Journal of the World Federation of Orthodontists 12 (2023) 220–228

Contents lists available at ScienceDirect

Journal of the World Federation of Orthodontists

journal homepage: www.ejwf.org

Research Article

Multinational study on profile preference of laypersons

Adam Taee[a], Ahmed Alsulaiman[b], Monika Hersberger-Zurfluh[c], Joseph Bouserhal[a,d], Nayla Bassil-Nassif[d], Rachel Sathekge[e], Kazuhito Arai[f], Misa Ikoma[f], Ghassan Al-Turki[g], Abdulrahman Idrees[g], Beyza Tagrikulu[h], Leslie Will[a], Melih Motro[a,*]

[a] Department of Orthodontics and Dentofacial Orthopedics, Henry M. Goldman School of Dental Medicine, Boston University, Boston, Massachusetts
[b] Department of Preventive Dental Sciences, College of Dentistry, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia
[c] Klinik für Kieferorthopädie und Kinderzahnmedizine, Zentrum für Zahnmedizine, University of Zurich, Zurich, Switzerland
[d] Department of Orthodontics, Faculty of Dental Medicine, Saint Joseph University, Beirut, Lebanon
[e] 1 Military Hospital, Pretoria, South Africa
[f] Department of Orthodontics, School of Life Dentistry, The Nippon Dental University, Tokyo, Japan
[g] Department of Orthodontics, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia
[h] Department of Orthodontics, Faculty of Dentistry, Istanbul University, Istanbul, Turkey

ARTICLE INFO

Article history:
Received 2 February 2023
Revised 27 April 2023
Accepted 21 May 2023
Available online 20 July 2023

Keywords:
Multicenter
Nose and Lip
Profile Preference

ABSTRACT

Background: This study aimed to assess the facial profile preferences of lay people in seven locations from different countries and whether their place of residence, sex, age, race, education, or income influenced the decision.

Methods: After altering the lip and nose in 1 mm increments in the sagittal and sagittal/vertical directions, 50 profile silhouettes with white-like facial features were rated by evaluators. The soft tissue values were integrated into the profiles, and profile preferences were identified for each location. An ANOVA with post hoc Tukey test was used to compare the differences in mean preference in each location. A multivariable regression model was used to assess the effect of the demographics of the evaluator on preference.

Results: Thirteen profiles were ultimately analyzed. The mean for profile preference was significantly different across locations ($P < 0.0001$). For evaluators in the United States and Lebanon, the most preferred profile had the original lip and original nose. In Switzerland and South Africa, retrusive lips, and a small and less upturned nose was most preferred. In Japan and Saudi Arabia, the most preferred profile had the original lip and a protrusive nose that was less upturned. A protrusive lip with a small, upturned nose was preferred in Turkey. Profile change ($P < 0.0001$), location ($P < 0.0001$), sex ($P < 0.0001$), and race ($P = 0.02$) were significant confounders; in contrast, age, education, and income were not significant.

Conclusions: Profile preference is different among the seven locations. For the most part, lay people prefer profiles within one SD from white norms. Also, an upturned nose is the least favored in most of the locations. Sex and race are also significant confounders.

Clinical Relevance: An orthodontic treatment plan decision is affected by an individual's preference for their facial appearance. This study helps clinicians understand how racial and regional differences may affect patients' preferences and, therefore, their expectations for orthodontic treatment results.

1. Introduction

Good occlusion and facial balance are two interdependent goals of orthodontic treatment [1]. When assessing the patient's profile, clinicians tend to apply their own biases of aesthetics and may not always consider the patient's preference [2,3]. A pleasant facial profile comprises harmonious projection and proportion of different facial structures [4], and therefore, it is essential for clinicians to set the goal of treatment to coordinate the proportions of each of those features into optimal balance [5]. However, the definition of

Funding: The authors have not declared a specific grant for this research from any funding agency in the public, commercial, or not-for-profit sectors.

Competing interests: Authors have completed and submitted the ICMJE Form for disclosure of potential conflicts of interest. None declared.

Ethical approval: This study was approved by the Institutional Review Board of Boston University Medical Campus (H-36414).

Informed Consent: Verbal consent was taken from all the raters, and no identifying information was gathered.

Provenance and peer review: Non-commissioned and externally peer reviewed.

* Corresponding author: Department of Orthodontics and Dentofacial Orthopedics, Henry M. Goldman School of Dental Medicine, Boston University, Boston, Massachusetts.

E-mail address: mmotro@bu.edu (M. Motro).

2212-4438/$ – see front matter © 2023 Published by Elsevier Inc. on behalf of World Federation of Orthodontists.
https://doi.org/10.1016/j.ejwf.2023.05.006

optimal balance becomes nebulous when recognizing differences in preference, and the patient may not agree with the clinician's treatment plan to restore facial balance.

Many authors have studied the preference of profile in different cohorts. The results imply that profile preference may vary by location, culture, age, sex, profession, and ethnicity [2,5–7]. For example, a flatter profile may be preferred by males, while a profile with maxillary retrusion may be preferable by females in China [6]. Similarly, in Japan, female judges prefer a more retrusive profile [5]. However, the preferred lip position may vary in other locations such as the United States, Kenya, and Australia [2,7]. In many cases, the demographics of the evaluator, such as their race, age, sex, and ethnicity, from different countries may make a difference in their preference [8].

To the best of our knowledge, there is no study comparing the preference of nose and lip position together in different cultures and regions around the world. Therefore, we intended to determine the soft tissue profile preference of lay people in the major cities of Boston, United States; Zűrich, Switzerland; Beirut, Lebanon; Pretoria, South Africa; Tokyo, Japan; Jeddah, Saudi Arabia; and Istanbul, Turkey, in association with the evaluator's race, age, sex, and socioeconomic status. It is important to note that the sample of evaluators from each country is not representative of the country as a whole and was only used for statistical purposes. Therefore, our null hypothesis was that there is no difference between lay people from different regions of the world in their profile preferences.

2. Materials and methods

This study was approved by the Institutional Review Board of Boston University Medical Campus (H-36414).

