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Influence of age, sex and occupation on the aesthetic perception of the facial profile

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Influencia de la edad, sexo y ocupación sobre la percepción estética del perfil facial

ABSTRACT

Objective: To study the influence of age, sex, and occupation in determining the aesthetic perception of the facial profile in the Chilean population through the analysis of silhouettes. **Methods:** From a profile photograph, a digital silhouette was designed, which was modified with 2mm movements from the original position of the chin, simulating mandibular protrusion and retrusion. The use of silhouettes allows for eliminating various distractions, prejudices, and predispositions when making an aesthetic judgment. All participants accepted informed consent. **Results:** 112 participants with a mean age of 33.99 ± 8.28 years were surveyed. When analyzing the most aesthetic option was a straight profile, followed by a slight retrusion of -2mm and a protrusion of +2mm. The least esthetic option was a severe protrusion of +12mm. Both results were repeated in all the groups analyzed. **Conclusions:** The results present similarities with the literature, however, the low concordance in this study may be due to possible indirect influences due to the contrast of the images that made up each set and the limited size of the studied sample. The present study was the first of these characteristics in a Chilean population.

Key words: Orthodontics; Esthetics; Adult; Photography dental; Face perception.

RESUMEN

Objetivo: estudiar la influencia de la edad, sexo y ocupación en la determinación de la percepción estética del perfil facial en la población chilena mediante el análisis de siluetas. **Métodos:** a partir de una fotografía de perfil se diseñó una silueta digital la cual se modificó con movimientos de 2mm desde la posición original del mentón simulando una protrusión y retrusión mandibular. El uso de siluetas permite eliminar diversas distracciones, prejuicios y predisposiciones al momento de emitir un juicio estético. Todos los participantes aceptaron el consentimiento informado. **Resultados:** se encuestaron 112 participantes con una edad media de 33.99 ± 8.28 años. Al analizar la opción más estética fue un perfil recto, seguido de una leve retrusión de -2mm y una protrusión de +2mm. La opción menos estética fue una protrusión severa de +12mm. Ambos resultados se repitieron en todos los grupos analizados. **Conclusiones:** los resultados presentan similitudes con la literatura, sin embargo, la baja concordancia en este estudio puede deberse a posibles influencias indirectas por contraste de las imágenes que compusieron cada set y el limitado tamaño de la muestra estudiada. El presente estudio fue el primero de estas características en la población chilena.

Palabras clave: ortodoncia; estética; adulto; fotografía dental; reconocimiento facial.

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Introduction

Facial aesthetics is a relevant factor for social development and self-esteem, being a physical trait that the population looks for (1). For this reason, many people seek orthodontic treatment for aesthetic reasons over function (2, 3). Furthermore, the literature has reported that people with more attractive faces appear to be more successful and pleasant, and even receive more favorable treatment, compared to those with faces that are not considered attractive (1, 4, 5). There are even cognitive science studies that have reported that the perception of facial attractiveness can be a determining factor when selecting couples (5, 6).

Due to this, in recent years there has been a large increase in the adult population seeking orthodontic treatment for aesthetic purposes due to the greater importance given to facial and dental aesthetics, as well as the increase in aesthetic therapeutic/invisible options (3, 6-10), considering that orthodontic treatment has a great influence on facial aesthetics by modifying the position of the anterior teeth and the influence they exert on the lips (4, 6, 11).

In a study carried out in a Korean population regarding the degree of satisfaction with orthodontic treatment, it was observed that the highest satisfaction rates were related to facial and dental aesthetics (7). However, aesthetics is a subjective factor and is determined by several factors such as sociocultural, sex, age, cognition, ethnicity, interindividual differences, cultural revolution, educational and economic level, which is why the concept of aesthetics has been so changing throughout the years, throughout history and cultures, although some studies indicate that age does not influence the perception of aesthetics (1, 6, 7, 11, 12). Due to this, orthodontists must be prepared to treat adult patients and know the parameters that are considered aesthetic for the population they will attend with the intention of performing aesthetically attractive treatments with adequate functional results and prognoses, avoiding disappointment and frustrations for both parties.

