SUMMARY

BACKGROUND: The female breast is an object of attraction to the opposite sex as well as a symbol of femininity. In recent years, there have been several important developments in the surgical management of breast diseases. In addition, the management of breast diseases has received considerable attention in the lay media with patients demanding effective surgical treatment with good aesthetic results as well. An essential part of aesthetic surgery is an understanding of the aesthetic ideals of the body. Quantitative analysis of breast morphometry is critical to breast plastic surgery.

OBJECTIVE: The aim of this study was to determine the normal reference data for nulliparous female breast shape, position and volume in a population of varying height, weight and age and also to determine the effects of weight, height and age on breast measurements.

METHODOLOGY: Five hundred (500) nulliparous females between the ages of 15 and 30 years, among patients presenting to the Plastic Surgery Clinic, hospital community and secondary school students were selected using a computer generated random sampling method and prospectively studied over a period of one year. The subjects’ breasts were examined clinically to rule out any underlying breast disease. Physical measurements were carried out on the breasts. These were suprasternal notch to nipple distance, nipple to nipple distance, midclavicular line to nipple distance, inframammary fold to nipple distance, areolar diameter, nipple diameter, breast diameter and chest circumference. The weight and height of each patient were also measured and the body mass index (BMI) was calculated.
Data analysis was conducted using version 16 of Statistical Package for Social Sciences and Microsoft Excel.

**RESULTS:** The mean age of patients was 18 (range 15-30) years. The mean values for the physical measurements were: suprasternal notch to right nipple distance (SNNR) 19.76cm, suprasternal notch to left nipple distance (SNNL) 20.09cm, midclavicular line to right nipple distance (MCLNR) 19.53cm, midclavicular line to left nipple distance (MCLNL) 19.72cm, nipple to nipple distance (NN) 21.12cm, right nipple to inframammary fold (NIMFR) 8.13cm, left nipple to inframammary fold (NIMFL) 8.28cm, right areolar diameter (ADR) 3.89cm and left areolar diameter (ADL) 3.92cm. The mean chest band size and breast cup size was 74D. The NIMF measurements were higher than the documented western values. Measurements on the left breast were greater than those of the right breast. Correlation of the age, breast cup size and BMI respectively with the nipple to inframammary fold were all statistically significant. Correlation of weight and BMI with breast cup size were also statistically significant.

**CONCLUSION:** The result of this study has shown that the physical measurements of the breast are within the same ranges as in other studies and that age, BMI and weight can influence breast cup size and nipple to inframammary fold measurements. Asymmetry of the breasts was also established in this study with the left breast being larger than the right breast.

**KEYWORDS:** Breast, morphometry, nulliparous, female.
CHAPTER ONE

INTRODUCTION

The female breast is an object of attraction to the opposite sex, a symbol of femininity and a source of milk to nourish the newborn infant. It is a very dynamic organ of the human body, continuously changing in size and position during the life of a person.

In recent years, there have been several important developments in the surgical management of breast diseases. There has been the emergence of new techniques for tumour resection, reconstructive surgery, lymph node assessment, and aesthetic surgery. Lately, the management of breast diseases has received considerable attention in the lay media and patients today are not only demanding effective surgical treatment, but good aesthetic results as well. Thus, perhaps more than any other field, breast surgery has evolved into both a surgical science and an art. An essential part of aesthetic surgery is an understanding of the aesthetic ideals of the body. These are the guidelines which allow for interpretation, manipulation and modification in order to create or recreate a determined aesthetic outcome.

Morphometry is the measurement of the form (of organism or their parts). Quantitative analysis of breast morphometry is critical to breast plastic surgery. The key morphological properties of the breast that are of interest to breast plastic surgery are breast shape, position and volume. The goal of plastic surgery of the breast is to recreate a natural breast that is satisfying to the patient.
MAGNITUDE OF THE PROBLEM

Recently, there has been an increased emphasis on improving quality of life worldwide for those afflicted with breast cancer. Surgeons have played a very important role in this endeavour. The surgeon is often the first to discuss the diagnosis and treatment options with the patient and effective communication skills can do much to allay anxiety and fear. Also, there is now a wider acceptance of breast reconstructive surgery as an important component in the overall management of breast cancer. Breast reconstruction can reduce the psychological trauma associated with mastectomy, particularly the sense of mutilation, depression, and misgivings concerning femininity. Surgeons throughout the world have described a wide array of reconstructive techniques, including the use of expanders, implants and tissue flaps.

With increasing information and communication technology, there is increasing awareness of the possibility of aesthetic and reconstructive surgery of the breast in Nigeria. There is also a dearth of data to guide the aesthetic and reconstructive breast surgeon in the subregion. Women with ptosis of the breast, too large or too small breast as well as congenital pathologies of the breast are now seeking aesthetic and reconstructive surgery for a possible better outcome.
JUSTIFICATION FOR THE STUDY

An “aesthetically perfect breast” has been defined as a breast shape for which no aesthetic procedure would be indicated.\(^3\) The problem with this definition is that different surgeons have different notions of when an aesthetic procedure is indicated. For example, in general, European Plastic Surgeons feel that what American Plastic Surgeons consider to be the “ideal breast” is really too large and they would recommend a breast reduction.\(^3\)

Series of reproducible measurements have been developed with reference to a single midline datum that describes the position of key landmarks on the female breast.\(^5\) In certain studies done in Western countries, measurements have been made on ‘normal’ population of subjects who are content with their breast shape in order to produce ‘normal’ reference data for breast shape in a population of varying weight and height and to evaluate factors which may influence these measurements.\(^5\) There has been commendable outcomes of surgeries done for the breast in Nigeria and by Nigerians but no local reference data on breast morphometry has been developed.\(^6\) This study aims to measure morphometric breast values in nulliparous Nigerian females and to create a reference data that describes position of key landmarks on the Nigerian female breast for breast aesthetic and reconstructive surgery.
RESEARCH OBJECTIVES

GENERAL OBJECTIVE

To determine normal reference data for breast shape, position and volume of the nulliparous female breast in a population of varying height, weight and age.

SPECIFIC OBJECTIVES

1. To obtain physical measurement of the breasts on every person in the study.
2. To compare dimensions of the right and left breast.
3. To determine the influence of weight, height and age on the breasts measurements.
CHAPTER TWO

LITERATURE REVIEW

In the year 2008, approximately 500,000 women in the United States underwent breast surgery, either aesthetic surgery or reconstruction following mastectomy for breast cancer. Spector et al noted that there was a growing body of literature on women's motivations to have these types of surgical procedures and on satisfaction with the aesthetic outcomes. In a work done in the eastern region of Nigeria, the low volume of patients presenting for reduction mammoplasty was noted. A number of reasons were adduced to the low level of patients. The level of awareness among the Nigerian populace for availability of aesthetic surgery within the country even among doctors is low. Also cost is a major factor in presentation for surgery and the poverty level of the populace is high. The morality of aesthetic surgery is still a major issue. Low volume of patients presenting for breast aesthetic surgery in the South–Western region has been documented although the outcomes of the surgeries were satisfactory, the indices were not stated.

ANATOMY AND PHYSIOLOGY OF THE BREAST

The breast undergoes multiple changes throughout life, from intrauterine life to senescence. The development of the breast has several implications that impact the breast surgeon.
BREAST EMBRYOLOGY

The primordial of the human breast first appear between the limb buds on the ventral surface of the embryo as two ectodermal ridges known as mammary ridges or "milk lines" at about the 5th week of intrauterine life. These ridges extend from each axilla to the ipsilateral groin. The duration of the mammary ridges on the fetus may vary, but normally a coalescence of cells persist in the cranial one-third of each ridge to become the future breast. These persisting elevations, known as the breast anlagen, will determine the future position of the breast. Additional mammary gland anlagen will persist along this line in lower mammals, but in humans regression is the rule.

At about the 6th gestational week, the ectoderm overlying the breast thickens and by the 10th week the ectoderm burrows into the mesenchyme, stimulated by the action of maternal and placental hormones to form the mammary bud. Vasculogenesis around the mammary bud begins and about the 15th week, epidermal sprouts appear that will become the mammary ducts. The developing breast is sensitive to the action of testosterone hormonal inhibition for several weeks at this juncture. The absence of testosterone in the female fetus allows female breast development to proceed.

Ductal development continues in the 20th to 32nd week under the varying influences of estrogen, insulin and glucocorticoids. During this time, the breast ducts canalize and lengthen. From the 32nd to 40th week, the relatively straight ducts arborize into the normal lobular-areolar pattern under the influence of progesterone, while estrogen, insulin and the glucocorticoids assume a permissive role. The common terminus of the ducts elevates to form the nipple. The surrounding areolas, with the progenitors of the specialized lubricating glands of Montgomery, are usually identifiable by the naked eye in the 20-week-old embryo. At birth, the
normal breast has the complete adult complement of 15 to 20 lobes of glandular tissue. Thelarche (the earliest breast growth, which is not in proportion to the body size) usually represents the first sign of puberty. In the presence of prolactin or growth hormone, the rising estrogen levels at puberty stimulate the ductal system to elongate and to branch, while vascularity, stroma and fat deposition all increase until the characteristic ductal spacing of the adult breast has occurred. The breast remains undeveloped in the female until puberty, when it enlarges in response to ovarian estrogen and progesterone, which initiate proliferation of the epithelial and connective tissue elements. However, the breasts remains incompletely developed until pregnancy occurs.