A black silhouette was created in natural head position using Adobe Illustrator (Adobe Systems, San Jose, CA) from a profile image of an actual adult female with 32 years of age, Class I skeletal Angle Class I occlusion, cephalometric measurements within one SD from the white norms (sella nasion point A: 84°, sella nasion point B: 82.2°, A point, nasion, B point: 1.7°, posterior/anterior facial height ratio: 67.9%, upper central incisor to sella nasion line: 104.7°, and incisor to mandibular plane angle: 95.2°), and no history of prior orthodontic treatment or orthognathic/facial surgery (Fig. 1). The subject's cephalometric soft tissue values also were within one SD from Hispanic and Asian norms and within two SDs from the black norms (Table 1). A total of 45 silhouettes were created by modifying the lip and nose positions using Dolphin Imaging & Management Solutions (Patterson Dental Supply Inc. Dolphin Imaging & Management Solutions, Chatsworth, CA). The upper and lower lips were moved together 0, 1, or 2 mm anterior and posterior to their original position relative to the true vertical line, creating a total of five lip positions. The position of the nasal tip was modified to 1 mm anteroposterior to the true vertical line and 1 mm vertically perpendicular to the true horizontal line, creating a total of three positions in each direction with the original position being midway. During this process the subnasale point was not modified, only columella was adjusted to smoothen the curvature of the nose. Positive and negative values were associated with these movements based on the new position of the lip/nose relative to the original silhouette on the Cartesian coordinate system. The nasolabial angle and the positions of both lips relative to the E-line and S line were determined cephalometrically for each silhouette.

Five random silhouettes were duplicated to test intrarater reliability, adding up to 50 silhouettes. The survey packages (Appendix A found at 10.1016/j.ejwf. 10.1016/j.ejwf.2023.05.006) were made available with consent forms and instructions in English, French, German, Japanese, Turkish, and Arabic. In the survey packages in addition to the silhouettes, demographic data regarding the participants' race/ethnicity, socioeconomic status, and education level were also collected to assess the influence on perception. Power analysis was completed using one-way ANOVA to compare means among groups in a previous study by Nomura et al. [7] with similar aims, the sample size was determined as 40 evaluators per site at a power of 80% with $\alpha = 0.05$.

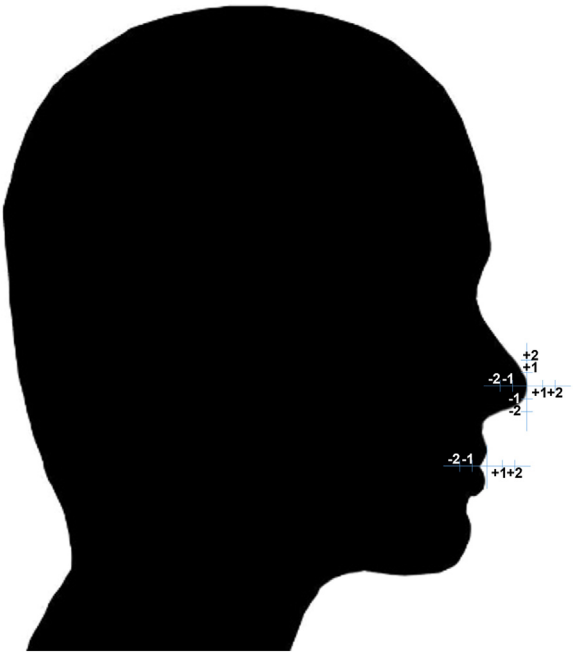

Fig. 1. Original profile silhouette (OL/ON) used to create all other silhouettes by changing the position of the lips and nose by 1-mm increments.

In total, 536 lay people who presented for orthodontic treatment to orthodontic clinics of institutions in seven different countries were offered to participate in the research. These institutions were selected based on our collegial relationship and for representing diverse populations with different demographics around the world. All participants were over 18 years of age with no prior training or experience in the dental or art fields, had no history of orthodontic treatment, and have been living in their current country for at least two-thirds of their life. Anyone who had previously participated in a similar study was excluded. Evaluators rated the silhouettes on a Likert scale of (1–5) based on desirability as follows; 1) Very undesirable; 2) Undesirable; 3) Neutral; 4) Desirable; and 5) Very desirable.

SAS Software Version 9.4 (SAS Institute Inc. Cary, NC) was used for statistical analysis. ANOVA and Tukey Range Test were used to test the difference in mean ratings from each country and racial/ethnic background. Multivariable regression was used to test the association between the outcome (desirability) and the included variables (age, sex, region, income level [for United States, Switzerland, and Turkey only], education level). Intra-rater reliability was analyzed using the intraclass correlation coefficient (ICC). The significance level was set at a $P < 0.05$.

3. Results

3.1. Sample

From the original 45 silhouettes, 32 silhouettes were excluded because the 1 mm changes in lip position in the sagittal/vertical

Table 1
Soft tissue cephalometric changes for the profiles.

