COMPARATIVE STUDY OF ANGULAR AND LINEAR MEASUREMENTS OF FACIAL SOFT TISSUE PROFILE OF ALAGO AND EGGON ETHNIC GROUPS IN NASARAWA STATE, NIGERIA

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BY

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN HUMAN ANATOMY

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AUGUST, 2023

DECLARATION

I, JOSEPH OLOTOCHE JOHN declare that the work in the dissertation titled ‘‘**Comparative study of Angular and Linear Measurements of facial Soft Tissue Profile of Eggon and Alago Ethnic Groups in Nasarawa State, Nigeria**’’ was carried out by me in the Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Medical Sciences, Ahmadu Bello University, Zaria. The information used for my literature review was fully acknowledged in the text and references. This dissertation has not been presented in any scientific gathering, neither has it been presented for another degree or diploma at any other institution.

JOHN JOSEPH OLOTOCHE …… …….

Signature **Date**

CERTIFICATION

This dissertation entitled ‘‘**Comparative study ofAngular and Linear Measurements of facial Soft Tissue Profile of Eggon and Alago Ethnic Groups in Nasarawa State, Nigeria**’’ by John Joseph Olotoche meet the regulation governing the award of Master of Science (M.Sc.) degree in Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Medical Sciences, Ahmadu Bello University, Zaria, under the supervision of **Dr. J. A. Timbuak and Dr. M. Tanko (JP)**. It is therefore approved for the contribution to knowledge and literary presentation.

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DEDICATION

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ABSTRACT

The knowledge of soft-tissue anthropometric profiles can never be overemphasized in the discipline of medicine, especially in specialties such as orthognathic and plastic surgery, orthodontics, and dental prosthesis. Although direct anthropometry was for years required for this aim, the use of standardized photography today is of the highest importance to achieve biological classification of individual's and for clinical research . Therefore, this research is essential for clinicians such as those working in the maxillofacial discipline, as knowledge of the standard anthropometric features of the face of a specific ethnic group would guide the repair of affected areas in their patient. This study was carried out to provide a data base and facial norms of soft tissue profile analysis of the Alago and Eggon adolescent and adults which is very important in forensic and investigative studies. This study was also aimed at showing sexual dimorphism in these anthropometric facial profile parameters within the adolescents and adults of both ethnic groups. Also, to investigate the relationship between various linear and angular facial parameters considered in the present study. A total of five hundred and eighty one subjects (students and non-students) participated in this study (n=581).This study comprising of 315 males and 266 females from Alago and Ethnic groups was conducted in Nasarawa State, Nigeria. The study covered Alago and Eggon adolescents and adults between the age of 13-32. Ethical clearance was obtained from the Health Research Ethics Committee on Human Subjects of the Ahmadu Bello University Zaria and a proforma was issued to the subjects. Pictures were taken in frontal and lateral position and exported to a computer. On the computer the Face arth software was used to measure the linear and angular parameters in the study.The angles measured were : facial convexity angle, upper lip angle, nasolabial angle, nasofacial angle, nasomental angle and mentocervical angle . The linear dimensions of interest were; inferior labial sulcus, interlabial gap, upper lip length, lower lip length, total facial height, true vertical line (TVL)-nasal tip, TVL

–upper lip, TVL-lower lip, TVL-pogonion, soft tissue A-TVL, and soft tissue B-TVL. Statistical analysis was done using program Statistical Package for Social Sciences (SPSS), version 26.0. The mean values for all the linear and angular parameters were established for both ethnic groups. The present study also showed that both adult and adolescent males of both ethnic groups had higher lower lip length, nasofacial angle and mentocervical angle than the females except for the angle of facial convexity where the females showed significantly higher values ($p<0.05$). Correlation patterns were established between the linear and angular facial profile of Alago and Eggon sample population. Nasolabial, nasomental and nasofacial angles showed strong positive correlation i.e. the three angles increase in a direct proportion while the facial height showed strong negative correlation with the angle of facial convexity and the nasolabial angle of both ethic groups. The results of this study are recommended for anthropological, forensic and clinical investigations of the Alago and Egoon ethnic groups.

TABLE OF CONTENTS

Content **Page**

Title page……..……...……..i

Declaration…….…….…….....……...ii

Certification..…….....iii

Acknowledgements……..…….…….…....iv

Dedication…….…….....vi

Table of Contents…….…….....vii

List of Tables…….……...…...x

List of Figures…….…….....xiii

List of Appendices……..……..……..…...xv

List of Plate…….....xvi

Abstract……xvii

1.0 INTRODUCTION…….…….....1

1.1 Background of Study…….....1

1.2 Statement Of research Problem …….....6

1.3 Justification of Study…….....6

1.4 Aims and Objectives of Study…….……..7

1.4.1 Aim of Study…….…….……....7

1.4.2 Objectives of Study…….……7

1.5 Research Hypothesis…….……7

2.0 LITERATURE REVIEW ……...……..8

2.1 Historical Background of study……..…….....8

2.2 The face…….....17

2.2.1Anatomy of the face……..….17

2.2.1.1 Muscles of the Face……...18

2.2.1.2 Arteries of the Face…….....19

2.2.1.3Venous supply of the face……...20

2.2.1.4 Lymphatic drainage of the face……..22

2.3 Angular and linear measurements of the face……..24

2.3.1 Angular measurements of the face……26

2.3.2 Linear measurements of the face…… …….28

2.3.3 Importance of angular and linear measurements of the face……29

2.3.3.1 Orthodontic Diagnosis and Treatment Planning……29

2.3.3.2Forensic Science…….31

2.3.3.3 Rhitidectomy……..32

2.3.3.4 Cosmestic Surgery…….....32

2.3.3.5 Perception of Facial Beauty……...32

2.4 Variation……..33

3.0 MATERIALS AND METHODS…….....35

3.1 Study Location…….35

3.2 Materials……..37

3.3 Methodology…….....37

3.4 Sample Size Determination……..39

3.5 Ethical Approval…….....39

3.6 Inclusion and Exclusion Criteria…….....40

3.6.1 Inclusion Criteria…….…....40

3.6.2 Exclusion Criteria…….…....40

3.7 Statistical Analysis…….....40

4.0 RESULTS……....46

4.1 Analysis of Study Population……..46

4.2 Descriptive statistics of variables…….....46

4.5 Correlation Between Anthropometric variables……..62

5.0 DISCUSSION……...……...69

6.0 CONCLUSSION AND RECOMMENDATION……79

6.1 Summary……..79

6.2 Conclusion……...80

6.3 Recommendations…….……...80

6.4 Contribution to knowledge……..80

REFERENCES……..……....86

APPENDICES……...89

LIST OF TABLES

Table 1.1 Anthropometric Landmarks used for facial studies……..…….…....5

Table 4.1 General Descriptive Statistics for both Alago and Eggon Population……..…….……48

Table 4.2 Descriptive statistics for adolescent Alago ethnic group in relation to gender…….…….....50

Table 4.3 Descriptive statistics for adult Alago ethnic group in relation to gender……,……..……...…51

Table 4.4 Descriptive statistics for adolescent Eggon ethnic group in relation to gender…….....52

Table 4.5 Descriptive statistics for adult Eggon ethnic group in relation to gender……...……...……53

Table 4.6 Comparison of adolescent Alago boys and girls…….……..……..…….….54

Table 4.7 Comparison between adult Alago males and females……...…...……...…….….55

Table 4.8 Comparison between adolescent Eggon males and females……...……..…...…….…..56

Table 4.9 Comparison between adult Eggon males and females……..……..…...……...…….…57

Table 4.10 Comparison between adolescent Alago and Eggon boys……..…….…….....58

Table 4.11 Comparison of adolescent Alago and Eggon girls……..……..59

Table 4.12 Comparison of adult Alago and Eggon Male…….…….....60

Table 4.13 Comparison of Adult Alago and Eggon females…….…….……61

Table 4.14 General Correlation……..…….64

Table 4.15 Correlation for general males…….……..65

Table 4.16 Correlation for general females……66

LIST OF FIGURES

Fig 2.1 Musculature of the face……..…….23

Fig 2.2 Facial profile showing landmarks…….…….25

Fig 2.3 Linear measurements of the facial frontal tissue……..…….27

Fig 3.1 Map showing Nasarawa State and its local governments……..36

Fig 3.2 Showing software analysis of soft tissue profile…….…….…….38

LIST OF PLATES

Plate I Showing subject at frontal position ready for capture……...……..…42

Plate II-III Showing subject ready for capture…….……...….43

Plate IV Face art software positioning landmarks to analyze angular measurements……..…….…….…….….44

Plate V Face art software showing frontal landmarks before analyzing linear parameters……..……..……...45

LIST OF APPENDICES

Appendice I Introduction letter……..…….....…….…….....89

Appendice II Consent Form…….....……..90

LIST OF ABBREVIATIONS

Tri-G	Superior facial third
Sts-Sti	Interlabial gap
Sti-Sm	Length of lower lip
Sn-Sts	Length of upper lip
Sn-Prn	Height of nasal tip
Sn-Me	Inferior facial third
Sn-Ls/Sn-Pg	Upper lip angle
Sm-Me	Height of chin
N-Sn	Nasal length
N-Prn-Pg	Angle of Fcaial Convexity
N-Prn-Pg	Total facial angle
N-Prn/N-Pg	Nasomental angle
N-Prn/N-Ort	Vertical nasal angle
Ls-Sts	Vermilion of upper lip
Li-Sti	Vermilion of lower lip
Li-Sm-Pg	Mentolabial angle
G-Sn-Pg	Facial angle
G-Sn	Middle facial third
G-Pg/C-Me	Cervicomental angle
Cm-Sn-Ls	Nasolabial angle

CHAPTER 1

1.0 INTRODUCTION

1.1 Background of Study

A very striking occurrence in humanpopulation is the disparity in their physicalmorphology. The physical proportions of human bodyare influenced by several factors which includes: ecological, geographical, racial, age and gender factors (Golalipour *et al*., 2001). All of these factors blend in unique proportions to give variations in the physical dimensions of the human body. Physical anthropometry which most likely started due to interest in racial taxonomy provides the various methods by which human body dimensions can be estimated andmeasured (Chamella, 1997; Heidari *et al.,* 2006). Different researches have shown the advantage of anthropometric measurement as a tool for studying the variation in human population and very important in forensic science for crime investigation (Oladipo, 2008).

From the time of Ancient Greece to this day, the human face has been subject to various analyses (Anand *et al.,* 2015). The early authors who paid attention to the face were artists such as Pythagora and Leonardo Da Vinci. They set new standards aiming to express the harmony of this part of the body (Malkoc *et al.,* 2015).

The face is the most important aspect in human identification. It also functions as the centre of attraction and of the appearance. However, the attractiveness of an individual is highly subjective, being dependent on many factors involved, some of which are culture, personality, ethnic background, and age (Sahin and Gazilerli, 2001).

Taking ethnic features into consideration as well as changes due to age and sex has been emphasized (Porter *et al.,* 2001).In 2001, Porter carried out a research on the facial analysis of African American women and established their unique facial features (Vahid *et al*., 2015). In

2004, Choe did another study on the facial anthropometry of American Chinese women and analyzed their aesthetic feature. Bozkir in 2004 carried out an anthropometric study on the face of Turkish young girls (Vahid *et al., 2015*). It is now apparent that what is considered beautiful and acceptable as the norm for one culture may be different for another (Choe *et al*., 2004). Measurements of facial soft tissue have determined normal reference values in different populations, and differences in dentofacial relationships between ethnic and racial groups have been reported. Therefore, it is important to develop standards for the different populations (Vahid *et al*., 2015). As these measurements are ethnicity and population specific, it becomes imperative to collect data from more populations and make a comprehensive database (Danborno *et al*., 2008).

Since the shape of the human face depends on both the structure of the hard tissue (bone) andsoft tissue that covers it, soft tissue should be analyzed for the correct evaluation of an underlying skeletal discrepancy because of individual differences in soft tissue thickness. The quantitative assessment of the size and shape of the facial soft tissue is widely used in several medical fields such as orthodontics, maxillofacial and plastic surgery, and clinical genetics for diagnosis, treatment planning, and postoperative assessment.

Orthodontics, plastic surgery, and prosthodontics have the ability to change facial features (Munish, 2011). Improvement of facial aesthetics is a main motivating factor for many patients and parents seeking orthodontic treatment, including up to 80% of adult patients (Baumrind and Frantz 1971). Hence there is a need for clinicians working in the dentofacial area to know the esthetic standards of a face that guide the esthetic soft tissue goals in their patients (Munish, 2011).

The table below shows some parameters that can be measured using the landmarks pointed out on the face.

Table 1.1 Anthropometric landmarks used in facial studies

Landmarks	**Definition**
Trichion (Tri)	the sagittal midpoint of the forehead that borders the hairline
Glabella (G)	the most anterior point of the middle line of the forehead
Nasion (N)	the point in the middle line located at the nasal root
Pronasal (Prn)	the most prominent point of the tip of the nose
Midnasal (Mn)	the middle point on the outer contour of the nose between the pronasal and nasion points
Columella (Cm)	the most inferior and anterior point of the nose
Subnasal (Sn)	the point where the upper lip joins the columella
Labial superior (Ls)	the point that indicates the mucocutaneous limit of the upper lip
Stomion superior (Sts)	the most inferior point of the upper lip
Stomion inferior(Sti)	the most superior point of the lower lip

Labial inferior (Li)	the point that indicates the mucocutaneous limit of the lower lip
Supramental (Sm)	the deepest point of the inferior sublabial concavity
Pogonion (Pg)	the most anterior point of the chin
Menton (Me)	the most inferior point of the inferior edge of the chin
Cervical (C)	the point at the junction of neck and throat borders
Tragus (Trg)	the most posterior point of the auricular tragus
Alar (Al)	the most lateral point of the alar contour of the nose
Ort	the point joining the TV and the TH
Left canthus (Cthl)	the entocanthion of the left eye
Right canthus (Cthr)	the entocanthion of the right eye
Left alar base (Albl)	the point on the lower margin of the left alar base where the ala disappears into the upper lip skin
Right alar base (Albr)	the point on the lower margin of the right alar base where the ala disappears into the upper lip skin

Left pupil (Pupl)	the centre point of the left eye pupil
Right pupil (Pupr)	the centre point of the right eye pupil
Stomion (Stm)	the midpoint of the labial fissure when the lips are closed naturally

1.2. Statement of Research Problem

Individual identification and population variations have been a subject of interest to the scientific world. Establishing the identity of an individual from body fragments or dismembered body parts has become a necessity in the event of homicide, suicide, accidents, and most natural disasters etc. Individual physique and body proportions vary from one ethnic group to another. Studies have been carried out to determine facial traits among several ethnic groups in Nigeria. However, there is paucity of data on the Eggon and Alago ethnic groups in Nasarawa state. Therefore, there is need to further expand the biological variability landscape by the inclusion of newer population. The present study intends to characterize and show the variability between the selected ethnic groups. Furthermore, this research will help to establish the relationship between these ethnic group as they reside in the same region and in forensic studies with the rise in crime rate in the nation.

1.3 Justification of Study

Establishing the identity of an individual from body fragments or dismembered body parts has become a necessity in the event of homicide, suicide, accidents, and most natural disasters etc. Result from this study will provide reference data on the linear and angular measurement of the soft tissue profile of the Eggon and Alago ethnic groups, which are useful for forensic investigations and also contribute in describing the human biology of the people of Nasarawa State. This study could predict biological similarities and differences among these ethnic groups. Facial parameters also provide vital information which can be used in plastic surgery and understanding the diagnosis between patients and normal individual. Soft-tissue analysis of the face is useful in inter- racial classification and intra- racial categorization. The result will also

help in corrective and cosmetic surgery using the data provided as normal values for facial measurements and determining the accuracy of surgical procedure.

1.4 Aim and Objectives of the Study

1.4.1 Aim of the Study

The aim of this study is to characterize the facial profile and to determine the variation between Alago and Eggon ethnic groups.

1.4.2 Objectives of the Study

The objectives of this study are to:

i. determine the linear facial profile among the Alago and Eggon ethnic groups.
ii. determine the angular facial profile among the Eggon and Alago etnic groups.
iii. investigate for sexual dimorphism in the angular and facial measurements of the facial soft tissue profile among the Alago and Eggon Ethnic group.
iv. determine the relationship between the linear measurements of the facial traits of the Alago and Eggon ethnic groups.

1.5 Research Hypothesis

There is no significant difference in the linear and angular facial profile among the Eggon and Alago ethnic groups.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 Historical Background on Studies of the Face and Facial Profile

Variation is one of the most important phenomena occurring in humans, and it has been attributed to a number of factors such as mutation and natural selection .The relevance of anthropometric measurements as a means of investigating variation in human populations and also as a very relevant tool in forensic science and crime detection has been emphasized in many studies. More sophisticated practices have replaced the use of anthropometry to study racial types and evaluating racial differences in the 20th century. In recent times, anthropometry has gained more acceptance and relevance in medical sciences especially in the field of forensic medicine (Ozaslan *et al*., 2003).

