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Review

The South Asian facial anthropometric profile: A systematic review

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ABSTRACT

Purpose: Craniofacial anatomy, as measured by facial anthropometric data, varies significantly between races. South Asia, comprised of eight countries, represents a large proportion of the global population and is the fastest-growing region of the world. This systematic review presents the facial anthropometric data collected for populations from this region.

Materials and methods: This systematic review was conducted in accordance with PRISMA guidelines. A systematic review of the literature was conducted by an electronic search of the MEDLINE and Cochran databases, returning 1675 articles. Bibliographies of accepted articles were screened to identify further eligible studies.

Results: A total of 12 articles were considered eligible for the systematic review. Two studies were conducted in Bangladesh, 7 in India, and 3 in Nepal. No facial anthropometric data were found for populations from Afghanistan, Bhutan, Maldives, Pakistan, or Sri Lanka. Qualitative and quantitative parameters from the 12 studies were extracted.

Conclusion: There is a paucity of facial anthropometric data for South Asian populations. As South Asia has a significant prevalence of craniofacial anomalies and a burgeoning cosmetic facial surgery market, it is in the interest of both the craniofacial surgeon and the South Asian patient to collect baseline facial anthropometric data for this population.

1. Introduction

Facial anthropometric data has become an invaluable tool in the craniofacial surgeon's arsenal (Farkas et al., 2005). Its medical use was initially pioneered by orthodontic researchers, who used cephalometry to guide orthodontic treatment (Durao et al., 2013; Cordasco et al., 2014; Gomes et al., 2014; Pittayapat et al., 2014; Smektala et al., 2014). Similarly, plastic surgeons are now relying on anthropometric data to guide craniofacial reconstruction.

Anthropometric studies have established significant differences between races, and craniofacial anatomy has been shown to be especially variable between ethnic groups (Durtschi et al., 2009). Hence, it is important to establish baseline facial anthropometric data for a variety of races, particularly when considering how craniofacial surgeons are now tasked with treating increasingly ethnically diverse patient populations (Farkas et al., 2005).

South Asia is the term used to encompass the eight countries of Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, India, Pakistan, and Sri Lanka. This region boasts a population of 1.766 billion people (The World Bank) and it is the fastest growing region in the world (The World Bank). With such an enormous potential patient population, it is important to have a thorough understanding of the facial anthropometric norms of these eight South Asian countries. Hence, this systematic review aims to identify and summarize the existing literature on the facial anthropometric parameters of the South Asian population and provide guidelines for future research. This systematic review is, to the author's knowledge, the first to summarize available facial anthropometric data for the South Asian population.

2. Materials and methods

2.1. Search strategy

This systematic review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. An electronic literature search was conducted of the MEDLINE and COCHRANE databases to identify studies that provided facial anthropometric data for any ethnic

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populations from the countries comprising South Asia. The database searches were performed using the key words "South Asia", "Afghanistan", "Bangladesh", "Bhutan", "India", "Maldives", "Nepal", "Pakistan", and "Sri Lanka" each meshed with the key words "craniofacial", "craniofacial norms", "facial anthropometry", "facial proportions", and "neoclassical cannon". The bibliographies of studies accepted after full text review were also screened to identify any relevant articles that may have been missed by the original database searches.

2.2. Inclusion and exclusion criteria

An independent researcher initially screened the search results by their title and abstract. The remaining articles were screened to exclude duplicates. Following exclusion, a full text review was conducted to identify articles for inclusion in this study. To be included, the article had to describe facial anthropometric data for any ethnic group from the eight countries identified as belonging to South Asia. Included articles must have recruited human subjects and presented male and female data separately.

Studies were excluded if they used nonhuman subjects or if they recruited participants who were considered beautiful, had severe malocclusion, developmental craniofacial disfigurement, facial trauma, or had previous craniofacial or cosmetic surgery. Studies were also excluded if they did not specify the anthropometric landmarks used to obtain the measurements, if mean and standard deviation information was not reported, or if data were grouped across genders. Editorials, commentaries, case reports, systematic reviews, meta-analyses, and articles not available in English were excluded.

2.3. Data extraction

The studies were thoroughly reviewed to identify the facial anthropometric parameters that were measured, and the landmarks used to obtain these measurements. The following qualitative outcomes were extracted: ethnic group, sample size, gender, age, method of evaluation, instrumentation used, comparison group, and general findings. Following qualitative analysis, all reported means and standard deviations for facial anthropometric parameters were extracted for males and females. All values were converted to and presented in centimetres. Where possible, weighted means and standard deviations were calculated. All results were analysed using Microsoft Excel: Mac 2016.

