

Smile-related oral characteristics in vietnamese students

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ABSTRACT

Aim: We evaluated various oral features related to the smile among Vietnamese students. Additionally, we identified gender differences in the oral features and the prevalence of attractive smiles. **Materials and Method:** We recruited 490 Vietnamese students with 18-29 years old and recorded their dynamic smiles. We determined the prevalence of the qualitative smile morphological features and the mean and standard deviation of the quantitative features, namely the buccal corridor space, the smile index, and dynamic smile symmetry. **Results:** There were diverse smile-related oral characteristics among the participants. The most common anterior smile line was “average” (42.6%), and “parallel” was the most prevalent smile arc (43.1%). We observed a “downward” upper lip curvature in 55.9% of the participants, and the “second premolar” was the most frequently displayed posterior tooth (58.6%). Most of the participants (79.2%) showed no contact between the upper teeth and the lower lip while smiling. The mean buccal corridor space was 0.59 ± 0.47 cm, the smile index was 5.85 ± 1.48 , and dynamic smile symmetry was 1.01 ± 0.06 . There were significant gender differences for several smile-related characteristics. **Conclusions:** Women more often display a favorable smile arc and more teeth when smiling, while men are more likely to have an attractive anterior smile line and upper lip curvature. These insights are vital to tailor effective aesthetic treatments.

Keywords: smiling - dental care - surgical procedures - students

Características orales relacionadas con la sonrisa en estudiantes vietnamitas

RESUMEN

Objetivo: Evaluamos diversas características bucales relacionadas con la sonrisa entre estudiantes vietnamitas. Además, identificamos las diferencias de género en las características orales y en la prevalencia de sonrisas atractivas.

Materiales y Método: Se reclutaron 490 estudiantes vietnamitas de entre 18 y 29 años y se registraron sus sonrisas dinámicas. Se determinó la prevalencia de las características morfológicas cualitativas de la sonrisa, así como la media y la desviación estándar de las características cuantitativas, a saber: el espacio del corredor bucal, el índice de sonrisa y la simetría de la sonrisa dinámica.

Resultados: Se observaron diversas características orales relacionadas con la sonrisa entre los participantes. La línea de sonrisa anterior más común fue la “media” (42,6%), y el arco de sonrisa más prevalente fue el “paralelo” (43,1%). Se observó una curvatura del labio superior “hacia abajo” en el 55,9% de los participantes, y el “segundo premolar” fue el diente posterior mostrado con mayor frecuencia (58,6%). La mayoría de los participantes (79,2%) no presentaron contacto entre los dientes superiores y el labio inferior al sonreír. El espacio medio del corredor bucal fue de $0,59 \pm 0,47$ cm, el índice de sonrisa fue de $5,85 \pm 1,48$ y la simetría de la sonrisa dinámica fue de $1,01 \pm 0,06$. Se encontraron diferencias significativas entre hombres y mujeres en varias características relacionadas con la sonrisa.

Conclusiones: Las mujeres muestran con mayor frecuencia un arco de sonrisa favorable y exhiben más dientes al sonreír; mientras que los hombres tienden a presentar una línea de sonrisa anterior y una curvatura del labio superior más atractivas. Estos hallazgos son fundamentales para personalizar tratamientos estéticos efectivos.

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INTRODUCTION

Smiles are universally recognized as a key expression of happiness, but their morphological features can differ significantly across various ethnic groups. Much of the existing research on smile dynamics and aesthetics has been concentrated on Caucasian populations, resulting in a restricted understanding of how ethnic differences shape the expression of smiles and the perceptions of beauty. This narrow focus complicates efforts to generalize findings from European-American samples to Asian populations, such as Vietnamese individuals, due to distinct morphological and cultural factors. Consequently, there is a crucial need for research that explores smile characteristics within diverse ethnic groups to achieve more accurate and culturally pertinent insights^{1,2}.