The analysis of the facial profile using silhouettes, instead of a photograph, allows eliminating distractions that can alter the perception of the population and produce a predisposition in the choice such as sex, eye color, skin and/or hair, as well as facial topography given that some studies have reported that the cheekbones, chin, and eyes are the main distractors when analyzing a profile (1, 11, 13). However, it has been shown that synthetic faces, such as silhouettes, allow a precise correspondence with photographs, even both produce very similar cognitive processing in the people who observe them, providing information on highly reliable and comparable perceptions of facial attractiveness, despite the fact that the silhouettes are flat images that lack textures and color, indicating that they present a large part of the information that is needed to determine the attractiveness of a face, regardless of the sex of the evaluator (11, 14).

Most of the studies on facial aesthetic parameters are in the US and European population who have a sociocultural context other than Latin American and, specifically, Chilean. In addition, no study was found that analyzes the perception of facial aesthetics according to age, sex, and occupation with respect to the mandibular position in the Chilean population using silhouettes. These factors are important to know because orthodon-

tic treatment should try to adapt, within the possible margins, to the concepts and standards of beauty of the patient, thus avoiding monotonous results in all patients, considering that each patient is a person unique and that their self-esteem and post-treatment satisfaction is as important as objective and functional outcomes (4, 6). For this reason, the objective of this study was to determine the differences by age, sex, and occupation in the perception of aesthetics in the mandibular position of the facial profile in the Chilean population using two-dimensional silhouettes. The research question was, do age, sex, and occupation influence the perception of aesthetics in the mandibular position when analyzing the facial profile of two-dimensional silhouettes?

The null hypothesis declared was that there are no differences in the aesthetic perception of the facial profile when analyzing the mandibular position in two-dimensional silhouettes according to age, sex, and occupation.

Methods

Take of the profile image

The profile image was taken on one of the authors with normal values according to the facial profile analysis described in Table 1. The image was taken with the person sitting and looking straight ahead in a natural guided head position. A white background was used to obtain adequate contrast and to cut the image. The image was taken in RAW format with a Nikon D5600 reflex camera in the vertical direction with a focal length of 105mm, aperture f/11, exposure time of 1/200s, ISO 200, 5500K, and the camera's flash in the obliquely to the person to eliminate shadows in the facial area. The distance between the camera and the individual was 150 centimeters.

Silhouettes preparation

The captured image was processed in Adobe Photoshop software (Version 19; Adobe Inc., San José, CA, USA) to cut out the facial profile and transform it into a silhouette. Subsequently, modifications were made to the original silhouette in the position of the jaw every 2 millimeters (mm) anteriorly (simulating class III) and posteriorly (simulating class II) until reaching silhouettes with a chin position of +12mm and -12mm, respectively. The variation of the silhouettes was defined as 2mm so as not to generate an excessive number of images, avoiding fatigue to the respondents, along with replicating the methodology used by studies carried out in other populations with the intention of making a comparison of the results.

Table 1. Facial analysis used for the profile photograph that originated the silhouettes

Analysis	Parameters in profile used
Legan and Burstone facial convexity	8°
Spradley subnasal vertical	Upper lip: +5mm Lower lip: +3mm Chin: -4mm
Middle and lower third facial proportion	43% / 57%
Sn-Pn distance	19mm
Nasolabial angle	95°
Ricketts line E	Upper lip: -4mm Lower lip: -2.5mm

Source: own elaboration

Questionnaire implementation

A questionnaire was carried out with the 13 silhouettes generated in which everyone had to identify the degree of facial attractiveness. The inclusion criteria were to be Chilean, over 18 years of age, and not present any physical or developmental alteration so that there were no difficulties when observing the images and classifying them. The data were analyzed by age range according to the classification of MeSH terms with a group of adults (19-44 years) and middle age (45-64 years), by sex and by occupation, differentiating lay people from dentists (including orthodontists).

