BMC Pregnancy and Childbirth

RESEARCH

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Development and validation of a tool to assess mothers' knowledge, perception, and practice of child growth monitoring

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Abstract

Background Child growth monitoring (CGM) is essential for the early detection and prevention of malnutrition and growth abnormalities. Despite its importance, there is a lack of validated instruments to assess mothers' knowledge, perceptions, and practices related to CGM. This study aimed to develop and validate a comprehensive questionnaire to assess these domains among mothers of children under five years of age.

Methods The study was conducted in two stages. First, a theory-driven questionnaire was developed based on an extensive literature review, global and national guidelines, and expert consultation. Second, the questionnaire's psychometric properties were evaluated using data from a cross-sectional survey of 436 mothers. An expert panel assessed content validity, internal consistency was examined using Cronbach's alpha, and construct validity was evaluated using confirmatory factor analysis (CFA).

Results The final questionnaire comprised 67 items across three domains: knowledge (27 items), perception (14 items), and practice (11 items). The instrument demonstrated good overall internal consistency (Cronbach's alpha = 0.82), with strong reliability across main domains (α = 0.81–0.92). CFA supported the hypothesized three-domain structure, with good model fit indices for the full measurement model (CMIN/DF = 1.62; CFI = 0.93; TLI = 0.93; RMSEA = 0.038).

Conclusion This study presents a valid and reliable questionnaire for assessing mothers' knowledge, perceptions, and practices regarding CGM. The tool can support research, inform maternal education strategies, and guide public health interventions to improve early childhood growth outcomes.

Keywords Parental Health Literacy, Maternal Health Education, Child Growth Monitoring, Early Childhood Development, Maternal Perceptions

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Background

Malnutrition among children under five remains a primary global health concern and contributes significantly to child morbidity and mortality [1]. According to the World Health Organization (WHO), stunting affected 149 million children under the age of five in 2022, while wasting affected 45 million children globally [2]. Several factors contribute to child malnutrition, including, but not limited to, maternal education, household income, maternal nutritional status, child age, birth order, and birth weight [3]. Early identification of growth faltering and timely intervention are essential to prevent long-term consequences, such as impaired cognitive development, reduced educational attainment, and decreased economic productivity later in life [4–6].

Child growth monitoring (CGM) is a preventive child health strategy recommended by WHO as part of the Integrated Management of Childhood Illness and the Baby-Friendly Hospital Initiative [7]. It involves the regular measurement and interpretation of a child's growth indicators, typically weight, height, and head circumference, over time, using standardized growth charts such as those developed by the WHO and the Centers for Disease Control and Prevention (CDC) [7, 8].

GM enables early detection of undernutrition, overnutrition, or growth faltering, prompting further assessment, counseling, or referral [9, 10]. However, effective growth monitoring requires more than measurement alone. The process includes various measurements, the appropriate use of sex-specific growth charts, plotting growth distinct curves, and interpreting these curves for both pattern and interval growth [11, 12]. It also depends on caregivers' understanding, attitudes, and actions toward growth monitoring practices. In particular, mothers play a critical role in interpreting growth chart information, recognizing warning signs, and seeking appropriate care [13].

Despite the centrality of mothers' roles in child health, research on maternal understanding of growth monitoring and growth charts is limited, with the existing literature revealing significant gaps in knowledge and a lack of valid and reliable assessment tools [14, 15], particularly in the context of the United Arab Emirates (UAE) and other Eastern Mediterranean (EMRO) countries. Existing studies in EMRO have relied mainly on unvalidated tools or qualitative methods, limiting their comparability and application for program evaluation [16–19]. The development of a psychometrically sound instrument to assess mothers' knowledge, perceptions, and practices (KPP) of GM is essential for understanding current gaps and informing targeted health promotion strategies. This study aimed to develop and validate a comprehensive questionnaire to assess KPP of child GM among mothers of children under five years of age in the UAE.

Methods

The study was conducted in two sequential stages. The first stage involved developing a theory-informed questionnaire based on a comprehensive literature review. The second stage entailed evaluating the instrument's psychometric properties through expert review and statistical validation using confirmatory factor analysis (CFA) on pilot data collected from a sample of mothers in the UAE. The reporting of the instrument development and validation followed the COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments) recommendations for studies on measurement properties [20, 21]. The COSMIN checklist is available in supplementary file 1.

