



Perception of Smile Attractiveness Based on Gingival Display and Smile Arc Among Dentists, Dental Students, and Laypersons

Hadia Khalil^{a*}, Urva Javed^a, Minahil Aruj^a, Sana Iqbal^a, Madiha Khalid^a

^aIslamic International Dental College, Riphah International University, Pakistan

*Corresponding address: *Islamic International Dental College, Riphah International University, Pakistan*

Email: hadia.khalil@riphah.edu.pk

Received: 30 April 2025 / Revised: 06 June 2025 / Accepted: 09 June 2025 / Available Online: 20 June 2025

ABSTRACT

Objective: Smile attractiveness is a multifactorial construct influenced by variables such as tooth alignment, gingival display, and smile arc curvature. Despite growing global research on smile aesthetics, there is limited data from South Asia, particularly Pakistan, that evaluates these features across diverse demographic groups.

Methods: A cross-sectional analytical study was conducted among 810 participants in Pakistan, stratified into dentists (n=186), dental students (n=366), and laypersons (n=258). Participants rated digitally modified images depicting varied smile arcs (consonant, reverse, flat) and gingival displays (normal, high, low) using a Visual Analog Scale (VAS). Data were analyzed using two-way ANOVA, Tukey's HSD, and Chi-square tests to evaluate group differences and demographic associations.

Results: Consonant arcs with normal gingival display received the highest attractiveness ratings across all groups, while reverse arcs with high gingival display were rated lowest. The two-way ANOVA indicated significant effects of participant group ($p < 0.001$) and smile type ($p < 0.001$) on attractiveness ratings, with an interaction effect ($p = 0.005$). Chi-square tests revealed significant associations between group, gender, and age distributions.

Conclusion: This study provides valuable insights into smile aesthetic perceptions in Pakistan, highlighting the influence of clinical training on aesthetic sensitivity. These findings can guide treatment planning in esthetic dentistry, though future research incorporating cross-cultural analyses and dynamic smile assessments is recommended.

Keywords: Aesthetics; Arch; Dental; Human; Smile

Copyright: © 2025 Khalil et al. This is an open-access article licensed under the terms of the [Creative Commons Attribution 4.0 International](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Citation: Khalil H *et al.*, Perception of Smile Attractiveness Based on Gingival Display and Smile Arc Among Dentists, Dental Students, and Laypersons. *J Sci Technol Educ Art Med.* 2025;2(1):33-38

Introduction

A smile is widely recognized as a non-verbal communicative cue that signifies positive affect and plays a pivotal role in human social interaction.¹ Its significance in dental esthetics arises from its impact on perceptions of health, confidence, and sociability, making it a central consideration in contemporary dental practice.²

Modern dentistry has increasingly emphasized esthetic outcomes in response to patient-driven demand, moving beyond the traditional curative model to embrace functionally and visually optimized dental care.³

Esthetic dentistry distinguishes itself from cosmetic dentistry by focusing on long-term oral function and natural replication of dentition, rather than solely enhancing appearance through elective

procedures.⁴ Smile attractiveness is a complex construct influenced by several morphological variables, including tooth alignment, gingival display, and smile arc configuration.⁵ Among these factors, gingival display defined as the extent of gingiva visible during smiling and the smile arc referring to the curvature alignment of the upper anterior teeth with the lower lip have emerged as key determinants of esthetic preference.⁵

Evidence from systematic reviews indicates that excessive gingival display, commonly referred to as a "gummy smile," is generally rated as less attractive, though cultural and individual differences play a moderating role.⁶ Cultural variations are further supported by studies showing that aesthetic ideals regarding gingival display differ significantly across ethnic and regional populations.⁷

