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ORIGINAL RESEARCH

A Donabedian-based instrument for measuring parental satisfaction in pediatric dental care: scale development and validation

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Abstract

Background: Parental satisfaction is a key indicator of healthcare quality in pediatric dentistry and influences service utilization and continuity of care. However, theory-based instruments specifically designed for pediatric dental services remain limited. This study aimed to develop and validate a parental satisfaction scale for pediatric dental care based on the Donabedian structure–process–outcome model. **Methods**: This methodological study followed established scale development and validation procedures. An initial item pool was generated through literature review and expert consensus and refined through content validation. The final scale was administered to parents of children receiving care at a university pediatric dental clinic (N = 442). Exploratory factor analysis was conducted on one subsample (n = 229), followed by confirmatory factor analysis on an independent subsample (n = 213). Model fit was evaluated using multiple fit indices. Internal consistency, convergent validity, and discriminant validity were assessed using Cronbach's alpha, McDonald's omega, composite reliability (CR), average variance extracted (AVE), and the heterotrait-monotrait ratio (HTMT). **Results**: The final instrument consisted of 24 items and demonstrated a stable four-factor structure: Professional Care and Communication, Service Delivery, Outcome, and Accessibility. Confirmatory factor analysis supported both first-order and hierarchical second-order structures. Model fit indices indicated a good fit (comparative fit index (CFI) = 0.982, Tucker-Lewis index (TLI) = 0.980, root mean square error of approximation (RMSEA) = 0.078, standardized root mean square residual (SRMR) = 0.042). Internal consistency was high for the overall scale (Cronbach's α = 0.95; ω = 0.97) and good to excellent across subscales (α = 0.81–0.94). Convergent and discriminant validity were supported. **Conclusions**: This study presents a theory-driven instrument for assessing parental satisfaction with pediatric dental services, and preliminary psychometric validation supports its use for evaluating service quality and informing research, quality improvement, and public health planning.

Keywords

Patient satisfaction; Pediatric dentistry; Health service research; Healthcare quality; Donabedian model

1. Introduction

Healthcare quality is defined as the degree to which health services increase the likelihood of achieving optimal health outcomes while adhering to established professional standards [1]. Patient satisfaction is a key indicator of healthcare quality and has been associated with improved treatment adherence, continuity of care, and overall efficiency of healthcare delivery [2]. In this context, healthcare systems have increasingly adopted patient-centered approaches that integrate patients' experiences and perceptions as integral components of service evaluation and quality improvement. Patient-centered approaches increasingly emphasize the integration of patient-reported experiences into clinical decision-making [3]. From this perspective, patient-evaluated dentistry, defined as the practice of using patient-reported data to tailor treatment to individual needs and preferences, is a primary driver of satisfaction [4]. This approach fosters a sense of value and understanding among patients and their families, thereby enhancing their overall healthcare experience [5].

The multidimensional and inherently complex nature of healthcare quality makes its systematic evaluation particularly challenging. To address this complexity, Donabedian introduced a framework that conceptualizes healthcare quality in terms of structure, process, and outcome [6]. "Structure" refers to the physical and organizational characteristics of the healthcare settings, including the clinical environment and administrative systems. "Process" involves the delivery of care, particularly the communication, empathy, and interactions of healthcare providers during patient care. "Outcome" focuses on the results of the care, such as patient satisfaction, health improvements, and continuity of care [6]. The Donabedian model enables a comprehensive assessment of healthcare services; however, despite its widespread use in health service research, it has rarely been applied through validated instruments to assess patient satisfaction in dentistry [7, 8].

In pediatric dentistry, parental satisfaction is particularly important, as it influences follow-up attendance and adherence to recommended dental care practices for children. Several studies have emphasized the vital connection between the accessibility and quality of dental services and the outcomes of children's oral healthcare [9, 10]. Accordingly, assessing parental perspectives provides valuable insights for improving clinical practice, health policy, and the overall delivery of pediatric dental care [11]. Within this context, determinants of parental satisfaction can be understood through the Donabedian framework. Structural factors such as the physical environment of the healthcare facility and the efficiency of administrative processes have been shown to play a vital role in patient satisfaction [12, 13]. Process-related factors include effective communication, empathy, and attentiveness of healthcare providers, as well as transparent communication regarding treatment procedures and costs, all of which significantly influence patients' overall perceptions of care quality [12, 14]. Outcome-related factors, such as overall parental satisfaction, play a critical role in informing improvements in clinical practice and health policy, thereby enhancing the delivery of pediatric dental care [11].

Despite the widespread use of satisfaction questionnaires in pediatric dentistry, relatively few instruments are explicitly grounded in a clear theoretical framework [15, 16], and often rely on context-specific or *ad hoc* item sets. In addition, many studies report limited psychometric evaluation, frequently focusing only on internal consistency without comprehensive validation of their construct structure, reliability, and validity. As a result, existing measures may inadequately capture the multidimensional nature of care quality and have limited comparability, interpretability, and applicability for systematic quality improvement [17–19].

To address these limitations, the present study aims to develop and psychometrically validate a theory-driven parental satisfaction scale for pediatric dental services, explicitly grounded in the Donabedian model. By integrating a structured conceptual framework with comprehensive psychometric evaluation, this study seeks to provide a standardized and methodologically robust instrument for assessing parental satisfaction in pediatric dentistry.

2. Materials and methods

2.1 Study design

This study was designed as a methodological study aimed at the development and validation of a parental satisfaction scale. Accordingly, established instrument development protocols were followed, including conceptualization, item generation, expert evaluation, and psychometric testing. The evaluation of the scale's measurement properties was guided by COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments) standards [20]. The workflow of the study is presented in Fig. 1.

Ethical approval was obtained from the institutional ethics committee prior to study initiation (No.: 23-5.1T/14). Written informed consent was obtained from all participating parents or legal guardians.

2.2 Phase 1: item generation

To initiate the scale development process, a comprehensive literature review was conducted to identify existing instruments assessing satisfaction in healthcare settings. A literature search was conducted in PubMed for studies published between January 2003 and January 2023 on parental satisfaction in pediatric dental services, using keywords such as "pediatric dentistry", "parental satisfaction", "quality of care", "scale development", and "psychometric validation". The review aimed to examine conceptual frameworks, item content, and psychometric limitations of previously published scales, thereby informing the theoretical foundation of the present instrument.

Guided by the Donabedian Healthcare Quality Model, the research team generated an initial pool of 40 items. The expert panel consisted of three specialists in pediatric dentistry, one public health specialist, and one health service researcher; detailed characteristics of the experts are provided in **Supplementary Table 1**.

During each meeting, items were evaluated based on three criteria: (1) relevance to the construct of parental satisfaction in pediatric dental care, (2) clarity and comprehensibility for the target population, and (3) conceptual alignment with the Donabedian structure–process–outcome framework.

Item generation was conducted through two structured consensus meetings, integrating expert panel discussions and iterative brainstorming during which proposed items were systematically evaluated for relevance, clarity, and conceptual alignment with the Donabedian framework (**Supplementary Table 2**). The preliminary version of the scale was organized into three hypothesized domains: structure, process, and outcome.

