




# Physical attractiveness: analysis of buttocks patterns for planning body contouring treatment

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## Abstract

**Background** As buttocks region is one of the most characteristic features of the ideal female body figure, the popularity of gluteal region contouring is on the rise. Perception of body form is influenced by its shape and size. Interventions to modify the form of this region are often difficult due to influence. The aim of this study is to investigate the attractiveness of various buttock shapes with the aid of a dedicated software.

**Methods** Standard personal photographs of the lower body were obtained from 200 healthy volunteers. Linear analyses were made and anatomical perception was calculated according to reference points.

**Results** Compared to males, all measurements concerning buttock dimensions were a significantly greater in females. Proportional assessments revealed that in females, the most attractive buttock waist-to-hip ratio was 0.75 from the posterior view. This ratio was 0.85 in males. From the lateral view, the most attractive buttocks have a waist-to-hip ratio of 0.70 in females. Positioning of the lateral prominence at the inferior gluteal fold was rated by 25% of the respondents as the most attractive in males from the posterior view. From the lateral view, the most prominent portion positioned at the midpoint (a 50:50 vertical ratio) was considered the most attractive for females.

**Conclusions** These results suggest that utilizing digitalized reference values for a given body region may be an invaluable tool for determination of the correct fat volume, thus individualization of body contouring procedures. With the help of certain software, this research has shown that it is possible to measure the parameters of buttock, which may in turn be used to offer the best solution for any individual in quest for an improved buttocks form. New ideal waist-to-hip ratios of 0.7 update the previous standards.

**Keywords** Buttocks · Body contouring · Buttock reshaping · Thighs · Liposuction · Cosmetic surgery · Lipodystrophy

## Introduction

As gluteal region contouring is rising in popularity among the cosmetic procedures, the buttocks is more and more appreciated as an important feature of the ideal body figure [1, 8, 16] (Figs. 1, 2). Media trends accompanied by an overwhelming supply of an array of body contouring procedures have led to a dramatic increase in the number of people seeking for so-called perfection, with a noticeable emphasis on

buttock enhancement, gluteal augmentation, micro-fat grafting, liposuction, and laser or ultrasound-assisted lipoplasty [2, 12, 13, 17, 19, 21–25, 33]. The shape and dimensions of the buttocks have become a factor dictating whether the individual is sexy, attractive, good-looking, or not [3, 10, 11, 15, 18, 28–31].

As women reach puberty, fat accumulates in the gynoid fat regions, notably, on the buttocks, thighs, and hips [3, 10]. Approximately 85% of post-pubertal women are affected by gynoid lipodystrophy and oedematous fibrosclerotic panniculopathy, commonly called as cellulite [13]. Cellulite represents one of the most common topographical alterations of cutaneous surfaces in the posterior-lateral thighs in post-pubertal women [16]. The skin presents a spectrum of findings ranging from an orange-peel appearance to mattress-like undulations of transverse dimpling, nodularity, and folds [29, 30].

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**Fig. 1** Lateral projection: supragluteal, perilumbar, subgluteal, and trochanteric areas having fat accumulation were defined as a natural inferior gluteal convexity

As for the consistency and proportions of gluteal region in reference to waist or hips, some individuals complain of an enlarged buttock, some of a deficient buttock; either may also present with gluteal flattening (platypygia), and yet others suffer from cellulite or a low infragluteal fold [2, 4, 12]. Main reasons why people request buttock augmentation are as follows: to regain shape lost by weight loss or ageing [17, 33], to increase attractiveness [10, 11, 15] and to correct lipoatrophy [25–28]. Adding volume with fat injections, stabilized hyaluronic acid (HA) gel injections, implants and fat grafts, require expert knowledge on the anatomy of the treatment site as well as experience with injection techniques for the target area [7, 8, 15, 16]. Aesthetic results can only be achieved on proper application of correct amount of volume to the correct area [1].

