Developmental Psychology

Abbreviated Version of the Maternal-Fetal Attachment Scale: Evidence of Validity and Reliability

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Abstract: The Maternal-Fetal Attachment Scale has been widely applied in research on the subject. There are no known studies that have validated a shortened version of this instrument in Brazil. This study aimed to propose a shortened version of the Maternal-Fetal Attachment Scale and examine its evidence of validity and reliability. This methodological study was carried out on a sample of 937 pregnant women in the Primary Health Care of Montes Claros, Minas Gerais - Brazil. Construct validity and reliability were measured. A trifactor version with 15 items was obtained, which presented satisfactory adjustment indexes. Convergent and discriminant validities were close to the recommended ones. The scale differentiated attachment scores according to different sample characteristics. Internal consistency (Cronbach's $\alpha = 0.878$) and composite reliability (> 0.70) were appropriate. The abbreviated Brazilian version of the Maternal-Fetal Attachment Scale presented satisfactory psychometric attributes for application to pregnant women in Primary Health Care.

Keywords: pregnancy, maternal-fetal relations, factor analysis statistical, validation study

Versão Abreviada da Escala de Apego Materno-Fetal: Evidências de Validade e Confiabilidade

Resumo: A Escala de Apego Materno-Fetal tem sido amplamente aplicada em pesquisas sobre a temática. Desconhecem-se investigações sobre a validade de uma versão reduzida desse instrumento no Brasil. Este estudo teve por objetivo propor uma versão abreviada da Escala de Apego Materno-Fetal e examinar suas evidências de validade e confiabilidade. Trata-se de um estudo metodológico, realizado com uma amostra de 937 gestantes no âmbito da Atenção Primária à Saúde de Montes Claros, Minas Gerais – Brasil. Obteve-se uma versão trifatorial com 15 itens, que apresentou índices satisfatórios de ajuste. As validades convergente e discriminante foram próximas do recomendado. A escala diferenciou os escores de apego segundo diferentes características da amostra. A consistência interna (α de Cronbach = 0,878) e a confiabilidade composta ($> 0,70$) foram apropriadas. A versão brasileira abreviada da Escala de Apego Materno-Fetal apresentou atributos psicométricos satisfatórios para aplicação a gestantes na Atenção Primária à Saúde.

Palavras-chave: gravidez, relações materno-fetais, análise fatorial, estudo de validação

Versión Corta de la *Maternal Fetal Attachment Scale*: Evidencia de Validez y Fiabilidad

Resumen: La *Maternal Fetal Attachment Scale* es ampliamente aplicada en estudios sobre la temática. No existen investigaciones sobre la validez de una versión corta de este instrumento en Brasil. Se pretende proponer una versión corta de esta escala y examinar su validez y fiabilidad. Estudio metodológico, realizado en la Atención Primaria de Salud de Montes Claros, Minas Gerais – Brasil en una muestra de 937 mujeres embarazadas. Se midieron la validez y la fiabilidad del constructo. Se obtuvo una versión de tres factores, con 15 ítems, e índices de ajuste satisfactorios. La validez convergente y discriminante se acercó a lo recomendado. La escala diferenció las puntuaciones de vinculación según las distintas características de la muestra. La consistencia interna (α de Cronbach = 0,878) y la fiabilidad compuesta ($> 0,70$) fueron adecuadas. La versión corta de *Maternal Fetal Attachment Scale* para Brasil presentó atributos psicométricos satisfactorios para aplicarse a gestantes en Atención Primaria de Salud.

Palabras clave: embarazo, relaciones materno-fetales, análisis factorial, estudio de validación

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Pregnancy is considered a period of transition to motherhood and adaptation in women's lives (Ertmann et al., 2021; Rosa et al., 2021). In this phase, the internal representation of the future child begins and the development of maternal-fetal attachment (MFA) is established. MFA includes behaviors and feelings of care, protection, and integration with the fetus, usually manifested by the pregnant woman. The relationship of affiliation and interaction with the unborn child (Cranley, 1981)

can be expressed through affection, emotions, perceptions, concerns, and expectations (Rosa et al., 2021). MFA is a subjective and multidimensional construct (McNamara, Townsend, & Herbert, 2019), which requires the use of accurate, valid, and reliable instruments to measure it (Echevarría-Guanilo, Gonçalves, & Romanoski, 2019).

The Maternal Fetal Attachment Scale (MFAS) was the first instrument developed for research on MFA. It was developed by Nurse Mecca S. Cranley, in 1981, in the United States of America (USA). Since then, the MFAS has been widely applied in research on the topic, as evidenced in a systematic review (McNamara et al., 2019). After the dissemination of this scale, other instruments were created and validated, such as the Antenatal Emotional Attachment Scale, the Maternal Adjustment And Maternal Attitudes During Pregnancy and After Delivery, and the Prenatal Attachment Inventory, in order to contribute to the development and deepening of theoretical conceptions about MFA (Lauriola, Panno, Riccardi, & Taglialatela, 2010; McNamara et al., 2019).

The MFAS contains 24 items answered on a Likert scale from one to five points (never to almost always). It is divided into five subscales: differentiating oneself from the fetus, interacting with the fetus, attributing characteristics to the fetus, surrendering to the fetus, playing a role. The minimum score is 24 and the maximum 120 - the higher the score, the higher the level of attachment. The reliability coefficient was 0.85, with the value of the subscales ranging from 0.52 to 0.73. The validation included 71 pregnant women in their third trimester, which participated in a prenatal preparation course or had medical follow-up in private practices. They were on average 27 years old, had a predominantly high school education, were Caucasian and married (Cranley, 1981).