Several studies and research have been carried out on the human face right from the ancient Greece to this day (Anand, 2015).The first authors who paid attention to that topic were artists such as Pythagora and Leonardo Da Vinci. This authors set new ideals aiming to show the harmony of this part of the body (Malkoc, 2016). The underlying skeleton and soft tissues determine the shape and size of the face. The variability and beauty of the face are expressed in the different sizes and shapes of the individual features of parts of the face and different facial angles (Ferdousi, 2013). The harmony and beauty of the face plays a very important role in social interaction and is responsible for psychological wellbeing and the self-esteem of an individual. However, the perception of a pleasing face is subjective to many factors like ethnic background, culture, personality, generation, age, etc. (Reddy, 2011). Facial analyses have been widely used for the biological categorization of individuals on the basis of their shape referred to as morphotype. The facial morphotype stands as the typical shape of a face (Farkas, 1981). It is

usually determined by anthropometrical measures of the face. These descriptive measures allow organizing the face shapes in different forms (Oliver, 1961). We then refer to very large face, large face, average or round face, long face or narrow, and very long face, according to international standards (Williams, 1995). Facial forms are classified according to facial index which is the ratio of facial height to facial breadth (Facial index is anatomically classified as Hypereuryprosopic face (very broad face, range <79.9); Euryprosopic face (broad face, range, 80-84.9); Mesoprosopic face (round face, range, 85-89.9); Leptoprosopic face (long face, range, 90-94.9) and Hyper leptoprosopic face (very long face, range, >95). Analyzing the human face is a science and an art, utilizing both aesthetic and anthropologic tools. Various methods have been used to evaluate facial characteristics, such as anthropometry (Farkas, 2005), photogrammetry (Gavan *et al*., 1952), and cephalometry (Garner, 1974). The application of photogrammetry in orthodontics was first proposed by Stoner (Oladipo, 2010), who compared pre- and post-treatment profiles with ideal profiles. Different authors have included soft tissue parameters in photogrammetry, and various facial soft tissue analyses based on standardized photogrammetric method have been described (Epker, 1992). Other photographic methods have also been used to quantify facial aesthetics (Peerlings *et al*.,1995) . Facial soft tissue analysis has been conducted using newer three-dimensional (3D) methods (Ferrario,2000), such as laser surface and, more recently, scanning digital 3D photogrammetry (Baik,*et al*., 2007).Direct measurement has been replaced by photogrammetry to obtain distances between facial landmarks using both two-dimensional and three-dimensional methods. Obtaining measurements from photographs is less invasive to the patient, more cost-effective, provides a stable data of the face that can be accessed at a later time, and provides homogeneousness in longitudinal studies in which diverse observers with different direct measuring techniques might participate (Douglas, 2004).

Several medical specialties like Orthodontics, plastic surgery, and prosthodontics have come up with feasible techniques to change facial features. Improvement of facial esthetics is a major inspiring factor for many patients and parents seeking orthodontic treatment, including up to 80% of adult patients (Baumrind and Frantz, 1971). Hence there is a need for clinicians working in the dentofacial area to know the esthetic standards of a face that guide the esthetic soft tissue goals in their patients.

Several studies have been carried out in Nigeria and around the world on the face. Leonardo da Vinci (1452-1519) reported extensively on the characteristics of the human body. He was the first to describe the three vertical divisions of the face, and body proportions were also reflected in his art. Leonardo da Vinci was a great painter, artist, philosopher and scientist in various fields of science, including anatomy. He first became interested in anatomy as an artist but later approached the subject from a scientific point of view.

Osunwoke *et al*., (2011) carried out a study on sexual dimorphism in facial parameters of adult Binis. They investigated the relationship between the structures of the face and how it differs between adult male and female Binis of South –Southern Nigeria. A total of one thousand (1000) subjects comprising 500 males and 500 females (18-45 years) were randomly selected from Benin City in Edo state. Measurements were taken using a digital vernier caliper. The mean Menton-Nasion distance in males was 113.62±9.44mm, and 109.05±6.58mm in females. Zygoma-Zygoma 124.63±5.78mm in males and 122.28±6.39mm in females, Subnasal-Subnasal 43.05±3.83 in males and 39.93±3.96mm in females, Ala-Ala 41.14±3.30mm in males and 37.34±3.50mm in females, Lip width 26.67±4.11 in males and 25.59±3.03mm in females, Menton-Subnasal 65.97±5.91mm in males and 60.35±5.71mm in females. Bini males had significantly higher values than Bini females in all the facial parameters measured ($p<0.05$). The

most prominent significant difference was observed in Ala-Ala (nose breadth) 90.8% and the least was observed in ZygomaZygoma (face breadth) 98.1%.

Oladipo *et al*., (2010) carried out a study to determine the mean values of facial, nasal, maxillary, mandibular and oro-facial heights of adult Ibibios. Eight hundred (800) subjects purely of Ibibio ethnic group comprising 400 males and 400 females, aged between 18 and 80 years were used for the study. The facial height, nasal height, maxillary height, mandibular height and oro-facial height were measured using sliding vernier caliper and the results gotten showed that the males had mean facial height of 11.14±0.77cm, nasal height of 4.15±0.34cm, maxillary height of 2.53±0.38cm, mandibular height of 4.46±0.43cm and oro-facial height of 6.99±0.59cm while the females had mean facial height of 10.55±0.74cm, nasal height of 3.93±0.35cm, maxillary height of 2.48±0.49cm, mandibular height of 4.14±0.33cm, and oro-facial height 6.63±0.60cm. Statistical analysis showed sexual dimorphism. Using the z-test the research showed that the males had significantly higher values than the females in all the facial parameters measured ($p<0.05$).

Oladipo *et al*., (2008) carried out a study on sexual dimorphism in facial dimensions of adult Ijaws comprising five hundred (500) males and five hundred (500) females aged 18 years and above. The results showed that Ijaw males had a mean facial height 11.8±0.5cm, nasal height 4.71±0.65cm, maxillary height 2.49±0.33cm, mandibular height 4.60±0.61cm and oro-facial height 7.12±0.9cm while mean facial dimensions for female Ijaws were facial height 10.71±1.03cm, nasal height 4.43±0.59cm, maxillary height 2.39±0.32cm, mandibular height 4.28±0.57cm and oro-facial height 6.50±0.87cm.

Didia and Dappa, (2005) reported facial, nasal, maxillary, mandibular and orofacial heights of adult Nigerians. They obtained figures for the male subjects as facial height 12.28±3.39cm, nasal

height 4.50±1.23cm, maxillary height 2.44±0.66cm, mandibular height 4.49±1.28cm and oro-facial height 6.90±1.89cm while figures obtained for the female subjects were facial height 11.77±3.5cm, nasal height 4.48±1.3cm, maxillary height 2.30±0.69cm, mandibular height 4.20±1.26cm and oro-facial height 6.32±1.91cm.

Göz and Hon, (2007) identified that anthropometric methods are preferable to cephalometric methods in determining the ideal face s dimensions, since anthropometric methods are valid, three dimensional, non-invasive, suitable for a great variety of purpose, and easy to implement. Symmetry and averageness play important roles in determining the attractiveness of a face, although distinguishing features make it extraordinarily beautiful. The work created an anthropometric database of some oro-facial parameters of the people of Bonny Island which hitherto is absent

Olotu *et al*., (2009) carried out a study on facial and nasal length of adult Igbos comprising 300 male and 300 female subjects. The result obtained showed that the average facial height for males was 12.55±2.11cm and nasal height 4.87±0.84cm while facial height for females was 11.9±1.92cm and nasal height 4.40cm±0.76cm.The study indicated sexual dimorphism with higher values of all parameters in males compared to females.

Ebite *et al*., (2009) reported data of five facial measurements: facial height, nasal height, maxillary height, mandibular height and oro-facial height among the Urhobo people of Southern Nigeria. The sample size comprised 140 individual, 60 males and 80 females. The result of the study showed that Urhobos are mesoproscopic. Sexual dimorphism was also observed with males having significantly higher indices than females.

Ugochukwu, (2010) reported facial, nasal, maxillary mandibular and oro-facial height of adult Ogbias and Nembes. The study was carried out using one thousand (1000) subjects purely of

Ogbia and Nembe origin. These comprised five hundred (500) Nembes and five hundred Ogbias. Two hundred fifty (250) were males and two hundred and fifty (250) were females in each group. The facial height, nasal height, maxillary height, mandibular height and oro-facial height were measured and the results obtained showed that the Nembe males had mean facial height of 12.33±0.2cm, nasal height 4.49±0.19cm, maxillary height 2.42±0.12cm, mandibular height 4.44±0.13cm and oro-facial height 6.83±0.25cm and the Nembe females had a mean facial height of 11.88±0.26cm, nasal height 44.62±0.15cm, maxillary height 2.44±0.14cm, mandibular height 4.49±0.22cm and oro-facial height 7.11±0.18cm. While the Ogbia males had facial height of 11.87±0.14cm, nasal height 4.79±0.04cm, maxillary height 2.53±0.45, mandibular height 4.59±2.4cm and oro-facial height 7.10±0.55cm and for the Ogbia females the mean facial height was10.68±0.15cm, nasal height 4.43±0.09cm, maxillary height 2.39±0.03cm, mandibular height 4.25±2.29cm and oro-facial 6.64±2.32cm. This study showed that the male values were higher than the females. Therefore, the study showed sexual dimorphism among the Nembes and Ogbias.

Sclafani*et al*., (2003) collected digital photographs of first generation Korean-American Women and then anonymously presented it to reviewers who would rate the global aesthetics of each face. The photographs collected would then be analyzed and a set of aesthetic measurements would be made. The overall averages of these measurements were then compared to published standards for Caucasians, as well as the average measurements for the most aesthetic decile of photographed Korean-American Women. After comparison with the Caucasian standard values, he found out that the Korean-American women had a wider and round face. Sclafani then concluded that the study would help guide facial plastic surgeons in caring for Korean-Americans.

Mohindra and Bulman (2002) investigated the effect of increasing vertical dimension of occlusion on facial aesthetics. The study considered ninety-six (96) patients whose facial aesthetic have been impaired by increasing vertical dimension of occlusion and concluded that the alternative to having the lower facial height inversing should be considered in some cases before embarking on cosmetic surgery. A combination of increase in lower facial height in addition to cosmetic surgery may achieve a more dramatic and pleasing result.

Asghari *et et.,* (2013) did a photometric study on the facial soft tissue of healthy Iranian young adults. Results from the research proved that there was statistically significant difference between males and females in 21 of our 26 measurements. The study showed that the most noticeable differences between the genders were seen in the measurements taken from the face region. Minimum frontal breadth and supraorbital breadth were larger in males than in females. Except for middle face height measurement, other horizontal and vertical measurements for the face were larger in males than in females, indicating wider and higher faces in men than in women. Some measurements of facial angles are discrepant between the two genders.

Sheldon *et al*., (1980) carried out an all-inclusive study on cephalometric analysis of normal adults with careful examination of selected subject group. Fifty-six (56) adult Caucasians with class I skeletal and dental relationships and good vertical facial proportions were analyzed morphologically with a computerized craniofacial model. By the incorporation of a large number of soft tissue measurements, facial profile and proportionality were analyzed and compared with methods that are presently used to evaluate facial aesthetic. The measurements from the research provides relevant data that are useful in the diagnosis and treatment of adults with dent to facial deformities. Horizontal soft tissues chin prominence was nearly equal for males and females relative to sub-nasal soft tissue, nasion and glabella.

Malkoc *et al.* (2008) did a research on the angular photogrammetric analysis of the soft tissue facial profile of Turkish adults. The nasofrontal (G – N – Prn), nasal (Cm – Sn/N – Prn), vertical nasal (N – Prn/TV), and nasal dorsum (N – Mn – Prn) angles showed statistically insignificant gender differences (P> 0.05). The nasolabial angle (Cm –Sn – Ls) demonstrated large variability. Gender differences were present in the mentolabial (Li – Sm – Pg) and cervicomental (G – Pg/C – Me) angles. The mentolabial angle showed a high method error and large variability. Facial (G – Sn – Pg) and total facial (G – Prn – Pg) convexity angles were similar, while Cm – Sn – Ls angle range was larger compared with other angles. The mean values obtained from this sample can be used for comparison with records of subjects with the same characteristics and following the same photogrammetric technique. Angular photogrammetric profile analysis can provide the orthodontist with a way of determining problems associated with various soft tissue segments of the face.

Samizadeh *et al*., (2018) conducted a research to investigate ideals of facial beauty among Chinese aesthetic practitioners. A questionnaire with simple sketches of facial features was given to aesthetic practitioners in Chinese cosmetology hospitals and clinics to assess aesthetic practitioners' ideals of beauty and their preferences for facial shapes, facial profile, nose and lip shape, jaw angle, and chin shape. A total of 596 surveys were completed. This survey revealed that Chinese aesthetic practitioners preferred a heart/inverted triangular facial shape with a reduced lower face height, a straight and small nose, as well as lips that are full medially and taper off laterally with well-defined borders and Cupid's bow. An obtuse jaw angle for women and a square well-defined jaw angle for men, and a round and pointy chin for both women and men were the most preferred. A majority (66.7%) of the respondents said they would have plastic surgery. However, if given the choice 82.9% indicated they would opt for non-surgical

procedures. Finally, a clear majority (90.5%) believed that being beautiful would improve their daily life.

Fang *et al.,* (2011) did a Systematic Review of Inter-ethnic Variability in Facial Dimensions. He reported that the greatest inter-ethnic variability in facial proportions exists in the height of the forehead and the least amount of variability is found in the ear height and upper, middle, and lower facial width the least amount of variability is found in the ear height and upper, middle, and lower facial widths. More pronounced difference among the ethnic groups is also present in the measurements of the eyes, nose, and mouth. The research showed that there is no significant difference between sexes in the neoclassical facial proportions.

Trehan *et al*., (2011) did a research on "Perception of Facial Profile: How You Feel About Yourself ". The study comprised of a total of 200 subjects divided into four groups of 50 subjects each: Laypeople, first-year dental students, final-year dental students and orthodontic patients. Participants were given a questionnaire regarding facial profile and what they expected from orthodontic treatment. The photographs of the facial profile of participants were analyzed by two orthodontists separately who matched the individual to the depicted silhouettes. Agreement between participants and orthodontists was evaluated by using the statistic $\chi 2$ test. Dental students and orthodontic patients were more aware of their facial profile as compared to the laypeople. The four groups were different in their abilities to recognize their own profiles. The difference in profile perception between orthodontists and subjects was statistically significant.

2.2 The Face

2.2.1 Anatomy of the Face

The face can be defined as the anterior aspect of the head. As an anatomical area it spreads out superiorly to the hairline,inferiorly to the chin and base of the mandible and on eachside to the auricle.Its physiological, expressive, aestheticfunctions and its role in identity require precise structural andfunctional organization of the anatomical features (Mendelson, 2009).

This face can be described in the following order: muscles of the face, vasculature of the face, and nerves of the face. Traditionally the face can be dividedhorizontally into three parts. The midface is defined by anupper horizontal line above the zygomatic arch extending from the superior helix insertion to the lateral canthus. The lower boundary extends from the inferior border of the tragalcartilage to the oral commissure. The upper face extendsfrom the hairline to the upper border of the midface, and thelower face extends from the lower border of the midface tothe chin. Another aspect of the face is the anterior and lateralareas of the face separated by a vertical line of retaining ligaments (temporal, lateral orbital, zygomatic, maseteric, andmandibular) extending from the lateral orbital rim to the oralcommissure (Mendelson, 2020).

2.2.1.1 Muscles of the face

The muscles of the face can be divided into two groups: mimetic muscles and muscles of mastication. Fig 2.1 shows the muscles of the face and their placement in relative to one another.

i. Mimetic muscles

The mimetic muscles play an important role in the expression of feelings and thoughts by elevating or depressing the eyebrows and lips. Located around the eyes and mouth, they also provide sphincteric action to these orifices (Siemionow *et al.,* 2011).The muscles of facial

expression originate from the facial skeleton that supports the overlying soft tissue andinsert into the skin. Although they commonly overlap each other, four anatomic layers can be distinguished: first-layer muscles: orbicularis oculi, risorius, zygomaticus minor, depressor anguli oris; second-layer muscles: depressor labii inferioris, risorius, zygomaticus major, levator labii superioris aleque nasi, platysma; third-layer muscles: orbicularis oris, levator labii superioris; and fourth-layer muscles: buccinators, mentalis, levator anguli oris. The more superficial three layers are invested by the superficial fascia, the superficial musculoaponeurotic system (SMAS), so they form the SMAS-mimetic muscle complex. The facial nerve lies deep to this plane, the superficial muscles receive theirneurovascular supply from their posterior surface, whereas the deeply situated muscles buccinator, mentalis, and levator anguli oris supply to their anterior surface (Stuzin, 2009).

ii. Masticatory muscles

In contrast to the mimetic muscles, which are located on the anterior aspect of the face, the masticatory muscles are found in the lateral aspect of the face. Muscles of mastication include the temporalis, masseter, lateral and medial pterygoid. They lie deep behind the deep fascia of the midface and are supplied by the branches of the mandibular nerve.