Recent studies described the anatomical criteria of the gluteal region in terms of shape, volume, and projection [4, 17, 19, 27] (Fig. 2). The researchers' focus generally lies on three determinants of buttock beauty: waist-to-hip ratio, body mass index (BMI), and curvaceousness [27–30]. Although ideal beauty of the female icons in this study had greater variation in waist-to-hip ratio ranging



**Fig. 2** Front view includes a well-projected gluteal region with a uniform line, square-shaped buttocks, natural supragluteal fosses and V-shaped crease

from 0.67 to 0.7, a waist-to-hip ratio of 0.7 is rated to be attractive by a wide range of people [27–30].

The choice of people looking for alteration of their body form tends to lean towards noninvasive treatment approaches that are painless, safe, and nonsurgical [6, 9, 14]. Recently, single session interventions on buttocks aesthetic which focus on volume augmentation and narrowing of gluteal region have gained popularity [32]. Personalized gluteal region definition, aetiology of deformities, anatomy, and diagnostic techniques are subjects of continued debate [20, 26].

Volume restoration and contouring procedures symmetrically accentuate thighs and buttocks and help to establish ideal buttock projection and waist-to-hip ratios [3, 10, 11, 15, 18, 27–30]. Quantitative methods like digitalized photogrammetry and three-dimensional imaging have proven to be invaluable and practical tools to assess ideal waist-to-hip ratios, gluteal beauty, smooth and symmetry of the buttocks [5, 30].

Conducting detailed measurements of the lower body is important in planning an individual treatment programme

for each patient. We proposed to analyze the gluteal region with reference measurements such as ideal linear analyses (vertical and transverse proportions) and group them under an anatomical classification (waist-to-hip ratio) in young adult buttocks.

### Materials and methods

200 volunteer adults (100 men, 100 women) aged between 19 and 21 years without lower body anomalies were enrolled in this study. The weight and height of the adults were recorded routinely. The criteria to exclude the subjects included obesity (Body Mass Index: BMI > 30), emaciation (BMI < 18), a history of congenital hip dislocation, major trauma and operation of the gluteal region, and pregnancy. The study was approved by the suitably constituted Ethical Committee at Researches of Ege University, and the study conforms to the Declaration of Helsinki (approval number: 16-10.1/14).

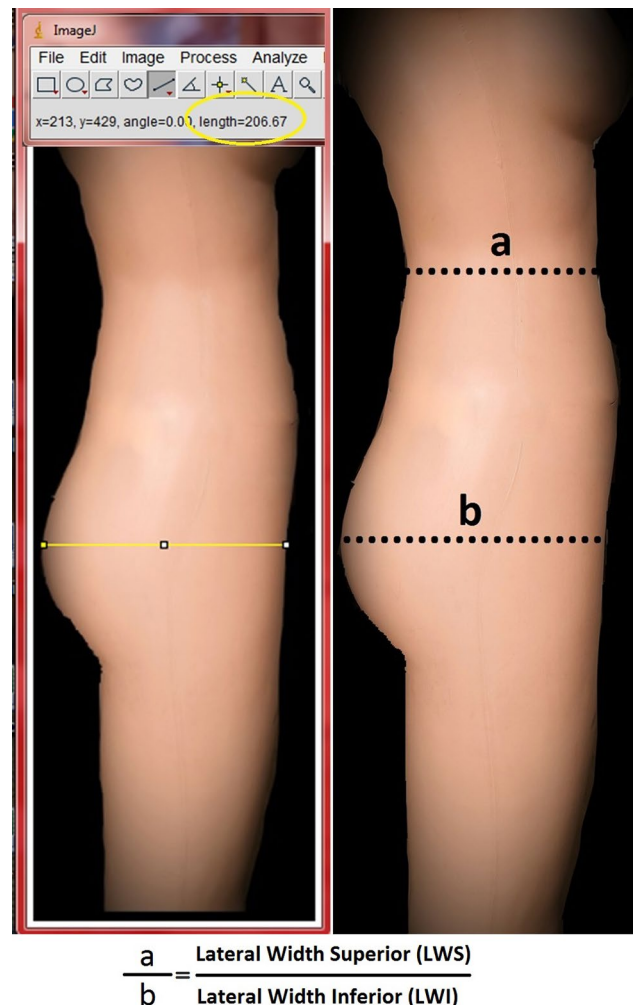
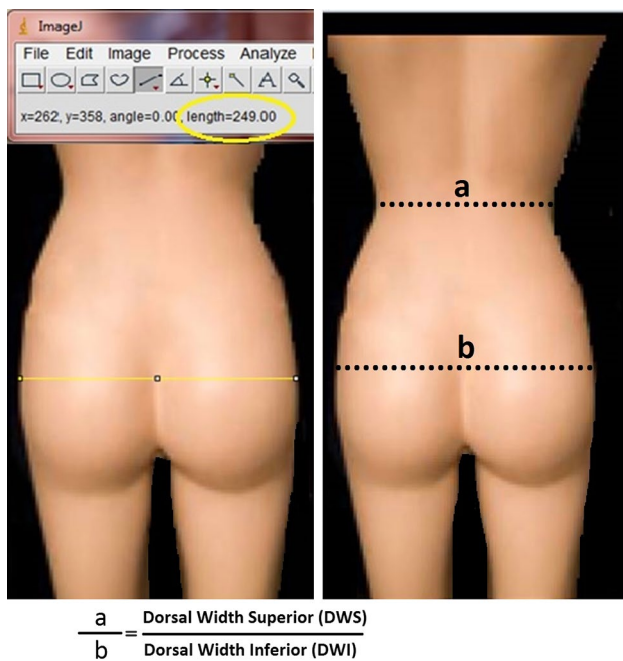
The gluteal region anatomy was assessed from digital images acquired from standard photographs of subjects' lower bodies from dorsal and lateral views standing upright with closed feet. Object-to-lens distance was 100 cm and the lens was used in priority mode (GC) (Fig. 3). The pictures were then uploaded onto a personal computer and Image J 1.48v software was used to calculate the distances and ratios (Figs. 3, 4, 5) [28]. All gluteal body landmarks used

