A STUDY ON ANTHROPOMETRIC BREAST MEASUREMENTS IN THE MALAY POPULATION IN MALAYSIAN WOMEN

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Main 6

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For any errors or inadequacies that may remain in this work, of course, the responsibility is entirely my own.

PREFACE

The need for continued research into the ideal breast size for women is considerable, considering the limited number of substantial academic works on the subject especially for Asian women. This thesis seeks to determine the aesthetically perfect breast size in regards to height and weight (Body Mass Index) based on anthropometric measurements in the Malay female population in Malaysia.

The reason that this study deals only within Malay female population in Malaysia: in the opinion of the present author, it would not have been desirable within the confines of this doctoral thesis, in addition to the work that has been undertaken, to address in sufficient depth all of all the major populations in Malaysia.

Instead, the focus has been to provide a comprehensive study of the population under discussion, which in fact has so far been afforded little attention. It is hoped that this study will represent a major step forward in understanding the ideal breast size for Asian women and will generate further interest for other scholars to study other populations in the region as to generate a comprehensive database that can be referenced by medical practitioners worldwide.

The fieldwork reported in this study has been approved by the Medical Ethics Committee of the School of Medical Sciences, Universiti Sains Malaysia and National Medical Research Register.

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ABSTRACT (ENGLISH)

Breasts have many anatomic variations with respect to volume, width, length, projection, density, composition, shape, and placement on the chest wall. Anthropometric measurements, which involve measuring distances between a set of anatomical landmarks and a geometric volume formula is known to be the ideal and one of the most accurate method of determining breast volume.

Our main objective in this study was to evaluate and measure breast anthropometric measurements in the Malay female population and obtain a baseline of normal parameters of the breast and nipple-areolar complex among them. We also aimed to compare the difference in breast volume between the right and left breast of individuals within the study population, to study the relationship between the breast volume and the height and weight of individuals and to evaluate the variation in breast volume in regards to Body Mass Index.

The study included 100 healthy 17-30 year old single nulliparous Malay females in Malaysia with "aesthetically perfect" breasts with a BMI between 17 – 24.9 kg/m^2. A total of 22 parameters were measured in standing position. The parameters measured were body weight, height, shoulder width, upper chest width and circumference, middle chest width and circumference, lower chest width and circumference, waist width, clavicle-nipple length, sternal notch–nipple length, nipple-nipple length, upper arm length, acromium to midhumeral point of nipple, medial mammary radius, lateral mammary radius, nipple–inframammary fold length, nipple diameter, areola diameter, nipple projection, and mammary projection. Breast volumes were also evaluated

Normal parameters were successfully obtained. The mean breast volume of right and left breast was determined to be 536.59± 339.21 cc and 553.38 ± 368.12 cc. There was no significant correlation between height and breast volume but a positive correlation between breast volume and weight .With the positive correlation between BMI and breast volume using a linear model and linear regression a formula is derived to calculate the expected breast volume of an individual solely on the BMI. The mean distance from the supra-sternal notch to the nipple on the right side and left side is 18.76 ± 2.44 cm and 18.85 ± 2.34 cm, and the mean difference between the nipples is 18.22 ± 2.25 cm, forming an equilateral triangle. The standard mammary projection is 4cm± 1.3cm.

This study will help in planning both aesthetic and reconstructive breast surgery and make it possible to compare the anthropometric breast values of young Malay Malaysian women with those of women in other countries.

ABSTRAK (BAHASA MALAYSIA)

Payu dara menpunyai banyak variasi anatomic berhubung isipadu, lebar, panjang, projeksi, kepadatan, komposisi, bentuk dan lokasi penempatan pada "chest wall". Ukuran "anthropometric" yang melibatkan pengukuran jarak di antara suatu set "anatomical landmarks" dan formula isipadu geometric adalah diketahui sebagai salah satu kaedah yang paling ideal and tepat untuk menentukan isipadu payu dara.

Objektf utama kajian ini adalah untuk menilai and mengukur payu dara secara anthropometric bagi populasi wanita Melayu serta untuk mendapatkan parameter normal yang asas bagi paui dara dan "nipple-areolar complex". Kajian ini juga bertujuan untuk membandingkan perbezaan isipadu payu dara kanan and kiri bagi individu dalam populasi kajian ini, mengkaji kaitan di antara isipadu payu dara, ketinggian dan berat badan individu serta untuk menilai variasi dalam isipadu payu dara berhubung "Body Mass Index".