3. Results

3.1. Studies retrieved

A total of 1675 articles were returned from the MEDLINE and Cochrane database searches, and an additional three articles were identified from study bibliographies. Of the articles, 59 were considered to be eligible for a full text review following exclusion of duplicates and screening of titles and abstracts. Following full text review, 12 articles were considered eligible for inclusion in the systematic review. Fig. 1 shows the selection process for the studies included in this review.

3.2. Outcome parameters

Of the 12 studies included in the review, two were conducted in Bangladesh, seven were conducted in India, and three were conducted in Nepal. Table 1 shows the facial anthropometric measurements presented in these studies, and the landmarks used to obtain these measurements. Tables 2–4 present the qualitative data for the studies conducted in Bangladesh, India, and Nepal, respectively.

The Bangladeshi studies were conducted on a general Bangladeshi sample and a Christian Garo sample, totalling 600 participants.

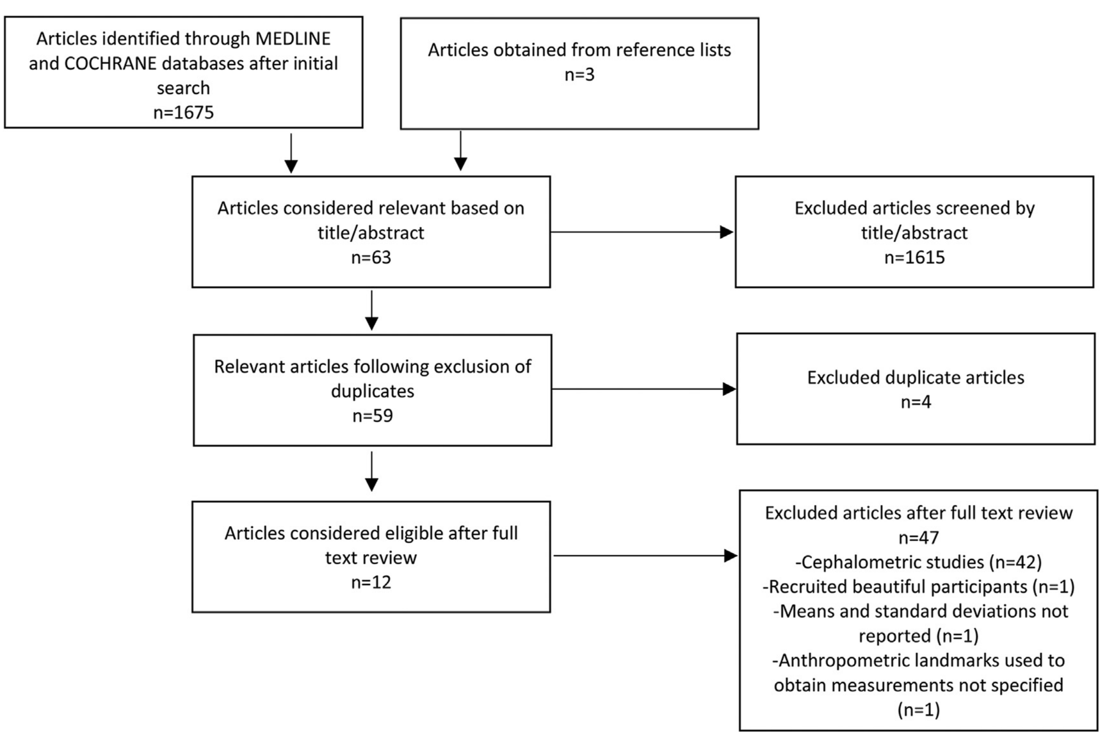

Fig. 1. Flowchart describing the process of the literature review.

Table 1
Overview of the facial anthropometric parameters measured by the studies, and the anthropometric landmarks used to obtain the measurements.

Facial Parameter	Anthropometric Landmarks	Abbreviation
Head		
Head vault	Tragion to tragion	t-t
Horizontal circumference	Glabella to glabella	g-g
Forehead height	Trichion to nasale	tr-n
Maximum head length	Glabella to opisthocranion	g-op
Minimum frontal breadth	Frontotemporal to frontotemporal	ft-ft
Maximum head breadth	Biparietal diameter	BPD
Face		
Morphological face height	Nasion to gnathion	n-gn
Morphological superior face height	Nasion to prosthion	n-pr
Physiognomic face height	Trichion to gnathion	tr-gn
Physiognomic upper face height	Trichion to glabella	tr-g
Physiognomic superior face height	Nasion to stomion	n-st
Physiognomic middle face height	Glabella to subnasale	g-sn
Physiognomic lower face height	Subnasale to gnathion	sn-gn
Lower face height	Stomion to gnathion	st-gn
Face width	Zygion to zygion	zy-zy
Mandible width	Gonion to gonion	go-go
Orbits		
Interocular width	Endocanthion to endocanthion	en-en
Biocular width	Exocanthion to exocanthion	ex-ex
Eye fissure length	Endocanthion to exocanthion	en-ex
Ear		
Ear length	Supraulare to subaurale	sa-sba
Physiognomic ear breadth	Pre-aurale to post-aurale	pra-poa
Nose		
Nasal length	Nasion to subnasale	n-sn
Nasal depth	Pronasale to subnasale	prn-sn
Inclination of nasal bridge	Nasion to nasal tip	in
Morphological nose width	Ala to ala	al-al
Labio-oral region		
Vermilion height	Labiale superious to labiale inferious	ls-li
Mouth width	Cheilion to cheilion	ch-ch

Table 2
Qualitative data extracted from studies conducted in Bangladesh.

