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Cross-cultural adaptation and psychometric validation of the Portuguese Maternal Health Literacy Inventory in Pregnancy (MHELIP)

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Abstract

Background

Maternal health literacy is a key determinant of informed decision-making, self-care, and pregnancy outcomes. It encompasses women's ability to access, understand, appraise, and apply health information during pregnancy. This study aimed to validate the Portuguese version of the Maternal Health Literacy Inventory in Pregnancy (MHELIP).

Methods

This methodological validation study followed established procedures for cross-cultural adaptation, including forward translation, synthesis, back-translation, expert committee review, and pretesting. The Portuguese MHELIP was administered to 886 pregnant women. Psychometric evaluation included confirmatory factor analysis, item reliability assessment, internal consistency analysis, and evaluation of convergent and discriminant validity.

Results

Confirmatory factor analysis supported a four-factor structure for the Portuguese version of the MHELIP. After item refinement, the final instrument comprised 23 items and demonstrated acceptable model fit ($\chi^2/df = 4.41$; GFI = 0.91; CFI = 0.90; RMSEA = 0.062; RMR = 0.024; SRMR = 0.047). A second-order hierarchical model further supported the representation of maternal health literacy as a multidimensional construct. Internal consistency was excellent for the total scale ($\omega = 0.92$) and acceptable across subscales ($\omega = 0.75–0.82$). Convergent validity was supported for three of the four domains, while the Maternal Health Decision-Making and Behaviour domain showed an AVE below the recommended threshold. Discriminant validity was generally satisfactory, although a high conceptual overlap was observed between the Search for Maternal Health Information and Assessment of Maternal Health Information domains.

Conclusions

The Portuguese MHELIP demonstrated satisfactory psychometric properties and provides a shorter and theoretically coherent measure of maternal health literacy during pregnancy. Its brevity may facilitate its use in antenatal care settings and research. Further studies should examine temporal stability, predictive validity, and performance in more diverse Portuguese populations.

Trial registration:

Not applicable.

Background

Health literacy (HL) is widely recognised as a key social determinant of health. It influences people's ability to make informed decisions about disease prevention, health promotion, and healthcare navigation throughout the life course [1]. In maternal health, maternal health literacy (MHL) refers to the cognitive and social skills that enable pregnant women to access, understand, appraise, and apply health-related information in ways that promote their own health and that of the fetus [2].

Pregnancy is a critical window for health promotion, but it is also marked by complex physiological and psychological changes and substantial information demands. Pregnant women must often use diverse health information sources, navigate antenatal care systems, interpret medical recommendations, and make timely decisions about nutrition, physical activity, medication, birth preparedness, and newborn care [3]. Limited health literacy during this period has been associated with delayed initiation of antenatal care, poorer self-care practices, pregnancy complications, and adverse birth outcomes [4, 5].

Systematic reviews have shown that MHL among pregnant women varies widely across settings and is often inadequate, particularly among those from socioeconomically disadvantaged backgrounds, ethnic minorities, and younger age groups [5, 6]. Functional literacy, referring to basic skills in reading and understanding health materials, is the most commonly assessed dimension; however, interactive and critical literacy, which are essential for shared decision-making and autonomy in maternity care, remain underexplored [3, 6].

Although HL is recognised as a modifiable factor, few intervention studies have explicitly targeted MHL during pregnancy, and existing trials are heterogeneous and make limited use of theory-driven approaches [7]. Available evidence nevertheless suggests that tailored HL education can improve pregnant women's self-care practices and engagement in health-promoting behaviours [8]. Higher MHL has also been associated with greater use of antenatal services, increased participation in decision-making, and lower maternal morbidity [4].

These findings highlight the need for valid and reliable instruments to assess MHL. General HL measures, such as the HLS-EU-Q and the Newest Vital Sign (NVS), may not capture the specific information-processing and behavioural demands of pregnancy. To address this gap, Taheri et al. [2] developed the Maternal Health Literacy Inventory in Pregnancy (MHELIP), a 48-item scale designed to assess maternal health knowledge, information-seeking behaviour, information appraisal, and decision-making during pregnancy. The original Iranian validation reported strong psychometric properties, including high internal consistency and construct validity.

After its initial development, the MHELIP was adapted and validated in Turkish samples [9, 22], supporting its cross-cultural relevance and providing further evidence for its four-factor structure. However, no culturally adapted and psychometrically tested version has been available for Portuguese-

speaking populations. This is an important gap, given evidence of health literacy vulnerability among Portuguese pregnant women [10, 11].

