ULTRASONOGRAPHIC MAPPING OF THE LOCATION AND DEPTH OF LABIAL ARTERIES PRIOR TO LIP AUGMENTATION: A PILOT STUDY

ABSTRACT

Aims: This study aims to map the superior and inferior labial arteries in terms of their anatomical location and depth using ultrasound imaging to optimise the planning of lip augmentation procedures in a Brazilian cohort.

Study Design: Observational cross-sectional pilot study.

Place and Duration of Study: The examinations were conducted at the dental clinic of the University of Fortaleza during October-November 2023

Methodology: Nineteen volunteers (both sexes, aged 18 to 55 years) with no history of previous lip augmentation participated in this study. Imaging was performed using a high-frequency ultrasound machine (Evus 5, Alliage S/A), equipped with a 7–14 MHz linear transducer, in both B-mode and Doppler modes. Statistical analyses included the Shapiro-Wilk test, Levene's test, analysis of variance (ANOVA), T-test, Pearson's correlation coefficient, standard deviation, confidence intervals, and Fisher's exact test, all conducted using Python software.

Results: The superior labial artery was predominantly located in the intramuscular region in 68.42% of cases, followed by the submucosa in 31.58%, with no instances in the subcutaneous layer. For the inferior labial artery, a similar distribution was observed: 63.16% intramuscular, 31.58% submucosal, and 5.26% subcutaneous. Statistically significant differences ($p < 0.05$) were identified in the depth and location of the labial arteries based on sex and specific anatomical regions.

Conclusion: This study demonstrates the variation in the depth and location of labial arteries, with a significant predominance in the intramuscular layer. Ultrasound serves as an essential tool for mapping vascular anatomy in the planning of lip augmentation, underscoring the value of thorough anatomical assessment to enhance procedural safety and efficacy.

Descriptors: Arteries; Anatomy; Lip; Ultrasonography.

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INTRODUCTION

In recent years, the demand for minimally invasive aesthetic procedures has grown exponentially. Certain beauty standards have become increasingly sought after by women interested in achieving almost immediate results with minimal side effects and swift recovery times. As a result, the popularity of facial fillers and other treatments associated with orofacial harmonisation has risen, as these procedures fulfil the desire for achieving aesthetic ideals through simpler, safer methods, offering rapid results with few adverse effects.[1]

Lip augmentation, commonly known as lip filler, is currently one of the most in-demand dermatological interventions. Fuller, more voluminous lips with elevated commissures are often perceived as youthful and attractive. In addition to these aesthetic benefits, lip fillers are popular because they provide patients with immediate and safe results.[2]

The natural and healthy effect of these lip procedures is ensured by maintaining the integrity of facial vascularisation. The lips, in general, are composed of skin, muscles, and blood vessels. Their proper function is a result of the coordinated action of a complex muscle group, working simultaneously through nerve impulses and adequate blood supply.[3]

As prominent facial features, the lips receive a rich blood supply from the labial arteries. Preserving this blood flow is crucial for the colour, facial expression, and overall health of the lips, preventing potential injuries. Therefore, ensuring the accurate location of vascular structures is essential to avoid trauma, infections, metabolic dysfunction, and neoplasms.[4]

The safety of these procedures is directly linked to a thorough understanding of facial anatomy. Knowledge of the varying types and locations of the labial arteries is crucial to the success of the procedure. It is believed that by properly placing fillers within the correct anatomical plane, the likelihood of damaging the neurovascular structures in this region can be significantly reduced.[1]

The lips consist of a moist internal portion composed of labial mucosa, a dry transitional portion known as the vermillion zone, and an external portion represented by skin and its appendages. The muscle fibres of the orbicularis oris are located at the boundary between the internal portion and the vermillion zone, separating two fat compartments: the superficial and deep fat compartments.[5]

In terms of vascularisation, the arteries supplying the lips are primarily the superior and inferior labial arteries, as well as several branches from other vessels, all originating from the facial artery. Together, they form a complex vascular network that must be preserved during procedures.[6]