Item and domain development

The conceptual development of the instrument was guided by the Knowledge-Attitude-Practice (KAP) model, adopted in mother and child health research, which posits that knowledge informs perceptions and attitudes, which in turn shape behaviors [22, 23]. In addition, health literacy frameworks were incorporated to reflect mothers' ability to obtain, understand, and apply health information related to child growth [24]. Based on a synthesis of regional and national guidelines [11], as well as relevant literature on maternal knowledge of CGM [14], a 73-item preliminary questionnaire was developed and organized into five sections:

- Sociodemographic characteristics: 13 items capturing maternal and child characteristics (e.g., age, education, household income, child gender, birth order).
- Awareness of child growth and development: two items assessing familiarity with growth concepts and sources of information.
- Maternal knowledge: 36 items covering core domains of growth monitoring, including definitions, timing, frequency, and interpretation of growth charts (including visual assessments).
- Maternal perception: 13 items to assess beliefs and attitudes toward CGM measured using a 5-point Likert scale.
- Practices: Nine items exploring maternal actions related to tracking child growth, including clinic visits and home-based practices.

Expert review and content validity testing

To establish face and content validity, the questionnaire was evaluated by a panel of six experts with backgrounds in maternal and child health, public health nutrition, and clinical dietetics. Items were rated for clarity and relevance using a 4-point Likert scale.

Item Content Validity Index (I-CVI) and Scale-Level Content Validity Index (S-CVI/Ave) were computed [25]. For relevance, I-CVI scores ranged from 0.83 to 1.00; for clarity, scores ranged from 0.67 to 1.00. Items scoring < 0.83 were revised based on expert feedback. Final S-CVI/Ave was 0.99 for relevance and 0.90 for clarity, indicating high content validity.

Pilot testing and inclusion criteria

The revised instrument was pilot tested on a convenience sample of 436 mothers attending pediatric outpatient clinics at two hospitals in Sharjah, UAE. Inclusion criteria included being the mother of a child under 5 years of age (0–59 months) and providing informed consent. The pilot aimed to test item clarity, internal consistency, and psychometric structure. The sample size exceeded the minimum recommended threshold of 300 for instrument validation [26].

The study targeted mothers of children under five years old attending paediatric clinics at two selected hospitals in Sharjah, UAE. The inclusion criteria required participants to be mothers with children aged 0–59 months, attending the paediatric clinics at the selected hospitals, and having provided informed consent to participate in the study.

Statistical analysis

Given the priori theoretical model and the predefined domain structure, only CFA was conducted. The instrument was conceptualized using a reflective measurement model, in which the observed questionnaire items were assumed to reflect the underlying latent constructs of Knowledge, Perception, and Practice. Exploratory factor analysis was therefore not pursued, as the conceptual domains were explicitly hypothesized based on the KAP framework and validated through expert review. Attempted data splitting for independent validation was deemed unfeasible due to insufficient subsample size ($n = 218$); therefore, CFA was performed on the full sample ($n = 436$), consistent with recommendations for initial psychometric evaluation of theory-driven instruments.

CFA was conducted using AMOS version 24, while SPSS version 28 was used for descriptive analysis and reliability testing. Model parameters were estimated using maximum likelihood estimation. Model fit was evaluated using a comprehensive set of indices. Absolute fit was assessed using the Root Mean Square Error of Approximation (RMSEA), the Root Mean Square Residual (RMR), and the Chi-square to degrees of freedom ratio (CMIN/DF). Incremental fit was evaluated using the Goodness-of-Fit Index (GFI), the Adjusted Goodness-of-Fit Index (AGFI), the Comparative Fit Index (CFI), and the Tucker–Lewis Index (TLI). These indices were interpreted jointly to determine the adequacy of model fit to the observed data.

Standardized factor loadings of ≥ 0.30 were considered acceptable indicators of the latent constructs. Model modification indices were inspected to assess localized misfit; however, cross-loadings were not permitted, and correlated error terms were introduced only when theoretically justified within the same factor. The final model represented a balance between empirical model fit and theoretical parsimony.