Under the influence of gonadotropin-releasing hormone from the hypothalamus puberty begins in children between 8 and 12 years of age. When balance of the hypophyseal-pituitary-ovarian axis is established and ovulatory cycles begin, the breast comes under the influence of progesterone from the corpus luteum, which stimulates development of the acinar, or milk-secreting structures.

CONGENITAL ANOMALIES OF THE BREAST

Accessory breasts (polymastia) or accessory nipples (polythelia) may occur along the milk line when normal regression fails. During infancy, a proliferation of mesenchyme transforms the mammary pit into a nipple. If there is failure of a pit to elevate above skin level, an inverted nipple results. Absence of the breast (amastia) is rare and results from an arrest in mammary ridge development that occurs during the sixth fetal week. Poland's syndrome consists of hypoplasia or complete absence of the breast, costal cartilage and rib defects, hypoplasia of the subcutaneous tissues of the chest wall, and brachysyndactyly. Breast hypoplasia also may be iatrogenically
induced prior to puberty by trauma or radiation therapy. Symmastia is a rare anomaly recognized as webbing between the breasts across the midline. Accessory nipples (polythelia) occur in less than 1% of infants. Supernumerary breasts may occur in any configuration along the mammary milk line, but most frequently occur between the normal nipple location and the symphysis pubis. Turner's syndrome (ovarian agenesis and dysgenesis) and Fleischer's syndrome (displacement of the nipples and bilateral renal hypoplasia) may have polymastia as a component.

**GROSS ANATOMY OF THE BREAST**

The breast is composed of 15 to 20 lobes, which are each composed of several lobules. The breast comprises three major structures, the skin, the subcutaneous tissue and the fibroglandular breast tissue. The mature female breast extends from the level of the second or third rib to the inframammary fold at the sixth or seventh rib. It extends transversely from the lateral border of the sternum to the anterior axillary line. The deep or posterior surface of the breast rests on the fascia of the pectoralis major, serratus anterior, and external oblique abdominal muscles, and the upper extent of the rectus sheath. The retromammary bursa may be identified on the posterior aspect of the breast between the investing fascia of the breast and the fascia of the pectoralis major muscles. The axillary tail of Spence extends laterally across the anterior axillary fold. The upper outer quadrant of the breast contains a greater volume of tissue than do the other quadrants.

The gland of the breast lies within the superficial fascia, with the anterior layer between the skin and the mammary gland, and the posterior layer between the gland and the fascia of the pectoralis major muscle. Connecting these two fascia layers are fibrous bands (Cooper suspensory ligaments). Cooper’s ligaments help give the breast its shape and anchor the gland to the skin.
and provide structural support. They are particularly dense at the lower periphery of the breast, where they maintain the inframammary fold. The breasts maintain mobility on the chest wall because of the retromammary bursae. The shape of the breast is not spherical, but rather that of a tear drop. Considerable variations in the size, contour, and density of the breast are evident among individuals. The nulliparous breast has a hemispheric configuration with distinct flattening above the nipple. With the hormonal stimulation that accompanies pregnancy and lactation, the breast becomes larger and increases in volume and density, while with senescence, it assumes a flattened, flaccid, and more pendulous configuration with decreased volume.

The volume of the breast can range from 21 to 2000 ml, with an average of 400 ml. The volume fluctuates with the menstrual cycle. The contour and volume of the breast, however, vary greatly among individuals, and may vary from left to right. More than half of women have volume differences of greater than 10% and more than one fourth of women have volume differences greater than 20%. These differences are typically not appreciated by most women.

The nipple-areolar complex is typically located over the fourth intercostal space (in the non-pendulous breast). Both the nipple and areola consist of a keratinizing stratified squamous epithelium with a dense basal melanin deposition, which accounts for the pigmentation. The areolar can range from 15 to 60 mm in diameter. Some other authors have quoted the average nipple diameter as 8 mm, while the average areolar diameter was 42 to 45 mm. The areola is darker in color than the surrounding breast mound. The areola has hair follicles, sebaceous glands, and sweat glands. At the periphery of the areola are the Morgagni tubercles, elevations formed by openings of the ducts of the Montgomery glands, which are capable of producing milk.
As puberty begins, the circulating estrogen causes the ductal epithelium and surrounding stroma of the breast to grow. These ducts begin to extend into the superficial pectoral fascia and arborize within the supporting stroma to form collecting ducts and terminal duct lobular units. These ultimately form buds that precede further breast lobules. Surrounding the ducts, vascularity increases and connective tissues increase in volume and elasticity, replacing adipose tissue and providing support for the developing ducts. The breast develops through various stages at puberty as shown in table 2.1.

Table 2.1: Tanner stages of the breast.¹⁰

<table>
<thead>
<tr>
<th>STAGE</th>
<th>APPROXIMATE AGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt; 11 years</td>
<td>Preadolescent, with slight elevation of the papilla</td>
</tr>
<tr>
<td>2</td>
<td>11.1±1.1 years</td>
<td>Elevation of the breast and papilla as a small mound</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase in size of the areola</td>
</tr>
<tr>
<td>3</td>
<td>12.2±1.1 years</td>
<td>Further enlargement of the breast</td>
</tr>
<tr>
<td>4</td>
<td>13.1±1.2 years</td>
<td>The areola and papilla form a secondary mound above the breast</td>
</tr>
<tr>
<td>5</td>
<td>15.3±1.7 years</td>
<td>Areola recedes into the general contour of the breast</td>
</tr>
</tbody>
</table>
Fakeye and Fagbule documented the ages, heights and weights of Nigerian girls at various stages of pubertal development. They stated that the first sign of puberty - breast bud appeared at mean age (year) 12.7 +/- 1.0 and reached full maturational stage at mean age (year) 14.7 +/- 1.3.

This showed that Nigerian girls attain full breast maturation earlier than documented in Tanner staging.

**BLOOD SUPPLY AND INNERVATION OF THE BREAST**

The breast receives its principal blood supply from (1) perforating branches of the internal mammary artery; (2) lateral branches of the posterior intercostal arteries; and (3) branches from the axillary artery, including the highest thoracic, lateral thoracic and pectoral branches of the thoracoacromial artery. The second, third, and fourth anterior intercostal perforators and branches of the internal mammary artery arborize in the breast as the medial mammary arteries. The veins of the breast and chest wall follow the course of the arteries with venous drainage being toward the axilla. The three principal groups of veins are (1) perforating branches of the internal thoracic vein; (2) perforating branches of the posterior intercostal veins and (3) tributaries of the axillary vein.

The breasts are richly innervated laterally from the anterior rami of the lateral cutaneous branches of the 3rd to the 6th intercostal nerves and medially through anterior branches of the 2nd through the 6th intercostal nerves. The skin of the upper pole of the breast is innervated by supraclavicular branches of the cervical plexus. The nipple-areola complex is innervated primarily from deep within the breast, usually by the 3rd, 4th, and 5th anterior cutaneous nerves and by the
4th and 5th lateral cutaneous nerves, with the lateral cutaneous branch of the 4th intercostal nerve described as a “unique nerve” to the nipple-areola.\textsuperscript{15}

The boundaries for lymph drainage of the axilla are not well demarcated, and there is considerable variation in the position of the axillary lymph nodes. The axillary lymph nodes usually receive more than 75\% of the lymph drainage from the breast.\textsuperscript{12} The rest is derived primarily from the medial aspect of the breast, flows through the lymph vessels that accompany the perforating branches of the internal mammary artery, and enters the parasternal (internal mammary) group of lymph nodes.\textsuperscript{12} Also lymph drains to the opposite breast and axilla. Lymphatic spread to the liver via the rectus abdominis muscle can occur.\textsuperscript{16}

\textbf{PHYSIOLOGY OF THE BREAST}

Breast development and function are initiated by a variety of hormonal stimuli, including estrogen, progesterone, prolactin, oxytocin, thyroid, cortisol, and growth hormone. Estrogen, progesterone, and prolactin especially have profound trophic effects that are essential to normal breast development and function. Estrogen initiates ductal development, while progesterone is responsible for differentiation of epithelium and for lobular development.\textsuperscript{12} The gonadotropins luteinizing hormone (LH) and follicle-stimulating hormone (FSH) regulate the release of estrogen and progesterone from the ovaries. In turn, the release of LH and FSH from the basophilic cells of the anterior pituitary is regulated by the secretion of gonadotropin-releasing hormone (GnRH) from the hypothalamus. Positive and negative feedback effects of circulating estrogen and progesterone regulate the secretion of LH, FSH, and GnRH. These hormones are responsible for the development, function, and maintenance of breast tissues. In the female neonate, circulating estrogen and progesterone levels decrease after birth and remain low
throughout childhood because of the sensitivity of the hypothalamic pituitary axis to negative feedback by these hormones. With the onset of puberty, there is a decrease in the sensitivity of the hypothalamic pituitary axis to negative feedback and an increase in its sensitivity to positive feedback by estrogen. These physiologic events initiate an increase in GnRH, FSH, and LH secretion, and ultimately an increase in estrogen and progesterone secretion by the ovaries, leading to establishment of the menstrual cycle. At the beginning of the menstrual cycle, there is an increase in the size and density of the breasts, which is followed by engorgement of the breast tissues and epithelial proliferation. With the onset of menstruation, the breast engorgement subsides and epithelial proliferation decreases.\textsuperscript{12}