In recent years, researchers have begun to address the ethnic gap by examining the smile characteristics of Chinese, Japanese and Indian populations³⁻⁸. These studies have yielded significant findings, such as variations in the smile curve, the upper lip arch, and teeth exposure. For example, research on Chinese individuals has highlighted distinctions in the types of smiles, with a predominance of commissure and cuspid smiles⁷. Similar variations in smile line and smile arc in a smile have been highlighted by studies on Indian smiles^{5,6}. In Vietnam, researchers have begun to identify certain characteristics of smile aesthetics. For example, Pham⁹ observed common traits of smile lines, a rising curvature of upper lip, and a parallel smile arc. Moreover, smiles often expose teeth up to the second premolar. Nevertheless, the current research was constrained by a small size of samples and did not offer a thorough overview of the morphological smile features, particularly regarding the interplay between the mouth and face. Understanding the complex nature of smiles requires an assessment of various features. Together, these components add to a smile's distinct beauty and expressiveness. There is an urgent need for region-specific analyses that consider the cultural and morphological features of smiles, given the significance of ethnic differences in aesthetic perceptions. There is a lack of data about smiles and their related oral features in Vietnam. To the best of our knowledge, there have been no comprehensive assessments on the smile-related oral characteristics on Vietnamese subjects of a wide range of ages. This endeavor is necessary to generate a comprehensive

database regarding the smile morphological features and the related oral factors of Vietnamese people. This information would support the establishment of treatment plans to improve the smile design and to perform future research on the beauty of Vietnamese smiles.

Given the aforementioned gaps in the literature, we conducted a comprehensive investigation into the morphology of smiles in Vietnamese participants of different ages. We evaluated various oral aspects of smiles among students at Vietnam National University, Ho Chi Minh City (VNU-HCM). Then, we determined gender differences in these smile features and the prevalence of attractive smiles. Our findings should help improve personalized treatment planning and benefit the larger field of facial aesthetics.

MATERIALS AND METHOD

Sampling and selection criteria

The sampling and smile recording processes are shown on Figure 1. A comprehensive dental check-up process was conducted to ensure the selection of a suitable study sample. Initially, the participants underwent a detailed oral examination conducted by dentists to assess their eligibility. This included a detailed oral examination and assessment of dental history, ensuring the presence of the necessary teeth and proper occlusion. Four hundred and ninety subjects (323 men and 167 women) Vietnamese students with the mean age of 21.04 ± 1.79 (18-29 years old) studying at VNU-HCM participated in this study. Criteria for choosing participants were as follows: (1) none of the eight anterior maxillary teeth were missing, there was mild or no crowding and no other malposition conditions; (2) missing no more than four maxillary and mandibular teeth (excluding the wisdom teeth); (3) Angle class I molar occlusion; (4) no record of orthodontic surgery or cosmetic surgery; and (5) no maxillofacial trauma, deformities, or lip abnormalities. The study process is illustrated in (Fig. 1). This research was approved by the Human Subjects Ethics Board of the University (number 256/DHYD-HDDD).

The students who met the sampling criteria are required to take part in a demographic survey to record their names, ages, genders, education, and jobs. The participants had their teeth scaled 1 week before their smiles were recorded. The participants

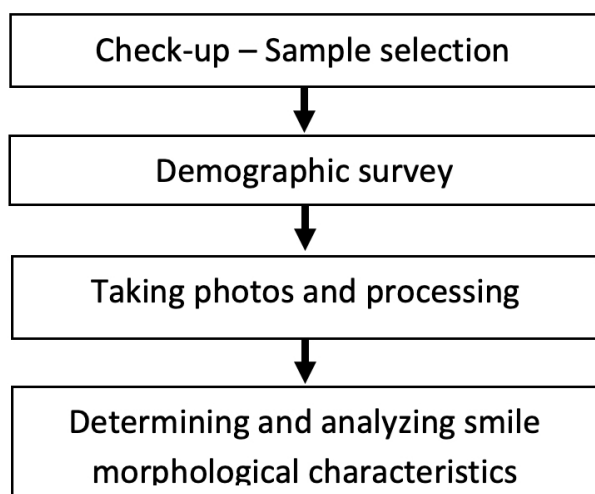


Fig. 1: The procedure used for dynamic smile recording

were instructed to sit up straight with their arms hanging naturally and their eyes looking straight at the camera. The head was adjusted so that the Frankfort plane was parallel to the floor throughout the imaging procedure. A ruler was placed with the smallest division of 1 mm close to the right side of the participant's face so that the distance from the lens to the ruler and to the central incisor was equal.

