

Spanish version of the mHealth App Usability Questionnaire (MAUQ) and adaptation to breastfeeding support apps

Running head: Translation and adaptation of the MAUQ questionnaire

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Keywords: Breastfeeding support, mHealth, questionnaire validation, usability

ABSTRACT

Introduction: Mobile applications (apps) are increasingly used during pregnancy, postpartum and lactation. To ensure the utility and usability of breastfeeding support apps, they need to be evaluated using a reliable scale specific to mHealth apps and breastfeeding users.

Objective: To translate the original the mHealth App Usability Questionnaire (MAUQ) questionnaire into Spanish and to adapt it to breastfeeding support apps environment.

Materials and Methods: The questionnaire was translated by one high English proficiency translator and was back translated. The items of the questionnaire were modified for Spanish readers and for breastfeeding users. The modified questionnaire was assessed for content validity with a panel of 5 experts and 12 users and the modified kappa statistic was used to determine the interrater agreement among the raters. The reliability of the questionnaire was assessed in a mobile application for breastfeeding support (LactApp) by 202 users. The structure of the questionnaire was validated using exploratory factor analysis.

Results: All items of the questionnaire were relevant, clear or comprehensible with content validity index values higher than 0.79. The modified kappa agreement for each item of the modified MAUQ (m-MAUQ) proved an excellent agreement ($\kappa=0.9-1.0$). Factor analysis of the m-MAUQ showed four subscales. The internal consistency of the complete questionnaire was high (Cronbach $\alpha = 0.89$).

Conclusions: The Spanish and modified MAUQ demonstrated high reliability and validity and it might be used to evaluate the usability, utility and acceptability of mHealth apps aiming to support lactating women.

Keywords: Breastfeeding support, mHealth, questionnaire validation, usability

1. INTRODUCTION

Breastfeeding is the optimal nutrition for neonates and has proved to reduce the risk of infant infection and sudden infant death syndrome. Despite this, worldwide breastfeeding rates are still low and only 2 out of 5 of the world's infants under 6 months are exclusively breastfed¹. In order to increase breastfeeding rates, women need to receive appropriate support. It has been estimated that around 60% of women cease breastfeeding earlier than they planned or wished² and one of the main reasons to stop breastfeeding includes difficulties with breastfeeding and not receiving adequate support.

Telehealth and mHealth interventions have proven to be a potential tool to improve obstetrics outcomes such as smoking cessation, control of gestational hypertension and reducing the in-person visits of high-risk obstetrics patients³. Likewise, mobile health also proved to be a useful tool to support breastfeeding and increase breastfeeding rates³⁻⁶.

Mobile Health applications must be designed to ensure good usability, they must be easy to use and be able to reach their goals efficiently. A mobile app is considered to have good usability when (1) it is efficient, (2) users have a positive opinion about the app, (3) it is easy to learn, (4) it is easy to remember even after users have not used it for a while, and (5) has a low error rate⁷. mHealth apps for breastfeeding support must be evaluated for usability to ensure the utility of the tool. Several usability scales have been proposed to evaluate the usability of mobile applications or general software systems and not necessarily mobile health applications such as the mobile app rating scale⁸, the user version of the mobile app rating scale⁹, the System Usability Scale (SUS)¹⁰, Post-Study System Usability Questionnaire (PSSUQ)¹¹, and Health IT Usability Evaluation Scale (Health ITUES)¹². However, those scales are not suitable for evaluating mHealth

apps since they were not developed to assess mHealth apps specifically. In this context, a new usability scale for evaluating the validity specifically of mHealth apps was developed, the mHealth App Usability Questionnaire (MAUQ) which evaluates the ease of use, interface, satisfaction, and the usefulness of mHealth apps to the end users¹³. The MAUQ has been translated to Malay¹⁴ and Chinese¹⁵ and the original questionnaire has also been adapted to an eye donation promotion system app¹⁶. But no literature has found reporting translated version of the questionnaire in Spanish and further adapted to the maternity and breastfeeding domain. In this work, we aimed to translate the original MAUQ questionnaire into Spanish and adapt it to the breastfeeding support apps environment.

2. MATERIALS AND METHODS

2.1. LactApp

LactApp is a free mobile application developed to support breastfeeding¹⁷⁻¹⁹. The main functionality of LactApp is to provide personalized answers to breastfeeding consultations through a self-administered questionnaire. The algorithm is based on 48 decision trees and includes topics related to breastfeeding, motherhood, and maternal and child health. The answers provided by the app are supported by scientific evidence and up-to-date official healthcare guidelines. Personalized responses include messages to seek professional medical help when needed.