Profile	Nasolabial angle (Norms = Hispanic 102, whites 102, African American 102, Asian 102)	Upper lip- S line (Norms = Hispanic 0, whites 0, African American 0, Asian 0)	Lower lip-S line (Norms = Hispanic 0, whites 0, African American 0, Asian 0)	Upper lip- E-plane (Norms = Hispanic −4, whites −5.3, African American 3, Asian −6)	Lower lip to E-plane (Norms = Hispanic −2, whites −2, African American 5, Asian −2)
Original Lip, Nose A 0, Nose V 0 (OL/ON)	94.5	−2.0	0.7	−6.1	−1.7
Original Lip, Nose A +1, Nose V + 1 (OL/ONA + 1/ONV + 1)	112.1	−2.9	−0.6	−6.4	−2.8
Original Lip, Nose A +1, Nose V − 1 (OL/ONA + 1/ONV − 1)	107.5	−3.5	0.1	−7.3	−2.2
Original Lip, Nose A − 1, Nose V + 1 (OL/ONA − 1/ONV + 1)	115.3	−2.0	0.3	−5.1	−1.5
Original Lip, Nose A − 1, Nose V − 1 (OL/ONA − 1/ONV − 1)	92.4	−2.8	0	−6.5	−2.3
Lip + 2, Nose A + 1, Nose V + 1 (OL + 2/ONA + 1/ONV + 1)	95.9	−1.1	1.3	−4.7	−1
Lip + 2, Nose A + 1, Nose V − 1 (OL + 2/ONA + 1/ONV − 1)	89.3	−1	1.5	−4.9	−0.8
Lip + 2, Nose A − 1, Nose V + 1 (OL+ 2/ONA − 1/ONV + 1)	96.9	0.5	2.5	−2.6	0.5
Lip + 2, Nose A − 1, Nose V − 1 (OL + 2/ONA − 1/ONV − 1)	85.7	0.4	2.3	−3	0.4
Lip − 2, Nose A + 1, Nose V + 1 (OL − 2/ONA + 1/ONV + 1)	113.5	−4.5	−2	−8.6	−4.7
Lip − 2, Nose A + 1, Nose V − 1 (OL − 2/ONA + 1/ONV − 1)	110.5	−4.3	−2.5	−8.4	−5.2
Lip − 2, Nose A − 1, Nose V + 1 (OL − 2/ONA − 1/ONV + 1)	116.4	−2.7	0.1	−6	−2.1
Lip − 2, Nose A − 1, Nose V − 1 (OL − 2/ONA− 1/ONV − 1)	97.5	−3.4	−1.1	−7.3	−3.4

direction were of minimal clinical importance [9]. The intrarater reliability of the lay people was assessed for the whole sample and determined to be poor for the 1 mm lip movements. The original lip (OL) had an ICC of 0.2, OL + 1 mm (OL + 1) had ICC of 0.3, OL + 2 had ICC of 0.4, OL − 1 had ICC of 0.4, and OL − 2 had ICC of 0.1. Therefore, the only silhouettes that were included in the final analysis were those with 2 mm changes that had an ICC value of $\geq$0.60 within each subset [10], which was only 13 silhouettes (Table 1).

In total, 536 evaluators were recruited that fit into the inclusion criteria. However, 13 evaluators were removed because of missing reported variables. A description of the sample distribution is summarized in Table 2.

3.2. Ratings across locations

The difference in rating of profiles was statistically significant among all participants across locations ($P < 0.01$) except for

Table 2
Distribution of the evaluators per location, by demographic type.

Variables	Boston, United States % (n = 99)	Zűrich, Switzerland % (n = 50)	Beirut, Lebanon % (n = 40)	Pretoria, South Africa % (n = 183)	Tokyo, Japan % (n = 27)	Jeddah, Saudi Arabia % (n = 71)	Istanbul, Turkey % (n = 53)
Sex							
Male	51	36	32.5	41	52	51	47
Female	49	64	67.5	59	48	49	53
Age							
18–35	63	42	22.5	31	44	67	47
36+	37	58	77.5	69	56	33	53
Race							
Black	29	0	0	58	0	0	0
White	32	96	95	27	0	99	100
Asians (including Japanese in Japan) and others	39	4	5	15	100	1	0
Education							
High school	20	42	25	35	7	41	45
College or university and above	80	58	75	65	93	59	55
Income							
< 50 K	54	46	90	91	59	87	94
> 50 K	46	54	10	9	41	13	6

K, thousand.

Table 3
Rating of the profiles across locations.

Profile	Boston, USA (n = 99) Mean (SD)	Zűrich, Switzerland (n = 50) Mean (SD)	Beirut, Lebanon (n = 40) Mean (SD)	Pretoria, South Africa (n = 183) Mean (SD)	Tokyo, Japan (n = 27) Mean (SD)	Jeddah, Saudi Arabia (n = 71) Mean (SD)	Istanbul, Turkey (n = 53) Mean (SD)
Original Lip, Nose A 0, Nose V 0 (OL/ON)	3.27 (0.91)	2.98 (0.71)	3.48 (0.75)	3.05 (0.94)	3.22 (0.50)	2.90 (1.21)	2.72 (1.01)
Original Lip, Nose A +1, Nose V +1 (OL/ONA + 1/ONV + 1)	3.01 (0.88)	2.28 (0.80)	2.78 (0.97)	3.03 (0.89)	3 (0.68)	2.80 (1.23)	2.66 (1.11)
Original Lip, Nose A +1, Nose V − 1 (OL/ONA + 1/ONV − 1)	2.74 (1.03)	3.02 (0.82)	3.13 (0.88)	3.16 (1.00)	3.25 (0.86)	3.21 (1.21)	2.58 (1.03)
Original Lip, Nose A − 1, Nose V +1 (OL/ONA − 1/ONV + 1)	2.72 (0.97)	2.80 (1.05)	2.40 (0.67)	2.91 (0.90)	2.67 (0.73)	2.66 (1.24)	2.79 (1.15)
Original Lip, Nose A − 1, Nose V − 1 (OL/ONA − 1/ONV − 1)	2.69 (1.08)	2.74 (0.88)	2.53 (0.96)	2.98 (1.05)	2.70 (0.72)	3.10 (1.38)	2.53 (1.17)
Lip +2, Nose A +1, Nose V +1 (OL + 2/ONA + 1/ONV + 1)	2.84 (1.00)	2.20 (0.81)	2.78 (0.95)	2.88 (0.98)	2.37 (0.69)	1.96 (1.07)	2.60 (1.18)
Lip +2, Nose A +1, Nose V − 1 (OL + 2/ONA + 1/ONV − 1)	3.17 (0.94)	2.72 (1.12)	2.95 (0.84)	3.12 (0.98)	2.77 (0.97)	2.46 (1.21)	2.68 (1.05)
Lip +2, Nose A − 1, Nose V +1 (OL+ 2/ONA − 1/ONV +1)	3.15 (0.95)	3.22 (0.86)	2.80 (0.82)	2.89 (0.98)	2.19 (0.88)	2.37 (1.09)	2.96 (1.13)
Lip +2, Nose A − 1, Nose V − 1 (OL+ 2/ONA − 1/ONV − 1)	3.05 (1.00)	2.50 (1.02)	2.53 (0.87)	2.97 (1.09)	2.26 (0.98)	2.42 (1.05)	2.62 (1.15)
Lip − 2, Nose A +1, Nose V +1 (OL − 2/ONA + 1/ONV + 1)	3.02 (0.94)	2.4 (0.78)	2.55 (0.84)	2.89 (0.96)	2.33 (0.78)	2.35 (1.30)	2.72 (1.23)
Lip − 2, Nose A +1, Nose V − 1 (OL − 2/ONA + 1/ONV − 1)	3.15 (0.90)	2.92 (0.99)	3.00 (0.91)	3.12 (0.98)	2.56 (0.97)	2.61 (1.25)	2.70 (1.23)
Lip − 2, Nose A − 1, Nose V +1 (OL − 2/ONA − 1/ONV + 1)	2.81 (1.02)	2.30 (0.97)	2.10 (0.90)	2.89 (1.07)	2.04 (0.90)	1.94 (1.1)	2.32 (1.09)
Lip − 2, Nose A − 1, Nose V − 1 (OL − 2/ONA − 1/ONV − 1)	3.18 (0.73)	3.34 (0.92)	3.10 (0.74)	3.20 (0.91)	2.70 (1.03)	3.04 (1.29)	2.83 (0.98)