In Brazil, the MFAS was named Maternal-Fetal Attachment Scale (MFAS) and so far we are only aware of the study in which its translation, cross-cultural adaptation, analysis of construct validity and reliability were processed. This adaptation and validation process was carried out in 1999, with 300 pregnant women from the sixth to the ninth month, users of outpatient clinics of two hospitals in the city of Rio de Janeiro, with ages ranging from 14 to 39 years (average of 25). Exploratory factor analysis was performed for a structure with five factors (subscales) and Cronbach's alpha coefficient indicated an internal consistency of 0.85 for the total scale and, for the subscales, it was between 0.52 and 0.73 (Feijó, 1999).

The scale, in its original 24-item version, has undergone assessments of its psychometric qualities in countries such as Germany (Doster et al., 2018), Hungary (Andrek, Kekecs, Hadhazi, Boukydis, & Katalin, 2016), and Italy (Busonera, Cataudella, Lampis, Tommasi, & Zavattini, 2016). In these studies, the samples were among 114 Hungarian (Andrek et al., 2016) and 482 Italian (Busonera et al., 2016) pregnant women, composed predominantly of adults aged 20-35 years, married, of good socioeconomic class, with high school and college education. Good psychometric results were found, with adequate internal consistency for the total scale, but the same was not identified for the subscales.

A revision of certain items and the adjustment of the five-factor model were suggested (Andrek et al., 2016; Busonera et al., 2016; Doster et al., 2018). A reduced version of the MFAS with 20 items was proposed in previous research in Italy, but achieved reasonable indices regarding factor structure (Busonera et al., 2016).

It is worth mentioning that the elaboration of the Cranley Scale (1981) and the cited psychometric investigations occurred in outpatient and hospital services in developed Western countries (Andrek et al., 2016; Busonera et al., 2016; Doster et al., 2018), with different realities of Latin American countries such as Brazil (Feijó, 1999), with insufficient evidence on pregnant women of different ethnicities and in situations of socioeconomic vulnerability. Little is known about the psychometric parameters of the MFAS in other populations, such as pregnant women assisted in the public health system and in Primary Health Care (PHC). This situation reveals the need to understand the construct in a contextualized way in Brazilian pregnant women who receive prenatal care in PHC.

The continuous development, refinement, and adaptation of measurement instruments, with acceptable levels of validity and reliability, are a fundamental part of research on constructs and subjective measures in health (Reichenheim & Bastos, 2021). The examination of an instrument in another sociocultural context is a complex process, but necessary so that studies conducted with different populations can maintain comparability, dialogue among them, and provide results with the highest possible reliability (Echevarría-Guanilo et al., 2019; Reichenheim & Bastos, 2021). In this sense, this research proposes an improvement of the Brazilian version of the MFAS, to contribute to a reduced instrument with satisfactory validity and reliability indices. The aim is both to enhance psychometric performance, as well as to reap the benefits of brevity in research processes. Instruments with fewer items may present greater comfort and agility in application since they demand less time for completion and respondents are less fatigued (Cogollo-Milanés, Campo-Arias, & Herazo, 2021).

Furthermore, to date, there are no studies that have proposed and validated an abbreviated version of the MFAS in Brazil, especially for use in pregnant women assisted in PHC, who live in a specific sociocultural environment, different from the scenarios of previous validation studies of the scale. This study aimed to propose an abbreviated version of the Maternal-Fetal Attachment Scale and examine its evidence of validity and reliability.

Method

This is a methodological study of validation of the abbreviated version of the MFAS. The cross-sectional data from the baseline of a population-based epidemiological research matrix entitled "*Avaliação das Condições de Saúde das Gestantes de Montes Claros, Minas Gerais - Brazil: estudo longitudinal (Estudo ALGE)*" was used.

Participants

The population of the matrix research consisted of pregnant women registered in the teams of the Family Health Strategy (FHS) in the urban area of the city in 2018. The sample size was established aiming to estimate population parameters with 50% prevalence (to maximize the sample size and due to the original project contemplating several events). A 95% confidence interval (95% CI) and a precision level of 2.0% were considered. A correction was made for finite population ($n = 1,661$) and a 20% add-on was included to compensate for possible non-responses and losses. Calculations showed the need for participation of at least 1,180 pregnant women. A total of 1,278 pregnant women participated in the larger study, a number higher than the minimum indicated in the calculations and which ensured population representativeness.

It was decided for this work of psychometric validation to cut the sample of the matrix research, so we analyzed data only from women in their second and third trimesters of pregnancy, which totaled 937 women. This cutout occurred because the MFA, as measured by the MFAS, is more evident from the second trimester on. As fetal growth occurs, the pregnant woman can feel the baby's new movements, which make the experience more corporeal for her and provides a more vivid interaction with the fetus (Busonera et al., 2016; Rosa et al., 2021). This sample size ($n = 937$) met the recommendations for assessing the construct validity, of five to ten individuals needed per parameter (k) to be estimated in structural equation models, which in this investigation was equal to 24 (Hair, Black, Babin, Anderson, & Tatham, 2009).