Following expert review and content refinement, item reduction was guided by predefined conceptual and methodological criteria. Specifically, items were excluded if they (1) demonstrated semantic redundancy or conceptual overlap with other items, (2) lacked clarity or were prone to ambiguous interpretation, or (3) were considered too context-specific, thereby limiting their generalizability across different clinical settings. This process resulted in a reduced draft instrument comprising 32 items. A sociodemographic section was also incorporated to facilitate comparison between groups.

2.3 Phase 2: content validity

To establish content validity, the preliminary item pool was subjected to expert evaluation focusing on relevance, clarity, and representativeness of the construct of parental satisfaction in pediatric dental care. Content validity was ensured through

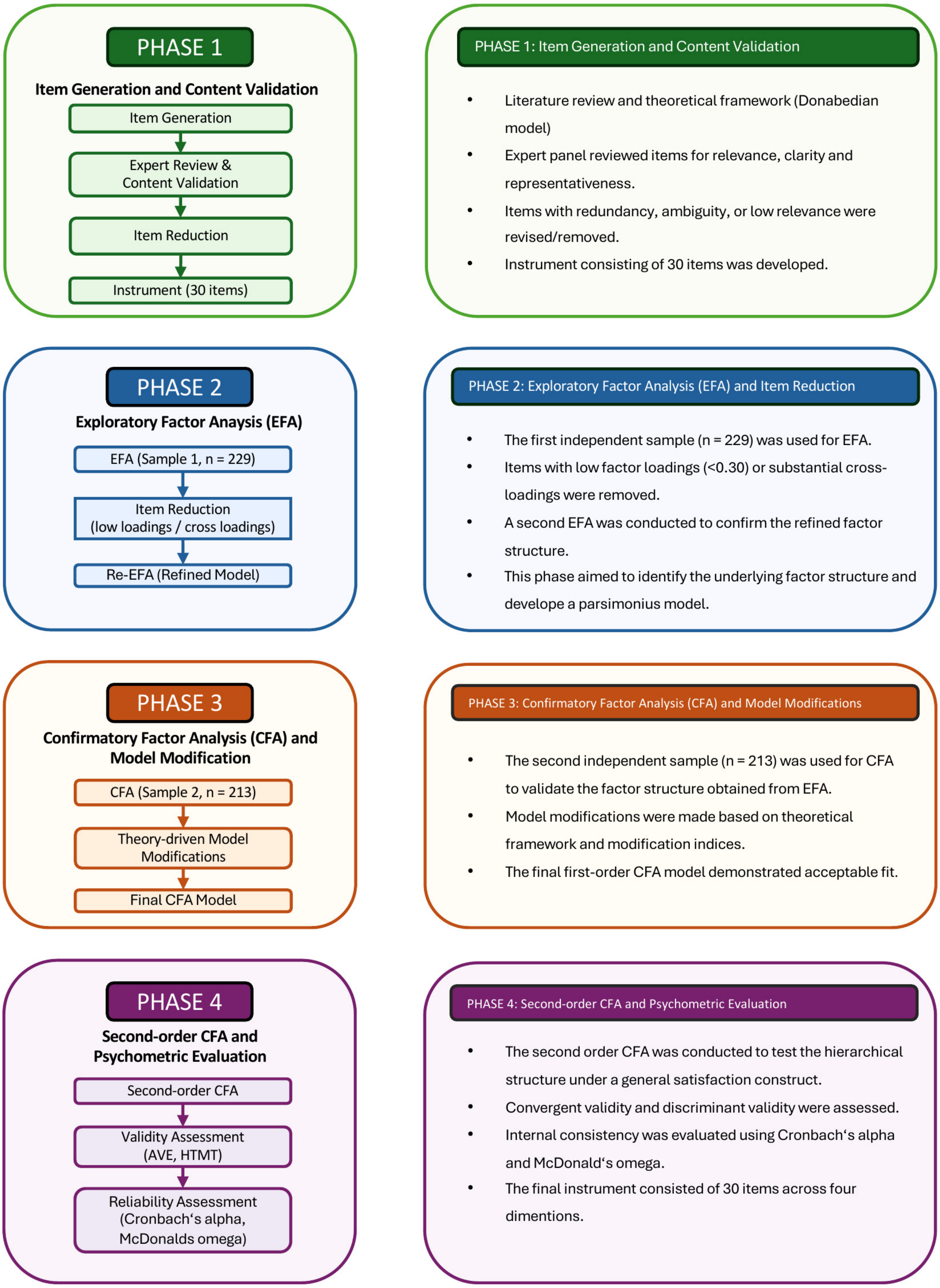

FIGURE 1. Flow diagram of the study. AVE: average variance extracted; HTMT: heterotrait-monotrait ratio.

a structured, expert-based consensus process; however, quantitative content validity indices were not used. Consensus was defined as agreement among at least four of the five panel members. Items that did not reach consensus were further discussed and re-evaluated in subsequent rounds.

Each item was independently assessed for its alignment with the theoretical foundations of the Donabedian Health Care Quality Model and its appropriateness for the target population. Through qualitative review and structured feedback, experts provided recommendations for revising, merging, or removing items that were redundant, ambiguous, or conceptually misaligned. Based on consensus-based qualitative judgments, the instrument was refined and finalized as a 30-item scale (**Supplementary Table 2**).

2.4 Phase 3: data collection and participants

The finalized version of the scale was administered between March 2023 and September 2023 at the Department of Pediatric Dentistry, Faculty of Dentistry, Ege University. Prior to the beginning of this study, a pilot test was conducted with 15 parents to assess the readability and clarity of the questionnaire items. Data collection was conducted using a cross-sectional design involving two independent samples to support the psychometric evaluation of the instrument. According to psychometric guidelines, when the relationships among items have not yet been empirically established, exploratory factor analysis (EFA) is recommended as the initial step to identify the underlying latent structure [21]. The use of confirmatory factor analysis (CFA) for exploratory purposes may be restrictive and potentially misleading [22]. Furthermore, scale development guidelines recommend the use of independent samples for EFA and CFA as a methodological standard to ensure appropriate validation of the factor structure [23, 24].

The first sample was utilized for EFA to identify the underlying factor structure. Following initial EFA, items with low loadings (<0.30) or substantial cross-loadings were removed to improve construct clarity. A second EFA was conducted to confirm the refined structure. This final structure was then tested using CFA on an independent sample. Modification indices were considered only when theoretically meaningful. Correlated errors were allowed between items measuring highly similar content, consistent with the conceptual framework. Accordingly, in the present study, two independent samples were used (n = 229 for EFA and n = 213 for CFA), adhering to this methodological standard.

Recommended sample sizes for EFA generally range from five to ten participants per item, with a minimum overall sample size of 100 being acceptable. Larger samples, around 200–300, are considered adequate or good according to established guidelines [25–27].

Although there is no universally accepted sample size for CFA, there is debate regarding using the same sample for both EFA and CFA. Methodological recommendations advise against performing CFA on the same dataset used for EFA [28]. Using the recommended participant-to-item ratios of ≥5:1 [24] and ideally 10:1 [29], the purposive CFA sample of 213 parents, corresponding to approximately 7 participants per item, was considered adequate.