Therefore, this study aimed to validate the Portuguese version of the MHELIP. By providing a culturally appropriate tool for assessing maternal health literacy, the study seeks to support evidence-based interventions and public health strategies that help pregnant women make informed health decisions throughout the perinatal period.

Methods

Development

The Maternal Health Literacy Inventory in Pregnancy (MHELIP) was developed by Taheri et al. [2] in Iran. It is a validated instrument designed to assess maternal health literacy among pregnant women. The scale comprises 48 items rated on a five-point Likert scale and is structured into two main sections: pregnancy-related health knowledge (21 items) and functional health literacy (27 items). The MHELIP includes four subscales: Maternal Health Knowledge, Search for Maternal Health Information, Assessment of Maternal Health Information, and Maternal Health Decision-Making and Behavior. Permission to adapt and validate the instrument was obtained from the original author before the study began.

The internal consistency of the original subscales, as assessed by Cronbach's alpha, was reported as 0.94, 0.66, 0.79, and 0.87, respectively. The total scale demonstrated excellent reliability, with an overall alpha of 0.94. Total raw scores range from 48 to 240, with higher scores indicating higher levels of maternal health literacy.

To standardise interpretation, raw scores are converted to a 0-100 scale using the formula: (raw score - minimum possible score)/ (maximum possible score - minimum possible score) × 100. Scores are classified into four levels: inadequate (0–50), problematic (50.1–66), sufficient (66.1–84), and excellent (84.1–100). This approach supports consistent interpretation and helps identify priority areas for health education interventions.

Cross-cultural adaptation

The cross-cultural adaptation of the MHELIP followed the five-stage process recommended by Beaton et al. [12]. In Stage 1 (translation), two bilingual translators, both native Portuguese speakers, independently translated the original English version into Portuguese. In Stage 2 (synthesis), the research team and translators compared the two versions, resolved discrepancies, and reached consensus on a preliminary Portuguese version. The few divergences identified were minor and mainly involved grammar or synonymous terminology with equivalent meaning in Portuguese.

Stage 3 (back-translation) was conducted by two certified translators whose native language was English and who were blind to the original version. They independently translated the synthesised Portuguese version back into English, thereby allowing verification of semantic equivalence and identification of any conceptual deviations from the source version.

In Stage 4 (expert committee review), a specialist panel evaluated the original, translated, and back-translated versions, focusing on conceptual, semantic, idiomatic, and experiential equivalence, as well as clarity and cultural appropriateness for Portuguese pregnant women. The expert committee included a PhD-level nursing researcher with methodological expertise, two senior specialist nurses with more than 20 years of clinical experience, and two certified native English-speaking translators.

Stage 5 (pretesting) involved administering the pre-final Portuguese version to a convenience sample of 50 women in the third trimester of pregnancy. Participants completed the questionnaire online using a QR code provided during antenatal care visits. Immediately after completion, cognitive interviews were conducted to assess clarity, semantic accuracy, and experiential relevance of the translated items. Although pretesting was not intended as formal psychometric validation, internal consistency of the original subscales was assessed using Cronbach's alpha. Reliability coefficients for the four subscales were 0.92, 0.84, 0.81, and 0.84, respectively, indicating acceptable to excellent consistency. The total scale showed excellent reliability ($\alpha = 0.95$). These preliminary results were used only to support semantic and cultural adaptation and were not included in the final validation analysis.

Participants and procedures

All participants provided informed consent before enrolment. For participants completing the questionnaire online, informed consent was obtained electronically by selecting an agreement statement before accessing the questionnaire. Participants completing the paper version provided written informed consent. Ethical approval was granted by the Institutional Health Ethics Committee of the Tondela-Viseu Hospital Centre (reference 29/13/09/2023) and the Central Regional Health Administration (process number 124–2023). All procedures complied with the ethical principles of the Declaration of Helsinki [13].

Eligibility criteria required participants to be pregnant women aged 18 years or older, with a gestational age of at least 10 weeks, and able to read and understand Portuguese. No exclusion criteria were established. Data collection was conducted from 15 October 2023 to 15 May 2024.

A non-probabilistic, multimodal convenience sampling strategy was employed. Recruitment took place during routine antenatal care visits in a public hospital, primary healthcare units, and private clinics. To encourage greater participation, QR codes and digital survey links were also disseminated via posters and flyers displayed in maternity care settings.

Although the final sample represented approximately 49% of the estimated pregnancies in the Viseu district during the study period, no stratification or weighting procedures were applied. This may restrict

the generalisability of the findings to other populations.

Statistical analysis

Descriptive statistics, correlational analyses, and internal consistency assessments were conducted using IBM SPSS Statistics, version 30.0. These analyses involved computing means, standard deviations, Pearson's correlation coefficients, and reliability estimates.