In this context, ultrasound imaging has been regarded as an excellent complementary tool prior to lip filler procedures. With a frequency greater than 15 MHz, ultrasound allows for the visualisation and identification of the different layers and anatomical structures within the skin. Given its low penetration depth, ultrasound does not expose patients to significant radiation, as is the case with other imaging techniques, making it a safe, practical, and effective method to be used before facial fillers.[7]

The primary aim of this research is to evaluate the location of the superior and inferior labial arteries within the upper and lower lips using facial ultrasonography, correlating their anatomical position with sex. Additionally, the study seeks to identify the safest areas for lip filler procedures, as well as key regions where vascular preservation is critical.

Thus, this research aims to map the location and depth of the superior and inferior labial arteries using facial ultrasound in a Brazilian sample population. It also evaluates the significance of requesting facial ultrasound prior to aesthetic procedures in the perioral region to help prevent potential injuries to the vascular structures of the lips.

METHODS

This research received approval from the Ethics Committee of the University of Fortaleza under opinion number 6,321,391. All participants voluntarily agreed to take part in the study by signing the Informed Consent Form (ICF), in accordance with the principles outlined in Resolution 466/2012/CNS/MS/CONEP.

It is a quantitative cross-sectional study conducted on healthy volunteers who were to undergo aesthetic procedures in the lip region. All participants had never previously received lip fillers and did not present any lesions or contraindications to the aesthetic procedure. The anatomy and location of the superior and inferior labial arteries were analysed using facial ultrasound in 19 participants, comprising both female and male individuals aged between 18 and 55 years, who had a prior indication for lip augmentation.

An ultrasound device operating at high frequencies of 7 to 14 MHz, the Evus 5 (Alliage S/A – Ribeirão Preto, São Paulo, Brazil), was utilised with a linear transducer model L741, operating at frequencies of 4.0-16.0 MHz, a field of view of 46 mm, and 128 crystals, in B-mode and Doppler mode, for the identification of the superior and inferior labial arteries.

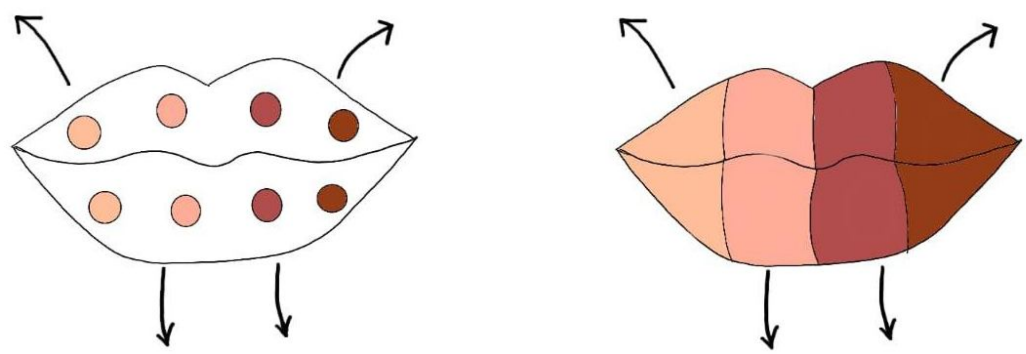
The examinations were conducted at the dental clinic of the University of Fortaleza during October and November 2023, using the Evus 5 Alliage S/A ultrasound device, which does not emit any ionising radiation harmful to the patient's health. During the procedure, the researchers employed personal protective equipment, and all safety measures were implemented, ensuring the study's safety for all involved.

For the execution of the research, a protocol was established whereby, initially, the transducer was positioned vertically to capture four images of the upper lip and four images of the lower lip. Subsequently, the transducer was modified to a horizontal position to capture six images, comprising three from the upper lip and three from the lower lip.