The evaluators were shown the images divided into two predefined sets with 8 silhouettes each, randomly, identified by two letters previously defined at random. One set includes the original silhouette, all silhouettes that simulate a class III (+2 to +12) and an intentionally selected class II silhouette; instead, the other set includes the original silhouette, all the silhouettes that simulate a class II (-2 to -12) and an intentionally selected class III silhouette. The original silhouette and the intentionally selected Class II and III silhouettes allow the determination of intra-examiner reliability.

They were asked to rate each image according to facial attractiveness with a Likert scale where: 1–very unattractive, 2–unattractive, 3–neither attractive nor unattractive, 4–slightly attractive and 5–very attractive. No more parameters were used so as not to confuse the evaluators and the use of very aggressive adverbs such as the word "extremely" was avoided so as not to induce the evaluators to consider this parameter as something very negative or close to perfection and difficult to achieve. Finally, and with the 13 silhouettes at their disposal, they were asked to identify the most attractive and the least attractive silhouette.

The survey was conducted using Google Forms (Google LLC; Mountain View, CA, USA). The form contains the description and objective of this study, together with the informed consent that they must accept to be able to observe and rate the silhouettes. After conducting the survey and evaluating the profiles, the silhouettes were ordered incrementally to be presented in this study and facilitate their understanding.

Statistical analysis

The differences and similarities between the groups (age, sex, and occupation) were analyzed using a one-way analysis of variance (ANOVA). Inter-examiner and intra-examiner agreement were determined using Cohen's Kappa index. Data tabulation was performed with Microsoft Excel spreadsheet software (Version 2105; Microsoft Corp.; Redmond, WA, USA) and statistical analysis was performed with SPSS statistical software (version 28.0.0.0; IBM Corp., Armonk, NY, USA). The level of significance determined was $p < 0.05$, so the confidence interval used was 95%.

Ethical considerations

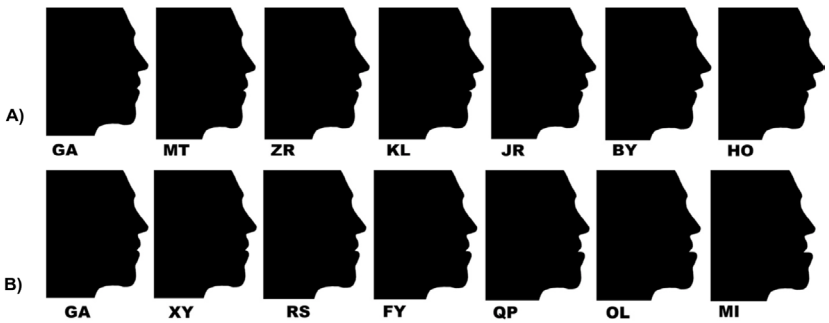
The author who was photographed, as well as the evaluators, accepted the informed consent regarding the objective of this study, the handling of their requested personal information (sex, age, and occupation), and the purpose of the information they are providing. If they do not accept the informed consent, they cannot continue with the survey to observe the silhouettes since it is a mandatory stage. The personal data collected was encoded and handled anonymously, without being present in the manuscript.

Results

Figure 1 shows the silhouettes ordered according to the magnitude of the change made to each silhouette simulating classes II and III. The RS profile (repeated as RT) and ZR (repeated as HG) were used as a control in the group of retruded and protruded silhouettes, respectively.

The survey was answered by 112 participants, 81 women and 31 men. The distribution by sex and occupation can be seen in figure 2. The mean age of the participants was 33.99 ± 8.28 years (range between 23 - 64, a median of 31, and mode of 27 years). The results of the analysis of the silhouettes are described in figure 3 (analysis of all the silhouettes), and figure 4 with the most and least aesthetic. The population of dentists was 29 and laypeople 83.