Author (Year)	Ethnic Group	Sample Size	Gender	Age	Method of Evaluation	Instruments Used	Comparison Group	Findings
Akhter et al. (2013)	Christian Garos	100	Female	25–45	A physical measurement was taken of ch-ch. Subjects were photographed, and photographs were converted to actual size using ch-ch measurement. tr-gn, n-sn, and ls-li parameters were obtained from photographs. Multiplication factors were calculated as tr-gn/n-sn and tr-gn/ls-li, in order to estimate tr-gn from n-sn and ls-li.	Slide calliper, Adobe Illustrator	N/A	A significant correlation was found between nasal length and vermillion height measurements and facial height. Multiplication factors are proposed as useful tools to determine one facial measurement from another.
Sheikh et al. (2014)	Bangladeshi	500	250 male, 250 female	18–25	Anthropometric landmarks were marked with a dermographic pen. tr-gn, g-sn, and sn-gn parameters were measured. Measurements were taken twice and taken a third time if they disagreed by more than 0.1 cm. The mean of the two closest measurements is reported. Chi square tests, paired t-tests, and Pearson's correlation coefficient were used to analyse data.	Digital Vernier sliding calliper	N/A	The study finds that male and female anthropometric features differ significantly proposes anthropometric features of the Bangladeshi population.

The Indian studies were conducted on North Indian, Northeast Indian, South Indian, Jat Sikh, Bania, Hindu Gujjar, Koli, and Kabui Naga populations, totalling 2607 participants.

The Nepali studies were conducted on Indigenous, Indo-Nepalese, and Tibeto-Nepalese samples, as well as ethnic groups from Dhulikhel and Kathmandu, with a total of 1040 participants.

Male and female anthropometric parameters were presented for Bangladesh, India, and Nepal.

The quantitative data, with weighted means and standard deviations, were presented separately for males and females for the studies conducted in Bangladesh (Tables 5 and 6), India (Tables 7 and 8), and Nepal (Tables 9 and 10). No weighted means or standard deviations were calculated for the Bangladeshi studies, because the studies did not overlap in the parameters presented.

4. Discussion

This systematic review examined 12 studies that collected facial anthropometric data for ethnic groups from Bangladesh, India, and Nepal. This represents anthropometric data from three of the eight countries comprising South Asia, and as such, reflects the paucity of literature on the facial anthropometric parameters of South Asian populations.

Table 3
Qualitative data extracted from studies conducted in India.

Author (Year)	Ethnic Group	Sample Size	Gender	Age	Method of Evaluation	Instruments Used	Comparison Group	General Findings
Farkas et al. (2005)	N/A	60	30 male, 30 female	18–30	tr-n, tr-gn, n-gn, sn-gn, n-sn, in, sa-sba, en-en, ex-ex, en-ex, zy-zy, go-go, al-al, and ch-ch parameters were measured. A goodness-of-fit statistic was calculated compared with the North American White reference group.	N/A	North American White	The study proposes anthropometric features of Indians.
Kumar and Chandra, (2006)	Kabui Naga of Imphal Valley, Manipur, Northeast India	199	Male	18–45	n-gn, tr-gn, ex-ex, en-en, zy-zy, and go-go parameters were measured. Pearson's r value, multiplication factors, and linear regressions were calculated.	Sliding calliper, spreading calliper	N/A	The study proposes anthropometric features of the Kabui Naga.
Krishan and Kumar (2007)	Kolis of North India	252	Male	12–18	g-op, BPD, t-t, ft-ft, g-g, zy-zy, go-go, n-sn, al-al, prn-sn, n-gn, n-pr, tr-gn, n-st, sa-sba, and pra-poa parameters were measured. Pearson's r coefficient, regression analysis, and standard error of estimate was calculated.	Standard anthropometric instruments	90 individuals of same age from mixed population of North india	Cephalo-facial dimensions of Kolis can be used for estimation of stature and generalizes to a mixed North Indian population.
Krishan (2008)	Hindu Gujjars of North India	996	Male	18–30	g-g, BPD, g-op, go-go and n-gn parameters were measured. Pearson's r coefficient and regression analysis were computed.	Anthropometric rod, sliding calliper, spreading calliper, measuring steel tape	100 individuals of same age from mixed population of North India	Cephalo-facial dimensions of Hindu Gujjars can be used for estimation of stature and generalizes to a mixed North Indian population.
Sahni et al. (2012)	Northeast Indians from Chandigarh zone	300	173 males, 127 females	18–70	n-gn, n-pr, st-gn, ft-ft, go-go, ex-ex, and en-en parameters were measured. Pearson's r coefficient, multiplication factors, and multiple regression analysis was computed.	N/A	N/A	Means of all facial measurements except for interocular breadth were significantly greater in males than females.
Singla et al. (2011)	Jat Sikhs and Banias of Punjab, India	300 Jat Sikhs, 300 Banias	Male	Adult	n-gn, and zy-zy parameters were measured. The morphological facial index was calculated as n-gn/zy-zy x 100.	Sliding caliper, spreading caliper	N/A	The study proposes anthropometric features of the Jat Siks and the Banias.
Prasanna et al. (2013)	North Indians and South Indians	200	100 male, 100 female	>18	n-gn, n-pr, and zy-zy parameters were measured. Total and upper facial indices were calculated and used to categorize facial shapes according to Bannister's classification. The Chi-square test was used to determine morphological means and the Student's t-test to compare the means of anthropometric measurements.	N/A	North Indian with South Indian	Statistically significant differences were found in all facial parameters and indices across between ethnicities and sexes.