Internal consistency was evaluated using Cronbach's alpha and McDonald's omega (ω). Cronbach's alpha was reported to enable comparison with the original instrument, whereas omega was computed using jamovi software, version 2.7.34.0 [14], because it provides a more appropriate reliability estimate when the tau-equivalence assumption is relaxed [15]. Values above 0.90 were interpreted as very good, 0.80–0.90 as good, 0.70–0.80 as acceptable, 0.60–0.70 as questionable, 0.50–0.60 as poor, and below 0.50 as unacceptable [16, 17].

Pearson's correlation coefficients were interpreted according to the following thresholds: values below 0.20 were considered very weak, between 0.20 and 0.39 weak, between 0.40 and 0.69 moderate, between 0.70 and 0.89 strong, and equal to or greater than 0.90 very strong [16].

Confirmatory factor analysis (CFA) was performed using AMOS, version 29.0 [18], employing maximum likelihood estimation. Prior to model estimation, assumptions of multivariate normality were assessed using skewness, kurtosis, and Mardia's multivariate coefficient. Reference thresholds of 3.0, 7.0, and 5.0 were adopted, respectively [16, 19, 20].

Model fit was evaluated using the chi-square to degrees of freedom ratio (χ^2/df), Goodness-of-Fit Index (GFI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), Root Mean Square Residual (RMR), and Standardised Root Mean Square Residual (SRMR). Model fit was interpreted using the following criteria: $\chi^2/df < 3.0$ for good fit, with values up to 5.0 considered acceptable; GFI and CFI ≥ 0.90; RMSEA ≤ 0.05 for close fit and ≤ 0.08 for acceptable fit; and RMR and SRMR ≤ 0.06 for close fit, with values up to 0.08 considered acceptable.

Local model fit was further evaluated by examining the standardised factor loadings (λ) and individual item reliability coefficients (r^2), using minimum thresholds of 0.50 and 0.25, respectively [16, 21].

Results

Participant Characteristics

The final sample consisted of 886 pregnant women, with an average age of 31.09 years (SD = 5.60) and ranging from 18 to 51 years. Regarding age distribution, 39.7% were between 18 and 29 years, 53.3% were between 30 and 39 years, and 7.0% were aged 40 years or older. The majority of participants (89.5%) lived in the Viseu district, Portugal, and most self-identified as Portuguese nationals (81.2%).

In terms of educational attainment, 42.6% held a university degree and 40.7% had completed secondary education. The remaining participants reported lower levels of formal education, with 13.0% having completed the third cycle of basic education and 3.7% the second cycle. Most participants were either married or in a cohabiting relationship (73.4%), while 25.2% were single and 1.5% reported being divorced, separated or widowed.

With respect to employment status, 77.8% of participants were professionally active, while 22.2% were unemployed or not in the labour force. When asked about their perceived financial situation, 36.9% reported managing their monthly expenses with ease, 54.2% reported some difficulty, and 7.6% found it very difficult to meet financial obligations. Only 1.4% considered their financial situation to be very easy.

Concerning health status, 19.2% of participants reported having a chronic condition or disability. Of these, 69.4% said they found it easy or very easy to manage their condition, while 30.6% said they found it difficult or very difficult.

Regarding pregnancy characteristics, the mean gestational age was 29.60 weeks. Most participants (68.3%) were in the third trimester (between 28 and 41 weeks), 19.1% were in the first trimester (between 10 and 13 weeks), and 12.6% were in the second trimester (between 14 and 27 weeks). In terms of pregnancy risk, 74.2% reported having a pregnancy not classified as high-risk, while 25.8% were identified as having a high-risk pregnancy.

Descriptive statistics of the MHELIP items

Across the 48 items analysed, the highest mean scores were recorded for item 40 (“I attend for prenatal care (examinations) as scheduled”; M = 4.08, SD = 0.56) and item 38 (“I take pregnancy supplements as prescribed by the doctor or midwife”; M = 4.06, SD = 0.55). Item 41 (“I perform ultrasound and tests in pregnancy recommended by healthcare professionals”) and item 28 (“It is easy for me to read and pronounce pregnancy-related vocabulary”) also yielded high mean values, both exceeding 3.97.

The lowest mean scores were observed for item 19 (“I know the methods of pain relief in vaginal delivery”; M = 3.16, SD = 0.89) and item 12 (“I know injecting safe (allowed) vaccines during pregnancy”; M = 3.18, SD = 0.97).

