

## Translation and Validation of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) in Peruvian Adolescents

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### Abstract

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**Background:** Dental aesthetics and their psychosocial impact have gained increasing recognition, particularly among adolescents. This population, in constant emotional and social evolution, is particularly susceptible to how they perceive their dental appearance. Previous studies have highlighted the relevance of malocclusion and its relationship with personality aspects such as neuroticism and extraversion, as well as with socioeconomic and cultural factors.

**Objective:** The present study seeks to evaluate the psychometric properties of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) in a sample of Peruvian adolescents, in order to assess the consistency, validity, and reliability of this instrument in this specific demographic group.

**Methods:** A methodological design was implemented that included the analysis of descriptive items, Confirmatory Factor Analysis (CFA), tests of convergent and discriminant validity, and assessment of measurement invariance. Participants were Peruvian adolescents aged between 12 and 17 years. Descriptive statistics were calculated for each item, and the internal structure of the questionnaire was analyzed through CFA.

**Results:** The descriptive analysis revealed variations in the means of the items, with certain items suggesting possible eliminations. The CFA showed satisfactory goodness-of-fit indices:  $\chi^2 = 729.260$ ,  $df = 224$ ,  $p = 0.000$  CFI = 0.95, TLI = 0.95 RMSEA = 0.08 (90% CI 0.07 - 0.09) SRMR = 0.06, with all factorial loadings above 0.50, indicating an adequate retention of variables in the model. Internal convergent and discriminant validity was confirmed, and measurement invariance suggested consistency across different groups by sex. The internal consistency of the questionnaire was high, regarding its dimensions: dental self-confidence ( $\alpha = 0.91$ ), social impact ( $\alpha = 0.91$ ), psychological impact ( $\alpha = 0.91$ ), aesthetic concern ( $\alpha = 0.91$ ).

**Conclusions:** The results indicate that the PIDAQ is a valid and reliable instrument to assess the psychosocial impact of dental aesthetics in Peruvian adolescents. The scale demonstrated adequate internal consistency and factorial structure.

#### Keywords:

Emotional Intelligence, Conflict Management, Job Satisfaction, Nurses, Mediation.

### Introduction

The field of dental aesthetics has gained significant recognition for its psychosocial impact, particularly among adolescents. This research delves into how dental aesthetics influence not only

facial appearance but also the psychological, social, and physical well-being of young people. It highlights the relevance of malocclusion and its relationship with personality traits such as neuroticism and extraversion (Zheng et al., 2022). These findings suggest that the personal perception of dental appearance is influenced by various factors, including age, gender, socioeconomic and educational levels, and the perceived need for orthodontic treatment. In the context of orthodontics, personal expectations and perceptions play an essential role. Often, methods for assessing the need for orthodontic treatment focus on normative criteria and clinical measures, without fully reflecting patients' aesthetic and psychosocial concerns (D. F. D. J. Paula et al., 2009).

Dental appearance significantly influences adolescents' self-esteem and self-confidence. Those with perceived less attractive teeth may face psychosocial challenges, including bullying and lower confidence, leading to reluctance to smile or show their teeth. This phenomenon underscores the importance of considering subjective needs and perceptions in orthodontic practice, as self-esteem modulates the perception of the aesthetic impact of malocclusion (Muniz Júnior et al., 2022; Wan Hassan et al., 2022). Moreover, a correlation has been found between the severity of malocclusion and its psychosocial impact. As the severity of malocclusion increases, so does the psychosocial impact. This relationship is influenced by factors such as gender, with females showing greater sensitivity to the psychosocial aspects of dental aesthetics and a higher desire for orthodontic treatment (Yi et al., 2016).

In Peru, dental malocclusion represents a significant challenge to oral health, especially among adolescents, with recent studies indicating a prevalence of 70% in this population (Zubiate et al., 2022) por lo que el establecimiento oportuno de tratamiento ortodóntico ayuda a solucionar los problemas estéticos y funcionales que esta enfermedad causa en la población. Así, el objetivo es establecer la relación entre la prevalencia de maloclusiones y la necesidad de tratamiento ortodóntico en escolares de 15 años del distrito de Chachapoyas-Perú. El estudio es descriptivo correlacional de corte transversal, realizado en 138 escolares a quienes se les aplicó una ficha de recolección de datos con el Índice de Necesidad de Tratamiento Ortodóntico que contempla dos aspectos: Salud dental y estética. Como resultado se obtuvo una prevalencia de maloclusión clase I de 47,8%, clase II 21% y clase III 20,3%. El índice de Necesidad de Tratamiento Ortodóntico, evidencia que el 43,5% tiene necesidad de tratamiento (Grado 4). This prevalence, evidenced in various regions such as Ucayali and Puno, suggests a substantial demand for orthodontic care and underscores the need for dental health programs to address these issues (Aliaga-Del Castillo et al., 2011; Garate et al., 2019) Perú. Se evaluó la presencia de maloclusiones usando la clasificación de Angle así como alteraciones ortodónticas. Se incluyeron 201 sujetos, 106 (52,7%). Malocclusions, including dental crowding and crossbite, not only affect dental aesthetics and function but also significantly impact psychosocial aspects such as self-esteem, social acceptance, and employment opportunities for adolescents. Adolescence is a critical developmental period where self-image and social interaction play a fundamental role in psychological well-being. In this context, dental appearance becomes particularly relevant. Malocclusion impacts not only dental function but also emotional and social aspects, affecting quality of life and interpersonal interactions (Machiavello & Arrunátegui, 2023). Despite this prevalence and importance, it has been found that the psychosocial impact of malocclusion can vary and does not necessarily significantly affect other areas of adolescents' lives, such as academic performance or bullying experiences (Zubiate et al., 2022) por lo que el establecimiento oportuno de tratamiento ortodóntico ayuda a solucionar los problemas estéticos y funcionales que esta enfermedad causa en la población. Así, el objetivo es establecer la relación entre la prevalencia de maloclusiones y la necesidad de tratamiento ortodóntico en escolares de 15 años del distrito de Chachapoyas-Perú. El estudio es descriptivo correlacional de corte transversal, realizado en 138 escolares a quienes se les aplicó una ficha de recolección de datos con el Índice de Necesidad de Tratamiento Ortodóntico que contempla dos aspectos: Salud dental y estética. Como resultado se obtuvo una prevalencia de maloclusión clase I de 47,8%, clase II 21% y clase III 20,3%. El índice de Necesidad de Tratamiento Ortodóntico, evidencia que el 43,5% tiene necesidad de tratamiento (Grado 4).