Parents or legal guardians aged 18 years or older who had a child aged 0–13 years receiving dental care at the Department of Pediatric Dentistry during the study period, who were the primary decision-makers for their child's dental care, had attended at least one dental visit prior to completing the questionnaire, were able to communicate in Turkish, and provided written informed consent were included in the study. To maintain sample independence, no participant overlapped in both the EFA and CFA datasets. The EFA and CFA samples were recruited from the same university-based pediatric dental clinic using a consecutive sampling approach during distinct time periods. The response rate was 88.1% for the EFA sample and 81.9% for the CFA sample. Participants were enrolled sequentially rather than randomly assigned.

2.5 Phase 4: assessment of reliability, validity, and scoring

Responses were recorded on a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The total scale score ranged from 30 to 150, with lower scores indicating lower levels of parental satisfaction.

Internal consistency reliability was assessed using Cronbach's alpha coefficients. Construct validity was examined through exploratory and confirmatory factor analyses, and the dimensional structure was further evaluated using a second-order CFA to assess whether first-order factors loaded onto an overarching parental satisfaction construct.

2.6 Data analysis

All analyses were conducted using the R programming language and the RStudio development environment. For exploratory factor analysis, the psych [30] and GPArotation packages [31] were used. Confirmatory factor analysis and the second-order factor model were performed using the lavaan [32] and semTools [33] packages. Additionally, the semPlot [34] package was employed for model visualization.

Sampling adequacy was evaluated using the Kaiser-Meyer-Olkin (KMO) measure. The factorability of the correlation matrix was assessed using Bartlett's Test of Sphericity. A KMO value greater than 0.60 and a statistically significant Bartlett's test were considered indicative of adequate sampling adequacy and factorability [35, 36].

The number of factors was determined using parallel analysis, based on the comparison of observed eigenvalues with those obtained from randomly generated data. EFA was conducted using maximum likelihood estimation with oblimin rotation, given the expected correlations among factors.

CFA was performed using the Weighted Least Squares Mean and Variance adjusted estimator (WLSMV), which is appropriate for ordinal data. Model fit was evaluated using multiple indices, including the chi-square statistic (χ^2), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Model fit was evaluated based on commonly recommended criteria [37, 38]. While RMSEA values ≤0.06 indicate a close fit, values up to 0.08 were considered acceptable in line with previous literature.

Reliability was assessed using Cronbach's alpha and McDonald's omega coefficients. Convergent validity was evaluated using composite reliability (CR) and average variance extracted (AVE), while discriminant validity was assessed using the heterotrait-monotrait ratio (HTMT) and the Fornell-Larcker criterion.

3. Results

This study was conducted at Ege University, a tertiary-level academic healthcare institution serving as a regional referral center for pediatric dental care. The sociodemographic and clinical characteristics of the participants included in the exploratory and confirmatory factor analysis samples are summarized in Table 1, which provides a detailed overview of the study population.

The EFA (N = 229) and CFA (N = 213) samples demonstrated broadly comparable sociodemographic profiles, supporting their use as independent subsamples for scale validation. Overall, participants were predominantly female, and most were clustered within the 30–49 age range. Educational levels of mothers were similarly distributed across samples, while minor variations were observed in fathers' education. Most families resided in urban areas, and households with two children were the most common. As intergroup differences were generally small (<10 percentage points) and no formal statistical comparisons were performed, these findings should be interpreted descriptively.

Item-level descriptive statistics for the Parental Satisfaction Scale (PSS) are presented in Table 2. Among the items, satisfaction with dentist–child communication (Item 7) demonstrated the lowest mean score (4.45 ± 0.74), reflecting higher perceived satisfaction, whereas perceived appropriateness of waiting time (Item 16) yielded the highest mean score (3.96 ± 1.01).

Data are presented as mean ± standard deviation. Item-total correlations are corrected for item overlap. Cronbach's alpha values represent internal consistency coefficients if the

TABLE 1. Sociodemographic characteristics of participants in the exploratory and confirmatory factor analysis samples.

Variable	Category	EFA Sample (n = 229)	%	CFA Sample (n = 213)	%
Age (yr)					
	<20	23	10.0	19	8.9
	20–29	15	6.6	16	7.5
	30–39	109	47.6	95	44.6
	40–49	74	32.3	75	35.2
	50–59	7	3.1	7	3.3
	≥60	1	0.4	1	0.5
Sex					
	Female	166	72.5	144	67.6
	Male	63	27.5	69	32.4
Education level of mother					
	Primary school graduate	57	24.9	50	23.5
	Secondary school graduate	38	16.6	51	23.9
	High school graduate	54	23.6	56	26.3
	University graduate	72	31.4	52	24.4
	Postgraduate	8	3.5	4	1.9
Education level of father					
	Primary school graduate	39	17.0	42	19.7
	Secondary school graduate	47	20.4	44	20.7
	High school graduate	62	27.0	80	37.6
	University graduate	71	30.9	38	17.8
	Postgraduate	10	4.3	9	4.2
Place of residence					
	İzmir city—Urban	157	68.6	164	77.0
	İzmir city—Rural	72	31.4	49	23.0
Number of children in the household					
	1	42	18.3	31	14.6
	2	102	44.3	99	46.5
	3	69	30.0	61	28.6
	≥4	16	7.0	22	10.3

Data are presented as number of participants (n) and percentage (%). EFA: Exploratory Factor Analysis; CFA: Confirmatory Factor Analysis.

TABLE 2. Item descriptives, item-total correlations and Cronbach's alpha values of scale.

Item	Content	Mean	SD	Corrected item-total correlation	Cronbach's α if item deleted
I1	The materials and technical equipment were sufficient.	4.14	0.87	0.66	0.97
I2	Sterilization and infection control procedures were appropriately implemented in the clinics.	4.34	0.76	0.73	0.97
I3	The number of practicing dentists was adequate.	4.08	0.95	0.73	0.97
I4	The number of support staff was sufficient.	4.03	0.93	0.72	0.97
I5	I trust the dentist's professional competence.	4.27	0.81	0.74	0.97
I6	I feel safe while receiving services.	4.30	0.78	0.80	0.97
I7	I am satisfied with the communication between my child and the dentist.	4.45	0.74	0.78	0.97
I8	I am satisfied with the dentist's attitude toward me as a parent.	4.42	0.78	0.80	0.97
I9	I am satisfied with the support staff's attitude toward me.	4.27	0.85	0.77	0.97
I10	The dentist provided sufficient information regarding the maintenance of my child's oral health.	4.31	0.84	0.75	0.97
I11	The dentist explained the procedures before and after the treatment.	4.42	0.75	0.77	0.97
I12	The dentist responds to my questions and concerns.	4.42	0.75	0.71	0.97
I13	I am informed about the cost (if any) before the procedures.	4.20	0.92	0.71	0.97
I14	The services are provided promptly.	4.10	0.93	0.84	0.97
I15	I believe that problems are addressed with a solution-oriented approach.	4.23	0.88	0.81	0.97
I16	The waiting time for clinical procedures is appropriate.	3.96	1.01	0.72	0.97
I17	The waiting time for radiography is appropriate.	4.17	0.83	0.64	0.97
I18	Treatments start on time.	4.06	1.02	0.75	0.97
I19	I am satisfied with the duration of the treatment.	4.16	0.93	0.82	0.97
I20	Consultation and referral services were adequate.	4.25	0.89	0.68	0.97
I21	I do not experience difficulties when booking appointments online.	3.92	1.22	0.51	0.97
I22	The current appointment scheduling system is convenient.	3.92	1.21	0.56	0.97
I23	Appointment times are suitable for us.	4.31	0.88	0.64	0.97
I24	It is easy to reach the institution.	4.10	1.06	0.66	0.97
I25	I could easily locate the clinical units I needed within the institution.	4.16	1.00	0.69	0.97
I26	My child's dental complaints were resolved following treatment.	4.16	0.93	0.77	0.97
I27	I am satisfied with the dental treatments my child received here.	4.23	0.92	0.78	0.97
I28	I am generally satisfied with the services received from this institution.	4.32	0.84	0.83	0.97
I29	If needed, I would apply to this institution again for my child's dental care.	4.38	0.82	0.81	0.97
I30	I would recommend this institution to others.	4.36	0.84	0.73	0.97

SD: standard deviation.

corresponding item were deleted.