**FACTORS AFFECTING BREAST SIZE**

Smaller and larger breasted women demonstrate differences in morphology, with body mass index (BMI) demonstrating strong relationships to breast mass. Measures of BMI and suprasternal notch to nipple distance enable predictions of breast mass and suggest that weight-related parameters are not appropriate exclusion criteria for mammoplasty.\textsuperscript{17}

The BMI is a measure for human body shape based on an individual’s weight and height. Body mass index is defined as the individual's body mass in kilogram divided by the square of their height in meters. Increase in BMI can lead to increase in breast volume and this can lead to more distally placed nipple with an increase in the nipple to inframammary distance \textsuperscript{5} (which is one of the objectives of this study). The formulae universally used in medicine produce a unit of measure of kg/m\textsuperscript{2}. BMI can also be determined using a BMI chart, which displays BMI as a function of weight (horizontal axis) and height (vertical axis) using contour lines for different values of BMI or colors for different BMI categories.\textsuperscript{18}
BREAST PTOSIS

The breasts will undergo changes with the different stages in a woman’s life resulting in sagging of the breasts (ptosis). Rinker\textsuperscript{19} in his study of ninety-three (93) patients to identify risk factors for the development of breast ptosis after pregnancy and to determine whether breastfeeding had an adverse effect on breast shape, found out that greater age, higher body mass index, greater number of pregnancies, larger prepregnancy bra size, and smoking were identified as significant independent risk factors for postpregnancy breast ptosis. Breastfeeding was not
found to be an independent risk factor for ptosis.\textsuperscript{19-20} Loss of breast volume commonly results from significant weight loss, postpartum atrophy, or postmenopausal involution. Gravity exerts a continual ptotic pull on the breast, elongating Cooper’s ligaments, stretching the skin and contributing to ptosis.\textsuperscript{21}

Breast ptosis was originally staged by Regnault\textsuperscript{20} (Figure 2.1). Minor ptosis (first degree) occurs when the nipple is at the level of the inframammary fold (IMF), moderate ptosis (second degree) is when the nipple is below the IMF but above the lowest breast contour, severe ptosis (third degree) is when the nipple is at the lowest breast contour and below the level of the IMF, glandular ptosis is characterized by a nipple above the IMF with breast tissue hanging below the IMF (Pseudoptosis).\textsuperscript{22}

![Figure 2.1: Breast ptosis classification. A: Normal. B: Minor or first degree. C: Moderate or second degree. D: Severe or third degree. E: Glandular ptosis.\textsuperscript{22}](image)
AESTHETIC SUBUNITS OF THE BREAST

Breast reconstruction obviously differs from nasal reconstruction because the breast lacks the shadowed valleys and light ridges that are present on the nose, but the concept of aesthetic units to hide scars might also apply. However, unlike the lip or the nose, the majority of the breast is often covered in clothing, adding a new dimension for camouflage. An approach to breast reconstruction that emphasizes the perceived subunits of the breast might help the surgeon in choosing more cosmetically attractive reconstructive options. The desirable aesthetic subunits of the breast are those which are outlined by tissue, color, or texture changes. Examples of these transitions are seen in Figure 2.2: (1) breast skin to areola, (2) areola to nipple, (3) breast skin to chest skin at the inframammary fold, (4) anterior axillary line and (5) breast to sternal skin. The aesthetic lines for scar placement in breast reconstruction should incorporate the inframammary fold, the areola, or the anterior axillary line as much as possible. The best aesthetic subunits of the breast include the periareolar subunit, the inferior half of the breast, the inferolateral crescent, and the whole breast. Patient satisfaction in breast surgery is dependent on achieving a balance between all aesthetic subunits.
Figure 2.2: Aesthetic subunits of the breast

INDICATIONS FOR BREAST AESTHETIC / RECONSTRUCTIVE SURGERY

1. Macromastia
2. Micromastia
3. Post mastectomy for cancer of the breast
4. Congenital abnormality of the breast
5. Trauma / burns to the breast
MORPHOMETRY OF THE FEMALE BREAST

Morphometric measurements of the breasts and their relevant position taken from fixed skeletal points provide a useful tool in the accurate evaluation of patients preoperatively and the assessment of surgical results.25

PHYSICAL MEASUREMENTS

Morphometry is the measurement of the form (of organism or their parts). The size, shape, and symmetry of a woman’s breasts can have a profound effect on her well-being, both mental and physical. Many women with excessively small or large breasts have an altered self-image and suffer from poor self-esteem and other psychological effects. In addition, women whose breasts are abnormally large relative to their habitus are frequently limited in their choice of clothing and lifestyle. They may find it difficult to exercise, to play sports, and to participate in other normal daily activities. In short, a woman’s breast size affects her attitudes, career choices, and personal and professional life in many ways.15 Given the different heights, weights, body shapes and physical condition of women seeking reduction mammoplasty, no single breast dimension will serve all. The surgeon should consider the patient’s own desires regarding ultimate breast size and shape in light of her age, physique, and surgical limitations. Although all candidates for reduction mammoplasty want to have their breasts made smaller, most do not wish their breast size to be out of proportion to their build.15

Much has been written on what constitutes the ideal breast but it has never been distilled into quantifiable parameters. Vague terms are often used such as proportion, harmony, shape and position which are not helpful as objective measurements of breast beauty. Until now the establishment of a basic template for breast beauty has been elusive. In a study of 100 topless
models selected by some newspaper editors because of their naturally attractive breasts, it was presumed that the editors responsible for their selection (like many of us) were able to recognize their attractiveness without knowing specifically what contributes to that attractiveness. Through analysis they were able to identify a consistent pattern in these breasts which was believed to have defined this sense of beauty. The essence of the attractiveness of these breasts were distilled into four key parameters which characterize simply and consistently an aesthetic norm for the breast, these are essential for rendering the breast attractive and deviation from these characteristics yields an unattractive breast. These parameters were summarized as follows: The upper (U) : lower (L) pole ratio is always such that the upper pole is not as full as the lower pole with 45% of the breast being made up of upper pole and 55% by lower pole the so called 45:55 ratio. The nipple sits at this upper/lower pole boundary (nipple meridian) and is forward pointing and deviated laterally (mean angle of 20 degree). The upper pole slope should ideally be either a straight line or mildly concave. The lower pole is a smooth convex curve. [U (upper pole), L (lower pole), UPS (upper pole slope), LPC (lower pole curve), UPL (upper pole limit), LPL (lower pole limit), NM (nipple meridian)]. (Figure 2.3).
Figure 2.3: An ideal breast showing the ratio of the upper and lower pole.¹

The author of this study emphasized that this study was not based on their opinion of what is deemed an aesthetic ideal (photos helped to document these parameters) but it was an observational study examining aesthetic proportions in a consecutive series of images of female breasts chosen for their attractiveness by the print media. The observations are simple but when used as a template upon which to analyze breast form, they are powerful indices of breast attractiveness.¹
An important part of preoperative assessment in breast reduction surgery is to locate the site of the nipple-areola complex for the newly structured breast. Inappropriate location is difficult to correct secondarily. Traditional methods of nipple localization taught and practiced suggest the nipple to be located anterior to the inframammary fold.\textsuperscript{26} Aesthetic placement of the nipples is at the lower angles of an equilateral or a short isosceles triangle on the chest with its apex at the sternal angle. The location of the lower angle is marked on the anterior surface of the breast (This is usually accomplished by palpating finger through the breast which is placed at level of the inframammary fold or by using large gynaecological calipers to transpose the position of the IMF on the anterior surface of the breast) and represents the new position of the nipple. In a study done by Khan\textsuperscript{26} forty patients had nipple localization performed in the above-described manner, with satisfactory placement of the nipple-areola complex.
Figure 2.4: Surface landmarks of an ideal breast
Morphometry is based on linear measurements between surface landmarks. Penn’s approach of defining nipple-to-sternal notch and midclavicular point distances based on 20 women with “aesthetically perfect” breasts has gained broad attention and has been adopted by some as normative.³

According to Penn, the most aesthetic location at which nipples should be placed is at the two basal angles of an imaginary equilateral triangle that has its apex at the sternal notch and has sides measuring 21 cm.²⁶ However, he based his idea on a small number of women between the ages of 18 and 39 years.²⁶ However, breast reduction patients present at different ages and sizes. With increasing age and weight of the breasts, there is inferior migration of the nipple and IMF, resulting in ptosis and some lateral deviation. Strict adherence to Penn’s measurements may not suit every patient. A slightly elongated triangle may be required for a more mature, slightly ptotic look in older and heavier patients.²⁶ Balancing the new position of the nipple with the inferiorly migrated IMF would achieve the required location in these patients. Similarly, the laterally deviated nipple may need to be brought in medially to lie within the aesthetic breast meridian.²⁶

Vandeput et al,²⁵ had breast measurements of nine hundred and seventy-three (973) females, most of them candidates for breast augmentation. They had non-ptotic breasts and their body mass indices (BMI) were between 20 and 30. Simple and reproducible protocols of breast measurements were selected, which were taken in the normal standing position, with a simple measuring tape. Parameters measured included - Length or body height, BMI, body type [asthenic (<20), normal (20–30), obese (>30)], upper breast width (BW) - upper circumference of the thorax below the axilla, breast circumference (BC) - circumference at the level of the nipples and torso width (T) - circumference of the thorax at the inframammary fold in the standing position. Others were nipple to suprasternal notch distance (NN), nipple to upper clavicular border distance (NC) -
taken at the middle of the clavicle, nipple to inframammary fold distance (NI) - taken vertically
down, circumference of the loin at the waistline (l) and circumference of the hips (H). The breast
cup size was also measured, which is an expression of the size of a breast using a combination of
the circumference of the breast at the level of the nipples in reference to the torso width. This
parameter indirectly gives the breast volume. If breast girth exceeds chest girth by 1 inch, cup size
is an A; 2 inches, a B; 3 inches, a C; 4 inches, a D; and 5 inches, a DD. With the international
system of units these measurements are now in centimetres (1 inch = 2.54cm).