2.2.1.2Arteries of the face

The vessels of the face form a series of plexuses: deep facial plexus, subcutaneous plexus, and subdermal plexus. Perforating arteries connect these plexuses. The facial plexus provides deep circulation to the anterior face lying deep behind or passing through the mimetic muscles. This plexus communicates with the subdermal plexus via a dense population of small musculocutaneous penetrating branches of facial, infraorbital, and supratrochlear arteries. In the

lateral face, the large sparsely populated fasciocutaneous perforators of the transverse facial, submental, and posterior auricular arteries reach the subdermal plexus passing through the deep facial planes and subcutaneous layers. The boundary of this distinct blood supply occurs immediately lateral to the nasolabial region, dividing the face into an anterior and lateral region (Whetzel, 1992).The primary blood supply of the face is from the branches of the external carotid artery. The internal carotid artery makes a smaller contribution. It supplies the central face that consists of the eyes, the upper two thirds of the nose, and the central forehead. The chief branch of the external carotid artery for the face is the facial artery. It arises at the level of the greater cornu of the hyoid bone in the carotid triangle of the neck. The level of the origin is situated 1 to 3.5 cm away from the bifurcation of the common carotid artery. It ascends under cover of the posterior belly of the digastric and stylohyoid muscles and grooves then submandibular gland, making a loop. Then it crosses the inferior border of the mandible in anoblique direction to enter the face at the anteroinferior angle ofthe masseter muscle. The facial artery is extremely windingand tortuous.Its branching pattern shows great variability. Nakajima *et al.*,(2006) and Loukas *et al*., (2002) popularized a newnomenclature for the branching pattern of the facial artery. According to this new nomenclature at the corner of themouth the facial artery gives off the inferior labial artery andthen bifurcates near the oral commissure into the superiorlabial artery and lateral nasal artery. The superior labial artery gives off septal branches to the nose. It runs between themucosa and orbicular is oris at approximately the borderbetween the white and red lips and anastomoses with theopposite artery in the middle of the lip. The lateral nasal arteryextends between the nose and cheek and gives off superiorand inferior alar arteries to supply the nose. The inferior alarbranch supplies the alar base and nostril floor and upper lip;the superior alar branch participates in the vascular plexus ofthe nasal dorsum and tip. The lateral nasal artery terminates asthe angular artery at the medial canthus. The angulararteryartery

lies 6 to 8 mm medial to the medial canthus and 5 mmanterior to the lacrimal sac. It ends joining the dorsal nasalbranch of the ophthalmic artery. The facial artery can alsoterminate as a rudimentary branch with no superior labialartery, lateral nasal, or angular arteries.The facial arteryand its branches supply mainly the mental region, the lips, theinferior part of the parotidomasseteric region, as well as thebuccal, orbital, infraorbital, and nasal regions (Greco, 2009).

2.2.1.3 Venous drainage of the face

Most of the veins of the face run parallel to the arteries they accompany and show many variations. In the classic pattern, supratrochlear and supraorbital veins join near the medial canthus to form the angular vein. The angular vein runs behind the angular and lateral nasal artery downwards in the nasolabial fold (Nakajima, 2002). At the lower border of the nose, it unites the superior labial vein to become the facial vein, which crosses the body of the mandible. The facial vein is the major venous drainage of the superficial regions of the face. In its course it receives the deep facial vein, which drains the pterygoid venous plexus of the infratemporal fossa, the masseteric and parotid veins, and veins from the inferior eyelid and lips (Zhang and Stringer, 2010).The superficial temporal vein unites the maxillary vein within the parotid gland to form the retromandibular vein. The retromandibular vein divides into anterior and posterior branches between the external carotid artery and facial nerve before leaving the parotid gland. Inferior and anterior to the angle of the mandible, the anterior branch joins the facial vein to form the common facial vein, which terminates entering the internal jugular vein. The common facial vein may also open into the external jugular vein. The posterior branch unites the posterior auricular vein and forms the external jugular vein to drain the deep regions of the face (Williams *et al.,* 1995). The superficial veins of the face are of great clinical importance as they have

connections with the cavernous sinus. As the flow in the angular vein goes in both directions, into either the facial vein or the ophthalmic veins, blood from the face may enter the cavernous sinus via the latter. Thus infections from the face may spread intracranially. The area around the nose, medial canthus, and lips, drained through the facial vein, is therefore called the “danger triangle” of the face. This bilateral triangle popularized by Maes in 1937 is bounded by the bridge of the nose and the angle of the mouth. The communication of the facial vein with the cavernous sinus can be through the angular vein; supraorbital, supratrochlear, and superior ophthalmic veins; or deep facial vein, pterygoid plexus, and inferior ophthalmic vein. According to classic clinical and anatomical textbooks, these veins have no valves, and studies have shown that the superior ophthalmic vein and the tributaries of the angular vein (supraorbital and supratrochlear veins) and the facial vein have no valves. Thus for the spread of infections inretrograde flow into the cavernous sinus, the important factor is not the valves but the consistent access of facial veins to the cavernous sinus (Midy *et al*., 1986).

2.2.1.4 Lymphatic drainage of the face

A thorough study of the mapping of the lymphatic drainage of the face shows that the lymphatic vessels are sparse and are found in a range of three to five. They extend in a direction from medial to lateral. Lymph vessels above the eyebrow drain to the preauricular and deep parotid lymph nodes. Lymph vessels from lateral eyelids drain mainly to the parotid lymph nodes. Lymph from the medial canthus, following the facial vein, empties into the submandibular lymph nodes but also into the buccinator and parotid lymph nodes. The external nose and cheeks drain directly to the submandibular lymph nodes in the submandibular triangle.The primary drainage of the perioral region is to the submental lymph nodes. Lymphatics from the central part of the lower lip, anterior tip of the tongue, floor of the mouth, and chin drain into the bilateral

submental lymph nodes, whereas lymphatics from the upper lip and lateral parts of the lower lip empty to the ipsilateral submandibular lymph nodes. Some lymph may go to the parotid and submental lymph nodes. Submental lymph nodes between the anterior bellies of the digastric muscles drain to the ipsilateral submandibular lymph nodes. From the submandibular and parotid lymph nodes, lymph empties into the jugulodigastric lymph nodes.Lymphoscintigraphy has demonstrated that lymph vessels in the face may bypass the submandibular lymph nodes and drain into the cervical nodes and the nodes at the base of the neck (Marur *et al.*, 2014).

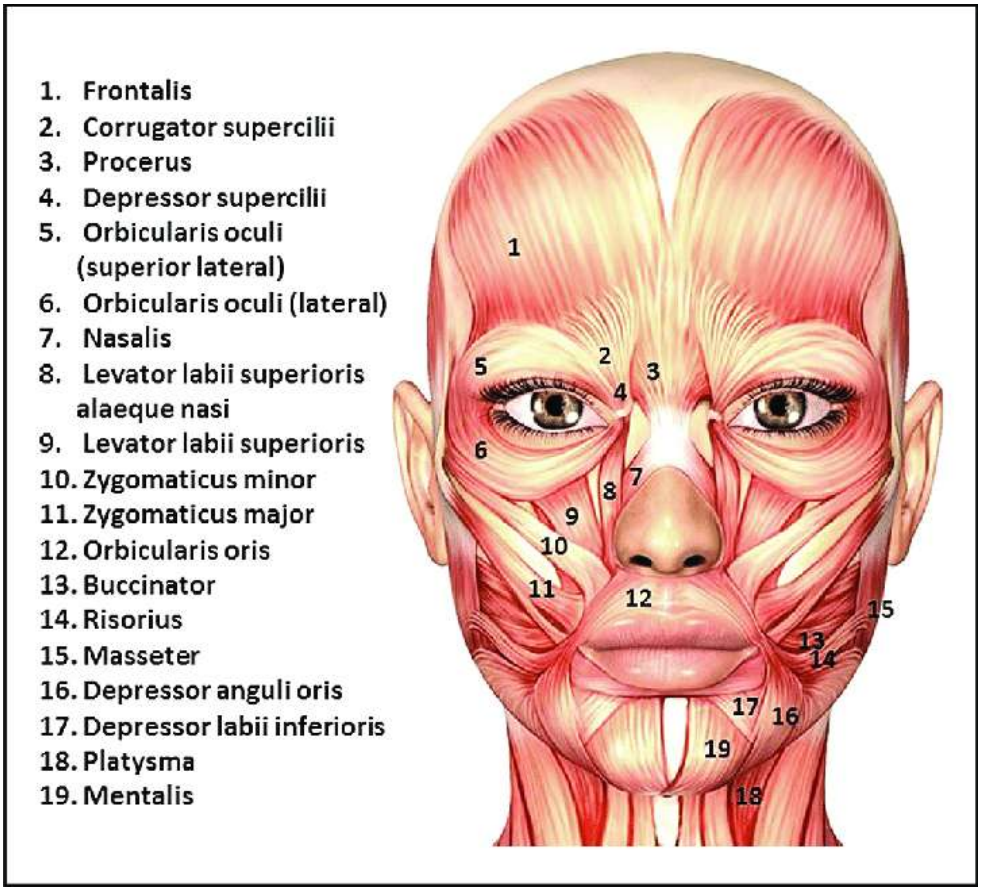


Fig 2.1 : Musculature of the face (Moore *et al*.,1999**).**

2.3 ANGULAR AND LINEAR MEASUREMENTS OF THE FACIAL PROFILE

The facial profile is the outline contour of the human face viewed from one side. There are various angular and linear measurements that can be gotten from this view following some standard landmarks as shown in the figure 2.2 below.

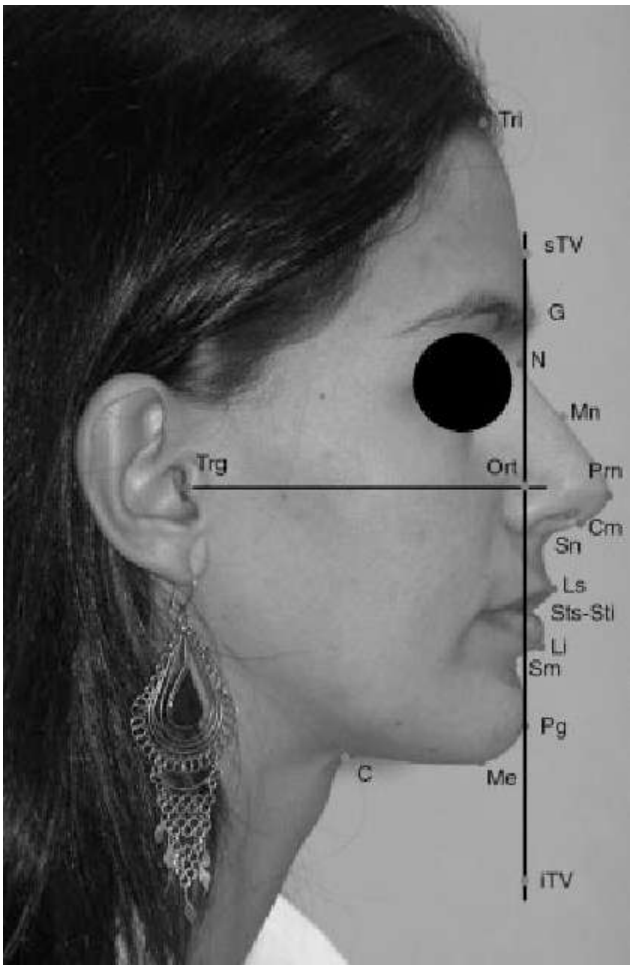
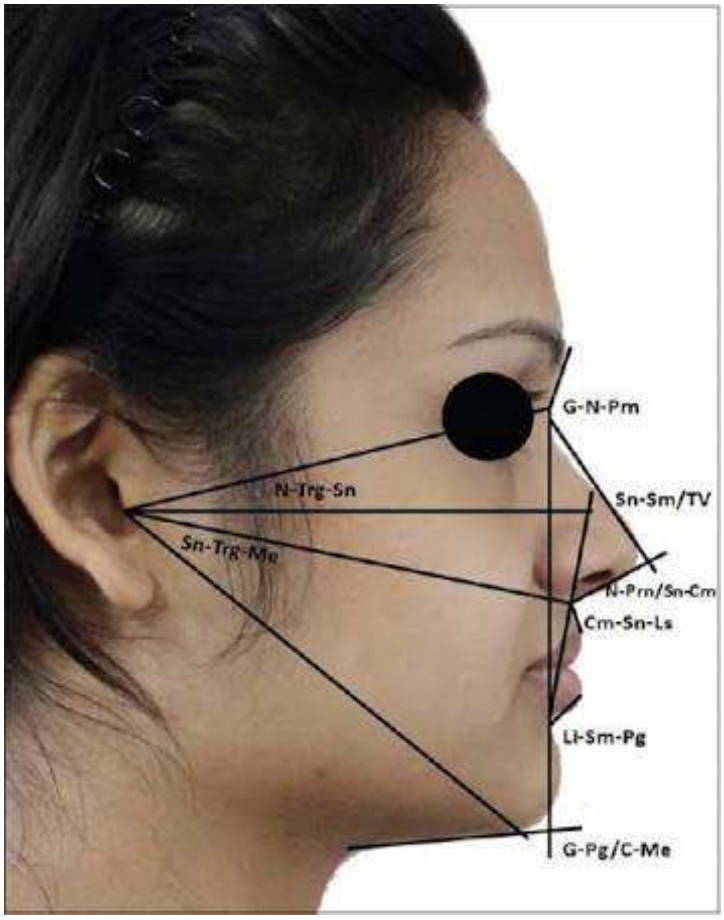


Fig.2.2 Facial profile showing landmarks (Anic-Milosevic*et al*., 2008)

2.3.1 Angular measurements of facial soft tissue profile

The various angular parameters that can be measured on the face include

- Angle of total facial convexity
- Nasolabial angle (Cm-Sn-Ls)
- Cervicomental angle (G-Pg/C-Me)
- Nasomental angle (N-Prn/N-Pg)
- Upper lip angle (Sn-Ls/Sn-Pg)
- Total facial angle (N-Prn-Pg)
- Facial angle (G-Sn-Pg)
- Mentolabial angle (Li-Sm-Pg)
- Vertical nasal angle (N-Prn/N-Ort)



2.3.2 linear measurements of the facial soft tissue (Anic-Milosevic*et al* ., 2008)

The various linear measurements that can be taken on the facial profile

- superior facial third (Tri-G),
- middle facial third (G-Sn),
- inferior facial third (Sn-Me),
- nasal length (N-Sn),
- length of upper lip (Sn-Sts)
- interlabial gap (Sts-Sti)
- length of lower lip (Sti-Sm)
- vermilion of upper lip (Ls-Sts)
- vermilion of lower lip (Li-Sti),
- height of chin (Sm-Me)
- height of nasal tip (Sn-Prn).

2.3.3. The Importance of Angular and Linear Measurements of Facial Profile

2.3.3.1. Orthodontic Diagnosis and Treatment Planning

The idea of beauty and the harmony of the face has evolved over the ages. Facial beauty can be defined as harmony and balance among facial proportions, established by skeletal structures, teeth, and soft tissue (Langlade, 1993). The desire to improve one's dentofacial aesthetics is one of the main reasons patients seek orthodontic treatment(Burstone, 1959).the differences in the soft tissue profile are closely related to dental and skeletal changes, caused by either orthodontic treatment or growth (Subtelny, 1961). In 1907, Angle emphasized the importance of soft tissues and facial aesthetics in orthodontics. He believed that, to a great extent, facial harmony and balance is hinged on the shape and beauty of the mouth (Erbay, 2002).Therefore, the main goal of any orthodontic treatment should to perfect and harmonize a dental relationship (Fitzgerald, 1992).In 1924, Carrea conducted the first investigation on facial profile on radiographs. In 1944, Tweed emphasized that ideal positioning of the mandibular incisors is imperative for facial balance and harmony. Orthodontists such as Downs and Holdaway included soft tissue profile measurements in their cephalometric analyses. Subsequently, numerous angular and linear measurements with respective norm values were presented. With Ricketts' aesthetic plane, the position of the lower lip in relation to line E (soft tissue pogonion—nose tip) is evaluated (Ricketts, 1957). Ideally, the upper and lower lips should be positioned about 2.0 mm behind the E line. Steiner suggested to use line S (a tangent from soft tissue chin to S = intersection of nasal columella and upper lip). If the lips touch the S line, the profile is straight. It is convex if the lips are positioned in front of this line and concave if positioned behind. In 1967, Burstone suggested a line through subnasale and soft tissue pogonion to verify the ideal position of the upper and lower lips in the anteroposterior direction. On average, the upper lip should be 3.5 ± 1.4 mm in

front of this line, whereas the lower lip should be 2.2 ± 1.6 mm behind it. In 1983, Holdaway defined line H, which connects the upper lip and soft tissue pogonion (Ls-Pg). Line H and line NB determine the angle H, which according to Holdaway, should ideally range between 7.0 degrees and 15.0 degrees Another important factor for facial analysis is the nasolabial angle, which is formed by Sn-Co (columella) and Sn-Ls (upper lip)(Brandão 2002). This angle was suggested by Scheideman *et al*.,1980. According to McNamara, (2010) it should be the main guide for defining the sagittal position of the maxilla. The ideal value of the nasolabial angle ranges from 90.0 degrees to 110.0 degrees, indicating maxillary retrusion if greater 110.0 degrees and protrusion if less than 90.0 degrees. Since physical appearance became ever more important to society, analyses such as the ones of Arnett and Bergman, (1993) became more and more complex comprising a big number of reference soft tissue points. Today, the analysis of the profile on lateral photographs and cephalograms is a substantial part of orthodontic diagnosis and treatment planning (Riveiro *et al*., 2002). According to Suguino*et al* ., (1996), it is a challenge to convert the results of any analysis into a well-defined, objective therapeutic goal. If orthodontic treatment aims at overcoming psychosocial difficulties related to facial and dental appearance, the evaluation of esthetics becomes increasingly more important. State-of-the-art orthodontic diagnosis and treatment planning aims at a balance and harmony among facial dimensions and proportions, primarily considering the soft tissue profile. Thus, the esthetic impact of dental correction on a patient's face should routinely be considered. In view of the importance of facial evaluation at the onset of orthodontic/orthopedic therapy, the following patient report will demonstrate that the profile improvement was predominant for orthodontic treatment planning.