The KMO measure was 0.94, indicating excellent sampling adequacy [39]. Bartlett's Test of Sphericity was significant (χ^2 = 7391.579, df = 435, $p < 0.001$), confirming that item correlations were sufficient for factor extraction [40].

Table 2 indicates generally high mean scores, reflecting overall high satisfaction, although greater variability in some items suggests differences across service dimensions. Item-total correlations were largely acceptable, supporting item adequacy, while the lack of improvement in Cronbach's alpha upon item deletion confirms strong internal consistency and overall scale homogeneity.

3.1 Exploratory factor analysis (EFA)

The 30-item scale demonstrated excellent internal consistency (Cronbach's alpha = 0.97), with item-total correlations ranging from 0.51 to 0.84. Removal of individual items did not improve the alpha coefficient (Table 2).

Parallel analysis was conducted to determine the number of factors. The first four observed eigenvalues (16.98, 1.58, 0.83, and 0.75) exceeded those obtained from randomly generated data (0.89, 0.66, 0.58, and 0.52). Although the fifth observed eigenvalue (0.468) slightly exceeded the mean eigenvalue obtained from simulated data (0.456), it did not surpass the more conservative 95th percentile threshold recommended for parallel analysis. These findings supported the retention of a four-factor structure. The scree plot of the parallel analysis is presented in Fig. 2.

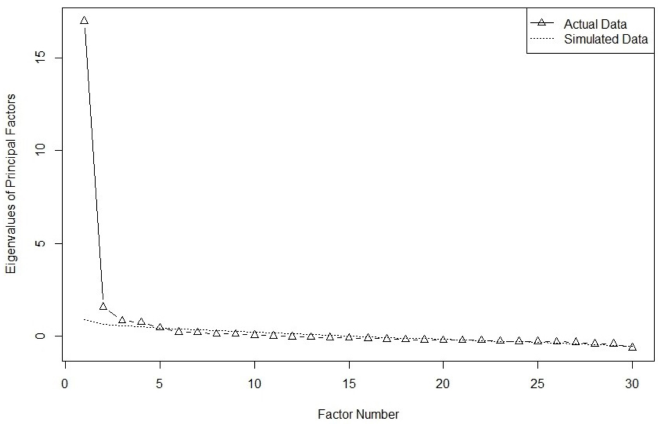

FIGURE 2. Parallel analysis scree plot.

A four-factor solution was specified and estimated using maximum likelihood extraction with oblimin rotation, given the expected correlations among factors. Factor loadings were examined to evaluate the structure and the distribution of items across the factors (Table 3).

In this study, loadings of 0.30 and above were regarded as meaningful. Higher factor loadings indicate that items are more strongly associated with their respective factors and contribute to well-defined latent constructs. Initial EFA results revealed that some items exhibited cross-loadings. These findings suggested that these items did not clearly represent a single factor; therefore, item reduction was applied.

Item reduction was guided by both statistical criteria and conceptual evaluation. Items I3 and I4, related to the adequacy of dentists and support staff, were excluded due to cross-loadings. Although intended to reflect structural aspects of care, these items appeared to overlap with the "Accessibility" domain, suggesting that parents may associate the number of dentists/support staff with ease of access to care. Item I15 was removed due to an unstable loading. As this item referred to a hypothetical situation, participants who had not encountered any problems may have responded based on general expectations rather than actual experiences, potentially introducing ambiguity in interpretation. Items I21 and I22, both addressing appointment scheduling, showed high loadings but reflected a narrow and specific aspect of service delivery. To enhance the parsimony and conceptual clarity of the scale, the more general item (I22) was retained, and the more specific item (I21) was removed. Finally, item I26 was excluded due to cross-loading, as it represented a global evaluation of care and overlapped with multiple domains.

Based on the criteria of cross-loading, low factor loading, and item redundancy, items I3, I4, I15, I26, I20, and I21 were excluded from the scale. Following item removal (Table 4), the factor structure became clearer and more parsimonious,

TABLE 3. Factor loadings obtained from EFA.

Item	F1	F2	F3	F4
I1	0.528	0.125		
I2	0.726			
I3	0.447	0.338		0.111
I4	0.356	0.378		0.163
I5	0.886			
I6	0.868			
I7	0.907			
I8	0.905	−0.124	0.160	
I9	0.704	0.152		0.139
I10	0.462	0.158	0.240	
I11	0.647		0.158	
I12	0.637	0.187		
I13	0.447	0.206		0.123
I14	0.212	0.576	0.158	
I15	0.380	0.349	0.167	
I16		0.903		
I17		0.705		0.114
I18		0.796		
I19	0.114	0.673	0.139	
I20	0.111	0.446		0.186
I21				0.952
I22				0.919
I23	0.123			0.658
I24		0.114	0.139	0.545
I25		0.143	0.113	0.587
I26		0.323	0.405	0.128
I27	0.196	0.133	0.585	
I28			0.828	
I29			0.934	
I30			0.915	

with substantially reduced cross-loadings and items primarily loading on their intended factors. This pattern is further illustrated in the heatmap (Fig. 3). Factor loadings showed distinct clustering, indicating well-defined and internally consistent dimensions, although minor secondary loadings suggest the presence of related components. While the first factor explained the largest share of variance, the remaining factors contributed meaningfully, supporting a multidimensional structure suitable for subsequent confirmatory analysis.

Examination of cross-loadings showed that some items had minor loadings on additional factors; however, as these values were below 0.30 and each item demonstrated a dominant loading on a single factor, they were not considered to represent meaningful cross-loading.

The proportion of variance explained by each factor was calculated. The four-factor structure accounted for 71% of the total variance, with the first factor explaining the largest share

TABLE 4. Factor loadings obtained from EFA after Item removal.