Calculating the correct brassiere band size is complicated by a variety of fact about bra sizes:
that a D cup looks the same on every band size or that having small breasts automatically means you
are an A cup is not correct. Actually, cup size is proportional to band size - meaning it is dependent
on the band measurement. To determine cup size, subtract the band size from the bust measurement.
The difference helps to calculate the cup size. The band size measurement are based on two primary
methods, either under the bust or over the bust, and sometimes both. For under the bust measurement,
with the woman standing with the hands by the side a measuring tape is pulled around the woman's
torso at the inframammary fold. The tape is then pulled tight while remaining horizontal and parallel
to the floor. In the above the bust method, a measuring tape is pulled around the woman's torso
under the axilla and measured as in under the bust measurement. The bust size is measured at the
fullest part of the breast preferably at the level of the nipple. The band sizes are most commonly
manufactured in even numbers, so the wearer must round up or down to the closest even number.
Previous studies done reported a statistically significant correlation between breast volume and NI. Penn from his study fixed the average value of NI at 6.74 cm. Smith published a mean value of 6.46 cm. Vandeput in his study related the NI to torso width or body height with an overall average of 6.94 cm for female patients who are 165 cm tall and have a B/C cup.

Brown et al's series of reproducible measurements was developed with reference to a single midline datum that describes the position of key landmarks on the female breast. Measurements were made on a 'normal' population of 60 subjects content with their breast shape in order to (1) produce 'normal' reference data for breast shape in a population of varying weight and height; and (2) to evaluate factors which may influence the measurements. The findings showed that the vertical positions of the measurements migrate inferiorly with increasing age. With increasing weight, the landmarks (except the medial end of the inframammary crease) migrated inferolaterally. The areolar diameter decreases with increasing age and increases with increasing weight. Only one of the 12 bilateral breast measurement parameters showed a significant mean difference between the right and left breast. However, in a proportion of subjects, individual measurements show fluctuating asymmetry. Subsequently, measurements were made on the breasts of women attending with requests for either reduction (n = 25) or augmentation (n = 6) mammoplasty. Compared with the 'normal' population, the group requesting reduction mammoplasty differed significantly in the majority of measurements. The group of patients requesting breast augmentation showed fewer differences compared with the 'normal' population. The average BMI of women requesting augmentation mammoplasty was significantly less and that of women requesting reduction mammoplasty was significantly greater than the normal population. This showed that there is a correlation between BMI and breast size.
Some studies of breast volume and size have failed to take into account the aesthetic value of the nipple-areola-breast proportion. These data are important to plastic surgeons in planning breast reduction, augmentation, and reconstruction. In another study, the anatomic size of the nipple, areola, and breast was measured in 37 women aged 20 to 64 years, and their proportions were calculated. The areola-breast and nipple-areola proportions were 1:3.4 and 1:3, respectively. The natural nipple-areola-breast proportion is approximately 1:3. This study did not take into account the possible ptotic breast with advancing age and the sample size was small.

Avsar et al measured the breast in Turkish female students and compared their values with those of women in other nations. The study included 385 female undergraduate student volunteers between the ages of 18 and 26 years with no physical or developmental deformity and with a body mass index between 20 and 26. A total of 19 parameters were measured in a standing position. The parameters measured were body weight, height, shoulder width, upper chest width, middle chest width, lower chest width, waist width, hip width, clavicle - nipple length, sternal notch – nipple length, nipple - nipple length, upper arm length, medial mammary radius, lateral mammary radius, nipple – inframammary fold length, nipple diameter, areola diameter, nipple projection, and mammary projection. Breast volume, breast ptosis and retracted nipple rates were also assessed. The mean breast volume was determined to be 407.2 ± 263.6 cc. The mean values of the right and left breast volumes were calculated as 415.2 ± 264.5 cc and 399.1 ± 265.5 cc, respectively; the right breast volume was significantly greater than the left breast volume (P < .001). The ideal external view of the breasts with equal volume for both sides and no ptosis was observed in 35.1% of the volunteers. The percentage of women with unilateral or bilateral retracted nipple was 2.6%.
In another study morphometric measurements were recorded from the breasts of 109 female volunteers. Images of their breasts were arranged into a computerized survey, and plastic surgeons, cosmetic breast surgery patients, and reconstructive breast surgery patients were interviewed for aesthetic feedback. In all, 252 plastic surgeons, 15 aesthetic patients, and 25 reconstructive patients submitted 4446 evaluations. The ideal sternal notch to nipple distance was 21 to 21.5 cm. The ideal nipple to base distance was 6 cm, and the ideal base to inframammary fold distance was 2 cm. These and other ideal morphometric measurements were calculated and compared with previously published values and their results were comparable with works that have been done. Among aesthetic patients, insufficient cleavage had the most negative effect on aesthetic value, and among reconstructive patients, severe asymmetry had the most negative effect.

A work done on young females breasts in Ghana West Africa included a total of 438 subjects, aged 16-22 years (mean = 17.43 years). The average distance from the suprasternal notch to the left and right breast nipples were 20.97 and 20.31 cm respectively. The average distances from the left and right nipples to their inframammary creases were 9.36 and 9.21 cm, respectively. The average distances from the midline in the xiphioid area to the left and right nipples were 10.94 and 10.84 cm, respectively. The average asymmetrical difference in length along the vertical midline between the left and right breasts for 53.4% (234) of the total subjects (438) was 1.32 cm; no differences were recorded for the remaining 204 subjects. The "normal values" for adolescent youthful breasts was shown to differ slightly from previous reports on adult breast. The nipple – inframammary distance was longer than that expected in the older age group apparently because of the non – ptotic nature of the subjects’ young breasts.
PHOTOMETRY

The value of photographs for subjective assessment of breast aesthetics is confirmed by comparable results for assessments based on photographs compared to physical examination. Prints produced from digital images, displayed on computer monitor, or conventional photographs are acceptable to observers for subjective assessment of breast aesthetics.3

Using standardized photographs and computer imaging software to match size and orientation, breast shape and size are measured and compared before and after cosmetic breast surgery. Practical landmarks and analysis allow assessment of results using standard two-dimensional frontal and lateral views. A horizontal plane at the level of maximum postoperative breast projection and a vertical plane dropped from the sternal notch serve as the reference planes. Breast projection, upper pole projection, lower pole level, nipple level, lower pole width, breast parenchymal ratio and lower pole ratio were defined and measured. These simple measurements may be easily used by surgeons to evaluate the effectiveness of their techniques in breast augmentation, mastopexy and reduction.32

Quantitative, objective measurements of breast curvature computed from clinical photographs could be used to investigate factors that impact reconstruction and facilitate surgical planning. A study introducing a novel quantitative measure of breast curvature based on catenary was carried out. Catenary is the theoretical shape of a flexible chain suspended by two fixed points and it can be used to approximate any string-like object. A catenary curve is used to approximate the overall curvature of the breast contour, and the curvature measure is extracted from the catenary curve. The catenary curve was verified by comparing its length, the area enclosed by the curve, and the curvature measure from the catenary curve to those from manual tracings of the breast.
contour. First, a catenary curve to approximate the overall curvature of the breast contour was used. After that, the shape parameter was extracted, which is our curvature measure of the breast, from the resulting catenary curve. Catenary theory has been adapted to approximate interesting curves in other medical applications, especially in orthodontics. However, this study was the first to apply catenary theory to approximate the overall shape of the breast contour and to quantify the curvature of the breast by using a key parameter of the catenary curve.\(^{33}\)

**Figure 2.5: A catenary curve\(^ {33}\)**

Recreating natural-appearing breast curvature is an important aspect of breast reconstruction. This process can be very challenging and currently depends largely on the individual surgeon’s qualitative, subjective assessment of breast morphology. Quantitative, objective measurements of breast curvature computed from clinical photographs could potentially be used to investigate factors that impact reconstruction and facilitate surgical planning.\(^ {33}\)

Photometry has advantages over physical measurement. A photograph is more efficient and less intrusive for the patient. It is a permanent record from which it is possible to retrospectively make a variety of measurements.\(^ {3}\) There is potential for more consistent, objective results by analyzing digital/digitized photographs on a computer.\(^ {3}\) The disadvantages are that some anatomic landmarks may not be visible and the measurements cannot be obtained following the contours of the patient's body. Some studies have reported substantial intra and interobserver
standard deviation for linear measurements on photographs, related primarily to the lack of consistency in the manual identification of anatomic landmarks. Consistent guidelines for standard photography are critical to obtaining reproducible assessment of aesthetic outcomes by photometry.³