2.3.3.2 Forensic Science

One of the greatest problems of the medico-legal system is the identification of human remains. Information such as the sex, age, and ethnicity can be gotten from careful examination of skeletal remains recovered from several crime site. Studying the unknown skeletal remains mostly becomes the only way to find out more information about individual characteristics, which could lead to identification of potential victim. The most accurate comparative techniques fail if there is no clue for probable identity, because of the impossibility to compare questioned remains with possible known material. In such cases one of the last options is to recreate ante mortem appearance by face reconstruction (Panenková *et al.*, 2012). Following the first introduction of reconstruction in the late 19th century, other techniques have been developed including radiography, 3D statistical model, ultrasound, MRI, CT and Cone Beam Computed Tomography (CBCT) (Masoume, 2014). Facial contours were traditionally considered to be the result of positioning of underlying hard tissue followed by the soft tissue. However, current trend shows a paradigm shift from the conventional hard tissue analysis to also include both hard- and soft-tissue analysis (Thomas, 2012). For facial reconstruction standard soft tissue thickness (STT) values and other anatomy-based rules are used. Soft tissue thickness values are commonly used to determine the amount or the depth of the tissues that fall on certain predetermined landmarks of the skull. This aids in the reconstruction of the face by giving a limit to work from when developing the initial face shape in the early stages of the reconstruction procedure. However, one of the problems associated with Forensic Facial Reconstruction (FFR) is the reliance on the use of these average facial STT's, as well as the difficulty of estimating these values (Cavanagh, 2011).

2.3.3.3 Rhytidectomy

A rhytidectomy or face lift can be defined as a surgical procedure carried out to improve visible signs of aging in the face and the neck. For this procedure to be successful experts require an accurate, precise and updated data on the facial profile of the youths of relevant ethnic background to restore the youthful contours of the face and neck (Trang,2020).

2.3.3.4 Cosmestic Surgery

This procedure involves facial profile balancing to create a well-balanced, pleasing and attractive face. This mostly involves include nose and chin reshaping and other reconstructions of facial soft tissue .The availability of an accurate data of the varying normal values of angular and linear facial measurements must be known before procedure to determine the possibility and the accuracy of the procedure (Trang, 2020).

2.3.3.5 Perception of Facial Beauty

The self-confidence of a person is directly affected by his/her perception of facial beauty. A good face without doubts enhances the self-esteem of a person. An unpleasant face can affect the person physically, mentally, psychosocially and emotionally causing a deep dent in his/ her self-confidence (Moyers, 1973). Profile plays an important role in the treatment plan as it shows the anteroposterior position of jaws, lip posture, lip prominence, vertical facial proportions and mandibular plane angle. Hence, the technique of facial profile analysis has sometimes been called the “poor man’s cephalometric analysis”. Attractive adults and children are judged more favourably and treated more positively than unattractive adults and children, even by those who know them (Langlois, 2000). People with attractive faces are regarded socially as more competent, successful and likeable. It has been shown that facial and dental anomalies that are sufficient to affect a person’s appearances and might put that person at a social disadvantage.

Hence, nowadays people seek orthodontic treatment to achieve pleasing esthetic facial profiles but the patient's perception of an attractive facial profile may differ from that of an orthodontist's perception (Langlois, 2000).

2.3.4 Variation

Heritable phenotypic variation is essential for evolution by natural selection, limiting both its rate and scope. It is generated by the more or less poorly understood intersection of genes, developmental processes, and the environment. It is not surprising that the features of such a central concept, including its production, regulation and measurement, remain current topics of research (Hallgrımsson, 2005). For a given population, there are three sources of variation: mutation, recombination, and immigration of genes. However, recombination by itself does not produce variation unless alleles are segregating already at different loci; otherwise there is nothing to recombine. Similarly, immigration cannot provide variation if the entire species is homo-zygous for the same allele. Ultimately, the source of all variation must be mutation (Griffiths*et al*., 2000).

I. Balance between inbreeding and Variation

Any population of any species is finite in size, so all populations should eventually become homozygous and differentiated from one another as a result of inbreeding. In nature, however, new variation is always being introduced into populations by mutation and by some migration between localities. Thus, the actual variation available for natural selection is a balance between the introduction of new variation and its loss through local inbreeding. The rate of loss of heterozygosity in a closed population is $1/2N$, so any effective differentiation between populations will be negated if new variation is introduced at this rate or higher (Griffiths, 2000).

II. Variation and Migration

A further source of variation is migration into a population from other populations with different gene frequencies. The resulting mixed population will have an allele frequency that is somewhere intermediate between its original value and the frequency in the donor population(Griffiths *et al*., 2000).

III. Gene Flow and Variation

Gene flow is the movement of genes into or out of a population. Such movement may be due to migration of individual organisms that reproduce in their new populations, or to the movement of gametes (e.g., as a consequence of pollen transfer among plants). In the absence of natural selection and genetic drift, gene flow leads to genetic homogeneity among demes within a metapopulation, such that, for a given locus, allele frequencies will reach equilibrium values equal to the average frequencies across the metapopulation. In contrast, restricted gene flow promotes population divergence via selection and drift, which, if persistent, can lead to speciation (Griffiths *et al*., 2000).

CHAPTER 3

3.0 Materials and Methods

3.1 Study Location

Nasarawa state is in the north central zone of Nigeria created on the 1st of october 1996 from Plateau state. It has a total land area of 27,117km^2 and a population of 1,869,377. It consist of 13 local government areas and several ethnic groups. Some of the major ethnic groups in Nasarawa State includes; Afo, Agatu, Akye, Alago, Baribari, Basa, Egbira, Eggon, Fulani, Gade, Gbagyi, Gwandara, Hausa, Jukun, Kanuri, Mada, Ninzom, Arum, Rindei, Yeskwa and Tiv. The ethnic groups of interest in this study are the Eggon and Alago ethnic groups .

The Eggon Ethnic group are a people with a common linguistic and cultural identities.The name Eggon refers to the hill where they settled before coming to the plains. They are divided into three major clans namely ; Anzo,Eholo and Eggon Ero. The people of Eggon are said to have migrated from ‘‘ngazaragamu’’ in the present Borno state and then merged with the Kwararafa kingdom before migrating through River Benue Abi to the hills of Naarawa. They are mainly found in Lafia, Akwanga, Kefffi and Nasarawa Eggon. They can also be found in Kokona, villages around Doma, keana, Obi and Wamba (Joshuaproject.net)

The Alago ethnic group are a grouip of people in Nasarawa state with commomn linguistic and cultural identities. It is one of the major ethnic groups in Nasarawa State with a population of over 700000 people according to the census in 2006. They are found predominantly in the following local government area of Nasarawa State ; Doma, Keana, Obi. Lafia-East, Azara, Giza and Nasarawa (Joshuaproject.net). Figure 3.1 shows the position of Nasarawa State on the map of Nigeria and the various local government areas in Nasarawa State.

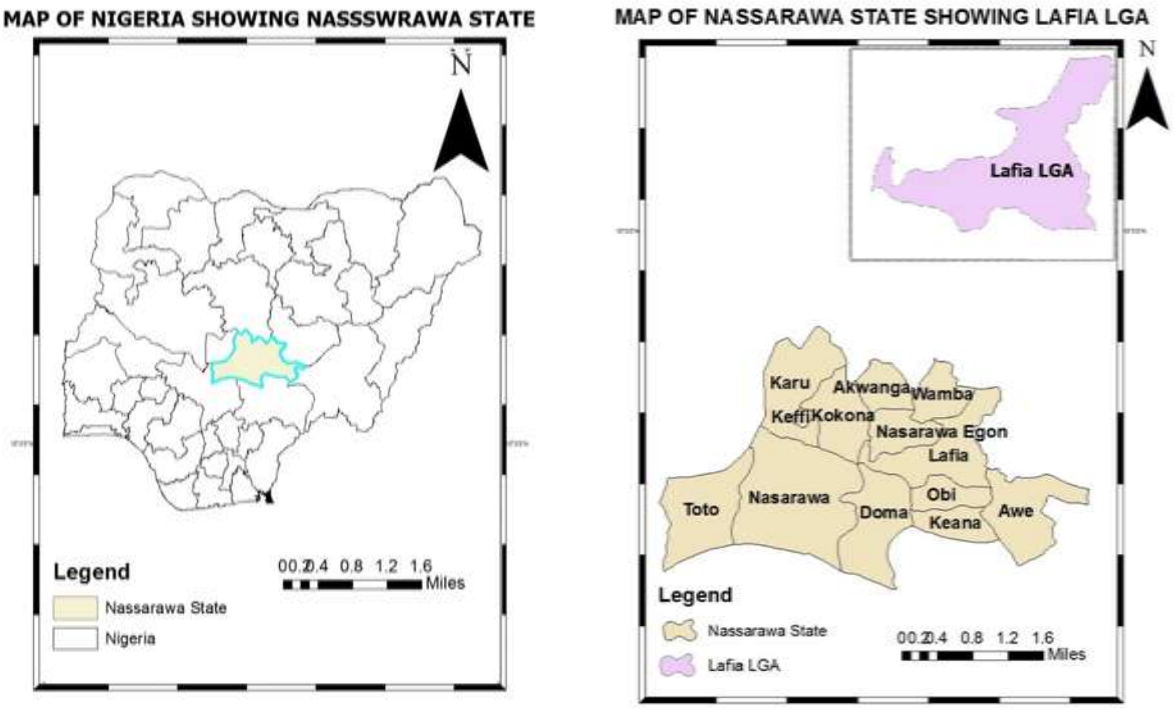


Fig 3.1 map showing Nasarawa state and the local government areas

Source: Adopted from the local governments of Nasarawa

(Joshuaproject.net)

3.2 MATERIALS

1. Spreading caliper

2. Venier caliper

3. Questionaires

4. Stool (chair)

5. Camera

6. Tripod stand

7. Stool

3.3 METHODS

With the consent of the institutions and subjects, photographs were taken using standard techniques for profile and frontal view of the face according to Ezeuko and Egboigbe2011. The photographic setup included mounting a camera (8.0 megapixel) on a tripod stand for stability and adjusting the height of the tripod stand to the height of the subject sitting on a stool with head and face relaxed at natural position focused on the camera for frontal photographs and facing the wall for lateral photographs. The subject stood 150cm away from tripod stand then lateral and frontal photographs are taken from each subject as shown in plate I, II AND III.All photographs were exported to Adobe Photoshop CS 5 Extended and the Anatomical points of reference of the face were digitally marked on the photographs of all the subjects system and the face arth software was then used to analyze the angular and linear soft tissue profiles. As shown in plate IV and V the software automatically identifies the various landmarks on the face. The points on the landmarks were adjusted using the mouse to accurately fit the landmarks and once

this was done the software proceeded to measure the linear and angular profile identified and exported it to an excel ;facial convexity angle, upper lip angle (Sn-Ls / Sn-P), nasolabial angle (CM-Sn-Ls), nasofacial angle (N-Sn / N-Prn), nasomental angle (N-Prn-P), and mentocervical angle (G-P/MC-C). The linear dimensions of interest were; inferior labial sulcus, interlabial gap, upper lip length, lower lip length, total facial height, true vertical line (TVL)-nasal tip, TVL – upper lip, TVL-lower lip, TVL-pogonion, soft tissue A-TVL, and soft tissue B-TVL. The result from the software were subjected to descriptive analysis. A total of five hundred and eighty one subjects (students and non-students) participated in this study (n=581).This study comprising of 315 males and 266 females from Alago and Ethnic groups was conducted in Nasarawa State, Nigeria. The study covered Alago and Eggon adolescents and adults between the age of 13-40.

Fig 3.2 shows how the face art software works in analyzing the frontal and profile view of the face.



Fig.3.2 showing software analysis of soft tissue profile (Vahid *et al*., 2015).

3.4 Sample Size Determination

The sample size for the study was determined using the sample formular by Naing *et al.,* 2006

$n= \underline{Z^2PQ} / d^2$

Where;

n= Minimum sample size

Z= Standard normal deviation with confidence

P= Proportion of the target population 50% (0.5)

Q= 1-P, 1-0.5= 0.5

d= Sample error which is 5% (0.05)

n= 384 (minimum sample size for the research)

For the purpose of this study a total of 581 subjects were recruited comprising of 315 males and 266 females from Alago and Ethnic groups in Nasarawa State, Nigeria

3.5 Ethical Approval

Ethical approval was obtained from the Committee on Ethics of the Ahmadu Bello University Zaria, and clearance letter were issued to the authorities of the various participating schools in the ethnic groups studied. Permission to use her students as subjects for the study was obtained from the authorities of the participating schools and the students were adequately educated about the importance of the research and that their participation will be absolutely based on consent.

3.6 Inclusion and Exclusion Criteria

3.3.1 Inclusion Criteria

The following were the inclusion criteria:

i. Subjects between the age range of 16-32years.
ii. Subjects with pure ethnic background.
iii. Apparently healthy individuals.
iv. Subjects willing to participate in the study.

3.3.2 EXCLUSION CRITERIA

The following were the exclusion criteria:

i. Subjects below or above the stipulated age range
ii. Subjects with either parents or grandparents from a different ethnic group.
iii. Subjects with facial or nasal deformities.
iv. Subjects not willing to participate in the study.

3.7 Statistical Analysis

i. Data were expressed as mean ± SD.
ii. Where data is normally distributed
   A. The independent sample t-test was used to check for sexual dimorphism,compare linear parameters, compare angular parameters and also the two age groups.
   B. The Pearson's moment correlation was used to investigate relationship between anthropometric variables.

iii. Data obtained was analyzed using the statistical software Statistical Package for Social Sciences (IBM SPSS version 26.0). Values from the research were considered significant at $p < 0.05$.



Plate I: showing subject at frontal position ready for capture





Plate II and III : Showing subject ready for capture

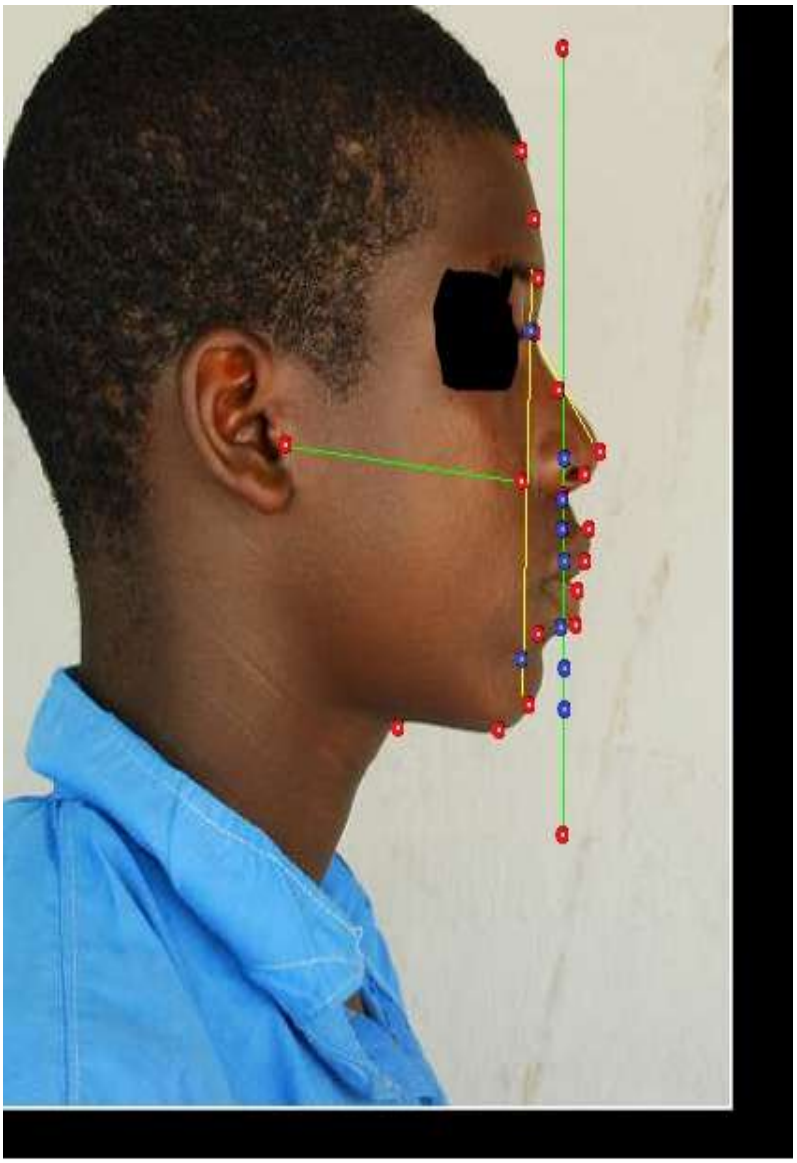


Plate IV: Face art software positioning landmarks to analyze angular measurements



Plate V: Face art software showing frontal landmarks before analyzing linear parameters

CHAPTER 4

4.0 RESULTS

4.1 DESCRIPTIVE STATISTICS OF VARIABLES

Descriptive statistics of the entire sample population is shown in Table 4.1. the mean angle of facial convexity (N-sn-pg) was 162.654 ±7.459mm, the mean cervico-mental angle was 100.023 ± 11.129mm, the mean interlabial space was 4.405 ±1.186, True vertical line to point A, B, labial inferior, pogonion, and pronasale were 5.299 ±5.057mm, 6.632 ±3.221mm, 4.952 ± 4.952 ± 3.419 , 5.676 ± 5.751mm, 8.315 ± 3.561mm respectively.