OL/Original Nose A − 1 (ONA − 1)/ON V + 1 (ONV + 1), OL/ONV − 1 and *OL −2/ONA − 1/ONV − 1* (Tables 3 and 4).

3.3. Ratings in each individual location

3.3.1. Boston

Lay people in Boston preferred the OL/original nose (ON) profile the most. A short and less upturned nose with the OL was the least desirable (Table 3) (Figs. 1 and 2).

3.3.2. Zurich

The most preferred profile had a more retrusive lip and a smaller and less upturned nose. The least favored profile was the opposite, with protrusive lips and a large, upturned nose.

3.3.3. Beirut

Lay people preferred the OL/ON. With the horizontal size of the nose kept constant, the less upturned nose was preferred in almost every instance.

3.3.4. Pretoria

Lay people preferred a more retrusive lip and nose. However, there was no significant difference between profile ratings for South African raters.

3.3.5. Tokyo

Lay people preferred the OL with a protrusive nose that was less upturned. In general, lip protrusion was seen as less desirable.

3.3.6. Jeddah

The most preferred profile had the OL with a protrusive nose that was less upturned. Profiles with an upturned nose were less desirable.

3.3.7. Istanbul

Lay people in Istanbul preferred protrusive lips with a small, upturned nose. However, it was still below the neutral level. Retrusive lips with an upturned nose were the least desirable.

Four locations ranked retrusive lips with a small, upturned nose the lowest. In the remaining three locations, this profile was 10th, 11th, and 12th of the 13 profiles.

3.4. Rating for each race

The mean rating of 11 out of 13 profiles differed significantly between three racial groups (white, black, and Asian/Others). Only OL/ONA + 1/ONV − 1 and OL − 2/ONA − 1/ONV − 1 did not show any difference between racial groups. In all the profiles with significant white-black differences ($P < 0.05$), the black group

Table 4
Pairwise comparisons between the profile perceptions of laypersons from different countries are shown. Only the statistically significant differences are depicted.

Profile	Difference between means	Simultaneous 95% confidence limits		*P*-value	Pairs
Original Lip, Nose A 0, Nose V 0 (OL/ON)	0.57	0.03	1.12	0.034	Lebanon>Saudi Arabia
	0.76	0.18	1.34	0.002	Lebanon>Turkey
	0.56	0.08	1.03	0.009	USA>Turkey
Original Lip, Nose A + 1, Nose V + 1 (OL/ONA + 1/ONV + 1)	0.75	0.30	1.20	<0.0001	South Africa>Switzerland
	0.73	0.24	1.22	0.0003	USA>Switzerland
	0.72	0.05	1.40	0.03	Japan>Switzerland
	0.52	0.00	1.04	0.049	Saudi Arabia >Switzerland
Original Lip, Nose A + 1, Nose V − 1 (OL/ONA + 1/ONV − 1)	0.47	0.01	0.94	0.04	Saudi Arabia >USA
	0.63	0.08	1.17	0.01	Saudi Arabia >Turkey
	0.43	0.06	0.81	0.01	South Africa>USA
	0.59	0.12	1.05	0.004	South Africa>Turkey
Original Lip, Nose A − 1, Nose V + 1 (OL/ONA − 1/ONV + 1)	None				
Original Lip, Nose A − 1, Nose V − 1 (OL/ONA − 1/ONV − 1)	None				
Lip + 2, Nose A + 1, Nose V + 1 (OL + 2/ONA + 1/ONV + 1)	0.68	0.21	1.15	0.0004	South Africa>Switzerland
	0.92	0.51	1.33	<0.0001	South Africa>Saudi Arabia
	0.64	0.13	1.15	0.004	USA>Switzerland
	0.82	0.24	1.40	<0.0001	USA>Saudi Arabia
	0.65	0.11	1.18	0.0007	Lebanon>Saudi Arabia
	0.66	0.12	1.20	0.007	Turkey>Saudi Arabia
Lip + 2, Nose A + 1, Nose V − 1 (OL + 2/ONA + 1/ONV − 1)	0.71	0.24	1.18	0.0002	USA>Saudi Arabia
	0.66	0.23	1.08	0.0001	South Africa>Saudi Arabia
Lip + 2, Nose A − 1, Nose V + 1 (OL + 2/ONA − 1/ONV + 1)	0.85	0.32	1.39	<0.0001	Switzerland>Saudi Arabia
	1.04	0.35	1.72	0.0002	Switzerland>Japan
	0.79	0.34	1.23	<0.0001	USA>Saudi Arabia
	0.97	0.34	1.59	0.0001	USA>Japan
	0.60	0.08	1.12	0.014	Turkey>Saudi Arabia
	0.78	0.10	1.46	0.014	Turkey>Japan
	0.53	0.12	0.93	0.003	South Africa>Saudi Arabia
	0.71	0.11	1.30	0.009	South Africa>Japan
Lip + 2, Nose A − 1, Nose V − 1 (OL + 2/ONA − 1/ONV − 1)	0.55	0.01	1.09	0.04	USA>Switzerland
	0.63	0.15	1.11	0.002	USA>Saudi Arabia
	0.79	0.12	1.46	0.01	USA>Japan
	0.55	0.11	0.98	0.004	South Africa>Saudi Arabia
	0.71	0.08	1.35	0.02	South Africa>Japan
Lip − 2, Nose A + 1, Nose V + 1 (OL − 2/ONA + 1/ONV + 1)	0.62	0.10	1.14	0.008	USA>Switzerland
	0.67	0.20	1.13	0.03	USA>Japan
	0.69	0.04	1.34	0.0005	USA>Saudi Arabia
	0.49	0.01	0.96	0.04	South Africa>Switzerland
	0.53	0.12	0.95	0.003	South Africa>Saudi Arabia
Lip − 2, Nose A + 1, Nose V − 1 (OL − 2/ONA + 1/ONV − 1)	0.55	0.07	1.02	0.01	USA>Saudi Arabia
	0.52	0.09	0.94	0.007	South Africa>Saudi Arabia
Lip − 2, Nose A − 1, Nose V + 1 (OL − 2/ONA − 1/ONV + 1)	0.57	0.08	1.05	0.01	South Africa>Turkey
	0.59	0.09	1.08	0.009	South Africa>Switzerland
	0.79	0.24	1.33	0.0004	South Africa>Lebanon
	0.85	0.21	1.49	0.002	South Africa>Japan
	0.94	0.51	1.38	<0.0001	South Africa>Saudi Arabia
	0.72	0.14	1.30	0.005	USA>Lebanon
	0.78	0.11	1.46	0.01	USA>Japan
	0.87	0.39	1.36	<0.0001	USA>Saudi Arabia
Lip − 2, Nose A − 1, Nose V − 1 (OL − 2/ONA − 1/ONV − 1)	None				

