA* <.08, 90% CI). Once the factorial structure with the best fit was obtained, Cronbach's alpha statistics ($\propto$) and the omega coefficient (Ω) were obtained to evaluate the internal consistency of the instrument.

For convergent and criterion validity, correlation analyses (Spearman's *Rho*) were performed between the BMQ and MARS-A scores, also, they were compared (Mann-Whitney *U*) with the adherence non-adherence criterion of the MARS-A, calculating the effect size [Rosenthal's $r= z/\sqrt{(n1+n2)}$; Field, 2009] with the following cut-off points: small effect (.1$\geq$ *r* <.3); moderate effect (.3$\geq$ *r* <.5); and large effect (*r* $\geq$.5; Cohen, 1988). Finally, to compare the adherence criterion with the BMQ-Specific categories of patients (accepting, ambivalent, skeptical, and indifferent), the χ^2 statistic was used with Fisher's exact test (considering sample sizes). In addition, we calculated the effect size using the Odds Ratio (*OR*) statistic. For these analyses, the SPSS 24 program was used in its version for Windows.

RESULTS

The *KSL* statistic confirmed that the items did not behave normally (*KSL*= .194-.280, *p* <.05). In the correlations between the items and the total test, data between *r*= .08 and *r*= .65 were identified, not considering items less than .20 for subsequent analyses (Ferrando & Anguiano, 2010).

Table 1 shows the models analysed in this study, previously defined in the section on the evidence of construct validity.

Table 1. Comparison of settings for BMQ models.

Models	χ^2	gl	p	CFI	TLI	RMSEA (90% CI)
1. One factor	1555.76	134	< .001	.531	.469	.18(.18 - .19)
2. Two factors	646.728	134	< .001	.731	.693	.14 (.13 - .15)
5. Four factors– Spanish	260.631	129	< .001	.931	.918	.07 (.06 - .09)
4. Four factors–original	257.462	129	< .001	.933	.920	.07 (.06 - .06)
3. Three factors–1 general	332.736	132	< .001	.934	.923	.07 (.06 - .08)
6. Three factors-Without overuse	143.791	87	< .001	.967	.961	.05 (.04 - .07)

The data show that, in general, models 3, 4, 5, and 6 have acceptable fit indicators, however, model 6 shows the best fit for each of the indicators. Taking this last model as a reference, Table 2 shows the data of the factorial weights (λ) and reliability ($\propto$ and Ω) for each of the dimensions of the BMQ. In addition, the internal consistency was also calculated for the BMQ-specific (two subdimensions, 10 items; $\propto$= .79, Ω= .87) and the BMQ as a whole (three subdimensions, 15 items; $\propto$= .78, Ω= .94) showed acceptable reliability. Finally, the normative data for the BMQ were distributed as follows, Mnecessity= 14.48, SD= 3.57, Mconcern= 11.78, SD= 3.42, and Mharm= 9.20, SD= 3.01.

Table 2. The statistical compartment of the Specific and General BMQ and reliability analysis.

	Items	λ^{**}	$\propto (\Omega)$
Specific BMQ-Necessity	1. My health, at present, depends on my maintenance medication	.81	$\propto$=.79 (Ω= .80)
	2. My life would be impossible without my maintenance medication	.75	
	3. Without my maintenance medication I would be very uncontrolled asthma	.73	
	4. My health in the future will depend on my maintenance medication	.78	
	5. My maintenance medication prevents my asthma worse	.62	
Specific BMQ-Concern	1. Having to take my maintenance medication worries me	.60	$\propto$=.76 (Ω= .76)
	2. I sometimes worry about the consequences of my maintenance medication	.83	
	3. I don't understand many things about my maintenance medication	.54	
	4. My maintenance medication disrupts my life	.63	
	5. I sometimes worry about becoming too dependent on my maintenance medication	.86	
General BMQ-Harm	1. People who take medicines should stop their treatment for a while	.59	$\propto$=.76 (Ω= .76)
	2. Most medications are addictive	.68	
	3. Natural remedies are safer than medicines	.73	
	7. Medicines do more harm than good	.81	
	5. All medicines are toxics	.68	

Notes: λ= Factorial weights; **= p <.001

In addition to identifying the correlations between the sub-dimensions of the BMQ, Table 3 shows the relationship between perception of medications in general (harm), perception of maintenance treatment (necessity-concern), and the balance between these sub-dimensions (DNP), with the self-report of adherence to treatment behaviors (MARS-A).