Following the ultrasound examination and the capture of the necessary images, in which the labial arteries to be analysed were clearly visible, the Caliper tool was employed for linear measurement in millimetres. Three points were selected at the site where the arteries were prominently displayed, and an average was calculated to establish a more precise location in relation to the skin. The measurements were assessed without compressing the underlying tissue to accurately determine vascular depth.

Four regions of the upper and lower lips were analysed: the left commissure, the midpoint between the left labial commissure and the midline , the midpoint between the right labial commissure and the midline, and the right commissure (Figure 1). The ultrasound captured the regions of the upper and lower lips of each participant, both in B-mode and using the Doppler tool. The obtained data were initially recorded in a Microsoft Excel spreadsheet (Microsoft Corporation, Redmond, WA), analysed by region, and correlated with sex.

Figure 1. Schematic diagram identifying the four regions selected for the analysis of the superior and inferior labial arteries in the upper and lower lips.



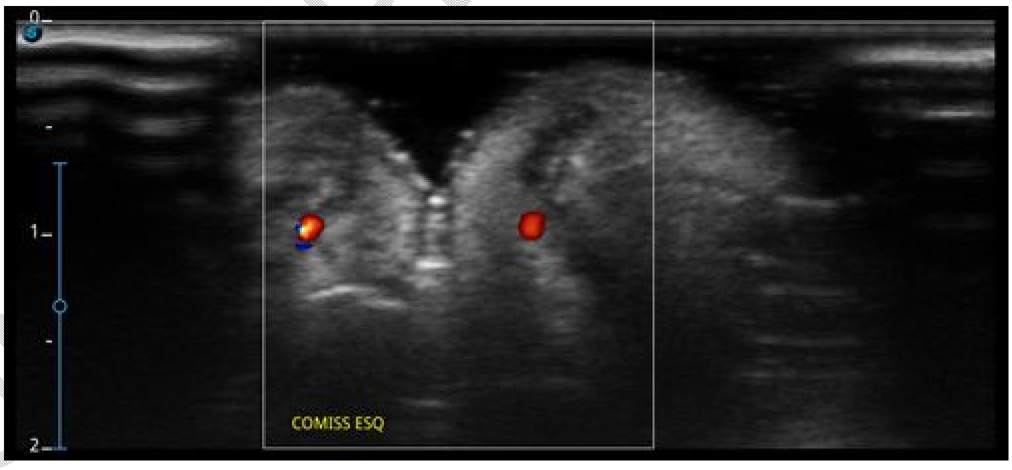
Source: Authors (2023)

Statistical analyses were performed using Python software (v. 2024.12.2; Python Software Foundation, Wilmington, DE, USA). The Shapiro-Wilk test, Levene's test, Analysis of Variance (ANOVA), T-Test, Pearson's correlation coefficient, standard deviation, confidence intervals, and Fisher's exact test were employed to rigorously assess and support the findings.

RESULTS

In the upper lip, at the left commissure (ULC), the depth of the superior labial artery (SLA) in both sexes was 5.04 mm (±1.16) [95% CI: 4.54 to 5.54]; in females, it measured 4.86 mm (±1.05) [95% CI: 4.22 to 5.51], and in males, 5.35 mm (±1.25) [95% CI: 4.25 to 6.45]. In the Left Mid-Point (ULMP) region, the depth for both sexes was 5.78 mm (±1.49) [95% CI: 5.05 to 6.51]; in females, it was 5.77 mm (±1.30) [95% CI: 4.93 to 6.63], and in males, 5.80 mm (±1.75) [95% CI: 4.19 to 7.43]. In the Right Mid-Point (URMP) region, the combined depth for both sexes was 4.73 mm (±1.21) [95% CI: 4.25 to 5.27]; for females, it was 4.65 mm (±1.21) [95% CI: 4.11 to 5.32], and for males, 4.87 mm (±1.20) [95% CI: 4.18 to 6.34]. The fourth region analysed was the right commissure (URC), where the depth for both sexes was 4.94 mm (±1.07) [95% CI: 4.49 to 5.39]; in females, it was 4.95 mm (±1.23) [95% CI: 4.20 to 5.70], and in males, 4.93 mm (±0.87) [95% CI: 4.15 to 7.71] (Table 1).