consistently rated the profiles lower than the white group. Similarly, the Asian/other lay people also rated the profiles consistently lower than the white group in all the profiles that showed significant differences except the OL/ON. Significant differences were observed between black and Asian/other groups only in three profiles (OL + 2/ONA + 1/ONV + 1, OL + 2/ONA + 1/ONV − 1, and OL/ON where Asian/others group rated those profiles higher than the black group ($P < 0.05$) (Table 5).

3.5. Multivariable regression analysis

In total, 6% of the variability of the profile rating was explained by the regression model controlling for covariates (Table 4).

3.5.1. Profile

Controlling for all covariates, including location, sex, age, race, income, and education, significant differences in ratings were observed between profiles except OL/ONA + 1/ONV − 1 and OL − 2/ONA + 1/ONV − 1.

3.5.2. Location

The rating of profiles was significantly different across locations except for South Africa (Table 6).

3.5.3. Sex

Females rated profiles 0.1 significantly less than males in every profile ($P < 0.0001$).

Table 5
Comparison of preferences between different racial backgrounds.

Profile	White mean (SD) n = 136	Black mean (SD) n = 254	Asians/ Other mean (SD) n = 133	*P*-value	White vs. black	White vs. Asians/Others	Black vs. Asians/Others
Original Lip, Nose A 0, Nose V 0 (OL/ON)	2.91 (0.95)	3.02 (0.99)	3.34 (0.82)	0.0005	-	*	*
Original Lip, Nose A + 1, Nose V + 1 (OL/ONA + 1/ONV + 1)	3.02 (0.93)	2.76 (1.07)	2.90 (0.80)	0.04	*	-	-
Original Lip, Nose A + 1, Nose V − 1 (OL/ONA + 1/ONV − 1)	3.01 (1.18)	3.02 (1.02)	3.05 (0.90)	0.95	-	-	-
Original Lip, Nose A − 1, Nose V + 1 (OL/ONA − 1/ONV + 1)	2.98 (0.95)	2.73 (1.10)	2.62 (0.80)	0.008	*	*	-
Original Lip, Nose A − 1, Nose V − 1 (OL/ONA − 1/ONV − 1)	3.18 (1.10)	2.74 (1.14)	2.62 (0.91)	<0.0001	*	*	-
Lip + 2, Nose A + 1, Nose V + 1 (OL + 2/ONA + 1/ONV + 1)	3.04 (1.02)	2.33 (1.03)	2.75 (0.91)	<0.0001	*	-	*
Lip + 2, Nose A + 1, Nose V − 1 (OL + 2/ONA + 1/ONV − 1)	3.32 (0.98)	2.67 (1.09)	3.02 (0.92)	<0.0001	*	*	*
Lip + 2, Nose A − 1, Nose V + 1 (OL + 2/ONA − 1/ONV + 1)	3.05 (1.01)	2.81 (1.04)	2.78 (0.94)	0.04	*	*	-
Lip + 2, Nose A − 1, Nose V − 1 (OL + 2/ONA − 1/ONV − 1)	3.24 (1.09)	2.55 (1.04)	2.68 (0.97)	<0.0001	*	*	-
Lip − 2, Nose A + 1, Nose V + 1 (OL − 2/ONA + 1/ONV + 1)	3.06 (1.02)	2.52 (1.09)	2.75 (0.85)	<0.0001	*	*	-
Lip − 2, Nose A + 1, Nose V − 1 (OL − 2/ONA + 1/ONV − 1)	3.20 (1.00)	2.79 (1.10)	3.02 (0.93)	0.001	*	-	-
Lip − 2, Nose A − 1, Nose V + 1 (OL − 2/ONA − 1/ONV + 1)	2.97 (1.12)	2.31 (1.10)	2.49 (1.00)	<0.0001	*	*	-
Lip − 2, Nose A − 1, Nose V − 1 (OL − 2/ONA − 1/ONV − 1)	3.27 (0.88)	3.09 (1.04)	3.02 (0.81)	0.075	-	-	-

* represents p<0.05.

Table 6
Multivariate analysis of the association between profile preference and all included covariates (n = 523).