Table 4.2 shows sexual dimorphism among Alago boys and girls. There was significant difference in the upper lip length (t=2.153, p=0.033), lower lip length(t=3.603, p=<0.001), total facial height (t=2.566, p=0.012), true vertical line to point B(t=2.010, p=0.044), angle of facial convexity (t=-4.026, p=<0.001),and cervico-mental angle (t=2.028, p=0.045) with the males having higher values in all save for the angle of facial convexity where the girls had higher mean value.

Table 4.3 shows sexual dimorphism among adult Alago males and females. There appear was significant difference in some of the linear and angular facial profile measurements. The males had higher values in inferior labial sulcus (t=2.388, p=0.020), the upper lip length (t=2.673, p=0.009), lower lip length (t=3.441, p=<0.001), the total facial height (t=3.261, p=<0.001), true vertical line to labial inferior (t=2.000, p= 0.048), and finally the cervico-mental angle (t=4.014, p=<0.001). The females only had significantly higher values in the angle of facial convexity (t=-4.501, p=<0.001).

Table 4.4 shows sexual dimorphism among Eggon boys and girls. There was significant difference in some of the linear and angular facial profile measurements .The males have higher values in nasal length (t=4.868, p=<0.001),inter labial space (t=2.151, p=0.033), upper lip length (t=2.799, p=0.006), total facial height (t=3.362, p=<0.001), and the naso labial angle (t=3.546, p=<0.001). The only parameter that had the girls higher than the boys is the angle of facial convexity (t=-5.958, p=<0.001).

Fig 4.5 shows sexual dimorphism among Eggon adult males and females. . There appear was significant difference in some of the linear and angular facial profile measurements. The angle of facial convexity for the females was higher (t=3.196, p=0.002). Meanwhile the upper lip angle (t=2.943, p=0.004) and the nasomental angle (t=5.100, p=<0.001).

Table 4.10.Shows the comparison between the anthropometric parameters among Alago and Eggon boys. The Eggon boys showed larger values in most of the parameters significant at p<0.05 and <0.001 except for the facial convexity angle and Tvl-B.

Table 4.11 shows the comparison between the facial profile of adolescent Alago and Eggon girls. The Eggon adolescent girls showed larger values in all parameters except at the nasolabial angle and nasofacial angle (p<0.001, p<0.005).

Table 4.12 shows the comparison between adult Eggon and Alago males. The result showed that the adult Eggon males had higher values for all the parameters except for the nasolabial angle (p<0.001, p<0.005).

Table 4.13 shows the comparison between adult Alago and Eggon females. The result showed that the Eggon females had relatively higher values for all parameters taken except for the facial convexity angle, upper lip angle and nasofacial angle (p<0.001, p<0.005).

Table 4.1 General Descriptive Statistics for Both Alago and Eggon Population

Linear and angular parameters	Mean	Std Dev	Min	Max
N_Sn (mm)	27.82	6.08	11.58	53.65
Sm_Pg (mm)	12.01	6.24	5.03	100.89
Sts_Sti (mm)	4.41	1.19	1.93	11.43
Sn_Sts (mm)	14.07	4.53	5.46	64.99
Sti_Me(mm)	28.51	6.34	4.25	67.62
N_Me (mm)	68.09	13.47	36.74	120.63
Tvl_Prn(mm)	8.32	3.56	2.81	50.25
Tvl_Ls (mm)	6.80	3.53	1.22	50.28
Tvl_Li (mm)	4.95	3.42	0.77	44.36
Tvl_A (mm)	5.29	5.06	0.55	78.52
Tvl_B (mm)	6.63	3.22	2.44	33.58
Tvl_Pg (mm)	5.68	5.75	1.54	87.87
G_Me (mm)	80.27	16.25	42.19	125.67
NSnPg	162.65	7.46	144.96	179.93
SnLsSnPg	45.36	12.69	17.10	159.43
CmSnLs	78.47	19.70	7.83	164.16
GPgNPrn	35.58	3.79	25.84	50.65
NPrnNPg	35.26	4.13	23.17	54.92
GMeC	100.02	11.78	17.18	173.80
GPgC	100.02	11.78	17.18	173.80
NSnNPrn	25.39	4.79	14.19	54.18

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle, NSnNPrn=Nasofacial angle

Table 4.2 : Descriptive Statistics for Adolescent Alago Ethnic Group in Relation to Gender

Variables	Males (n = 61) Mean + SD	Min – Max	Females (n = 50) Mean +SD	Min – Max
N-Sn (mm)	25.84 ± 3.23	18.95 - 32.87	25.25 ± 3.66	11.58 - 33.62
Sm-Pg (mm)	11.39 ± 2.12	5.42 - 16.64	10.89 ± 2.51	6.37 - 20.25
Sts-Sti (mm)	4.55 ± 1.03	3.09 - 8.12	4.19 ± 0.95	1.93 - 7.04
Sn-Sts (mm)	12.66 ± 2.12	7.82 - 17.26	11.83 ± 1.91	8.12 - 18.21
Sti-Me (mm)	27.84 ± 3.26	21.09 - 35.12	25.69 ± 2.93	20.73 - 31.99
N-Me (mm)	64.80 ± 6.61	46.48 - 77.00	61.57 ± 6.60	50.23 - 78.11
Tv-Prn (mm)	7.17 ± 1.87	3.66 - 11.58	7.85 ± 1.90	4.52 - 11.58
Tvl-Ls (mm)	6.73 ± 1.60	3.56 - 13.51	7.06 ± 2.04	3.66 - 13.51
Tvl-Li (mm)	4.44 ± 1.63	1.93 - 13.51	4.18 ± 2.27	1.93 - 13.51
Tvl-A (mm)	5.06 ± 1.11	2.81 - 8.12	4.84 ± 0.93	3.47 - 6.84
Tvl-B (mm)	7.75 ± 5.31	3.86 - 33.20	6.15 ± 1.78	3.11 - 11.58
Tvl-Pg (mm)	4.88 ± 2.21	1.59 - 11.43	4.71 ± 1.86	1.93 - 8.71
G-Me (mm)	76.39 ± 8.65	53.79 - 92.75	72.92 ± 8.57	58.83 - 90.79
NSnPg	160.93 ± 5.68	146.87-174.66	165.24 ± 5.54	151.81- 174.66
SnLsSnPg	46.95 ± 9.42	30.61 - 79.42	48.68 ± 10.39	23.98 - 68.23
CmSnLs	81.34 ± 16.70	50.58 - 131.60	79.17 ± 17.81	46.96 - 148.33
GPgNPrn	35.79 ± 3.51	27.30 - 45.81	35.99 ± 3.61	29.39 - 43.48
NPrnNPg	35.41 ± 3.61	26.62 - 44.20	35.70 ± 3.29	29.63 - 42.06
GMeC	99.22 ± 6.13	88.59 - 121.05	96.69 ± 6.99	83.63 - 121.05
GPgC	99.22 ± 6.13	88.59 - 121.05	96.69 ± 6.99	83.63 -121.05
NSnNPrn	24.45 ± 3.81	16.21 - 34.73	27.37 ± 4.01	15.19 - 34.07

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle, NSnNPrn= Nasofacial angle

TABLE 4.3: Descriptive Statistics for Adult Alago Males and Females

Variables	Males (n = 70) Mean + SD	Min – Max	Females (n = 57) Mean + SD	Min – Max
NS-n (mm)	24.48 ± 3.55	16.23 - 32.81	24.40 ± 3.21	15.83 - 31.27
Sm-Pg (mm)	11.58 ± 3.41	5.99 - 29.71	10.29 ± 2.52	5.08 - 17.96
Sts-Sti (mm)	4.23 ± 0.96	2.320 - 6.99	3.93 ± 0.85	2.08 - 6.18
Sn-Sts (mm)	12.19 ± 1.82	7.61 - 15.56	11.37 ± 1.56	8.54 - 14.55
Sti-Me (mm)	25.82 ± 3.47	16.76 - 33.04	23.75 ± 3.25	15.99 - 32.40
N-Me (mm)	62.01 ± 7.11	42.46 - 74.31	57.92 ± 6.92	41.87 - 75.33
Tvl-Prn (mm)	7.70 ± 2.33	3.11 - 14.67	8.03 ± 1.88	3.94 - 12.12
Tvl-Ls (mm)	6.29 ± 1.10	3.82 - 8.75	6.34 ± 1.39	3.30 - 9.30
Tvl-Li (mm)	4.21 ± 1.19	1.93 - 7.21	3.81 ± 1.05	2.35 - 6.10
Tvl-A (mm)	4.84 ± 0.89	3.09 - 7.04	4.89 ± 0.83	3.11 - 8.19
Tvl-B (mm)	5.91 ± 1.54	3.45 - 10.54	5.79 ± 1.46	2.81 - 9.27
Tvl-Pg (mm)	4.43 ± 2.04	1.54 - 9.27	4.57 ± 1.65	2.08 - 9.34
G-Me (mm)	72.12 ± 8.78	46.33 - 91.71	68.56 ± 8.84	48.66 - 90.76
NSnPg	162.52 ± 6.46	146.58 - 177.71	167.33 ± 5.36	157.04 - 177.21
SnLsSnPg	44.77 ± 9.78	21.09 - 68.34	47.81 ± 9.77	31.20 - 71.42
CmSnLs	77.39 ± 21.06	20.09 - 133.41	71.99 ± 14.49	38.06 - 111.92
GPgNPrn	36.72 ± 4.41	27.31 - 50.65	35.52 ± 3.61	26.07 - 43.75
NPrnNPg	36.65 ± 4.69	27.13 - 51.26	35.51 ± 3.78	26.12 - 43.34
GMeC	99.18 ± 6.09	86.86 - 114.47	94.85 ± 5.98	83.43 - 113.85
GPgC	99.18 ± 6.09	86.86 - 114.47	94.85 ± 5.98	83.43 - 113.85
NSnNPrn	26.49 ± 4.19	18.14 - 36.61	28.32 ± 3.08	21.26 - 34.83

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle, NSnNPrn= Nasofacial angle

Table 4.4 :Descriptive Statistics for Adolescent Eggon Boys and Girls

Variables	Males (n = 109) Mean + SD	Min – Max	Females (n = 105) Mean + SD	Min – Max
NS-n (mm)	33.01 ± 6.08	22.03 - 47.87	29.03 ± 5.86	19.44 - 53.65
Sm-Pg (mm)	13.43 ± 9.89	5.89 - 100.89	13.19 ± 9.09	5.42 - 100.89
Sts-Sti (mm)	4.82 ± 1.59	2.73 - 11.43	4.44 ± 0.94	2.73 - 6.96
Sn-Sts (mm)	17.48 ± 5.61	9.55 - 64.99	15.27 ± 5.908	6.39 - 64.99
Sti-Me (mm)	32.04 ± 7.66	4.25 - 67.62	30.25 ± 6.70	21.35 - 67.62
N-Me (mm)	78.53 ± 13.94	39.18 - 120.63	72.27 ± 13.28	52.81 - 120.63
Tvl-Prn (mm)	8.24 ± 5.04	3.11 - 50.25	9.49 ± 4.76	3.30 - 50.25
Tvl-Ls (mm)	7.19 ± 5.43	1.22 - 50.28	7.04 ± 5.02	3.09 - 50.28
Tvl-Li (mm)	6.23 ± 5.15	0.77 - 44.36	5.65 ± 4.75	1.93 - 44.36
Tvl-A (mm)	6.00 ± 8.35	0.55 - 78.52	5.82 ± 7.99	2.35 - 78.52
Tvl-B (mm)	7.41 ± 4.11	3.09 - 33.58	6.85 ± 3.50	2.44 - 33.58
Tvl-Pg (mm)	8.01 ± 9.08	1.73 - 87.87	6.51 ± 8.51	1.54 - 87.87
G-Me (mm)	93.58 ± 15.88	45.22 - 121.99	85.09 ± 15.79	45.22 - 119.07
NSnPg	157.09 ± 7.74	144.96 - 177.59	163.13 ± 7.05	144.96 - 177.59
SnLsSnPg	42.43 ± 14.99	20.15 - 159.24	45.95 ± 18.69	17.10 - 159.43
CmSnLs	87.79 ± 22.36	8.48 - 145.50	77.29 ± 20.94	7.83 - 164.16
GPgNPrn	35.46 ± 3.50	27.53 - 44.49	34.85 ± 3.53	26.66 - 45.53
NPrnNPg	34.93 ± 4.02	27.53 - 54.92	34.66 ± 4.14	26.71 - 54.92
GMeC	105.64 ± 19.84	17.18 - 173.80	99.18 ± 13.03	20.69 - 161.23
GPgC	105.64 ± 19.84	17.18 - 173.80	99.18 ± 13.03	20.69 - 161.23
NSnNPrn	22.07 ± 5.18	14.85 - 54.18	25.24 ± 4.98	14.85 -54.18

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle, NSnNPrn= Nasofacial angle

TABLE 4.5 : Descriptive Statistics of Adult Eggon Males and Females

Variables	Males (n = 75) Mean + SD	Min – Max	Females (n = 54) Mean + SD	Min – Max
NS-n (mm)	27.06 ± 6.64	15.87 - 48.64	28.67 ± 7.15	15.46 - 42.09
Sm-Pg (mm)	11.74 ± 2.97	5.03 - 17.39	11.35 ± 2.48	6.57- 17.14
Sts-Sti (mm)	4.40 ± 1.43	2.47 - 8.53	4.26 ± 0.97	2.73 - 6.39
Sn-Sts (mm)	13.84± 3.59	5.46 - 23.97	14.17 ± 3.52	7.10 - 20.73
Sti-Me (mm)	28.73 ± 6.81	15.10 - 43.10	29.58 ± 6.79	17.21 - 45.01
N-Me (mm)	66.74 ± 15.60	36.74 - 99.31	69.12 ± 14.92	39.80 - 104.62
Tvl-Prn (mm)	8.33 ± 2.65	3.09 - 15.23	8.98 ± 3.02	2.81 - 16.06
Tvl-Ls (mm)	6.93 ± 2.49	2.47 - 14.05	6.29 ± 2.48	2.70 - 13.51
Tvl-Li (mm)	4.71 ± 1.86	1.97 - 11.81	4.82 ± 2.58	1.59 - 13.51
Tvl-A (mm)	5.22 ± 1.76	2.35 - 12.36	4.70 ± 1.33	2.44 - 9.27
Tvl-B (mm)	6.12 ± 2.05	2.44 - 11.61	6.34 ± 2.05	2.44 - 11.59
Tvl-Pg (mm)	5.06 ± 2.66	1.59 - 13.58	4.78 ± 2.43	1.93 - 11.97
G-Me (mm)	78.30 ± 19.11	42.19 -120.43	80.87 ± 17.91	47.55 - 125.67
NSnPg	163.08 ± 7.51	146.75 - 177.26	167.15 ± 6.54	152.34 - 179.93
SnLsSnPg	46.24 ± 7.81	23.82 - 63.41	42.18 ± 7.63	24.14 - 57.70
CmSnLs	72.59 ± 17.33	39.91 - 134.94	74.45 ± 15.39	39.91 - 123.30
GPgNPrn	36.88 ± 4.01	27.11 - 45.36	33.45 ± 3.21	25.84 - 40.96
NPrnNPg	36.45 ± 4.46	25.62 - 45.59	32.75 ± 3.42	23.17 - 41.91
GMeC	100.68 ± 6.09	86.11 - 117.71	99.96 ± 7.05	85.72 - 121.05
GPgC	100.68 ± 6.09	86.11 - 117.71	99.96 ± 7.05	85.72 -121.05
NSnNPrn	26.57 ± 4.05	14.33 - 34.67	25.49 ± 4.49	14.19 - 37.38

