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# A Comparative Study of Facial Morphometrics of the Yakkure and Henanigala Vedda: Insights into Population Affinities and Evolutionary Patterns

## Estudio Comparativo de la Morfometría Facial de los Vedda Yakkure y Henanigala: Perspectivas Sobre las Afinidades Poblacionales y los Patrones Evolutivos

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**SUMMARY:** Sri Lanka's Indigenous population, the Veddas, demonstrate substantial biological continuity with island's earliest Homo sapiens inhabitants. Despite their importance for assessing evolutionary continuity and population affinities, contemporary facial morphometric data remain limited. This study provides the first detailed comparison of facial morphometry between two Indigenous Vedda groups, the Yakkure and Henanigala, to document population specific variation and situate them within broader regional patterns. A purposive sample of 328 adults (164 per group) was assessed using standardized anthropometric protocols. Measurements included total facial height (TFH), upper facial height (UFH), lower facial height (LFH), and facial breadth (FB), from which facial indices were derived. Marked sexual dimorphism was observed in both populations ($p < 0.001$), with males exhibiting significantly larger linear dimensions across all variables; however, proportional shape indices remained relatively conserved between sexes. At the population level, the Yakkure consistently exhibited significantly greater vertical dimensions than the Henanigala, with mean TFH (108.96 mm *vs.* 106.59 mm), UFH (63.33 mm *vs.* 61.18 mm), and LFH (61.56 mm *vs.* 58.59 mm) all differing significantly ($p < 0.001$). However, facial breadth (FB) did not differ significantly between the groups ($p > 0.05$). Consequently, the Yakkure displayed a significantly higher Upper Facial Index (UFI: 53.70 *vs*. 52.32), indicating relatively narrower upper facial proportions. Morphologically, the Yakkure proportions align with vertically elongated (leptoprosopic to hyperleptoprosopic) populations such as historical Vedda, Coastal Vedda, Sri Lankan Tamils, North Indians, East African Nilotes, and Andamanese groups. In contrast, the Henanigala show broader (mesoprosopic) affinities comparable to Sinhalese, South Indians, Orang Asli (Malaysia), Andhranians, Indonesians, and Australian Aboriginal groups. These findings highlight clear intra Vedda differentiation likely shaped by varying degrees of isolation, admixture, and ecological adaptation. As the first population specific analysis of its kind, this study provides essential baseline data for anthropological, forensic, and archaeological comparisons in South Asia.

**KEY WORDS: Anthropometry; Face; Indigenous Peoples; Sex Characteristics; Sri Lanka.**

## INTRODUCTION

Sri Lanka occupies a pivotal position in the South Asian dispersal corridor, and its long record of human occupation provides critical context for understanding population history in the region. Among its present-day communities, the Veddas are widely regarded as the Indigenous descendants of the island's earliest Homo sapiens populations, retaining measurable biological continuity with Late Pleistocene forager groups documented in the archaeological evidence (Kennedy, 1971; Kennedy *et al*., 1987; Deraniyagala, 1992; Wijeyapala, 1997; Perera, 2010; Wedage *et al*., 2019).

This continuity has long been a subject of anthropological interest. Historically, scholars observed that the morphological traits of the prehistoric "Balangoda Man" were remarkably consistent with the modern Vedda phenotype. Deraniyagala noted that key features such as dolichocephaly (long-headedness), protuberant glabella, robust zygomatics (cheekbones), and a receding chin suggested strong morphological affinities consistent with biological continuity linking the prehistoric inhabitants to the living Vedda. He further emphasized these broad affinities, stating: "…the overall characteristics of Vedda are

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common to the Australoid race…" (Stoudt, 1961, p. 158; Deraniyagala, 1985). This classification explicitly linked the Vedda to Indigenous Australian populations, a morphological connection that remains a critical comparative framework for understanding the broader facial robusticity observed in certain Vedda subgroups (Birdsell, 1993; Brown, 1997).

Based on these distinct cranial and facial features, early biological anthropologists classified the Vedda as the type-population for the "Veddoid" racial group. Carleton Coon and others notably expanded this classification, identifying "Veddoid" affinities in diverse populations ranging from South Arabia to Southeast Asia and Indonesia (Coon, 1965; Kennedy, 1971). These classifications reflect mid-20th century typological frameworks and are cited here for historical comparison rather than as contemporary taxonomic categories.

Although cultural assimilation and demographic reduction have reduced their numbers, the Veddas remain an essential population for examining microevolutionary processes, regional affinities, and the effects of isolation and admixture on craniofacial diversity in South Asia (Kennedy, 1971; Brow, 1978; Seligman & Seligman, 2011; Silva & Punchihewa, 2011). However, contemporary morphometric data on living groups are limited. Existing records are largely historical and unevenly distributed, leaving significant gaps in our understanding of their current evolutionary pathways. Classical cranial descriptions from the 19th and early 20th centuries (Virchow, 1881; Sarasin & Sarasin, 1886; Stoudt, 1961) remain foundational but offer limited insight into modern subpopulations shaped by recent demographic shifts.

This lack of modern data is critical because different Vedda subgroups have experienced contrasting historical trajectories. The Yakkure Vedda have historically maintained relative geographic and social isolation, preserving a more traditional demographic profile. In contrast, groups such as the Henanigala Vedda have undergone substantial interaction and admixture following state led development and relocation programs (Ananda & Nahallage, 2024). These diverging histories offer a valuable "natural experiment" to examine how isolation versus integration influences contemporary facial morphology.