Table 4
Qualitative data extracted from studies conducted in Nepal.

Author (Year)	Ethnic Group	Sample Size	Gender	Age	Method of Evaluation	Instruments Used	Comparison Group	Findings
Sharma (2014)	Dhulikhel, Nepal	300	150 male, 150 female	18–25	n-gn and zy-zy parameters were measured. The facial index was calculated as n-gn/zy-zy x 100.	Sliding calliper	N/A	The study proposes anthropometric features of the Nepalese population.
Shah et al. (2015)	Indigenous, Indo-Nepalese, and Tibeto-Nepalese ethnic races	600; Indigenous (n = 200), Indo-Nepalese (n = 200), Tibeto-Nepalese (n = 200)	300 male, 300 female	17–26	n-gn and zy-zy parameters were measured. The proscopic index was calculated as n-gn/zy-zy x 100.	Sliding calliper	N/A	Significant differences were found between males and females of all three ethnic races
Pandey et al. (2015)	Kathmandu, Nepal	140	96 male, 44 female	18–24	n-gn and zy-zy parameters were obtained. The total facial index was calculated as n-gn/zy-zy x 100.	Spreading calliper	N/A	The study proposes anthropometric features of the Nepalese population.

Of the three countries represented in this review, the data for Indian ethnic groups appears to be the most comprehensive, with a total of 2607 participants across seven studies. Eight specific Indian ethnic groups are represented in these studies, as seen in Table 3. The diversity of ethnicities that populate India, and the accompanying differences in anthropometric parameters, are clearly evident. In particular, significant differences are found between North and South Indian populations (Prasanna et al., 2013), reflecting the distinct Aryan and Dravidian ethnic groups (Ali et al., 2014). The variation in anthropometric parameters of ethnic groups within the country itself reflects the importance of collecting anthropometric data from as many different Indian samples as possible: there is no standard Indian population whose facial anthropometric data can be extrapolated to the entire population. More data are available (in terms of number of participants, distinct ethnic groups, and anthropometric landmarks) for male Indians than for female Indians, which is evident when comparing Tables 7 and 8. Only four of the seven studies included female participants; it is important to collect further data on females to improve the accuracy of their facial anthropometric parameters, especially

Table 5
Bangladeshi male facial anthropometric parameters (mean ± SD).

	Sheikh et al. (2014)
Head	
t-t	–
g-g	–
tr-n	–
g-op	–
ft-ft	–
BPD	–
Face	
n-gn	–
n-pr	–
tr-gn	–
tr-g	6.16 ± 0.62
n-st	–
g-sn	6.68 ± 0.30
sn-gn	6.96 ± 0.35
st-gn	–
zy-zy	–
go-go	–
Orbits	
en-en	–
ex-ex	–
en-ex	–
Ear	
sa-sba	–
pra-poa	–
Nose	
n-sn	–
prn-sn	–
In (°)	–
al-al	–
Labio-oral region	
ls-li	–
ch-ch	–

NOTE: All measurements are given in cm, excluding *in*, which is given in degrees.

Table 6
Bangladeshi female facial anthropometric parameters (mean ± SD).