Figure 2. Left Labial Commissure Region, using ultrasound equipment with Doppler functionality, featuring the transducer positioned vertically, highlighting the superior and inferior labial arteries.



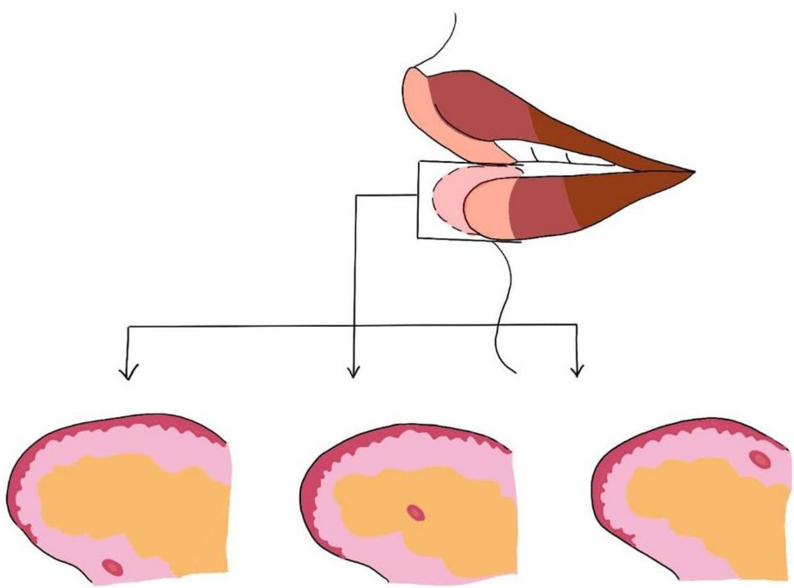
Source: Authors (2023)

The same measurements were conducted on the lower lip. In the left commissure region (LLC), the depth of the inferior labial artery (ILA) for both sexes was 5.08 mm (±1.48) [95% CI: 4.38 to 5.78]; in females, the average depth was 5.25 mm

(±1.68) [95% CI: 4.22 to 6.31], and in males, it was 4.77 mm (±1.19) [95% CI: 3.66 to 5.89]. In the Left Mid-Point (LLMP) region, the depth for both sexes was 4.75 mm (±1.20) [95% CI: 4.22 to 5.28]; in females, it was 4.78 mm (±1.26) [95% CI: 4.00 to 5.57], and in males, 4.70 mm (±1.16) [95% CI: 3.65 to 5.76]. The third region measured was the Right Mid-Point (LRMP), where the depth for both sexes was 5.20 mm (±1.04) [95% CI: 4.88 to 5.77]; in females, it was 4.84 mm (±1.04) [95% CI: 4.22 to 5.48], and in males, 5.81 mm (±1.04) [95% CI: 4.93 to 6.70]. The final region analysed was the right commissure (LRC), where the depth for both sexes was 5.93 mm (±1.42) [95% CI: 5.30 to 6.49]; in females, it measured 6.04 mm (±1.37) [95% CI: 5.17 to 6.82], and in males, 5.75 mm(±1.46) [95% CI: 4.50 to 7.01] (Table 2).

After completing the measurements in each predefined region using linear assessment, the location of both SLA and ILA was classified in relation to the layers and structures within the lips. It was observed that the course of the labial arteries followed three distinct patterns, varying between submucosal (SM), intramuscular (IM), and subcutaneous (SC) locations.

Figure 3. Schematic drawings identifying three positions of the superior and inferior labial arteries in the upper and lower lips: (right) submucosal, (centre) intramuscular, and (left) subcutaneous.