Missing data were minimal and handled using complete-case analysis, in which only observations with complete responses for the analyzed items were included in the CFA and reliability analyses. Internal consistency was assessed using Cronbach's alpha (α) for each domain and for the total scale. Because the instrument comprises three theoretically distinct domains, reliability coefficients were interpreted at the domain level. Values of $\alpha \geq 0.70$ were considered acceptable.

Results

Questionnaire structure

After refinement based on expert review and pilot testing, the final questionnaire consisted of four sections with a total of 67 items: knowledge (27 items), perception (14 items), practice (11 items), and socio-demographic and child-related characteristics (15 items) (Supplementary file 2). These domains were designed to assess maternal knowledge, perception, and practices related to CGM among mothers of children under five years of age.

Participant characteristics

Table 1 summarizes the socio-demographic characteristics of participants and their children. The study included 436 mothers with a mean age of 31.9 ± 5.8 years. The majority of them, 255(58.5%), had a bachelor's degree or diploma. About one-third were employed full-time, while more than half were housewives 242(55.5%) and reported a monthly household income between 15,000 and 35,000 AED. Most participants were Emirati 277(63.5%), followed by non-Emirati Arabs 113(25.9%). The mean number of pregnancies was 3.2 ± 2.0(range: 1–12), and the mean number of children was 2.7 ± 1.57(range:1–8). Around 52% of the children were less than 2 years old, 55% were male, and 54% were the eldest child. Additionally, 22.7% of the children were born prematurely, and around 18% had a health condition.

Reliability analysis

Internal consistency was evaluated using Cronbach's alpha at both the domain and factor levels (Supplementary file 3). Cronbach's alpha coefficients for each factor within the knowledge, perception, and practice domains are presented in. Cronbach's alpha (α) indicates good

Table 1 Socio-demographic characteristics of participants and their children ($n = 436$)

Variables		*N*	(%)
Mother age (mean ± SD)	31.9 ± 5.8		
Mother education Level	Less than high school	22	(5.0)
	High school	114	(26.1)
	Bachelor's/Diploma	255	(58.5)
	Higher education (MSc/PhD)	45	(10.3)
Mother marital status	Married	435	(99.8)
	Widowed	1	(0.2)
Mother employment	Full-time	169	(38.8)
	Housewife	242	(55.5)
	Self-employed\student	25	(5.7)
Monthly household income AED (USD)*	< 5,000 (< 1,360)	52	(11.9)
	5,000–<15,000 (1,360–<4,080)	74	(17.0)
	15,000–<25,000 (4,080–<6,800)	123	(28.2)
	25,000–<35,000 (6,800–<9,520)	113	(25.9)
	≥ 35,000 AED (≥ 9,520)	74	(17.0)
Mother nationality	Emirati	277	(63.5)
	Non-Emirati Arab	113	(25.9)
	Non-Arab (Asian)	42	(9.6)
	Non-Arab (Western)	4	(0.9)
Total number of pregnancies	1	97	(22.2)
	2	105	(24.1)
	3	81	(18.6)
	4	61	(14.0)
	5+	92	(21.1)
Total number of children	1	117	(26.8)
	2	118	(27.1)
	3	80	(18.3)
	4	65	(14.9)
	5+	56	(12.8)
Child age group	< 1 year	139	(31.9)
	1-<2 years	87	(20.0)
	2-<3 years	76	(17.4)
	3-<4 years	78	(17.9)
	4–5 years	56	(12.8)
Child gender	Male	240	(55.0)
	Female	196	(45.0)
Child order categories	First child	49	(11.2)
	Middle child	35	(8.0)
	Only child	117	(26.8)
	Eldest child	235	(53.9)
Child born prematurely	Yes	99	(22.7)
	No	337	(77.3)
Children suffer from any health condition	Yes	78	(17.9)
	No	358	(82.1)

*Values represent approximate equivalents based on average exchange rates during the study period.

overall reliability with an alpha value of 0.82 for the entire instrument. Specifically, the knowledge domain (27 items) had a Cronbach's alpha of 0.81, the perception domain (14 items) had 0.86, and the practice domain (11 items) had 0.92, demonstrating a strong reliability across all domains.

Confirmatory factor analysis

CFA was conducted to assess the factorial validity of the three hypothesized domains: knowledge, perception, and practice. Each domain was analyzed separately, followed by an integrated full measurement model.