Additionally, the influence of digital platforms on aesthetic perception is increasingly recognized, particularly among younger demographics who are frequent users of social media.⁸ Social platforms such as Instagram and TikTok amplify exposure to digitally enhanced smiles and curated dental aesthetics, potentially shaping user expectations and fueling demand for cosmetic procedures like veneers, whitening, and orthodontic interventions.⁸ Despite the global proliferation of research on smile esthetics, limited data is available from South Asia particularly Pakistan that integrates professional and lay perspectives on gingival display and smile arc.⁹ Existing regional studies often focus on isolated populations and lack the methodological integration of realistic visual stimuli and multi-group evaluation.⁶

This study aims to address this gap by examining perceptions of smile attractiveness among dentists, dental students, and laypersons in Pakistan, using digitally modified images to systematically vary gingival display and smile arc configurations.

Materials and Methods

This study employed a cross-sectional analytical design to investigate the perceptions of smile attractiveness based on variations in gingival display and smile arc among dentists, dental students, and laypersons in Pakistan. Ethical approval for the study was obtained from the Institutional Review Board (IRB) of the concerned institution under approval reference number

IIDC/IRC/2024/007/001 in accordance with the Declaration of Helsinki. All participants provided written informed consent before enrollment, and anonymity and confidentiality were ensured throughout the research process.

Participants were recruited using a convenience sampling strategy from various dental institutions, public health clinics, and the general population across major urban centers of Pakistan, including Karachi, Lahore, Islamabad, and Peshawar. The sample was stratified into three equal groups: dentists, dental students, and laypersons. Dentists included in the study were required to have a valid dental degree from a recognized institution, a minimum of one year of clinical experience post-graduation, and proficiency in English to ensure comprehension of the survey materials. Dental students in their third or final years at accredited dental schools were eligible, while students in earlier academic years or those with incomplete surveys were excluded. For the layperson group, inclusion criteria required participants to be at least 18 years of age, Pakistani residents, and without formal education or training in dentistry. Across all groups, individuals with uncorrected visual impairments, cognitive limitations, or those who declined to provide informed consent were excluded. Participants remained blinded to the study's specific objectives and hypotheses to reduce potential response biases.

The perceptual evaluation involved real-life digital images of adult smiles, each systematically modified to depict distinct gingival display and smile arc configurations. Gingival display was categorized as normal (0.5–1.0 mm), high (>1.0 mm), or low (<0.5 mm), while the smile arc was classified as consonant, reverse, or flat. The images were standardized for lighting, frontal facial orientation, and neutral expression, ensuring consistency across all stimuli. All photographs were digitally altered using Adobe Photoshop 2023. Gingival display was adjusted in 0.5 mm increments based on the original image's baseline. Digital calipers within the software ensured consistent vertical manipulation of the gingival region across all images. To validate the images, a panel of five dental experts (prosthodontists and orthodontists) reviewed them for clinical relevance, realism, and appropriateness. Additionally, a pilot study involving 30 participants (10 from each subgroup) was conducted to assess the feasibility of the image-based evaluation and the clarity of the measurement instruments. Feedback from this pilot

led to minor refinements in image resolution, instructions, and survey flow. To control for potential order bias, the sequence of image presentation was randomized for each participant using a computer-generated random sequence algorithm.

Participants assessed the attractiveness of each smile image using a Visual Analog Scale (VAS), a validated tool widely employed in aesthetic perception research. The VAS comprised a 10 cm horizontal line, anchored at 0 cm with “Not attractive at all” and at 10 cm with “Extremely attractive.” Participants marked their perceived level of attractiveness for each image along this continuum. In addition to the VAS, participants completed a structured questionnaire, adapted from Shah, which had previously been used in a similar study on smile aesthetics in India.¹¹ This questionnaire included demographic questions and perception-based items tailored to the Pakistani context, ensuring cultural and linguistic appropriateness.