For the sample selection, we considered the FHS poles in all regions of the city, which totaled 15 in the period of this research and among which 135 family health teams were distributed. The number of pregnant women sampled in each center was proportional to its representativeness in relation to the total population of registered pregnant women.

Pregnant women who were registered with the family health team at any gestational age were included. Women who were pregnant with twins and those with cognitive impairment were not included, as informed by the family and/or the FHS team.

Instruments

For this study, a *structured questionnaire* was applied which included socio-demographic variables - age range (up to 20 years, 21 to 30, over 30), marital status (with a partner, without a partner), self-reported color (brown, black, white, yellow), education (elementary school, high school, college), family income (less than R$1,000.00, R$1,001.00 to 2,000.00, over R$2,000.00); and clinical - gestational trimester (second, third), pregnancy planning (yes, no), previous abortion (yes, no), parity (nulliparous, primiparous, multiparous). Nationally validated instruments were also used to investigate the following constructs: MFA, social support, perceived stress, and depressive symptoms.

The *Brazilian version of the MFAS* (Feijó, 1999), described in the previous section, was applied to evaluate the MFA.

The presence of social support was measured using the Brazilian version of the *Social Support Scale*, composed of 19 questions that comprise five dimensions: material, affective, emotional, positive social interaction, and information. For each item, the participant indicates how often he/she considers each type of support, using a Likert-type scale: never (1), rarely (2), sometimes (3), almost always (4), and always (5). The closer the final score is to 100, the better the perceived social support (Griep, Chor, Faerstein, Werneck, & Lopes, 2005). The overall score of the scale was calculated by the total sum of the 19 items, and a score above 66, which corresponds to the second term, was considered high social support (Rocha et al., 2016). This instrument showed construct validity in the Brazilian validation in a cohort study of workers (Griep et al., 2005).

Stress was measured by means of the *Perceived Stress Scale* (PSS-14), an instrument that identifies situations in the life of the individual judged as stressful, establishing levels of intensity. The questions are general in nature and apply to any population subgroup. It contains 14 items about the frequency in which certain feelings and thoughts occurred in the last month, with answers ranging from zero (never) to four (always) (Luft, Sanches, Mazo, & Andrade, 2007). The score is obtained by reversing the scores of the positive items and summing the responses of the 14 items, with total scores ranging from zero (no stress symptoms) to 56 (extreme stress symptoms) (Cavalcante, Lamy Filho, França, & Lamy, 2017; Luft et al., 2007). The analysis looked for results less than or equal to 30 indicating the absence of stress symptoms, and greater than this value indicating the presence of stress symptoms (Cavalcante et al., 2017). The PSS-14 proved to be clear and reliable to measure perceived stress in Brazil, with adequate criteria for internal consistency and construct validity (Luft et al., 2007).

The *U.S. Center for Epidemiologic Studies Depression Scale* (CES-D), also validated in Brazil (Silveira & Jorge, 1998), was used to screen for depressive symptoms in the sample of pregnant women assessed. The CES-D is composed of 20 items, of which four are positive, in which the interviewee reports the frequency of occurrence of symptoms in the last week. Each response can involve four increasing degrees of intensity on a Likert scale - never or rarely, sometimes, frequently, and always - with scores corresponding to 0, 1, 2, and 3. The score of the four positive items is inverted and added to the score of the others, which yields a final result ranging from zero to 60 points (Fernandes & Rozenthal, 2008; Ribeiro et al., 2019; Silveira & Jorge, 1998). We proceeded to categorize into: absent/light depressive symptoms (score <16), moderate (score ≥16 or ≤21), and severe symptoms (score ≥22) (Ribeiro et al., 2019). The instrument showed reliable psychometric properties, with adequate results for factor, concurrent, and reliability validations in the Brazilian validation (Silveira & Jorge, 1998).

Procedure

Data collection. As for the data collection process, we initially contacted the managers of the PHC coordination of the municipality to raise awareness and explain the purpose of the research. After their consent, the family health teams were also visited by the researchers for clarification about the study. The professionals from these teams responsible for prenatal care provided a list of pregnant women in their area of coverage containing their names, phone numbers, and addresses. With these lists, a team of interviewers made initial telephone contact with the women, when there was an approach with the invitation and awareness about the study, and then the data collection was scheduled and carried out.

Data was collected by a multi-professional health team and scientific initiation students (nursing, medicine, and physical education) between October 2018 and November 2019, at the FHS health units or at the participants' homes, according to their availability. Data collection occurred face to face, individually with each pregnant woman, with an average duration of one hour. As for the order of application of the instruments, first a structured questionnaire was applied to investigate the socio-demographic and clinical characteristics, and then the scales referring to MFA, social support, perceived stress, and depressive symptoms.

Prior to data collection, the interviewers were trained, as well as a pilot study with pregnant women registered at an FHS unit (who were not included in the analyses of the study), in order to standardize the data collection procedures of the survey.

Data analysis. Initially, a descriptive analysis of the variables related to the socio-demographic and clinical profile of pregnant women was performed through absolute and relative frequencies. To verify the psychometric properties of the abbreviated version of the MFAS, the construct validity was assessed through the analysis of the factor structure, hypothesis testing, and discriminant, and convergent validity. The evidence of internal consistency (Cronbach's alpha and Composite Reliability) was also verified.