Item	F1	F2	F3	F4
I1	0.503	0.110		0.153
I2	0.710	0.117		
I5	0.864		−0.102	
I6	0.849			
I7	0.893			
I8	0.905	−0.103	0.150	
I9	0.700	0.105	−0.128	0.221
I10	0.465	0.150	0.190	
I11	0.649		0.124	0.110
I12	0.621	0.155	−0.134	0.186
I13	0.447	0.163		0.237
I14	0.216	0.532	0.141	
I16		0.901		
I17		0.692		0.181
I18		0.866		
I19	0.102	0.727	0.114	
I22	−0.114		0.152	0.724
I23			0.102	0.583
I24				0.801
I25				0.855
I27	0.213	0.156	0.541	
I28			0.787	
I29			0.904	
I30			0.891	

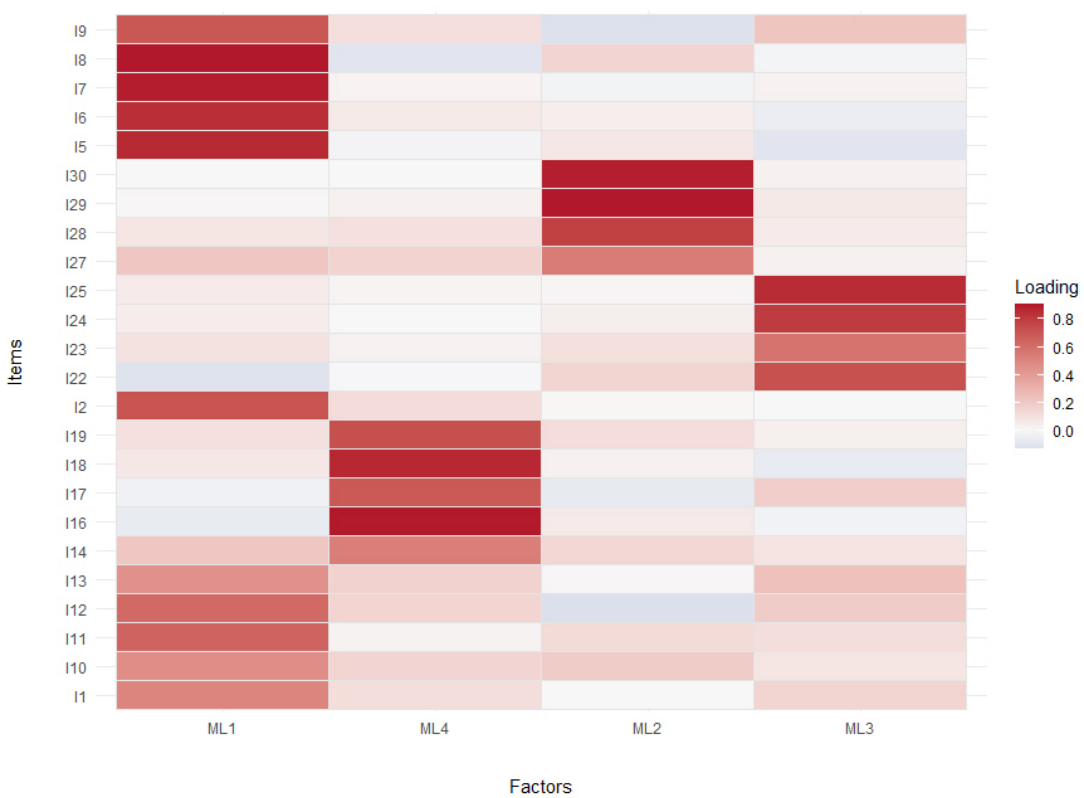

FIGURE 3. Heatmap of exploratory factor analysis loadings after Item reduction. ML: maximum likelihood.

(28%), followed by the second (16%), third (14%), and fourth (13%) factors (**Supplementary Table 3**). These findings indicate that all factors contributed meaningfully to the overall variance and support the adequacy of the multidimensional structure of the scale.

3.2 Confirmatory factor analysis (CFA)

Confirmatory factor analysis (CFA) was conducted to evaluate the fit of the four-factor structure identified in the EFA. The analysis was performed on the second independent sample (N = 213), yielding an approximate participant-to-item ratio of 7:1, consistent with recommended guidelines for structural equation modeling [38, 41].

Parameter estimation was carried out using the WLSMV estimator in R, which is recommended for ordinal data [21, 42]. This estimator accounts for non-normality and provides robust standard errors and adjusted chi-square statistics [43]. The four-factor model identified in the exploratory phase was specified a priori. The latent variables and their respective observed indicators were as follows:

- Professional Care & Communication (Factor 1): Items 1, 2, 5–13.
- Service Delivery (Factor 2): Items 14, 16–19.
- Outcome (Factor 3): Items 27–30.
- Accessibility (Factor 4): Items 22–25.

The model fit indices indicated that $\chi^2(df = 246) = 695.07$ ($p < 0.001$), CFI = 0.974, TLI = 0.971, RMSEA = 0.093 (90% Confidence Interval (CI): 0.085, 0.101), and SRMR = 0.046. Although the initial CFA demonstrated good fit according to CFI and TLI, the RMSEA value exceeded the recommended threshold [37], which may be attributed to shared variance among conceptually similar items not fully captured by the latent structure.

Based on modification indices and guided by theoretical considerations, a number of cross-loadings were introduced to improve model performance (Table 5).

Modification indices were examined to identify parameters with the potential to improve model fit. The inclusion of theoretically justified error covariances can be interpreted as accounting for local dependence arising from conceptually similar items. Such modifications are common in scale development when items share similar wording or capture closely related aspects of a construct. Only theoretically supported modifications were retained, while cross-loading or conceptually unjustified changes were excluded to minimize the risk of overfitting.

The highest modification indices were observed between items I5–I6, I7–I8, and I29–I30. The inclusion of correlated error terms was theoretically justified based on the conceptual similarity of specific item pairs. The covariance between items I5 and I6 reflects a shared underlying theme of trust and perceived safety, as I5 assesses trust in the dentist's professional competence, while I6 captures the patient's sense of safety during treatment. Similarly, items I7 and I8 both relate to the dentist's interpersonal behavior, with I7 focusing on child and I8 on the parent, indicating provider–patient interaction. Furthermore, the covariance between items I29 and I30 is supported by their shared focus on behavioral intentions as outcomes of satisfaction. These items represent closely related outcome-oriented evaluations of care. Taken together, these modifications were considered theoretically meaningful and consistent with the underlying construct, while also contributing to improved model fit.

Following these modifications, a revised CFA model was estimated, and the corresponding fit indices were obtained. The revised model demonstrated improved fit compared to the initial model, as reflected by increased CFI (0.982) and TLI (0.980) values and decreased RMSEA (0.078) and SRMR (0.042). The CFI and TLI values exceeded the 0.95 threshold, indicating a good model fit, while the RMSEA value suggested

TABLE 5. Model modifications based on modification indices.

Suggested Modification	MI Value	Decision	Rationale
I5–I6	57.03	Included	Reflect a shared underlying construct of trust and perceived safety within the same factor
I7–I8	50.62	Included	Capture closely related aspects of interpersonal behavior (communication and attitude)
I29–I30	34.06	Included	Conceptually overlapping items within the same dimension
I1–I2	23.01	Not included	Not theoretically supported; parsimony considerations
I23–I25	26.93	Not included	Weak conceptual similarity
I24–I25	14.59	Not included	Parsimony considerations
F3–I19	42.95	Not included	Cross-loading
F2–I24	27.40	Not included	Inconsistent with factor structure
F4–I19	25.94	Not included	Not theoretically justified
F1–I23	20.38	Not included	Not theoretically justified

an acceptable level of fit. The SRMR value further supported good model fit by indicating a low residual error. Overall, these results indicate that the applied modifications led to a meaningful improvement in model fit.