Kajian ini melibatkan 100 wanita bujang di Malaysia yang sihat, berumur di antara 17-30 tahun, mepunyai payu dara astetik yang sempurna dan mempunyai BMI di antara 17 – 24.9 kg/m^2. Sebanyak 22 parameter diukur di mana subjek berada didalam posisi berdiri. Parameter yang diukur adalah berat badan, tinggi, lebar bahu, lebar dada di bahagian atas, tengah dan bawah, lebar pinggang, jarak "clavicle-nipple", jarak "sternal notch–nipple", jarak "nipple-nipple", panjang "upper arm", jarak "acromium" ke "midhumeral point of nipple", jejari "medial mammary", jejari "lateral mammary" , jarak "nipple–inframammary fold", diameter "nipple", diameter "areola", "nipple projection" dan "mammary projection" . Isipadu payu dara juga telah dikira.

Parameter normal telah didapati dengan sukses. Nilai min payu dara sebelah kanan dan kiri didapati ialah 536.59± 339.21 cc dan 553.38 ± 368.12 cc. Tidak terdapat sebarang korelasi di antara tinggi dan isipadu payu dara namum terdapat korelasi positif di antara isipadu payu dara and berat badan. Satu formula untuk mengira nila isipadu payu dara sesesorng individu bedasarkan BMI telah diperoleh dengan menggunakan model linear and regressi korelasi positif BMI dan isipadu payu dara. Jarak min dari "supra-sternal notch" ke "nipple" sebelah kanan and kiri adalah 18.76 ± 2.44 cm dan 18.85 ± 2.34 cm, dan perbezaan mindi antara kedua-dua "nipple" adalah 18.22 ± 2.25 cm, membentuk segi-tiga sama sisi. Ukuran piawai "mammary projection" adalah 4cm± 1.3cm..

Kajian in akan membantu dalam perancangan surgery payu dara astetik and reconstruktif serta mebolehkan perbandingan nilai payu dara arthropometric bagi wanita Melayu Malaysia dengan wanita lain di negara lain.

INTRODUCTION

AND

LITERATURE REVIEW

INTRODUCTION AND LITERATURE REVIEW

1.0 Research Background

Across the world, almost in all cultures from the beginning of human civilization, the female breast which is a secondary sexual characteristic of female gender, has been endowed with many symbolic functions and meanings. For most women, their breasts represent femininity, fertility, sensuality, and the ability to nurture.[1] Some cultures especially in our modern era, stress that ideal breast size should be ample to be adequate, which is almost always influenced by the lifestyle of celebrities via media or internet photographs. However, very large breasts can produce psychological embarrassment and physical discomfort and cause much distress in a variety of situations.[2] Patients pursuing breast surgery, for aesthetic or reconstructive reasons have many options to consider before surgery. The most important factor to settle with certainty before surgery is the final outcome of the breast size. Many plastic surgeons today know verbal communication alone between the patient and physician, even with adjunctive information, is an unreliable method for determining final breast size and it is often difficult to communicate with patients about the size of breasts after surgery. The "leave it to me, I know best" approach may be fine for patients without specific expectations, but it may lead to disappointment for others. When the decision is perceived to be a unilateral on the part of the physician, the patient does not feel compelled to accept responsibility for that decision if she is disappointed after surgery. The need for additional surgery for a size change is associated with anxiety, urgency, and the belief that the surgeon is at fault or at least should bear the responsibility for the cost of replacement

surgery. Some surgeons tend to use a size larger than may be necessary to avoid this situation, as it is well known patients always wish they were a little larger.

1.1 Breast Morphology

Breasts have many anatomic variations with respect to volume, width, length, projection, density, composition, shape, and placement on the chest wall. Changes in the shape of the body and the extremities can affect the shape or location of the breasts. Specifically, hormonal changes during adolescence and early adulthood which results in changes in breast shape and dimension. The final shape of the adult breast results after three to four years of increased hormonal activity. Size, stiffness, and nodularity of the breast in an adult woman may change with weight, menstrual period, gestation, and lactation. The shape of the breast in an adult woman is conical for those who are nulliparous and may become ptotic and teardrop shape after breastfeeding. Obesity also contributes to the fat tissue content of the breast which determines the size and shape of the breast. After menopause, breasts become asymmetric and demonstrate irregularity on palpation. With aging, the amount of fatty and connective tissue of the breast decreases and breasts become smaller, and also become ptotic due to laxity of Coope's ligaments with age. Current studies have even revealed different standards of body development between different races resulting in a variation of breast size among different races and ethnic origin. A study released in 2013 suggests the existence of a single genetic mutation responsible for multiple characteristics of East Asians , including thicker hair, more sweat glands and smaller breasts on women. [3]

1.2 "Aesthetically Perfect" Breasts

The definition of an ideal breast varies; however, some specific criteria are universally accepted: Proportional size with respect to the body, absence of ptosis, tear-drop shape, and anteriorly placed nipples are some of the characteristics of an aesthetic breast.[4] The main goal of aesthetic and reconstructive breast surgery is to achieve these characteristics. Penn [20] made this observation when he studied measurements of 20 female models with "aesthetically perfect" breasts, however he did not define the criteria he used to select the women studied. Westreich and colleagues [4] in later studies defined "Aesthetically perfect" breasts as a nonptotic breast in which no common aesthetic procedure would be considered appropriate (excluding augmentation) to enhance the breast's form. The study was aimed at determining normal values for perfect breasts in the hope that the "normal values" obtained could be applied to aesthetic breast surgery. [5,6,7]

1.3 Breast Volume

Over years many research have been carried out on breast volume and body surface anatomy in order to find the standards of breast volume, shape and body development. The significance in breast volume measurement has been well documented by Kayar et al [8] as the following :

• Measurement of breast volume is an objective criterion for establishing the diagnosis and classification of macromastia.