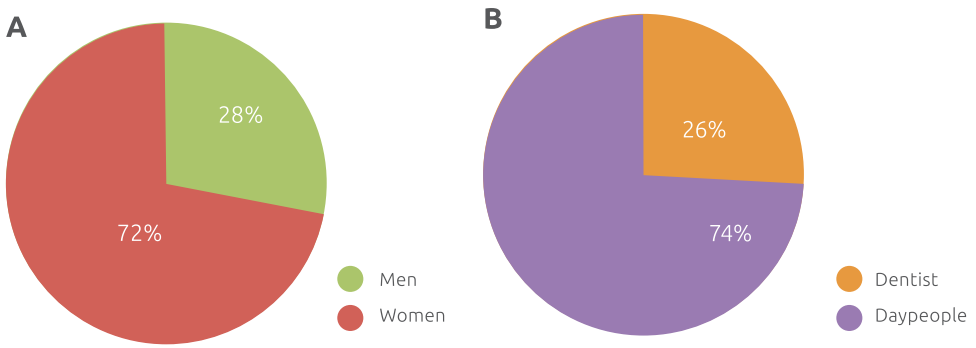
Figure 1. Set of ordered silhouettes simulating a class II and class III.



A) Set of silhouettes arranged in descending order simulating a class II. The variations of each categorization are as follows: GA= 0mm; MT= -2mm; ZR= -4mm; KL= -6mm; JR= -8mm; BY= -10mm; HO= -12mm.
B) Set of silhouettes arranged in increasing order simulating a class III. The variations of each categorization are as follows: GA= 0mm; XY= +2mm; RS= +4mm; FY= +6mm; QP= +8mm; OL= +10mm; MI= +12mm

Source: own elaboration.

Figure 2. Distribution of the sample by sex and occupation.

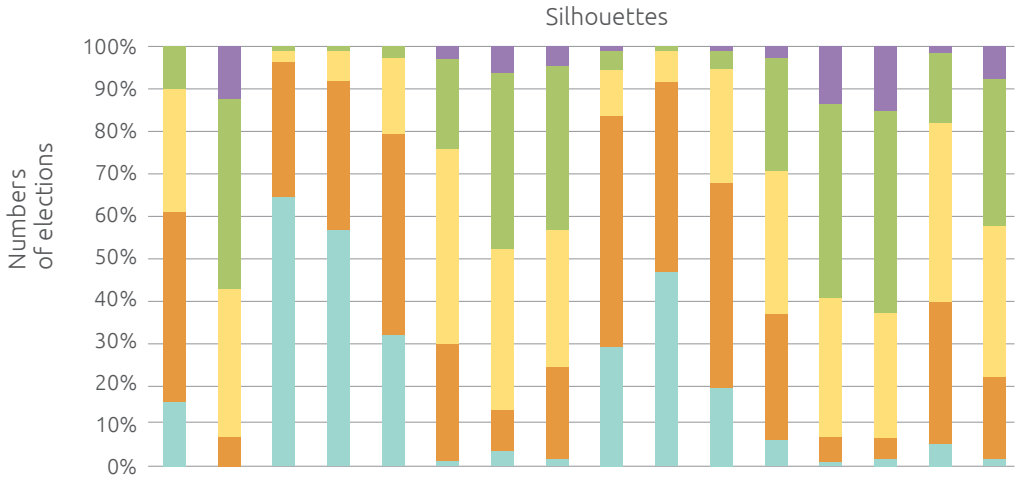


A. Distribution of the sample by sex

B. Distribution of the sample by occupation

Source: own elaboration.

Figure 3. Analysis of all silhouettes according to the Likert scale.