Statistical analysis

Data collection was followed by statistical analysis using SPSS version 26 (IBM Corp., Armonk, NY). Descriptive statistics, including means, standard deviations, frequencies, and percentages, were calculated for demographic variables and VAS scores. To evaluate differences in smile attractiveness ratings across the three participant groups and varying levels of gingival display and smile arc, Analysis of Variance (ANOVA) was conducted. Post-hoc Tukey’s tests were applied for pairwise comparisons. Additionally, Chi-Square tests examined associations between categorical variables, such as demographic factors and smile attractiveness ratings. Effect sizes were reported using partial eta squared (η^2) to provide insight into the magnitude of the observed differences.

Results

A total of 810 participants were included in the final analysis, comprising 186 dentists (23%), 366 dental students (45%), and 258 laypersons (32%). The overall mean age of participants was 29.3 ± 6.7 years, with a gender distribution of approximately 54% male and 46% female.

Attractiveness Ratings Across Smile

Configurations

Participants evaluated the attractiveness of smile images featuring varied combinations of smile arcs (consonant, reverse, flat) and gingival displays (normal (0.5–1.0 mm), high (>1.0 mm), low (<0.5 mm)) using a Visual Analog Scale (VAS). The mean attractiveness scores demonstrated clear patterns across smile configurations and participant groups (Figure 1).

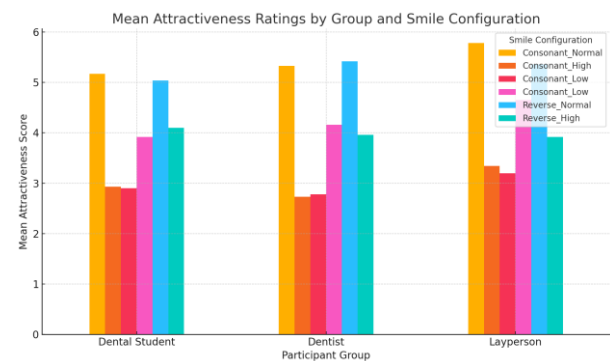


Figure 1: A bar chart illustrating mean attractiveness ratings for each smile configuration across the participant groups

A two-way ANOVA revealed significant main effects for both participant group ($F(2, 4845) = 11.11, p < 0.001, \eta^2 = 0.004$) and smile type ($F(4, 4845) = 147.23, p < 0.001, \eta^2 = 0.108$) on attractiveness ratings. Additionally, there was a significant interaction effect between participant group and smile type ($F(8, 4845) = 2.75, p = 0.005, \eta^2 = 0.005$), indicating that the impact of smile configurations on perceived attractiveness varied across different groups. The main effect of smile type accounted for the largest variance, highlighting that variations in smile arc and gingival display substantially influenced attractiveness perceptions. The group effect showed that dentists, dental students, and laypersons exhibited distinct preferences. The interaction effect suggested that professional training modulated the perception of different smile configurations.

To further explore these differences, Tukey’s HSD post-hoc analysis was conducted. The results confirmed that Consonant arc with normal gingival display was rated significantly higher in attractiveness compared to all other configurations ($p < 0.001$). Notably, Consonant arc with high gingival display received significantly lower ratings compared to Consonant normal and Consonant low, as well as compared to Reverse configurations. These findings reinforce the clinical



importance of maintaining consonance in the smile arc and moderating gingival display to optimize perceived smile attractiveness.

A Chi-square test of independence was conducted to examine potential associations between participant group (dentists, dental students, laypersons) and demographic variables, specifically gender and age group.

The analysis revealed a statistically significant association between participant group and gender distribution ($\chi^2(2) = 24.51, p < 0.001$), indicating that the proportion of males and females differed across the three participant groups. Similarly, a significant association was found between participant group and age group distribution ($\chi^2(8) = 191.51, p < 0.001$), demonstrating that the age profile varied significantly between dentists, dental students, and laypersons. These findings suggest demographic factors could influence perception patterns and were accounted for in subsequent analyses.