Source: Authors (2023)

In the SLA, the predominant pattern in both sexes was IM, accounting for 68.42%, followed by the SM pattern at 31.58%, while the SC pattern was not observed in any of the research participants (0%). In females, the SM pattern was present in 41.67%, with IM at 58.33%. In males, the SM pattern accounted for 14.29%, while the IM pattern was predominant at 85.71% (Table 3).

Finally, the ILA was classified, where the IM pattern predominated in both sexes at 63.16%, followed by the SM pattern at 31.58%, and the SC pattern at 5.26%. In the female group, the SM pattern had a prevalence of 41.67%, while the IM pattern was observed at 58.33%; no female participants were recorded with the SC pattern in the inferior lip. In the male group, the IM pattern was predominant at 71.42%, with both the SM and SC patterns showing an equal prevalence of 14.29% (Table 4).

Figure 4. Region of the UMP, using ultrasound with Doppler tool, featuring a horizontally positioned transducer, highlighting the SLA in the IM region.

Source: Authors (2023)

Standard deviation analysis showed that variability differed between male and female groups, depending on the region (Tables 1-4). Regions with lower standard deviations exhibited more homogenous artery depths, while those with higher values indicated greater variation. Confidence intervals provided further insights into the variance and mean artery depths across different regions. Significant differences were observed between the sexes, with some regions showing greater depth and variability in males, while others showed the opposite in females. In some regions, overlapping confidence intervals suggested similarity in artery depths between the groups.

The Shapiro-Wilk and Levene's tests were initially conducted to assess data normality and homogeneity of variances across groups (Table 5). The results indicated normal distribution for all means and homogeneity of variances ($p = 0.4431$). Following this, ANOVA was performed to compare the mean depth of the arteries between male and female participants across two regions (Table 6). Out of 21 comparisons, 14 showed statistically significant differences.

The T-Test further revealed significant differences in 15 out of 20 comparisons, with only "ULC vs URC" ($p = 0.63$) and "URMP vs LLMP" ($p = 0.29$) showing similar means (Table 7). Pearson's correlation coefficient showed that most correlations between the variables were not significant, indicating no substantial linear relationship between them (Table 8). The only significant correlation was a moderate negative relationship between the ULC and URC.

DISCUSSION

In recent decades, minimally invasive techniques for aesthetic procedures in the facial region have become increasingly common worldwide. Consequently, the rising incidence of postoperative complications has become more frequent.[8] Many of these occurrences stem from a lack of specific anatomical knowledge, as dental surgeons may exhibit overconfidence or believe that the surgeries are simple areas with no inherent risks. Successful facial procedures in aesthetic areas require adequate knowledge of regional anatomy and the assistance of technologies to ensure a safe prognosis.[8]

Ultrasound is regarded as a cost-effective imaging modality that is safe and poses no harmful effects to patients, with no contraindications regarding age or for pregnant women; however, its use is directly dependent on the individual needs of each patient and the dentist's experience.[9] In addition to providing detailed images of soft tissues, the Doppler tool enables the acquisition of real-time projections of vascularisation with colour overlays, indicating flow and intensity. The assurance of effective individual patient assessment is facilitated through a comprehensive understanding of anatomy and the utilisation of imaging technology.[9]

The labial artery, like various vascular structures, exhibits a high degree of variability in its insertion and location; thus, understanding this is of paramount importance for identifying safe regions for the deposition of filler material.In this study, mean artery depths varied by region, with deeper arteries observed in areas such as the LRC and shallower depths in the URPM. Standard deviations and confidence intervals suggested greater inter-individual variation in some regions than others. Fisher's exact test revealed consistency in the SM location of arteries in both superior and inferior regions (31.58%). However, IM arteries were more common in the superior region, while SC arteries were absent from the superior region and present in only a small percentage (5.26%) in the inferior region.