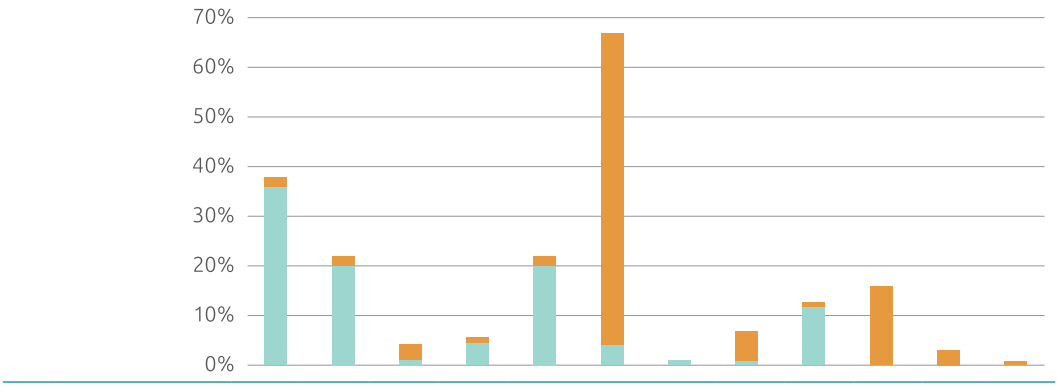


	FY	GA (PH)	MI	OL	QP	RS (RT)	XY	HG (ZR)	BY	HO	JR	KL	MT	PH (GA)	RT (RS)	ZR (HG)
Very attractive	0	14	0	0	0	3	7	5	1	0	1	3	14	17	1	8
Slightly attractive	11	51	1	1	3	24	47	44	5	1	5	30	53	53	19	40
Neither attractive nor unattractive	33	39	3	8	20	52	43	36	12	8	30	38	37	34	48	40
Unattractive	51	8	36	40	54	32	11	25	62	51	55	34	7	6	38	22
Very unattractive	17	0	72	63	35	1	4	2	32	52	21	7	1	2	6	2

The total number of participants who considered each of the 16 exposed silhouettes as very attractive, slightly attractive, neither attractive nor unattractive, unattractive, and very unattractive is observed.

Source: own elaboration.

Figure 4. Distribution of the silhouette considered the most and least aesthetic for the total population.



	GA	XY	RS	KL	MT	MI	FY	HO	ZR	OL	BY	QP
Least aesthetic	2%	2%	3%	1%	2%	63%		6%	1%	16%	3%	1%
Most aesthetic	36%	20%	1%	5%	20%	4%	1%	1%	12%			

Percentage of the most and least aesthetic silhouettes according to the surveyed.

Source: own elaboration.

When dividing the sample by age range, we found that in the adult group the silhouette considered the most aesthetic is the GA (n=35) followed by the MT (n=21), XY (n=19), ZR (n=11), KL (n=5), MI (n=3), RS (n=1), FY (n=1) and HO (n=1). For the group of middle-aged adults, the silhouette considered the most aesthetic was also the GA (n=5), but closely followed by the XY (n=4), MT (n=2), ZR (n=2), MI (n=1) and KL (n=1). However, the group of adults (n=97) was much more abundant than that of middle-aged adults (n=15). According to sex, for men the most aesthetic silhouette was GA (n=8) and MT (n=8) followed by XY (n=7), ZR (n=4), MI (n=2), RS (n=1) and KL (n=1); on the other hand, for women it was GA (n=32) followed by XY (n=16), MT (n=15), ZR (n=9), KL (n=5), MI (n=2), FY (n=1) and HO (n=1).

When analyzing the silhouette chosen as the least aesthetic, the group of adults chose MI (n=65) followed by OL (n=15), HO (n=6), BY (n=3), RS (n=3), MT (n=2), KL (n=1), XY (n=1) and QP (n=1); on the other hand, in the group of middle-aged adults it was MI (n=6), OL (n=3), GA (n=2), BY (n=1), XY (n=1), ZR (n=1) and HO (n=1). When analyzed by sex, it was found that for men it was the silhouette MI (n=20) followed by GA (n=2), BY (n=2), OL (n=2), RS (n=1), MT (n=1), HO (n=1), ZR (n=1) and KL (n=1); on the other hand, for women it was MI (n=51) followed by OL (n=16), HO (n=6), BY (n=2), XY (n=2), RS (n=2), MT (n=1) and QP (n=1).