- Knowledge domain: The model demonstrated acceptable fit indices (CMIN/DF = 1.95; CFI = 0.91; TLI = 0.90; RMSEA = 0.047, 90% CI: [0.041–0.052]).
- Perception domain: The model showed good fit (CMIN/DF = 2.22; CFI = 0.97; TLI = 0.96; RMSEA = 0.053, 90% CI: [0.041–0.065]).
- Practice domain: The model exhibited excellent fit (CMIN/DF = 1.36; CFI = 0.99; TLI = 0.99; RMSEA = 0.029, 90% CI: [0.000–0.046]).

In addition, a full model (Table 2), combining all three domains, was tested and yielded satisfactory goodness-of-fit indices, supporting the hypothesized structure (CMIN/DF = 1.62; CFI = 0.93; TLI = 0.93; RMSEA = 0.038, 90% CI: [0.035–0.041])

Standardized factor loadings for each item are presented in Fig. 1. Most items showed strong and acceptable loadings on their respective latent constructs. Two items related to "age" and "weight" in the Knowledge_3 subdomain (important information about growth monitoring) demonstrated lower factor loadings; however, they were retained due to their conceptual and clinical relevance. Inter-factor correlations among the three domains were weak to moderate, indicating acceptable discriminant validity across constructs (Supplementary file 3).

Discussion

Although parents express a desire to know whether their child is at risk of malnutrition or obesity and how to monitor their growth effectively [25–27], there is limited evidence on the availability of tools that assess maternal understanding, perception, and practices of CGM. This study developed and psychometrically validated a novel questionnaire to assess mothers' KPP related to CGM in the United Arab Emirates.

Prior research across diverse settings has consistently reported gaps in parental knowledge and in the use of growth charts. For example, in Saudi Arabia, only 35.8% of mothers were aware of growth charts, and a mere 8.6% had ever used one [16]. Another pooled analysis showed that more than half of parents underestimate their child's weight status when the child is overweight or obese [27]. This misperception, shaped by cultural norms,

Table 2 Goodness-of-fit indicators of the confirmatory factor analysis

Model fit statistics	χ^2	DF	Absolute fit index			Incremental fit index			
			CMIN/DF	RMSEA (90%CI)	RMR	GFI	AGFI	CFI	TLI
Knowledge	597.3	307	1.95	0.047 (0.041–0.052)	0.032	0.91	0.89	0.91	0.90
Perception	144.2	65	2.22	0.053 (0.041–0.065)	0.041	0.96	0.93	0.97	0.96
Practice	58.4	43	1.36	0.029 (0.00–0.046)	0.007	0.98	0.96	0.99	0.99
Full mode	1986.4	1225	1.62	0.038 (0.035–0.041)	0.032	0.85	0.83	0.93	0.93
Standard	---	---	< 3.0	≤ 0.05 or ≤ 0.10	≤ 0.05	> 0.9	> 0.9	> 0.9	> 0.9

CMIN The model Chi-squared, *DF* The degrees of freedom, *RMSEA* The Root Mean Square Error, *RMR* The Root Mean Square Residual, *GFI/AGFI* The (Adjusted) Goodness of Fit, *CFI* The Comparative Fit Index, and *TLI* Tucker-Lewis Index.

socioeconomic status, and personal beliefs, can hinder early intervention. Parents are pivotal in promoting healthy growth by ensuring proper nutrition and routine health monitoring [28–31]. Growth charts, when appropriately understood, offer a validated and accessible tool for both caregivers and healthcare providers to detect undernutrition or obesity early [17, 32, 33]. However, studies have shown that parents often misinterpret these charts due to poor health literacy or confusion about percentiles and reference standards [34–37].

Most previous studies on mothers and caregivers' understanding of CGM used ad-hoc questionnaires focused on a few indicators of awareness or utilization [38–42]. Only a few recent studies have provided knowledge scoring [44] or focused on growth monitoring literacy and behavior [14]. On the other hand, our present CGM instrument was constructed through a rigorous, theory-driven process informed by the KAP model and health literacy frameworks. The validated questionnaire includes 67 refined items across three domains, knowledge, perception, and practice, and demonstrated robust psychometric properties. Internal consistency was high across domains (α = 0.81–0.92), indicating strong reliability. Content validity was supported by high expert consensus (S-CVI/Ave = 0.99 for relevance), and the three-domain structure was further confirmed by CFA. Most items demonstrated satisfactory loadings, and even those with lower values (e.g., age- and weight-related knowledge items) were retained due to their conceptual importance. The CFA results, including excellent model fit indices, reinforce the tool's internal structure and theoretical alignment.