The entire imaging process was standardized and the same for all imaging sessions. A Canon EOS 6D digital camera and accompanying flash system was placed on a camera tripod 150 cm from the participant's upper lip to the closest point of the camera. The background was plain white. The center of the camera lens was placed above the occlusal plane, and the shooting direction was perpendicular to the sagittal plane. Two images were recorded for each patient: an image of the mouth when smiling naturally, and an image of the mouth at rest. The camera was connected directly to the computer to control image quality. A satisfactory image was high resolution, was not blurred, and had sufficient brightness and realistic colors. All photos were taken by a single trained photographer.

The captured images were saved to a computer as JPEG files and edited by Adobe Photoshop CS6 software. They were adjusted to remove the effect of facial features and skin colors on aesthetic evaluation. Finally, these images were standardized in a size of 5 × 3 inches, black and white color, and 70 dpi, and saved as JPEGs. These images were copied into PowerPoint to perform the evaluation. All images were evaluated by the same previously

trained dentist to assess smile characteristics according to the following criteria.

1. There were 4 types of anterior smile line based on the visible teeth and gingiva³. The first type is very high, which indicates > 2-mm marginal gingiva visible. The second type is high which indicates 0-2-mm marginal gingiva while the third type is average which indicates only the gingiva embrasure. The last type was low, which was impossible to see the gingiva.
2. The smile curve³ is determined based the correlation between the line drawn along the incisal edges of the maxillary central incisors and the superior border of the lower lip. There are 3 types, including a parallel smile arc, a straight smile arc, and a reverse smile arc.
3. The upper lip curvature³ describes the morphology of the inferior border of the upper lip based on the relationship between the corner of the mouth and the center of the inferior border of the upper lip. There are 3 types: a straight lip curvature, a downward lip curvature, and an upward lip curvature.
4. The most posterior tooth displayed when smiling³ is divided as up to the canine, up to the first premolar, up to the second premolar, up to the first molar, or up to the second molar.
5. The relationship between the upper teeth and the lower lip¹ has three categories: not touch, touching, and slightly covering
6. For the buccal corridor space¹⁰, the black area that forms at the corners of the mouth when smiling horizontally is measured.
7. The smile index³ is the ratio of the horizontal distance and the vertical distance. It is determined based on four reference points in (Fig. 2) as $[(1 - 2) / (3 - 4)]$.
8. The dynamic smile symmetry³ refers to the uniformity of movement of the bilateral outer commissure in the horizontal and vertical direction. It is determined based on the four reference points in (Fig. 2) as $[(1 - 3) + (1 - 4)] / [(2 - 3) + (2 - 4)]$.

Data analysis

The software to be used in the current study was SPSS Statistics version 23.0 for Windows. The prevalence of the qualitative smile morphological features and the mean ± standard deviation (SD) of



Fig. 2: The reference points used to calculate the smile index and dynamic smile symmetry

the quantitative features was determined. Gender differences were determined with the chi-squared test (for the qualitative features) and the t-test (for the quantitative features).

Research ethics

The current study follows the regulations of biomedical research ethics. The students (and their families) were informed about their oral health status. All of the information collected is confidential and for research purposes only.

RESULTS

Smile-related oral characteristics

Table 1 shows the qualitative smile-related oral characteristics. For the anterior smile line, the majority of individuals fell into the average category (42.6%), followed by the low (32.7%), high (13.3%), and very high (11.4%) categories. Regarding the smile arc pattern, parallel (43.1%) was most prevalent, followed by straight (26.1%) and reverse (30.8%). The majority of participants had a downward curvature (55.9%), while 33.9% displayed a straight upper lip, and 10.2% had an upward curvature. For most posterior tooth displayed when smiling, the second premolar was the most frequent (58.6%), followed by the first molar (20.2%) and the first premolar (20.0%). The second molar and canine were rarely the most posterior tooth visible, each accounting for less than 1% of the total sample. Finally, when evaluating the relationship between the upper and lower lip, the majority of the participants (79.2%) exhibited no contact between their upper and lower lip. A smaller proportion demonstrated touching (17.1%), while a few participants had slightly covering (3.7%).