Skewness values ranged from − 1.45 to -0.11, indicating mild to moderate negative asymmetry across the item set. The most pronounced negative skewness was found in item 5 (“I know proper activity and status in pregnancy”; skewness = -1.45) and item 4 (“I know personal health care”; skewness = -1.13). In terms of kurtosis, most items demonstrated a mesokurtic distribution, with values close to zero. The highest kurtosis values were noted for item 28 (4.71), item 4 (3.89), and item 41 (3.54), suggesting a slightly peaked distribution. The lowest kurtosis values were recorded for item 20 (“I know neonatal and infant care in the postpartum period”; kurtosis = -0.88) and item 19 (-0.87).

All skewness and kurtosis statistics remained within the acceptable threshold for univariate normality, indicating that there were no severe deviations from the normal distribution assumption (see Table 1).

Table 1
Descriptive statistics of the Maternal Health Literacy Inventory items (*n* = 886)

Item	Mean	SD	Skewness	Kurtosis
1. I know natural physical changes during pregnancy.	3.71	0.67	-0.863	1.435
2. I know natural psychological changes during pregnancy.	3.36	0.76	-0.381	-0.225
3. I know proper nutrition during pregnancy.	3.79	0.63	-1.207	2.481
4. I know personal health care.	3.89	0.54	-1.133	3.885
5. I know proper activity and status in pregnancy.	3.79	0.65	-1.449	3.006
6. I know proper exercise during pregnancy.	3.64	0.70	-1.072	1.098
7. I know pregnancy supplements (vitamins).	3.71	0.74	-1.095	1.476
8. I know the appropriate referral timing for pregnancy examinations (visits).	3.51	0.85	-0.728	0.283
9. I know diagnostic examination (ultrasound and tests) of maternal and fetal health in pregnancy.	3.50	0.89	-0.727	0.106
10. I know the acceptable and normal amount of weight gain during pregnancy.	3.60	0.74	-0.590	0.248
11. I know common pregnancy problems such as nausea, vomiting, lower back pain.	3.78	0.66	-1.116	2.039
12. I know injecting safe (allowed) vaccines during pregnancy.	3.18	0.97	-0.397	-0.578
13. I know the proper sexual relation during pregnancy.	3.72	0.68	-0.748	1.067
14. I know the normal number of fetal movements.	3.50	0.84	-0.812	-0.003
15. I know the factors affecting fetal health such as photography, medications, chemicals such as botox, etc.	3.72	0.79	-0.875	0.772
16. I know risk signs in pregnancy.	3.63	0.71	-0.892	0.758
17. I know pregnancy disease symptoms such as gestational diabetes, high blood pressure in pregnancy and other diseases.	3.37	0.81	-0.231	-0.396
18. I know childbirth such as the advantages and disadvantages of each of the natural delivery methods and cesarean section and their associated care.	3.37	0.87	-0.500	-0.413
19. I know the methods of pain relief in vaginal delivery.	3.16	0.89	-0.271	-0.866
20. I know neonatal and infant care in the postpartum period.	3.26	0.85	-0.400	-0.983
21. I know required postpartum care of mother.	3.27	0.87	-0.436	-0.725

Item	Mean	SD	Skewness	Kurtosis
22. I acquire information from written materials such as books, educational notes, pamphlets and medication brochures.	3.86	0.63	-1.107	2.638
23. I acquire information from radio and television.	3.53	0.80	-0.918	0.964
24. I acquire information from internet sources such as websites, instagram and telegram.	3.80	0.70	-0.895	1.707
25. I acquire information from other pregnant women.	3.49	0.71	-0.141	0.157
26. I acquire information from family, friends and acquaintances.	3.53	0.68	-0.114	0.044
27. I acquire information from healthcare professionals such as a physician or midwife.	3.86	0.56	-0.701	1.971
28. It is easy for me to read and pronounce pregnancy-related vocabulary from information sources such as books, educational booklets, internet, telegram and Instagram.	3.97	0.55	-0.998	4.706
29. The information obtained from different sources of information are understandable for me.	3.81	0.62	-0.890	2.103
30. I know valid and verified sources for getting the right pregnancy related information.	3.35	0.86	-0.470	-0.301
31. I ask of the doctor or midwife to make sure pregnancy related information.	3.72	0.65	-0.611	0.893
32. I Evaluate the accuracy of pregnancy-related information obtained from online sources such as websites, instagram and telegram.	3.20	0.89	-0.288	-0.642
33. I Evaluate the accuracy of pregnancy-related information obtained from friends and relatives	3.28	0.80	-0.303	-0.301
34. I able to control/management physical and psychological changes in pregnancy.	3.30	0.77	-0.454	0.025
35. I implement a proper diet for pregnancy.	3.55	0.76	-0.985	0.654
36. I implement necessary measures for personal health care during pregnancy.	3.73	0.60	-1.052	1.333
37. I adhere to the principles of activity and proper condition during pregnancy.	3.66	0.67	-1.072	1.021
38. I take pregnancy supplements as prescribe by doctor or midwife.	4.06	0.55	-0.621	3.223
39. I consult with the doctor or midwife for taking any type of medication during pregnancy (chemical and herbal).	3.81	0.61	-0.894	2.341
40. I attend for prenatal care (examinations) as scheduled.	4.08	0.56	-0.592	2.943