for assessments were extracted as shown in Figs. 3, 4 and 5 and Tables 1, 2, 3 and 4.

These anatomical landmarks were taken as reference points in the gluteal region. All records were analyzed by correlation matrix using computer based SPSS 7.5 programme (Upper Saddle River, N.J.: Prentice Hall, © 1996). Statistical significance was presumed at  $p < 0.05$ .

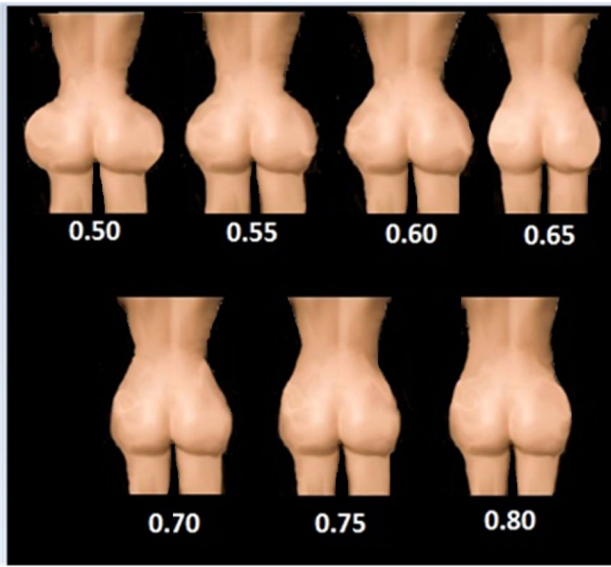
### Gluteal body shape

Buttock sizes relative to body were grouped into seven categories according to dorsal view waist-to-hip ratios by another anatomist (FG) (Fig. 5). The categorisation using the waist-to-hip ratios in 10% increments were based on a range of scales up or scales down with buttock size, and targeting a waist-to-hip ratio of 0.74 (Fig. 5). The dorsal waist-to-hip ratio [dorsal width superior (DWS)/dorsal width inferior (DWI)] ranged between 0.8 and 0.85 in males and 0.6–0.8 in



**Fig. 3** Measurement of the landmarks of posterior view of gluteal region using Image J 1.47 version. **a** Dorsal width superior, **b** dorsal width inferior

**Fig. 4** Measurement of the lateral view of gluteal region using Image J 1.47 version. **a** Lateral width superior, **b** lateral width inferior



$$\frac{DWS}{DWI} = \text{Dorsal Width Superior to Dorsal Width Inferior Ratio}$$

**Fig. 5** Posterior view with varying waist-to-hip ratios in women

females (Fig. 6). The lateral waist-to-hip ratio (lateral width superior (LWS)/and width inferior (LWI)) ranged between 0.65 and 0.88 in men, and, 0.6–0.95 in female (Fig. 7).