Table 1: The qualitative smile-related oral characteristics

Feature		N	%
Anterior smile line	Low	160	32.7
	Average	209	42.6
	High	65	13.3
	Very high	56	11.4
Smile arc	Reverse	151	30.8
	Parallel	211	43.1
	Straight	128	26.1
Upper lip curvature	Upward	50	10.2
	Downward	274	55.9
	Straight	166	33.9
Most posterior tooth displayed	First premolar	98	20
	Second premolar	287	58.6
	First molar	99	20.2
	Second molar	2	0.4
	Canine	4	0.8
Relationship between the upper teeth and the lower lip	Touching	84	17.1
	Not touching	388	79.2
	Slightly covering	18	3.7

Abbreviation: N = Sample size

Table 2: The quantitative smile-related characteristics

Measure	Minimum	Maximum	Mean	Standard deviation
Buccal corridor space	0	2	0.59	0.47
Smile index	2.50	13.40	5.85	1.48
Dynamic smile symmetry	0.85	1.21	1.01	0.06

Table 2 presents the data for the quantitative smile-related characteristics. The mean $\pm$ SD was 0.59 ± 0.47 for the buccal corridor, 5.85 ± 1.48 for the smile index, and 1.01 ± 0.06 for dynamic smile symmetry. Figures 3- present representative examples of smile patterns analyzed in this study. Consistent with the criteria proposed by Pham⁹, (Fig. 3) illustrates a prototypical smile that encompasses all four key characteristics contributing to smile attractiveness. (Figs. 4,5) demonstrate specific aesthetic features considered attractive that appears more often in male and female smiles, respectively, as identified through the current analysis.

Gender differences for smile-related characteristics

Table 3 showed that the results were significant ($p < 0.05$) gender differences and dynamic smile symmetry.

DISCUSSION

We have provided a comprehensive analysis of smile-related oral characteristics among Vietnamese students, revealing significant variations in the anterior smile line, the smile arc, the upper lip curvature, and other key features. The most prevalent anterior smile line was average (42.6%), while the



Fig. 3: A smile exhibiting all four features associated with aesthetic attractiveness, including an average or high anterior smile line, a parallel smile arc, an upward curvature of the upper lip, and visibility of the second premolar as the most posterior tooth displayed



Fig. 4: A smile of a female participant demonstrating two of the four established features of smile attractiveness, namely a parallel smile arc and visibility of the second premolar as the most posterior tooth displayed



Fig. 5: Smile of a male participant exhibiting two of the four recognized features of smile attractiveness, specifically an average or high anterior smile line and an upward curvature of the upper lip.

parallel smile arc was the most common (43.1%). Notably, the majority of the participants exhibited a downward upper lip curvature (55.9%), and the second premolar was the most frequently displayed posterior tooth (58.6%).

The distribution of smile characteristics greatly contributed to the typical aesthetic preferences and anatomical features of the Vietnamese population. The predominance of the average anterior smile line and the parallel smile arc are similar to research on the Germany population¹. According to a previous study of Machado⁴, people with a parallel smile arc tend to appear younger, happier, and more beautiful than those with a nonparallel smile arc. This type of smile arc is also known as the “consonant” smile arc, and according to Krishnan et al⁶, orthodontists should not intervene with this type of smile; rather, they should use the right bracket positioning to create it. The downward upper lip curvature, seen in over half of our participants, contrasts with the more common upward curvature observed in Western populations in Germany¹ and Spain². This difference

Table 3: Gender differences in the smile-related oral characteristics

Feature		Gender		Statistical analysis
		Male N (%)	Female N (%)	P*
Anterior smile line	Low	125 (38.7)	35 (21)	<0.001
	Average	151 (46.7)	58 (34.7)	
	High	31 (9.6)	34 (20.4)	
	Very high	16 (5)	40 (24)	
Smile arc	Reverse	100 (31)	51 (30.5)	<0.001
	Parallel	115 (35.6)	96 (57.5)	
	Straight	108 (33.4)	20 (12)	
Upper lip curvature	Downward	194 (60.1)	80 (47.9)	0.014
	Straight	95 (29.4)	71 (42.5)	
	Upward	34 (10.5)	16 (9.6)	
	Canine	4 (1.2)	0 (0)	
Most posterior tooth displayed when smiling	First premolar	64 (19.8)	34 (20.4)	0.031
	Second premolar	177 (54.8)	110 (56.9)	
	First molar	76 (23.5)	23 (13.8)	
	Second molar	2 (0.6)	0 (0)	
Relationship between the upper teeth and the lower lip	Touch	48 (14.9)	36 (21.6)	0.063
	Not touch	260 (80.5)	128 (76.6)	
	Slightly covering	15 (4.6)	3 (1.8)	
Total		323 (100)	167 (100)	
Measure		Mean $\pm$ SD	Mean $\pm$ SD	P**
Buccal corridor space		0.6 $\pm$ 0.54	0.57 $\pm$ 0.29	0.454
Smile index		5.81 $\pm$ 1.57	5.93 $\pm$ 1.28	0.409
Dynamic smile symmetry		1.01 $\pm$ 0.07	0.99 $\pm$ 0.05	0.001