When analyzing the results by occupation, we found that the most attractive silhouette for dentists was GA (n=11), MT (n=10), ZR (n=4), XY (n=3) and KL (n=1). In the case of the lay population, the most aesthetic was GA (n=29), XY (n=20), MT (n=13), ZR (n=9), KL (n=5), MI (n=4), FY (n=1), HO (n=1) and RS (n=1). In the case of the less aesthetic silhouette for dentists it was MI (n=18), OL (n=4), HO (n=3), RS (n=2), ZR (n=1) and XY (n=1). In the case of the laypeople, it was MI (n=53), OL (n=14), HO (n=4), BY (n=4), MT (n=2), GA (n=2), RS (n=1), KL (n=1), QP (n=1) and XY (n=1).

When analyzing the intra-examiner agreement for GA a Kappa index=0.205 was obtained, for RS Kappa=0.138 and ZR Kappa=0.347. When performing the same analysis but

only between dentists, it was observed that the agreement for GA was Kappa=0.399, for RS Kappa=0.085, and for ZR Kappa=0.246. When performing the same analysis but with the lay population a Kappa index=0.126 was obtained for GA, for RS Kappa=0.154, and for ZR Kappa=0.356. When analyzing the inter-examiner agreement, a Kappa index=0.596 was found.

According to the one-factor ANOVA analysis, it was found that, in general, there are no statistically significant differences according to occupation for the most aesthetic and the least aesthetic silhouette (p> 0.05 in both cases). In individual analysis, the silhouettes that presented significant differences according to occupation were FY, QP, OL, and MI (p <0.05 in all cases). When analyzing the differences by age group, statistically significant differences were only found in the choice of the least aesthetic silhouette, OL, MT, and ZR (P <0.05 in all cases). Finally, when analyzed by sex, no statistically significant differences were found in any of the silhouettes analyzed.

Discussion

Within the group of dentists, only 1 orthodontist responded, which may affect the results found by not having a representative number of orthodontists, in addition, the lay population was higher than dentists. On the other hand, the silhouette chosen as the most aesthetic for the two age groups was the GA, corresponding to the original silhouette and without modifications, however, these figures may have been conditioned by the limited size of the sample and the differences in the size of both groups since most of the participants were young (median 31 years). For men, the most aesthetic silhouette is the GA and MT, original silhouette and -2mm respectively, in the same proportion, which may show a preference for a straight or slightly retruded profile; instead, women chose GA as the most aesthetic silhouette. However, the group of women was twice the size of men, which could have influenced the differences observed. A partially different trend is observed in the occupation since, despite the fact that for dentists and laypeople the most aesthetic silhouette was the GA, the second most aesthetic for dentists was the TM corresponding to a slight retrusion of -2 mm; on the other hand, for lay people it was XY, which represents a slight protrusion of + 2mm, partially similar results, in the case of dentists, to other studies that show that orthodontists are more likely to classify the facial profile of a skeletal class I as the most attractive (12).

When observing the less aesthetic silhouettes for the two age groups, the least aesthetic was the MI silhouette which represented a +12mm protrusion followed, in both cases, by OL which represents a +10mm protrusion. For both sexes, the least aesthetic silhouette was the MI, the same result as for occupation, which would suggest some rejection of concave profiles. We can observe that, as reported by other studies, age does not seem to influence the perception of aesthetics (1).