To examine construct validity, we first performed the exploratory factor analysis (EFA), followed by the confirmatory factor analysis (CFA) - with the same sample in both analyses. In the EFA, we adopted the extraction of the factors by the principal components method with Varimax rotation. The common factors retained were those that presented an eigenvalue greater than one, in accordance with the slope diagram and with the percentage of variance explained, concomitant with the analysis of item coherence. The behavior of the item loadings in the factors was evaluated, adopting as an exclusion criterion loadings below 0.40. For items that presented factor loadings above 0.40 in more than one factor, the allocation criterion was by judging item coherence. To measure data adequacy, we used the Kaiser-Meyer-Olkim (KMO) measure, for which a value higher than 0.5 was accepted. The presence of correlation between variables was measured by analyzing the correlation matrix and Bartlett's Test of Sphericity (significance level of 0.05) (Dziuban & Shirkey, 1974).

The CFA was used to ratify the dimensional structure extracted in the EFA and attest to structural validity. The quality of fit per model item was considered adequate for factor loadings greater than or equal to 0.50. To judge the adequacy of the model's global fit, the following indexes were evaluated: chi-square ratio by degrees of freedom (χ^2/df), confirmatory fit index (CFI), the goodness of fit index (GFI), Tucker-Lewis index (TLI) and root mean square error of approximation (RMSEA). Model fit was considered adequate if $\chi^2/gl \leq 5.0$; CFI, GFI and TLI ≥ 0.90; RMSEA < 0.10 (Marôco, 2010).

The convergent construct validity of the MFAS factors was assessed using the Mean Extracted Variance (MEV), considered adequate if ≥ 0.50. Discriminant validity was demonstrated by comparing the Mean Extracted Variances (MEVs) of two factors with the square of the correlation coefficient between these factors. This property was confirmed when the MEVs of the factors were greater than or equal to the square of the correlation between them (Marôco, 2010).

The hypothesis test analysis was conducted to observe the scale scores stratified in different groups of pregnant women, who hypothetically could present different levels of maternal-fetal attachment. For this, the Mann-Whitney's U Test or the Kruskal Wallis Test was used to examine the association of the following variables: marital status, family income, gestational trimester, pregnancy planning, social support, depressive symptoms and perceived stress. A 5% significance level ($p < 0.05$) was adopted to reject the null hypothesis.

The internal consistency of the instrument, as well as its factors, was verified using Cronbach's alpha coefficient (α) and Composite Reliability (CR). Values of α and CR ≥ 0.70 were considered adequate (Marôco, 2010). Additionally, item-total correlations and Cronbach's alpha coefficient were calculated if an item was excluded from the scale.

The organization and statistical analyses of the data were performed using IBM Statistical Package for the Social Sciences (SPSS) Statistics software, version 22.0®, where they were also previously subjected to quality control and double-checking. The CFA was conducted via Analysis of Moments Structures Software (AMOS®) 22.0 (IBM Corp., Armonk, NY, USA).

Ethical Considerations

The study was approved by the Research Ethics Committee of the Universidade Estadual de Montes Claros (CAAE 80957817.5.0000.5146, Consubstantiated Opinion No. 2.483.623/2018) and authorized by the Municipal Health Secretariat. Participants of legal age read and signed the Free and Informed Consent Term. Those who were under 18 years old presented the Free and Informed Agreement Term, in addition to the Free and Informed Consent Term signed by their legal guardians. In addition, the author of the Brazilian version of the MFAS granted authorization to conduct this study.

Results

As for the socio-demographic and clinical characteristics of the sample surveyed (n = 937 pregnant women), 47.7% were between 21 and 30 years old, 77.2% reported being married to a partner, 46.7% had a monthly family income of up to 1,000 reais. Of the interviewees, 55.0% were in the 2nd trimester, 61.0% reported unplanned pregnancy, 48.7% were multiparous and 18.9% reported previous abortion.

The EFA detected the reliability of the data matrix with a KMO value equal to 0.914 and a significant Bartlett's Test of Sphericity (p = 0.000). This analysis showed three factors (F1, F2, and F3) that explained 56.5% of the variance. Table 1 shows the values of the factor loadings of the items, as well as the variance explained by the factors.

The inspection of factor loadings was performed and only the items that were in accordance with the established exclusion criteria remained in the abbreviated version of the scale: greater theoretical relation with the construct and high factor loading. Items with low factor loadings and with little contribution to explaining the construct were eliminated in this situation, aiming to keep only those that really measured MFA accurately. A total of nine items were excluded: 6, 7, 10, 13, 16, 19, 21, 22, 24.

The allocation of the 15 selected items was processed according to consistency with the three factors indicated in the EFA, and each factor was composed of five items. Factor 1 (F_1), consisting of items one to five, was entitled "Experiencing Expectations" and refers to the imaginary experience of the pregnant woman in relation to the future baby. Factor 2 (F_2) was named "Imagining and Caring for the Fetus", made up of items six to 10 that address what the pregnant woman imagines about her fetus and the self-care experienced by her. Factor 3 (F_3), called "Interacting with the fetus", included the five remaining items (11 to 15), which express the attitudes of the pregnant woman in her relationship with the fetus.