• In order to establish the medical indication for breast reduction surgery other than cosmetic concerns in macromastia cases, and to calculate specimen volume preoperatively, which is essential information required by insurance and social security companies, breast volume should be measured.

• Breast volume should be measured in breast cancer because the tumor/breast volume ratio is of significance with respect to breast-conserving surgery; breast volume measurement is necessary in order to establish the indication for breast-conserving surgery and to predict the tumor/breast volume ratio.

• Breast volume measurement is a determining factor for selecting the approach to be used in all types of breast surgery (reduction, augmentation, reconstructive, and oncoplastic) in order to obtain symmetry of both breasts.

• Breast volume measurement is necessary to evaluate the cosmetic results more objectively following breast surgery.

1.4 Methods of Breast Volume Measurement

In the general public, breast volumes are traditionally expressed in terms of bra size. Measurements used in the determination of bra size include band size, bust circumference, and cup size. Bra size has been found to correlate poorly with actual breast volume and is thus an inaccurate method as it differs from manufacturer to manufacturer. The general rule to determine cup size is to measure the circumference in inches around the chest at the inframammary line and add 5 to determine the band size (taken to an even number). Then the circumference is measured across the nipples and a difference of 1 inch between the two equals an A cup, a difference of 2

inch is a B cup, etc. Thus, the volume of the breast in a 34A cup is not the same size as for a 36A cup.

Literature describes numerous techniques for measuring breast volume based on methods that fall into one of three categories: biostereometric evaluations, special measurement devices, and anthropometric measurements. There are six main methods within these categories which are : Archimedes (displacement of water) , anthropometry (anatomic) measurement , biostereometrics (3-D surface scanning), imaging (mammography, magnetic resonance imaging, computed tomography, ultrasonography) , Grossman-Roudner device method and casting.

Studies have claimed several of these methods to be accurate in breast volume measurement. However they have failed to gain acceptance as routine due to high costs, technical difficulties, and patient discomfort. Kayar et al [8] in 2011 based on their study comparing five methods of breast volume measurement with specimen volume in 30 mastectomy cases concluded that the most accurate method of breast volume measurement is mammography, followed by the Archimedes method. However, when patient comfort, ease of application, and cost were taken into consideration, the Grossman- Roudner device and anatomic measurement were relatively less expensive and easier methods with an acceptable degree of accuracy.

1.4.1 Biostereometric Evaluations

Most often this method is classified under imaging. Biostereometric evaluations involve the use of anterior and lateral photographs of the breasts. The photographs are digitized into a computerized plotting device that enables breast volume determination through mathematically derived algorithms. This method has been shown to be simple, noninvasive and accurate but is generally not favored because of its expense and dependence on technical support.[9]

An alternative to these classical methods is 3D body surface imaging. With the help of different 3D imaging devices, a non-invasive recording in standing position and the creation of a virtual 3D model of the breast region is possible. 3D technology makes it possible to quantitatively evaluate symmetry, volume, shape, contour, surface, and distance measurements.[10] As the image is taken in the standing position it mimics exactly the properties of the actual breast unlike in MRI or Ct scan imaging which is done in supine position and causes deformation of the chest region which distorts the real anatomical shape of the breast and is of little help to the surgeon. In 2006 Kovacs[10] studied the comparison between breast volume measurement using 3D surface imaging and classical techniques, and concluded that 3D scanning provides acceptable accuracy for breast volume measurement, better spatial interpretation of the anatomical area, non-invasiveness and good patient tolerance.[10]

1.4.2 Casting

Casting was first introduced by Ingleby in 1949. In this method gypsum, paraffin, and thermoplastic materials are used. This method involves forming a cast around the breast together with the chest wall and breast volume is then measured by filling the cast with water up to the plane passing through the two points at the base. Previous studies have used plaster casts as described by Campaigne et al [11] with accuracy of this method shown to be 99 percent and test-retest reliability shows a correlation coefficient(R= 0.97) indicating excellent reproducibility[11]

