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Evaluation of the relationship between the psychosocial impact of dental appearance and self-perceived esthetic treatment need among dental students

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Abstract

Background Understanding the relationship between self-perceived need for esthetic dental treatment and the psychosocial effects of dental appearance is essential, particularly for dental students who will become future professionals. This connection may shape how they understand and respond to esthetic concerns in their patients. This study aimed to evaluate the relationship between the need for esthetic treatment based on self-perception and the psychosocial impact of dental appearance among dental students.

Methods A total of 585 dental students completed a three-part questionnaire. The first part included demographic questions. The second part used the Turkish validated version of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) to assess psychological and social impacts. In the third part, the Aesthetic Component of the Index of Orthodontic Treatment Need (IOTN-AC) was used to evaluate esthetic treatment need based on self-perception. Linear regression analysis was conducted to identify associations between PIDAQ scores, IOTN-AC ratings, and other variables. A confirmatory factor analysis (CFA) was also conducted to assess the construct validity of the PIDAQ in this population.

Results Regarding the IOTN-AC, 74.7% of participants rated themselves as having no or minimal need for orthodontic treatment. The mean total PIDAQ score was 71.95 ± 13.44. Statistically significant differences in PIDAQ scores were observed across age groups, academic years, and IOTN-AC categories ($p = 0.002$, $p = 0.027$, and $p < 0.001$, respectively). Regression analysis revealed that having an IOTN-AC score of 4 or higher had a statistically significant effect on the total PIDAQ score ($p < 0.001$). The CFA supported the four-factor structure of the Turkish version of the PIDAQ with acceptable model fit indices (RMSEA = 0.07, CFI = 0.92, TLI = 0.94, CMIN/df = 3.829).

Conclusions The findings highlight the importance of dental appearance in psychological and social well-being and emphasize the need to support dental students in managing esthetic concerns. These findings may inform dental education curricula and improve communication strategies by encouraging greater awareness of esthetic concerns and their psychosocial impacts.

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Keywords Esthetic dental treatment, Dental students, Dental appearance, Orthodontic treatment need, Psychosocial impact, PIDAQ, IOTN-AC, Confirmatory factor analysis, Construct validation

Background

Esthetics, derived from the Greek word *aesthesis*, pertains to the science of sensory cognition and emphasizes the appreciation of beauty and emotional judgment [1]. In dentistry, esthetic dental treatment plays a crucial role, as the pursuit of an esthetically pleasing smile is fundamental [2, 3]. An attractive smile not only enhances self-confidence but also facilitates interpersonal interactions. This highlights the psychosocial importance of dental appearance [4]. Key elements such as tooth shape, color, and texture are essential in defining dental appearance and play a pivotal role in smile enhancement [5]. Given that the orofacial region is central to communication, dental appearance is vital for both social integration and psychological well-being [6]. Dental appearance significantly influences individuals' psychosocial status. Severely compromised dental appearance have been associated with negative impacts on components of oral health-related quality of life (OHRQoL), particularly in terms of emotional well-being and self-confidence [7]. Dental appearance also contributes to the development and maintenance of self-esteem and personality, especially among young adults. When there is a divergence from accepted esthetic norms, individuals may experience a decline in self-esteem and negative impacts on well-being [8]. Understanding the effects of dental appearance is crucial for delivering patient-centered care, as perceptions of esthetic need influence both treatment expectations and outcomes [9].

Oral health is not only a cornerstone of physical well-being but also profoundly influences social and psychological dimensions of health [10]. Therefore, understanding its effect on components of OHRQoL is essential for providing dental care that considers both clinical outcomes and patient-reported psychosocial impacts [11]. Malocclusion, defined as the misalignment of dental arches and teeth, is one of the most common reasons individuals seek esthetic dental treatment. Correcting malocclusion improves dental function and dental appearance, offering substantial psychosocial benefits [12]. Beyond functional concerns, malocclusion and other dentofacial irregularities can have a significant psychological impact. Individuals with visible malocclusion often report lower self-esteem, greater social anxiety, and reduced confidence in social interactions [8, 13]. These effects are especially pronounced in adolescents and young adults, among whom self-image and peer acceptance are particularly influential [14, 15]. Several studies have also highlighted how dissatisfaction with dental appearance can lead to avoidance behaviors, embarrassment, and impaired social functioning [16, 17]. Emphasizing these associations underscores the importance of evaluating self-perceived esthetic treatment need in relation to psychosocial well-being, particularly in young adults.

Discrepancies between dentists' and patients' perceptions of treatment need underscore the importance of incorporating patient perspectives into treatment planning [18]. These perceptions are valuable for evaluating treatment needs and tailoring individualized care [19]. Bridging the gap between professional judgment and patient expectations is essential to optimizing outcomes in esthetic dentistry [20].