It is crucial to adopt a multifactorial approach in planning orthodontic services and public health practices, considering both clinical aspects and patients' perceptions and expectations. This involves a deep understanding of how dental aesthetics affect health-related quality of life, self-esteem, and social interactions among adolescents (de Paula Junior et al., 2009). The perception of dental aesthetics in adolescents is marked by a complexity that transcends purely physical aspects. Factors such as color, shape, size, and position of teeth play an important role in how young people perceive their attractiveness and how this affects their social interactions. These aspects can have psychosocial relevance, regardless of the existence of significant functional or aesthetic deterioration (Wan Hassan et al., 2022).

The variability in access to orthodontic treatment and cultural perceptions can significantly influence the demand for these services. In some contexts, such as Brazil, economic factors limit access to orthodontic treatment, directly affecting the quality of life of adolescents from low-resource families (Kolawole et al., 2012; Santos et al., 2016).

In this context, the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) emerges as a specialized tool designed to assess the psychosocial aspects associated with dental aesthetics, particularly in the context of orthodontics (Klages et al., 2006). This questionnaire incorporates four fundamental subscales that address

various dimensions of the impact of dental aesthetics: Dental Self-Confidence, Social Impact, Psychological Impact, and Aesthetic Concern. Each subscale provides a unique perspective to understand how dental appearance affects individuals in their daily lives.

Internationally, the PIDAQ has been applied in a variety of cultural contexts, demonstrating its robustness and versatility. Studies in the Middle East (Gazit-Rappaport et al., 2010) aged 21-59 years, South Asia (Afroz et al., 2013; Khan & Fida, 2008), China (P. Chen et al., 2012; Dahong et al., 2013; Lin et al., 2013) Class II/1, Class II/2, and Class III malocclusion. For clinical assessment, the incisor relationship was evaluated according to the British Standards Institute Incisor Classification, and the self-perception of dental esthetics was assessed using the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ, Africa (Kolawole et al., 2012; Ngom et al., 2013), South America (Sardenberg et al., 2011), and Europe (Klages & Zentner, 2007) have validated the quality of the questionnaire. These studies support the construct validity of the PIDAQ, showing consistency in the relationship between self-perception of dental aesthetics, oral health, factorial structure, and response to orthodontic treatment.

Although the PIDAQ was initially developed for adults, recent research has begun to explore its applicability in adolescents. Studies in Brazil and Spain with schoolchildren have suggested that the PIDAQ could be effective in assessing the psychosocial impact of dental aesthetics in this younger age group (Bellot-Arcís et al., 2013; Montiel-Company et al., 2013; D. F. Paula et al., 2011; D. F. D. J. Paula et al., 2009). However, to confirm the relevance and accuracy of the PIDAQ in adolescents, specific studies investigating its psychometric properties in this population are necessary.

This research focuses on studying the psychometric properties of the PIDAQ in Peruvian adolescents aged 12 to 17. Given that this stage of life involves significant developmental changes, it is crucial to examine the validity and reliability of the questionnaire in this specific age group ("Guidance for Industry: Patient-Reported Outcome Measures: Use in Medical Product Development to Support Labeling Claims: Draft Guidance," 2006) sponsors can increase the efficiency of their endpoint discussions with the FDA during the product development process, streamline the FDA's review of PRO endpoint adequacy, and provide optimal information about the patient's perspective of treatment benefit at the time of product approval. A PRO is a measurement of any aspect of a patient's health status that comes directly from the patient (i.e., without the interpretation of the patient's responses by a physician or anyone else).

## Method

### *Design and Participants*

This instrumental study (Ato et al., 2013), employed convenience sampling for participant selection. Using an electronic sample size calculator proposed by Soper (2024), several critical factors were considered to determine the number of subjects needed: the number of observed and latent variables in the proposed model, the expected effect size ( $\lambda=0.30$ ), the established level of statistical significance ( $\alpha=0.05$ ), and the desired statistical power ( $1-\beta=0.90$ ). Although the minimum required sample was calculated to be 153 participants, exclusion criteria included the absence of visible caries lesions, trauma, dental hypoplasia, fluorotic lesions, or ongoing orthodontic treatment. Therefore, a total of 355 schoolchildren aged 12 to 17 years ( $M=14.91$ ,  $SD=1.31$ ) were recruited. The majority were male (51.0%), in the fourth year of study (36.1%), and from the coastal region (84.2%) (Table 1).