Facial morphometrics, specifically total (TFH), upper (UFH), lower facial height (LFH), facial breadth (FB), and derived indices (Upper Facial Index [UFI = UFH/FB*100], Total Facial Index [TFI = TFH/FB*100]) remain powerful tools for assessing population structure, sexual dimorphism, functional adaptation, and microevolutionary divergence (Carey & Steegmann, 1981; Beals *et al*., 1984; Farkas, 1994; Noback *et al*., 2011). Yet, in South Asia, normative datasets for small Indigenous groups are almost nonexistent, limiting the ability to evaluate intra Vedda variation or situate these populations within regional contexts.

The present study addresses these gaps by providing the first systematic comparison of facial morphology in the Yakkure and Henanigala Vedda populations of Sri Lanka. Based on their divergent histories, we hypothesize that the relatively isolated Yakkure will retain a more elongated (leptoprosopic) facial morphology consistent with historical Vedda phenotypes, whereas the Henanigala, with a documented history of relocation and admixture, will exhibit broader (mesoprosopic) facial proportions convergent with neighboring Sinhalese and other regional populations. Using standardized anthropometric methods in a well-defined adult sample, we aim to: (1) quantify key facial dimensions, (2) examine sex and age specific variation, (3) evaluate interpopulation differences, and (4) contextualize these findings within broader South Asian and global facial patterns. By integrating morphometric evidence with the known historical trajectories of these communities, this study contributes essential population specific reference data and advances our understanding of how isolation, admixture, and ecological settings shape facial form within Sri Lanka's Indigenous continuum.

## MATERIAL AND METHOD

### Study Sites

The study was conducted in two Vedda settlements shaped by large scale resettlement under Sri Lanka's Mahaweli Development Project. Henanigala South (Eastern Province, Ampara District) comprises communities relocated in the 1980s from several traditional Vedda villages, currently numbering approximately 1,450 individuals of Indigenous descent. Yakkure (North Central Province, Polonnaruwa District) includes a community resettled in 1987 from its former location at Parana Yakkure, with a present Indigenous population of about 380 individuals.

Both sites represent contemporary Vedda communities with documented Indigenous lineage but differing histories of relocation, isolation, and sociocultural change factors relevant to interpreting observed morphometric variation.

### Sampling Procedure

A purposive sampling strategy was employed to include individuals with confirmed Indigenous ancestry through both matrilineal and patrilineal descent, verified by community leaders and Village Officer's records. The present morphometric analysis was restricted to adults aged ≥19 years to ensure skeletal maturity and measurement reliability.

The final adult sample distribution for each community is presented in Table I.

Table I. Age and sex distribution of adult participants from Yakkure and Henanigala indigenous populations.

| Age Group | Village | Male (n) | Female (n) | Total (n) |
|---|---|---|---|---|
| **19 – 29** | Yakkure | 16 | 24 | **40** |
| | Henanigala | 15 | 29 | **44** |
| **30 – 39** | Yakkure | 16 | 14 | **30** |
| | Henanigala | 12 | 37 | **49** |
| **40 – 49** | Yakkure | 8 | 14 | **22** |
| | Henanigala | 12 | 10 | **22** |
| **50 – 59** | Yakkure | 16 | 28 | **44** |
| | Henanigala | 8 | 14 | **22** |
| **60+** | Yakkure | 12 | 16 | **28** |
| | Henanigala | 11 | 16 | **27** |
| **Total** | | **126** | **202** | **328** |

### Data Collection

Facial measurements were performed according to standardized protocols outlined in the NHANES Anthropometric Procedure Manual (Centers for Disease Control and Prevention, 2009). To minimize intra-observer error, each measurement was taken twice using a digital sliding caliper, and the arithmetic mean was recorded to the nearest millimeter. The Technical Error of Measurement (TEM) was calculated to assess consistency. The TEM for linear dimensions ranged from 0.34 mm to 0.36 mm, and the relative TEM was consistently < 1 % (well within the acceptable limit of < 2 %), indicating high reliability of the anthropometric data.

### Data Analysis

Quantitative data were analyzed using SPSS and Microsoft Excel. Descriptive statistics (mean, minimum, maximum, standard deviation) were generated for all variables. Parametric comparisons between the Yakkure and Henanigala adult populations were conducted using Independent Samples t-tests, with statistical significance set at $p < 0.05$. Facial indices were calculated to evaluate proportional morphology. To interpret facial shape, indices were categorized using standard international classification systems: Upper Facial Morphology was classified using the Martin–Saller system (Martin & Saller, 1957; Farkas, 1994). Total Facial Morphology was classified based on the ranges defined in Gray's Anatomy (Williams *et al.*, 1995).

### Ethical Considerations

Ethical clearance for the study was obtained from the Ethics Review Committee of the Faculty of Medical Sciences, University of Sri Jayewardenepura (Ref. No. 18/18). Informed consent was obtained from all participants prior to data collection.

## RESULTS

### Descriptive Morphometry

The final sample consisted of 328 individuals, equally stratified between the Yakkure (n=164) and Henanigala (n=164) settlements, comprised 126 males (38.4 %) and 202 females (61.6 %). The age distribution was restricted to adults (19 years), with a mean age of 43.94 years (SD = 15.68) for Yakkure and 41.23 years (SD = 16.10) for Henanigala. An independent samples t-test revealed no statistically significant difference in the age distributions of the two village populations ($t = 1.54$, $p = 0.12$), indicating the groups were well matched for age.

Descriptive statistics for TFH, UFH, LFH, and facial indices are summarized in Table II. Across both populations, males displayed consistently larger linear dimensions than females, indicating pronounced sexual dimorphism in size.

At the population level, Yakkure individuals exhibited slightly larger mean facial measurements than Henanigala individuals. Pooled TFH averaged 108.96±6.50 mm in Yakkure and 106.59 ± 5.32 mm in Henanigala; similar patterns were observed for UFH, LFH, and FB. In contrast, proportional indices (UFI and TFI) showed only modest differences, suggesting that overall facial shape remained largely conserved despite population differences in size.