Table 1

Factorial loadings of the items of the abbreviated version of the Maternal-Fetal Attachment Scale obtained by Exploratory Factor Analysis

Item	Content	F1	F2	F3
1	I am really looking forward to seeing what my baby will be like.	.779	.277	.176
2	I think that despite all the difficulty, the pregnancy was worth it.	.552	.274	.242
3	I can see myself feeding the baby.	.741	.217	.175
4	I can imagine taking care of the baby.	.745	.366	.179
5	I can't wait to hold the baby.	.755	.257	.176
6	I wonder if the baby can hear, inside me	.287	.688	.198
7	I wonder if the baby thinks and feels "things" inside me	.174	.717	.240
8	I do things, to stay healthy, that I wouldn't do if I wasn't pregnant.	.228	.687	.053
9	I try to eat the best I can so that my baby will have a good diet.	.237	.587	.112
10	I stop doing certain things for the sake of my baby.	.269	.555	.160
11	I like to see my tummy move when the baby kicks.	.286	.069	.767
12	I talk to my baby in my tummy.	.283	.321	.436
13	I poke my baby so that it will poke me back.	.076	.149	.762
14	I caress my belly to calm the baby when he kicks a lot.	.282	.080	.782
15	I can almost guess what my baby's personality is going to be by the way he moves.	.052	.247	.594
Percentage of variance explained (56.5%) KMO (.914) Bartlett's test (.001)		40.0%	50.0%	56.5%

Note. F1 = factor 1; F2 = factor 2; F3 = factor 3; KMO = Kaiser-Meyer-Olkim.

Through the CFA, a good quality fit of the three-factor model was identified. All items had satisfactory factor loadings, ranging from 0.50 to 0.83. The correlations between the three factors were high. The model fit quality indicators obtained were: $\chi^2/\text{df} = 3.59$, CFI = 0.959, GFI = 0.958, TLI = 0.949, RMSEA = 0.053 (90% CI = 0.049-0.059, p = 0.238). The final factor structure of the MFAS, the abbreviated version, is shown in Figure 1.

The scale was able to significantly differentiate the maternal-fetal attachment scores according to different characteristics of the pregnant women: marital status (p = 0.014), family income (p = 0.005), trimester of pregnancy (p = < 0.001), pregnancy planning (p = 0.019), social support (p = < 0.001), depressive symptoms (p = < 0.001) and perceived stress (p = < 0.001) (Table 2).
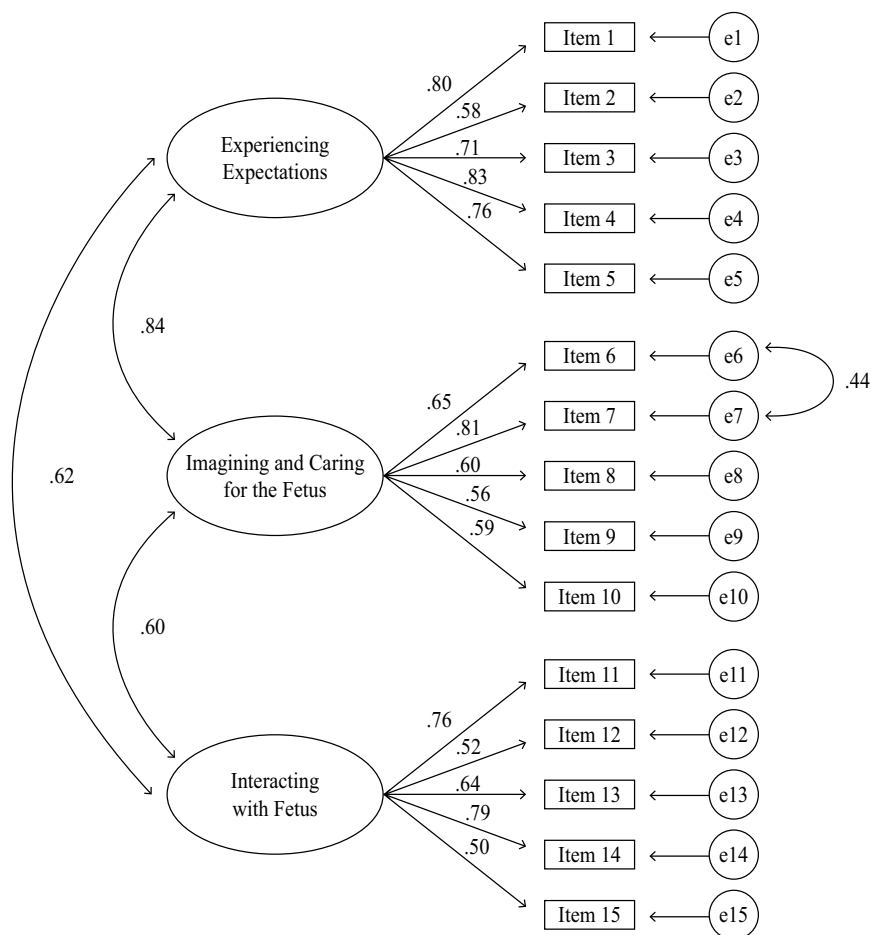
Figure 1. Factorial structure of the abbreviated Brazilian version of the Maternal-Fetal Attachment Scale.