Abbreviations: N = sample size; SD = standard deviation
 * Pearson χ^2 test
 ** t-test.

emphasizes the importance of considering ethnic-specific characteristics in dental aesthetics, as applying a Western-centric standard to Vietnamese patients may not achieve optimal results.

In the Vietnamese context, Pham⁹ outlined some characteristics of smile aesthetics, including a high or average smile line, an upward upper lip curvature, and a parallel smile arc. Compared with this previous study, our study's strength lies in its comprehensive

evaluation of smile characteristics across a broader sample size (490 participants compared with 200) and its focus on additional features. Unlike that previous study, which primarily addressed perceptual differences, our study provides a more detailed analysis, revealing that a significant portion of Vietnamese individuals have a downward upper lip curvature and display up to the second premolar when smiling. Because the upper lip curvature cannot be changed, it is more difficult for patients with a downward lip curvature to achieve their ideal smile. Thus, these findings suggest that ethnic-specific characteristics are crucial for understanding and improving smile aesthetics in the Vietnamese population.

Our findings align with previous research conducted on different populations, emphasizing the importance of ethnic-specific studies in understanding smile aesthetics. For example, Wang³ and Liang⁷ investigated Chinese smiles and highlighted variations in the smile arc and upper lip curvature, findings that are in line with our observations regarding the parallel smile arc. However, we found that a downward upper lip curvature was the most popular in our population, which is upward in the study of Wang³ and straight in the one of Liang⁷. Hence, ethnic and cultural factors influence smile characteristics.

Regarding the smile line, in Germany, researchers found that the majority of patients (52%) had an average smile line, followed by 38% with a high smile line and 10% with a low smile line¹. This suggests a predominant tendency towards average smile lines within the German population. In Spain, there was an even stronger prevalence of average smile lines, with 84.3% of patients exhibiting this characteristic, while only 8.6% had a low smile line and 7.1% had a high smile line, indicating a clear preference or genetic inclination toward an average smile line in the Spanish population². In contrast, Pham⁹ showed a different distribution, with nearly half of the patients (49.5%) having a high and very high smile line, 33% with an average smile line and 17.5% with a low smile line. The higher dominance of a high smile line suggests distinct aesthetic or anatomical differences prevalent in the Vietnamese population. Our findings are different: 42.6% of patients presented an average smile line, 32.7% a low smile line, and 24.7% a high smile line. Compared with the previous Vietnamese study, we

found a noticeable increase in an average smile line and a reduction in a high smile line. This feature is very important in treatment of patients to avoid excessive gingival display that can affect the overall smile aesthetics.

Considering the most posterior tooth displayed when smiling, our findings align with previous studies, reflecting similar trends and distributions of dental display, which was mostly up to the second premolar. However, we revealed a more diverse range of the most posterior tooth displayed when smiling, including up to the second molar and even the canine^{1, 2, 9, 11}. Moreover, most of the participants had upper teeth not touching their lower lip. These findings were similar to that reported in previous studies: This dentolabial relationship is considered to be the most aesthetic^{1, 12}.

Regarding the buccal corridor space, Ker et al.¹³ established a maximum tolerable buccal corridor width of 1.6, an ideal width of 1.16, and a minimum tolerable width at 0.58. Our mean width of 0.59 falls just above the minimum tolerable threshold, suggesting that while some individuals may have a less ideal buccal corridor, their width is still within acceptable limits. According to Machado⁴, a wider buccal corridor is considered to be unattractive, while an intermediate width is more aesthetic. Our findings support this view, indicating that the participants' buccal corridors, while close to the minimum threshold, do not significantly detract from their smile aesthetics.