As future providers of esthetic dental treatment, dental students' understanding and perception of dental appearance are important for the development of clinical empathy and patient communication [21, 22]. Their ability to recognize esthetic concerns and understand associated psychosocial impacts will directly affect their clinical decision-making and patient management strategies [23]. Dental education and clinical experience significantly shape students' familiarity with esthetic principles and patient-centered care [24]. Integrating comprehensive esthetic education into the dental curriculum can enhance students' diagnostic capabilities, treatment planning skills, and ability to address esthetic concerns, ultimately improving patient satisfaction and treatment outcomes [25]. Therefore, assessing how dental students perceive their own dental appearance and how it affects their psychosocial well-being, may provide valuable insights into both personal and professional development.

While previous research has examined the psychosocial effects of dental esthetics and the influence of malocclusion on self-esteem and social functioning, few studies have explored how these dynamics manifest among dental students—a population that is both professionally informed and personally affected by appearance-related perceptions. This study aims to address this gap by evaluating the relationship between self-perceived esthetic dental treatment need and the psychosocial impact of dental appearance among undergraduate dental students. Informed by theories of appearance-related self-concept and social comparison, we hypothesized that students with greater self-perceived esthetic treatment need would report higher levels of psychosocial impact related to their dental appearance. The null hypothesis of the study was that self-perceived esthetic treatment need does not affect the psychosocial status of undergraduate dental students. By focusing on future dental professionals,

this study aims to contribute to educational strategies that promote a more empathetic, esthetically aware, and patient-centered approach in dental practice.

Methods

Study design

This cross-sectional study was conducted with undergraduate students from all years, from first-year to senior-year, enrolled at the School of Dentistry, Marmara University, during the 2022–2023 academic year. The study received approval from the Clinical Research Ethics Committee of Marmara University Dental School under protocol number 2022-70. It was conducted and reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines. The researchers provided detailed information about the study to the students through face-to-face interactions in a classroom setting. Informed consent forms outlining the study's details were distributed and signed by the students. It was clearly stated that participation was entirely voluntary. The study adhered to all ethical principles and guidelines of the Declaration of Helsinki, including its later amendments or equivalent ethical standards.

Sample size calculation

Sample size estimation was performed using G*Power version 3.1 (Faul, Erdfelder, Lang, & Buchner; Heinrich Heine University, Düsseldorf, Germany). The study by Garg et al. [26], which evaluated changes in the psychosocial impact of malocclusion using the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) before and after one year of orthodontic treatment, was used as a reference. In that study, a statistically significant difference was reported between the PIDAQ total scores of participants with an Index of Orthodontic Treatment Need-Aesthetic Component (IOTN-AC) score of 1–4 (53.50 ± 18.15) and those with a score of 5–7 (62.95 ± 14.47), with a p-value of 0.004. Based on these values, the effect size was calculated as 0.576. With a power level of 0.99 and an alpha error probability of 0.05, the minimum required total sample size was determined to be 192. After accounting for a potential 20% dropout rate, the final minimum sample size was set at 230 participants.

Study participants

A total of 654 students studying in the 2022–2023 academic year were invited to participate in the research. This included 156 first-year students, 145 second-year students, 123 third-year students, 117 fourth-year students, and 113 senior-year students from the School of Dentistry at Marmara University. Dental education in Türkiye spans five years, or ten semesters. While all years involve theoretical education, the first three years include preclinical training, and the fourth and senior years focus on clinical practice [27]. Students who reported having a diagnosed psychological or psychiatric disorder were not included in the study. During the informed consent process, students were provided with detailed information about the study's aims and procedures, including the exclusion criteria related to psychological or psychiatric diagnoses. Participants were informed that individuals with a diagnosed psychological or psychiatric condition should refrain from participating to avoid potential confounding effects on psychosocial assessments. This information was communicated verbally in face-to-face sessions and was explicitly stated in the informed consent form. Additionally, individuals who had received orthodontic treatment in the past or were currently undergoing orthodontic treatment were excluded from the study.

Data collection

The questionnaire used in this study was structured into three sections. The first section collected demographic information from participants, including age, gender, and year. The second section administered the validated Turkish version of the PIDAQ, consisting of 23 questions distributed across four subscales: Dental Self-Confidence (Questions 1 to 6), Social Impact (Questions 7 to 14), Psychological Impact (Questions 15 to 20), and Aesthetic Concern (Questions 21 to 23) [7, 28, 29]. The PIDAQ is a crucial tool for assessing the psychosocial impact of dental esthetics, providing comprehensive insights into patients' perceptions and attitudes regarding their dental appearance [28]. It assesses the influence of dental esthetics on OHRQoL and evaluates whether mental distress arises from somatic symptoms [7, 28, 29]. The internal consistency of the Turkish version of the PIDAQ, as determined by Cronbach's alpha coefficient, ranged from 0.534 to 0.904 across its four subscales, according to the study by Ağlarcı et al. [29].

The Dental Self-Confidence Subscale (Questions 1 to 6) was positively framed, focusing on aspects such as the dental appearance, tooth alignment, and comfort in smiling openly. In contrast, the other subscales were negatively framed. The Social Impact Subscale evaluates participants' perceptions of their own teeth and how their daily social interactions are influenced by their own dental appearance. The Psychological Impact Subscale involves participants comparing their own dentition with that of others. The Aesthetic Concern Subscale includes participants' attitudes related to disliking their dental appearance when observing them in the mirror or in pictures. Participants were asked to rate the items using a 5-point Likert scale, with 1 indicating "strongly disagree" and 5 indicating "strongly agree." The scores for the positive domain (Dental Self-Confidence) were reversed: 1 became 5, 2 became 4, 3 remained 3, 4 became 2, and 5

became 1. Then, all items were re-coded so that 5 became 4, 4 became 3, 3 became 2, 2 became 1, and 1 became 0. After this re-coding process, the possible range of total scores was from 0 to 92. Higher total scores signified a greater negative psychosocial impact resulting from dental appearance [7, 28, 29].