There are commercial software systems for working with digital/digitized photographs in plastic surgery, such as Nautilus Plastic Designer™ (NauSoft LLC, St. Louis, MO), Mirror™ software (Canfield Clinical Systems, Fairfield, NJ), and iMARS™ software (iMARS Medical Office Management Systems). However, it should be noted that most products are focused on data management rather than analysis. Some such systems will allow the surgeon to simulate the postoperative result in an artistic manner that is not really representative of the actual surgical outcome.³

THREE-DIMENSIONAL IMAGING OF THE BREAST

Quantitative analysis of breast morphometry is critical to breast plastic surgery. Recently, three-dimensional (3D) photography has emerged as a strong new alternative for breast morphometry analysis in comparison to other existing techniques; three-dimensional photography enables the capture of the entire breast surface topology virtually in a single snapshot and without any direct contact with the patient, thus causing minimal discomfort.²

Overall, three-dimensional imaging is very helpful in providing objective information about the breast for use in preoperative planning. In addition, by analyzing clinical cases, it can provide objective data about the breast and surgical mammoplasty (especially augmentation
mammoplasty) that may help Surgeons better understand those factors that contribute to breast shape and influence surgical outcomes.\textsuperscript{34}

Several technologies such as stereo photogrammetry, laser scanning, three-dimensional digital photography, and light digitizers can be used to create three-dimensional (3D) images. Photogrammetry encompasses methods of image measurement and interpretation in order to derive the shape and location of an object from one or more photographs of that object. The primary purpose of a photogrammetric measurement is the three-dimensional reconstruction of an object in digital form. Laser scanning is the controlled steering of laser beams followed by a distance measurement at every pointing direction. This method, often called 3D object scanning or 3D laser scanning, is used to rapidly capture shapes of objects. A graphics tablet or digitizer is a computer input device that enables a user to hand-draw images, animations and graphics, similar to the way a person draws images with a pencil and paper. These tablets may also be used to capture data or handwritten signatures. For breast surgery, 3D imaging permits evaluation of differences in volume, surface area, shape, size, contour, and symmetry. A single 3D image yields more information regarding breast appearance than multiple conventional photographs including data regarding some elements of the breast appearance, such as volume, that are not available from two-dimensional images.\textsuperscript{3}

Commercially available 3D imaging systems for plastic surgeons include features such as morphing operations and a broad range of art tools for simulation of cosmetic alterations on images. Some of the popular software systems include 3dMD Breast Analysis\textsuperscript{TM} (3-Q, Inc., Atlanta, GA) and 3D Surgeons (Genex Technologies Inc., Kensington, MD). However, as is the case for systems for analyzing 2D images, some systems for 3D imaging will allow the surgeon to simulate the postoperative result in an artistic manner that is not really representative of the actual
surgical outcome. The high cost for this procedure and the unavailability of trained personnel has limited its use.
CHAPTER THREE

METHODOLOGY

SCOPE OF THE STUDY

This was a community based study aimed at analyzing the morphometric details of the female breast in Enugu, South Eastern Nigeria. It was a prospective and observational study.

PLACE AND PERIOD OF STUDY

This study was carried out over a 12 month (April 2014 - March 2015) period. Approval for this study was obtained from the Ethical Committee of the hospital and permission was obtained from the Ministry of Education for the three secondary schools (See Appendix).

The study was carried out in National Orthopaedic Hospital Enugu (NOHE) on female members of the hospital community and also on secondary school girls in Enugu metropolis (Queens College, Urban Girls, City Girls Secondary schools all in New Layout Enugu). The hospital is a referral centre for Orthopaedic, Plastic and Reconstructive Surgery. It serves as referral centre for all the states in the South- East, South- South and even the North- Central geopolitical regions of Nigeria. The hospital also has Post Basic School of Nursing and School of Cast Orthopaedic Technology.

The hospital and the secondary schools are located in Enugu metropolis with a projected population of three million, two hundred and fifty seven thousand, and two hundred and ninety eight (3,257,298) people. (National population commission: 2006 census based projection).
SUBJECT SELECTION

During the period under study all females presenting to the Plastic Surgery Clinic, hospital community and secondary school students were included in the study based on the inclusion criteria below and a computer generated simple random sampling using Microsoft Excel was used. Subjects who did not meet the inclusion criteria were excluded from the study.

SAMPLE SIZE

This was determined using the formula for reference population of more than 10,000.

SAMPLE SIZE ESTIMATION

The sample size was calculated using the Leslie Kish formula for single proportion:

\[ n = \frac{z^2pq}{d^2} \]

Where \( n \) = Desired sample size. (When population is greater than 10,000)

\( z \) = Standard normal deviation being 1.96 at 95% confidence level.

\( p \) = the population in the target population was estimated to have a particular characteristics of 50%. This is used when there is no reasonable estimate.

\( q = 1 - p = 0.5 \)

\( d \) = the difference between the true population rate and the sample (precision) set at 5% = 0.05.

Substituting in the formula;

\[ n = 1.96^2 \times 0.5 \times 0.5 \]
This work is expected to establish a baseline; therefore a sample size of five hundred (500) was used for this study.

During the period of study, all female doctors, nurses, nursing students, paramedics, patients and secondary school students between the ages of 15-30 years in the hospital community and Enugu metropolis were included in the study based on the inclusion criteria. This is based on the age at which the breasts are fully developed as shown by the work done in this sub-region by Fakeye and Fagbule\textsuperscript{14} and the age at which most females are nulliparous.

**INCLUSION CRITERIA**

\begin{enumerate}
  \item All females within the age range (who are nulliparous)
  \item Females with no history of breast disease or surgery
\end{enumerate}

**EXCLUSION CRITERIA**

\begin{enumerate}
  \item Females that are pregnant (using last menstrual period)
  \item Females using hormones in any form
  \item Females with congenital abnormality of the chest and breast
  \item Previous injuries / burns to the breast
  \item Clinically detectable breast diseases
  \item Unable to stand for examination
\end{enumerate}

**ETHICAL CONSIDERATIONS/ INFORMED CONSENT**

1. Permission was obtained from the Ethical Committee of the NOHE and from the Enugu State Ministry of Education, for this study to be undertaken in the secondary schools.
2. All Consultants, Heads of Department and Post Basic Schools, Residents and nurses in the NOHE were informed of the study and their cooperation solicited.

3. Informed consent was obtained from all subjects recruited for the study. (Appendix I) Parents/guardians signed appropriate section when the subjects were less than 18 years of age.

METHOD

Physical measurement of the breast was chosen as the morphometric method in this study because of its reproducibility and simplicity. A proforma (Appendix II) designed by the investigator was used to record details of subjects’ personal and clinical data as well as findings from relevant measurements. All measurements on the subjects’ breasts were taken by the investigator with a measuring tape and a metre rule. A Resident who was trained by the investigator assisted with the weight and height measurement using a bathroom weighing scale and a metre rule respectively. All measurements were done on the subjects in the standing position with their heads up and with both upper limbs by their sides. The privacy of the subjects were duly considered. The subjects’ breasts were examined clinically to rule out any underlying breast disease like breast lumps and nipple abnormalities. Measurements carried out on the breasts in centimetres included:

1. Suprasternal notch to nipple distance (SNN): This was done using a metre rule and measurements were taken from the middle of the notch to the mid nipple diameter on either side.

2. Nipple to nipple distance (NN): Using a metre rule, measurements were taken at the mid nipple diameter on both sides.
3. Midelavicular line to nipple distance (MCLN): Using a metre rule, measurements were taken from the mid clavicle to the mid nipple.

4. Infra mammary fold to nipple distance (NIMF): Using a measuring tape, measurements were taken from the base of the breast to the base of the nipple.

5. Areolar diameter (AD): A metre rule was placed to measure from one end to the other end of the areolar.

6. Nipple diameter (ND): A metre rule was used to measure the width of the nipple.

7. Breast diameter (widest part of breast at the nipple - BD): This was taken with a measuring tape circumferentially around the thorax at the level of the nipple and the figure was rounded up to the nearest even number.

8. Chest diameter (At the level of the inframammary fold - CD): This was taken firmly with a measuring tape circumferentially around the thorax at the level of the inframammary fold. Measurement was rounded up to the nearest even number.

9. Chest and breast circumference (To determine bra cup size and indirectly breast volume): The difference between BD and CD is calculated and if it is 2.54cm, the breast cup size is A. 5.08cm the breast cup size is B, 8.62cm the cup size is C, 11.16cm the cup size is D.

Other measurements included

1. Weight of patient (kg): This was measured using a bathroom scale.

2. Height of patient (m): This was measured with a metre rule.

3. Body mass index (kg/m\(^2\)): This was calculated using the formula - weight divided by the height squared.
STATISTICAL ANALYSIS

Data obtained from the proforma were entered into a spreadsheet for analysis. Data analysis was conducted using version 16 of SPSS (Statistical Package for Social Sciences) and Microsoft Excel. Data was summarized as frequencies, percentages, means, and standard deviations. Test of correlation at 95% confidence limit and p – value of 0.05 were done (Student t- test, Pearson, linear regression and logistic regression). Data were presented in tables, charts and scatter plots.

LIMITATION

1. The inability to use more standardised methods like thermoplastic casting or biostereometrics to estimate breast volume because of lack of necessary equipment was a limitation and this necessitated the use of bra cup size (a less standardized method).