### Interpopulation Variation

A statistical comparison between the two Indigenous communities revealed a clear divergence in vertical facial morphology (Table III). The Yakkure population consistently exhibited significantly larger vertical dimensions than the Henanigala population. Specifically, TFH was significantly greater in Yakkure (108.96±6.50 mm) compared to Henanigala (106.59±5.33 mm; $t=3.60$, $p < 0.001$). This pattern of elongation was observed across the entire vertical axis, with both UFH ($t=4.47$, $p<0.001$) and LFH ($t=5.73$, $p< 0.001$) showing highly significant differences.

In contrast to the vertical dimensions, horizontal FB did not vary significantly between the groups ($t=1.89$, $p<0.060$). This disparity between vertical and horizontal scaling resulted in significant differences in facial shape. The UFI was significantly higher in the Yakkure group ($p<0.003$), indicating a relatively narrower and longer upper face compared to the broader upper face of the Henanigala population. The TFI followed a similar trend toward

elongation in Yakkure, though the difference fell just short of statistical significance ($p<0.066$).

Table II. Population and sex-based descriptive statistics for facial measurements.

| Measurement | Population | Sex | N | Min | Max | Mean (SD) |
|---|---|---|---|---|---|---|
| **TFH (mm)** | **Yakkure** | Male | 68 | 98.62 | 121.17 | 112.54 (5.56) |
| | | Female | 96 | 91.68 | 117.19 | 106.43 (5.93) |
| | | **Pooled** | **164** | **91.68** | **121.17** | **108.96 (6.50)** |
| | **Henanigala** | Male | 58 | 97.75 | 118.03 | 108.70 (5.47) |
| | | Female | 106 | 96.67 | 118.00 | 105.44 (4.89) |
| | | **Pooled** | **164** | **96.67** | **118.03** | **106.59 (5.32)** |
| | **Grand Total** | | **328** | **91.68** | **121.17** | **107.78 (6.05)** |
| **UFH (mm)** | **Yakkure** | Male | 68 | 57.81 | 72.63 | 65.72 (3.69) |
| | | Female | 96 | 55.37 | 71.28 | 61.64 (3.95) |
| | | **Pooled** | **164** | **55.37** | **72.63** | **63.33 (4.33)** |
| | **Henanigala** | Male | 58 | 54.80 | 70.74 | 62.46 (4.81) |
| | | Female | 106 | 51.58 | 69.85 | 60.48 (4.02) |
| | | **Pooled** | **164** | **51.58** | **70.74** | **61.18 (4.41)** |
| | **Grand Total** | | **328** | **51.58** | **72.63** | **62.26 (4.49)** |
| **LFH (mm)** | **Yakkure** | Male | 68 | 51.75 | 71.55 | 63.57 (4.56) |
| | | Female | 96 | 47.48 | 69.18 | 60.14 (4.36) |
| | | **Pooled** | **164** | **47.48** | **71.55** | **61.56 (4.75)** |
| | **Henanigala** | Male | 58 | 49.02 | 69.54 | 60.54 (5.32) |
| | | Female | 106 | 49.39 | 65.58 | 57.52 (3.87) |
| | | **Pooled** | **164** | **49.02** | **69.54** | **58.59 (4.65)** |
| | **Grand Total** | | **328** | **47.48** | **71.55** | **60.08 (4.92)** |
| **FB (mm)** | **Yakkure** | Male | 68 | 110.00 | 130.30 | 120.59 (6.55) |
| | | Female | 96 | 110.00 | 130.00 | 116.50 (5.56) |
| | | **Pooled** | **164** | **110.00** | **130.30** | **118.19 (6.30)** |
| | **Henanigala** | Male | 58 | 110.20 | 125.00 | 118.17 (4.25) |
| | | Female | 106 | 110.00 | 120.50 | 116.44 (4.74) |
| | | **Pooled** | **164** | **110.00** | **125.00** | **117.05 (4.64)** |
| | **Grand Total** | | **328** | **110.00** | **130.30** | **117.62 (5.55)** |
| **UFI** | **Yakkure** | Male | 68 | 47.05 | 65.24 | 54.62 (3.83) |
| | | Female | 96 | 46.10 | 64.80 | 53.04 (4.43) |
| | | **Pooled** | **164** | **46.10** | **65.24** | **53.69 (4.26)** |
| | **Henanigala** | Male | 58 | 45.55 | 59.11 | 52.91 (4.34) |
| | | Female | 106 | 46.27 | 62.49 | 52.00 (3.74) |
| | | **Pooled** | **164** | **45.55** | **62.49** | **52.33 (3.97)** |
| | **Grand Total** | | **328** | **45.55** | **65.24** | **53.01 (4.17)** |
| **TFI** | **Yakkure** | Male | 68 | 80.80 | 106.85 | 93.55 (6.23) |
| | | Female | 96 | 76.40 | 106.05 | 91.58 (6.97) |
| | | **Pooled** | **164** | **76.40** | **106.85** | **92.39 (6.73)** |
| | **Henanigala** | Male | 58 | 82.99 | 103.44 | 92.11 (5.68) |
| | | Female | 106 | 82.93 | 107.27 | 90.66 (4.78) |
| | | **Pooled** | **164** | **82.93** | **107.27** | **91.17 (5.15)** |
| | **Grand Total** | | **328** | **76.40** | **107.27** | **91.78 (6.01)** |

Note: TFH = Total Facial Height; UFH = Upper Facial Height; LFH = Lower Facial Height; FB = Facial Breadth; UFI = Upper Facial Index; TFI = Total Facial Index. N = Sample Size; Min = Minimum; Max = Maximum; SD = Standard Deviation.