The standardized factor loadings of the revised model are presented in Table 6 and visually summarized in the heatmap (Fig. 4).

After these modifications, every item loaded significantly onto its designated factor. Given the well-documented sensitivity of the chi-square statistic to sample size [38, 41], model evaluation focused primarily on relative and incremental fit indices.

Examination of the standardized factor loadings indicated that all items loaded strongly on their respective factors, with values ranging from 0.65 to 0.95. All loadings exceeded the commonly accepted threshold of 0.50, supporting good construct validity. Particularly high loadings were observed for items I25, I28, and I29, indicating that these items strongly represent their underlying latent constructs. In particular, positive perceptions of service accessibility (I25) may contribute overall satisfaction (I28), which in turn is strongly linked to future behavioral intentions such as willingness to use the services again (I29). Therefore, the observed overlap can be interpreted as a theoretically coherent pattern consistent with the multidimensional yet interrelated nature of healthcare service evaluation, rather than mere item redundancy.

3.3 Internal consistency and reliability

Reliability analyses based on Cronbach's alpha and McDonald's omega coefficients were conducted to assess the internal consistency of the final scale. The results are presented in Table 7.

Cronbach's alpha and McDonald's omega indicated good to excellent internal consistency across subscales (α = 0.81–0.94; ω = 0.88–0.96), with high overall reliability (α = 0.95; ω = 0.97). Although such high values may suggest item redundancy, the multidimensional structure supports a coherent rather than overlapping construct. Convergent validity was supported by acceptable CR and AVE values (**Supplementary Table 4**). Discriminant validity was also confirmed, as all HTMT values were below the recommended threshold of 0.85 (**Supplementary Table 5**) [35, 44, 45]. Following the evaluation of reliability and validity, inter-factor correlations of the final model were examined to further explore the relationships among the constructs (Table 8).

Examination of inter-factor correlations revealed moderate

TABLE 6. Standardized factor loadings from the revised (second) CFA model.

Item	F1	F2	F3	F4
I1	0.653			
I2	0.824			
I5	0.897			
I6	0.916			
I7	0.910			
I8	0.910			
I9	0.825			
I10	0.877			
I11	0.919			
I12	0.898			
I13	0.813			
I14		0.878		
I16		0.858		
I17		0.823		
I18		0.839		
I19		0.928		
I27			0.916	
I28			0.956	
I29			0.953	
I30			0.891	
I22				0.680
I23				0.875
I24				0.702
I25				0.944

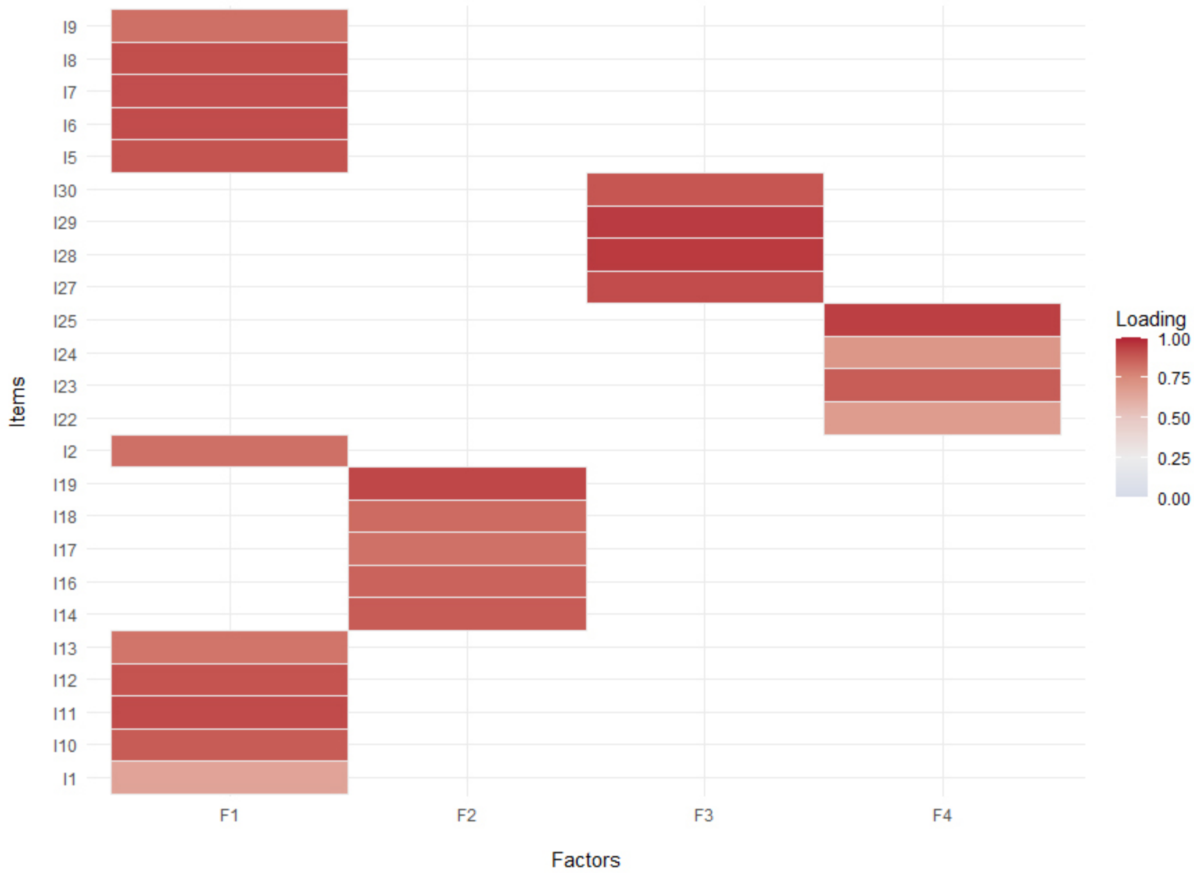

FIGURE 4. Heatmap of standardized factor loadings (Revised CFA Model).

TABLE 7. Reliability coefficients of the subscales.

	Factors	Cronbach's α	McDonald Omega
Factor 1	Professional Care and Communication	0.94	0.96
Factor 2	Service Delivery	0.90	0.91
Factor 3	Outcome	0.93	0.95
Factor 4	Accessibility	0.81	0.88
	Total	0.95	0.97

TABLE 8. Inter-factor correlations of the final CFA model.

	F1	F2	F3	F4
F1	1.000			
F2	0.818	1.000		
F3	0.817	0.718	1.000	
F4	0.707	0.667	0.809	1.000

to high relationships among the factors. Some correlations exceeded 0.70, indicating that the factors are related, while all values remained below 0.90, suggesting that the constructs are distinguishable rather than redundant.

Discriminant validity was further evaluated using the Fornell-Larcker criterion, which requires that the square root of AVE for each construct exceeds its correlations with other constructs [44]. This condition was met for most factors, with the square root of AVE values (0.86 for F1, 0.87 for F2, and 0.93 for F3) exceeding the corresponding inter-factor correlations (0.66–0.81). However, for F4, the square root of AVE (0.81) was very close to its correlation with F3 (0.81), indicating a high degree of overlap between these two constructs.