LactApp also offers other breastfeeding tracking functionalities, such as child growth tracking, child bowel movements, and breastfeeding tracker. It is also possible to ask questions through a live chat function, conducted by breastfeeding experts from the LactApp team.

2.2. MAUQ Questionnaire

The mHealth App Usability Questionnaire (MAUQ) was first developed by Zhou et al. 2019¹³. The authors developed a questionnaire for interactive mHealth apps and for standalone ones. The difference between these two types of apps is the level of interactivity: In interactive mHealth apps, users can communicate, send and receive information from their health care provider or doctor, whereas in standalone mHealth apps, the users collect or enter health information without interacting with the health provider.

According to these definitions, LactApp is a standalone mHealth app, so we have translated and adapted the specific MAUQ for standalone apps to the LactApp environment.

The original questionnaire consisted of 18 items with 3 subscales. The overall Cronbach's alpha coefficients were 0.847 for the subscale “Ease of use”, 0.908 for “Interface and satisfaction”, and 0.717 for “Usefulness” which indicated strong internal consistency of the questionnaire.

The questionnaire uses a 7-point Likert scoring system: 7 (strongly agree), 6 (agree), 5 (somewhat agree), 4 (neither agree nor disagree), 3 (somewhat disagree), 2 (disagree), and 1 (strongly disagree). The questionnaire score is the total score of each item divided by the number of items. The closer the value is to 7, the greater the usability of the mHealth app.

2.3. Questionnaire translation, cross-cultural adaptation and fitting into the breastfeeding support app environment

We first contacted the author of the original questionnaire to ask for permission to translate and adapt the questionnaire to women and breastfeeding users.

The original MAUQ questionnaire for standalone mHealth app was translated into Spanish using the healthcare translation guidelines and cross-cultural adaptation to reach equivalency between the original and translated versions²⁰.

The questionnaire was first translated by one high English proficiency translator. Then the back translation was verified by translating the Spanish version to English. Then, the research group compared the translated version with the original questionnaire and made modifications to make the questionnaire more understandable to Spanish readers and to breastfeeding users.

2.3.1. Expert's and user's evaluation

A panel of experts including two researchers with expertise in scale validation, one lactation consultant, one senior software engineer, and one product analyst rated if each item was relevant to the usability of the app, was clear and concise and ambiguous. The experts score the items with “Yes”, “No” and “Partly”. They were also asked to write suggestions to improve the items if required.

The questionnaire was then modified according to the experts' suggestions and was further pilot tested by 12 users that were also asked to rate each item if it was relevant to the usability of the app, clear and concise, and ambiguous using the same scale. Users also provided suggestions if needed.

2.4. Validation of the modified MAUQ

2.4.1. Content validity and reliability

Content validation aims to assess the relevancy and the clarity of each item of the translated and modified questionnaire. Content validity was performed with the evaluation of experts and users that score each item in terms of relevancy, clarity, and understandability.

Item-level content validity index (I-CVI) was calculated as follows:

$$I-CVI= A/N$$

Where A is the number of raters that were in agreement that the item was relevant, clear, or unambiguous and N is the total number of experts²¹.

Accepted values of item-level content validity index was above 0.79.

Agreement between the 5 experts and the 12 users was determined using the modified kappa statistic which is a consensus index of inter-rater agreement that adjusts for chance agreement²¹. Then, first, it is necessary to measure the probability of chance agreement (Pc) using the following formula²¹:

$$Pc=[(N!/A!)(N-A)!]*0.5^N$$

Kappa was then calculated using the following formula:

$$\kappa =(item-level\ content\ validity\ index-Pc)/(1-Pc)$$

Values of kappa >0.74 are considered excellent, values between 0.60 and 0.74 as good, and between 0.40 and 0.59 as fair²².

2.4.2. Design, setting, and participants

The modified MAUQ (m-MAUQ) was validated in a prospective cross-sectional survey design including 227 LactApp users.

Participants were recruited through a campaign on social media and were asked to fill out a form that included sociodemographic data and the m-MAUQ to evaluate LactApp's usability.

The inclusion criteria were women older than 18 years who ever used LactApp.

Incomplete surveys were removed from the analysis and data from 202 participants were included. The survey was completely anonymous and participants gave their consent to participate in the study through the online form.