Table III. Comparison of facial measurements and indices between Yakkure and Henanigala.

| Measurement | Yakkure (n=164) Mean ± SD | Henanigala (n=164) Mean ± SD | t-value | p-value |
|---|---|---|---|---|
| **TFH (mm)** | 108.96 ± 6.50 | 106.59 ± 5.33 | 3.60 | **< 0.001*** |
| **UFH (mm)** | 63.33 ± 4.33 | 61.18 ± 4.41 | 4.47 | **< 0.001*** |
| **LFH (mm)** | 61.56 ± 4.75 | 58.59 ± 4.65 | 5.73 | **< 0.001*** |
| **FB (mm)** | 118.20 ± 6.30 | 117.05 ± 4.63 | 1.89 | 0.060 (ns) |
| **UFI** | 53.70 ± 4.26 | 52.32 ± 3.98 | 3.02 | **0.003*** |
| **TFI** | 92.39 ± 6.73 | 91.17 ± 5.15 | 1.85 | 0.066 (ns) |

*Note: (ns) = not significant; Significant difference at $p < 0.01$.

Table IV. Analysis of sexual dimorphism.

| Measurement | Male (n=126) Mean ± SD | Female (n=202) Mean ± SD | t-value | p-value |
|---|---|---|---|---|
| **TFH (mm)** | 110.77 ± 5.82 | 105.91 ± 5.42 | 7.68 | **0.001*** |
| **UFH (mm)** | 64.22 ± 4.52 | 61.03 ± 4.02 | 6.65 | **0.001*** |
| **LFH (mm)** | 62.18 ± 5.14 | 58.77 ± 4.31 | 6.47 | **0.001*** |
| **FB (mm)** | 119.48 ± 5.72 | 116.47 ± 5.13 | 4.94 | **0.001*** |
| **UFI** | 53.84 ± 4.15 | 52.50 ± 4.11 | 2.86 | **0.004*** |
| **TFI** | 92.88 ± 6.00 | 91.09 ± 5.93 | 2.65 | **0.009*** |

*Values are presented as Mean ± SD. Significant difference at $p < 0.01$.

## Sexual Dimorphism

Analysis of the total pooled sample demonstrated pronounced sexual dimorphism in facial morphometry (Table IV). As expected, males exhibited significantly larger absolute dimensions than females across all measured variables, including TFH, UFH, LFH, and FB (all $p < 0.001$). The magnitude of difference was most pronounced in TFH ($t=7.68$) and UFH ($t=6.65$). Importantly, sexual dimorphism was not limited to size but also extended to facial shape. Contrary to the assumption that indices are sex-independent, this study found significant differences in facial proportions. Males displayed a significantly higher UFI ($p<0.004$) and TFI ($p<0.009$) compared to females.

## Age-Related Trends

Detailed descriptive statistics stratified by population, sex, and age group are presented in Table V. Across the adult lifespan, facial dimensions generally demonstrated morphological stability, with no drastic increase or decrease in linear measurements (TFH, FB) observed after the third decade of life. However, distinct variations appeared when comparing the two populations within specific age groups.

Interpopulation analysis revealed a "divergence-convergence" pattern (Table VI). Differences between Yakkure and Henanigala were strongest in early and middle adulthood (19–49 years) but manifested differently between the sexes. In the youngest age group (19–29 years), significant differences were driven primarily by males, who exhibited significant variation in FB ($t=4.40$, $p<0.001$) and UFH ($t=3.22$, $p=0.004$), whereas females in this age group were statistically homogeneous. Conversely, in the 30–39 age group, females showed strong divergence in vertical dimensions, particularly LFH ($t=5.14$, $p<0.001$), while males showed greater stability.

Table V. Population, age, and sex-specific descriptive statistics (Mean ± SD) of facial measurements.

| Sex | Age Group | Population | N | TFH (mm) | UFH (mm) | LFH (mm) | FB (mm) | UFI | TFI |
|---|---|---|---|---|---|---|---|---|---|
| Female | 19–29 | Yakkure | 24 | 104.95 | 59.49 | 59.33 | 117.75 | 50.58 | 89.27 |
| | | Henanigala | 29 | 106.40 | 58.82 | 59.08 | 117.39 | 50.13 | 90.70 |
| | 30–39 | Yakkure | 14 | 109.03 | 62.31 | 62.25 | 117.53 | 53.06 | 92.85 |
| | | Henanigala | 37 | 104.60 | 59.93 | 56.28 | 115.65 | 52.06 | 90.52 |
| | 40–49 | Yakkure | 14 | 103.92 | 60.59 | 59.84 | 114.55 | 52.99 | 90.90 |
| | | Henanigala | 10 | 106.08 | 59.88 | 58.17 | 114.14 | 52.56 | 93.12 |
| | 50–59 | Yakkure | 28 | 107.89 | 62.35 | 60.63 | 116.63 | 53.64 | 92.83 |
| | | Henanigala | 14 | 106.10 | 61.27 | 60.12 | 118.70 | 51.74 | 89.54 |
| | 60+ | Yakkure | 16 | 105.96 | 63.99 | 58.96 | 115.23 | 55.73 | 92.32 |
| | | Henanigala | 16 | 104.63 | 64.39 | 54.85 | 115.95 | 55.61 | 90.35 |
| Male | 19–29 | Yakkure | 16 | 112.64 | 65.36 | 64.16 | 125.12 | 52.30 | 90.12 |
| | | Henanigala | 15 | 110.21 | 61.12 | 61.77 | 117.53 | 52.06 | 93.86 |
| | 30–39 | Yakkure | 16 | 113.40 | 64.03 | 64.38 | 119.10 | 53.94 | 95.49 |
| | | Henanigala | 12 | 108.90 | 60.38 | 63.69 | 118.60 | 51.00 | 91.98 |
| | 40–49 | Yakkure | 8 | 117.05 | 67.20 | 67.49 | 122.80 | 54.85 | 95.36 |
| | | Henanigala | 12 | 108.30 | 61.94 | 60.35 | 115.40 | 53.80 | 94.05 |
| | 50–59 | Yakkure | 16 | 111.15 | 65.76 | 62.34 | 119.09 | 55.30 | 93.56 |
| | | Henanigala | 8 | 110.74 | 65.79 | 61.65 | 121.30 | 54.23 | 91.31 |
| | 60+ | Yakkure | 12 | 110.17 | 67.36 | 60.75 | 117.07 | 57.57 | 94.28 |
| | | Henanigala | 11 | 105.36 | 64.68 | 54.81 | 119.31 | 54.26 | 88.30 |