Discussion

This study aimed to evaluate the perceptions of smile attractiveness across different gingival displays and smile arcs among dentists, dental students, and laypersons in Pakistan. The findings demonstrated significant variations in how these groups perceived smile attractiveness, particularly emphasizing the importance of a consonant smile arc and controlled gingival display. Consonant arcs with normal gingival display were rated highest across all participant groups, while reverse arcs with high gingival display were consistently perceived as the least attractive. This underscores the critical role of smile design parameters in shaping aesthetic perceptions, suggesting that dental professionals' training enhances sensitivity to such features. Moreover, significant associations between demographic factors (age, gender) and participant groups indicate that these variables may influence aesthetic judgments.

The observed differences in esthetic perception among dentists, students, and laypersons may be attributable to professional exposure, diagnostic training, and frequent interaction with clinical cases. Dental professionals are trained to assess occlusion, symmetry, and gingival health, which may subconsciously influence their attractiveness ratings. Incorporating esthetic perception training into dental curricula could

enhance communication with patients and promote shared decision-making during treatment planning."

Comparing these findings with recent literature, the study by Pham and Nguyen, conducted in Vietnam, similarly reported that parallel smile arcs with minimal gingival display were rated as the most attractive by both dental professionals and laypersons, although the influence of evaluator demographics was minimal in their cohort.⁷ This aligns with the current study's observation that consonant arcs were universally preferred, yet differences emerged across professional backgrounds. In contrast, Nguyen and his team observed that dentists were more sensitive to changes in gingival display compared to laypersons, which closely mirrors our findings, suggesting that clinical training heightens awareness of subtle aesthetic nuances.^{7,10} Furthermore, other studies examined buccal corridor spaces and gingival displays, concluding that orthodontists and general dentists rated aesthetic features differently, particularly in regard to gingival exposure, supporting our observation of professional variability in smile assessment.^{11,12}

However, a study highlighted cross-cultural discrepancies in smile attractiveness judgments, where upper lip curvature and degree of gingival display were evaluated differently among diverse populations.¹³ This contrasts with our relatively homogeneous Pakistani cohort, potentially explaining the strong consensus on consonant arcs but revealing the context-specific nature of aesthetic preferences. Additionally, scientists demonstrated that the relationship between maxillary incisor positioning and gingival display plays a crucial role in perceived attractiveness, reinforcing the emphasis on gingival display control found in our study.¹³ Together, these comparisons suggest that while global standards for smile aesthetics are emerging, cultural and educational backgrounds continue to shape individual perceptions.

Despite its robust sample size and methodological rigor, this study has several limitations. Firstly, the use of digitally modified images may not fully capture the complexities of real-life smile dynamics, including facial expressions and skin tone variations. The study employed a convenience sampling method, which may introduce selection bias. As a result, the findings may not be generalizable to all populations beyond the sampled groups. Future studies should



aim to use randomized or stratified sampling approaches to enhance external validity. Moreover, while VAS scoring provides quantitative insights, it remains subjective and could be influenced by individual mood or personal biases during assessment.

Future research should explore cross-cultural comparisons to further elucidate regional differences in smile perception. Future studies should prioritize the use of dynamic smile evaluations—such as videos or 3D simulations—to more accurately reflect real-life expressions. These methods may yield deeper insights into how subtle muscular movements and emotional expressions influence esthetic perception across different populations. Furthermore, longitudinal studies assessing whether training interventions can modify laypersons' perceptions toward professional standards may provide insights into how aesthetic ideals evolve.

Conclusion

This study highlights the critical influence of gingival display and smile arc on perceived smile attractiveness across diverse groups in Pakistan, including dentists, dental students, and laypersons. The findings underscore the universal preference for consonant arcs with normal gingival display, while reverse arcs with high gingival display were rated the least attractive. These variations in perception, particularly the heightened sensitivity among dental professionals, emphasize the role of clinical training in shaping aesthetic judgments. The study not only fills a significant gap in regional data on dental aesthetics but also offers valuable insights to dental practitioners for aligning treatment planning with patient expectations. However, further research incorporating cross-cultural perspectives and dynamic smile evaluations is warranted to broaden these insights.