The third part of the questionnaire included the IOTN-AC, which was used to assess participants' subjective perception of orthodontic treatment needs [30, 31]. This component utilizes a dental appearance scale depicted through 10 black and white photographs illustrating varying levels of dental appearance. The IOTN-AC is an internationally recognized scoring system for assessing orthodontic treatment needs from both professional and patient perspectives [30, 31]. The students conducted the assessments themselves, determining the degree of esthetic compromise in the scale images that closely resembled their own smiles. They were asked to rank their teeth on a scale from 1 to 10, with 1 representing the most attractive and 10 representing the least attractive. The photographs were categorized into three groups: group numbers 1 to 4 represented patients with no or minimal orthodontic treatment needs; group numbers 5, 6, and 7 represented patients with moderate orthodontic treatment needs; and group numbers 8, 9, and 10 represented patients with severe orthodontic treatment needs [30, 31].

The decision to utilize both the PIDAQ and the IOTN-AC instruments was based on their strong relevance to the study's aims. The PIDAQ is a validated tool specifically developed to assess the psychosocial impact of dental appearance across four domains—dental self-confidence, social impact, psychological impact, and aesthetic concern. This aligns directly with the objective of our study, which centers on exploring how dental appearance affect the psychosocial well-being of dental students. On the other hand, the IOTN-AC allows participants to subjectively assess their need for orthodontic treatment based on dental attractiveness. It serves as a standardized method to quantify participants' self-perceived esthetic concerns, making it a suitable complement to the PIDAQ in capturing both psychological impact and perceived treatment need.

Data analysis

Statistical analyses were performed using IBM SPSS 26.0 software (IBM Corporation, Armonk, NY, USA). Descriptive statistics are reported as numbers, percentages, means, standard deviations, medians, minimums, and maximums. The assumption of normal distribution was assessed using the Shapiro-Wilk test. Additionally, the histogram and normal Q–Q plot of the residuals were examined to evaluate the normality assumption for the linear regression model. Furthermore, the skewness and kurtosis values of the residuals were within the acceptable range (±1), further supporting the assumption of normality. When normality assumptions were not met, comparisons between two independent groups were conducted using the Mann-Whitney U test, and comparisons among three or more independent groups were performed using the Kruskal-Wallis test. Post-hoc Bonferroni tests were utilized to determine specific groups responsible for observed differences. Although the IOTN-AC scores are ordinal and could be treated as continuous or divided into finer categories (e.g., mild, moderate, severe), we chose to merge scores ≥ 4 into a single group due to the low number of participants in higher score categories. Treating IOTN-AC as a continuous variable in additional regression analyses yielded results consistent with the grouped analysis, indicating that higher IOTN-AC scores were significantly associated with increased total PIDAQ scores. After determining which variables had a statistically significant effect on the total PIDAQ score through bivariate analysis, their effect on the total PIDAQ score was evaluated using multivariate linear regression analysis, after confirming the normal distribution of residuals. The IOTN-AC score, age (21–23), and year (second-year), which were observed to have a statistically significant effect in the initial statistical analysis, were included as explanatory variables in the total PIDAQ score outcome variable model. Statistical significance was set at a p-value of less than 0.05.

In addition, a confirmatory factor analysis (CFA) was conducted using IBM SPSS AMOS 26.0 (IBM Corp., Armonk, NY, USA) to assess the construct validity of the Turkish version of the PIDAQ within the current sample. The original four-factor model—Dental Self-Confidence, Social Impact, Psychological Impact, and Aesthetic Concern—was tested. Model fit was evaluated using conventional goodness-of-fit indices, including the chi-square/degrees of freedom ratio (CMIN/df), Root Mean Square Error of Approximation (RMSEA), Normed Fit Index (NFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Goodness of Fit Index (GFI), Tucker-Lewis Index (TLI), and Adjusted Goodness of Fit Index (AGFI).