A multicentric study assessed the distribution of the SLA and ILA in relation to depth in cadavers.[10] In the upper lip, the SC region presented 2.1%, followed by the IM region at 17.5%, with the SM region prevailing at 78.1% in its location.[13] This study demonstrates similarities with the present research regarding the SC region, but differences in the results for the prevalence of the SM and IM regions, as shown in Table 3.

A study conducted in 2020, also utilising facial ultrasound and the Doppler tool, evaluated the distribution and location of the SLA and ILA, finding a predominant presence in the SM layer in most cases, with a prevalence of 36% in the upper lip and 41.5% in the lower lip.[12] Although the percentages are similar to those obtained in the present study, as presented in Tables 03 and 04, the prevalence of the SLA and ILA in this research was IM. Therefore, lip filler should be injected into the SC region (hypodermis), as it is the area with the highest safety regarding vascular structures.[11]

In addition to the location of the arteries concerning labial structures, a study in 2022 assessed the distance, in millimetres, between the skin and the vessels at points between the midline and the oral commissure.[8] A distance of 7.5 mm was observed for the ILA and 8.5 mm for the SLA at the commissural region. At the midline, the distance for the SLA varied from 4.8 mm to 5.6 mm, while ILA exhibited a depth variation of 4.1 mm to 5.4 mm near the midline.[8] The values demonstrated in the 2022 research were comparable to the results obtained in the present study, showing convergence of data at the upper midpoints (4.73 mm to 5.78 mm) and the lower midpoints (4.75 mm to 5.20 mm), as indicated in Tables 1 and 2. However, when comparing the commissural regions, there is a noticeable divergence in data compared to the authors, with values ranging from 4.94 mm to 5.04 mm for the SLA and from 5.08 mm to 5.93 mm for the ILA, as shown in Tables 1 and 2.

In terms of gender differences, men had a significantly lower likelihood of SM arteries in both superior and inferior regions compared to women. IM arteries were more prevalent in men, particularly in the superior region, while SC arteries were more common in men in the inferior region. In summary, the most notable differences between men and women were observed in the ILA location, with a predominance of IM arteries in men and SM arteries in women.

Ultrasound in dentistry offers various advantages, promising applications, and benefits; however, its use is still in a phase of development and adaptation.[9] More research and studies are needed to refine imaging capture methods, expand clinical indications, and validate its efficacy in different dental contexts and purposes.[12]

Recent studies highlight the efficacy of ultrasound examinations in detecting pathological lesions, assessing soft tissues, and providing three-dimensional imaging of the evaluated regions.[9] With the continuous advancement of technology and professionals' understanding of how to handle and interpret images, coupled with further research, it is likely that dental ultrasound will play an even more significant role in clinical practice, enhancing the precision and effectiveness of procedures.[13]

The observed variability may reflect the high level of miscegenation present within the Brazilian population, highlighting the necessity for detailed anatomical knowledge prior to any intervention. Recognising and studying insights from existing anatomical research is essential for developing a comprehensive understanding of labial anatomy, thereby ensuring safer and more effective outcomes for patients.

In this context, the importance of conducting further studies on the subject becomes evident. The limitations of the sample size have been acknowledged, and future research should aim to expand this sample by including as many volunteers as possible. Furthermore, it is recommended that other researchers in this field undertake similar efforts, with the aim of achieving greater ethnic variability. This approach will help to address the current limitations, promoting increased clinical variability and a more thorough understanding of the depth and location of the arteries.

CONCLUSION

This study concluded that the SLA is most commonly located in the IM region within the evaluated population, followed by the SM region. Likewise, in this specific group, the ILA predominantly occupies the IM region, with the SM and SC regions being less prevalent. Notably, the depth of both arteries varied significantly across this particular sample. These findings highlight the need for conducting facial ultrasound scans prior to aesthetic lip procedures in this population to account for individual anatomical variations and mitigate potential complications, particularly in an ethnically diverse group such as Brazilians.

THEMATICA AREA

Dental Imaging.