*Note: Comparisons are between Yakkure and Henanigala within each age/sex cohort. Only key variables shown for brevity. Significant at $p < 0.05$.

Notably, a period of morphological convergence was observed in the 50–59 age group, where no statistically significant differences were found between the Yakkure and Henanigala populations for any facial measurement in either sex. However, significant variation reemerged in the elderly age group (60+), specifically in LFH, which differed significantly for both females ($p<0.003$) and males ($p<0.010$). These fluctuating patterns suggest that the observed variation is likely influenced by cohort-specific factors (such as recent environmental or genetic shifts in younger generations) rather than uniform biological aging.

**Facial Type Distribution**

The frequency distribution of facial indices (Table VII) revealed distinct morphological patterns between the two communities. For the UFI, the Mesene (medium) type was dominant in both groups, accounting for 47.6 % of the Yakkure and 42.7 % of the Henanigala population. However, significant variance was observed at the extremes. The Henanigala population exhibited a notably higher frequency of broad upper faces (Euryene), comprising 28.7 % of the sample compared to only 19.5 % in Yakkure. Conversely, the Yakkure population displayed a shift toward extreme narrowness, with 8.5 % classified as Hyperleptene, whereas this type was nearly absent in Henanigala (1.2 %).

This pattern of divergence was even more pronounced in the TFI. The Henanigala population showed a clear preference for intermediate facial shapes, with the Mesoprosopic type being the most frequent (38.4 %), followed by Leptoprosopic (28.7 %). In contrast, the Yakkure population exhibited a marked trend toward facial elongation; the majority of Yakkure individuals fell into the long faced categories, with Hyperleptoprosopic being the single most common type (34.1 %), followed closely by Leptoprosopic (30.5 %). Only 20.7 % of Yakkure individuals were Mesoprosopic, compared to nearly double that proportion in Henanigala.

Table VI. Age-Based interpopulation dimorphism of facial measurements (Independent Samples t-test).

| Age Group | Measurement | Female | Female | Male | Male |
|---|---|---|---|---|---|
| **19 – 29** | TFH | -1.31 | 0.197 | 1.54 | 0.136 |
| | UFH | 0.84 | 0.407 | 3.22 | **0.004*** |
| | LFH | 0.28 | 0.782 | 2.49 | **0.019*** |
| | FB | 0.29 | 0.771 | 4.40 | **< 0.001*** |
| | TFI | -1.23 | 0.227 | -2.41 | **0.022*** |
| **30 – 39** | TFH | 2.85 | **0.006*** | 2.26 | **0.033*** |
| | UFH | 2.07 | **0.043*** | 2.08 | 0.056 |
| | LFH | 5.14 | **< 0.001*** | 0.36 | 0.728 |
| **50 – 59** | **All Variables** | - | *(ns)* | - | *(ns)* |
| **60+** | LFH | 3.24 | **0.003*** | 2.82 | **0.010*** |
| | TFI | 0.79 | 0.438 | 2.33 | **0.030*** |

Note: Comparisons are between Yakkure and Henanigala within each age/sex cohort. Only key variables shown for brevity. Significant at $p < 0.05$.

Table VII. Frequency distribution of upper facial and total facial types.

| Classification | Facial Type | Yakkure (n) | Yakkure (%) | Henanigala (n) | Henanigala (%) |
|---|---|---|---|---|---|
| **Upper Facial Index** | | | | | |
| < 45.0 | Hypereuryene | 0 | 0.0 % | 0 | 0.0 % |
| 45.0 – 49.9 | Euryene | 32 | 19.5 % | 47 | 28.7 % |
| 50.0 – 54.9 | Mesene | 78 | 47.6 % | 70 | 42.7 % |
| 55.0 – 59.9 | Leptene | 40 | 24.4 % | 45 | 27.4 % |
| ≥ 60.0 | Hyperleptene | 14 | **8.5 %** | 2 | **1.2 %** |
| **Total Facial Index** | | | | | |
| < 79.9 | Hypereuryprosopic | 4 | 2.4 % | 0 | 0.0 % |
| 80.0 – 84.9 | Euryprosopic | 20 | 12.2 % | 18 | 11.0 % |
| 85.0 – 89.9 | Mesoprosopic | 34 | 20.7 % | 63 | **38.4 %** |
| 90.0 – 94.9 | Leptoprosopic | 50 | 30.5 % | 47 | 28.7 % |
| ≥ 95.0 | Hyperleptoprosopic | 56 | **34.1 %** | 36 | 22.0 % |

## DISCUSSION

This study presents the first comprehensive morphometric comparison of the Yakkure and Henanigala Vedda populations and establishes population specific reference data for adult facial dimensions and proportions. Three key findings emerge: (1) the two populations differ consistently in facial size and type; (2) both exhibits pronounced sexual dimorphism, particularly in vertical facial dimensions; and (3) proportional indices, such as the FI and UFI, remain relatively stable despite variability in absolute measurements. These results underscore the internal heterogeneity of Sri Lanka's Indigenous populations and highlight the combined influence of isolation, admixture, and ecological context on facial morphology.