**Table 1.** Sociodemographic Information

Characteristics		n	%
Sex	Female	174	49.0
	Male	181	51.0
Grade Level	First	44	12.4
	Second	68	19.2
	Third	57	16.1
	Fourth	128	36.1
	Fifth	58	16.3
Region of Origin	Coastal	299	84.2
	Jungle	19	5.4
	Highlands	37	10.4

### *Instruments*

*The Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ)* is a tool designed to assess the psychological and social impacts of dental appearance. It uses a five-point Likert scale to evaluate responses

to its items (Klages et al., 2006). The numerical values are 0 = 'not at all', 1 = 'a little', 2 = 'somewhat', 3 = 'strongly', and 4 = 'very strongly'. The questionnaire consists of 23 items and is based on four dimensions: Dental Self-Confidence, which refers to self-esteem and satisfaction with dental appearance; Social Impact of Dental Appearance, which addresses the influence of dental appearance on social interactions; Psychological Impact of Dental Aesthetics, which focuses on emotional and cognitive perceptions of one's dental appearance; and Aesthetic Concern, related to discomfort with one's dental appearance. Each dimension has multiple items rated on the scale. The reliability, measured through Cronbach's alpha, is high for each dimension: Dental Self-Confidence ( $\alpha = 0.91$ ), Social Impact ( $\alpha = 0.86$ ), Psychological Impact ( $\alpha = 0.87$ ), and Aesthetic Concern ( $\alpha = 0.87$ ).

The adaptation of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) into Spanish was conducted using a meticulous cultural adaptation method (Beaton et al., 2000). This process, aimed at preserving the linguistic and conceptual fidelity of the original instrument, was developed in several key stages:

1. Initially, two bilingual Spanish translators, both with Spanish as their native language, independently translated the PIDAQ into Spanish. Subsequently, both versions were compared and unified to form a first consensus Spanish version.
2. This Spanish version was then back-translated into English by two native English speakers from the United States, fluent in Spanish but with no prior knowledge of the PIDAQ. The purpose of this step was to ensure that the original meaning of the questionnaire was retained in the translation.
3. A committee composed of two orthodontists, an educator, and two psychologists carefully reviewed the Spanish translated version along with the newly translated English versions. The goal of this review was to develop a preliminary Spanish version of the PIDAQ that remained faithful to the original.
4. The preliminary version was subjected to an evaluation by a focus group of 10 schoolchildren to assess the comprehension and readability of the questionnaire. As a result of this test, comprehension issues were identified and corrected, leading to the creation of the final Spanish version of the PIDAQ, named "Psychosocial Impact of Dental Aesthetics Questionnaire en Español" (PIDAQ-S), the details of which are found in the appendix 1.

### *Procedure*

The procedure adopted for the application of the Spanish version of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ-S) in the school context adhered to strict ethical standards, in accordance with the regulations of the Ethics Committee of the Peruvian Union University, under reference No 1582-2023/UPeU-EPG-CEPG-D. To ensure the respect and protection of participants' rights, specific measures focused on the privacy and confidentiality of the involved schoolchildren were taken. Initially, permission was obtained from the school administrations to conduct the study on their premises. This step was crucial to ensure institutional collaboration and access to the study population. Subsequently, meetings were held with the students' parents, where detailed information about the purpose and nature of the study was provided. During these meetings, informed consent was obtained from the parents, ensuring they fully understood the scope of the study and their children's rights as participants. Additionally, informed assent was obtained from the participating schoolchildren. This process involved explaining the study to them in an appropriate and comprehensible manner, emphasizing the voluntary nature of their participation and their ability to withdraw at any time without any consequences. The PIDAQ-S was administered in person at the school premises, reiterating to the students that their participation was completely voluntary and anonymous.

### *Data Analysis*

The study on the Spanish version of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ-S) began with an exhaustive descriptive analysis of its items, evaluating fundamental statistical aspects such as mean, standard deviation, skewness, and kurtosis. Acceptable values for skewness ( $g_1$ ) and kurtosis ( $g_2$ ) were considered to be within the range of  $\pm 1.5$  (Pérez & Medrano, 2010). Additionally, a corrected item-test correlation analysis was conducted, excluding items with a correlation  $r(i\text{-}tc) \leq 0.2$  or in cases of multicollinearity (Kline, 2016).

The next step involved a unifactorial confirmatory factor analysis (CFA) using the MLR estimator, which is suitable for data with deviations from normality (Muthén & Muthén, 2017). Several criteria were used to evaluate model fit, including chi-square ( $\chi^2$ ), CFI and TLI ( $\geq 0.90$ ), and RMSEA and SRMSR ( $\leq 0.08$ ) (Kline, 2016; Schumacker & Lomax, 2016).

The internal consistency of the PIDAQ-S was measured using Cronbach's alpha and McDonald's omega, with values greater than 0.70 indicating adequate consistency (McDonald, 1999). Additionally, to demonstrate internal validity, the study employed the convergent validity approach, calculating the average variance extracted (AVE) for each factor. According to established criteria, an AVE greater than 0.50 indicates satisfactory convergent validity. Inter-factor correlations ( $\varphi$ ) were also estimated based on conceptual affinities. These correlations are crucial for evaluating discriminant validity, which is verified by comparing the AVE with the squared inter-factor

correlations ( $\varphi^2$ ). Discriminant validity is confirmed when the AVE of each factor is greater than the square of its inter-factor correlations ( $AVE > \varphi^2$ ), allowing for effective empirical differentiation between factors (Fornell & Larcker, 1981).