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle, NSnNPrn=Nasofacial angle

TABLE 4.6 : Comparison of Fcaial Traits Between Adolescent Alago Boys and Girls

Variables	Males(n=61) Mean + SD	Females (n = 50) Mean + SD	t-value	p-value
N-Sn	25.84 ± 3.23	25.25 ± 3.66	0.89	0.37
Sm-Pg	11.39 ± 2.12	10.89 ± 2.51	1.12	0.26
Sts-Sti	4.55 ± 1.03	4.18 ± 0.95	1.91	0.06
Sn-Sts	12.66 ± 2.12	11.83 ± 1.91	2.15	0.03
Sti-Me	27.84 ± 3.26	25.69 ± 2.93	3.60	<0.001
N-Me	64.80 ± 6.61	61.57 ± 6.60	2.57	0.01
Tv-Prn	7.17 ± 1.87	7.85 ± 1.90	1.89	0.06
Tvl-Ls	6.73 ± 1.59	7.06 ± 2.04	-0.96	0.34
Tvl-Li	4.44 ± 1.63	4.18 ± 2.27	0.69	0.49
Tvl-A	5.06 ± 1.11	4.84 ± 0.93	1.09	0.28
Tvl-B	7.75 ± 5.31	6.15 ± 1.78	2.04	0.04
Tvl-Pg	4.88 ± 2.21	4.709 ± 1.858	0.43	0.67
G-Me	76.39 ± 8.65	72.92 ± 8.57	2.11	0.04
NSnPg	160.93 ± 5.68	165.24 ± 5.54	-4.03	<0.001
SnLsSnPg	46.95 ± 9.42	48.68 ± 10.39	-0.92	0.36
CmSnLs	81.34 ± 16.70	79.17 ± 17.81	0.66	0.51
GPgNPrn	35.79 ± 3.51	35.98 ± 3.61	-0.28	0.78
NPrnNPg	35.41 ± 3.61	35.70 ± 3.29	-0.44	0.66
GMeC	99.22 ± 6.13	96.69 ± 6.99	2.03	0.05
GPgC	99.22 ± 6.13	96.68 ± 6.99	2.03	0.05
NSnNPrn	24.46 ± 3.81	27.37 ± 4.01	-3.89	<0.001

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle, NSnNPrn=Nasofacial angle

TABLE 4.7 : Comparison of Facial Traits Between Adult Alago Males and Females

Variables	Males (n = 70) Mean + SD	Females (n = 57) Mean + SD	t-Value	P-Value
NS-n	24.48 ± 3.55	24.40 ± 3.21	0.13	0.89
Sm-Pg	11.58 ± 3.41	10.29 ± 2.52	2.36	0.02
Sts-Sti	4.23 ± 0.96	3.92 ± 0.85	1.89	0.06
Sn-Sts	12.19 ± 1.82	11.37 ± 1.56	2.67	0.009
Sti-Me	25.82 ± 3.47	23.75 ± 3.25	3.44	<0.001
N-Me	62.01 ± 7.11	57.92 ± 6.92	3.26	<0.001
Tvl-Prn	7.70 ± 2.33	8.03 ± 1.88	-0.86	0.39
Tvl-Ls	6.29 ± 1.10	6.34 ± 1.39	-0.20	0.84
Tvl-Li	4.21 ± 1.19	3.81 ± 1.05	2.00	0.05
Tvl-A	4.84 ± 0.89	4.89 ± 0.83	-0.38	0.70
Tvl-B	5.91 ± 1.54	5.79 ± 1.46	0.47	0.64
Tvl-Pg	4.43 ± 2.04	4.57 ± 1.65	-0.42	0.68
G-Me	72.12 ± 8.78	68.56 ± 8.84	2.27	0.025
NSnPg	162.52 ± 6.46	167.33 ± 5.36	-4.50	<0.001
SnLsSnPg	44.77 ± 9.78	47.81 ± 9.77	-1.74	0.09
CmSnLs	77.39 ± 21.06	71.99 ± 14.49	1.64	0.11
GPgNPrn	36.72 ± 4.41	35.52 ± 3.61	1.66	0.099
NPrnNPg	36.65 ± 4.69	35.51 ± 3.79	1.49	0.139
GMeC	99.18 ± 6.09	94.85 ± 5.99	3.01	<0.001
GPgC	99.18 ± 6.09	94.85 ± 5.99	4.01	<0.001
NSnNPrn	26.49 ± 4.19	28.32 ± 3.08	-2.74	0.007

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle, NSnNPrn=Nasofacial angle

TABLE 4.8 :Comparison of Facial Traits Between Adolescent Eggon Boys and Girls

Variables	Males (n = 109) Mean + SD	Females (n = 105) Mean + SD	T-value	P-Value
NS-n	33.01 ± 6.08	29.03 ± 5.86	0.89	0.37
Sm-Pg	13.43 ± 9.89	13.19 ± 9.09	1.12	0.26
Sts-Sti	4.82 ± 1.59	4.44 ± 0.94	1.91	0.06
Sn-Sts	17.48 ± 5.61	15.27 ± 5.91	2.15	0.03
Sti-Me	32.04 ± 7.66	30.25 ± 6.71	3.60	<0.001
N-Me	78.53 ± 13.94	72.27 ± 13.28	2.57	0.01
Tvl-Prn	8.24 ± 5.04	9.49 ± 4.76	1.89	0.06
Tvl-Ls	7.19 ± 5.43	7.04 ± 5.02	-0.96	0.34
Tvl-Li	6.23 ± 5.15	5.65 ± 4.75	0.69	0.49
Tvl-A	6.00 ± 8.35	5.82 ± 7.99	1.09	0.28
Tvl-B	7.41 ± 4.11	6.85 ± 3.50	2.04	0.04
Tvl-Pg	8.01 ± 9.08	6.51 ± 8.51	0.43	0.67
G-Me	93.58 ± 15.88	85.09 ± 15.79	2.11	0.04
NSnPg	157.09 ± 7.74	163.13 ± 7.05	-4.03	<0.001
SnLsSnPg	42.43 ± 14.99	45.95 ± 18.68	-0.92	0.36
CmSnLs	87.79 ± 22.36	77.28 ± 20.94	0.66	0.51
GPgNPrn	35.46 ± 3.50	34.85 ± 3.53	-0.28	0.78
NPrnNPg	34.93 ± 4.01	34.66 ± 4.14	-0.44	0.66
GMeC	105.64 ± 19.84	99.18 ± 13.03	2.03	0.05
GPgC	105.64 ± 19.84	99.18 ± 13.03	2.03	0.05
NSnNPrn	22.07 ± 5.18	25.24 ± 4.98	-3.89	<0.001

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle, NSnNPrn=Nasofacial angle

TABLE 4.9 : Comparison of Facial Traits Between Adult Eggon Males and Females

Variables	Males (n = 75) Mean + SD	Females (n = 54) Mean + SD	t-value	P-Value
NS-n	27.06 ± 6.64	28.67 ± 7.15	-1.31	0.19
Sm-Pg	11.74 ± 2.97	11.35 ± 2.48	0.79	0.43
Sts-Sti	4.40 ± 1.43	4.26 ± 0.97	0.63	0.53
Sn-Sts	13.84 ± 3.59	14.17 ± 3.52	-0.53	0.59
Sti-Me	28.73 ± 6.81	29.58 ± 6.79	0.70	0.48
N-Me	66.74 ± 15.60	69.11 ± 14.92	-0.86	0.38
Tvl-Prn	8.33 ± 2.65	8.98 ± 3.02	-1.29	0.19
Tvl-Ls	6.93 ± 2.49	6.29 ± 2.49	1.43	0.16
Tvl-Li	4.71 ± 1.86	4.82 ± 2.58	-0.27	0.79
Tvl-A	5.23 ± 1.76	4.70 ± 1.33	1.81	0.07
Tvl-B	6.12 ± 2.05	6.34 ± 2.05	-0.58	0.56
Tvl-Pg	5.06 ± 2.66	4.78 ± 2.43	0.62	0.54
G-Me	78.30 ± 19.11	80.87 ± 17.91	-0.77	0.44
NSnPg	163.08 ± 7.51	167.15 ± 6.54	-3.19	0.002
SnLsSnPg	46.24 ± 7.81	42.18 ± 7.63	2.94	0.004
CmSnLs	72.59 ± 17.33	74.45 ± 15.39	-0.63	0.53
GPgNPrn	36.88 ± 4.01	33.45 ± 3.21	5.19	<0.001
NPrnNPg	36.45 ± 4.46	32.75 ± 3.42	5.10	<0.001
GMeC	100.68 ± 6.09	99.96 ± 7.05	0.62	0.54
GPgC	100.68 ± 6.09	99.96 ± 7.05	0.62	0.54
NSnNPrn	26.57 ± 4.05	25.49 ± 4.49	1.47	0.16

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle, NSnNPrn=Nasofacial angle

Table 4.10 : Comparison of Facial Traits Between Adolescent Alago and Eggon Boys

Variables	Males (n = 61) Mean + SD	Males (n = 109) Mean + SD	t-value	P-Value
NS-n	25.84 ± 3.23	33.01 ± 6.09	-8.55	<0.001
Sm-Pg	11.39 ± 2.12	13.43 ± 9.89	-1.58	0.14
Sts-Sti	4.55 ± 1.03	4.82 ± 1.59	-1.21	0.23
Sn-Sts	12.66 ± 2.12	17.48 ± 5.61	-6.44	<0.001
Sti-Me	27.84 ± 3.28	32.04 ± 7.69	-4.08	<0.001
N-Me	64.80 ± 6.61	78.53 ± 13.94	-7.24	<0.001
Tvl-Prn	7.17 ± 1.87	8.24 ± 5.04	-1.59	0.11
Tvl-Ls	6.73 ± 1.59	7.19 ± 5.43	-0.65	0.52
Tvl-Li	4.44 ± 1.63	6.23 ± 5.15	-2.64	0.01
Tvl-A	5.06 ± 1.11	6.00 ± 8.35	-0.88	0.38
Tvl-B	7.75 ± 5.31	7.41 ± 4.11	0.46	0.64
Tvl-Pg	4.88 ± 2.21	8.01 ± 9.08	-2.65	0.009
G-Me	76.39 ± 8.65	93.58 ± 15.88	-7.83	< 0.001
NSnPg	160.93 ± 5.68	157.09 ± 7.74	3.39	0.001
SnLsSnPg	46.95 ± 9.42	42.43 ± 14.99	2.13	0.04
CmSnLs	81.34 ± 16.70	87.79 ± 22.36	-1.97	0.05
GPgNPrn	35.79 ± 3.51	35.46 ± 3.50	0.61	0.54
NPrnNPg	35.41 ± 3.61	34.93 ± 4.02	0.78	0.44
GMeC	99.22 ± 6.13	105.64 ± 19.84	-2.46	0.02
GPgC	99.22 ± 6.13	105.64 ± 19.84	-2.46	0.02
NSnNPrn	24.46 ± 3.81	22.07 ± 5.18	3.16	0.02

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle

Table 4.11 : Comparison of Facial Traits Between Adolescent Alago and Eggon Girls

Variables	Females (n = 50) Mean + SD	Females (n = 105) Mean + SD	t-value	P-Value
NS-n	25.25 ± 3.66	29.03 ± 5.86	-2.88	0.005
Sm-Pg	10.89 ± 2.51	13.19 ± 9.09	-0.31	0.76
Sts-Sti	4.19 ± 0.95	4.44 ± 0.94	-0.82	0.41
Sn-Sts	11.83 ± 1.91	15.27 ± 5.91	-3.45	<0.001
Sti-Me	25.694 ± 2.93	30.25 ± 6.71	-3.21	0.03
N-Me	61.57 ± 6.60	72.27 ± 13.28	-2.32	0.02
Tvl-Prn	7.85 ± 1.90	9.49 ± 4.76	-1.51	0.13
Tvl-Ls	7.06 ± 2.04	7.04 ± 5.02	-1.95	0.05
Tvl-Li	4.18 ± 2.27	5.65 ± 4.75	-1.91	0.06
Tvl-A	4.84 ± 0.93	5.82 ± 7.99	-1.63	0.11
Tvl-B	6.15 ± 1.78	6.85 ± 3.50	-0.69	0.49
Tvl-Pg	4.71 ± 1.86	6.512 ± 8.51	-1.61	0.11
G-Me	72.92 ± 8.57	85.09 ± 15.79	-2.47	0.02
NSnPg	165.24 ± 5.54	163.13 ± 7.05	-0.49	0.63
SnLsSnPg	48.68 ± 10.39	45.95 ± 18.69	-1.00	0.32
CmSnLs	79.169 ± 17.813	77.29 ± 20.94	1.50	0.14
GPgNPrn	35.99 ± 3.61	34.85 ± 3.53	-0.22	0.83
NPrnNPg	35.70 ± 3.29	34.66 ± 4.14	0.27	0.79
GMeC	96.69 ± 6.99	99.18 ± 13.03	-1.48	0.14
GPgC	96.69 ± 6.99	99.18 ± 13.03	-1.48	0.14
NSnNPrn	27.37 ± 4.01	25.24 ± 4.98	-0.12	0.91

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle, NSnNPrn=Nasofacial angle

Table 4.12 : Comparison of Facial Traits Between Adult Alago and Eggon Males

Variables	Alago Males (n = 70) Mean + SD	Eggon Males (n = 75) Mean + SD	t-value	P-Value
NS-n	24.481 ± 3.550	27.056 ± 6.641	-2.882	0.005
Sm-Pg	11.579 ± 3.414	11.741 ± 2.965	-0.305	0.761
Sts-Sti	4.234 ± 0.962	4.402 ± 1.430	-0.821	0.413
Sn-Sts	12.186 ± 1.820	13.837 ± 3.593	-3,451	<0.001
Sti-Me	25.817 ± 3.466	28.731 ± 6.807	-3.214	0.032
N-Me	62.011 ± 7.114	66.741 ± 15.601	-2.321	0.022
Tvl-Prn	7.700 ± 2.327	8.328 ± 2.654	-1.511	0.133
Tvl-Ls	6.298 ± 1.102	6.927 ± 2.488	-1.945	0.054
Tvl-Li	4.212 ± 1.199	4.711 ± 1.858	-1.908	0.058
Tvl-A	4.836 ± 0.894	5.219 ± 1.763	-1.631	0.105
Tvl-B	5.912 ± 1.540	6.123 ± 2.048	-0.697	0.487
Tvl-Pg	4.425 ± 2.040	5.062 ± 2.658	-1.609	0.110
G-Me	72.124 ± 8.782	78.301 ± 19.111	-2.471	0.015
NSnPg	162.517 ± 6.456	163.083 ± 7.514	-0.485	0.629
SnLsSnPg	44.774 ± 9.780	46.244 ± 7.808	-1.004	0.317
CmSnLs	77.391 ± 21.058	72.587 ± 17.332	1.504	0.135
GPgNPrn	36.720 ± 4.405	36.877 ± 4.010	-0.224	0.825
NPrnNPg	36.649 ± 4.692	36.447 ± 4.464	0.265	0.791
GMeC	99.178 ± 6.088	100.679 ± 6.086	-1.484	0.140
GPgC	99.178 ± 6.088	100.679 ± 6.086	-1.484	0.140
NSnNPrn	26.494 ± 4.189	26.574 ± 4.046	-0.117	0.907

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle, NSnNPrn=Nasofacial angle

Table 4.13 : Comparison of Facial Traits Between Adult Alago and Eggon Females

Variable	Females (n = 57) Mean + SD	Females (n = 54) Mean + SD	t	P
NS-n	24.40 ± 3.21	28.67 ± 7.15	-4.09	<0.001
Sm-Pg	10.29 ± 2.52	11.35 ± 2.48	-2.21	0.03
Sts-Sti	3.93 ± 0.84	4.26 ± 0.97	-1.94	0.06
Sn-Sts	11.37 ± 1.56	14.17 ± 3.52	-5.47	<0.001
Sti-Me	23.75 ± 3.25	29.59 ± 6.79	-5.82	<0.001
N-Me	57.92 ± 6.92	69.12 ± 14.92	-5.11	<0.001
Tvl-Prn	8.03 ± 1.88	8.98 ± 3.02	-2.00	0.05
Tvl-Ls	6.34 ± 1.39	6.29 ± 2.48	0.13	0.89
Tvl-Li	3.81 ± 1.05	4.82 ± 2.57	-2.72	0.01
Tvl-A	4.89 ± 0.83	4.70 ± 1.33	0.92	0.36
Tvl-B	5.79 ± 1.46	6.34 ± 2.05	-1.63	0.11
Tvl-Pg	4.57 ± 1.65	4.78 ± 2.43	-0.54	0.59
G-Me	68.56 ± 8.84	80.87 ± 17.91	-4.63	<0.001
NSnPg	167.33 ± 5.36	167.15 ± 6.54	0.16	0.87
SnLsSnPg	47.81 ± 9.77	42.18 ± 7.63	3.37	0.001
CmSnLs	71.99 ± 14.49	74.45 ± 15.39	-0.87	0.39
GPgNPrn	35.52 ± 3.61	33.45 ± 3.21	3.18	0.002
NPrnNPg	35.51 ± 3.79	32.75 ± 3.42	4.01	<0.001
GMeC	94.85 ± 5.99	99.96 ± 7.05	-4.12	<0.001
GPgC	94.85 ± 5.99	99.96 ± 7.05	-4.12	<0.001
NSnNPrn	28.32 ± 3.09	25.49 ± 4.49	3.87	<0.001

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle

4.3Correlation Between Anthropometric Variables

Table 4.14 shows the overall correlation matrix of the studied subjects and their anthropometric characteristics at $p<0.05$. nasal length showed weak and insignificant correlation with all the anthropometric parameters. Inferior labial sulcus showed an inverse significant correlation with Tvl-B and N-Sn-Pg, interlabial sulcus showed significant correlation with Sn-Ls/Sn-Pg, N-prn/N-Pg, G-Pg/N-Prn, G-Me-C and it showed weak insignificant correlations with other parameters. Also, nasolabial angle showed positive significant correlation with Sn-Sts, Tvl-Li, G-Pg/N-Prn, N-Prn/N-Pg, Tvl-B.