	Akhter et al. (2013)	Sheikh et al. (2014)
Head		
t-t	–	–
g-g	–	–
tr-n	–	–
g-op	–	–
ft-ft	–	–
BPD	–	–
Face		
n-gn	–	–
n-pr	–	–
tr-gn	16.88 ± 1.11	–
tr-g	–	5.58 ± 0.52
n-st	–	–
g-sn	–	6.17 ± 0.24
sn-gn	–	6.27 ± 0.30
st-gn	–	–
zy-zy	–	–
go-go	–	–
Orbits		
en-en	–	–
ex-ex	–	–
en-ex	–	–
Ear		
sa-sba	–	–
pra-poa	–	–
Nose		
n-sn	4.53 ± 0.36	–
prn-sn	–	–
In (°)	–	–
al-al	–	–
Labio-oral region		
ls-li	1.63 ± 0.23	–
ch-ch	–	–

NOTE: All measurements are given in cm, excluding *in*, which is given in degrees.

as significant differences between male and female facial anthropometry have already been established (Sahni et al., 2012; Prasanna et al., 2013).

The three studies conducted in Nepal encompassed two distinct ethnic groups and recruited both male and female participants. As with the Indian studies, the vast ethnic variation within Nepal (Aasland and Haug, 2011) suggests that these data do not generalize to much of the Nepalese population. Furthermore, across the three studies, only two facial anthropometric parameters were obtained: morphological face height (n-gn) and face width (zy-zy). These parameters do not even encompass the 10 standard neoclassical canons that are considered most relevant for a craniofacial surgeon (Farkas et al., 2005). There is an equal availability of data for both sexes, as all included studies recruited both male and female participants.

Of the two studies conducted in Bangladesh, a similar lack of distinct ethnic groups and facial anthropometric parameters measured is observed. Only one specific ethnic group, the Garos, is represented (Akhter et al., 2013). For males, only three parameters are reported from one study; for females, six are reported. No weighted means or standard deviations were calculated for the Bangladeshi values, as the two studies had no overlap in the parameters measured.

Even though data exist for Bangladesh and Nepal, the parameters available are of limited use to a craniofacial surgeon working with either population. At the very least, the standard 10 neoclassical measurements (Farkas et al., 2005) should be obtained for these populations, in order to provide enough data to be of use.

Five of the eight South Asian countries (Afghanistan, Bhutan, Maldives, Pakistan, and Sri Lanka) have no facial anthropometric data available for their populations. From a basic research view point, this represents a significant gap in the database of facial anthropometry; collectively, these five countries represent a population of over 250 million people (The World Bank) on whom there is no baseline facial anthropometric data. This also means that there is no literature on the anthropometric differences between the distinct ethnic groups within these countries, which has been shown to exist in the three countries included in this review.

From the perspective of a craniofacial surgeon, the lack of data for populations from Afghanistan, Pakistan, and Sri Lanka, and the lack of parameters collected for populations from Bangladesh and Nepal, is especially relevant due the particularly high incidence of craniofacial anomalies in these countries. Considering cleft lip and palate alone, India is ranked second, and Pakistan fourth, in the world in terms of number of children born with cleft every year (Elahi et al., 2004). In the US, cleft prevalence has been calculated to be anywhere between 0.775 and 1.063 per 1000 live births (Parker et al., 2010; Tanaka et al., 2012). South Asia shows a much higher prevalence; Nepal has a prevalence of 1.65/1000 births (Panamonta et al., 2015), Pakistan that of 1.91/1000 births (Elahi et al., 2004), Sri Lanka a prevalence of 2.19/1000 births (Panamonta et al., 2015) and Afghanistan that of 4.6 per 1000 live births (Singh et al., 1982). The occurrence of clefts in South Asia is so high that these countries are often the destinations of humanitarian cleft missions by international craniofacial surgeons (Abenovoli, 2005; Fayyaz et al., 2015). One must also consider the high incidence of adult cleft repairs in South Asian countries (Albert et al., 1990; Ward and James, 1990; McCance et al., 1990; Arvier et al., 1997; Morioka et al., 2007; Murthy 2009; Aziz et al., 2009; Sohail et al., 2010; Rai et al., 2013), repair of which would be aided by the collection

Table 7
Indian male facial anthropometric parameters (mean ± SD).