Table 2

Hypothesis test: comparison of scores of the abbreviated version of the Maternal-Fetal Attachment Scale according to selected variables

Variables	Mean	Standard Deviation ±	Median	Interquartile range	p-value
Marital status					.014*
With partner	62.8	9.7	63.0	14.0	
Without partner	60.8	10.4	61.0	12.0	
Monthly family income (*reais*)					.005**
≤1,000.00	61.2	10.3	61.0	13.0	
1,001.00 to 2,000.00	63.4	9.5	64.0	13.0	
>2,000.00	63.3	9.6	65.0	13.0	
Gestational trimester					<.001*
Second	60.5	10.7	61.0	14.0	
Third	64.6	8.6	66.0	13.0	
Planned pregnancy					.019*
Yes	63.6	8.9	64.0	13.0	
No	61.6	10.5	62.0	13.0	
Social support					<.001*
Low	58.7	11.5	60.0	14.0	
High	63.2	9.4	64.0	13.0	
Depressive symptoms					<.001**
Absent/light	63.8	8.8	64.0	13.0	
Moderate	61.6	9.3	62.0	11.0	
Severe	59.1	12.0	61.0	13.0	
Stress					<.001*
Without stress	63.2	8.8	63.0	13.0	
With stress	58.3	13.4	61.0	14.0	

Note. *Mann-Whitney U Test; **Kruskal Wallis Test.

With regard to convergent construct validity, F_1 and F_3 presented satisfactory MEV values, 0.55 and 0.50, respectively (Table 3). Discriminant validity was verified for factors F_1 and F_3, whose squared correlation ($r^2 = 0.38$) was lower than the MEV values of these factors, as well as between factors F_2 and F_3, which presented MEV values higher than the square of the correlation coefficient between them ($r^2 = 0.36$). However, discriminant validity was not verified for factors F_1 and F_2, since the squared correlation between these factors ($r^2 = 0.71$) was higher than the values of their MEVs.

The results of internal consistency, item-total correlation, and CR are shown in Table 3. The scale presented Cronbach's α equal to 0.878 (95% CI = 0.866-0.889). The internal consistency values of the three factors were greater than 0.70. The CR values were also adequate (> 0.70).

Table 3

Total item correlation measures, Cronbach's alpha, average variance extracted, and composite reliability of the abbreviated version of the Maternal-Fetal Attachment Scale

Factors/items	Parameters				
	Total item correlation	*Cronbach's α if item deleted*	*Cronbach's α (95% CI)*	MEV	CR
Experiencing expectations			.852 (.836-.866)	.55	.857
Item 1	.644	.867			
Item 2	.548	.870			
Item 3	.590	.868			
Item 4	.683	.865			
Item 5	.622	.868			
Imagining and caring for the fetus			.757 (.732-.781)	.42	.780
Item 6	.592	.868			
Item 7	.566	.869			
Item 8	.479	.873			
Item 9	.464	.873			
Item 10	.490	.872			
Interacting with fetus			.766 (.741-.789)	.50	.782
Item 11	.577	.868			
Item 12	.523	.870			
Item 13	.482	.875			
Item 14	.587	.868			
Item 15	.433	.879			
Total			.878 (.866-.889)		

Note. MEV = Mean Extracted Variance; CR = Composite Reliability; 95% CI = 95% Confidence Interval.

Table 4 shows the two Brazilian versions of the MFAS, the original and the abbreviated version proposed in this study, with their factors and respective items, as well as the instructions for application and the suggested order for the presentation of the items (questions) allocated to their factors. The items were reallocated and renumbered in three new factors (subscales), by performing the MFA and the CFA. Efforts were made to maintain a nomenclature similar to that of the original scale, with no changes in the content of the questions.

After the adaptation process of the scale for the reduced version with 15 items, a new score of the instrument was established whose values vary from 15 to 75, since the response options of the items maintained the same Likert-type scale (1 to 5) of the original version. Thus, it is proposed that a lower score indicates a lower level of attachment, while a higher score close to 75 equals a higher MFA - similar to the original instrument. It was observed in the surveyed sample a mean score equal to 62.36 (± 9.95) for the total scale, and for the proposed factors the following values were observed: Experiencing Expectations: 21.99 (± 3.40); Imagining and Caring for the Fetus: 21.28 (± 3.70); Interacting with the Fetus: 19.17 (± 4.77).

Table 4

Description of the Maternal-Fetal Attachment Scale, according to factors and items of the original and shortened versions

Please answer the following questions about yourself and the baby you are expecting. There are no right or wrong answers.
Your first impression is the one that best shows your feelings. Please mark only one answer per question.

Original scale		
Factors	**Items**	**Item description**
1. Differentiating from fetus	3	I like to see my belly move when the baby kicks.
	5	I'm really looking forward to seeing what my baby will look like.
	10	I've already decided what I'm going to name it if it's a girl.*
	13	I've decided what I'm going to name it if it's a boy.*
2. Interacting with fetus	1	I talk to my baby in my belly.
	7	I call my baby by a nickname.*
	17	I poke my baby to get him to poke me back.
	20	I caress my tummy to calm the baby when it kicks too much.
	24	I try to hold my baby's foot to play with him.*
3. Assigning characteristics to the fetus	6	I wonder if the baby feels tight in there.*
	9	I can almost guess what my baby's personality is going to be by the way he moves.
	12	I wonder if the baby can hear, inside me.
	14	I wonder if the baby thinks and feels "things" inside me.
	16	It seems that my baby kicks and moves to tell me it's time to eat.*
	21	I can tell when the baby has the hiccups.*
4. Giving yourself to the fetus	2	I think that, despite all the difficulty, the pregnancy was worth it.
	11	I do things, to stay healthy, that I wouldn't do if I wasn't pregnant.
	15	I try to eat the best I can so that my baby will have a good diet.
	22	I feel that my body is ugly.*
	23	I stop doing certain things for the sake of my baby.
5. Playing a role	4	I imagine myself feeding the baby.
	8	I picture myself taking care of the baby.
	18	I can't wait to hold the baby.
	19	I try to imagine who the baby will look like.*
Abbreviated version		
1. Experiencing expectations	1 (5)	I am really looking forward to seeing what my baby will be like.
	2 (2)	I think that despite all the difficulty, the pregnancy was worth it.
	3 (4)	I can see myself feeding the baby.
	4 (8)	I can imagine taking care of the baby.
	5 (18)	I can't wait to hold the baby.
2. Imagining and caring for the fetus	6 (12)	I wonder if the baby can hear, inside me.
	7 (14)	I wonder if the baby thinks and feels "things" inside me.
	8 (11)	I do things to stay healthy that I would not do if I were not pregnant.
	9 (15)	I try to eat the best I can so that my baby will have a good diet.
	10 (23)	I stop doing certain things for the sake of my baby.
3. Interacting with fetus	11 (3)	I like to see my belly move when the baby kicks.
	12 (1)	I talk to my baby on my tummy.
	13 (17)	I poke my baby to get him to poke me back.
	14 (20)	I caress my tummy to calm the baby when it kicks too much.
	15 (9)	I can almost guess what my baby's personality is going to be by the way he moves.