Population-Specific Morphometric Patterns: Yakkure individuals displayed consistently greater vertical facial dimensions (TFH, UFH, and LFH) compared to the Henanigala group. This pronounced vertical elongation shows partial resemblance in vertical facial proportions with historical observations of the Veddas (Virchow, 1881; Sarasin & Sarasin, 1886; Kennedy, 1971) and is supported by biometric comparisons showing significant differences in facial height between traditional Vedda groups (Dambana) and the Sinhalese (Wikramanayake & Chandrasekara, 1996). These dimensions are also comparable to patterns observed in other specific groups, including Coastal Veddas (Liyanage *et al*., 2024), North Indians (Prasanna *et al*., 2013; Zohra *et al*., 2022), East African Nilotes, (Hiernaux, 1974), and Andamanese groups (Kennedy, 2000; Henn *et al*., 2011). Notably, Yakkure morphometry parallels the elongated facial form of prehistoric Balangoda Man, whose skeletal remains from Batadomba-lena and Fa-Hien-lena exhibit similar vertical development (Deraniyagala, 1992). This biological continuity is further supported by archaeological evidence of specialized rainforest foraging and microlithic technologies that have persisted in these wet zone environments for over 45,000 years (Wijeyapala, 1997; Perera, 2010; Wedage *et al*., 2019). While multifactorial in origin, the Yakkure pattern is consistent with long term genetic continuity, reduced admixture, ecological conditions typical of long-term Dry Zone occupation. The recurrence of elongated facial morphology across several Vedda subgroups suggests that this trait may have been historically widespread within the Indigenous continuum.

In contrast, Henanigala individuals display more moderate vertical facial dimensions and broader upper facial proportions, resulting in a tendency toward mesoprosopy. This pattern is consistent with morphometric data reported for the Sinhalese (Ranaweera *et al*., 2018), South Indian populations (Kumari *et al*., 2015), Han Chinese (Kurnia *et al*., 2013), Indonesians (Artaria, 2008), and Malaysians (Yesmin *et al*., 2014). Given the Henanigala subgroup's well-documented resettlement history and increased interpopulation interaction following the Mahaweli Development Programme (Ananda & Nahallage, 2022, 2024), their morphology probably reflects recent admixture and sociocultural change, particularly through assimilation with the Sinhalese. However, their morphometric affinities with broader groups, such as Australian Aboriginals (Birdsell, 1993; Brown, 1997), underscore deep-time population connections that require further investigation. A comprehensive re-evaluation is essential to establishing these deep-time population affinities and building a robust hypothesis regarding the early dispersals of Homo sapiens from Africa throughout the Asian region.

Sexual Dimorphism and Its Mechanisms: Both populations showed strong sexual dimorphism in linear measurements, with males consistently larger in TFH, UFH, LFH, and FB. However, the TFI and UFI showed minimal sex-linked variation, indicating that facial shape remains relatively conserved even when size differs. Yakkure males displayed more pronounced vertical elongation, whereas Henanigala males exhibited greater heterogeneity, possibly reflecting the combined effects of mixed ancestry and variable developmental environments. Female morphology in both groups was comparatively conserved, mirroring global patterns suggesting that female facial traits often exhibit lower eco sensitivity and interpopulation variance than males reflecting distinct dynamics in sexual dimorphism.

Age Stratified Patterns and Developmental Considerations: Interpopulation differences were strongest in early and middle adulthood (19–39 years), lessened in the 50–59 age group, and reemerged among older individuals. This temporary convergence is consistent with established models of craniofacial growth and remodeling, which indicate that facial height and proportional relationships stabilize after early adulthood, with only modest age related changes thereafter (Enlow & Hans, 1996). This biological stabilization may temporarily obscure population specific differences, which become more apparent again in later ages. The divergence observed in the oldest group likely reflects a cohort effect, representing distinct early life environmental or nutritional conditions rather than aging biology alone. Yakkure individuals exhibited more stable patterns of sexual dimorphism across age groups, whereas the Henanigala group showed fluctuating dimorphism. These fluctuations may indicate greater developmental plasticity in response to changing childhood environments and recent demographic transitions.

Facial Type Distributions and Population History: Facial type classifications further support the metric findings: Yakkure individuals, particularly males, exhibit a higher prevalence of mesene, leptene, and hyperleptene types, consistent with their distinctively elongated facial morphology. Conversely, Henanigala individuals demonstrate a greater representation of euryene and mesoprosopic types. These trends parallel broader regional distinctions between specialized dry-zone hunter-gatherers, which often exhibit relatively elongated craniofacial forms consistent with hypotheses of thermoregulatory adaptation, and populations with mixed or agricultural histories, which tend to show broader and more intermediate facial proportions (Carey & Steegmann, 1981; Beals *et al*., 1984; Noback *et al*., 2011).

Synthesis and Implications: Overall, the two Vedda populations retain distinct craniofacial signatures shaped by their differing histories of isolation, admixture, and ecological exposure. These results do not imply a single causal mechanism but illustrate how genetic continuity, demographic change, and environmental adaptation collectively shape facial morphology. Beyond their anthropological significance, these findings offer valuable population-specific baselines for forensic, archaeological, and comparative research. The demonstrated variability within Vedda subgroups further emphasizes the limitations of relying on generalized South Asian standards for Indigenous groups.