Item	Mean	SD	Skewness	Kurtosis
41. I Perform ultrasound and tests in pregnancy recommended by healthcare professionals such as doctor or midwife.	4.03	0.64	-1.041	3.543
42. I monitor and control the weight gain during pregnancy.	3.47	0.82	-0.412	-0.276
43. I use the appropriate methods of sexual relation during pregnancy.	3.66	0.73	-1.047	1.844
44. I avoid taking actions that are harmful to pregnancy.	3.88	0.59	-0.844	2.228
45. I see the doctor or midwife as soon as possible when any signs of danger in pregnancy is observed.	3.75	0.69	-0.670	0.986
46. I ask the doctor or midwife for further explanation if the information and recommendations are not clear enough.	3.53	0.83	-0.365	-0.279
47. I participate in decision making about pregnancy issues with the doctor or midwife (providing personal opinions).	3.32	0.89	-0.291	-0.487
48. I pay attention to the accuracy and appropriateness of information given to other pregnant women.	3.49	0.68	-0.163	-0.103

[1] SD, Standard deviation.

Confirmatory factor analysis and hierarchical modelling of the MHELIP

CFA was conducted to evaluate the factor structure of the MHELIP. Initially, standardised factor loadings, item reliability coefficients, and critical ratios were examined in the first-order measurement model. All critical ratios were statistically significant ($p < 0.05$), supporting the adequacy of the estimated parameters.

Several items had standardised factor loadings below the recommended threshold of 0.50 and individual item reliability coefficients (r^2) below 0.25, which negatively affected overall model fit. In line with established psychometric criteria [16], these items were progressively removed during model refinement. This process excluded 25 items from the original scale while retaining the theoretical four-factor structure of the MHELIP.

Subsequent model testing revealed high correlations between several first-order latent variables, suggesting conceptual proximity among the subscales. To improve theoretical parsimony, a second-order hierarchical model was specified. The higher-order structure supported the interpretation of maternal health literacy as a multidimensional construct represented by four interrelated domains. This

hierarchical structure improved conceptual clarity while preserving the theoretical framework underlying the original MHELIP.

Evaluation of model fit indices

As summarised in Table 2, progressive model refinement improved the fit indices. The initial model showed suboptimal fit, particularly for χ^2/df and comparative fit indices. Iterative modifications, guided by statistical criteria and theoretical justification, led to improvements across the global fit measures.

The final item-reduced and second-order models produced values within or close to accepted thresholds. Although χ^2/df remained above the stricter threshold for good fit, it was within the commonly accepted range for adequate fit. GFI and CFI approached or met the conventional 0.90 benchmark, supporting acceptable model fit.

For the second-order model, χ^2/df was 4.407, GFI was 0.908, CFI was 0.900, RMSEA was 0.062, RMR was 0.024, and SRMR was 0.047. These values indicate an acceptable overall fit of the hierarchical model, supporting the representation of maternal health literacy as a multidimensional construct composed of four interrelated domains.

Overall, the final Portuguese MHELIP demonstrated satisfactory psychometric performance and conceptual coherence, particularly when represented as a second-order hierarchical model.

Table 2
Goodness-of-fit indices for all model specifications

Model	χ^2/df	GFI	CFI	RMSEA	RMR	SRMR
Initial model	9.181	0.580	0.648	0.096	0.045	0.080
Model with modification indices	4.361	0.803	0.864	0.062	0.036	0.062
Model with deleted items	4.362	0.909	0.903	0.062	0.024	0.046
Second-order model	4.407	0.908	0.900	0.062	0.024	0.047

Note: χ^2/df, chi-square to degrees of freedom ratio; GFI, Goodness-of-Fit Index; CFI, Comparative Fit Index; RMSEA, Root Mean Square Error of Approximation; RMR, Root Mean Square Residual; SRMR, Standardised Root Mean Square Residual.

Internal consistency and item analysis

Table 3 presents descriptive statistics and internal consistency indicators for each of the four subscales in the final MHELIP. For each domain, the table reports the mean, standard deviation, corrected item-total correlation, squared multiple correlation (SMC), Cronbach's alpha if the item was deleted (α), and McDonald's omega if the item was deleted (ω). Global α and ω values are also provided for each subscale and for the total instrument.