1.4.3 Grossman-Roudner Device Method

Adjustable geometric cones such as the Grossman-Roudner device are simple to use but have not been shown to be accurate. The Grossman-Roudner device is a graduated disc made of hard transparent polyvinyl chloride material, which can be formed into a cone-shaped device by means of a cut to the center along a radius line.(Figure 1) Patients should be in sitting position with their arms at their sides (if the breasts are large or pendulous, the hands should be elevated to the neck) during the measurement procedure. One-fifth of the area on the disc has markings. The graduated scale of the disc is aligned with the upper outer aspect of the breast and at the same time the lower end of the disc is placed according to the lower breast contour. Then, by pressing gently on the breast, the disk is converted into a cone by its cut edge covering the breast tissue. The breast should be supported from below and lifted gently into the cone. The cone should be filled completely. If the cone cannot cover the breast completely, then a larger size

disc should be used. The volume can be read from the calibrations marked on the disc. (Figure 2)[8]

1.4.4 Archimedes (Displacement of Water)

This water displacement maneuver requires the female patient to bend over a water-filled vessel, lowering her breasts into the water and breast volume is calculated based on displaced water. It is time-consuming and the rather cumbersome nature of this technique has made it impractical for use in the clinical setting. It was first described by Bouman, and alternatively many modifications have followed to ease the technique. Recent modification by Tezel et al,[12] describes using calibrated measurement cylinders placed against the thorax wall to avoid patient contact with water.

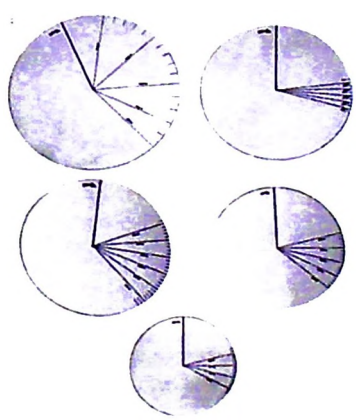


Figure 1 Grossmann-Roudner-Disks.

Figure 2. Measurement with GR discs.

(Ragip Kayar, Serdar Civelek, Murat Cobanoglu, Osman Gungor, Hidayet Catal, Mustafa Emiroglu : Five Methods of Breast Volume Measurement: A Comparative Study of Measurements of Specimen Volume in 30 Mastectomy Cases. *Breast Cancer: Basic and Clinical Research* 2011:5 43–52)

1.4.5 Imaging

Ultrasonography, computed tomography (CT) and nuclear magnetic resonance imaging (MRI) offer an alternative means of breast volume measurement. The main drawback to these procedures is the cost. Current modern imaging procedures allows us to obtain images of the breast in 3D as the patient is placed in the scanner in a prone position, and the breast volume is calculated by the summation of segmented monolayers.[13,14] Using mammography on the other hand has practical advantages as all women undergoing breast reconstruction for cancer will have had recent mammography. Deriving breast volume from mammographic measurements using formulas proposed by Keddy and Brebner[15] , Katariya et al[16] , Stomper et al[17] and Kalbhem et al [18] has been well documented.

1.4.6 Anthropometric Measurements

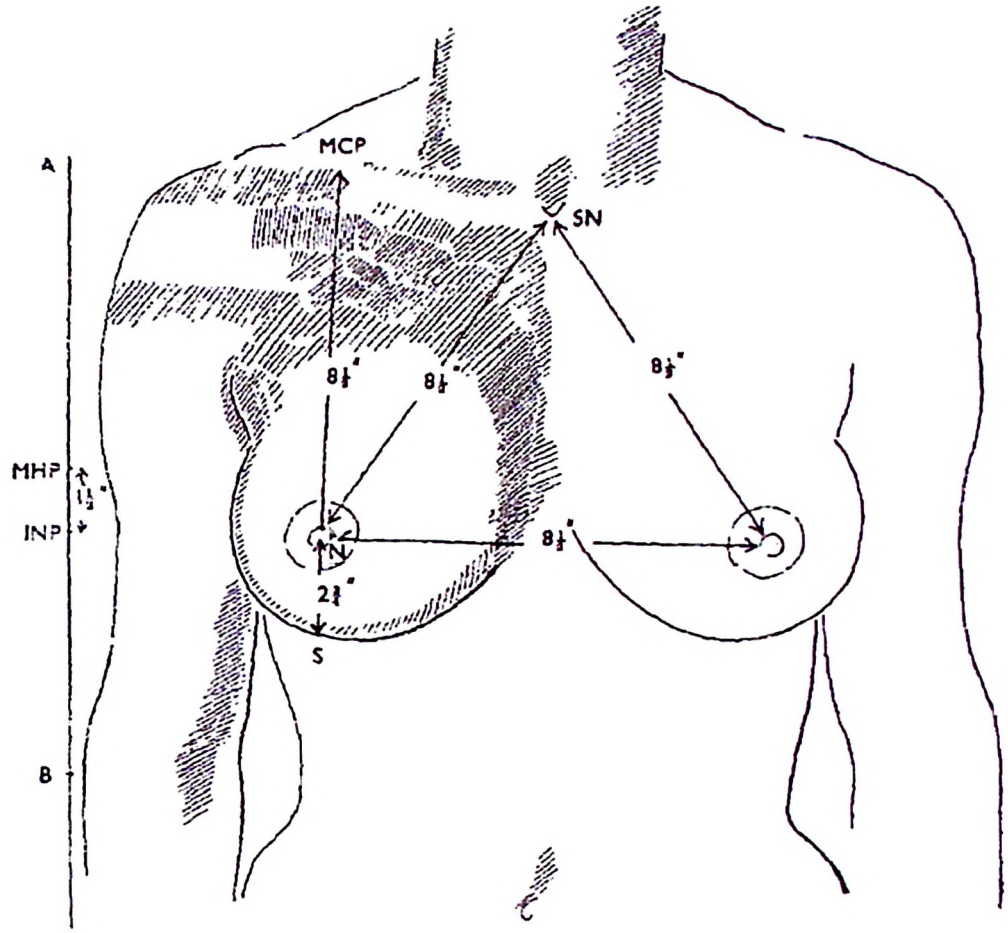
Anthropometric measurements, which involve measuring distances between a set of anatomical landmarks and a geometric volume formula is known to be the ideal and one of the most accurate method of determining breast volume. Maliniac [19] was the first to attempt to collate the standards for measuring the breast. In 1955, Penn [20] made his landmark paper on breast reconstruction where he measured 20 female models with "aesthetically perfect" breasts and his measurements since then have been utilized as normal values for aesthetic breast surgery. The parameters studied by Penn were age, height, acromial span, "ideal nipple plane," midclavicle to "ideal nipple plane" , midclavicle to nipple, nipple to nipple, nipple to submammary, and manubrium to nipple. (Table 1, Figure 3)