The study was approved by the deontological ethic committee of the University Jaume I (CD/77/2022). Moreover, this study followed the Spanish Organic Law 3/2018, of

December 5, on the Protection of Personal Data and guarantee of digital rights.

Registration in LactApp requires users to accept Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 regarding the protection of individuals with respect to the processing of personal data and the free circulation of these data (General Regulation of Data Protection).

2.5. Data analysis

Data was entered into Microsoft Excel and all the statistical analysis was performed in R (version 3.6.2).

The factorability of the data was assessed before performing the Exploratory Factor Analysis²³. The Kaiser-Meyer-Olkin (KMO) index was used to evaluate sampling adequacy and Bartlett's test of sphericity was used to evaluate the distribution of the participant's responses and to confirm the applicability of the factor analysis. The number of factors was determined by looking into the scree plot of the successive eigenvalues and using parallel analysis. Parallel analysis is a technique that compares the scree of factors of the observed data with that of a random data matrix of the same size as the original.

Exploratory factor analysis was then performed using Principal Components Analysis with Varimax Rotation.

To assess the internal consistency of the subscales and the total scale, Cronbach's alpha was computed. The interpretation values are: Excellent > 0.9, Good= 0.8-0.9, Acceptable = 0.7-0.8, Questionable = 0.6-0.7, Poor= 0.5-0.6 and Unacceptable < 0.5 unacceptable^{24,25}.

Bi-variate analysis (t-test for continuous variables or Chi-squared for categorical variables) were performed to assess the effect of the demographical data of the participants on the scores of the m-MAUQ.

3. RESULTS

3.1. Content validity of the translated and modified questionnaire

Table 1 shows the original and the modified items of the questionnaire and the content validity index and the modified kappa agreement values of each item of the m-MAUQ. All items were relevant, clear, or comprehensible with content validity index values higher than 0.79.

The content validity index (CVI) for the relevancy and clarity of the m-MAUQ was 0.984 for both characteristics, and the face validity for understandability was 0.912. Thus, the items of the m-MAUQ are relevant, clear, and understandable for the target users according to the CVI threshold of 0.79¹⁸. The modified kappa agreement for each item of the m-MAUQ proved an excellent agreement ($\kappa=0.78-1.02$).

The panel of experts recommended not to include item 8 (“The app adequately acknowledged and provided information to let me know the progress of my action”) since it was not suitable for the LactApp environment and caused confusion, thus this item has been removed from the questionnaire.

Table 1. The modified MAUQ questionnaire for breastfeeding support mHealth apps and the content validity and modified kappa agreement of each questionnaire item in terms of relevancy, clarity and understandability by 5 experts and 12 app users (total n= 17).

Item	Original MAUQ items	English version of modified MAUQ items ^a		Item-level content validity index ^b	Modified kappa ^c
I1	The app was easy to use	The app was easy to use	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9
I2	It was easy for me to learn to use the app	It was easy for me to learn to use the app	Item relevancy	0,9	0,9
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9
I3	The navigation was consistent when moving between screens	The navigation was consistent when moving between screens	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9
I4	The interface of the app allowed me to use all the functions (such as entering information, responding to reminders, viewing information) offered by the app	The interface of the app allowed me to use all the functions (such as consult on breastfeeding topics, use trackers, use the tests and personalized plans, access the live chat, or play the audiovisual content).	Item relevancy	1,0	1,0
			Item clarity	0,9	0,9
			Item understandability	0,9	0,9
I5	Whenever I made a mistake using the app, I could recover easily and quickly	Whenever I made a mistake using the app, I could recover easily and quickly	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9
I6	I like the interface of the app	I like the interface of the app	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0

			Item understandability	0,9	0,9
I7	The information in the app was well organized, so I could easily find the information I needed	The information in the app was well organized, so I could easily find the information I needed	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9
I8	The app adequately acknowledged and provided information to let me know the progress of my action.	The app adequately acknowledged and provided information to let me know the progress of my action.	Item relevancy	0,9	0,9
			Item clarity	0,9	0,9
			Item understandability	0,8	0,8
I9	I feel comfortable using this app in social settings	I feel comfortable using this app in social settings such as public transport, supermarket, bar, restaurant, park, theater, etc.	Item relevancy	0,9	0,9
			Item clarity	0,9	0,9
			Item understandability	0,8	1,0
I10	The amount of time involved in using this app has been fitting for me	The amount of time involved in using this app has been fitting for me	Item relevancy	0,9	0,9
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9
I11	I would use this app again	I would use this app again	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9
I12	Overall, I am satisfied with this app	Overall, I am satisfied with this app	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9
I13	The app would be useful for my health and well-being	The app would be useful for my health and well-being	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9