## CONCLUSIONS

This study provides the first standardized facial morphometric baseline for the Yakkure and Henanigala Vedda, revealing clear intra-Indigenous variation despite shared ancestry. Yakkure individuals exhibit consistently greater vertical facial dimensions, whereas Henanigala individuals show comparatively broader and more moderate proportions, reflecting differing histories of isolation, admixture, and ecological pressures. Despite these size differences, proportional indices remained largely stable, and facial type distributions confirmed population specific structuring. These findings offer essential reference data for anthropological and forensic applications and highlight the need for further genomic and osteological research to clarify the microevolutionary processes underlying these patterns.

**ANANDA, D. T. H. & NAHALLAGE, C. A. D.** Estudio comparativo de la morfometría facial de los Vedda Yakkure y Henanigala: Perspectivas sobre las afinidades poblacionales y los patrones evolutivos. *Int. J. Morphol., 44(3)*:747-755, 2026.

**RESUMEN:** La población indígena de Sri Lanka, los Vedda, demuestra una considerable continuidad biológica con los primeros habitantes de Homo sapiens de la isla. A pesar de su importancia para evaluar la continuidad evolutiva y las afinidades poblacionales, los datos morfométricos faciales contemporáneos siguen siendo limitados. Este estudio proporciona la primera comparación detallada de la morfometría facial entre dos grupos indígenas Vedda, los Yakkure y los Henanigala, para documentar la variación específica de cada población y situarla dentro de patrones regionales más amplios. Se evaluó una muestra intencional de 328 adultos (164 por grupo) utilizando protocolos antropométricos estandarizados. Las mediciones incluyeron la altura facial total (AFT), la altura facial superior (AFS), la altura facial inferior (AFI) y el ancho facial (AF), a partir de los cuales se derivaron los índices faciales. Se observó un marcado dimorfismo sexual en ambas poblaciones ($p < 0,001$), con los hombres exhibiendo dimensiones lineales significativamente mayores en todas las variables; sin embargo, los índices de forma proporcionales se mantuvieron relativamente conservados entre los sexos. A nivel poblacional, los Yakkure exhibieron consistentemente dimensiones verticales significativamente mayores que los Henanigala, con AFT media (108,96 mm *vs*. 106,59 mm), AFS (63,33 mm *vs*. 61,18 mm) y AFI (61,56 mm *vs*. 58,59 mm) que difirieron significativamente ($p < 0,001$). Sin embargo, el ancho facial (AF) no difirió significativamente entre los grupos ($p > 0,05$). En consecuencia, los Yakkure mostraron un Índice Facial Superior (IFS) significativamente mayor (53,70 frente a 52,32), lo que indica proporciones faciales superiores relativamente más estrechas. Morfológicamente, las proporciones de los Yakkure se alinean con poblaciones de rostro alargado verticalmente (leptoprosópico a hiperleptoprosópico), como los Vedda históricos, los Vedda costeros, los tamiles de Sri Lanka, los indios del norte, los nilotas de África Oriental y los grupos andamaneses. Por el contrario, los Henanigala muestran afinidades más amplias (mesoprosópicas) comparables a las de los cingaleses, los indios del sur, los Orang Asli (Malasia), los andhranianos, los indonesios y los aborígenes australianos. Estos hallazgos resaltan una clara diferenciación intra-Vedda, probablemente moldeada por distintos grados de aislamiento, mestizaje y adaptación ecológica. Como primer análisis específico de población de este tipo, este estudio proporciona datos de referencia esenciales para comparaciones antropológicas, forenses y arqueológicas en el sur de Asia.

**PALABRAS CLAVE: Antropometría; Rostro; Pueblos indígenas; Características sexuales; Sri Lanka.**

## REFERENCES

Ananda, D. T. H. & Nahallage, C. A. D. Evaluation of cephalic index of the Henanigala indigenous community in Sri Lanka. *Int. J. Multidiscip. Stud., 11(1)*:1-10, 2024.

Ananda, D. T. H. & Nahallage, C. A. D. *Present Sociocultural Status of the Sri Lankan Indigenous People (the Veddas) and Future Challenges.* In: Chatterjee, U.; Kashyap, A.; Everard, M.; Krishna Panda, G. & Mahata, D. (Eds.). Indigenous People and Nature: Insights for Social, Ecological, and Technological Sustainability. Amsterdam, Elsevier, pp.381-96, 2022.

Artaria, M. D. Comparative study of cephalometric traits in various ethnic groups in Indonesia. *Majalah Biomorfol., 21(1)*:25-36, 2008.

Beals, K. L.; Smith, C. L. & Dodd, S. M. Brain size, cranial morphology, climate, and time machines. *Curr. Anthropol., 25(3)*:301-30, 1984.

Birdsell, J. B. *Microevolutionary Patterns in Aboriginal Australia: A Gradient Analysis of Clines.* New York, Oxford University Press, 1993.

Brow, J. The changing structure of appropriations in Vedda agriculture. *Am. Ethnol., 5*:448-67, 1978.

Brown, P. *Australian Palaeoanthropology*. In: Spencer, F. (Ed.). History of Physical Anthropology: An Encyclopedia. New York, Garland Publishing, 1997. pp.138-45.

Carey, J. W. & Steegmann Jr., A. T. Human nasal protrusion, latitude, and climate. *Am. J. Phys. Anthropol., 56(3)*:313-9, 1981.

Centers for Disease Control and Prevention (CDC). *National Health and Nutrition Examination Survey (NHANES) Anthropometry Procedures Manual*. Washington D.C., U.S. Department of Health and Human Services, 2009.

Coon, C. S. *The Living Races of Man.* London, Jonathan Cape, 1965.

Deraniyagala, S. U. Prag Eythihasika Pasuthalaya. *Mahawali Wanshaya, 1*:60-3, 1985.