Table 4.15 shows the correlation matrix of the anthropometric parameters in the general male studied in the research at $p < 0.05$. Nasal length showed no significant correlation with all parameters. Mentocervical angle showed inverse significant correlation with angle of facial convexity and showed positive significant correlation with G-Pg/N-Prn, and Tvl-Li. Nasolabial angle showed inverse significant correlation with Sn-Sts, Tvl-Li and G-Pg/N-Prn but showed positive significant correlation with Tvl-B. interlabial space showed strong positive correlation with Tvl-Prn,Sn-Ls/Sn-Pg, G-Pg/N-Prn and N-Prn/N-Pg with weak and significant correlation with other parameters.

Table 4.16 shows the correlation matrix of the anthropometric parameters in the general female population at $p< 0.05$. Nasal length showed no correlation with any parameter save the nasolabial angle. Nasolabial angle showed positive significant correlation with N-Sn, Tvl-B, and Gp -Pg/N-Prn while it showed strong negative correlation with Tvl-Li. Cervicomental angle showed positive significant correlation with angle of facial convexity, G-Pg/N-Prn and showed negative significant correlation with interlabial space. Also interlabial gap positive significant correlation

with Tvl-A and showed negative significant correlation with Sn-Ls/Sn-Pg and N-Prn/N-Pg. inferior labial sulcus showed negative correlation with Tvl-B and showed positive significant correlation with the angle of facial convexity and G-Pg/N-Prn.

TABLE 4.14 Showing General CorrelationBetween the Linear and Angular Measurements in the Alago and Eggon Groups

	N-Sn	Sm-Pg	Sts-Sti	Sn—Sts	Sti-Me	N-Me	Tvl –Prn	Tvl–Ls	Tvl –Li	Tvl-A	Tvl –B	Tvl –Pg	G-Me	Nsnpg	SnLs/SnPg	CmSnLs	GPg/NPrn	NPrn/NPg	G-Me-C	NSn/NPrn
N-Sn		0.20	0.34	0.51	0.54	0,67	0.24	0.18	0.21	0.14	0.19	0.22	0.67	-0.18	-0.09	0.15	-0.08	-0.10	0.13	-0.23
Sm- Pg			0.12	0.74	0.23	0.25	0.13	0.16	0.22	0.81	-0.04	0.79	0.14	-0.005	0.46	-0.11	0.07	0.24	-0.47	0.19
Sts-Sts				0.25	0.42	0.50	0.07	0.15	0.09	0.07	0.15	0.07	0.49	-0.25	0.004	0.18	0.02	0.03	0.04	-0.19
Sn-Sts					0.44	0.59	0.27	0.28	0.30	0.69	0.15	0.75	0.53	-0.09	0.19	-0.04	0.08	0.17	-0.13	0.07
Sti-Me						0.90	0.37	0.37	0.38	0.21	0.18	0.09	0.82	-0.29	0.13	0.26	-0.06	-0.04	0.19	-0.30
N-Me							0.39	0.32	0.32	0.19	0.28	0.18	0.95	-0.28	0.16	0.25	-0.09	-0.08	0.25	-0.31
Tvl –Prn								0.67	0.51	0.41	0.13	0.19	0.25	0.35	0.09	-0.29	0.01	0.03	0.11	0.34
Tvl –Ls									0.87	0.44	-0.13	0.07	0.19	0.18	0.21	-0.14	0.07	0.05	0.12	0.19
Tvl –Li										0.42	-0.22	0.07	0.20	0.15	0.09	-0.04	-0.01	-0.03	0.11	0.09
Tvl-A											-0.04	0.79	0.01	0.09	0.45	-0.17	0.07	0.26	-0.36	0.29
Tvl –B												0.25	0.28	-0.21	0.03	0.04	0.06	0.07	0.25	-0.10
Tvl –Pg													0.08	-0.04	0.53	-0.17	0.13	0.31	-0.30	0.25
G-Me														-0.29	0.22	0.28	-0.05	-0.11	0.30	-0.34
Nsnpg															0.18	-0.55	-0.29	-0.32	-0.07	0.62
SnLs/SnPg																-0.47	0.07	0.19	-0.32	0.37
CmSnLs																	0.02	0.02	0.13	-0.48
GPg/NPrn																		0.92	0.08	0.48
NPrn/NPg																			-0.08	0.53
G-Me-C																				-0.12
NSn/NPrn																				

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle (correlation significant at $p < 0.05$)

TABLE 4.15: Correlation of Linear and Angular Measurements Among the Male Alago and Eggon Ethnic groups

	N-Sn	Sm-Pg	Sts-Sti	Sn—Sts	Sti-Me	N-Me	Tvl –Prn	Tvl–Ls	Tvl –Li	Tvl-A	Tvl –B	Tvl –Pg	G-Me	Nsnpg	SnLs/SnPg	CmSnLs	GPg/NPrn	NPrn/NPg	G-Me-C	NSn/NPrn
N-Sn		0.21	0.34	0.56	0.53	0.07	0.18	0.19	0.24	0.14	0.15	0.26	0.71	-0.22	-0.10	0.22	-0.06	-0.09	0.13	-0.25
Sn- Pg			0.10	0.74	0.23	0.24	0.16	0.18	0.24	0.80	-0.04	0.78	0.44	-0.01	0.50	-0.10	0.07	0.23	-0.47	0.19
Sts-Sts				0.27	0.40	0.49	0.02	0.14	0.07	0.08	0.09	0.06	0.48	-0.26	0.02	0.19	0.03	0.056	0.47	-0.19
Sn-Sts					0.44	0.61	0.27	0.28	0.29	0.69	0.14	0.75	0.56	-0.12	0.29	-0.01	0.05	0.14	-0.16	0.03
Sti-Me						0.90	0.27	0.35	0.36	0.19	0.16	0.09	0.82	-0.32	-0.13	0.30	-0.01	0.03	0.18	-0.27
N-Me							0.29	0.30	0.29	0.18	0.23	0.19	0.96	-0.32	-0.16	0.29	-0.07	-0.05	0.25	-0.31
Tvl –Prn								0.68	0.58	0.45	0.09	0.24	0.17	0.34	0.19	-0.33	0.06	0.06	0.06	0.36
Tvl –Ls									0.86	0.45	0.19	0.05	0.19	0.21	0.25	-0.16	0.06	0.06	0.07	0.22
Tvl –Li										0.42	-0.23	0.08	0.19	0.19	0.12	-0.04	-0.04	-0.04	0.04	0.12
Tvl-A											-0.02	0.78	0.02	0.09	0.52	-0.16	0.05	0.23	-0.37	0.27
Tvl –B												0.25	0.24	-0.21	-0.05	0.03	0.06	0.07	0.20	-0.10
Tvl –Pg													0.10	-0.08	0.57	-0.14	0.13	0.28	-0.30	0.21
G-Me														-0.34	-0.22	0.33	-0.05	-0.08	0.29	-0.35
Nsnpg															0.21	-0.57	-0.26	-0.31	-0.04	0.61
SnLs/SnPg																-0.47	0.09	0.21	-0.33	0.39
CmSnLs																	-0.01	0.01	0.12	-0.49
GPg/NPrn																		0.19	0.06	0.52
NPrn/NPg																			-0.07	0.55
G-Me-C																				-0.08
NSn/NPrn																				

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle (correlation significant at $p<0.05$).

TABLE 4.16: Correlation of Linear and Angular Measurements Among the Female Alago and Eggon Ethnic groups

	N-Sn	Sm-Pg	Sts-Sti	Sn--Sts	Sti-Me	N-Me	Tvl –Prn	Tvl–Ls	Tvl –Li	Tvl-A	Tvl –B	Tvl –Pg	G-Me	Nsnpg	SnLs/SnPg	CmSnLs	GPg/NPrn	NPrn/NPg	G-Me-C	NSn/NPrn
N-Sn		0.19	0.31	0.43	0.55	0.63	0.35	0.17	0.15	0.13	0.26	0.17	0.61	-0.072	0.08	0.02	-0.13	-0.15	0.09	-0.18
Sn- Pg			0.13	0.74	0.24	0.27	0.09	0.15	0.19	0.82	-0.05	0.81	0.14	0.031	0.42	-0.14	0.06	0.24	-0.49	0.24
Sts-Sts				0.21	0.45	0.51	0.70	0.18	0.12	0.06	0.26	0.08	0.51	-0.52	0.05	0.11	-0.06	-0.05	-0.03	-0.17
Sn-Sts					0.43	0.51	0.32	0.28	0.31	0.71	0.17	0.75	0.49	0.023	0.13	-0.10	0.09	0.19	-0.14	0.18
Sti-Me						0.91	0.52	0.39	0.39	0.22	0.26	0.09	0.82	-0.21	-0.13	0.18	-0.16	-0.16	0.17	-0.32
N-Me							0.54	0.35	0.35	0.21	0.35	0.17	0.95	0.17	-0.15	0.16	-0.16	-0.17	0.21	-0.28
Tvl –Prn								0.68	0.59	0.37	0.21	0.16	0.40	0.33	-0.02	-0.21	-0.005	0.01	0.24	0.29
Tvl –Ls									0.87	0.44	-0.10	0.08	0.21	0.18	0.17	0.12	0.07	0.04	0.19	0.17
Tvl –Li										0.42	-0.23	0.07	0.22	0.14	0.61	-0.05	0.02	-0.02	0.21	0.09
Tvl-A											-0..03	0.81	-0.005	0.11	0.39	-0.18	0.09	0.29	-0.37	0.34
Tvl –B												0.26	0.36	0.03	0.002	0.04	0.03	0.06	0.31	-0.08
Tvl –Pg													0.04	-0.18	0.05	-0.22	0.13	0.35	-0.34	0.34
G-Me														0.17	-0.21	0.18	-0.10\	-0.19	0.29	-0.29
Nsnpg															0.13	-0.51	-0.26	-0.28	0.03	0.59
SnLs/SnPg																-0.48	0.08	0.21	-0.31	0.35
CmSnLs																	0.01	0.002	0.09	-0.44
GPg/NPrn																		0.92	0.04	0.54
NPrn/NPg																			-0.17	0.59
G-Me-C																				0.12
NSn/NPrn																				

N-sn= nasal length, Sm-Pg= interlabial sulcus, Sts-Sti= interlabial space, Sn-Sts= upper lip length, Sti-Me =lower lip length, N-Me= ,TVL=true vertical line, Ls=labial superior, Li= labial inferior, Pg=pogoniom,NSnPg= angle of facial convexity, SnLsSnPg=upper lip angle, CmSnLs=nasolabial angle , GPgNPrn=nasofacial angle NPrnNpg= nasomental angle, GMeC= mento-cervical angle (correlation significant at $p<0.05$).

CHAPTER 5

5.0 Discussion

The knowledge of soft-tissue anthropometric profiles can never be overemphasized in the discipline of medicine, especially in specialties such as orthognathic and plastic surgery, orthodontics, and dental prosthesis. Although direct anthropometry was for years required for this aim, the use of standardized photography today is of the highest importance to achieve biological classification of individual's and for clinical research (Ezeuko *et al* ., 2011). Therefore, research work of this type is essential for clinicians such as those working in the maxillofacial discipline, as knowledge of the standard anthropometric features of the face of a specific ethnic group would guide the repair of affected areas in their patients (Ezeuko, 2011).For instance, the application of nasolabial angle (Cm-Sn-Ls) is important in the evaluation of the relationship between the nasal base and the upper lip during orthodontic diagnosis and treatment planning. It is of great clinical relevance because its magnitude depends on the anteroposterior position and inclination of the upper anterior teeth. It can be altered in orthodontics or orthognathic surgery (Wamalwa, 2011). Also, inter-ethnic/racial facial variations have long been of interest to the general public, anthropologists, and medical and dental practitioners, studies providing solid evidence on this issues are surprisingly sparse. Research on the value of facial, nasal, maxillary, mandibular and oro-facial heights in Nigeria have been carried out. Results showed that there was sexual dimorphism in all the parameters measured with the males having higher values than the females. Soft tissue profile of other races have also been reported for Urhobos and Itsekiris in Nigeria, in which sexual differences were observed between the males and females in the parameters measured except the lower face and for residents of Jos in Nigeria. The present study also showed that both adult and adolescent males of both ethnic groups had higher linear and angular facial features than the females. These sex differences in physical

characteristics are often related to hormonal, genetic, and environmental factors . Sexual dimorphism is an important concern for the forensic anthropologists as it is a key to individual identification. Assessing sexual dimorphism eliminates approximately half of the population from further considerations in cases of missing persons or unknown identity (Shah, *et al*., 2015).

In humans gene flow usually comes about through the actual migration of human populations, either voluntary or forced. Gene flow accelerated by intermarriage between national or state communities occurs frequently within a short time period. It remains a challenge to determine temporal control and spatial control of historical human migration (UKEssays, 2018) .The study showed that both Alago and Eggon ethnic group have many similar facial features and this could be due to gene flow as these ethnic groups share boundaries and even inter-marry.

This study was carried out to provide a data base and facial norms of soft tissue profile analysis of the Alago and Eggon adolescent and adults which is very important in forensic and investigative studies. This study is also aimed at showing sexual dimorphism in these anthropometric facial profile parameters within the adolescents and adults of both ethnic groups.

In the present study the angle of facial convexity for Adult Alago males and females showedsignificant sexual dimorphism , this is in accordance with Bhandari, (2015) who recorded that the male himachal population had significantly higher facial convexity angle than the females. Arnett and Bergman *et al.,* (1999) also reported same values with Bhandari *et al*., (2015). The Alago adolescents also showed sexual dimorphism with females showing significantly higher facial convexity angle which is in accordance with adolescent Persian population by Moshkelhosha *et al.,* (2015). Anic-Milosevic *et al., (*2012) in his study reported that there was insignificant sexual dimorphism among the male and female Turkish adult but with males having higher nasolabial angles than the females.

The result from the research showed that the adult Eggon females have significantly higher angle of facial convexity than the males. Asghari *et al*., (2014).on his research also found out that Iranian female young adults had higher angle of facial convexity than the males. However, the research carried out by Bhandari *et al.*, (2015) and Arnet and Bergman, (1993)showed adult males having higher angle of facial convexity than the females. The adolescents Eggon boys and girls also showed significant difference in angle of facial convexity with the females having larger angle than the males showing sexual dimorphism. Moshkelgosha's study on adolescent Persian adolescents agreed with this study.

From the study both Alago and Eggon ethnic group have very similar angles of facial convexity with no statistically significant difference. The adult Eggon males had slightly higher angle of facial convexity than Alago males while the female Alago had slightly higher angle of facial convexity than the adult Eggon females. More so, adolescent Alago boys and girls had slightly higher angles than Eggon boys and girls.

The study showed sexual dimorphism in the adults and adolescents of both ethnic groups with the males having higher values in all except for the adult Eggon where the adult females had higher nasolabial angle.

The result from the study showed that both the adult and adolescent Alago and Eggon ethnic group have the same range of nasolabial angles. Moshkelgosha *et al*., (2015) on adolescent Persians recorded that the girls had larger nasolabial angle than the boys and this agrees with the result for adult Eggon males.

The present study compared with the study by Ezeuko *et al*., (2015) on adult Bini ethnic group of Nigeria showed that the value of the nasolabial angle for the Alago, Eggon and Bini ethnic group are similar. Also, Moussa *et al.,*(2018*)* on his non gender categorization of Ivorian facial

profile got 85.0 ± 5.01 for large face, 89.97 ± 6.21 for average face and 88.76 ± 5.35 for long face. However, Malkoc *et al.,* (2008) reported that adult turrkish females had statistically significant higher nasolabial angles than adult Turkish males.

The application of nasolabial angle (Cm-Sn-Ls) is important in the evaluation of the relationship between the nasal base and the upper lip during orthodontic diagnosis and treatment planning. It is of great clinical relevance because its magnitude depends on the anteroposterior position and inclination of the upper anterior teeth. It can be altered in orthodontics or orthognathic surgery (Ferdousi *et al.,* 2013).