The first subscale, Maternal Health Knowledge, includes seven items (1, 6, 10, 11, 13, 15, and 20) and demonstrated very good internal consistency, with α = 0.81 and ω = 0.82. Corrected item–total correlations ranged from 0.497 (item 20) to 0.612 (item 11), all above the recommended threshold of 0.40. The SMC values ranged between 0.262 and 0.393, indicating a moderate proportion of variance explained by the remaining items.

The second subscale, Search for Maternal Health Information, comprised five items (22, 24, 25, 26, and 27) and showed acceptable reliability (α = 0.77; ω = 0.77). Corrected item-total correlations ranged from 0.417 to 0.628. Items 25 and 26 had the highest SMC values (0.568), indicating strong associations with the latent factor.

The third subscale, Assessment of Maternal Health Information, comprised four items (29, 30, 31, and 33) and showed acceptable reliability (α = 0.78; ω = 0.79). Corrected item-total correlations ranged from 0.541 to 0.632, and SMC values exceeded 0.29 for all items, supporting adequate item contribution to the factor.

The fourth subscale, Maternal Health Decision-Making and Behavior, comprised seven items (34, 36, 39, 41, 42, 43, and 48). Internal consistency was acceptable, with α = 0.75 and ω = 0.75. Corrected item-total correlations ranged from 0.411 to 0.505, while SMC values ranged from 0.187 to 0.259, the lowest among the four subscales, but still within acceptable limits.

At the instrument level, the MHELIP global score demonstrated excellent internal consistency, with both α and ω equal to 0.92.

These results indicate satisfactory to excellent internal consistency for the subscales and the total instrument, supporting the reliability of the final Portuguese MHELIP.

Table 3
Internal consistency and Item Analysis of the MHELIP

Items	Mean	SD	Corrected item-total correlation	Squared multiple correlation	Cronbach's α without item	McDonald's ω without item
Maternal Health Knowledge					0.81	0.82
1	3.71	0.67	0.542	0.300	0.79	0.80
6	3.64	0.70	0.559	0.320	0.79	0.79
10	3.60	0.74	0.569	0.358	0.79	0.79
11	3.78	0.66	0.612	0.393	0.78	0.78
13	3.72	0.68	0.519	0.299	0.79	0.80
15	3.72	0.79	0.582	0.359	0.78	0.79
20	3.26	0.85	0.497	0.262	0.80	0.80
Search for Maternal Health Information					0.77	0.77
22	3.87	0.63	0.417	0.239	0.77	0.78
24	3.80	0.70	0.577	0.341	0.71	0.73
25	3.49	0.71	0.628	0.568	0.69	0.70
26	3.53	0.68	0.626	0.568	0.70	0.70
27	3.86	0.56	0.455	0.223	0.75	0.77
Assessment of Maternal Health Information					0.78	0.79
29	3.81	0.62	0.588	0.347	0.74	0.74
30	3.35	0.86	0.632	0.407	0.71	0.72
31	3.72	0.65	0.541	0.298	0.75	0.77
33	3.28	0.80	0.627	0.398	0.71	0.72
Maternal Health Decision Making and Behavior					0.75	0.75
34	3.30	0.77	0.432	0.216	0.73	0.73
36	3.73	0.60	0.489	0.248	0.71	0.72

Items	Mean	SD	Corrected item-total correlation	Squared multiple correlation	Cronbach's α without item	McDonald's ω without item
39	3.81	0.61	0.436	0.217	0.72	0.73
41	4.03	0.64	0.411	0.187	0.73	0.73
42	3.47	0.82	0.505	0.259	0.71	0.71
43	3.66	0.73	0.478	0.236	0.71	0.72
48	3.49	0.68	0.504	0.255	0.71	0.71
MHELIP Global					0.92	0.92

Simultaneous confirmatory factor analysis

To evaluate construct validity and determine how well each item reflected its underlying domain, standardised factor loadings were examined. Higher loadings indicate stronger alignment between each item and its latent factor, supporting the internal consistency and theoretical structure of the measurement model.

In parallel, inter-factor correlations were calculated to examine the degree of conceptual and statistical association between subscales. This step is particularly relevant in hierarchical modelling, because strong and significant correlations among first-order factors may justify the specification of a higher-order latent construct. Together, these analyses provide evidence for factorial validity, convergent validity, and the theoretical robustness of the instrument.