In 1985 an article on breast measurements by Smith et al [21] differed from Penn's as it was not restricted to only those women with aesthetically perfect breasts but collected 55 cases through newspaper advertisements and measured volume using gypsum casting technique. In his study almost one-third off the women had marked hypertrophy or both which had little clinical importance as all cosmetic surgery is aimed at creating an aesthetically pleasing breast. Hence it would have been more useful to determine the measurements of an aesthetically pleasing breast. The parameters studied by Smith et al. were breast size, lateral breast crease, axilla to nipple, nipple to midline, nipple to inframammary crease, nipple to lowest point on breast, breast volume, and nipple to nipple.

In 1997 Westreich and colleagues [4] initial study, a protocol was used that reported on 50 women with aesthetically perfect breasts. It was in this article that "Aesthetically perfect" breast was defined. Subjects in this study were nulliparous Caucasians. The study was aimed at determining normal values for perfect breasts in the hope that the "normal values" obtained could be applied to aesthetic breast surgery.

Table 1 : Data Adapted from Penn *(Penn J: Breast reduction. Br J Plast Surg 1955;7(4):357–371)*

Model No.	Age	Height		Weight	Acromial Span	Ideal Nipple Span	Midclavicle to Ideal Nipple Plane	Midclavicle to Nipple		Sternal Notch to Nipple		Nipple to Nipple	Nipple to Submammary	
								Right	Left	Right	Left		Right	Left
	Yrs	Ft.	In.	Lb.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
1	21	5	0	117	14.5	8	8	8	8	8	8	8	2.75	2.75
2	19.5	5	2	134	14	7.25	7.5	7.5	7.5	7.5	7.5	7.5	2.75	2.75
3	33	5	3	114	14	7.75	7.75	7.75	7.75	7.75	7.75	7.75	3	3
4	39	5	3	125	15.5	7.75	7.75	8.5	8.5	8.5	8.5	8.5	2.5	2.5
5	19	5	3	105	14.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	2.75	2.75
6	19	5	4	126	15.5	7.75	8	8.75	8.75	8.75	8.75	8	2.5	2.5
7	19	5	5	125	15	8	8	8.25	8.25	8.25	8.25	8.5	2.75	2.75
8	27	5	5	138	14.5	8.25	8.5	8.5	8.5	8.5	8.5	8.5	2.75	2.75
9	26	5	5	128	15	7.75	7.75	8.75	8.75	8.25	8.5	8.75	2.5	2.5
10	18	5	5	120	14.5	7.75	7.75	8	7.5	8	7.5	8	3	2.5
11	25	5	5	133	15	8	9.25	8.75	8.75	8.75	8.75	8.75	2.75	2.75
12	25	5	5	133	15	8.75	8.75	8.75	8.75	8.75	8.75	8.75	2.75	2.75
13	20	5	6	130	14.5	8.25	8.25	8.5	8.5	8.5	8.5	8.5	2.75	2.75
14	24	5	6	135	14.5	7.75	7.75	7.75	7.75	7.75	7.75	7.75	2.75	2.75
15	22	5	6	140	14	8	8.5	7.75	7.75	7.75	7.75	8	2.75	2.75
16	24	5	7	130	15.5	8	8.5	8.25	8.5	8.25	8.5	8.5	2.5	2.5
17	29	5	8	126	15	8	8	8	8	8	8	8.5	2.75	2.75
18	28	5	8	148	14.5	7.75	8	8.25	8.25	8.25	8.25	8.25	2.5	2.5
19	34	5	9	142	15	8.5	8.5	8	8.5	8.5	8.5	8.5	2.5	2.25
20	34	5	10	134	14.5	8	8.25	8.25	8.25	8.25	8.5	8.5	2.25	2.5



A = Acromion level
MHP = Midhumeral plane
N= Nipple
MCP = Midcalvicular point
Measurements : MCP to NP = 8 to 8.5 in.
N to N = 8 to 8.5 in.