Results

Description of participants and Index of Orthodontic Treatment Need-Aesthetic Component

Data from 585 of the 654 dental students were included in the study, representing a response rate of 89.5%. Three students were excluded because they were diagnosed with psychological/psychiatric diseases, and 59 students were excluded due to their orthodontic treatment history. Additionally, seven students either did not agree to participate or filled out the survey forms incompletely or incorrectly. Of the students, 67.5% (n = 395) were female and 32.4% (n = 190) were male. More than half

Table 1 Distribution of participants by demographic and clinical characteristics

		N	%
Gender	Female	395	67.5
	Male	190	32.5
Age range	18–20	168	28.7
	21–23	329	56.2
	24–26	81	13.8
	27–30	7	1.2
Education year	First-year	144	24.6
	Second-year	125	21.4
	Third-year	113	19.3
	Fourth-year	100	17.1
	Senior-year	103	17.6
IOTN-AC	1	437	74.7
	2	53	9.1
	3	37	6.3
	≥ 4	58	9.9

N, number; *IOTN-AC*, The Index of Orthodontic Treatment Need-Aesthetic Component

of the participants were between the ages of 21–23 (n = 329, 56.2%). The data included 144 first-year students, 125 second-year students, 113 third-year students, 100 fourth-year students, and 103 senior-year students. Participants with an IOTN-AC score of 1 constituted 74.7% (n = 437) of the sample, while those with a score of 4 or above constituted 9.9% (n = 58) (Table 1). Due to the small number of participants falling into groups 4 and above, these groups were combined into a single group [29].

Psychosocial impact of dental appearance and scale reliability

The distribution of total scores for the PIDAQ scale and its subscales was presented in Table 2. A reliability analysis was conducted to assess the internal consistency of the PIDAQ scale based on participants' responses. The PIDAQ scale demonstrated high reliability with a Cronbach's alpha coefficient of 0.948. Additionally, the subscales of Dental Self-Confidence, Social Impact, Psychological Impact, and Aesthetic Concern also showed high to very high levels of reliability, with Cronbach's alpha coefficients calculated as 0.921, 0.846, 0.768, and 0.912, respectively.

The mean total PIDAQ score was 71.95 ± 13.44. Among the specific subscales of the questionnaire, the highest mean score was observed in the Aesthetic Concern Subscale (21.29 ± 5.40), followed by the Dental Self-Confidence Subscale (20.03 ± 4.83) and the Social Impact Subscale (17.18 ± 4.20). The Psychological Impact Subscale had a mean score of 13.45 ± 4.61, indicating relatively lower ratings.

Confirmatory Factor Analysis of the Psychosocial Impact of Dental Aesthetic Questionnaire

CFA was performed to assess the construct validity of the Turkish version of the PIDAQ within the study sample. The original four-factor model—including Dental Self-Confidence, Social Impact, Psychological Impact, and Aesthetic Concern—was tested through structural equation modeling. The analysis demonstrated a statistically significant model fit (χ^2 = 846.308, $p < 0.001$), supporting the factorial structure of the 23-item scale. The model showed acceptable-to-good fit with the following values: RMSEA = 0.07, NFI = 0.93, CFI = 0.92, IFI = 0.92, GFI = 0.90, TLI = 0.94, AGFI = 0.85, and CMIN/df = 3.829. To improve model fit, post hoc modifications were applied by introducing covariances between error terms that exhibited high shared variance (e24–e29, e40–e41, and e41–e46). These findings confirm that the Turkish version of the PIDAQ has a valid and reliable factorial structure in this population. The final CFA model illustrating the relationships among latent constructs and observed variables is presented in Fig. 1.

Effects of demographic and clinical factors on the psychosocial impact of dental appearance

The analyses revealed no statistically significant differences in the total scores of the PIDAQ scale and its subscales between genders ($p > 0.05$). However, statistically significant differences were observed between the Dental Self-Confidence Subscale, Aesthetic Concern Subscale, and total PIDAQ scores across age groups ($p = 0.037$, $p = 0.012$, and $p = 0.002$, respectively). Significant differences were also observed in the Dental Self-Confidence Subscale, Aesthetic Concern Subscale, and total PIDAQ scores across student years ($p = 0.039$, $p = 0.001$, and $p = 0.027$, respectively). Additionally, statistically significant differences were identified in all PIDAQ subscale

Table 2 Distribution of participants' total scores on the PIDAQ scale and subscales

	Min.	Max.	Mean	SD	Median	Cronbach Alpha
Dental Self-Confidence Subscale	0.00	30.00	20.03	4.83	20.00	0.921
Social Impact Subscale	5.00	30.00	17.18	4.20	17.00	0.846
Psychological Impact Subscale	0.00	20.00	13.45	4.61	14.00	0.768
Aesthetic Concern Subscale	0.00	35.00	21.29	5.40	21.00	0.912
PIDAQ	20.00	109.00	71.95	13.44	72.00	0.948

Min, minimum, *Max*, maximum, *SD*, Standard deviation, *PIDAQ*, The Psychosocial Impact of Dental Aesthetics Questionnaire

scores and total scores according to IOTN-AC groups ($p < 0.001$, $p < 0.001$, $p = 0.01$, $p < 0.001$, and $p < 0.001$, respectively) (Table 3). Further analyses were conducted to examine the associations between IOTN-AC scores and each PIDAQ subscale. Higher IOTN-AC scores were significantly correlated with higher Social Impact, Psychological Impact, and Aesthetic Concern subscale scores ($p < 0.001$ for each), indicating greater psychosocial burden. Conversely, Dental Self-Confidence scores were significantly lower in participants with higher IOTN-AC scores ($p < 0.001$), reflecting decreased self-confidence.