The validated CGM KPP instrument shows strong potential for use in maternal and child health research and programming, as it serves as a diagnostic tool to identify specific knowledge gaps, misperceptions, or poor practices among mothers. Health practitioners can use the questionnaire in clinical or community settings to screen for mothers who may not understand how to track their child's growth. Moreover, the tool can be used for monitoring and evaluation of public health initiatives. Agencies implementing nutrition or growth monitoring programs can administer the KPP questionnaire before and after interventions (such as mass media campaigns or community workshops) to quantitatively assess improvements in maternal knowledge and practices.

Several limitations must be acknowledged. First, the cross-sectional design prevented assessment of test–retest reliability. Future studies should examine the instrument's temporal stability. Second, the sample was drawn from two hospitals in Sharjah using convenience sampling, which may limit generalizability. Larger, more diverse samples are needed to validate the tool across other cultural and clinical contexts. Third, although detailed sociodemographic and socioeconomic data were collected, this study did not examine their associations with domain scores. Future work should assess concurrent and predictive validity by testing hypotheses about how factors such as maternal education, household income, and health service utilization relate to domain-specific scores.

Another methodological limitation is that CFA was conducted without prior Exploratory Factor Analysis. While CFA can be used independently when the factor structure is firmly grounded in theory and expert input, as was the case in this study, the absence of EFA means that potential alternative factor structures may not have been fully explored. Future research should consider conducting EFA in separate or larger samples to verify and potentially refine the factor structure. Additionally, measurement invariance across subgroups (e.g., nationality, education level) was not assessed. Establishing invariance is essential to confirm that the instrument performs equivalently across diverse maternal populations. Future studies should evaluate subgroup invariance and investigate how cultural, literacy, and socioeconomic differences may influence responses to the CGM instrument. Despite these limitations, this study provides a validated and theory-informed tool for assessing maternal engagement in CGM. By offering insights into mothers' knowledge gaps