I14	The app improved my access to healthcare services	Using this app I felt supported in my breastfeeding experience.	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9
I15	The app helped me manage my health effectively	The app helped me manage my breastfeeding effectively	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0
			Item understandability	1,0	1,0
I16	This app has all the functions and capabilities I expected it to have	This app has all the functions and capabilities I expected it to have	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9
I17	I could use the app even when the Internet connection was poor or not available	I could use the app even when the Internet connection was poor or not available	Item relevancy	0,9	0,9
			Item clarity	0,9	0,9
			Item understandability	1,0	1,0
I18	This mHealth app provides an acceptable way to receive healthcare services, such as accessing educational materials, tracking my own activities, and performing self-assessment	This mHealth app provides an acceptable way to receive healthcare services, such as accessing reliable information about breastfeeding, the tracking of feedings, my child's weight and height, and my child's bowel movements, as well as access to breastfeeding education materials	Item relevancy	1,0	1,0
			Item clarity	1,0	1,0
			Item understandability	0,9	0,9

^aThe modified questionnaire has been only validated in Spanish

^bItems with a content validity index >0.79 indicates that the item are relevant, clear or comprehensible

^ckappa interpretation: Excellent= $\kappa > 0.7$, Good= $0.6 \leq \kappa \leq 0.74$, and Fair= $0.40 \leq \kappa \leq 0.5$

3.2. Structural validation of the modified MAUQ

3.2.1. Demographic characteristics of the study participants

The age of most of the participants ranged from 25 to 44 years (n=199, 98%), most of them (72%, n=146) had one child, 89.6% (n=181) of the women were currently breastfeeding and for most of them was their first breastfeeding experience (74.6%, n=150). Most of the women exclusively breastfed their infant (85%, n=153) and the age of the major part of the nursing infants ranged from 15 days to 12 months (30.9%, n=56 15 days to 3 months; 27.1%, n=49 4 to 6 months; 22.7%, n=41 7 to 12 months) .97% of the participants were Spanish (n=197), most of them had a high level of education (89.1%, n=180), were middle class (93%, n=187) and lived as a couple (99%, n=199). 39.8% (n=80) of the participants were employed and the same amount were on maternity leave, and 20% (n=41) were not working since they were either unemployed or on leave of absence (Table 2).

Table 2. Demographic characteristics of the

Characteristic		Frequency (n)	%
Age	18-24 years	1	0.5
	25-34 years	98	48.8
	35-44 years	101	50.2
	45-54 years	1	0.5
	>55 years	0	0.0
Number of born children	0	2	1.0
	1	146	72.3
	2	49	24.3
	3	5	2.5
Number of nursing infants	0	21	10.4
	1	175	86.6
	2	6	3.0
Age of the nursing infant	0-15 days	2	1.1
	15 days- 3 months	56	30.9
	4-6 months	49	27.1
	7-12 months	41	22.7
	13-18 months	18	9.9
	19-24 months	5	2.8
	2-3 years	9	5.0
	More than 3 years	1	0.6

Lactation	Exclusive Breastfeeding*	153	85.0	
	Mixed feeding	27	15.0	
	Formula feeding	0	0	
Number of lactations	0	4	2.0	
	1	150	74.6	
	2	41	20.4	
	3	5	2.5	
	4	1	0.5	
Nationality	Spain	197	97.5	
	Argentina	2	1.0	
	Colombia	2	1.0	
	Italia	1	0.5	
	Rest of countries	0	0.0	
Home country	Spain	192	95.0	
	United Kingdom	3	1.5	
	Germany	2	1.0	
	Andorra	1	0.5	
	Colombia	1	0.5	
	France	1	0.5	
	Portugal	1	0.5	
	Sweden	1	0.5	
	Level of education	Primary studies	2	1.0
		Secondary studies	20	9.9
University and higher education		180	89.1	
Social class	Working or lower class	12	6.0	
	Middle class	187	93.0	
	Upper class	2	1.0	
Employment	Employed	80	39.8	
	Unemployed	20	10.0	
	Maternity leave	80	39.8	
	Leave of absence	21	10.4	
Lives as a couple	Yes	199	99.0	
	No	2	1.0	
	No, lives with family or friends	0	0.0	

*Including tandem breastfeeding

3.2.2. Exploratory factor analysis (EFA) and internal consistency

Most responses were skewed to the right, with the majority of participants responding “extremely strongly agree” and “strongly agree” on most of the items, only one item was not skewed and most participants responded “Neither agree nor disagree”.