A linear regression analysis with a stepwise approach was employed to investigate the influence of demographic and clinical characteristics on PIDAQ scores. The reference categories were first-year students, female gender, 18–20 years of age, and IOTN-AC group 1. The analysis revealed that being in IOTN-AC group ≥ 4, being in the 21–23 age group, and being a second-year student had a statistically significant effect on the total PIDAQ score ($\beta = 7.347$, $p < 0.001$; $\beta = -4.105$, $p = 0.001$; and $\beta = 2.774$, $p = 0.041$, respectively). ANOVA testing was applied to assess the significance of the model, and the regression model was found to be significant ($F = 9.197$, $p < 0.001$) (Table 4).

Discussion

This study aimed to assess the impact of the perceived esthetic treatment need on the psychosocial aspects of dental appearance among a large sample of undergraduate dental students. The secondary aim was to examine the influence of various factors on the psychosocial impact of dental appearance. The null hypothesis was rejected, as perceived esthetic treatment need was found to significantly affect the psychological aspects of dental appearance among dental students. These findings contribute to a deeper understanding of how perceived esthetic treatment needs may shape future healthcare professionals' perceptions of dental appearance, with potential implications for patient care.

Physical appearance significantly affects individuals' lives, with orofacial appearance playing a particularly prominent role in social interactions. Dental malocclusions can impair functions such as biting and chewing, and may lead to dental damage, pain, and discomfort [32, 33]. The negative impact of malocclusion on OHRQoL has been documented [34]. The perception of one's oral and maxillofacial appearance plays a crucial role in subjective well-being. Therefore, esthetic treatment planning in this area must consider the patient's subjective perceptions and sociocultural context [35, 36]. Individuals with dentofacial abnormalities may face prejudice from family, friends, teachers, and their communities [37]. Besides the loss of physical functionality, impairments in psychological functioning should not be overlooked in oral health assessments. Thus, oral health should be defined not only by physical factors but also by psychological well-being [38].

Assessing the psychological effects of dental appearance among dental students is crucial for developing tailored treatment plans that promote optimal oral health and well-being. By focusing on future dental professionals, this study aimed to enhance the educational framework that supports the development of a more empathetic and patient-centered approach in dental practice. Such insights are vital for training well-rounded dentists who can effectively blend clinical expertise with an understanding of the psychosocial dimensions of oral health.

The perspectives of dentists and patients often differ, underscoring the importance of a comprehensive evaluation of treatment needs and patient expectations to achieve satisfactory outcomes [39]. Therefore, exploring the psychosocial impact of dental appearance is believed to provide valuable support in patient management and treatment planning [40]. It is expected that the perception and awareness of dental students may develop and change as a consequence of the theoretical knowledge and clinical experiences received during their undergraduate education, which typically spans approximately five years before students become eligible to practice dentistry [41–43]. In the present study, total PIDAQ scores of first and second-year dental students were found to be higher than those of students in other grades. This may be attributed to the fact that the first and second years are considered 'preclinical years', during which students undergo intensive theoretical training and receive initial lectures on dental appearance, leading to a relatively fresh understanding compared to students in later years. Additionally, as students progress through their years and enter clinical training, they may have already addressed their own esthetic expectations and undergone necessary treatments.

The utilization of standardized tools such as PIDAQ and IOTN-AC enabled a structured assessment of participants' perceptions and treatment needs [28, 30]. This methodological approach is consistent with previous studies that employed these tools to evaluate the psychosocial impact of dental appearance [44]. The internal consistency of the Turkish version of the PIDAQ, as calculated by Ağlarcı et al. [29] in 2016, supports the reliability of our findings. The current study found that the assessment of orthodontic treatment need using IOTN-AC revealed diverse perceptions among participants, with a significant proportion perceiving little or no esthetic treatment need. This emphasizes the subjective nature of evaluating dental appearance and underscores the importance of taking individual perspectives into account in treatment planning [19]. The results of