Variables	B Estimate	SE	*P*-value
Intercept	3.283	0.058	<0.0001
Profile			
Profile 1 Original Lip, Nose A 0, Nose V 0	Reference	.	.
Profile 5 Original Lip, Nose A + 1, Nose V + 1	−0.204	0.062	0.001
Profile 6 Original Lip, Nose A + 1, Nose V − 1	−0.053	0.062	0.3873
Profile 8 Original Lip, Nose A − 1, Nose V + 1	−0.306	0.062	<0.0001
Profile 9 Original Lip, Nose A − 1, Nose V − 1	−0.191	0.062	0.002
Profile 23 Lip + 2, Nose A + 1, Nose V + 1	−0.456	0.062	<0.0001
Profile 24 Lip + 2, Nose A + 1, Nose V − 1	−0.143	0.062	0.0203
Profile 26 Lip + 2, Nose A − 1, Nose V + 1	−0.207	0.062	0.0008
Profile 27 Lip + 2, Nose A − 1, Nose V − 1	−0.312	0.062	<0.0001
Profile 41 Lip − 2, Nose A + 1, Nose V + 1	−0.350	0.062	<0.0001
Profile 42 Lip − 2, Nose A + 1, Nose V − 1	−0.115	0.062	0.0635
Profile 44 Lip − 2, Nose A − 1, Nose V + 1	−0.544	0.062	<0.0001
Profile 45 Lip − 2, Nose A − 1, Nose V − 1	−0.182	0.062	0.0033
Location			
Location 1 USA	Reference	.	.
Location 2 Switzerland	−0.246	0.054	<0.0001
Location 3 Lebanon	−0.193	0.058	0.0009
Location 4 South Africa	0.054	0.039	0.1687
Location 5 Japan	−0.304	0.065	<0.0001
Location 6 Saudi Arabia	−0.470	0.050	<0.0001
Location 7 Turkey	−0.380	0.054	<0.0001
Sex			
Sex 1 Male	Reference	.	.
Sex 2 Female	−0.115	0.025	<0.0001
Age			
Age 1 18–35	Reference	.	
Age 2 36 +	−0.041	0.027	0.125
Race			
Black	Reference	.	.
White	0.144	0.062	0.0211
Asian/others	−0.066	0.035	0.0557
Education			
Education 1 Less than college	Reference	.	.
Education 2 College and above	0.005	0.027	0.862
Income (n = 202)			
Income 1 Less than $50,000	Reference	.	.
Income 2 $50,000 and more	0.012	0.034	0.715

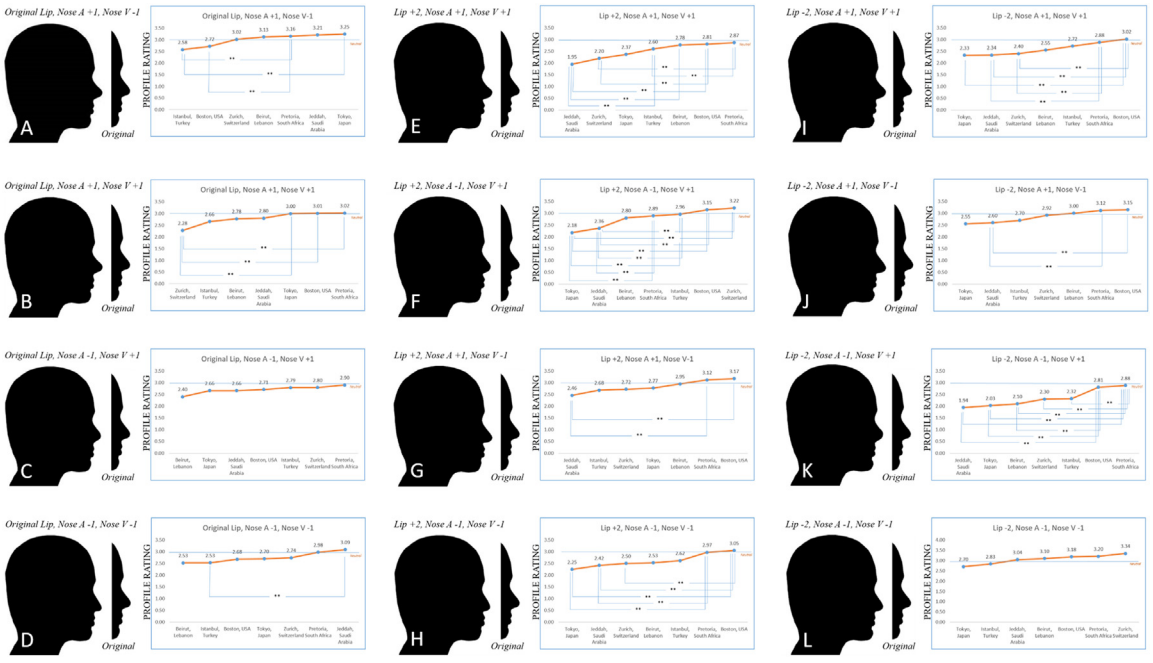

Fig. 2. Preference level of each country for profile ordered from lowest to highest rating. (A) OL/ONA + 1/ONV + 1, (B) OL/ONA + 1/ONV - 1, (C) OL/ONA - 1/ONV + 1, (D) OL/ONA - 1/ONV - 1, (E) OL + 2/ONA + 1/ONV + 1, (F) OL + 2/ONA + 1/ONV - 1, (G) OL + 2/ONA - 1/ONV + 1, (H) OL + 2,/ONA - 1/ONV - 1, (I) OL - 2/ONA + 1/ONV + 1, (J) OL - 2/ONA + 1/ONV - 1, (K) OL - 2/ONA - 1/ONV + 1, (L) OL - 2/ONA - 1/ONV - 1.

3.5.4. Age

The rating of profiles between age groups was different but not significant. Lay people aged 36 years and older rated profiles 0.04 less than those who were 18–35 years old ($P = 0.125$).

3.5.5. Race

The rating of profiles between races was different. Whites rated profiles 0.14 points higher than blacks for every profile ($P = 0.02$). Asians and others rated profiles 0.06 less than blacks did, but this was statistically insignificant ($P = 0.055$).