Acknowledgments

We highly acknowledge all the participating institutions and participants for their time.

Author Contribution

All authors have made substantial contributions to the study. HK, UJ and SI conceived the study and designed the work. HK, MA and MK collected the data. UJ, MA analyzed and interpreted the data and

generated themes. All the authors contributed to the drafting and writing of the manuscript. SI, HK critically reviewed and revised the manuscript. All authors read and approved the final manuscript.

Data Availability Statement

All relevant data are within the manuscript. Additional data supporting this study are available from the corresponding author upon reasonable request.

Ethical Considerations

All methods were carried out in accordance with the declaration of Helsinki. The study was approved by Ethical Review Board of IIDC/IRC/2024/007/001. Written and verbal consent was obtained from all participants.

Funding

The research did not receive funding from any profit / non-profit organization.

Conflict of Interest

None

References

1. Cross MP, Acevedo AM, Leger KA, Pressman SD. How and why could smiling influence physical health? A conceptual review. *Health Psychology Review*. 2023;17(2):321-43.
2. Vargo M, Ding P, Sacco M, Duggal R, Genther DJ, Ciolek PJ, et al. The psychological and psychosocial effects of facial paralysis: a review. *Journal of Plastic, Reconstructive & Aesthetic Surgery*. 2023;83:423-30.
3. Mutlu-Sagesen H, Sagesen EA. Evolution of Esthetic Publications in Dentistry, Research Trends, and Global Productivity: A Bibliometric Analysis. *International Journal of Prosthodontics*. 2024;37(3).
4. Buchholz VS. Facial harmony: dental aesthetics and digital smile analysis. A systematic review. 2022.
5. Kau CH, Christou T, Sharma S. Contemporary smile design: an orthodontic perspective. *Dental Clinics*. 2022;66(3):459-75.
6. Yuen JJX, Saw ZK, Ashari A, Lau M, Mustapha N, Kuppusamy E, et al. Aesthetic perception of gingival display on smiling among laypeople seeking dental treatment. *Australasian Orthodontic Journal*. 2023;39(2):136-44.
7. Pham TAV, Nguyen PA. Morphological features of smile attractiveness and related factors influence perception and gingival aesthetic parameters. *International Dental Journal*. 2022;72(1):67-75.
8. Abbasi MS, Lal A, Das G, Salman F, Akram A, Ahmed AR, et al., editors. Impact of social media on aesthetic dentistry: General practitioners' perspectives. *Healthcare*; 2022: MDPI
9. Shah A, Bharvijani DKS, Agarwal N, Rathor AS, Mehta A. Evaluation of Smile Perception: A Questionnaire Survey. *Journal of Positive School Psychology*. 2022;6(7):1084-91-91.
10. Rotundo R, Nieri M, Lamberti E, Covani U, Peñarrocha-Oltra D, Peñarrocha-Diago M. Factors influencing the aesthetics of

smile: an observational study on clinical assessment and patient's perception. *Journal of Clinical Periodontology*. 2021;48(11):1449-57.

11. Niknam O, Yousefi Hafshejani S, Rakhshan V. Attractive combinations of female Ednur MP, Rahmawati AD, Octavia A, Medawati A. Correlation between central incisor eruption status and lower facial height in children aged 6-8: a cross-sectional study. *Padjadjaran Journal of Dentistry*. 2024;36(3):372-80.

12. Lim ZW. The Influence of Buccal corridors on perceived smile aesthetics—A dynamic smile visualisation study: Queen Mary University of London; 2023.

13. Valverde-Montalva SH, Flores-Mir C, Rinchuse D, Arriola-Guillén LE. Influence of upper lip curvature on smile attractiveness in patients with different degrees of gingival smiles: A cross-sectional study with opinions from oral health providers and laypersons. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2021;159(4):e321-e9