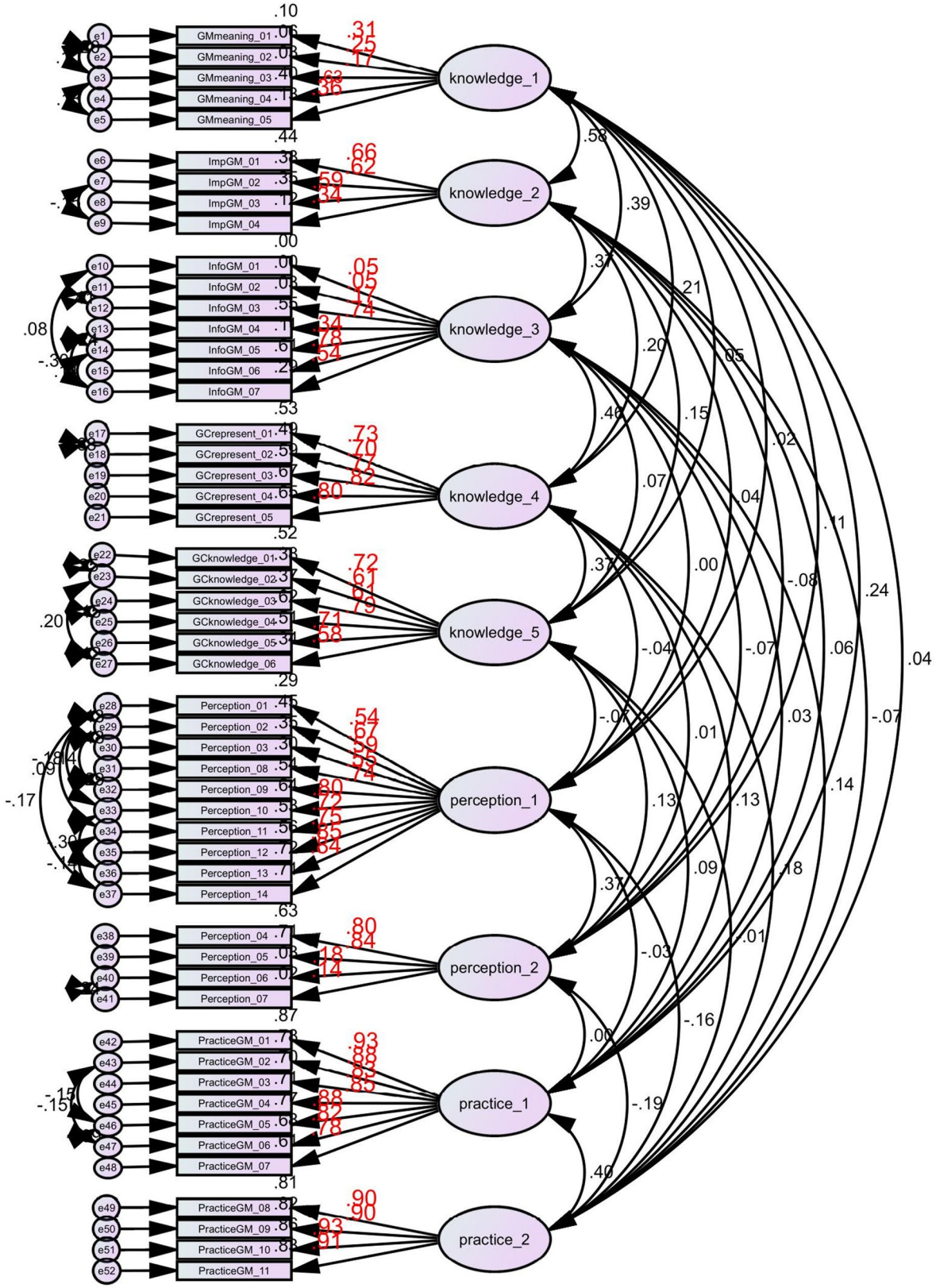

Fig. 1 Path diagram of the full model with standardized coefficients and modification indices

and behavioral patterns, the tool can support tailored health education, inform intervention development, and enhance public health surveillance systems. The instrument is also adaptable for use in other Arabic-speaking countries. It can be translated and validated across different settings, contributing to global efforts to address child malnutrition and obesity.

Conclusion

This study developed and validated a culturally relevant and psychometrically robust questionnaire to assess mothers' KPP regarding CGM. The tool demonstrated strong internal consistency, apparent construct validity, and strong model fit across all domains. It fills a critical gap in maternal and child health research. It can serve as a valuable tool for guiding public health interventions, education campaigns, and policy development to improve child growth outcomes.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12884-026-08972-y.

Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Authors' contributions

EM: Conceptualization, Methodology, Validation, Formal analysis, Writing - Original Draft, Writing - Review & Editing. LCI: Conceptualization, Methodology, Validation, Investigation, Resources, Supervision, Project administration, Writing - Original Draft, Writing - Review & Editing. STS: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing - Original Draft, Writing - Review & Editing. MH: Investigation, Supervision, Writing - Review & Editing. HH: Investigation, Supervision, Writing - Review & Editing MNM: Conceptualization, Investigation, - Review & Editing. LS: Conceptualization, Investigation, Writing - Review & Editing YAME: Writing - Original Draft, critically revised the manuscript draft for intellectual content, and contributed to Writing - Review & Editing. ASA: Conceptualization, Investigation, Resources, Project administration, Writing - Review & Editing.

Funding

This research did not receive any external funding. The work was supported through the resources and facilities provided by the University of Sharjah, United Arab Emirates.

Data availability

All data supporting this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study adhered to the guidelines outlined in the Declaration of Helsinki. Ethical approval was granted by the Research Human Ethics Committee at the University of Sharjah (Ref: REC-23-02-09-01), the UAE Ministry of Health and Prevention (Ref: MOHAP/REC/2022/21-2023-PG-M), and the University Hospital of Sharjah (Ref: UHS-HERC-132-21052023). Additionally, internal approval was secured from the management of each participating hospital. Informed written consent was obtained from all participants before the study commenced. The data collection process involved systematically recording participant responses online through a digital platform. These responses were then exported into an Excel spreadsheet for comprehensive analysis. The collected data were securely stored on a password-protected research computer to ensure confidentiality and maintain data integrity throughout the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 30 September 2024 / Accepted: 18 March 2026
Published online: 26 March 2026

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