2. Some subjects were unsure of their last menstrual cycle, which limited the investigator in assessing the changes in breast sizes with the cycle.
CHAPTER FOUR

RESULTS

Five hundred randomly selected nulliparous female were studied over a 12 month period.

SOCIODERMOGRAPHIC CHARACTERISTICS

Subjects’ age in this study ranged from 15 – 30 years with an approximate mean age of 18 ± 3 years. 75% of subjects were aged 15-19 years, 21% were aged 20 – 24 years, 3% were aged 25 – 29 years and 1% was within 30 – 34 years age bracket. All subjects were Christians. State of origin were Enugu – 80%, Abia – 10%, Imo – 0.4%, Delta - 0.2%, Edo – 0.2% , Oyo - 0.2%. All the subjects were single and they were all urban dwellers. Sixty percent of them were secondary school students while 30% were Nursing students and 10% were Plaster Technician students.

4.1. PHYSICAL MEASUREMENTS

Their BMI, height and weight mean as well as standard deviations were 21.35 ± 2.83 kg/m², 1.63 ± 0.06m, 57.09 ± 8.71 kg respectively. The mean cup size for respondents was 11 ± 3.44cm (size D). The mean nipple to nipple diameter was 21.12cm ± 1.99cm. As shown in table 4.1 the mean values of all the breast parameters measured were within the ranges quoted in other works, except for the nipple to inframammary fold distance which was higher than the western value. Subjects weighing 30Kg - 60 Kg were 70.4% of the total population, while those weighing 61Kg - 90 Kg constituted 29.6% of subjects. Subjects with height range 1.30m - 1.60m constituted 35.0% while 65.0% were within the 1.60m - 1.90m group.
Table 4.1: Physical measurements

<table>
<thead>
<tr>
<th>All variables</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean±Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIMFR</td>
<td>5.00</td>
<td>14.00</td>
<td>8.13 ± 1.49 cm</td>
</tr>
<tr>
<td>NIMFL</td>
<td>5.00</td>
<td>14.00</td>
<td>8.28 ± 1.55 cm</td>
</tr>
<tr>
<td>MCLNR</td>
<td>14.00</td>
<td>28.00</td>
<td>19.53 ± 2.56 cm</td>
</tr>
<tr>
<td>MCLNL</td>
<td>13.50</td>
<td>29.00</td>
<td>19.72 ± 2.64 cm</td>
</tr>
<tr>
<td>NN</td>
<td>16.00</td>
<td>29.00</td>
<td>21.12 ± 1.99 cm</td>
</tr>
<tr>
<td>ADR</td>
<td>1.80</td>
<td>8.00</td>
<td>3.89 ± 1.09 cm</td>
</tr>
<tr>
<td>ADL</td>
<td>1.80</td>
<td>7.50</td>
<td>3.92 ± 1.11 cm</td>
</tr>
<tr>
<td>NDR</td>
<td>0.50</td>
<td>1.50</td>
<td>0.95 ± 0.16 cm</td>
</tr>
<tr>
<td>NDL</td>
<td>0.40</td>
<td>1.90</td>
<td>0.95 ± 0.17 cm</td>
</tr>
<tr>
<td>CD</td>
<td>60.96</td>
<td>91.44</td>
<td>73.66 ± 5.05 cm</td>
</tr>
<tr>
<td>BD</td>
<td>66.04</td>
<td>114.30</td>
<td>84.76 ± 6.07 cm</td>
</tr>
<tr>
<td>HEIGHT</td>
<td>1.46</td>
<td>1.79</td>
<td>1.63 ± 0.06 m</td>
</tr>
<tr>
<td>WEIGHT</td>
<td>39.00</td>
<td>89.0</td>
<td>57.09 ± 8.71 kg</td>
</tr>
<tr>
<td>BMI</td>
<td>15.80</td>
<td>32.30</td>
<td>21.35 ±2.83 kg/m²</td>
</tr>
<tr>
<td>Breast Cup Size</td>
<td>2.54</td>
<td>22.86</td>
<td>11.28 ±3.44 cm</td>
</tr>
</tbody>
</table>
Figures 4.1 and 4.2, shows that the distributions of the right (19.76±2.42cm) and left (20.09±2.42cm) breasts SNN measurements is bell shaped, thus the data collected follows a normal distribution allowing for the use of parametric statistics in the analysis of the data collected.

Figure 4.1: Suprasternal notch to right nipple measurements
Figure 4.2: Suprasternal notch to left nipple measurements
In figure 4.3, 75.40% of the subjects were of normal weight, 14.00% were underweight, 9.40% were overweight and 2.00% were shown to be in Class 1 Obesity.

![Body mass Index (Kg/m²)](image)

**Figure 4.3: Body mass index**

### 4.2. COMPARING DIMENSIONS OF THE RIGHT AND LEFT BREAST

Measurements of the left breast were greater than those of the right breast and the independent sample t-test and p-value conducted revealed that the mean and standard deviations of the breast dimensions were all strongly statistically significant. (Tables 4.2 and 4.3)
Table 4.2: Student t-tests analysis for single breast measurements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Mean + std</th>
<th>t-test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast diameter</td>
<td>73.65 ± 5.05cm</td>
<td>312.31</td>
<td>0.00*</td>
</tr>
<tr>
<td>Chest diameter</td>
<td>84.76 ± 6.07cm</td>
<td>325.99</td>
<td>0.00*</td>
</tr>
<tr>
<td>Breast cup size</td>
<td>11.28 ± 3.44cm</td>
<td>73.33</td>
<td>0.00*</td>
</tr>
<tr>
<td>Nipple to nipple</td>
<td>21.12 ± 1.99cm</td>
<td>237.28</td>
<td>0.00*</td>
</tr>
<tr>
<td>Measurement</td>
<td>Right breast mean ± std</td>
<td>Left breast mean ± std</td>
<td>t-test right</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------------------</td>
<td>------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Nipple to infra-mammary fold</td>
<td>8.13 ± 1.49cm</td>
<td>8.28 ± 1.55cm</td>
<td>115.78</td>
</tr>
<tr>
<td>Suprasternal notch to nipple</td>
<td>19.76 ± 2.43cm</td>
<td>20.09 ± 2.43cm</td>
<td>182.09</td>
</tr>
<tr>
<td>Midclavicular line to nipple</td>
<td>19.53 ± 2.56cm</td>
<td>19.72 ± 2.64cm</td>
<td>170.92</td>
</tr>
<tr>
<td>Areolar diameter</td>
<td>3.88 ± 1.09cm</td>
<td>3.92 ± 1.10cm</td>
<td>79.45</td>
</tr>
<tr>
<td>Nipple diameter</td>
<td>0.95 ± 0.25cm</td>
<td>0.95 ± 0.22cm</td>
<td>85.60</td>
</tr>
</tbody>
</table>
In table 4.4, the Pearson correlation of NIMFR for BMI (r = 0.39, p-value = 0.00) and weight (r = 0.35, p-value = 0.00) both show positive strong correlation, although the strength of the relationship between age and NIMFR is weak (r = 0.09, p-value = 0.04) the relationship is statistically significant and this means with every unit increase in the measurement of NIMFR there is an increase in the strength of the relationship and vice-versa for BMI, weight and age. The same relationship pattern holds true between age, BMI and weight for NIMFL. However this study shows that the relationship between height with left and right NIMF dimensions is not significant with (Right; r = 0.03, p-value = 0.52; Left; r = 0.04, p-value = 0.36). The data supports the hypothesis that there is a relationship between the NIMF and weight of subjects, though weak at a statistically significant p-value < 0.05.
Table 4.4: Pearson correlation (r) between left and right breast measurements with age, BMI, height and weight

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Age</th>
<th>BMI</th>
<th>Height</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p-value</td>
<td>r</td>
<td>p-value</td>
</tr>
<tr>
<td>NIMFR</td>
<td>0.09**</td>
<td>0.04</td>
<td>0.39**</td>
<td>0.00</td>
</tr>
<tr>
<td>NIMFL</td>
<td>0.10**</td>
<td>0.02</td>
<td>0.40**</td>
<td>0.00</td>
</tr>
<tr>
<td>SNNR</td>
<td>0.34**</td>
<td>0.00</td>
<td>0.58**</td>
<td>0.00</td>
</tr>
<tr>
<td>SNNL</td>
<td>0.33**</td>
<td>0.00</td>
<td>0.58**</td>
<td>0.00</td>
</tr>
<tr>
<td>MCLNR</td>
<td>0.30**</td>
<td>0.00</td>
<td>0.59**</td>
<td>0.00</td>
</tr>
<tr>
<td>MCLNL</td>
<td>0.31**</td>
<td>0.00</td>
<td>0.60**</td>
<td>0.00</td>
</tr>
<tr>
<td>ADR</td>
<td>0.18**</td>
<td>0.00</td>
<td>0.39**</td>
<td>0.00</td>
</tr>
<tr>
<td>ADL</td>
<td>0.23**</td>
<td>0.00</td>
<td>0.41**</td>
<td>0.00</td>
</tr>
<tr>
<td>NDR</td>
<td>0.19**</td>
<td>0.00</td>
<td>0.16**</td>
<td>0.00</td>
</tr>
<tr>
<td>NDL</td>
<td>0.26**</td>
<td>0.00</td>
<td>0.19**</td>
<td>0.00</td>
</tr>
<tr>
<td>BD</td>
<td>0.18**</td>
<td>0.00</td>
<td>0.22**</td>
<td>0.00</td>
</tr>
<tr>
<td>CD</td>
<td>0.18**</td>
<td>0.00</td>
<td>0.65**</td>
<td>0.00</td>
</tr>
<tr>
<td>BCS</td>
<td>0.06</td>
<td>0.19</td>
<td>0.31**</td>
<td>0.00</td>
</tr>
<tr>
<td>NS</td>
<td>0.23**</td>
<td>0.00</td>
<td>0.46**</td>
<td>0.00</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).
In table 4.5, the percentages of the asymmetry were greater in the left breast measurements. Symmetry was noted to be greater than 50% in all the measurements.