All standardised factor loadings ranged from 0.62 to 0.86, indicating moderate to strong associations between items and their respective subscales. The highest loadings were observed for items 31 and 33 (both $\lambda = 0.86$) in the Assessment of Maternal Health Information subscale, indicating substantial contributions to the underlying construct. All loadings were statistically significant ($p < 0.001$), supporting factorial validity.

Inter-factor correlations were uniformly positive and statistically significant ($p < 0.001$), ranging from 0.60 to 0.88. The strongest correlation was found between Search for Maternal Health Information and Assessment of Maternal Health Information ($r = 0.88$), suggesting considerable conceptual proximity between these dimensions. These findings support the plausibility of a second-order hierarchical model, in which the four first-order subscales load onto a broader latent construct representing overall maternal health literacy (Table 4).

Table 4
Factor loadings and inter-factor correlations from confirmatory factor analysis

MHELIP	Factor loading
Maternal Health Knowledge	
1. I know natural physical changes during pregnancy.	0.74
6. I know proper exercise during pregnancy.	0.68
10. I know the acceptable and normal amount of weight gain during pregnancy.	0.74
11. I know common pregnancy problems such as nausea, vomiting, lower back pain.	0.75
13. I know the proper sexual relation during pregnancy.	0.69
15. I know the factors affecting fetal health such as photography, medications, chemicals such as botox…	0.64
20. I know neonatal and infant care in the postpartum period.	0.66
Search for Maternal Health Information	
22. I acquire information from written materials such as books, educational notes, pamphlets and medication brochures.	0.62
24. I acquire information from internet sources such as websites, Instagram and telegram.	0.72
25. I acquire information from other pregnant women.	0.71
26. I acquire information from family, friends and acquaintances.	0.72
27. I acquire information from healthcare professionals such as a physician or midwife.	0.66
Assessment of Maternal Health Information	
29. The information obtained from different sources of information are understandable for me.	0.80
30. I know valid and verified sources for getting the right pregnancy related information.	0.84
31. I ask of the doctor or midwife to make sure pregnancy related information.	0.86
33. I Evaluate the accuracy of pregnancy-related information obtained from friends and relatives	0.86
Maternal Health Decision Making and Behavior	
34. I am able to control/manage physical and psychological changes in pregnancy.	0.70

MHELIP			Factor loading
36. I implement necessary measures for personal health care during pregnancy.			0.77
39. I consult with the doctor or midwife for taking any type of medication during pregnancy.			0.71
41. I perform ultrasound and tests in pregnancy recommended by healthcare professionals…			0.77
42. I monitor and control the weight gain during pregnancy.			0.74
43. I use the appropriate methods of sexual relation during pregnancy.			0.73
48. I pay attention to the accuracy and appropriateness of information given to other pregnant women.			0.72
Factors	Search for Maternal Health Information	Assessment of Maternal Health Information	Maternal Health Decision Making and Behavior
Maternal Health Knowledge	0.60	0.60	0.65
Search for Maternal Health Information		0.88	0.71
Assessment of Maternal Health Information			0.82

Note

All coefficients are statistically significant ($p < 0.001$)

Convergent validity

Convergent validity was assessed using average variance extracted (AVE) and McDonald's omega (ω). Omega coefficients indicated satisfactory internal consistency across all domains: Maternal Health Knowledge (ω = 0.821), Search for Maternal Health Information (ω = 0.814), Assessment of Maternal Health Information (ω = 0.793), and Maternal Health Decision-Making and Behaviour (ω = 0.754). AVE values were 0.502, 0.595, 0.596, and 0.389, respectively. AVE exceeded the recommended threshold of 0.50 for Maternal Health Knowledge, Search for Maternal Health Information, and Assessment of Maternal Health Information, supporting convergent validity for these domains. The Maternal Health Decision-Making and Behaviour domain showed an AVE below the recommended threshold, suggesting that convergent validity for this domain should be interpreted with caution. Nevertheless, all standardised factor loadings were statistically significant, and the reliability estimates supported the overall adequacy of the measurement model.

Discriminant validity

Discriminant validity was assessed using the heterotrait–monotrait ratio of correlations (HTMT). HTMT values ranged from 0.788 to 0.912. Most values were below the recommended threshold of 0.90, supporting discriminant validity between the four domains. A slightly elevated HTMT value was observed between Search for Maternal Health Information and Assessment of Maternal Health Information (HTMT = 0.912), suggesting substantial conceptual overlap between these closely related dimensions.

Discussion

This study provides evidence for the factorial validity and internal consistency of the Portuguese version of the MHELIP. The four-factor structure originally reported in the Iranian validation by Taheri et al. [2] and subsequently examined in Turkish validation studies [9, 22] was retained in the Portuguese context. This cross-cultural replication supports the conceptual relevance of maternal health literacy as a multidimensional construct encompassing knowledge, information seeking, critical appraisal, and decision-making.