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TABLES

Table 1. Depth of the Superior Labial Artery in Millimetres across the Left and Right Labial Commissures and the Left and Right Midline Regions

Region	Both Sexes	Female	Male
ULC	5.04 mm	4.86 mm	5.35 mm
ULMP	5.78 mm	5.77 mm	5.80 mm
URMP	4.73 mm	4.65 mm	4.87 mm
URC	4.94 mm	4.95 mm	4.93 mm

Source: Authors (2024)

Table 2. Depth of the Inferior Labial Artery in Millimetres across the Left and Right Labial Commissures and the Left and Right Midline Regions

Region	Both Sexes	Female	Male
LLC	5.08 mm	5.25 mm	4.77 mm
LLMP	4.75 mm	4.78 mm	4.70 mm
LRMP	5.20 mm	4.84 mm	5.81 mm
LRC	5.93 mm	6.04 mm	5.75 mm

Source: Authors (2024)

Table 3. Location of the Superior Labial Artery in Relation to the Layers and Structures of the Upper Lip

Region	Both Sexes	Female	Male
SM	31.58%	41.67%	14.29%
IM	68.42%	58.33%	85.71%
SC	0%	0%	0%

Source: Authors (2024)

Table 4. Location of the Inferior Labial Artery in Relation to the Layers and Structures of the Lower Lip

Region	Both Sexes	Female	Male
SM	31.58%	41.67%	14.29%
IM	63.16%	58.33%	71.42%
SC	5.26%	0%	14.29%

Source: Authors (2024)

Table 5. Results of Normality and Equal Variances Tests Across Groups Using Shapiro-Wilk and Levene Tests

Region	W (S-W)	p (S-W)	D (S-W)	H (L)
ULC	9.668	7.114	Normality	Homogeneous
ULMP	9.485	3.723	Normality	Homogeneous
URMP	9.310	1.806	Normality	Homogeneous
URC	9.802	9.443	Normality	Homogeneous
LLC	9.673	7.219	Normality	Homogeneous
LLMP	9.097	731	Normality	Homogeneous
LRMP	9.542	4.647	Normality	Homogeneous
LRC	9.730	8.336	Normality	Homogeneous

Source: Authors (2024) | Abbreviations: W – W-value; p – P-value; S-W – Shapiro Wilk; D – Distribution; H – Homogeneity; L – Levene.

Table 6. Results of ANOVA Test for Differences Across Groups.

Group 1	Group 2	Mean Diff	p-adj	Lower	Upper	Reject
LRC	URC	-0.6901	0.0000	-1.0761	-0.3040	True
LRC	ULC	-0.6247	0.0000	-1.0108	-0.2387	True
LRC	LRMP	-0.7189	0.6000	-1.1050	-0.3328	True
LRC	LLMP	-1.0874	0.0000	-1.4735	-0.7013	True
LRC	URMP	-1.2167	0.0000	-1.6028	-0.8306	True
LRC	ULMP	-0.2450	0.5243	-0.6311	0.1411	False
URC	ULC	0.0653	0.9996	-0.3208	0.4514	False
URC	LRMP	-0.0289	1.0000	-0.4149	0.3572	False
URC	LLMP	-0.3974	0.0386	-0.7834	-0.0113	True
URC	URMP	-0.5267	0.0011	-0.9127	-0.1406	True
URC	ULMP	0.4451	0.0117	0.0590	0.8312	True
ULC	LRMP	-0.0942	0.9954	-0.4803	0.2919	False
ULC	LLMP	-0.4627	0.0073	-0.8487	-0.0677	True
ULC	URMP	-0.8592	0.0001	-0.9781	-0.2059	True
ULC	ULMP	0.3798	0.0575	-0.0063	0.7659	False
LRMP	LLMP	-0.3685	0.0734	-0.7546	0.0176	False
LRMP	URMP	-0.4978	0.0027	-0.8839	-0.1117	True
LRMP	ULMP	0.4740	0.0053	0.0879	0.8600	True
LRMP	URMP	-0.1293	0.9704	-0.5154	0.2568	False
LRMP	ULMP	0.8424	0.0600	0.4564	1.2285	True
URMP	ULMP	0.9717	0.0000	0.5857	1.3578	True

Source: Authors (2024)

Table 7. Results of the t-test for Differences Across Groups.