	Farkas et al. (2005)	Kumar and Chandra, (2006)	Krishan and Kumar (2007)	Krishan (2008)	Sahni et al. (2012)	Singla et al. (2011) (Jat Sikh)	Singla et al. (2011) (Bania)	Prasanna et al. (2013) (North Indian)	Prasanna et al. (2013) (South Indian)	Weighted Mean ± Weighted SD
Head										
t-t	–	–	33.95 ± 1.28	–	–	–	–	–	–	33.95 ± 1.28
g-g	–	–	52.70 ± 2.57	53.21 ± 2.57	–	–	–	–	–	53.12 ± 2.57
tr-n	6.55 ± 0.74	–	–	–	–	–	–	–	–	6.55 ± 0.74
g-op	–	–	16.28 ± 0.92	17.83 ± 0.89	–	–	–	–	–	17.52 ± 0.90
ft-ft	–	–	9.92 ± 0.79	–	10.59 ± 0.62	–	–	–	–	10.19 ± 0.73
BPD	–	–	13.01 ± 0.68	13.92 ± 0.62	–	–	–	–	–	13.74 ± 0.63
Face										
n-gn	11.25 ± 0.62	11.25 ± 0.61	10.24 ± 0.82	10.81 ± 0.73	11.25 ± 0.67	11.35 ± 0.72	10.99 ± 0.61	12.36 ± 0.40	11.9 7 ± 0.59	10.97 ± 0.70
n-pr	–	–	6.30 ± 0.41	–	6.85 ± 0.48	–	–	7.21 ± 0.37	11.93 ± 0.47	7.10 ± 0.44
tr-gn	16.13 ± 0.23	18.22 ± 0.86	16.38 ± 0.48	–	–	–	–	–	–	17.13 ± 0.66
tr-g	–	–	–	–	–	–	–	–	–	–
n-st	–	–	7.05 ± 0.31	–	–	–	–	–	–	7.05 ± 0.31
g-sn	–	–	–	–	–	–	–	–	–	–
sn-gn	6.27 ± 0.5	–	–	–	–	–	–	–	–	6.27 ± 0.5
st-gn	–	–	–	–	3.67 ± 0.37	–	–	–	–	3.67 ± 0.37
zy-zy	13.58 ± 0.43	10.51 ± 0.60	9.94 ± 0.68	–	–	13.76 ± 0.49	13.84 ± 0.57	12.22 ± 0.31	11.93 ± 0.47	12.27 ± 0.57
go-go	10.28 ± 0.33	14.12 ± 0.50	8.34 ± 0.38	9.78 ± 0.38	10.64 ± 0.63	–	–	–	–	10.00 ± 0.43
Orbits										
en-en	3.41 ± 0.22	3.21 ± 0.31	–	–	2.27 ± 0.33	–	–	–	–	2.82 ± 0.31
ex-ex	9.88 ± 0.35	9.64 ± 0.47	–	–	9.86 ± 0.60	–	–	–	–	9.75 ± 0.52
en-ex	3.02 ± 0.2	–	–	–	–	–	–	–	–	3.02 ± 0.2
Ear										
sa-sba	6.11 ± 0.35	–	5.38 ± 0.40	–	–	–	–	–	–	5.46 ± 0.40
pra-poa	–	–	3.09 ± 0.32	–	–	–	–	–	–	3.09 ± 0.32
Nose										
n-sn	4.72 ± 0.37	–	4.77 ± 0.25	–	–	–	–	–	–	4.76 ± 0.26
prn-sn	-	–	1.92 ± 0.20	–	–	–	–	–	–	1.92 ± 0.20
In (°)	3.25 ± 0.56	–	-	–	–	–	–	–	–	3.25 ± 0.56
al-al	3.79 ± 0.35	–	3.19 ± 0.21	–	–	–	–	–	–	3.25 ± 0.23
Labio-oral region										
ls-li	–	–	–	–	–	–	–	–	–	–
ch-ch	5.10 ± 0.46	–	–	–	–	–	–	–	–	5.10 ± 0.46

NOTE: All measurements are given in cm, excluding *in*, which is given in degrees.

Table 8
Indian female facial anthropometric parameters (mean ± SD).

	Farkas et al. (2005)	Sahni et al. (2012)	Prasanna et al. (2013) (North Indian)	Prasanna et al. (2013) (South Indian)	Weighted Mean ± Weighted SD
Head					
t-t	–	–	–	–	–
g-g	–	–	–	–	–
tr-n	6.42 ± 0.93	–	–	–	6.42 ± 0.93
g-op	–	–	–	–	–
ft-ft	–	9.90 ± 0.59	–	–	9.90 ± 0.59
BPD	–	–	–	–	–
Face					
n-gn	10.15 ± 0.55	10.80 ± 0.54	11.70 ± 0.74	10.10 ± 0.62	10.76 ± 0.60
n-pr	–	6.53 ± 0.42	6.56 ± 0.35	6.19 ± 0.45	6.46 ± 0.41
tr-gn	16.3 ± 0.83	–	–	–	16.3 ± 0.83
tr-g	–	–	–	–	–
n-st	–	–	–	–	–
g-sn	–	–	–	–	–
sn-gn	5.72 ± 0.45	–	–	–	5.27 ± 0.45
st-gn	–	3.53 ± 0.30	–	–	3.53 ± 0.30
zy-zy	12.49 ± 0.84	–	10.88 ± 0.41	11.85 ± 0.49	11.62 ± 0.56
go-go	9.74 ± 0.52	10.26 ± 0.68	–	–	10.16 ± 0.65
Orbits					
en-en	3.09 ± 0.29	2.21 ± 0.23	–	–	2.38 ± 0.24
ex-ex	9.75 ± 0.50	9.68 ± 0.47	–	–	9.84 ± 0.48
en-ex	3.13 ± 0.22	–	–	–	3.13 ± 0.22
Ear					
sa-sba	5.71 ± 0.52	–	–	–	5.71 ± 0.52
pra-poa	–	–	–	–	–
Nose					
n-sn	4.37 ± 0.36	–	–	–	4.37 ± 0.36
prn-sn	–	–	–	–	–
In (°)	31.7 ± 4.6	–	–	–	31.7 ± 4.6
al-al	3.38 ± 0.24	–	–	–	3.38 ± 0.24
Labio-oral region					
ls-li	–	–	–	–	–
ch-ch	4.65 ± 0.30	–	–	–	4.65 ± 0.30