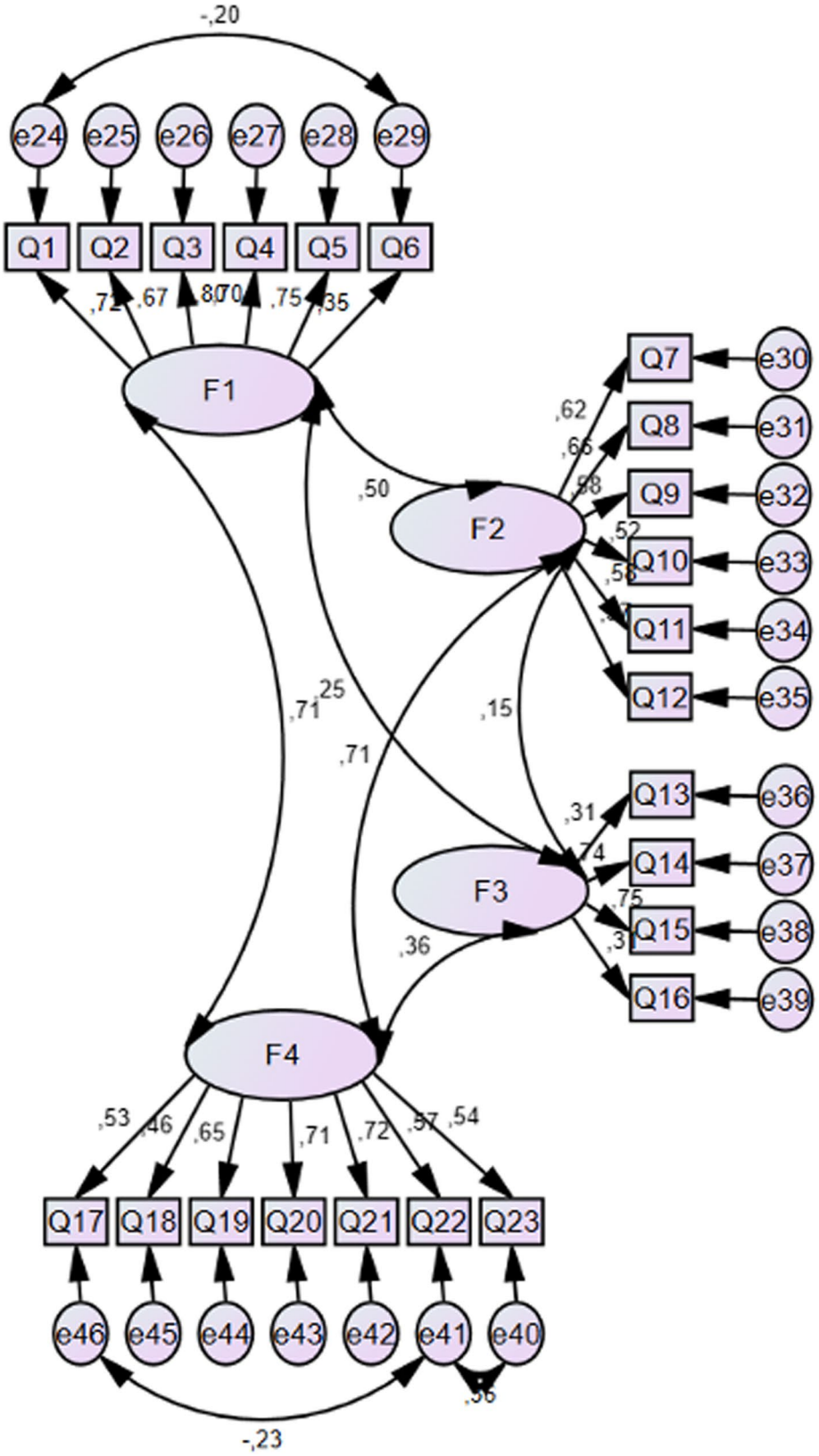


Fig. 1 Structural model of the confirmatory factor analysis (CFA) for the Turkish version of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) for undergraduate dental students. The model illustrates the four-factor structure of the PIDAQ, including Dental Self-Confidence, Social Impact, Psychological Impact, and Aesthetic Concern. Standardized factor loadings are shown on the paths, and covariances between selected error terms (e24–e29, e40–e41, e41–e46) were added to improve model fit

Table 3 Distribution and comparison of PIDAQ scale and subscales according to participants' variables

		Dental Self-Confidence Subscale	Social Impact Subscale	Psychological Impact Subscale	Aesthetic Concern Subscale	Total PIDAQ
		Mean ± SD (Median)	Mean ± SD (Median)	Mean ± SD (Median)	Mean ± SD (Median)	Mean ± SD (Median)
Gender	Female	20.05 ± 4.57 (20)	16.76 ± 4.57 (20)	13.56 ± 4.08 (14)	21.17 ± 4.98 (21)	71.54 ± 12.38 (73)
	Male	20.02 ± 4.95 (20)	17.38 ± 4.95 (20)	13.40 ± 4.84 (14)	21.34 ± 5.60 (21)	72.14 ± 13.93 (72)
	Test statistics	−0.147	−1.477	−0.346	−0.031	−0.026
***p*-value**		0.883	0.140	0.730	0.976	0.980
Age Range	18–20	20.87 ± 4.60 (21)	17.7 ± 4.6 (21)	14.16 ± 4.29 (15)	22.31 ± 5.50 (22)	75.04 ± 12.82 (75)
	21–23	19.67 ± 4.94 (19)	17.05 ± 4.94 (21)	13.00 ± 4.95 (14)	20.92 ± 5.35 (21)	70.64 ± 13.76 (69)
	24–26	19.88 ± 4.26 (20)	16.59 ± 4.26 (20)	13.64 ± 3.62 (14)	20.57 ± 5.33 (21)	70.68 ± 12.38 (71)
	27–30	18.57 ± 8.48 (20)	17.43 ± 8.48 (20)	15.43 ± 2.94 (16)	22.29 ± 3.09 (22)	73.71 ± 14.92 (79)
	Test statistics	8.480	4.237	7.288	11.007	15.283
***p*-value**		**0.037**	0.237	0.063	**0.012**	**0.002**
Education year	First-year	20.33 ± 5.20 (20)	17.63 ± 5.2 (20)	13.06 ± 4.90 (14)	21.55 ± 5.96 (21)	72.57 ± 14.12 (72)
	Second-year	21.07 ± 4.58 (20)	17.59 ± 4.58 (20)	13.43 ± 4.49 (14)	22.94 ± 4.97 (22)	75.04 ± 13.07 (74)
	Third-year	19.50 ± 4.78 (20)	17.04 ± 4.78 (20)	13.27 ± 5.39 (14)	20.72 ± 4.85 (21)	70.52 ± 12.91 (70)
	Fourth-year	19.30 ± 4.25 (19)	16.81 ± 4.25 (19)	13.79 ± 3.64 (14)	20.44 ± 5.40 (21)	70.34 ± 12.59 (69)
	Fifth-year	19.64 ± 4.98 (20)	16.55 ± 4.98 (20)	13.89 ± 4.25 (15)	20.36 ± 5.28 (20)	70.45 ± 13.81 (71)
	Test statistics	10.083	5.347	1.623	19.969	10.942
***p*-value**		**0.039**	0.254	0.805	**0.001**	**0.027**
IOTN-AC groups	1	19.49 ± 4.12 (19)	16.71 ± 4.12 (19)	13.80 ± 4.17 (14)	20.67 ± 5.00 (21)	70.67 ± 12.45 (70)
	2	21.26 ± 7.10 (23)	18.09 ± 7.1 (23)	11.96 ± 5.18 (12)	23.23 ± 6.88 (23)	74.55 ± 17.59 (76)
	3	20.05 ± 7.52 (21)	19.19 ± 7.52 (21)	11.16 ± 6.28 (12)	21.59 ± 6.57 (21)	72.00 ± 17.96 (71)
	≥ 4	22.98 ± 3.76 (23.5)	18.59 ± 3.76 (23.5)	13.62 ± 5.33 (14)	24.00 ± 4.87 (24.5)	79.19 ± 10.32 (81)
	Test statistics	47.675	24.119	11.425	33.303	28.302
***p*-value**		**< 0.001**	**< 0.001**	**0.010**	**< 0.001**	**< 0.001**