Overall, these findings support acceptable discriminant validity, while also suggesting that the relatively high inter-factor correlations may reflect the presence of a broader underlying construct. Accordingly, a second-order confirmatory factor analysis was conducted to examine the hierarchical structure of the scale. The results are presented in Table 9, and model fit indices were reported based on scaled estimates obtained using the Diagonally Weighted Least Squares (DWLS) estimator in R.

Both models demonstrated good fit to the data. Examination of the goodness-of-fit indices for the second-order model showed that the CFI (0.977) and TLI (0.974) values exceeded the critical threshold of 0.95, indicating excellent model fit.

The RMSEA value was 0.088 (90% CI [0.079–0.096]). Although values $\leq$0.06 are often considered indicative of close fit, values up to 0.08–0.10 may be acceptable depending on model complexity and should be interpreted alongside other fit indices. In the present study, the high CFI and TLI values support the overall adequacy of model fit despite the slightly elevated RMSEA [37, 38, 46–49].

Second-order CFA showed that the general satisfaction factor loaded strongly on all subdimensions (0.81–0.92; $p < 0.001$), indicating that the higher-order construct is well represented by the underlying factors (**Supplementary Table 6**). These findings support a multidimensional yet integrated structure and the appropriateness of a hierarchical model (Fig. 5).

To assess the extent to which the second-order structure explains relationships among first-order dimensions, the target coefficient (T) was calculated using scaled chi-square values [49]. The resulting value (T = 0.87) indicates that the higher-order factor accounts for a substantial proportion of covariance among the first-order factors. Consistently, the higher-order factor explained a large proportion of variance in each dimension (66–85%).

Together with high inter-factor correlations and strong factor loadings, these findings support the adequacy and parsimony of a hierarchical model over a bifactor alternative.

3.4 Scoring guide

The scale used in this study was rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicate higher levels of satisfaction. Subscale scores were calculated using a unit-weighting approach, whereby the mean of the items corresponding to each factor was computed. Similarly, the total score was obtained by averaging all items.

The use of equal weighting (*i.e.*, summing or averaging items) has been recommended as a reliable and robust approach in the literature, as it reduces the influence of sample-specific factor loadings and enhances the generalizability of the scale across different samples [50]. Given the high and relatively homogeneous factor loadings observed in this study, the unit-weighting method was deemed appropriate. Since all items were scored in the same direction, no reverse coding was required.

4. Discussion

Understanding and measuring satisfaction in pediatric dental care remains a complex and dynamic construct, which is shaped by several factors [51, 52], yet many existing instruments are not grounded in a clear theoretical

TABLE 9. First and second-order model fit indices.

Model	χ^2	*df*	CFI	TLI	RMSEA	SRMR
First-order Model	558.11	243	0.982	0.980	0.078	0.042
Second-order Model	642.760	245	0.977	0.974	0.088	0.049

CFI: Comparative Fit Index; TLI: Tucker-Lewis Index; RMSEA: Root Mean Square Error of Approximation; SRMR: Standardized Root Mean Square Residual; df: degrees of freedom.

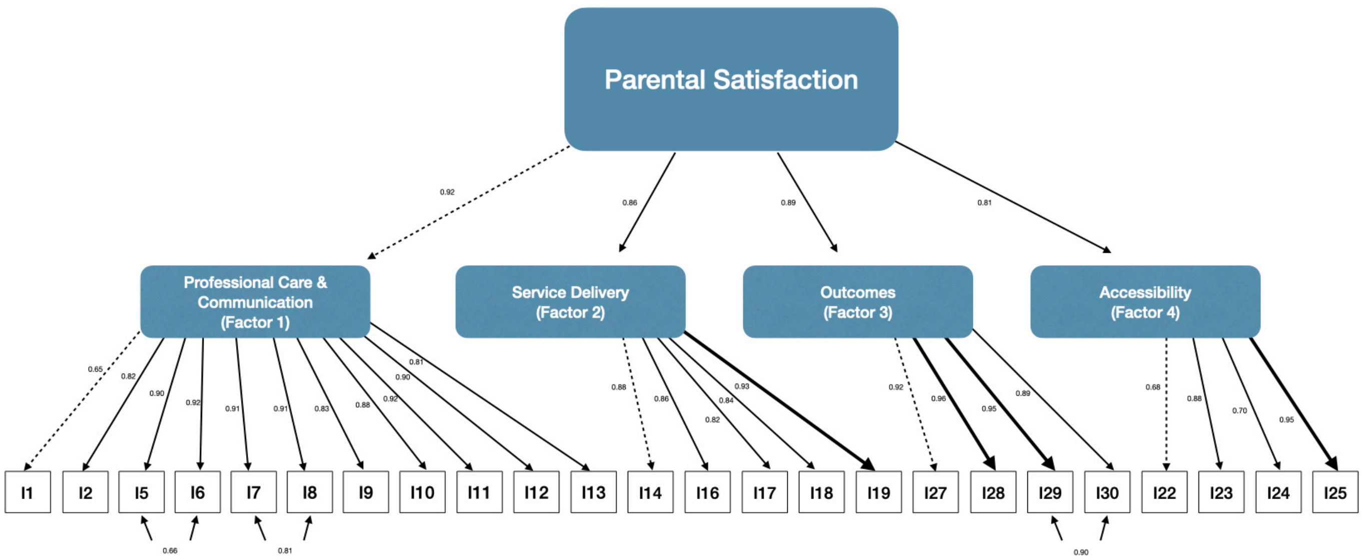

FIGURE 5. Path diagram of the second-order confirmatory factor analysis.

framework. The present study aimed to develop and validate a comprehensive parental satisfaction survey for pediatric dental services, explicitly grounded in the Donabedian structure-process-outcome model of healthcare quality. Within this framework, parental satisfaction was conceptualized across four interrelated dimensions: Professional Care & Communication, Service Delivery, Accessibility, and Outcome (Fig. 6). The resulting factor structure suggests the applicability of the Donabedian model in pediatric dental settings; however, this support should be considered preliminary, given the limitations of the study. Moreover, analysis showed that these dimensions represent distinct yet interconnected aspects of care, such that the observed overlap between factors likely represents the inherently integrated nature of parental satisfaction rather than a measurement limitation.

Several previous studies have assessed parental satisfaction in pediatric dental settings using self-developed questionnaires; however, important methodological limitations remain. For instance, Balhaddad *et al*. [53] primarily relied on clinic-specific instruments structured around domains such as appointment, facilities, and treatment, without a clearly defined theoretical framework, limiting the conceptual grounding of the measured constructs. AlMutairi *et al*. [11] and Tellez [10] used a measurement scale comprising domains such as access, availability, pain, quality, continuity, and general satisfaction, originally developed several decades ago [15], which may not adequately capture the evolving nature of patient satisfaction in contemporary settings. Similarly, Llena *et al*. [54] developed their questionnaire by drawing on previously published instruments and expert input; however, psychometric validation remained limited, relying primarily on internal consistency measures without comprehensive evaluation. Furthermore, the processes of item generation and refinement were rarely described in detail, reducing transparency and reproducibility. In contrast, the present study aimed to address these limitations by developing a theoretically grounded instrument and conducting a comprehensive psychometric evaluation.