SN = Sternal notch
S = Submammary groove
B = Lateral epicondyle
INP = Ideal nipple plane
SN to N = 8 to 8.5 in.
N to S = 2.5 to 3 in.

Figure 3 : Normal Breast Measurements in Penn's Landmark Paper. *(Penn J: Breast reduction. Br J Plast Surg 1955;7(4):357–371)*

Brown et al [22] in 1999 using the same protocol as Smith conducted a study in a series of 60 subjects. But similar to the study by Smith they included women with breast pathology measuring the average breast instead of the ideal breast. The author also measured from soft tissue landmarks which flawed the study.

Qiao and colleagues [6, 7] performed a study in which they compared weight of the subject with the norm and measured the circumference of the chest at the height of the axilla, nipples, and abdomen as well as the circumference of the thigh. It was concluded that there is a correlation between breast volume and the difference in the circumference taken across the axilla and over the nipples and also with the amount that the patient was overweight. However the article does not state if the subjects had perfect breasts as the initial study by Penn.

Later in 2009 Westreich [4,23] noted that normal respirations or minor position changes caused fluctuations of a number of millimeters making Smith et al's level of accuracy impractical as the results were reported in centimeters taken to the second decimal place. Penn reported his results to the nearest quarter-inch (equal to 0.68 cm) with a higher accuracy level hence Westreich opted to use measurements to the nearest half-centimeter. In his further article he revised his protocol and introduced a protocol sheet (Table 2). His aim was to standardize further anthropometric measurements by defining the points of references, he also specifies that the body be in the normal anatomic position with the elbows bent at 90 ° and the palms up. To improve accuracy

Table 2 : Protocol Sheet for Anthropomorphic Assessment of Breasts. *(Westreich. M. Anthropomorphic breast measurement. Breast Augmentation. Chapter 3.Springer :2009)*

Please Read Breast Morphology Protocol Instructions Prior to Measuring!!

Patient Information: _____ _____ _____
Family Name First Name Record Number

_____ _____ _____ _____
Address Phone Procedure Date of exam

_____ _____ _____ _____
Age Height Weight Bra size and manufacturer

Right	Left	Midline Measurements (*= use carpenter level)
_____	_____	1. Manubrium to inframammary crease*
_____	_____	2. Manubrium to lowest point on breast*
_____	_____	3. Manubrium to xyphoid
_____	_____	4. Manubrium to umbilicus
_____	_____	5. Manubrium to pubis
		Linear Measurements
_____	_____	6. Manubrium to nipple
_____	_____	7. Manubrium to acromion
_____	_____	8. Nipple to clavicle
_____	_____	9. Nipple to nipple
_____	_____	10. Areola to inframammary line
_____	_____	11. Areola to lowest (most dependent) point of breast
_____	_____	12. Nipple to acromion
_____	_____	13. Areolar width
_____	_____	14. Areolar height
Right	**Left**	**Arm Measurements**
_____	_____	15. Acromion to olecranon
_____	_____	16. Acromion to inframammary line height*

_____ _____ 17. Acromion to nipple height*

_____ _____ 18. Acromion to height of lowest point on breast*

_____ _____ 19. Breast projection (passive)

_____ _____ 20. Breast projection (active)

_____ _____ 21. Inframammary line length

_____ _____ 22. Width of breast envelope

_____ _____ 23. Thickness of breast envelope—upper

_____ _____ 24. Thickness of breast envelope—lower

_____ _____ 25. Volume

_____ _____ 26. Regnault ptosis gradation (0-A-B-C)

_____ _____ 27. Baker classification if previous implants (0-1-2-3-4)

_____ _____ 28. Chest circumference

_____ _____ 29. Chest depth—use anthropomorphic caliper

_____ _____ 30. Chest width—use anthropomorphic caliper

31. Breast envelope – Describe skin (striae and tonus), subcutaneous, scars, previous breast surgery:

_____

_____

32. Morphological pathology of breast: ☐ None ☐ Present – describe:

_____

_____

Westreich et al elected not to use soft tissue landmarks at all except those directly related to the breast (nipple and inframammary crease). In the article breast volume measurements are made using the Grossman-Roudner device. The definitions of the parameters Westreich [23] measured are as follows : (Figure 4)