Ackerman and Ackerman^{14, 15} originally developed the smile index, which is a crucial indicator of an attractive smile. An attractive smile is frequently considered to have a smile index of > 5.0 . Wang et al.³ showed a smile index of 6.02 for girls and 6.31 for boys in China. The smile index for Japanese women was ranged from 5.37 to 7.0¹⁶. The mean smile index in our study was 5.85, which aligns with the attractive range identified in previous research. Hence, our participants' smiles generally fall within the aesthetically pleasing category.

Another crucial metric for assessing smile aesthetics is dynamic smile symmetry, which may be calculated using the method described by Wang et al.³ A smile that is visually appealing usually has a symmetry value of approximately 1. Our Vietnamese participants had a dynamic smile symmetry of 1.01 with a standard deviation of 0.06, indicating that their smiles have a high degree of bilateral

uniformity. Our findings are consistent with the established standard for attractive smiles; in other words, our participants' smiles generally display a balance that is considered to be aesthetically pleasing.

We identified significant gender differences for the anterior smile line, the smile arc, the upper lip curvature, and the most posterior tooth displayed when smiling. Compared with the men, women displayed a parallel smile arc (57.5% vs 35.6%) and a straight upper lip curvature (42.5% vs 29.4%) more frequently. Regarding the anterior smile line, the women more often exhibited a high or very high smile line, while the men more often had a low or average smile line. There was a minor gender difference in the most posterior tooth displayed when smiling. Men and women predominantly displayed their second premolar (54.8% and 56.9%, respectively). However, men displayed their first molar (23.5%) more frequently than women (13.8%), suggesting a broader smile. Finally, there was slight difference in dynamic smile symmetry, which refers to the uniformity of movement of the smile. Women had a mean $\pm$ SD of 0.99 ± 0.05 , while men had a mean $\pm$ SD of 1.01 ± 0.07 . Although the difference was statistically significant, the clinical relevance of this difference may be minimal.

According to Pham,⁹ attractive smiles are likely to have some features such as an average or a high anterior smile line, a parallel smile arc, an upward upper lip curvature, and display up to the second premolar. In the current research, 56% of the students had an average or a high anterior smile line, 43.1% of the participants had a parallel smile arc, 10.2% of the participants had an upward upper lip curvature, and 58.6% displayed the second premolar. When examining these criteria through the lens of gender differences, although fewer women than men had an average or a high anterior smile line (55.1% vs. 56.3%) and an upward upper lip curvature (9.6% vs. 10.5%), more women had a parallel smile arc (57.5% vs. 35.6%). Additionally, more women than men had a smile that extended to their second molar (56.9% vs. 54.8%), which closely aligns with the characteristics of attractive smiles.

We found significant gender differences in various smile-related oral characteristics. Regarding the four characteristics of an attractive smile, the women tended to have two of these features more frequently than the men: the smile arc and the most posterior

tooth displayed when smiling. On the other hand, the men tended to have more frequently the anterior smile line and upper lip curvature associated an attractive smile. These insights are crucial for dental professionals aiming to provide appropriate and effective aesthetic treatments.

Despite offering valuable insights, this study has several limitations. The sample consisted exclusively of university students aged 18-29 years, representing a relatively narrow and homogeneous age group. As a result, the generalizability of the findings to other age cohorts or Vietnamese populations with varying socio-demographic backgrounds may be limited. To enhance external validity and further substantiate the current findings, future research by our group

will involve broader age distributions and more diverse demographic profiles.

CONCLUSION

We found significant gender differences in various smile-related oral characteristics. Regarding the four characteristics of an attractive smile, the women tended to have two of these features more frequently than the men: the smile arc and the most posterior tooth displayed when smiling. On the other hand, the men tended to have more frequently the anterior smile line and upper lip curvature associated an attractive smile. These insights are crucial for dental professionals aiming to provide appropriate and effective aesthetic treatments.

CONFLICT OF INTERESTS

The authors declare no potential conflicts of interest regarding the research, authorship, and/or publication of this article.

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