Comparison	t-statistic	p-value	Outcome
ULC vs ULMP	-2.9081	0.0052	There is a significant difference between the means.
ULC vs URMP	4.4308	0.0000	There is a significant difference between the means.
ULC vs URC	0.4772	0.6350	There is no significant difference between the means.
ULC vs LLMP	3.5196	0.0009	There is a significant difference between the means.
ULC vs LRMP	0.7142	0.4780	There is no significant difference between the means.
ULC vs LRC	-4.5389	0.0000	There is a significant difference between the means.
ULMP vs URMP	8.0077	0.0000	There is a significant difference between the means.
ULMP vs URC	3.5628	0.0007	There is a significant difference between the means.
ULMP vs LLMP	7.0805	0.0000	There is a significant difference between the means.
ULMP vs LRMP	3.9684	0.0002	There is a significant difference between the means.
ULMP vs LRC	-1.9476	0.0564	There is no significant difference between the means.
URMP vs URC	-4.1123	0.0001	There is a significant difference between the means.
URMP vs LLMP	-1.0575	0.2947	There is no significant difference between the means.
URMP vs LRMP	-4.0564	0.0002	There is a significant difference between the means.
URMP vs LRC	-9.4387	0.0000	There is a significant difference between the means.
URC vs LLMP	3.1580	0.0025	There is a significant difference between the means.
URC vs LRMP	0.2286	0.8200	There is no significant difference between the means.
URC vs LRC	-5.2167	0.0000	There is a significant difference between the means.
LLMP vs LRMP	-3.0612	0.0033	There is a significant difference between the means.
LLMP vs LRC	-8.5841	0.0000	There is a significant difference between the means.
LRMP vs LRC	-5.6563	0.0000	There is a significant difference between the means.

Source: Authors (2024)

Table 8. Pearson Correlation Results for Group Comparisons.

Comparison	Pearson Correlation Coefficient	p-value	Significance
ULC and ULMP	-2.130	2.585	Not significant
ULC and URMP	116	9.516	Not significant
ULC and URC	-4.318	172	Significant
ULC and LLMP	2.492	1.842	Not significant
ULC and LRMP	-735	6.997	Not significant
ULC and LRC	954	6.161	Not significant
ULMP and URMP	581	7.604	Not significant
ULMP and URC	542	7.761	Not significant
ULMP and LLMP	564	7.671	Not significant
ULMP and LRMP	-978	6.071	Not significant
ULMP and LRC	-2.240	2.342	Not significant
URMP and URC	-1.602	3.978	Not significant
URMP and LLMP	978	6.070	Not significant
URMP and LRMP	525	7.831	Not significant
URMP and LRC	1.525	4.213	Not significant
URC and LLMP	-751	6.932	Not significant
URC and LRMP	768	6.867	Not significant
URC and LRC	-1.354	4.757	Not significant
LLMP and LRMP	-2.803	1.335	Not significant
LLMP and LRC	-249	8.963	Not significant
LRMP and LRC	-152	9.363	Not significant

Source: Authors (2024)

Table 9. Fisher's Exact Test Results for Group Comparisons

Comparison	Category	Odds Ratio	p-value
SM vs IM	General Comparisons	233	333
SM vs SC	General Comparisons	na (not applicable)	1.0
IM vs SC	General Comparisons	na (not applicable)	1.0
SM vs IM	Gender Comparisons	279	33
SM vs SC	Gender Comparisons	0.0	2,60E-04
IM vs SC	Gender Comparisons	0.0	82

Source: Authors (2024)