The KMO measure of sampling adequacy values was 0.89 and Bartlett's test of sphericity achieved statistical significance (chi-square = 1725.66, $p < 0.001$), indicating

that the data were suited for factor analysis. Factor analysis of the m-MAUQ showed four subscales (Table 3) and were labeled “Satisfaction and usefulness” (5 items), “Ease of use” (6 items), “Access to the information and errors” (3 items), and “Convenience of use” (3 items). The internal consistency of the complete m-MAUQ was high ($\alpha = 0.89$). Cronbach's alpha for the four subscales “Ease of use”, “Satisfaction and usefulness”, “Access to the information and errors”, and “Convenience of use” was 0.85, 0.87, 0.58, and 0.58 respectively.

The final m-MAUQ in Spanish for breastfeeding support apps can be viewed in supplementary material.

Table 3. Exploratory factorial analysis

	English version of modified MAUQ items ^a	Factor loadings				Communities	uniqueness
		1	2	3	4	h^2	u^2
<i>Satisfaction and usefulness</i>							
I12	Overall, I am satisfied with this app	0.54	0.45	0.13	0.42	0.68	0.32
I13	The app would be useful for my health and well-being	0.66	0.15	0.02	0.35	0.57	0.43
I14	Using this app I felt supported in my breastfeeding experience.	0.78	0.16	0.15	0.18	0.69	0.31
I15	The app helped me manage my breastfeeding effectively	0.74	0.27	0.2	0.2	0.7	0.3
I16	This app has all the functions and capabilities I expected it to have	0.52	0.42	0.23	0.26	0.57	0.43
<i>Ease of use</i>							
I1	The app was easy to use	0.25	0.78	0.09	0.03	0.69	0.31
I2	It was easy for me to learn to use the app	0.13	0.78	-0.01	0.19	0.65	0.35
I3	The navigation was consistent when moving between screens	0.05	0.62	0.33	0.11	0.5	0.5
I4	The interface of the app allowed me to use all the functions (such as consult on breastfeeding topics, use trackers, use the tests and personalized plans, access the live chat, or play the audiovisual content).	0.16	0.49	0.28	0.08	0.35	0.65
I6	I like the interface of the app	0.23	0.61	0.2	0.18	0.5	0.5
I7	The information in the app was well organized, so I could easily find the information I needed	0.18	0.66	0.12	0.24	0.54	0.46
<i>Access to the information and errors</i>							
I5	Whenever I made a mistake using the app, I could recover easily and quickly	0.02	0.22	0.62	0.18	0.46	0.54
I17	I could use the app even when the Internet connection was poor or not available	0.06	0.07	0.41	0.03	0.18	0.82

	This mHealth app provides an acceptable way to receive healthcare services, such as accessing reliable information about breastfeeding, the tracking of feedings, my child's weight and height, and my child's bowel movements, as well as access to breastfeeding education materials	0.37	0.12	0.58	0.13	0.5	0.5
I18	<i>Convenience of use</i>						
	I feel comfortable using this app in social settings such as public transport, supermarket, bar, restaurant, park, theater, etc	0.2	0.06	0.16	0.57	0.39	0.61
I9							
	The amount of time involved in using this app has been fitting for me	0.26	0.39	0.13	0.7	0.72	0.28
I10							
	I would use this app again	0.4	0.2	0.12	0.63	0.61	0.39
I11							

3.2.3. m-MAUQ scores according to demographic characteristics

The demographic characteristics of the participants such as age, number of children, number of nursing infants, age of the nursing infant, type of lactation, experience with breastfeeding, nationality or home country, level of education, social class, employment activity, and living as a couple did not impact on the scores of the total scale of the m-MAUQ.

Exclusive breastfeeding significantly increased scores of the subscale 2 (ease of use).

Women who exclusively breastfed their children scored subscale 2 on average 6.04 ± 0.7 , whereas women who mixed-fed scored on average 5.68 ± 0.97 ($p=0.025$).

Women with higher education level (university studies) significantly scored lower the subscale 3 “Access to the information and errors” (mean of 5.47 ± 0.86) than women with secondary studies (mean score of 5.96 ± 0.75) ($p=0.006$).