**Subject**

Same 200 volunteer adults were subjected to physical attractiveness test in this study.

**Results**

The BMI was classified as BMI 18–24.99 in 79%, BMI 25–29.99 in 17%, BMI 30–39.99 in 4% frequency and BMI > 40 in 0% (Fig. 8).

**Table 1** Gluteal region aesthetic references as posterior view

Ratio	Most attractive (%)	Second attractive (%)	Third attractive (%)
DWS-to-DWI total	0.75 (30.43%)	0.85 (24.22%)	0.70 (19.87%)
DWS-to-DWI male	0.85 (60.93%)	0.80 (35.93%)	0.81 and 0.82 (3.12%)
DWS-to-DWI female	0.75 (50.51%)	0.70 (32.98%)	0.65 and 0.80 (10.30%)

*DWS* dorsal width superior, *DWI* dorsal width inferior

**Table 2** Buttock aesthetic references as lateral view

Ratio	Most attractive (%)	Second attractive (%)	Third attractive (%)
LWS-to-LWI total	0.70 (38.50%)	0.76 (8.69%)	0.70 (7.45%)
LWS-to-LWI male	0.75 (25%)	0.70 (15.62%)	0.76 (12.5%)
LWS-to-LWI female	0.70 (21.64%)	0.75 (15.46%)	0.78 (9.27%)

*LWS* lateral width superior, *LWI* lateral width inferior (LWS/LWI)

**Table 3** Gluteal region aesthetic references as lateral view

Ratio	Most attractive (%)	Second attractive (%)
LLS-to-LLI total	50:50 (93.16%)	40:60 and 45:55 (2.48%)
LLS-to-LLI male	50:50 (90.62%)	40:60 and 45:55 (6.25%)
LLS-to-LLI female	50:50 (95.87%)	(15.46%)

*LLS* lateral length superior, *LLI* lateral length inferior

**Table 4** Gluteal region aesthetic references as posterior view

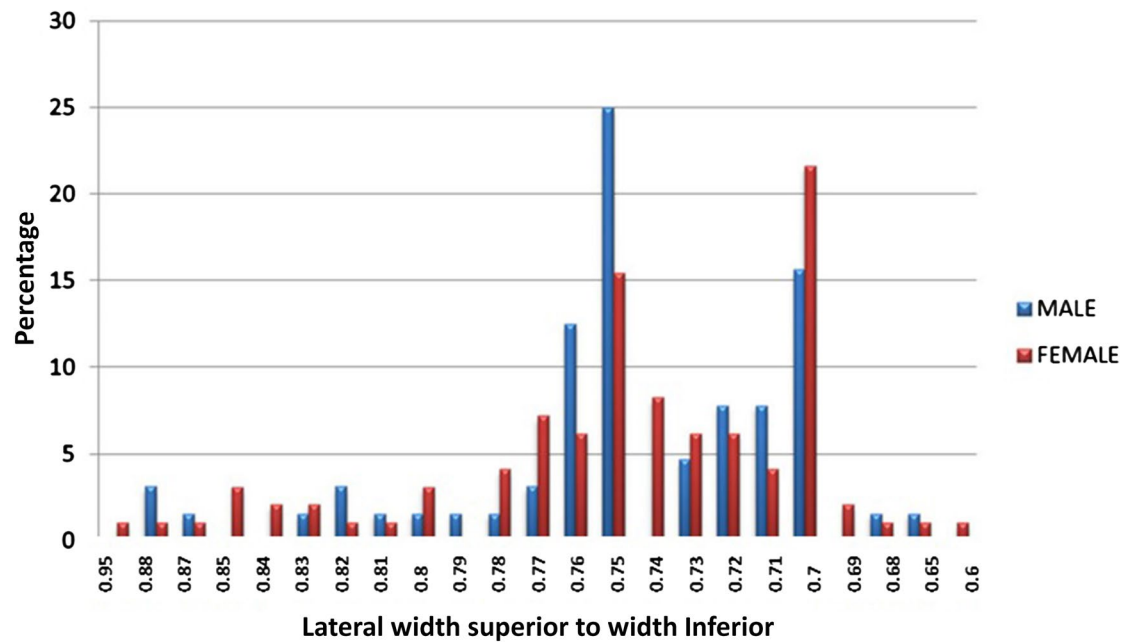
Ratio	Most attractive (%)	Second attractive (%)
DVLS-to-DVLI total	54:46 (15.52%)	55:45 and 56:44 (10.55%)
DVLS-to-DVLI male	54:46 (17.18%)	55:45 (12.5%)
DVLS-to-DVLI female	56:46 (14.43%)	56:44 (12.5%)
		51:49 (12.37%)