Table 4.5: Asymmetry of the breasts in subjects

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Right &gt; Left</th>
<th>Right = Left</th>
<th>Left &gt; Right</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nipple to inframammary fold (NIMF)</td>
<td>13.40%</td>
<td>58.60%</td>
<td>28.00%</td>
<td>0.00</td>
</tr>
<tr>
<td>Suprasternal notch to nipple (SNN)</td>
<td>9.80%</td>
<td>52.00%</td>
<td>38.20%</td>
<td>0.00</td>
</tr>
<tr>
<td>Midclavicular line to nipple (MCLN)</td>
<td>12.80%</td>
<td>59.60%</td>
<td>27.60%</td>
<td>0.00</td>
</tr>
<tr>
<td>Areolar diameter (AD)</td>
<td>8.40%</td>
<td>77.00%</td>
<td>14.60%</td>
<td>0.00</td>
</tr>
<tr>
<td>Nipple diameter (ND)</td>
<td>5.20%</td>
<td>87.80%</td>
<td>7.00%</td>
<td>0.00</td>
</tr>
</tbody>
</table>

4.3 Determinant factors which influence breasts measurements

Logistic regression was conducted to assess the effects of age, height, weight, BMI, and cup size on left and right nipple to inframammary fold. Preliminary analysis was conducted to ensure no violation of assumptions of normality, linearity, multicollinearity and homoscedasticity. The nipple to inframammary fold measurements were seen to increase with increases in breast cup size, age and BMI. The height of the subjects had no effect on the nipple to inframammary fold measurement. This is as shown in Table 4.6.
### Table 4.6: Comparing effects of age, BMI, weight, height, cup size on left and right nipple to inframammary folds measurements

<table>
<thead>
<tr>
<th>Independent / Dependent Variables</th>
<th>Regression Coefficient (β)</th>
<th>95% Confidence Interval for β</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable: right nipple to inframammary fold (NIMF)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>-1.92</td>
<td>-12.36</td>
<td>8.51</td>
</tr>
<tr>
<td>HEIGHT</td>
<td>2.59</td>
<td>-3.85</td>
<td>9.04</td>
</tr>
<tr>
<td>WEIGHT</td>
<td>-0.03</td>
<td>-0.12</td>
<td>0.06</td>
</tr>
<tr>
<td>BODY MASS INDEX</td>
<td>0.20</td>
<td>-.04</td>
<td>0.43</td>
</tr>
<tr>
<td>CUP SIZE</td>
<td>0.45</td>
<td>0.37</td>
<td>0.54</td>
</tr>
<tr>
<td>BMI GROUPS</td>
<td>0.19</td>
<td>-0.19</td>
<td>0.57</td>
</tr>
<tr>
<td>AGE</td>
<td>0.10</td>
<td>0.00</td>
<td>0.19</td>
</tr>
<tr>
<td><strong>Dependent variable: left nipple to inframammary fold (NIMF)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>-2.55</td>
<td>-13.18</td>
<td>8.10</td>
</tr>
<tr>
<td>HEIGHT</td>
<td>3.17</td>
<td>-3.41</td>
<td>9.74</td>
</tr>
<tr>
<td>WEIGHT</td>
<td>-0.05</td>
<td>-0.14</td>
<td>0.05</td>
</tr>
<tr>
<td>CUP SIZE</td>
<td>0.50</td>
<td>0.41</td>
<td>0.58</td>
</tr>
<tr>
<td>BMI</td>
<td>0.21</td>
<td>0.00</td>
<td>0.48</td>
</tr>
<tr>
<td>AGE</td>
<td>0.04</td>
<td>-0.06</td>
<td>0.13</td>
</tr>
</tbody>
</table>
Linear regression was conducted for continuous dependent variable to assess the effect of age, height, weight and BMI, height on breast cup size on differing levels. Preliminary analysis was conducted to ensure no violation of assumptions of normality, linearity, multi-collinearity and homoscedasticity. The analysis revealed that when BMI and age were compared against breast cup size there was a significant relationship with BMI (p-value = 0.00), and when age, BMI and weight were compared with breast cup size only weight (p-value = 0.01) was associated with the dependent variable, this means that when cup size is compared with BMI and age, BMI influences cup size or with BMI, weight and age, weight influences cup size. When all the Independent variables, age, BMI, weight and height were in play there was no significant relationship. Therefore only a situation with model 2 and 3 show any influence on the breast cup size. (Table 4.7)
Table 4.7: Comparing effects of age, weight, height and BMI on cup size

<table>
<thead>
<tr>
<th>MODEL</th>
<th>Independent / Dependent Variables</th>
<th>Regression Coefficient (β)</th>
<th>95% Confidence Interval for β</th>
<th>T</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dependent variable: Breast cup size</td>
<td></td>
<td>Lower bound</td>
<td>Upper bound</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>3.97</td>
<td>3.26</td>
<td>4.68</td>
<td>10.95</td>
</tr>
<tr>
<td></td>
<td>AGE (Years)</td>
<td>0.03</td>
<td>-0.01</td>
<td>0.07</td>
<td>1.31</td>
</tr>
<tr>
<td>2</td>
<td>(Constant)</td>
<td>1.42</td>
<td>0.45</td>
<td>2.40</td>
<td>2.86</td>
</tr>
<tr>
<td></td>
<td>AGE (Years)</td>
<td>-0.01</td>
<td>-0.05</td>
<td>0.03</td>
<td>-0.57</td>
</tr>
<tr>
<td></td>
<td>BODY MASS INDEX (Kg/m2)</td>
<td>0.15</td>
<td>0.11</td>
<td>0.19</td>
<td>7.12</td>
</tr>
<tr>
<td>3</td>
<td>(Constant)</td>
<td>1.40</td>
<td>0.43</td>
<td>2.37</td>
<td>2.83</td>
</tr>
<tr>
<td></td>
<td>AGE (Years)</td>
<td>-0.01</td>
<td>-0.05</td>
<td>0.03</td>
<td>-0.64</td>
</tr>
<tr>
<td></td>
<td>BODY MASS INDEX (Kg/m2)</td>
<td>0.07</td>
<td>-0.00</td>
<td>0.15</td>
<td>1.80</td>
</tr>
<tr>
<td></td>
<td>WEIGHT (kg)</td>
<td>0.03</td>
<td>0.01</td>
<td>0.06</td>
<td>2.47</td>
</tr>
<tr>
<td>4</td>
<td>(Constant)</td>
<td>3.51</td>
<td>-6.93</td>
<td>13.94</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>AGE (Years)</td>
<td>-0.01</td>
<td>-0.05</td>
<td>0.03</td>
<td>-0.67</td>
</tr>
<tr>
<td></td>
<td>BODY MASS INDEX (Kg/m2)</td>
<td>0.03</td>
<td>-0.21</td>
<td>0.26</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>WEIGHT (kg)</td>
<td>0.05</td>
<td>-0.04</td>
<td>0.14</td>
<td>1.08</td>
</tr>
<tr>
<td></td>
<td>HEIGHT</td>
<td>-1.29</td>
<td>-7.63</td>
<td>5.06</td>
<td>-0.40</td>
</tr>
</tbody>
</table>

** Statistically Significant at p value < 0.05
CHAPTER FIVE
DISCUSSION

The five hundred (500) subjects studied were all unmarried and 90.40 % of them were from the South East with Enugu state representing as much as 80.00%. The figures from this study therefore represents the South Eastern part of the country. All subjects were urban dwellers who wore brassiere right from when their breasts were big enough to enter a size. All subjects were Christian and they were mainly students.

The mean age of 18 years in this study is in keeping with a similar study done in Ghana with a sample size of four hundred and thirty eight (438) and age range of 16 – 22 years and with a mean age of 17 years. These studies measured nulliparous breast bearing in mind the continuous changes in breast shape, size and volume at every stage of a woman’s developmental cycle and considering the fact that every woman coming for a breast aesthetic procedure would expect her breast to be more youthful looking and not sagging. Vandeput’s work did not put into consideration the different changes in women when he measured 973 women’s breast who were between 18 – 60 years. The study did not exclude women who had undergone changes in their breast as a result of ageing, breastfeeding and pregnancy as was done in this study. All the subjects in this study met the inclusion criteria by careful selection.