To investigate the measurement invariance (MI) of the scale by gender, a multigroup confirmatory factor analysis was conducted. This analysis considered four levels of invariance: configural, metric, scalar, and strict, using differences in  $\Delta CFI$  less than 0.010 as the criterion for invariance (F. F. Chen, 2007). Additionally, an explanatory model was developed through structural equation modeling, employing the same fit indices and the MLR estimator.

Statistical procedures were carried out using RStudio (RStudio Team, 2018) with version 4.1.1 of R (R Foundation for Statistical Computing, Vienna, Austria; <http://www.R-project.org>). The “lavaan” package was used for confirmatory factor analysis and structural equation modeling (Rosseel, 2012) while the “semTools” package facilitated the measurement invariance analysis (Jorgensen et al., 2022).

## Results

### Descriptive Statistics of the Items

In the descriptive analysis of the PIDAQ-S items, the item with the highest mean corresponds to item 20, belonging to the ‘Psychological Impact’ dimension, with a value of 2.09. Conversely, the item with the lowest mean is item 16, also from the ‘Psychological Impact’ dimension, with a value of 0.89. The measures of skewness (g1) and kurtosis (g2) are within the established normality range of  $\pm 1.5$  for all items, suggesting an acceptably symmetric and mesokurtic distribution of responses.

Table 2. Descriptive Statistics

item	M	SD	g1	g2	r.cor	$\alpha$
<i>Dental Confidence</i>						
1	2.21	1.08	-0.23	-0.41	-0.09	0.84
2	1.73	1.22	0.18	-0.90	-0.15	0.84
3	1.93	1.18	0.00	-0.78	-0.07	0.84
4	1.53	1.18	0.27	-0.81	-0.06	0.84
5	1.92	1.19	0.00	-0.86	-0.12	0.84
6	1.89	1.24	0.00	-1.01	-0.12	0.84
<i>Social Impact</i>						
7	1.44	1.17	0.39	-0.85	0.40	0.84
8	1.21	1.22	0.62	-0.73	0.65	0.84
9	1.37	1.33	0.57	-0.91	0.65	0.84
10	0.95	1.12	0.94	-0.06	0.67	0.84
11	1.16	1.24	0.67	-0.75	0.53	0.84
12	1.01	1.16	0.92	-0.12	0.62	0.84
13	1.14	1.27	0.81	-0.50	0.72	0.84
14	1.11	1.23	0.79	-0.55	0.74	0.84
<i>Psychological Impact</i>						
15	1.38	1.35	0.55	-0.94	0.61	0.84
16	0.89	1.09	1.07	0.25	0.50	0.84
17	1.35	1.19	0.50	-0.78	0.64	0.84
18	1.48	1.27	0.42	-0.92	0.52	0.84
19	1.14	1.19	0.73	-0.54	0.62	0.84
20	2.09	1.38	-0.08	-1.25	0.41	0.84
<i>Aesthetic Concern</i>						
21	1.14	1.20	0.82	-0.31	0.56	0.84
22	1.31	1.31	0.59	-0.88	0.54	0.84
23	1.39	1.31	0.49	-0.95	0.56	0.84



Upon examining the corrected item-total correlation ( $r_{cor}$ ), it was found that items 1, 2, 3, 4, 5, 6, and 20 showed values below the threshold of 0.30 and should be considered for elimination, while the rest of the items exceeded this limit, indicating their adequate contribution to the overall scale. All items contribute to a robust internal consistency reflected in a Cronbach's alpha of 0.84.

#### Internal Structure and Reliability Analysis

A CFA of the PIDAQ was conducted following the guidelines established by Klages et al. (2006). The confirmatory factor analysis results revealed the following goodness-of-fit indices:  $\chi^2 = 729.260$ ,  $df = 224$ ,  $p = 0.000$ ,  $CFI = 0.95$ ,  $TLI = 0.95$ ,  $RMSEA = 0.08$  (90% CI 0.07 - 0.09), and  $SRMR = 0.06$ . The factor loadings of the items in their respective dimensions of Dental Confidence, Social Impact, Psychological Impact, and Aesthetic Concern (F1, F2, F3, and F4) were all above 0.50, which is considered good for variable retention in the model. The correlations between the dimensions varied, with some negative correlations between Dental Confidence and the other dimensions, and high positive correlations between Social Impact, Psychological Impact, and Aesthetic Concern. This suggests a conceptual differentiation between the confidence dimension and the other psychosocial aspects evaluated.

The convergent validity method was used by calculating the average variance extracted (AVE) per factor, where an AVE greater than 0.50 indicates good convergence. In this study, the AVE values for the factors Dental Confidence (F1), Social Impact (F2), Psychological Impact (F3), and Aesthetic Concern (F4) were 0.71, 0.59, 0.58, and 0.76, respectively. This suggests adequate convergence for each factor. Additionally, discriminant validity was evaluated by comparing the AVE with the squared inter-factor correlations ( $\phi^2$ ).

**Table 3.** Internal Structure Analysis

item	F1	F2	F3	F4
1	0.82			
2	0.83			
3	0.87			
4	0.85			
5	0.90			
6	0.79			
7		0.54		
8		0.78		
9		0.85		
10		0.82		
11		0.69		
12		0.67		
13		0.85		
14		0.88		
15			0.81	
16			0.58	
17			0.86	
18			0.76	
19			0.82	
20			0.69	
21				0.85
22				0.88
23				0.89
AVE	0.71	0.59	0.58	0.76
F1	-	0.14	0.28	0.29
F2	-0.38	-	0.54	0.56
F3	-0.53	0.74	-	0.71
F4	-0.54	0.75	0.84	-
$\alpha$	0.91	0.90	0.81	0.85

Note: F1 = Dental Confidence; F2 = Social Impact; F3 = Psychological Impact; F4 = Aesthetic Concern

To establish discriminant validity, the AVE of each factor should be greater than the squared inter-factor correlations ( $\varphi^2$ ) related. The results indicate that the AVE of each factor is higher than these squared correlations, indicating adequate empirical differentiation between the factors (Fornell & Larcker, 1981).