Within this multidimensional structure, the first domain, "Professional Care & Communication" represents a central dimension of parental satisfaction, encompassing the interpersonal and professional aspects of care delivery. Although the "Professional Care & Communication" factor also involves items related to structural attributes (sterilization and adequacy of technical equipment), it mainly encompasses interpersonal elements, such as communication. Items referring to both dentists and auxiliary staff clustered within the same domain, reflecting parents' perception of these as interconnected aspects of care. Previous research has shown that parental satisfaction is strongly influenced by dentists' perceived competence, the clarity of communication, and staff attentiveness, particularly in pediatric settings where dental anxiety affects children's cooperation [11, 54–56]. In this context, dental teams' communication and behavioral management skills play a critical role in shaping overall perception of care quality and satisfaction.

Organizational factors, including appointment systems, care coordination, accessibility, waiting times, and the physical environment, play a central role in shaping parental satisfaction with pediatric dental services [53, 57, 58]. While Balhaddad *et al*. [53] conceptualized patient satisfaction across domains such as appointment scheduling, facilities, treatment, and overall satisfaction, Alshahrani *et al*. [19] adapted this framework to pediatric dentistry and identified waiting time as a critical factor influencing parental satisfaction. In line with these findings, the "Service Delivery" dimension identified in the present study encompasses both waiting time and responsiveness. In busy clinical settings, delays and prolonged waiting times may negatively affect parental perceptions. In Türkiye, the performance-based healthcare system, which emphasizes

FIGURE 6. Factor structure of parental satisfaction scale (PSS).

quantitative service indicators, may also contribute to a more quantity-oriented approach to care delivery [59, 60]. This context may have influenced how parents evaluate care, potentially increasing the importance of efficiency-related aspects such as waiting time and promptness.

From a methodological perspective, item reduction was performed in accordance with model recommendations and further guided by conceptual evaluation. Two items related to the adequacy of dentists and support staff (I3, I4) were excluded due to cross-loading. Although intended to reflect structural aspects of care, they shared a common theme of personnel insufficiency and overlapped with the "Accessibility" domain, suggesting that parents may associate these items with ease of access to care.

As item I15 refers to a hypothetical situation, responses may have been based either on prior experiences or on general expectations and perceptions of trust. This ambiguity likely contributed to unstable loading; therefore, it has been removed from the model. Items I21 and I22, both related to the appointment scheduling system, were excluded as they formed a separate but weak factor. These items capture a narrow and specific aspect of service delivery, which appears to be only partially related to the broader care process. Item I26 was excluded due to cross-loading, as it captures a global evaluation of care, leading to overlap across domains.

In the present study, the scale demonstrated very high internal consistency (Cronbach's $\alpha = 0.97$). However, values above 0.95 may suggest item redundancy and overlap in content. This high level of homogeneity may also be reflected in the distribution of responses, as the relatively low mean scores observed across items indicate high levels of parental satisfaction and may suggest a potential ceiling effect. Ceiling effects occur when responses cluster at the end of a scale, potentially limiting the instrument's ability to discriminate between respondents or detect changes over time. However, formal floor and ceiling effect analyses were not conducted in the present study, and therefore this possibility cannot be confirmed. Given that scale development is an iterative process, further refinement and optimization of the scale, as well as formal evaluation of floor and ceiling effects, may be considered in future studies.

The study was conducted in a high-volume tertiary university hospital providing care to a large pediatric population. Most patients are covered by public health insurance, and only a limited proportion receive care on a fee-paying basis. Although the EFA and CFA samples demonstrated comparable sociodemographic characteristics, care within the institution is delivered by faculty members, residents, and undergraduate students, which may result in variability in caregiver experiences across clinical units. In addition, as a regional referral center, the hospital serves families from diverse geographic backgrounds, and a substantial proportion of children are long-term follow-up patients. Consequently, satisfaction responses may partially reflect the perceptions of families who are already engaged with the service and familiar with the institutional care environment.

The developed scale has several practical implications for pediatric dental care. Based on the identified factor structure and item loadings, it may support quality improvement initiatives by highlighting specific domains of care requiring attention. It also enables benchmarking across institutions, facilitating comparisons of service quality. Furthermore, the scale may inform service planning and resource allocation by providing structured insights into areas perceived as critical by parents. In addition, it can be used to monitor changes in satisfaction over time and to evaluate the impact of targeted interventions.

These findings should be interpreted in light of several limitations. The study was conducted in a single tertiary academic institution, which may limit external validation and cultural generalizability. In addition, test–retest reliability was not assessed; therefore, the temporal stability of the instrument remains uncertain. Furthermore, the reliance on self-reported perceptions rather than objective quality indicators may introduce reporting bias. Another limitation of this study is the lack of extensive target population involvement during the item development phase. Although a pilot test was conducted to assess readability, more in-depth cognitive debriefing was not performed. A further limitation in item development is that content validity was based on expert consensus, without the use of quantitative indices such as the Content Validity Index (CVI), Item-Level Content Validity Index (I-CVI), Scale-Level Content Validity Index (S-CVI), or Content Validity Ratio (CVR). In addition, although the response rates were relatively high (88.1% for EFA and 81.9% for CFA), data on individuals who declined participation were not collected. Therefore, nonresponse bias could not be assessed, which may have led to an overestimation of parental satisfaction if non-participants were less satisfied with the provided care.

Future research should focus on multi-center validation and cross-cultural adaptation of the scale, as well as longitudinal assessments to establish temporal stability and responsiveness to changes over time, thereby further strengthening its applicability across diverse clinical settings.

5. Conclusions

This study developed and provided preliminary psychometric validation of a theory-based instrument for the assessment of parental satisfaction with pediatric dental services, grounded in the Donabedian framework. The identified four-factor structure offers initial evidence of the multidimensional nature of parental satisfaction in pediatric dentistry. This instrument may serve as a framework for evaluating service quality and supporting quality improvement initiatives in pediatric dental care.

ABBREVIATIONS

AVE, average variance extracted; CFA, confirmatory factor analysis; CFI, comparative fit index; CI, confidence interval; COSMIN, Consensus-based Standards for the Selection of Health Measurement Instruments; CR, composite reliability; CVI, content validity index; CVR, content validity ratio; DWLS, diagonally weighted least squares; EFA, exploratory factor analysis; HTMT, heterotrait-monotrait ratio; I-CVI, item-level content validity index; KMO, Kaiser-Meyer-Olkin measure of sampling adequacy; PSS, parental satisfaction scale; RMSEA, root mean square error of approximation;

S-CVI, scale-level content validity index; SRMR, standardized root mean square residual; TLI, Tucker-Lewis index; WLSMV, weighted least squares mean and variance adjusted estimator.

AVAILABILITY OF DATA AND MATERIALS

Semi-anonymized data may be made available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTIONS

SA—Conceptualization; Methodology; Data curation; Writing–original draft; Writing–review & editing. YY—Formal analysis; Software; Visualization; Writing–review & editing. CS—Investigation; Validation; Writing–review & editing. HM—Investigation; Validation; Writing–review & editing. DÇ—Conceptualization; Supervision; Project administration; Resources; Writing–review & editing. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ege University Faculty of Dentistry Ethics Committee (Approval No: 23-5.1T/14). Written informed consent was obtained from all participating parents or legal guardians.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at `https://oss.jocpd.com/files/article/2095408699398864896/attachment/Supplementary%20material.docx`.

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