Note. *Items excluded in the process of adaptation to the shortened version; Numbers in parentheses indicate correspondence between the items of the abbreviated version and the items of the original version.

Discussion

In this study, an abbreviated version of the MFAS was proposed and its psychometric evidence of validity and reliability was evaluated. The instrument obtained construct validity, supported by an adequate factor structure and hypothesis testing, as well as evidence of discriminant and convergent validity close to what is recommended. It also proved to be reliable, through high internal consistency and composite reliability. Such qualities support the use of the scale for measuring MFA in the context of PHC.

In this research, through the EFA and the CFA, an adequate factor structure of this scale was evidenced, which indicates appropriate construct validity. A three-factor model with good quality of fit was obtained, with the retention of the items with the best statistical performance and theoretical relation with the construct. The items with unsatisfactory factor loading and that were removed during the factor analyses possibly did not fit the construct, describing attitudes that may not integrate the behavior of the sample analyzed in relation to the affective bond with the fetus.

In a Hungarian study, in the EFA of the MFAS with 24 items, the optimal number of factors was explored with various model fit indices. The scale was analyzed with two-, four-, five- and six-factor models. However, the one-factor model was chosen, as it proved to be more reliable (Andrek et al., 2016). Similarly, in an investigation in Germany, the 24-item version of the scale was tested with EFA and the following results were obtained: KMO = 0.762, Bartlett's test = p < 0.001, average explained variance = 34.9%, two items (9 and 13) did not show satisfactory factor loading in any of the extracted factors (Doster et al., 2018). In an Italian study, by means of EFA and CFA, a version of the instrument with 20 items structured into three factors was proposed, explaining 36.76% of the model. Items 10 and 13 were agglutinated, and three, 22, and 24 were deleted - similarly to the current work in which items 10, 13, 22, and 24 were excluded. The quality of fit was reasonable but superior to a five-factor or one-factor model: CFI = 0.90, RMSEA = 0.06 (90% CI = 0.051-0.071) (Busonera et al., 2016). The verified findings imply the need to deepen the understanding of the theoretical and cultural particularities of the items representing the MFA construct. It should be noted that the researched scenarios and samples are different from this study, which was conducted with pregnant women in a city in the interior of Brazil, assisted by family health teams in the Unified Health System (UHS).

In this study, the three-factor version with 15 items obtained satisfactory indicators of model fit quality in the CFA. This is a finding in line with the recommendations for construct validity. It is denoted that such a version contains a set of factors that represent the construct it was designed to measure (Echevarría-Guanilo et al., 2019; Reichenheim & Bastos, 2021), that is, it can provide a better understanding of women's attachment behaviors during the gestational phase (Lauriola et al., 2010). This is because all items of the instrument had high factor loadings, and thus have a theoretical connection with their domains. Another aspect positively assessed was the dimensionality of the instrument (structural validity), in which its multi-item structure adequately reflected the multidimensionality of the construct hypothesis under analysis (Calderón Garrido, Navarro González, Lorenzo Seva, & Ferrando Piera, 2019; Echevarría-Guanilo et al., 2019).

As for convergent validity, there was an acceptable level in the first and third factors. In the adjusted measurement model, MEV values indicate that the constructs to which the items belong explain an acceptable proportion of variance (Marôco, 2010; Reichenheim & Bastos, 2021; Rubia, 2019). The second factor, on the other hand, did not obtain a recommended MEV, which may have been influenced by the heterogeneity of the sample of pregnant women, residing in different geographic locations of the city, with diverse socio-demographic and economic characteristics. In turn, factors two and three achieved adequate discriminant validity, since the shared variance between constructs was not greater than their respective extracted variances. The results suggest that the items of one factor are not more strongly correlated with those of another factor, which signals that the factors are distinct from each other (Hair et al., 2009; Marôco, 2010; Reichenheim & Bastos, 2021). In light of these findings, further research is recommended to advance the quality of these two psychometric properties.