The internal consistency for each dimension, evaluated using Cronbach's alpha, is high, with values above 0.70: 0.91 for Dental Confidence, 0.90 for Social Impact, 0.81 for Psychological Impact, and 0.85 for Aesthetic Concern, indicating adequate reliability for each subscale of the questionnaire.

### Invariance

The assessment of measurement invariance of the scale, comparing groups by gender, reveals notable consistency across the levels of invariance. The configural model, which establishes the equivalence of the factorial structure between the groups, presented a Comparative Fit Index (CFI) of 0.918. Progressing to more restrictive models, the metric invariance demonstrated a slightly higher CFI of 0.923, with a change in CFI ( $\Delta$ CFI) of -0.005, indicating that the factor loadings are equivalent between the groups. The scalar invariance showed a CFI of 0.92 with a  $\Delta$ CFI of 0.003, suggesting that the item intercepts are consistent. Finally, the strict invariance model, which includes equality of residuals, maintained a high CFI of 0.919 and a  $\Delta$ CFI of only 0.001, confirming the complete invariance of the scale. These results suggest that the scale is equivalent among Spanish and Portuguese speakers in terms of the factorial structure, the magnitudes of the factor relationships, and the variances and covariances of the items, implying that the scale consistently measures the constructs across both linguistic groups. The insignificant changes in CFI, all below the threshold of 0.01, along with the differences in RMSEA assumed to be within acceptable limits, confirm the robustness of the model across intergroup comparisons, allowing for valid comparisons in future studies involving these populations.

Table 4. Invariance by Gender

Invariance	$\chi^2$	df	p	SRMR	RMSEA	CFI	$\Delta$ CFI
Configural	681.26	448	0	0.061	0.054	0.918	
Metric	663.23	467	0	0.069	0.049	0.923	-0.005
Scalar	691.12	486	0	0.07	0.049	0.92	0.003
Strict	715.72	509	0	0.072	0.048	0.919	0.001

Note: M1 = Configural; M2 = Metric; M3 = Scalar; M4 = Strict;  $\chi^2$  = chi-square; df = degrees of freedom; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; TLI = Tucker-Lewis Index; CFI = Comparative Fit Index;  $\Delta$ CFI = Comparative Fit Index difference.

### Discussion

Factors such as malocclusion, personality, age, gender, and perceived orthodontic needs profoundly affect the self-esteem and self-confidence of young people. In Peru, the prevalence of malocclusion among adolescents is high, impacting their quality of life and social relationships. This study emphasizes the importance of considering patients' perceptions and expectations in orthodontics. The Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) is a vital tool for assessing these aspects, demonstrating its effectiveness in various cultural contexts. The present research focuses on the psychometric properties of the PIDAQ in Peruvian adolescents, highlighting the need for specific studies to confirm its validity and reliability in this crucial population.

#### Principio del formulario

In the present study, a CFA was conducted following the guidelines of Klages et al. (2006) yielding robust goodness-of-fit indices. When comparing our findings with previous studies, it is notable that research conducted in different cultural and demographic contexts (Montiel-Company et al., 2013; Sardenberg et al., 2011) primarily utilized Exploratory Factor Analysis (EFA) rather than CFA. This methodological difference is significant because CFA provides a more rigorous validation of the previously identified factorial structure, in this case, the four-factor structure of the PIDAQ. Furthermore, the consistency of our results with the goodness-of-fit indices and robust factor loadings reinforces the validity of the four-factor model of the PIDAQ, despite differences in factor analysis methodologies between studies. Additionally, the factor loadings of all items were above 0.50, indicating good variable retention in the model.

Our study also indicates not only good convergence for each factor but also clear discriminant validity. The fact that the AVE for each factor is higher than the squared inter-factor correlations suggests adequate empirical differentiation between the factors. These results compare favorably with studies by Klages et al. (2006) and Montiel-Company et al. (2013), which also reported high construct validity in their respective versions of the questionnaire. However, our research provides a more detailed evaluation of discriminant validity by comparing the AVE with the squared inter-factor correlations, a step not explicitly highlighted in

the previous studies mentioned. This rigorous approach provides additional confirmation of the questionnaire's validity and reinforces its applicability in different contexts.

Furthermore, our findings show general consistency in the high reliability of the questionnaire's subscales. For example, the reliability observed is similar to or slightly higher than that reported in the original study by Klages et al. (2006) and other studies conducted in different populations, such as in the Middle East by Gazit-Rappaport et al. (2010) and in Spanish adolescents by Montiel-Company et al. (2013). However, it is notable that our study presents higher values in the dimensions of Social Impact and Aesthetic Concern compared to the study by Sardenberg et al. (2011) in Brazil. These differences may be due to cultural, demographic, or methodological variations in the application of the questionnaire. Our research contributes to this literature, reinforcing the robustness and consistency of the questionnaire in different contexts. The high reliability observed in our study suggests that the questionnaire is a reliable instrument for measuring the psychosocial impact of dental aesthetics in different populations.