The mean value of all the breast parameters measured were stated. They were within the ranges quoted in other works except for the NIMF measurements which was higher in this study (8.21cm) compared to the western value by Smith – 6.64cm, Penn – 6.74cm and Vandeput – 6.94. The NIMF parameter was 9cm in the study done in Ghana; a lower value would have been expected from the Ghana study because the age groups studied were younger

54
than the age groups in this study and it is expected that NIMF measurement increases with age.\textsuperscript{5}. This indicate a geographical variation in the positioning of the breast as NIMF is an important landmark for breast reconstruction in aesthetic surgery. As already mentioned above that despite the fact that the exclusion criteria in the study was not taken into consideration (that is ensuring that only the nulliparous breasts with no abnormalities were measured) the western NIMF was still lower than what was measured in this study.

The mean BMI of the study group was within the normal range (18.50 – 24.99 kg/m\textsuperscript{2}).\textsuperscript{18} The mean breast cup size was 11.28cm, this is equivalent to cup size D and the mean chest diameter was approximately 74cm (which is equivalent to breast band size 32). A 74D brassiere size is equivalent to a size 76C (sister size bra). This variability in brassiere sizing is a drawback for standardization.

The measurements of the left breast dimensions were greater than the right breast. These measurements include the mean of the nipple to inframammary fold distance, suprasternal notch to nipple distance, midclavicular line to nipple distance, areolar diameter and nipple diameter. Breast asymmetry is a difference of form, position or volume of the breast. Perfect symmetry may be disturbed by a number of intrinsic and extrinsic factors, including the secretion of hormones such as estrogen.\textsuperscript{36} The small random deviations from perfect symmetry that results from such factors are termed fluctuating asymmetry. Fluctuating asymmetry refers to a pattern of bilateral variation where variations on the right and left sides is both random and independent.\textsuperscript{37}

Pathological causes of asymmetry like breast masses, chest wall deformities and congenital deformities of the breast like Poland’s syndrome were all excluded from the group. Breast asymmetry has been noted during menstrual cycle and the breast has been observed to be symmetrical during ovulation.\textsuperscript{10, 12} This study did not look as the effects of menstrual cycle on
breast morphometry because a good number of the subjects did not keep records of their LMP. Symmetry was observed in more than 50% of the respondents. In those with asymmetry it was greater in the left breast (as in the study in Ghana\textsuperscript{31}) and it was statistically significant. It has been suggested by anecdotes that the left breast responds more to surging estrogen levels, explaining the reason for the increase in left breast volume but the right breast too has also been found to be significantly greater in volume than the left breast.\textsuperscript{29}

Correlation of all the breasts measurements with age, BMI, height and weight showed that there was a positive strong correlation but it was noticed that the correlation with height was weak in most instances. The results revealed that with every unit increase in the breast measurements there is an increase in the strength of the relationship with age, BMI and weight.

Logistic regression was conducted to assess the effects of age, height, weight, BMI, and breast cup size on left and right nipple to inframammary fold. The analysis revealed that only breast cup size and age had an effect on the position of the right breast. Cup size and BMI were predictors in its effect on position of the left breast in this study. Breast cup size puts into consideration the breast and chest diameter and it indirectly measures the volume of the breast.

The breast cup size was used as the dependent variable and linear regression was done to determine the effects of age, weight, height and BMI. The analysis revealed that only weight and BMI influenced the breast cup size measurement. The breast cup size is a very important parameter in breast aesthetics and reconstructive surgery because it indirectly measures the volume of the breast. The main reason why such an important measurement is not routinely applied is the absence of a standard, simple, inexpensive and accurate method for measurement. Other methods of breast volume measurements includes; water displacement, thermoplastic casting, biostereometrics (3D surface scanning), anthropometry and Grossman Roudner device.\textsuperscript{38}
The higher the volume of the breast, the higher the breast cup size. The findings in this study show that the vertical position of the measurements of the breasts migrate inferiorly with increasing age. With increasing weight, the landmarks migrate inferiolaterally as noted also by Brown et al. 5

Gravity of the breast resulting from increase in breast cup size, increasing BMI and increasing age have been noted in previous studies as causes of ptosis of the breast amongst other factors. 19 - 21 This study has been able to show the positive influence of age, weight and BMI on both the breast cup size and nipple to inframammary fold distance. The height of the subjects when regressed with breast cup size and NIMF did not show any significant correlation. This study like other studies has been able to determine the factors that influence breast measurements.
CONCLUSION

The results of this study has shown that the physical measurements of the Nigerian female breast are within the same ranges as in other studies with the exception of the NIMF which was higher than the western value and that age, weight and BMI can influence breast cup size and inframammary fold to nipple distance measurements. Asymmetry of the breasts was also established in this study with the left breast being larger than the right breast. A normal reference data should be established from this study.
RECOMMENDATIONS

1. The results obtained from this study should be used as normal reference data in planning for aesthetic and reconstructive procedures of the breast in our subregion.

2. This study was carried out on 500 female subjects in the Enugu metropolis only, therefore more studies need to be done in other geopolitical zones of the country to establish a national reference data.

3. A limitation of this study was absence of facilities for standardized estimation of breast volume therefore facilities at the NOHE should be updated to make these measurements possible.
REFERENCES


APPENDIX I

CONSENT FORM

The procedure involved in this study has been explained to me and I understand that:

1. Personal and medical history will be taken.
2. Direct measurements will be taken on my breast.
3. Weight and height will be taken.
4. The methods have been explained to me.
5. My involvement in the study is purely voluntary and I can withdraw from the study whenever I want.
6. My identity will not at any time be identifiable or divulged.

Name and signature of interviewer

Name and signature of subject

..................................................  ..................................................

Date........................................ Date........................................

Parent/Guardian’s name and signature.................................................................

Date........................................

APPENDIX II

PROFORMA

A MORPHOMETRIC ANALYSIS OF THE NULLIPAROUS FEMALE BREAST IN ENUGU, SOUTH EASTERN NIGERIA

BY

DR ISIWELE, EGIIEHIOKHIN

Date.................................

(A) DEMOGRAPHIC DATA

Serial number..........................................................

Age (Years)..........................................................

Geopolitical zone.............................................

Occupation

- Doctor........................................................... ☐
- Nurse.......................................................... ☐
- Pharmacist................................................. ☐
- Medical laboratory scientist......................... ☐
- Student....................................................... ☐
- Others (specify)........................................... ☐
**Marital status:** Single [ ] Married [ ] Divorced [ ] Widowed [ ]

**Address:** Urban [ ] Rural [ ]

- Mobile phone no. .................................................................

**Religion**

- Christianity [ ]
- Islam [ ]
- Others (Specify) .................................................................

**(B) RELEVANT MEDICAL HISTORY**  Yes [ ] or No [ ]

1) Breast disease [ ]
2) Breast surgery [ ]
3) Congenital abnormality of the chest / breast [ ]
4) Hormonal contraceptives [ ]
5) Last menstrual period [ ]
6) Trauma / burns to the breast [ ]

**(C) MORPHOMETRY OF THE BREAST**

- Suprasternal notch to nipple distance ........................................ [ ]
- Midclavicular line to nipple distance ......................................... [ ]
- Nipple to nipple distance ....................................................... [ ]
- Nipple to inframammary fold distance .................................... [ ]
• Areolar diameter……………………………………………
  
• Nipple diameter……………………………………………
  
• Upper chest circumference………………………………
  
• Breast diameter……………………………………………
  
• Chest + breast circumference……………………………

(D) Others

• Height........................................................................
  
• Weight........................................................................
  
• Body mass index........................................................
### APPENDIX III

#### LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>Body mass index</td>
</tr>
<tr>
<td>SNNR</td>
<td>Suprasternal notch to right nipple</td>
</tr>
<tr>
<td>SNNL</td>
<td>Suprasternal notch to left nipple</td>
</tr>
<tr>
<td>MCLNR</td>
<td>Midclavicular line to right nipple</td>
</tr>
<tr>
<td>MCLNL</td>
<td>Midclavicular line to left nipple</td>
</tr>
<tr>
<td>NN</td>
<td>Nipple to nipple distance</td>
</tr>
<tr>
<td>ADR</td>
<td>Areolar diameter right</td>
</tr>
<tr>
<td>ADL</td>
<td>Areolar diameter left</td>
</tr>
<tr>
<td>NDR</td>
<td>Nipple diameter right</td>
</tr>
<tr>
<td>NDL</td>
<td>Nipple diameter left</td>
</tr>
<tr>
<td>IMF</td>
<td>Inframammary fold</td>
</tr>
<tr>
<td>NIMFR</td>
<td>Nipple to right inframammary fold</td>
</tr>
<tr>
<td>NIMFL</td>
<td>Nipple to left inframammary fold</td>
</tr>
<tr>
<td>MCP</td>
<td>Midclavicular point</td>
</tr>
<tr>
<td>BD</td>
<td>Breast diameter</td>
</tr>
<tr>
<td>CD</td>
<td>Chest diameter</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>BCS</td>
<td>Breast cup size</td>
</tr>
<tr>
<td>NAC</td>
<td>Nipple areolar complex</td>
</tr>
<tr>
<td>FSH</td>
<td>Follicle stimulating hormone</td>
</tr>
<tr>
<td>LH</td>
<td>Luteinizing hormone</td>
</tr>
<tr>
<td>GnRH</td>
<td>Gonadotropin releasing hormone</td>
</tr>
<tr>
<td>NOHE</td>
<td>National Orthopaedic Hospital Enugu</td>
</tr>
<tr>
<td>STD</td>
<td>Standard deviation</td>
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</table>