Table 3. Correlation between the sub-dimensions of the BMQ and the adherence self-report (MARS).

Variables	BMQ-Specific			BMQ-General	MARS
	Necessity	Concern	NCD	Harm	Adherence
Necessity	--				
Concern	.155**	--			
NCD	.610**	-.626**	--		
Harm	-.115**	.437**	-.433**	--	
Adherence	.294**	-.233**	.421**	-.251**	--

Note: NCD: Necessity-Concern Difference. The NCD is obtained by subtracting the score of Concern subdimension from that of Necessity score

As can be seen, a perception of greater necessity for the maintenance treatment is associated in a positive and statistically significant way with the level of adherence. On the contrary, perception of harm or concern about the adverse effects of the maintenance treatment is associated negatively and statistically significantly with the level of adherence.

The criterion evidence showed that the scores obtained in the sub-dimensions of the BMQ are different depending on the adherence category in the MARS-A (See Table 4). It is shown that the score of perception of harm and concern is higher for non-adherent patients, and the scores of necessity and DNP are higher in adherent patients. Even though the results are statistically significant, the effect size is small for all the variables, with the necessity-concern difference being the variable of greatest importance.

Table 4. Adherence criterion validity tests for the BMQ.

BMQ	MARS-A	Mdn	IR	U	Z	p	r
Necessity	Adherents	16	4.50	8926.000	-2.468	.014	.14
	Non-adherents	14	5.00				
Concern	Adherents	11	4.00	8368.500	-3.220	.001	.18
	Non-adherents	12	4.50				
NCD	Adherents	4	6.00	7319.500	-4.628	.000	.26
	Non-adherents	2	4.00				
Harm	Adherents	8	4.00	8046.500	-2.660	.000	.15
	Non-adherents	10	4.00				

Notes: *IR*= Interquartile range; *Mdn*= Median); NCD= Necessity-Concern Difference; *r*= Effect size (Rosenthal's *r*).

Along the same lines, when contrasting the BMQ-Specific categories, it was possible to identify that only patients in the accepting category (high necessity-low concern) are mostly distributed in the adherence category (MARS-A). Also there was a significant association between the accepting category and the adherence category. According to the OR statistic, accepting patients are 2.4 times more adherents than non-accepting (ambivalent, skeptical, or indifferent; See Table 5).

Table 5. Criterion validity tests for the BMQ categories.

BMQ-Specific Categories	Comparison	Adherents n= 105	Non-adherents n= 205	X^2	p	Odds Ratio (CI)
Accepting	Yes	53.3 (56)	31.7 (65)	13.646	.000	2.462 (1.518-3.991)
n= 121	No	46.7 (49)	68.3 (140)			
Ambivalent	Yes	27.6 (29)	36.6 (75)	2.504	.128	.661 (.396-1.105)
n= 104	No	72.4 (76)	63.4 (130)			
Skeptical	Yes	1.9 (2)	9.3 (19)	5.962	.015	.190 (.043-.832)
n= 21	No	98.1 (103)	90.7 (185)			
Indifferent	Yes	17. 1 (18)	22.4 (46)	1.189	.302	.715 (.391-1.309)
n= 6	No	82.9 (87)	77.6 (159)			

DISCUSSION

The importance of having evidence for the validity of the BMQ lies in having an instrument that yields better measures to evaluate treatment perception since this variable is one of the main predictors of adherence behaviors in patients with asthma and other chronic diseases (Foot *et alia*, 2016; Holmes *et alia*, 2014; Horne *et alia*, 2013). In this sense, adherence and its determinants, such as the treatment perception, are relevant elements for asthma management in the national and international guidelines on asthma consider them as a fundamental pillar for controlling of this (GINA, 2019). This is one of the reasons why the BMQ has been adapted in a wide variety of countries (Alsous *et alia*, 2017; Arikan *et alia*, 2018; Çınar *et alia*, 2016; Fall *et alia*, 2014; Gatt *et alia*, 2017; Karbownik *et alia*, 2020; Komninis *et alia*, 2013; Salgado *et alia*, 2013; Wei *et alia*, 2017), not to mention the adaptations that have been made for the Spanish-speaking population (Beléndez *et alia*, 2007; De las Cuevas *et alia*, 2011; Jiménez, Vargas, García, Guzmán, Angulo, & Billimek, 2017).