4. DISCUSSION

Breastfeeding support through mHealth solutions has proved to be useful to improve rates of exclusive breastfeeding, breastfeeding efficacy, and women's attitudes toward breastfeeding²⁶. Thus, mHealth apps that provide information and support women during the postpartum and their breastfeeding journey may be helpful, and their usage

might be encouraged. Moreover, the development of digital tools related to breastfeeding helps health professionals in assisting women to stay updated, search for information or to solve doubts related to breastfeeding, as well as improve care and provide more effective support to mothers who wish to breastfeed. In this context, online solutions and mHealth apps that help and provide information to breastfeeding mothers are gradually being developed^{4,26-29}, and a rigorous and validated scale to evaluate the usability and utility of these solutions is needed.

In this work, we have translated to Spanish the original MAUQ questionnaire, adapted it for breastfeeding users, and validated the modified questionnaire. The content of the items and the structure of the questionnaire were both validated. According to our results, the items of the modified questionnaire are clear, relevant, and unambiguous and the kappa statistic indicated excellent agreement between expert and user raters for the content validity. The reliability of the modified questionnaire was assessed using Cronbach's α coefficient and indicated that the questionnaire had a good internal consistency and stability, similar to the original questionnaire which obtained an α of 0.91¹³.

The Exploratory Factor Analysis revealed four subscales with acceptable Cronbach's α coefficient and we labeled them as "Satisfaction and usefulness", "Ease of use", "Access to the information and errors", and "Convenience of use". The subscales of the questionnaire differed from the original MAUQ which only had three subscales and some items were grouped differently, only subscale 2 "Easy of use" was similar to the original questionnaire¹³. The difference from the original questionnaire may be related to type of users who use specific applications for breastfeeding support as they have unique usability requirements of the app to be able to get the right information that they require.

In general, the participant's sociodemographic characteristics did not significantly influence the scoring of the total questionnaire or the subscales, only the level of education and breastfeeding exclusively affected the scoring of the subscales “Access to the information and error” and “Ease of use”, respectively. Higher education levels have been associated with higher breastfeeding rates and longer lactations³⁰. And women with high level of education might be less influenced by the dimension “Access to the information and errors”, and thus the total score for this subscale in this group results to be lower. Moreover, women breastfeeding exclusively might use the breastfeeding support app more frequently than women mix-feeding. And for this reason, the dimension “Ease of use” is influenced by the type of lactation the users are following. Future studies could use a larger sample of women with mix-feeding and/or different levels of education to test these hypotheses.

Our study has some limitations, most of the participants were Spanish or lived in Spain so some cultural bias might have been introduced. Also, the majority of the participants were exclusively breastfeeding and had a high level of education which may not represent all lactating women. It has been demonstrated than women who seek for breastfeeding support in technology-based solutions and those who find relevant information about lactation are more likely to breastfeed for longer time^{31,32}.

The sample size (N=202) was considered sufficient for Exploratory Factor Analysis since we considered including 10 to 15 participants per item as recommended³³, thus we needed between 170 and 255 to perform an adequate validation.

In conclusion, the Spanish and modified MAUQ demonstrated high reliability and validity and it might be used to evaluate the usability, utility and acceptability of mHealth apps aiming to support lactating women.

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Author contribution:

P.Q.R, D.M.T and L.A.C were responsible for concept and design, methodology and interpretation of data. P.Q.R extracted the data and performed the analysis. P.Q.R drafted the manuscript and created tables. I.G.S and A.P.A reviewed the manuscript. All approved the final version of the manuscript.

All authors meet the criteria detailed in Author Instructions

Competing Interests statement:

The authors declared the following potential conflicts of interest with respect to the research, authorship and/or publication of this article: A.P.A created and designed the LactApp. L.A.C serves as a consultant at LactApp. Nevertheless, none of these potential conflicts affected the study design, the collection, analysis and interpretation of data, or the writing of the manuscript produced by P.Q.R and D.M.T.

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Summary points:

- The original MAUQ questionnaire (mHealth App Usability Questionnaire) has been translated to Spanish and further adapted to the maternity and breastfeeding domain.
- The modified MAUQ has been validated for content validity through a panel of experts
- The reliability of the questionnaire was assessed in a mobile application for breastfeeding support (LactApp) by its users.
- The new scale showed high reliability and validity and will be useful to evaluate the usability, utility and acceptability of mHealth apps aiming to support lactating women.