Explaining 3% of the variability, blacks in the United States of America, South Africa, and Saudi Arabia were not significantly different in profile ratings ($P = 0.08$). Whites in South Africa rated profiles 0.6 higher than whites in Turkey ($P = 0.02$), while whites in other locations were not significantly different in profile rating ($P = 0.09$). Asians and others were not significantly different in profile rating across locations, controlling for other variables ($P = 0.29$).

3.5.6. Education

The rating of profiles between education groups was not significantly different ($P = 0.86$).

3.5.7. Income

There was no significant difference in profile preference among lay people based on income in the United States, Switzerland, and Turkey ($P = 0.7$). Income was not included in the regression model for Lebanon, Japan, South Africa, and Saudi Arabia since no income adjustment to Gross Domestic Product was made by these research locations.

4. Discussion

Identifying patient preference for lip and nose shape and position is very important in treatment planning for orthodontics and orthognathic surgery. To the best of our knowledge, there is no other study combining changes in lip and nose position to understand lay people's preferences in seven different locations in the world.

Cultural and ethnic differences have been shown before to have an effect on the perception of attractiveness and beauty that these traits are not universally perceived similar across cultures [9]. We have shown that there are significant differences in perception of profile among different regions and cultures. These findings were consistent with previous studies, which also found significant differences in layperson preference for profile existing among different geographic regions [2,6,7]. However, the reasons behind the perception differences between different regions are not clear. Even countries in close proximity, such as Lebanon, Turkey, and Saudi Arabia had distinct differences in terms of profile preference. Further studies will be required to look into the reasons.

It is important to note that laypeople in the United States and South Africa rated profiles higher in general compared with Switzerland, Lebanon, Japan, Saudi Arabia, and Turkey, suggesting a greater tolerance for what was considered attractive. We attribute this to the diversity of population and the long-established mixed society in these two locations, making citizens more likely to like profiles that are unlike their own racial norms.

We also assessed the differences between racial groups. In our study, whites rated most of the profiles significantly higher than both blacks and Asians/Others. This result may be attributed to the fact that the original profile was chosen based on white norms. However, when we controlled for the covariates, despite the statistically significant difference in ratings between whites and blacks, race did not play a clinically significant role in laypeople's preferences. This agrees with studies by Foster et al. [11] and Nomura et al. [7] which found that Japanese and Hispanic judges preferred flatter profiles than blacks, while whites were not statistically significantly different than Japanese, Hispanic, and blacks in their rat-

ings. One of the limitations of Nomura's study was that only 30 subjects were included from each race [7]. In our study, Asians in Japan liked the original profile and considered lip protrusion as less desirable in agreement with studies by Maganzini et al. [6], Soh et al. [12], Chong et al. [2], Ioi et al. [13], Nomura et al. [7], and Shimomura et al. [5]. Overall, however, the significant differences between white and black laypeople suggest that regardless of the country of residence, racial identity may influence profile preferences.

Females rated profiles lower than males by 0.1 points, consistent with previous studies of Nomura et al. [7], Shimomura et al. [5], Morar et al. [8], Abu Arqoub et al. [14], and Park et al. [15]. Foster et al. [12], Hier et al. [16], and Nomura et al. [7] found that females preferred more retrusive profiles than males.

The age was included as a categorical variable, and 36 was chosen as a cutoff since it was the median age of the participants. Age was not found to be a significant confounder, in agreement with the study by Pithon et al. [17] and in contrast to Foster et al. [11], Hier et al. [16], Shimomura et al. [5], Abu Arqoub et al. [14] and Park et al. [15], which showed older adults' preference for more retrusive profiles. In our study, the limited changes made to retrude or protrude the profiles may not have been distinct enough for different age groups to detect any significant differences.

Additionally, we did not find any significant differences between groups of different income or education levels. One reason might be the widespread accessibility of communication technologies such as social media as a free resource of information, regardless of income or education, and thus these technologies might affect their preference.

The OL had an ICC of 0.2, OL + 1 had ICC of 0.3, OL + 2 had ICC of 0.4, OL − 1 had ICC of 0.4, and OL − 2 had ICC of 0.1 [18]. The reasons behind this poor reliability are likely because of two main factors. First, the redundancy created by the number of silhouettes used in this study to include all the possible combinations involving all lip and nose positions may have led to "sensory overload" for observers. Second, lay people may not be able to detect changes within 2 mm. It is important to note that there are only a few studies investigating profile preferences that include duplicate profiles to determine the intrarater reliability, which is a strength of our study [4,19].

A notable trend in our study was that most overall preferences were neutral at best. The profiles with the most locations having an overall positive reaction had five locations out of seven reacting positively, and three had no mean positive reactions. This could reflect the fact that attractiveness is comprised much more than the profile, and without full-face pictures, the respondents could muster no more than neutral regard for the profile. There were some consistent preferences displayed in the lay people's ratings, however. With the lip and anteroposterior nose position kept constant, the less upturned nose was preferred five times out of six. When the only change was made in the lip protrusion, a more protrusive lip was only preferred over the original with a smaller, more upturned nose. A more retrusive lip was only preferred over the original with a smaller, less upturned nose. Perhaps the overall balance of the lip and nose protrusion influenced these subtle differences. One exception was the profiles with more upturned noses were almost always among the least favored regardless of the size and lip position.

The chin may have played into the laypeople's preferences as well. Although chin protrusion was not altered, its relative position changed with changes in lip and nose positions. When the lips are retrusive, the chin is relatively more prominent, and the number of locations with positive reactions to all four OL − 2 profiles is not different from the number of locations with positive reactions to the OL scores, which, in turn, are relatively much more positive than the reactions to the OL + 2 profiles. This may suggest that some degree of chin prominence might be considered during the preference decision.

One limitation of our study was the sample distribution in the subcategories of sex, age, race, education, and income. These were not equal among the seven locations, which might have affected the association of those variables with preferences. In addition, there is a possibility of misclassification bias as changes in the nose and lip were not separated in the analysis.

In contrast, this study is the first to include lay people's perspectives toward profile preference from seven different regions of the world. The sample included most racial backgrounds as well as a diverse variety of ages, income, and education levels.