The purpose of analyzing the factorial validity of the BMQ, as well as its ability to discriminate between adherent and non-adherent participants, responds to the intention of obtaining more data on its reliability and validity, that is why also comparing the different measurement models proposed so far in the different adaptations, and the original model of Horne *et alia* (1999). Furthermore, in this research, confirmatory factor analysis is carried out that takes into account non-normal behavior and in which the categorical nature of the variables is not considered.

Our study showed that the BMQ for Mexican patients with asthma is an instrument with acceptable reliability (harm ∝= .76 [Ω= .76], necessity ∝= .79 [Ω= .80] and concern ∝= .76 [Ω= .76]). Those reliability outcomes are similar to what was reported in the original study (Horne *et alia*, 1999), in the Turkish adaptation for patients with asthma and COPD (Arikan *et alia*, 2018), and in one of the most current versions for users with heart disease (Karbownik *et alia*, 2020).

Regarding the factorial structure, the BMQ-Specific remained with two factors (Arikan *et alia*, 2018; Horne *et alia*, 1999; Karbownik *et alia*, 2020). However, the overuse subdimension in the BMQ-General, was eliminated as it did not have the minimum number of items required to constitute a dimension (Lloret Segura, Ferreres Traver, Hernández Baeza, & Tomás Marco, 2014). We also found that the item content of this dimension corresponded to the perception of the behavior of the doctors (excessive prescription of medicines, excessive confidence in medicines, little time in consultation) and not to the perception of patients towards the treatments. Therefore, in the adaptation to Spanish (Beléndez *et alia*, 2007), item number three ("Natural remedies are safer than drugs") was grouped into the harm factor and not the overuse factor, which is understandable if its content is reviewed. Regarding the adjustment indices in the confirmatory factor analysis, it was found that the model obtained in this study showed better results in the χ^2 statistic, *CFI, TLI,* and *RMSEA* than the two-factor model, the three-factor model (necessity, concern, and specific aspects), the original model (Horne *et alia*, 1999) and the model in its Spanish version (Beléndez *et alia*, 2007).

In the context of convergent and criterion validity, the data showed consistency with the research findings that describe treatment perception, measured with the BMQ, as being positively correlated to adherence behaviors, and concern and harm perception levels being negatively correlated with this variable (Brandstetter *et alia*, 2017; Foot *et alia*, 2019; Foot *et alia*, 2016; Horne *et alia*, 2013). In addition, it was confirmed that adherent patients score higher in the dimension of necessity, in contrast to those of perception of harm and concern for treatment. Finally, it was shown that accepting patients have a better level of adherence, specifically 2.4 times more than non-accepting patients, that is, ambivalent, skeptical, and indifferent patients (Menckeberg *et alia*, 2008; Ponieman *et alia*, 2009; Van Steenis, Driesenaar, Bensing, Van Hulteng, Souverein, Van Dijk, De Smet, & Van Dulmen, 2014; West *et alia*, 2018).

One of the initial limitations of the study could be the adjustment made in the number of response options, from five to four, since it has been described that response variability and internal consistency may be affected by the response format (Lozano, García Cueto, & Muñiz, 2008; Simms, Zelazny, Williams, & Bernstein, 2019). Despite this, it is estimated that this format avoids a central tendency of the responses (Reyes Lagunes & García Barragán, 2008) and that they are accessible at any educational, sociodemographic, and clinical level (Lozano *et alia*, 2008).

Finally, the type of sampling would imply a series of problems since, when carried out in the hospital's outpatient clinic, it could consider a profile of patients

with characteristics of low severity of the disease or prolonged time with it, aspects that generate a different way of treatment perception (GINA, 2019; Hannane, Misane, Devouassoux, Colin, & Letrilliart, 2019). In addition to this, the sample was constituted mainly by women, which could manifest a problem given the differences in the illness and treatment perception attributed to gender (Colombo, Zagni, Ferri, Roncari, & Canonica, 2019), however, it is normal to find these distributions since the prevalence of asthma it is higher in them than in men, at least during adolescence and adulthood (GINA, 2019).

It is concluded that the BMQ for Mexican patients with asthma is a reliable instrument. However, the original four-factor structure could not be replicated. The adjustment of the confirmatory model is superior to the compared models.

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