The results obtained were like those found in the studies by Salehi et al and Rezaei et al in which the different age groups preferred a straight profile or a slight mandibular retrusion of -2mm (1,15). Similar results were found by Torul et al when surveying men and women and determining that for all groups the most aesthetic facial profile is straight, followed by convex profiles, while concave profiles were the least aesthetic (16). The only different result in our study was in the lay population that, although their choice

of the most aesthetic silhouette corresponded to the straight profile, the second most aesthetic silhouette was a slight +2mm protrusion. In the same study by Salehi et al (1), they found that for the population studied, the least aesthetic profile was the silhouette with a retrusion of -12mm, results that differ slightly from those of the present investigation given that for our study population the profile less aesthetic was the +12mm protrusion. However, in both studies it is possible to find that both the most extreme protrusions and retrusions are considered the least aesthetic (1).

In another study by Oliveira et al (4), despite using a different methodology when using profile photographs instead of silhouettes and generating changes in the maxillary and mandibular position, a certain concordance with the present study can be evidenced by finding that the profile most aesthetic in women was a slight biretrusive followed by a mandibular retrusion. On the other hand, in the profile of men the most aesthetic was a straight profile followed by a slight biprotrusive (4). Although it is true that the methodologies are not comparable, it is possible to notice a tendency towards straight or slightly retruded profiles, and even a biprotrusive profile is reported as an aesthetic predilection, which may be like the predilection of the lay population for a silhouette with a slight protrusion of +2mm as the second most aesthetic option in the present study. These results are like those found by Quiroz et al (6), where their study population chose the straight profile as the most aesthetic, but when differentiating it by occupation (orthodontist, general population, and maxillofacial surgeons) they reported that the three groups considered the most aesthetic a profile with a slight mandibular prognathism (6). Likewise, Macias Gago et al; when analyzing the levels of aesthetic consideration of different profile photographs of different individuals through surveys, found that, as the present study, there is a tendency to consider, in men and women, a straight profile as the most aesthetic, followed by a slightly concave profile in females (17).

The silhouettes considered the most aesthetic in a study carried out in an American population was a slight mandibular retrusion of -2mm and the least aesthetic silhouette was a mandibular protrusion of +6mm, without finding significant differences by sex, race, or study area, although this study measured the values from the Ricketts line E without being completely comparable results with our investigation (11). Although the methodology used was different, it is possible to find a tendency towards a predilection for a slightly retruded profile and a rejection towards profiles with very pronounced protrusions.

The contradictory results can be explained by the study design when presenting the same silhouettes in different questions with different names and randomly ordered so that the respondents did not identify them, an action that could indirectly influence the choice by conditioning the choice to the order of appearance and the characteristics of the silhouettes of each set presented, which could also explain the low intra-examiner agreement when analyzing the same control silhouettes (GA, RS, ZR corresponding to the original silhouette, +4mm and -4mm, respectively) with slight Kappa values for RS and fair for GA and ZR (18), low concordances that are repeated if the same analysis is performed only in the lay population, eliminating the possible influence of a larger population, and even repeating itself in the population of dentists. However, the inter-examiner agreement was moderate, evidenced by the agreement in the silhouettes chosen as the most aesthetic and least aesthetic in all the groups studied (18).

The null hypothesis is confirmed given that the most aesthetic and least aesthetic silhouette options chosen by the respondents did not show differences between sex, age, and occupation.

More studies are needed with populations more homogeneous and representative of reality to avoid possible biases and limitations such as those found in the present study. In addition, a new study design should be considered so as not to indirectly influence the choice of silhouettes by the participants and thus obtain better intra-examiner concordances with the intention of obtaining results that are representative of reality. This study is the first that seeks to determine the aesthetic preferences of the facial profile in the Chilean population (dentists and laypeople) using silhouettes. This study is the starting point to invite future research to complement it and gather more information on the aesthetic preferences of the Chilean population.

Authors' contributions

Guiñez Marcial: Term, Conceptualization, Methodology, Validation, Investigation, Resources, Data curation, Writing – Original Draft, Writing – Review & Editing, Visualization, Supervision, Project administration. Letelier Gabriela: Validation, Formal Analysis, Investigation, Resources, Data curation, Writing – Review & Editing.

Conflicts of interest

We declare that we have no conflict of interest of any kind.

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