SD, Standard deviation; *PIDAQ*, The Psychosocial Impact of Dental Aesthetics Questionnaire; *IOTN-AC*, The Index of Orthodontic Treatment Need-Aesthetic Component. Bold values mean statistically significant (< 0.05)

Table 4 Linear regression analysis for total PIDAQ score

Variables	β	SE	t	*p*-value	VIF
Constant	73.430	1.064	68.994	**< 0.001**	
IOTN-AC score ≥ 4	7.347	1.830	4.015	**< 0.001**	1.023
Age (21–23)	−4.105	1.225	−3.350	**0.001**	1.264
Second-year	2.774	1.356	2.046	**0.041**	1.057

F:9.197, *p*-value < 0.001

S.E.: Standard error; *VIF*: The Variance Inflation Factor; *IOTN-AC*: The Index of Orthodontic Treatment Need-Aesthetic Component. Bold values mean statistically significant (< 0.05)

the present study showed that total PIDAQ scores were higher among dental students who self-rated moderate or severe esthetic treatment need according to IOTN-AC, indicating a greater psychosocial impact of dental appearance in these individuals. This finding aligns with studies that have demonstrated the significant role of dental appearance in shaping self-confidence and social functioning [45, 46]. In the present study, stepwise linear regression analysis further identified IOTN-AC (≥ 4) as a significant predictor of PIDAQ scores, reinforcing the association between perceived esthetic treatment need and psychosocial outcomes related to dental appearance. The decision to combine IOTN-AC scores ≥ 4 into a single category was primarily driven by the low frequency of participants in higher score ranges, which would have compromised statistical power if analyzed separately. Nevertheless, treating IOTN-AC as a continuous variable produced similar results, confirming the robustness of the observed relationship between perceived esthetic treatment need and psychosocial impact. The additional subscale analyses revealed that higher IOTN-AC scores were associated with increased social anxiety, psychological distress, and aesthetic concern, while dental self-confidence decreased. These findings suggest that self-perceived esthetic treatment need affects multiple psychosocial dimensions among dental students, underscoring the complexity of dental appearance-related quality of life.

It has been shown that significant differences exist in body perception between genders and across age groups [47]. However, the PIDAQ measures the psychosocial impact of dental appearance rather than general body image or esthetic perception. In the present study, it was found that age and gender did not significantly influence total PIDAQ scores. While these findings are consistent with other studies [28, 40, 48], the topic remains contentious [49, 50]. Yu et al. [51] reported that females pay greater attention to dental appearance than males.

Althagafi et al. [22] reported that female dental students, regardless of their year of study, exhibited greater esthetic concerns about their smile than their male counterparts. Similarly, Gavranović-Glamoč et al. [50] reported that female participants exhibited significantly higher levels of dissatisfaction with the appearance of their teeth compared to male participants. Therefore, the differing perceptions of dental appearance across genders and age groups do not necessarily translate into a greater psychosocial impact, which may explain the lack of gender and age effects observed in this study.