A distinctive finding of the Portuguese validation was the reduction from 48 to 23 items. In the original Iranian validation [2] and in the Turkish validation studies [9, 22], the full 48-item instrument was retained. In the present study, item removal was driven by predefined psychometric criteria, particularly low standardised factor loadings and low item reliability, while preserving the theoretical four-factor structure. The resulting shorter version maintained satisfactory reliability and factorial validity, suggesting that a more parsimonious Portuguese form may be feasible. This reduction may reflect linguistic adaptation, cultural relevance, and the relatively high educational profile of the sample, which may have made some items redundant or less discriminative.

Another methodological strength was the use of a diversified data collection strategy, allowing participants to complete the questionnaire online, with interviewer support, or on paper. Providing multiple participation options improved accessibility for women with different levels of digital competence, educational backgrounds, and personal preferences. This flexibility may have increased participation and broadened inclusion. Previous research suggests that combining digital and traditional survey methods can increase response rates, widen demographic reach, and maintain data quality in maternity research [7, 23].

The findings also highlight the importance of condition-specific tools for evaluating health literacy during pregnancy. Generic health literacy measures may not capture the cognitive, behavioural, and emotional processes required to understand and act on antenatal health information. The shorter Portuguese MHELIP may therefore be useful for identifying women who could benefit from tailored education, counselling, or decision-support interventions. Its reduced length may be particularly valuable in routine antenatal care, where time constraints can limit the feasibility of longer instruments. This is relevant to woman-centred maternity care, in which informed and autonomous decision-making is a core professional and ethical principle [3].

Strengths and limitations

A major strength of this study is the rigorous cross-cultural adaptation process, conducted in accordance with internationally recognised guidelines, combined with the large sample of pregnant women recruited from multiple healthcare settings. The use of confirmatory factor analysis and complementary psychometric indicators, including McDonald's omega, average variance extracted, and the heterotrait–monotrait ratio, provided a comprehensive evaluation of the Portuguese MHELIP.

The findings should be interpreted in light of some limitations. Although the sample size was robust, participants were recruited from a single Portuguese region, which may limit the generalisability of the results. The cross-sectional design precluded the assessment of temporal stability, and test–retest reliability was therefore not evaluated. In addition, one domain showed an AVE below the recommended threshold, and the high HTMT value between two domains suggests some conceptual overlap that warrants further investigation in future validation studies.

Conclusions

The Portuguese MHELIP demonstrated satisfactory psychometric properties, preserving the theoretical four-factor structure while reducing the number of items. This shorter format may provide a feasible tool for assessing maternal health literacy in antenatal care and research. The adaptation underscores the importance of cultural and linguistic validation when applying health literacy instruments across settings. Future studies should confirm the shortened structure in independent samples, examine test-retest reliability and predictive validity, and evaluate whether MHELIP scores can inform targeted interventions to improve maternal health literacy and pregnancy-related outcomes.

Abbreviations

AVE: Average variance extracted

HTMT: Heterotrait–monotrait ratio of correlations

HL: Health literacy

MHL: Maternal Health Literacy

HLS-EU-Q: European Health Literacy Survey Questionnaire

NVS: Newest Vital Sign

MHELIP: Maternal Health Literacy Inventory in Pregnancy

ω: McDonald's omega

WHO: World Health Organization

χ^2/df: Chi-square to degrees of freedom ratio

GFI: Goodness-of-Fit Index

CFI: Comparative Fit Index

RMSEA: Root Mean Square Error of Approximation

RMR: Root Mean Square Residual

SRMR: Standardised Root Mean Square Residual

SD: Standard deviation

CFA: Confirmatory factor analysis

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Institutional Health Ethics Committee of the Tondela-Viseu Hospital Centre (reference 29/13/09/2023) and the Central Regional Health Administration (process number 124-2023). All participants provided informed consent before data collection. Participants completing the online questionnaire provided electronic informed consent by confirming their agreement before accessing the survey, whereas participants completing the paper version provided written informed consent. All procedures were conducted in accordance with the ethical standards of the institutional and national research committees and with the principles of the Declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analysed during the current study are not publicly available due to ethical and privacy considerations but are available from the corresponding author on reasonable request and in accordance with applicable ethical approvals and institutional regulations.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

NF designed the study. NF and SF collected data. NF performed the analysis, and all authors interpreted the data. NF wrote the main manuscript text. NF conducted the software-based analyses. MF, SF, and AC read, provided feedback on, and approved the final version of the manuscript. All authors read and approved the final manuscript.

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