*DVLS* dorsal vertical length superior, *DVLI* dorsal vertical length inferior

**Gluteal measurements**

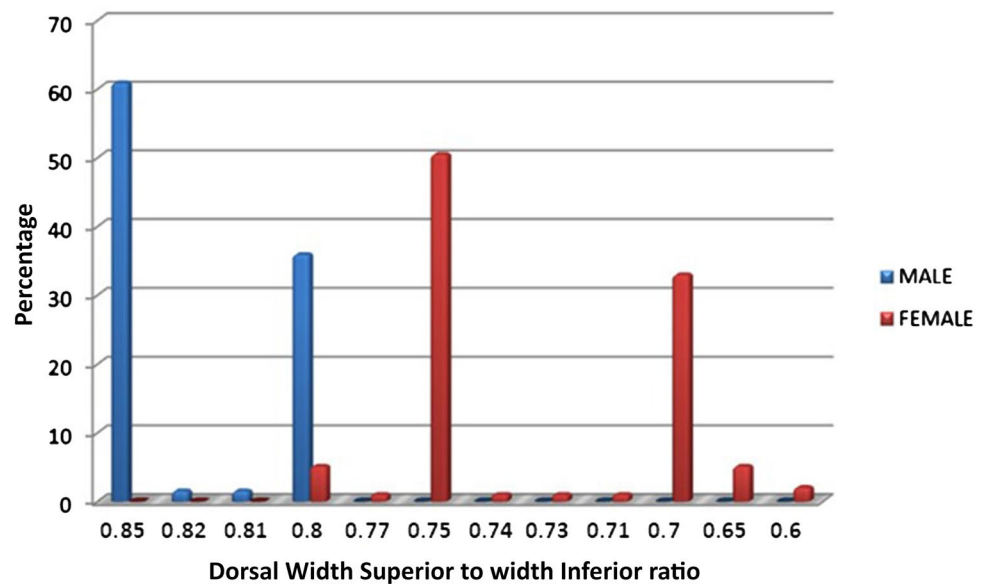
The measurements concerning the buttocks and lower body by the selected reference points are presented in Tables 1, 2, 3 and 4. The most attractive DWS-to-DWI ratio was 0.85 (60.9%) in males, 0.75 (50.5%) in females. The most attractive LWS-to-LWI ratio was 0.70 (25%) in males, and 0.70 (21.6%) in females.

The most frequent dorsal vertical length superior (DVLS) to dorsal vertical length inferior (DVLI) ratio was 54:46 and 17.18% highest in males, 56:46 and 14.43% highest in females. The most frequent lateral length superior (LLS) to lateral length inferior (LLI) ratio was 50:50 and 90.6% highest in males, 50:50 and 95.9% highest in women. The vertical proportions selected had percentage ratios of 70:30, 60:40, 50:50, 40:60, and 30:70. For