The measurement of nasomental angle in this study showed that adult Alago males had higher values than females while Adolescent Alago females had higher values than the adolescent males but not statistically significant . This was also so for the Eggon adolescents whose mean nasomental angle had no significant difference.

However, the study showed that there was a significant difference in the nasomental angle of Adult Eggon .The values show sexual dimorphism with the males having higher values across the age groups.

According to Lines *et al*., (1978) the nasomental angle (N-Prn/N-Pg) showed aesthetically most acceptable within a range of 20–30.Bhandari reported that Himachali males have significantly higher nasomental angles than females showing sexual dimorphism. Anic-Milosevic*et al.,* (2009) stated no gender differences were found.

The findings of this study showed that the Alago adult males have significantly higher meto-cervical angle than the females. The Eggon adults showed a little difference too but it was not statistically different.

The study showed that there is no variation in the mentocervical angles between the Alago and Eggon ethnic groups. However, the adolescents of both ethnic groups had larger mentocervical angles than the adults.

The study also showed generally that females across both ethnic groups have more acute mentocervical angles i.e the males have more protruded faces. However, the study by on Chinese people showed that the Chinese young adults have generally showed higher values for females than the males.

Meshklegosha *et al.,* (2015) reported that there was sexual dimorphism with males having higher values than the female for the Persian population. Malkoc *et al*., (2008) also reported that the male Turkish Adults had higher mentocervical angle than the females but the difference was statistically insignificant.

This study showed that both Alago and Eggon ethnic group have the same range of nasofacial angles with the adults having higher values than the adolescents in both ethnic groups. The similarity in this facial feature between the two ethnic groups could be because of several scientific factor and the closest will be Gene flow as suggested previously. The two ethnic groups share boundaries, markets and inter-marry giving very strong chances of gene flow.

The measurement for nasofacial angle in the study for both Alago adult and adolescent males and females showed no statistical difference with the adult males having higher values than the females.

The study also showed that the adolescent male Eggon have higher nasofacial angle but with no statistical significant gender difference.

However, the measurement for nasofacial angle in the study for adult Eggon showed statistical difference with the males having higher nasofacial angle than the females. A higher nasofacial angle suggests a greater projection of the nose.

This study is at variance with the study by Ezeuko *et al*., (2015), who studied the nasofacial angle of adult Bini people in Nigeria and showed that the males have significantly higher nasofacial angle than the females but agrees with Ferdousi *et al*., (2013), who found no statistically significant deference in nasofacial angles between the males and females among the Garo population of Bangladesh.

The measurement of upper lip angle in the present study for Alago adults and adolescents showed that the females have larger upper lip angle but it is not statistically significant. However, there was statistically significant difference in the upper lip angle between the adult male and female Eggon with the males having larger angles. The adolescent Eggon showed no statistical significant difference like the adolescent Alago with the females having relatively larger angles.

This study is in accordance with the study conducted by Arnett *et al.,* (1999), on Caucasian population, who also found this angle to be greater in the females (12.1 ± 5.1) as compared to the males (8.3 ± 5.4). Anic-Milosevic*et al.,* (2008) also found the upper lip angle more in females as compared to males.

The measurement of upper lip length from this study for Alago ethnic group showed sexual dimorphism. The males of both the adult and adolescents Alago showed thicker lips. The study also showed sexual dimorphism among the Eggon adults and adolescents with the males having longer upper lip length.

Generally, both ethnic groups have similar upper lip length for both adults and adolescents.This agrees with the report by Bhandari *et al.,* (2015) on the Himachali population where the males had significantly higher values for length of upper lip.

The measurement of the length of lower lip from the study for Alago ethnic group showed that the adult males have statistical higher values for the length of lower lips than the females .the adolescent Alago males and females also showed statistical significant gender difference with the males having higher values.

The measurement of the length of lower lips from the study for Eggon ethnic group was 28.731 mm ± 6.807 for adult males and 29.583 mm ± 6.793 for female adults with no statistical significant gender difference at $p<0.05$, but the adolescents showed statistical significant gender difference at $p=0.006$ with 32.040 mm ± 7.658 for males and 30.253 ± 6.709 for females.This study is in accordance with the study conducted by Fernández- Riveiro*et al*., (2010) who also found larger lip length in males as compared to females.

Measurement of inter labial gap from the study for Alago ethnic group was 4.234 mm ± 0.962 for adult males and 3.925mm ± 0.849 for female adults with no statistical significant difference although the males had higher mean values. The adolescent males had higher mean value with 4.551 mm ± 1.025 for males and 4.189 mm ± for females with no statistical significant difference.

Measurement of inter labial gap for Eggon ethnic group showed that the adult males have statistical significant higher interlabial gap than the females while the adolescents showed no statistical significant difference but the males had higher mean.

The result for the adolescents from both Alago and Eggon ethic groups agrees with the report form Moshkelgosha on Persian adolescents although the values were a little different and this

could be due to different resting postures of the lips in the different studies. He reported higher mean value for inter labial gap for males than females with no statistical significant difference. Legan and Burstone also reported higher inter labial gap for Adult males than females.

The measurement of nasal length from the study showed higher means for the males against the females in both ethnic groups and across the age groups. This agrees with several studies including Omotoso *et al*., (2012) on adult Bini tribe in Nigeria and Oladipo *et al*., (2014) on adults of ebony ethnic group in Nigeria.

The measurement of true vertical line to pronasale in this Alago adults was 7.700 mm ± 2.327 for males and 8.027 mm ± 1.876 for females showing higher mean values for female than males but no statistical significant difference. Adolescent Alago also showed no statistical significant difference with females having higher means than males. The males had 7.174 mm ± 1.868 and the females having 7.852 mm ± 1.902.

The measurement of true vertical line to pronasale in this study for Eggon ethnic group was 8.328 mm± 2.654 for adult males and 8.976 mm ± 3.019 for adult females with the females having higher mean than females with no statistical significant difference. The measurement for the adolescent Eggon showed 8.240 mm ± 5.038 for boys and 9.492 mm ± 4.763 for girls with the females also showing higher mean values than the males.

The study by Scavone *et al*., (2008), reported sexual dimorphism among Brazillian adults significant at $p<0.001$. The study also shows that the Brazillians have a larger distance between tvl and nasal tip compared to both the Alago and Eggon ethnic group. However, Scalfani, (2002) also recorded that Americans had larger nasal project thanBrazillians .

The measurement of true vertical line to soft tissue labial superior from this study was 6.298 mm ± 1.102 for adult male Alago,6.344 mm ± 1.394 for adult alago females , 6.731 mm ± 1,599 for adolescent Alago males, 7.603 mm ± 2.036 for adolescent Alago female , 6.927 mm ± 2.488 for adult Eggon males, 6.924 mm ± 2.478 for adult Eggon females, 7.193 mm ± 5.431 for adolescent eggon males and 7.041 mm ± 5.016 for adolescent Eggon females. Across the two ethnic groups and age groups the male and adolescent boys have higher mean values than the females and adolescent girls Scavone *et al*., (2008) also recorded sexual dimorphism among adult Brazillians but with different values (male =1.3 mm ± 1.8, males = 2.3 mm ± 1.8) significant at p= 0.05. Large values between Tvl and labial superior indicates protruded or thick lips and sometimes protruded faces.

Generally from this study the upper lip is more protruded compared to the protrusion of the lower lips in reference to TVL (True Vertical Line). This is in accordance to several researches including the research by Moshkelgosha *et al.*,(2015) on adolescent Persians which showed that the upper lips of both male and female adolescent Persians protruded more than the lower lips with the boys having higher mean values than the females.

This study showed that the measurement of true vertical line to labial inferior was higher for both Alago and Eggon adult males and adolescent boys than the adult females and adolescent girls with no statistical significant difference except for the adult alago males and females that showed statistical significant difference at p=0.048.

Also, the result showed that the Alago and Eggon population has more protruded upper lips than the lower lips which is higher in males than females which agrees with the report by Scavone *et al*., (2008) on the soft tissue profile of white Brazillian adults.

The measurement of true vertical line to soft tissue point A from this study showed no statistical significant difference across the two ethnic groups and across the age groups but the male and adolescent boys showed higher means compared to the females and adolescent girls.

The measurement of true vertical line to soft tissue point B from this study showed no statistical significant difference across the two ethnic groups and across the age groups but the male and adolescent boys showed higher means compared to the females and adolescent girls.

From this study, the measurement of true vertical line to the soft tissue pogonion showed that across both ethnic groups the adult males and adolescent boys have higher tvl – pogonion values than the adult females and adolescent girls except for Eggon adults where the females had higher mean value. Scavone recorded that the adult female Brazilians also had higher tvl- pogonion values than the males (males = 4.5 mm ± 5, female =6.4 mm ± 5.2). Also, Moshkelgosha *et al*., (2015) reported that male adolescent Persians had more protruded chins compared to females ($p>0.001$). However, other investigators, like Park and Burstone did not find any differences between males and females in their analysis of chin height.

Relationship Between Variables

From the result of the study the nasolabial angle showed strong positive correlation with the nasofacial angle and the nasomental angle but showed negative correlation with the length of lower lip. Also, the total facial height showed negative correlation with nasofacial angle across both ethnic group.

The correlation between linear facial measurements and angular measurements showed how much the shape of the face depends on these factors and how these factors depend on each other. This is in line with the studies of Diamonde *et al*., (2017) on the facial shape of young Ivorians. He noted the correlation between the facial indices and the angles of the face width (Zy.r-Tr-

Zy.l), interlabial (Sn-Ls/LiSm) angles, and the zygomatic and the mandibular width (Go.r -Gn-Go.l) angles.

CHAPTER 6

6.0 Summary,Conclusion and Recommendation

6.1 Summary

In conclusion, variation in facial anthropometry with relation to race and ethnicity is well documented and accepted. The present study, therefore, presents the norm for the angular facial profile among the Alago and Eggon population.

This study has shown that, as in most other populations, some of the angular and linear variables in facial tissue profile are sexually dimorphic among the Alago and Eggon ethnic group. The result from the study showed that the males have significantly higher angles of facial convexity and nasolabial angles for both ethnic group and across both age groups.The study also showed the adult male Eggon have significantly higher nasomental and mentocervical angles than the females but the adult Alago do not show any significant gender difference.

Sexual dimorphism was observed on almost all the linear facial features across both ethnic and age group. The result showed that the males have generally more protruded lips, thicker lips, interlabial gap, longer and more protruded faces.

Also, the result from this study showed that there are variations in some of the linear and angular features of both the Alago and Eggon ethnic groups while some of the facial traits showed no significant difference.

The result from this study would help in forensic investigations given that it has provided a standardized normal value for the Alago and Eggon ethnic group. It would also help in understanding how this population stands anthropometrically among the various populations of the world indicating the variations it shows from other populations.

6.2 Conclusion

The study has characterized the facial traits of the Alago and Eggon Ethnic groups and also showed that there are significant differences in some linear and angular facial profile between Alago and Eggon ethnic groups.

6.3 Recommendations

Based on the findings of the present study, the following recommendations are formulated:

1. This research was carried out using photometric method and analysis. New research should be carried out on the same ethnic group using direct measurements where possible with more number of variables. This is necessary to clear controversy on the accuracy of photometry measurements and to provide baseline data from direct measurement of the facial profile of the Alago and Eggon ethnic group.

2. This research covered just two ethnic groups in NasarawaState. Further research should be carried out on other ethnic groups with wider population and more number of measurable variables.

6.4 Contribution to Knowledge

i. Baseline data were obtained for some very important linear and angular facial profile of the Eggon ethnic group. They include nasofacial angle (adult male=36.88 ±4.01, adult female = 33.45±3.21, adolescent male =35.46±3.56, adolescent female =34.85± 3.53), nasomental angle (adult male =36.45±4.46, adult female=32.75±3.42, adolescent male=34.93±4.02, adolescent female=34.66±4.14), nasolabial angle (adult male=72.59±17.33, adult female=74.45±15.39, adolescent male =87.79±22.36, adolescent female = 77.29±20.94), mentocervical angle (adult male=99.96±7.05,

adult

female=100.68±6.09,adolescentmale=105.64±19.84,adolescentfemale=99.18±13.03), TVL-A(adult male= 5.22±1.76, adult female=4.76±1.33, adolescent male= 6.08±8.35, adolescent female=4.70±1.33), TVL-B (adult male=6.12±2.05, adult female=6.34±2.05, adolescent male, adolescent female).

ii. Baseline data were obtained for the facial profile of the Alago ethnic group (Adult and adolescents all inclusive).They include nasofacial angle (adult male=36.72±4.41, adult female=35.52±3.61, adolescent male=35.79±3.51, adolescent female=35.99±3.61), nasomental angle (adult male=36.65±4.69, adult female=35.51±3.78, adolescent male35.41±3.61, adolescent female=37.70±3.29), nasolabial angle (adult male=77.39±21.06, adult female=71.99±14.49, adolescent male=81.34±16.70, adolescent female=79.17±17.81), mentocervical angle (adult male=99.18±6.09, adult female=94.85±5.98, adolescent male=99.22±6.13, adolescent female=96.69±6.99), TVL-A(adult male=4.84±0.89, adult female=4.89±0.83, adolescent male=5.06±1.11, adolescent female=4.84±0.93), TVL-B (adult male=5.91±1.54, adult female=5.79±1.46, adolescent male=7.75±5.31, adolescent female=6.15±1.78).

iii. Correlation patterns were established between the linear and angular facila profile of Alago and Eggon sample population. Nasolabial, nasomental and nasofacial angles showed strong positive correlation i.e the three angles increase in a direct proportion.

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APPENDIX I

CONSENT FORM

DEPARTMENT OF HUMAN ANATOMY

FACULTY OF MEDICINE

AHMADU BELLO UNIVERSITY, ZARIA

Dear Respondent,

I, John Joseph Olotoche, an M.Sc student in the Department of Human Anatomy of the above named institution, I am carrying out a research on the linear and angular measurements of facial soft tissue profile of Eggon and Alago ethnic groups in Nasarawa state, Nigeria. Participation is voluntary. It involves collection of certain information about your personal and family characteristics and measurements of some facial parameters by first taking photographs of your face and analysing it digitally.

The information collected from you will be used strictly to achieve the objectives of this study and for scientific publication. I assure you that this study has been reviewed and approved by my supervisors and the University Committee on Research Ethics.

Thank you for your cooperation.

Yours sincerely,

John, Joseph Olotoche

APPENDIX II

CONSENT TO PARTICIPATE IN RESEARCH

Angular and Linear measurements of facial soft tissue profile of Eggon and Alago Ethnic groups in Nasarawa state, Nigeria.

You are kindly being asked to participate in a research study conducted by John Joseph Olotoche for a Master of Science degree under the supervision of Dr. J.A. Timbuak, and Dr. M. Tanko, from the Department of Human Anatomy, Faculty of basic medical science, Ahmadu Bello University, Zaria.

If you have any questions or concerns about the research, please feel free to contact: John Joseph Olotoche, Faculty of basic medicine, Tel: 07031207142, Dr.J.A. Timbuak, Faculty of medicine, Tel: 08036986537 Dr. M. Tanko, Faculty of medicine, Tel: 08029314944

PURPOSE OF THE STUDY

The present study is primarily aimed to determine the linear and angular measurements of facial soft tissue profile of Eggon and Alago Ethnic groups in Nasarawastate . However, it is also expected that the results might implicate certain anthropometric indexes, ethnicity, demography, of the ethnicities in the local government area.

If you volunteer to participate in this study, I would ask you to do the following things:

To fill in proforma and I shall take some of your anthropometric measurements.

POTENTIAL RISKS AND DISCOMFORT

This study does not pose any form of physical, emotional or psychological risks to you.

POTENTIAL BENEFITS TO PARTICIPANTS

The result of this study, when published will help to provide anthropometric data on the Alago and Eggon ethnic groups of Nasarawa state, contribute to understanding of the relative status of this population in the context of anthropometric variations round the world, used by law enforcement agents and forensic scientists to identify fragmentary and dismembered human remains in Nigerian people of Alago and Eggon Ethnic groups of Nasarawa State, and to create or predict the relationship between the facial traits of the Alago and Eggon ethnic groups.

PAYMENT FOR PARTICIPATION

Participation will not attract any financial benefit.

CONFIDENTIALITY

Every effort will be made to ensure confidentiality of any identifying information that is obtained in connection with this study.

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise that warrant doing so.

RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethics clearance through Ahmadu Bello University Research Ethics Board. If you have questions regarding your rights as a research participant, contact:

Dr.J.ATimbuak,

Department of Anatomy,

Faculty of basic Medical science,

Ahmadu Bello University.

Tel: 08036986537

E-mail: jtimbuak@gmail.com

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I have read the information provided for the study ‘‘ as described herein. I have been given a copy of this form.Angular and Linear measurements of facial soft tissue profile of Eggon and Alago Ethnic groups in Nasarawa state’’,

_____

Name of Participant

_____ _____

Signature of Participant Date

SIGNATURE OF WITNESS

_____

Name of Witness

_____ _____

Signature of Witness Date