1. Manubrium (M; suprasternal notch, SSN) to inframammary crease (M-In): Vertical midline measurement from M to the point level with the most inferior point on the inframammary crease (use carpenter' s level)
2. Manubrium to lowest point on breast (LPB; M-LPB): As in 1, to point equal to this height in midline
3. Manubrium to xyphoid (M-Xy): As in 1, to palpable tip of xyphoid
4. Manubrium to umbilicus (M-Um): As in 1, to upper border of umbilicus
5. Manubrium to pubis (M-Pub): As in 1, to superior edge of pubis
6. Manubrium to center of nipple (M-N)
7. Manubrium to point of maximum lateral prominence of acromion (M-Ac)
8. Nipple to clavicle (N-Cl): Vertical measurement from a point 5 cm lateral to the manubrial clavicular joint to the center of the nipple
9. Nipple to nipple (N-N): Horizontal measurement from center of one nipple to the other
10. Areola to inframammary (Inf; Ar-In): Vertical measurement from inferior edge of areola to lowest point on inframammary crease
11. Areola to lowest point of breast (Ar-LPB): Vertical measurement from inferior edge of areola to most dependent point of breast

12. Nipple to acromion (Ac; N–Ac): Measurement from tip of acromion to center of nipple

13. Areolar width (A–Wi): Horizontal measurement of areolar width

14. Areolar height (A–He): Vertical measurement of areolar height

15. Acromion to olecranon (Ac–Ol): Vertical measurement from tip of acromion to tip of olecranon (elbow bent at 90 °)

16. Acromion to inferior point (Ac–In): Vertical measurement on a line from tip of acromion to olecranon to a point on the arm level with the inframammary line (use carpenter's level)

17. Acromion to nipple height (Ac–Ni): As in 15, to a point on the arm level with the nipple

18. Acromion to LPB height (Ac–LPB): As in 15, to a point on the arm level with the lowest point of breast

19. Breast projection (B–pr): Breast projection measured at 90 ° to chest wall just beneath breast (passive)

20. Breast distraction (B–D): Breast projection measured at 90 ° to chest wall just beneath breast (active) when grasping nipple and distracting anteriorly

21. Infra (Infra): Circumlinear measurement of the inferior 180 ° about the nipple on the inframammary crease

22. Width of breast envelope from lateral to median extent of inframammary fold (use caliper)

23. Thickness of breast envelope–upper: Caliper measurement 2 cm above areola

24. Thickness of breast envelope–lower: Caliper measurement 2 cm below areola

25. Volume: Volume of each breast using Grossman– Roudner device

26. Regnault ptosis gradation

27. Baker capsule classification if previous breast implants

28. Chest circumference (Ch-ci): Chest circumference measured at the level of the most inferior point of the inframammary crease

Chest circumference axilla (Ch-ci-ax): Chest circumference measured at the level of axilla

Chest circumference nipples (Ch-ci-Ni): Chest circumference measured across and over the nipples; if the breast is ptotic, the woman should wear her bra for this measurement

29. Chest depth (Ch-de): Chest depth measured with anthropometric caliper at the level of the most inferior point of the inframammary crease

30. Chest width (Ch-wi): Chest width measured with anthropometric caliper at the level of the most inferior point of the inframammary crease

31. Breast envelope: Describe skin (striae and tonus), subcutaneous tissue, scars, and previous surgery

32. Morphological pathology of breast

In 2002, Vandeput and Nelissen [24] performed anthropometric measurements on 973 women. They selected women with near-ideal breast characteristics and noted the absence of ptosis in their evaluation. The defined measurements and proportions based on these studies have made a significant contribution to the science of aesthetic and reconstructive plastic surgery. Recent studies on the relationship between breast morphology and changes in weight and height have reported conflicting results. Vandeput and Nelissen [24] reported that breast volume was independent of weight and chest diameter. However, in Westreich's study [4] breast volume was found to increase by 20 mL for each kilogram of weight gain above the ideal weight.