The evaluated scale was also able to distinguish MFA scores according to different characteristics of the surveyed pregnant women: marital status, income, trimester of pregnancy, pregnancy planning, social support, depressive symptoms, and perceived stress. In a validation study of the Hungarian version of the MFAS, an association of MFA with the stable union and gestational age was identified (Andrek et al., 2016). Among pregnant women in Italy, there was a relationship between 3rd trimester and social support (Busonera et al., 2016). In other psychometric assessments, no statistically significant results were found regarding income (Andrek et al., 2016; Doster et al., 2018), pregnancy planning (Andrek et al., 2016), the presence of depressive and stress symptoms (Andrek et al., 2016; Busonera et al., 2016; Doster et al., 2018; Lingeswaran & Bindu, 2012).

Such differences in relation to this study may be attributed to the greater variability and the large sample size of pregnant women interviewed, compared to the aforementioned investigations, in which the samples were smaller and more homogeneous in terms of socioeconomic and educational aspects. It can be inferred that the proposed reduced version has some novelty and a better ability to discriminate the levels of MFA. This is a relevant psychometric feature since it allows identifying differences in the construct's values between distinct groups in which such differences are theoretically expected (Echevarría-Guanilo et al., 2019; Polit & Yang, 2016). Moreover, in order to provide a more humanized and adequate care to the most vulnerable pregnant women in the FHS, the MFA examination should consider different interfering factors in specific cultural contexts (Andrek et al., 2016; Koss, Bidzan, Smutek, & Bidzan, 2016;

Rosa et al., 2021), as in the FHS of the northern region of the state of MG - the setting of this research. Early screening of women in social and psychological vulnerability is also indicated, since conditions such as stress and depression, observed in this research, are frequent during pregnancy, can compromise the mental health of the mother-child binomial, and continue after birth (Koss et al., 2016; McNamara et al., 2019).

With regard to the reliability of the abbreviated version of the MFAS, satisfactory indices of internal consistency were found for the overall scale and for its three factors. In the Italian version of 20 items, Cronbach's α value was appropriate for the total scale and for two of the three subscales (Busonera et al., 2016). The result of the total scale in this research was analogous to findings ascertained in psychometric evaluations of the 24-item version conducted in countries such as Germany (Doster et al., 2018), Hungary (Andrek et al., 2016), Italy (Lauriola et al., 2010), and India (Lingeswaran & Bindu, 2012). It was also similar to the Brazilian validation (Feijó, 1999). However, the factors of the version under analysis achieved higher reliability than that observed in the subscales of the original version in the aforementioned studies, in which deficiencies were observed in the measurement of Cronbach's α (Andrek et al., 2016; Busonera et al., 2016; Doster et al., 2018; Feijó, 1999; Lauriola et al., 2010; Lingeswaran & Bindu, 2012).

It is worth considering that reliability is not a fixed measurement property, since it can vary from one population to another and in different contexts. The positive result found in this study is relevant because reliability includes the degree of consistency with which the items of the instrument measure the proposed attribute free of measurement error. Thus, they have homogeneity: they measure the same construct and produce consistent results (Echevarría-Guanilo et al., 2017; Polit & Yang, 2016). Internal consistency also depends on the number of items in the scale, generally being higher as the number of items increases (Echevarría-Guanilo et al., 2017). This parameter possibly contributed to the satisfactory consistency of the three factors in this version of the MFAS.

This study is not without limitations. It was not possible to assess the concurrent criterion validity due to the absence in Brazil of another validated instrument or a "gold standard" measure related to the MFA construct. This indicates the need to develop and validate other scales on the subject in the country, which would enable the assessment of the aforementioned validity. The information was self-reported, so it is susceptible to social desirability. Reproducibility should be investigated in other studies. However, it must be emphasized that this is an unprecedented study to adapt and validate a reduced version of the MFAS in the context of PHC because other publications after the original study of validation of the instrument in the national scenario are unknown to date. The data came from a considerable sample of pregnant women, with population variability, addressed in a robust epidemiological survey covering all territories covered by the local FHS. This strength, together with the multiple techniques of psychometric analysis adopted, may also have conferred greater accuracy to the results found.

In summary, we believe that the reduced version of the MFAS may contribute to accurately identifying the peculiarities of MFA (Lingeswaran & Bindu, 2012), especially in PHC. In the context of the FHS and the UHS, this version may have practical implications regarding the identification of pregnant women and families who need a professional approach with a view to the quality of the mother-child bond. During prenatal care, it could be useful for strategies focusing on MFA quality and early screening of pregnant women at risk of developing a poor attachment relationship (Andrek et al., 2016; Busonera et al., 2016). Family health professionals need to establish a more humanized and welcoming relationship, in the process of preparing pregnant women and their families for prenatal care and the formation of healthier bonds (Rossen et al., 2017), going beyond the technicist approach to women. With this, we aim for maternal well-being and mental health, as well as the emerging mother-baby bond (Ertmann et al., 2021; Rosa et al., 2021).

This study provided evidence of construct validity, discriminant and convergent validity, and reliability of the abbreviated version of the MFAS. Therefore, the instrument proved to be applicable, which can encourage adherence to its use and facilitate the data collection process, maintaining a high psychometric level. This corroborates its use for the analysis of the MFA in the context of prenatal care to pregnant FHS users in the Brazilian PHC. The use of this version validated for the population of pregnant women in the UHS setting allows more accurate capture of attachment behaviors. Thus, it provides a better understanding and ability to assess attachment, with a view to contributing to the comprehensive care of pregnant women and their families assisted in the FHS, considering the context of public policies aimed at promoting maternal and child health.

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