**Fig. 6** Frequency in dorsal width superior to width inferior ratio of women and men

**Fig. 7** Frequency in lateral width superior to width inferior ratio of women and men



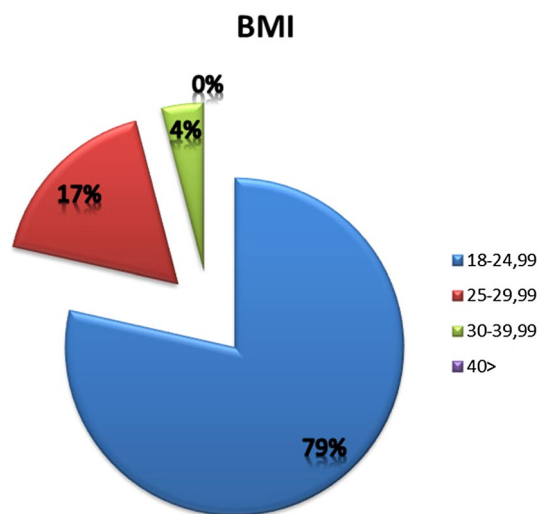
example, a ratio of 70:30 indicated positioning of the most prominent point at a horizontal line dividing the buttock height into an upper 70% and lower 30% portion (Tables 1, 2, 3, 4). Buttocks with the lateral prominence positioned at the inferior gluteal fold were defined as having an inferior gluteal convexity, or natural appearance.

No significant differences were found in preferences between the respondents' ages, genders, or ethnicities in males compared to females considering. On the other hand, in females, the most preferred ratios of the

dorsal body as DWS-to-DWI, LWS-to-LWI ratios were at 0.70. This could be explained that most of the volunteers included in this study had the ideal ratio of 0.70.

### Gluteal shape

Among males waist-to-hip ratio frequency was detected as 0.75 in 25%, 0.70 in 15.7% and 0.76 in 12.5%. In females, the frequency of waist-to-hip ratio was seen as 21.64% in 0.70, 15.46% in 0.75 and 9.27% in 0.78. There were significant



**Fig. 8** Chart of body mass index

gender differences in the aesthetic rankings of buttock body shapes. The waist-to-hip ratio of 0.75 was associated with the most attractive fraction in males, whereas the 0.70 ratio were found to be dominant in females (Figs. 7, 6).

## Discussion

Buttocks region is a key element of the body perception and beauty, with aesthetic procedures such as liposuction, fat grafting, roller pump injection, implant placement, and thigh lift, along with side interventions such as aspiration of oil cyst and graft harvest, rapidly gaining popularity [2, 12, 13, 21–23, 33, 35]. Well-projected buttocks in continuum with a uniform line drawn from waist to knee on front view makes a natural and aesthetically appealing curve (Figs. 1, 2) [3, 10, 11, 15, 18, 28–31]. Although female and male icons studied are represented as an ideal forms of beauty, they have unique characteristics and may not represent the average body type or the aesthetic ideals of the general population [5]. In the quest to better define the “ideal” buttocks, previous studies assume interdependence among variables such as region, sex, age, occupation, and anatomical details, yielding a waist-to-hip ratio that appear most pleasing across most cultures and geographical locations [10, 11, 15, 18, 27–29, 33, 35]. However, no clear standard for the ideal buttocks stand out among them.

The anthropometric analysis of the gluteal region is studied among various populations as Brazilian, Korean, Chinese, Mexican and North American [20, 26, 34]. For example, surgeons (and patients per se) in Latin America preferred the largest buttocks, followed by surgeons in Asia, North America, and Europe, with non-Caucasians preferring larger buttocks than Caucasians. A waist-to-hip ratio

of 0.7 has been suggested as the aesthetic ideal according to Miss America pageant winners, Playboy Playmates, and line drawings of female figures. The waist-to-hip ratio of 0.7, however, is rejected by some authors in their articles [27–30]. It is said that the studied female population had greater variation in waist-to-hip ratio, moreover in actuality the average ratio was 0.67.

Excessive fat accumulation at the supragluteal, periumbar, subgluteal, and trochanteric areas not only disturbs the natural anatomy of the gluteal region but also the natural supragluteal fosses and the V-shaped crease (Fig. 1) [11]. The supragluteal fosses (fossae lumbales laterales or colloquially called as dimples of Venus) are two hollows located on either sides of the medial sacral crest. The V-shaped crease, or the lower half of the Rhombus of Michaelis which is named after nineteenth century obstetrician Gustav Adolf Michaelis (by which the size of pelvis, thus risks of labour is estimated), is formed by two lines arising in the proximal portion of the gluteal crease directed toward the supragluteal fosses (Fig. 2) [15]. Moreover, volume deficiency in the buttocks presents as a lack of the lateral projection giving the buttocks a flat shape [1, 17, 25, 27, 34]. In a surgical point of view, for sculpturing the gluteal region best solutions can be offered according to individual anatomy and these solutions can be pursued with precision based on mathematical values.