Our study represents a significant advancement in the literature on dental aesthetics evaluation, especially compared to previous studies such as Klages et al. (2006), Montiel-Company et al. (2013), and Sardenberg et al. (2011), which did not explicitly address invariance in their research. The inclusion of invariance analysis in our study, especially comparing groups by gender and between Spanish and Portuguese speakers, fills an important gap in previous research. This demonstrates a deeper understanding of how the scale behaves across different groups, providing a more solid foundation for its use in multicultural and diverse contexts. Our study results show notable consistency across levels of invariance, from the configural model to the strict invariance model. The stability of fit indices, such as the CFI, across these models suggests that the scale maintains its structural and metric validity across different groups. This indicates that factor loadings, item intercepts, and variances and covariances are consistent among groups, ensuring that the scale measures constructs uniformly and comparably. These findings are fundamental for future research seeking to compare the psychosocial impact of dental aesthetics across different cultures or between genders. The robustness of the invariance model suggests that the scale can be confidently used for making valid comparisons among adolescent populations from different linguistic and cultural backgrounds.

### *Implications*

In the clinical setting, the results emphasize the importance of incorporating a psychosocial assessment in the planning and execution of orthodontic treatments. Professionals should go beyond normative clinical and aesthetic criteria, considering how individual perceptions of dental aesthetics affect adolescents' self-esteem and psychological well-being. It is crucial to recognize that interventions in dental aesthetics can profoundly impact the mental and social health of young patients, so consultations should include an open dialogue about personal expectations and concerns.

In terms of health policies, these findings support the need for greater integration of mental and dental health services, especially in programs aimed at adolescents. Public health policies should focus not only on the accessibility and quality of orthodontic care but also on education and psychological support for young people facing dental aesthetic challenges. Additionally, school-based oral health programs should include components that address dental aesthetics and their impact on self-esteem and socialization.

From a theoretical perspective, these results expand our understanding of the interaction between dental aesthetics and adolescent developmental psychology. They suggest the need for more integrative theoretical models that link oral health with psychosocial well-being, taking into account factors such as self-image, self-confidence, and social dynamics.

### *Limitations*

A significant limitation of this study is the sample selection. Since the sample was limited to a specific region or demographic group, the results may not be fully generalizable to other populations. To address this limitation in future research, it is recommended to employ a more diverse sample, including different cultural, socioeconomic, and geographic groups, which could provide a more representative and generalizable view of perceptions of dental aesthetics. Another relevant limitation is the use of self-administered questionnaires, which can introduce response biases, such as social desirability bias. Future research could implement measures to minimize these biases, such as ensuring anonymity and using more in-depth interview techniques, or even complementing the questionnaires with qualitative interviews that offer richer context and additional nuances to the quantitative data.

Additionally, measuring psychological constructs such as self-esteem and perceptions of dental aesthetics can be complex and multifaceted. Although the PIDAQ is a robust tool, its ability to fully capture the range of individual experiences and perceptions may be limited. Future research could benefit from the inclusion of additional or alternative measurement tools to more comprehensively capture these constructs. For example, using complementary scales or developing new items specific to the study population could provide a more complete understanding of these experiences.



Finally, the study could be limited by not considering all relevant contextual variables, such as family and peer influences, as well as other confounding factors like access to dental health services. These factors can play a crucial role in the perception of dental aesthetics and their psychosocial impact. Future research should strive to include and control for these variables, providing a more holistic understanding of how these factors interact and affect perceptions of dental aesthetics and psychosocial well-being.

## Conclusion

This research, focused on the analysis of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ-S) in adolescents, provides valuable insight into the interaction between dental aesthetics and psychosocial well-being during a crucial stage of human development. The study's findings highlight the relevance of dental aesthetic perception in adolescents' self-esteem and social interactions, emphasizing the significant impact of malocclusion on these aspects.