The subjective experience of satisfaction with dental appearance is influenced by various factors, including the level and type of education an individual has received [50]. In the current study, significant differences in total PIDAQ scores were observed across academic grades, with first and second-year students exhibiting greater esthetic concerns compared to their senior counterparts. Gavranović-Glamoč et al. [50] reported that senior-year undergraduate dental students showed significantly higher satisfaction with the overall appearance of their teeth and tooth color compared to first-year dental students. Similarly, Althagafi et al. [22] found that fifth-year dental students had a more favorable perception of the esthetic components of the smile than fourth-year students. The heightened self-awareness and increased social interactions in later academic years might contribute to these differences. The results of the current study may be attributed to the fact that the first and second years are considered 'preclinical years', during which students undergo intensive theoretical training and receive initial instruction on dental esthetics, resulting in a relatively fresh perspective compared to students in later years. Additionally, as students progress through their grades and enter clinical years, they may have already addressed their own esthetic expectations and undergone necessary treatments.

It should be noted that this study is subject to certain limitations. Firstly, reliance on self-reported data introduces inherent limitations, such as recall bias, over- or underestimation of self-perceived needs, and the influence of participants' personal attitudes or expectations. Although validated instruments were used, responses remain subjective in nature and may not fully capture objective clinical indicators. Given that the participants were dental students, there is a possibility of social desirability bias influencing their responses. Their academic background and awareness of esthetic norms may have led them to provide answers they perceived as professionally or socially appropriate, potentially affecting the objectivity of self-assessments. Secondly, this study is institution-based and focused on a specific population within a particular region of Türkiye, which limits its representativeness of the natinal dental student population. As the sample was drawn from a single dental school located in a major urban area, the findings may not capture the full range of perceptions found among dental students from other regions or institutions. Differences in city size, population density, access to dental care, and educational resources—as well as socioeconomic and cultural contexts—can influence students' esthetic self-perceptions and treatment expectations. Future multicenter studies across various regions of Türkiye are recommended to assess whether these findings are generalizable to a broader population. However, the high response rate and the robustness of the survey design mitigate some of these concerns. Despite these limitations, this study is among the first to evaluate the psychosocial impact of dental appearance and self-perceived esthetic treatment needs among undergraduate dental students in Türkiye.

Understanding the intricate relationship between dental esthetic and psychosocial well-being is essential for delivering patient-centered care and optimizing treatment outcomes. By addressing both clinical and psychosocial aspects, dental professionals can enhance patient satisfaction and overall treatment outcomes, ultimately promoting optimal oral health and well-being across diverse patient populations. Evaluating dental students in this study presents several distinct advantages, particularly considering their future roles as dental professionals. As future dentists, these students will be responsible not only for addressing the clinical aspects of dental care but also for understanding and managing the psychosocial dimensions of oral health. Assessing their perceptions of dental esthetics and its psychosocial impact provides valuable insights into their awareness and sensitivity to these issues—key components of patient-centered care. This early exposure and evaluation can help shape their professional development, ensuring they become more empathetic and responsive practitioners. Furthermore, understanding their own esthetic concerns and treatment needs can enhance their ability to empathize with patients, thereby improving communication and treatment outcomes. This study therefore contributes to the holistic training of dental students by emphasizing the importance of integrating psychosocial considerations into dental practice—an essential factor for enhancing patient satisfaction and overall oral health outcomes. Moreover, these findings can inform dental curricula by emphasizing the importance of psychosocial education in esthetic dentistry. Integrating psychosocial assessment tools such as the PIDAQ into student training may enhance future practitioners' ability to recognize and address the emotional and social aspects of their patients' esthetic concerns. Additionally, fostering open communication skills and encouraging empathy-driven consultation techniques can help bridge the gap between clinical

indicators and patient expectations, ultimately improving satisfaction and long-term adherence to treatment.

Conclusions

This study demonstrated that the perceived need for esthetic dental treatment significantly affects the psychosocial dimensions of dental appearance among undergraduate dental students. The findings suggest that factors such as academic grade and perceived esthetic treatment need—particularly when assessed using validated tools like the IOTN-AC and PIDAQ—play a critical role in shaping students' psychological and social responses to dental esthetics. These insights highlight the importance of incorporating psychosocial education into dental curricula and underscore the value of training future practitioners to recognize and address the emotional aspects of dental appearance. By fostering a more holistic, empathetic, and patient-centered approach to care, dental education can better equip students to manage both the clinical and psychosocial components of esthetic treatment—ultimately enhancing communication, patient satisfaction, and long-term outcomes.

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Authors' contributions
E.A.Ş., B.S., U.K., and B.K. planned the study, determined the methodology, and explored the sources. E.A.Ş. and U.K. performed the data curation. E.A.Ş. and B.S. interpreted data and wrote the original draft. All authors have read and approved the final manuscript.

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Data availability
The data that support the findings of this study are available from the corresponding author (B.S.) upon reasonable requests.

Declarations

Ethics approval and consent to participate
The study received approval from the Clinical Research Ethics Committee of Marmara University Dental School under protocol number 2022-70. It was conducted and reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines. The study adhered to all ethical principles and guidelines of the Declaration of Helsinki, including its later amendments or equivalent ethical standards.

Consent for publication
All authors consent for the publication of this manuscript.

Competing interests
The authors declare no competing interests.

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