Deraniyagala, S. U. *The Prehistory of Sri Lanka: An Ecological Perspective.* Colombo, Department of Archaeology, 1992.

Enlow, D. H. & Hans, M. G. *Essentials of Facial Growth*. Philadelphia, W. B. Saunders, 1996.

Farkas, L. G. *Anthropometry of the Head and Face*. 2nd ed. New York, Raven Press, 1994.

Hiernaux, J. *The People of Africa.* New York, Charles Scribner's Sons, 1974.

Henn, B. M.; Gignoux, C. R.; Jobin, M.; Granka, J. M.; Macpherson, J. M.; Kidd, J. M.; Rodríguez-Botigué, L.; Ramachandran, S.; Hon, L.; Brisbin, A.; *et al*. Hunter-gatherer genomic diversity suggests a southern African origin for modern humans. *Proc. Natl. Acad. Sci. U. S. A., 108(13)*:5154-62, 2011.

Kennedy, K. A. R. The concept of the Vedda phenotypic pattern: A critical analysis of research on the osteological collections of a remnant population. *Spolia Zeylan., 32(1)*:25-60, 1971.

Kennedy, K. A. R. *God-Apes and Fossil Men: Paleoanthropology in South Asia.* Ann Arbor, Michigan Press, 2000.

Kennedy, K. A.; Deraniyagala, S. U.; Roertgen, W. J.; Chiment, J. & Disotell, T. Upper Pleistocene fossil hominids from Sri Lanka. *Am. J. Phys. Anthropol., 72(4)*:441-61, 1987.

Kumari, K. L.; Babu, P. V. S. S. V.; Kumari, P. K. & Nagamani, M. A study of cephalic index and facial index in Visakhapatnam, Andhra Pradesh, India. *Int. J. Res. Med. Sci., 3(3)*:656-8, 2015.

Kurnia, C.; Susiana, S. & Husin, W. Facial indices in Chinese ethnic students aged 20–22. *J. Dent. Indones., 19(1)*:1-4, 2013.

Liyanage, S.; Devasingha, D. M. L. C. D.; Dissanayake, D. M. P. V. & Ranaweera, L. A morphometric analysis of craniofacial features of the coastal indigenous people in Sri Lanka. *Int. J. Morphol., 42(6)*:1638-45, 2024.

Martin, R. & Saller, K. *Lehrbuch der Anthropologie.* Stuttgart, Gustav Fischer Verlag, 1957.

Noback, M. L.; Harvati, K. & Spoor, F. Climate-related variation of the human nasal cavity. *Am. J. Phys. Anthropol., 145(4)*:599-614, 2011.

Perera, N. *Prehistoric Sri Lanka: Late Pleistocene Rockshelters and an Open-Air Site*. BAR International Series 2142. Oxford, Archaeopress, 2010.

Prasanna, L. C.; Bhosale, S.; D'Souza, A. S.; Mamatha, H.; Thomas, R. H. & Sachin, K. S. Facial indices of North and South Indian adults: Reliability in stature estimation and sexual dimorphism. *J. Clin. Diagn. Res., 7(8)*:1540-2, 2013.

Ranaweera, A. R. L. K.; Karunarathne, I. & Wijayasooriya, L. Anthropometric analysis of the craniofacial region in the Sinhalese population of Sri Lanka. *Int. J. Sci. Res., 7(5)*:26-9, 2018.

Sarasin, C. F. & Sarasin, P. B. Outline of two years research in Ceylon. *J. R. Asiat. Soc. (Ceylon Branch), 9*:289-305, 1886.

Seligman, C. G. & Seligman, B. Z. *The Veddas. (Trans. C. Ranasinghe).* Colombo, Surasa Publication, 2011.

Silva, P. D. & Punchihewa, A. G. *Socio-Anthropological Research Project on Vedda Community in Sri Lanka.* Colombo, University of Colombo, 2011.

Stoudt, H. W. *The Physical Anthropology of Ceylon.* Ceylon National Museums Ethnographic Series Publication No. 2. Colombo, National Museums of Ceylon, 1961.

Virchow, R. The Veddas of Ceylon, and their relation to the neighbouring tribes. *J. R. Asiat. Soc. (Ceylon), 9*:349-495, 1881.

Wedage, O.; Amano, N.; Langley, M. C.; Douka, K.; Blinkhorn, J.; Crowther, A.; Deraniyagala, S.; Kourampas, N.; Simpson, I.; Perera, N.; *et al*. Specialized rainforest hunting by Homo sapiens ~45,000 years ago. *Nat. Commun., 10(1)*:739, 2019.

Wijeyapala, W. H. *New Light on the Prehistory of Sri Lanka in the Context of Recent Investigations of Cave Sites*. PhD Thesis. Peradeniya, University of Peradeniya, 1997.

Williams, P. L.; Bannister, L. H.; Berry, M. M.; Collins, P.; Dyson, M.; Dussek, J. E. & Ferguson, M. W. J. *Gray's Anatomy*. 38th ed. Edinburgh, Churchill Livingstone, 1995.

Wikramanayake, E. R. & Chandrasekara, M. S. *Anthropometry of Veddas of Dambana.* Proceedings of the Annual Research Sessions, University of Peradeniya, Sri Lanka, 1996. pp.144.

Yesmin, T.; Thwin, S. S.; Uisen, S. A. & Afrin, S. A study of facial index among Malay population. *J. Anthropol., 2014*:726974, 2014.

Zohra, B.; Paswan, D.; Potdar, P. & Sharma, J. Morphometric study of facial index in North Indian population. *J. Pharm. Negat. Results, 13(Special Issue 6)*:567-70, 2022.

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