Increasing reports of success with autologous fat transfer and liposuction led to more developed sense of aesthetic gluteal contouring [13, 21, 22]. In their study, devoid of enough samples from different ethnic groups, Wong et al. defined the most attractive buttocks waist-to-hip ratio from posterior view as 0.65, and second as 0.60 from lateral view the ratio was 0.70 [34].

In this study, we exhibited morphological aspects of the buttocks region via digitalized standard lower body photographs obtained from normal subjects, highlighting the differences related to gender factors with computer-aided technology (Figs. 3, 4). Photogrammetry is one of the most widely used method for noninvasive measurement of body parts, as it eliminates the risk of exposure to harmful radiation associated with the radiographic method, and it does not even require printing. Photogrammetry quantifies assessment of buttocks by topology measuring distances on digital photographs using a dedicated software. The objective of this study was to propose reference values for buttock analysis in sagittal and coronal planes, measured by means of computerized photogrammetry, in healthy young adults.

In terms of gender, all the buttocks with attractive ratio calculations such as DWS-to-DWI, LWS-to-LWI, LLS-to-LLI and DVLS to DVLI ratio contained no significant differences in preferences in ages, genders, or ethnicities ( $p \geq 0.05$ ). In the meantime compared to women, the ratios of the dorsal body as DWS-to-DWI, LWS-to-LWI ratios were at 0.70 (Tables 1, 2, 3, 4).

This study clearly revealed the number of buttock size intervals determining the shape (Figs. 5, 7, 6). Among young males, frequencies of waist-to-hip ratio were detected as 0.75 in 25%, and 0.70 in 15.7%. In females, this incidence was seen as 21.64% in 0.70, and 15.46% in 0.75 (Tables 1, 2, 3, 4). There were significant gender differences in the aesthetic rankings of buttock body shapes. The waist-to-hip ratio of 0.75 was associated with the most attractive intervals in males, whereas the 0.70 ratio was dominant in women (Figs. 5, 7, 6). These conclusions led us to the idea that this shape of buttocks in men gives a stronger impression thus bringing out an evolutionary advantage. In women on the other hand, relatively larger buttocks and prominent gluteal features may give a more fertile impression.

In this study, we aimed to identify and if the results imply, update the current ideal waist-to-hip ratio using personalized images representing a broader, more realistic range of shapes and ratios. Briefly, these results reveal that in women the buttock would occupy a much larger proportion in the centre of the dorsal body surface, and therefore, might have a greater aesthetic impact.

In this study, images of buttocks were digitally altered to group buttocks under varying proportions on posterior and lateral views (Figs. 3, 4, 5). The first step to achieve this goal was to conduct a detailed research on the geometrical forms and mathematical value of the gluteal region for personalized reconstruction. Second step was to identify the anatomic landmarks that influence such subjective evaluations would provide useful insight into how to achieve ideal buttocks and gluteal body morphology in terms of both individual lower body details and the patient's individual preferences.

## Conclusion

Incorporating digitalized technology to decision making process before surgery lets the surgeon to predict the outcome of the treatment, allows for a better risk management, and assists to obtain more individual information for the patient. All in all, advanced technology concerning body topography contributes to set the standards higher in planning of any resurfacing procedure. This study was designed to find a practical method for standardization in planning phase before attempting to modify gluteal region topography.

**Author contributions** GNC: Data collection. FG: Conception and design; writing the article; statistical expertise. AB: Conception and design; writing the article. MAO: Protocol/project development. YP: Data collection and provision of materials.

## Compliance with ethical standards

**Conflict of interest** All the authors certify that they have no potential conflicts of interest with any entity mentioned in this manuscript and that they received no specific financial support for this work.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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