NOTE: All measurements are given in cm, excluding *in*, which is given in degrees.

Table 9
Nepalese male facial anthropometric parameters (mean ± SD).

	Sharp et al. (2014)	Shah et al. (2015)	Pandey et al. (2015)	Weighted Mean ± Weighted SD
Head				
t-t	–	–	–	–
g-g	–	–	–	–
tr-n	–	–	–	–
g-op	–	–	–	–
ft-ft	–	–	–	–
BPD	–	–	–	–
Face				
n-gn	11.24 ± 0.72	11.96 ± 0.46	10.96 ± 0.60	11.58 ± 0.57
n-pr	–	–	–	–
tr-gn	–	–	–	–
tr-g	–	–	–	–
n-st	–	–	–	–
g-sn	–	–	–	–
sn-gn	–	–	–	–
st-gn	–	–	–	–
zy-zy	12.92 ± 0.81	13.51 ± 0.25	13.64 ± 0.49	13.37 ± 0.51
go-go	–	–	–	–
Orbits				
en-en	–	–	–	–
ex-ex	–	–	–	–
en-ex	–	–	–	–
Ear				
sa-sba	–	–	–	–
pra-poa	–	–	–	–
Nose				
n-sn	–	–	–	–
prn-sn	–	–	–	–
In (°)	–	–	–	–
al-al	–	–	–	–
Labio-oral region				
ls-li	–	–	–	–
ch-ch	–	–	–	–

NOTE: All measurements are given in cm, excluding *in*, which is given in degrees.

Table 10
Nepalese female facial anthropometric parameters (mean ± SD).

	Sharp et al. (2014)	Shah et al. (2015)	Pandey et al. (2015)	Weighted Mean ± Weighted SD
Head				
t-t	–	–	–	–
g-g	–	–	–	–
tr-n	–	–	–	–
g-op	–	–	–	–
Ft-ft	–	–	–	–
BPD	–	–	–	–
Face				
n-gn	11.27 ± 0.57	11.96 ± 0.45	10.13 ± 0.68	11.59 ± 0.51
n-pr	–	–	–	–
Tr-gn	–	–	–	–
Tr-g	–	–	–	–
n-st	–	–	–	–
g-sn	–	–	–	–
sn-gn	–	–	–	–
st-gn	–	–	–	–
zy-zy	13.02 ± 0.91	13.41 ± 0.33	12.76 ± 0.49	13.23 ± 0.58
go-go	–	–	–	–
Orbits				
en-en	–	–	–	–
ex-ex	–	–	–	–
en-ex	–	–	–	–
Ear				
Sa-sba	–	–	–	–
Pra-poa	–	–	–	–
Nose				
n-sn	–	–	–	–
prn-sn	–	–	–	–
In (°)	–	–	–	–
al-al	–	–	–	–
Labio-oral region				
ls-li	–	–	–	–
ch-ch	–	–	–	–

NOTE: All measurements are given in cm, excluding *in*, which is given in degrees.

of robust facial anthropometric norms. Prevalence rates for craniofacial anomalies as a whole in South Asian countries are hard to come by. However, the burden of craniofacial anomalies is well documented in India (Reddy et al., 2009; Mukherjee and Mukherjee, 2012, Kumar 2014), Pakistan (Raja et al., 2011; Ghaffar et al., 2016) and Nepal (Moss and Singh, 2015). Hence, it is evident that a more complete databank of facial anthropometric norms for these populations would greatly aid both local and international surgeons in their efforts.