5. Conclusion

Our study draws a picture of a sample of lay people's preference for nose and lip position across cultures.

1. The laypeople's preference for lip and nose position is significantly different among cities of Boston, Zűrich, Beirut, Pretoria, Tokyo, Jeddah, and Istanbul.
2. Participants in Beirut, Zűrich, Tokyo, and Jeddah were more critical in their rating than those in Boston, Pretoria, and Istanbul.
3. Laypeople in Boston and Beirut preferred the original lip and nose, whereas people in Zűrich preferred a more retrusive lip and a nose that is smaller and less upturned. Lay people in Pretoria preferred a more retrusive lip and nose. In Tokyo and Jeddah, the OL with a protrusive nose that is less upturned was preferred, and in Istanbul, it was a protrusive lip with a small, upturned nose.
4. Lay people are not reliable in their rating of lip changes within 2 mm.
5. Sex and race have significant effects on profile preference, unlike age, education, and income.
6. Racial identity may influence profile preferences regardless of the country of residence.
7. The most favored profiles across most of the regions were the original profile (except Saudi Arabia and Turkey); OL − 2/ONA − 1/ONV − 1 (more retrusive lip, smaller and downturned nose) (except Japan and Turkey), and OL/ONA + 1/ONV − 1 (more prominent and downturned nose) (except the United States of America and Turkey). In all seven locations, an upturned nose was usually less desired.

CRediT authorship contribution statement

Adam Taee: Conceptualization, Methodology, Investigation, Writing – original draft. **Ahmed Alsulaiman:** Formal analysis, Writing – review & editing. **Monika Hersberger-Zurfluh:** Investigation, Writing – review & editing. **Joseph Bouserhal:** Investigation, Writing – review & editing. **Nayla Bassil-Nassif:** Investigation, Writing – review & editing. **Rachel Sathekge:** Investigation, Writing – review & editing. **Kazuhito Arai:** Investigation, Writing – review & editing. **Misa Ikoma:** Investigation, Writing – review & editing. **Ghassan Al-Turki:** Investigation, Writing – review & editing. **Abdulrahman Idrees:** Investigation, Writing – review & editing. **Beyza Tagrikulu:** Investigation, Writing – review & editing. **Leslie Will:** Writing – review & editing, Supervision. **Melih Motro:** Conceptualization, Methodology, Investigation, Writing – original draft.

Acknowledgment

The authors would like to thank Ms. Priscilla Soares for her contribution to preparing this article for submission to the Journal of the World Federation of Orthodontists. All the contents of this paper are original and have not been published, nor are they under review for any other scientific journal.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ejwf.2023.05.006.

References

[1] Merrifield LL. The Profile Line as an aid in critically evaluating facial esthetics. Am J Orthod 1966;52:804–22.
[2] Chong HT, Thea KW, Descallar J, et al. Comparison of white and Chinese perception of esthetic Chinese lip position. Angle Orthod 2014;84:246–53.
[3] Pearson DC, Adamson PA. The ideal nasal profile: rhinoplasty patients vs the general public. Arch Facial Plast Surg 2004;6:257–62.
[4] Naini FB, Donaldson ANA, Cobourne MT, McDonald F. Assessing the influence of mandibular prominence on perceived attractiveness in the orthognathic patient, clinician, and layperson. Eur J Orthod 2012;34:738–46.
[5] Shimomura T, Ioi H, Nakata S, Counts AL. Evaluation of well-balanced lip position by Japanese orthodontic patients. Am J Orthod Dentofacial Orthop 2011;139:e291–7.
[6] Maganzini AL, Tseng JYK, Epstein JZ. Perception of facial esthetics by native Chinese participants by using manipulated digital imagery techniques. Angle Orthod 2000;70:393–9.
[7] Nomura M, Motegi E, Hatch JP, et al. Esthetic preferences of European American, Hispanic American, Japanese, and African judges for soft-tissue profiles, Japanese. Am J Orthod Dentofacial Orthop 2009;135:S87–95.
[8] Morar A, Stein E. A method of assessing facial profile attractiveness and its application in comparing the aesthetic preferences of two samples of South Africans. J Orthod 2011;38:99–106.
[9] Zhan J, Liu M, Garrod OGB, et al. Modeling individual preferences reveals that face beauty is not universally perceived across cultures. Curr Biol 2021;31:2243–52 e6.
[10] Kokich VO, Kiyak HA, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. J Esthet Dent 1999;11:311–24.
[11] Foster EJ. Profile preferences among diversified groups. Angle Orthod 1973;43:34–40.
[12] Soh J, Chew MT, Wong HB. A comparative assessment of the perception of Chinese facial profile esthetics. Am J Orthod Dentofacial Orthop 2005;127:692–699.
[13] Ioi H, Shimomura T, Nakata S, Nakasima A, Counts AL. Comparison of anteroposterior lippositions of the most-favored facial profiles of Korean and Japanese people. Am J Orthod Dentofacial Orthop 2008;134:490–5.
[14] Abu Arqoub SH, Al-Khateeb SN. Perception of facial profile attractiveness of different antero-posterior and vertical proportions. Eur J Orthod 2011;33:103–11.
[15] Park NS, Park JH, Bayome M, Mo SS, Kim Y, Kook YA. An evaluation of preferred lip positions according to different age groups. Int J Oral Maxillofac Surg 2013;42:637–42.
[16] Hier LA, Evans CA, BeGole EA, Giddon DB. Comparison of preferences in lip position using computer animated imaging. Angle Orthod 1999;69:231–8.
[17] Pithon MM, Silva ISN, Almeida IO, et al. Photos vs silhouettes for evaluation of profile esthetics between white and black evaluators. Angle Orthod 2014;84:231–8.
[18] Portney LG, Watkins MP. Foundations of clinical research: applications to practice. Upper Saddle River, NJ: Prentice Hall; 2000. p. 84.
[19] Modarai F, Donaldson JC, Naini FB. The influence of lower lip position on the perceived attractiveness of chin prominence. Angle Orthod 2013;83:795–800.