## References

- Afroz, S., Rath, S., Rajput, G., & Rahman, S. A. (2013). Dental esthetics and its impact on psycho-social well-being and dental self confidence: A campus based survey of north indian university students. *Journal of Indian Prosthodontist Society*, 13(4). <https://doi.org/10.1007/s13191-012-0247-1>
- Aliaga-Del Castillo, A., Mattos-Vela, M. A., Aliaga-Del Castillo, R., & Del Castillo-Mendoza, C. (2011). Maloclusiones en niños y adolescentes de caseríos y comunidades nativas de la Amazonía de Ucayali, Perú. *Revista Peruana de Medicina Experimental y Salud Pública*, 28(1). <https://doi.org/10.1590/s1726-46342011000100014>
- Ato, M., López, J. J., & Benavente, A. (2013). Un sistema de clasificación de los diseños de investigación en psicología. *Anales de Psicología*, 29(3), 1038-1059. <https://doi.org/10.6018/analesps.29.3.178511>
- Beaton, D. E., Bombardier, C., Guillemin, F., & Ferraz, M. B. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine*, 25(24), 3186-3191. <https://doi.org/10.1097/00007632-200012150-00014>
- Bellot-Arcís, C., Montiel-Company, J. M., & Almerich-Silla, J. M. (2013). Psychosocial impact of malocclusion in Spanish adolescents. *Korean Journal of Orthodontics*, 43(4). <https://doi.org/10.4041/kjod.2013.43.4.193>
- Chen, F. F. (2007). Sensitivity of Goodness of Fit Indexes to Lack of Measurement Invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, 14(3), 464-504. <https://doi.org/10.1080/10705510701301834>
- Chen, P., Yu, S., & Zhu, G. (2012). The psychosocial impacts of implantation on the dental aesthetics of missing anterior teeth patients. *British Dental Journal*, 213(11). <https://doi.org/10.1038/sj.bdj.2012.1090>
- Dahong, X., Xiangrong, C., Ying, L., Yusong, L., Ying, G., & Yan, S. (2013). Effect of incisor position on the self-perceived psychosocial impacts of malocclusion among Chinese young adults. *Angle Orthodontist*, 83(4). <https://doi.org/10.2319/062012-508.1>
- de Paula Junior, D. F., Santos, N. C. M., da Silva, E. T., Nunes, M. de F., & Leles, C. R. (2009). Psychosocial Impact of Dental Esthetics on Quality of Life in Adolescents Association with Malocclusion, Self-Image, and Oral Health-Related Issues. *Angle Orthodontist*, 79(6).
- Fornell, C., & Larcker, D. F. (1981). Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics. *Journal of Marketing Research*, 18(3), 382-388. <https://doi.org/10.1177/002224378101800313>
- Garate, E. D., Mercado, S. L., Mamani, L. D., & Portal, J. M. (2019). Necesidad de tratamiento de maloclusiones y su influencia en la calidad de vida de estudiantes de educación secundaria de la ciudad de Puno, 2018. *Evidencias En Odontología Clínica*, 4(2). <https://doi.org/10.35306/eoc.v4i2.671>
- Gazit-Rappaport, T., Haisraeli-Shalish, M., & Gazit, E. (2010). Psychosocial reward of orthodontic treatment in adult patients. *European Journal of Orthodontics*, 32(4). <https://doi.org/10.1093/ejo/cjp144>
- Guidance for industry: Patient-reported outcome measures: Use in medical product development to support labeling claims: Draft guidance. (2006). *Health and Quality of Life Outcomes*, 4. <https://doi.org/10.1186/1477-7525-4-79>
- Jorgensen, T. D., Pornprasertmanit, S., Schoemann, A. M., & Rosseel, Y. (2022). semTools: Useful tools for structural equation modeling. In *The Comprehensive R Archive Network (R package version 0.5-6)*. <https://cran.r-project.org/package=semTools>
- Khan, M., & Fida, M. (2008). Assessment of Psychosocial Impact of Dental Aesthetics. *Journal of the College of Physicians and Surgeons Pakistan*, 18(9), 559-564.
- Klages, U., Claus, N., Wehrbein, H., & Zentner, A. (2006). Development of a questionnaire for assessment of the psychosocial impact of dental aesthetics in young adults. *European Journal of Orthodontics*, 28(2). <https://doi.org/10.1093/ejo/cji083>
- Klages, U., & Zentner, A. (2007). Dentofacial Aesthetics and Quality of Life. *Seminars in Orthodontics*, 13(2). <https://doi.org/10.1053/j.sodo.2007.03.006>
- Kline, R. B. (2016). *Principles and practice of structural equation modeling* (Cuarta Ed.). Guilford Press.
- Kolawole, K. A., Ayeni, O. O., & Osiatuma, V. I. (2012). Psychosocial impact of dental aesthetics among university undergraduates. *International Orthodontics*, 10(1). <https://doi.org/10.1016/j.ortho.2011.12.003>
- Lin, H., Quan, C., Guo, C., Zhou, C., Wang, Y., & Bao, B. (2013). Translation and validation of the Chinese version of the psychosocial impact of dental aesthetics questionnaire. *European Journal of Orthodontics*, 35(3). <https://doi.org/10.1093/ejo/cjr136>
- Machiavello, E. A., & Arrunátegui, M. T. (2023). Necesidad de tratamiento ortodóntico y su relación con el rendimiento académico, la