Like the majority of medical research (Burchard et al., 2003, 2015; Murthy et al., 2004; Wendler et al., 2006; Chen et al., 2014; George et al., 2014; Sardar et al., 2014; Oh et al., 2015), the most extensive facial anthropometry data exist for North American and European white populations (Farkas, 1978; Farkas and Cheung, 1979; Farkas et al., 1984, 1985a, 1985b, 1986; Farkas and Kolar, 1987; Miyajima et al., 1996; Dawei et al., 1997; Wang et al., 1997; Sim et al., 2000; Le et al., 2002; Leong and White, 2004, 2006; Ioi et al., 2007; Claes et al., 2012; Kramer et al., 2012; Zacharopoulos et al., 2012, 2016; Liu et al., 2013; Wirthlin et al., 2013; Milutinovic et al., 2014; Kim et al., 2015). However, an extensive literature also exists for East Asian populations, encompassing populations from China, Japan, and South Korea (Kawakami et al., 1989; Xuetong et al., 1990; Miyajima et al., 1996; Dawei et al., 1997; Wang et al., 1997; Alcalde et al., 1998, 2000; Sim et al., 2000; Le et al., 2002; Choe et al., 2004; Leong et al., 2004; Ioi et al., 2007; Nakahara; Nakahara, 2007; Song et al., 2007, 2009; Park et al., 2008; Jayaratne et al., 2012, 2013, 2014; Chen et al., 2013; Liu et al., 2013, 2014, 2015; Shindoi et al., 2013; Wirthlin et al., 2013; Lee et al., 2014; Kim et al., 2015; Yeung et al., 2015). Whilst there are many reasons for this, it could be attributed to the recent boom in cosmetic facial plastic surgical procedures in East Asia (Kim 2003; Kwak 2010; Swami et al., 2012; Tam et al., 2012; Aquino et al., 2016), as cosmetic surgical outcomes can be optimized by use of anthropometric data (William et al., 1999; Edler et al., 2006, 2010; Senna-Fernandes 2008; Fantozzi 2013). Although South Asia may not represent a significant cosmetic surgery market at the moment, it is gradually becoming one. In 2010, 400 000 cosmetic surgical procedures were reported in India alone (Rohrich et al., 2016) and the rapidly growing South Asian middle class is predicted to contribute to the continued rise in demand for cosmetic procedures (Rohrich et al., 2016). Furthermore, there is significant immigration to Western countries from South Asia: South Asians represent the largest non-white ethnic group in the United Kingdom (UK Office for National Statistics Ethnicity and National Identity in England and Wales) and Canada (Statistics Canada Immigration and Ethnocultural Diversity in Canada: National Household Survey) and are one of the fastest growing ethnic groups in the United States (Hoeffel et al., 2010). As Western countries become increasingly accepting of cosmetic surgical procedures (Brooks 2004; Delinsky 2005; Sarwer et al., 2005; Lunde 2013; Sharp et al., 2014), it is entirely probable that the number of South Asians seeking cosmetic craniofacial procedures in the West will steadily increase in the near future. Literature is already beginning to emerge on the unique cosmetic desires of South Asians (Baser 2003; Bhat et al., 2008; Husein et al., 2010; Patil et al., 2011; Patel and Daniel, 2012; Rohrich et al., 2016), reflecting the growing cosmetic surgery trend in this population.

Ultimately, both reconstructive and cosmetic surgical procedures consider the aesthetic outcome (Fisher et al., 2012; Foo et al., 2013; Bendon et al., 2014; Broyles et al., 2014; Rajappa et al., 2014; Mueller et al., 2015; van Veelen et al., 2015; Wallins et al., 2015; Mahmoud et al., 2016; Sosin et al., 2016) and facial anthropometric data play a significant role in achieving an optimal aesthetic result (Farkas et al., 2005). South Asia has shown an established need for reconstructive craniofacial surgery and a growing cosmetic facial surgery market. Obtaining extensive facial anthropometric data can be an expensive and time-consuming endeavour; this can be overcome by obtaining measurements from photographs, a method that has been validated (Gavan et al. 1952; de Menezes et al., 2009; Franke-Gromberg et al., 2010; Liu and Chia, 2010; Schaaf et al., 2010) and may be a more efficient method of data collection in developing nations. One of the studies conducted in Bangladesh used a photo-anthropometric method to obtain data (Akhter et al., 2013), demonstrating its feasibility. Photo-anthropometric measurements may be the way to overcome the lack of facial anthropometric data in South Asian countries and establish robust craniofacial norms for this population.

5. Conclusion

This systematic review presents the facial anthropometric data collected from South Asian populations. Relatively extensive data are available for Indian populations, and minimal data are presented for Bangladeshi and Nepali populations. No facial anthropometric data are available for populations from Afghanistan, Bhutan, Maldives, Pakistan, or Sri Lanka. As South Asia shows a significant need for reconstructive craniofacial surgery and a growing interest in cosmetic craniofacial procedures, collecting more extensive facial anthropometric parameters from this population is recommended for the benefit of both the craniofacial surgeon and the patient.

Ethical approval

Not applicable.

Financial interests

The author does not have a financial interest in any products, devices or drugs mentioned in this manuscript.

Conflicts of interest

The author declares no conflict of interest, and has no financial interests in any products, devices or drugs mentioned in this manuscript.

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