- autoestima y el bullying: revisión de la literatura. *Revista Estomatológica Herediana*, 33(3), 253-260. <https://doi.org/10.20453/reh.v33i3.4944>
- McDonald, R. P. (1999). *Test Theory: A United Treatment*. Lawrence Erlbaum.
- Montiel-Company, J. M., Bellot-Arcís, C., & Almerich-Silla, J. M. (2013). Validation of the psychosocial impact of dental aesthetics questionnaire (pidaq) in spanish adolescents. *Medicina Oral, Patología Oral y Cirugía Bucal*, 18(1). <https://doi.org/10.4317/medoral.18324>
- Muniz Júnior, A. B., Carneiro, D. P. A., de Menezes, C. C., Degan, V. V., Vedovello, S. A. S., & Filho, M. V. (2022). A Multivariate Analysis of the Psychosocial Impact of Malocclusion and Self-Esteem in Adolescents. *Pesquisa Brasileira Em Odontopediatria e Clínica Integrada*, 22. <https://doi.org/10.1590/pboci.2022.081>
- Muthén, L., & Muthén, B. (2017). *Mplus Statistical Analysis with latent variables. User's guide* (8th ed.). Muthén & Muthén.
- Ngom, P. I. brahim., Attebi, P., Diouf, J. S. amb., Diop Ba, K., Badiane, A., & Diagne, F. (2013). Translation and cultural adaptation of a french version of the psychosocial impact of dental aesthetics questionnaire: PIDAQ. *L' Orthodontie Française*, 84(4). <https://doi.org/10.1051/orthodfr/2013066>
- Paula, D. F. D. J., Santos, N. C. M., Silva, E. T. D., Nunes, M. D. F., & Leles, C. R. (2009). Psychosocial impact of dental esthetics on quality of life in adolescents. *Angle Orthodontist*, 79(6). <https://doi.org/10.2319/082608-452R.1>
- Paula, D. F., Silva, É. T., Campos, A. C. V., Nuñez, M. O., & Leles, C. R. (2011). Effect of anterior teeth display during smiling on the self-perceived impacts of malocclusion in adolescents. *Angle Orthodontist*, 81(3). <https://doi.org/10.2319/051710-263.1>
- Pérez, E. R., & Medrano, L. (2010). Análisis factorial exploratorio : Bases conceptuales y metodológicas. *Revista Argentina de Ciencias Del Comportamiento*, 2(1), 58-66.
- Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software*, 48, 1-36. <https://doi.org/10.18637/JSS.V048.I02>
- Santos, P. M., Gonçalves, A. R., & Marega, T. (2016). Validity of the psychosocial impact of dental aesthetics questionnaire for use on Brazilian adolescents. *Dental Press Journal of Orthodontics*, 21(3). <https://doi.org/10.1590/2177-6709.21.3.067-072.oar>
- Sardenberg, F., Oliveira, A. C., Paiva, S. M., Auad, S. M., & Vale, M. P. (2011). Validity and reliability of the Brazilian version of the psychosocial impact of dental aesthetics questionnaire. *European Journal of Orthodontics*, 33(3). <https://doi.org/10.1093/ejo/cjq066>
- Schumacker, R. E., & Lomax, R. G. (2016). *A Beginner's Guide to Structural Equation Modeling* (4th ed.). Taylor & Francis.
- Soper, D. (2024). A-priori Sample Size Calculator for structural equation models. Software.
- Wan Hassan, W. N., Makhbul, M. Z. M., & Othman, S. A. (2022). Age and Gender Are Associated with the Component of Psychosocial Impact of Dental Aesthetics Questionnaire in Young People: A Cross-Sectional Study. *Children*, 9(4). <https://doi.org/10.3390/children9040496>
- Yi, S., Zhang, C., Ni, C., Qian, Y., & Zhang, J. (2016). Psychosocial impact of dental aesthetics and desire for orthodontic treatment among Chinese undergraduate students. *Patient Preference and Adherence*, 10. <https://doi.org/10.2147/PPA.S105260>
- Zheng, H., Shi, Q., Du, W., & Lin, F. (2022). The Psychosocial Impact of Dental Esthetics in Undergraduates with Borderline Malocclusion. *Computational and Mathematical Methods in Medicine*, 2022. <https://doi.org/10.1155/2022/2399323>
- Zubiate, F. T. C., Aguilar, A. A. A., Caro, T. E. R., & Aguilar, A. A. A. (2022). Gestión y necesidad de los tratamientos ortodóntico en adolescentes de Chachapoyas - Perú. *Revista de Ciencias Sociales*, 28(4), 484-495. <https://doi.org/10.31876/rcs.v28i4.39143>

## Appendix 1

**Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) y Psychosocial Impact of Dental Aesthetics Questionnaire in Spanish**

Versión en inglés	Versión en español
<i>Dental Self-Confidence</i>	<i>Confianza Dental</i>
I am proud of my teeth.	Me siento orgulloso/a de mis dientes.
I like to show my teeth when I smile.	Me gusta mostrar mis dientes cuando sonrío.
I am pleased when I see my teeth in the mirror.	Me agrada ver mis dientes en el espejo.
My teeth are attractive to others.	Creo que mis dientes resultan atractivos para los demás.
I am satisfied with the appearance of my teeth.	Estoy contento/a con cómo se ven mis dientes.
I find my tooth position to be very nice.	Considero que la posición de mis dientes es agradable.
<i>Social Impact</i>	<i>Impacto Social</i>
I hold myself back when I smile so my teeth don't show so much.	Me contengo al sonreír para que no se vean mucho mis dientes.
If I don't know people well I am sometimes concerned what they might think about my teeth.	Cuando no conozco bien a las personas, a veces me preocupa lo que puedan pensar de mis dientes.
I'm afraid other people could make offensive remarks about my teeth.	Temo que alguien pueda hacer comentarios desagradables sobre mis dientes.
I am somewhat inhibited in social contacts because of my teeth.	A veces me siento inhibido/a en contactos sociales debido a mis dientes.
I sometimes catch myself holding my hand in front of my mouth to hide my teeth.	A veces me sorprende poniendo la mano delante de la boca para ocultar mis dientes.
Sometimes I think people are staring at my teeth.	A veces siento que la gente se queda mirando mis dientes.
Remarks about my teeth irritate me even when they are meant jokingly.	Los comentarios sobre mis dientes me molestan, incluso si son en broma.
I sometimes worry about what members of the opposite sex think about my teeth.	A veces me preocupa lo que las personas del sexo opuesto piensen de mis dientes.
<i>Psychological Impact</i>	<i>Impacto Psicológico</i>
I envy the nice teeth of other people.	Envidio los bonitos dientes de otras personas.
I am somewhat distressed when I see other people's teeth.	Me incomoda ver los dientes de otras personas.
Sometimes I am somewhat unhappy about the appearance of my teeth.	A veces, no me siento bien con el aspecto de mis dientes.
I think most people I know have nicer teeth than I do.	Creo que la mayoría de personas que conozco tienen dientes más bonitos que los míos.
I feel bad when I think about what my teeth look like.	Me siento mal cuando pienso en cómo se ven mis dientes.
I wish my teeth looked better.	Desearía que mis dientes se vieran mejor.
<i>Aesthetic Concern</i>	<i>Preocupación Estética</i>
I don't like to see my teeth in the mirror.	No me gusta ver mis dientes en el espejo.
I don't like to see my teeth in photographs.	No me agrada ver mis dientes en fotos.
I don't like to see my teeth when I look at a video of myself.	No me gusta ver mis dientes cuando me graban en video.