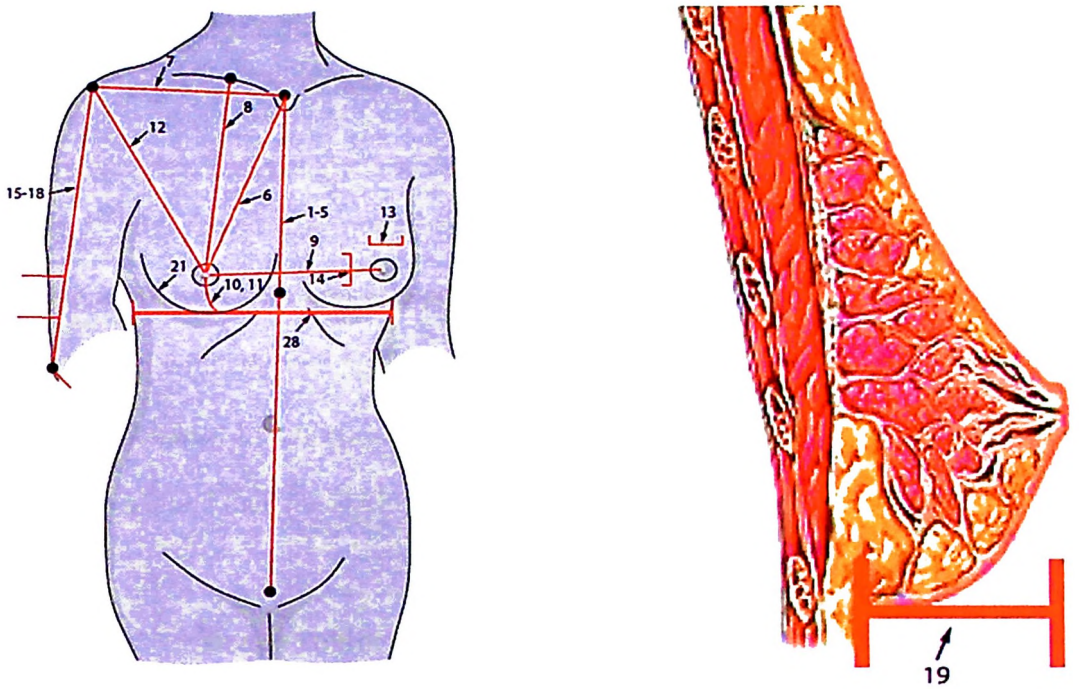


Figure 4 : Lines of measurement for the anterior chest, breast, and arm. *(Westreich, M. Anthropomorphic breast measurement. Breast Augmentation. Chapter 3.Springer :2009)*

Using measured distances between a set of anatomical landmarks the volume can be calculated using geometric formulas. The most common formula is the one proposed by Qiao et al [5] , as follows: Where MP = mammary projection, MR = medial breast radius, LR = lateral breast radius, and IR = inferior breast radius.

$$\textbf{Breast volume} = \pi/3 \times \textbf{MP2} \times (\textbf{MR} + \textbf{LR} + \textbf{IR} - \textbf{MP})$$

The measurements should be performed with patient in standing with her arms at her sides. This breast volume formula proposed in a study of 125 Chinese women appeared to be

geometrically derived based on the volume of a cone; this would have little applicability in the measurement of larger breasts, which typically do not conform to this shape.

Sigurdson [25] developed a formula based on anthropomorphic measurements to determine breast volume in patients with breast hypertrophy. The breast volume equation: where PP is the measurement taken with the tape placed at the inframammary fold and encircles the base of the breast and FP is obtained by transposing the position of the inframammary fold onto the anterior surface of the breast and then measuring from the fold to this mark along the breast meridian.

Breast volume (cc) = 35.5(PP) + 37.7(FP) – 1305

However the author felt the formula would not be suitable for breasts that lack ptosis because key landmarks are based on the inframammary fold. Furthermore, projection of this fold anteriorly onto the breast can be difficult to evaluate accurately, particularly in women with thick breast bases.

Vandeput and Nelissen [24] stated the vertical and the horizontal arches should be equal in a hemisphere. Mathematically, a female breast could vary in shape and volume between half a sphere as maximum and a right cone as minimum: $1/2 - 4/3\ \pi R^2h >$ breast $> 1/3\ \pi R^2h$, where R is the radius of circular base, h is the protrusion, and if R = h: $2R^3 >$ breast $> R^3$. More generally he concluded that the breast volume depends on the size of the base and on the protrusion h. Hence breast volume can be measured as:

$$\textbf{Breast Volume} = k\,(\pi R^2) f(h)$$

Westreich and colleagues [23] for ease in the clinical setting, propose the following multiple regression formula using only two variables to determine breast volume: Where the two measurements are the distance from the manubrium notch to the center of the nipple (M–Ni), and then the nipple-to-nipple distance (N–Ni) :

$$\textbf{Volume} = (\text{M–Ni})^{1.103} \times (\text{N–Ni})^{0.811}$$

or

$$\log(\text{volume}) = [1.103 \times \log(\text{M–Ni})] + [0.811 \times \log(\text{N–Ni})]$$

Since publication the author noted that the use of logarithms scares most surgeons so they compiled a table that allows the surgeon to simply put in the appropriate M–Ni distance on the table and then go down the appropriate row until he or she finds where it crosses the appropriate Ni–Ni distance. The number in the square is the volume in cubic centimeters of the appropriate "ideal normal breast" for those measurements. The author suggested to use this number, the preoperative breast volume (of the unoperated breast) is measured directly using the Grossman–Roudner device and by subtracting the subjects actual breast volume from the "appropriate" volume, we obtain the volume of the required prosthesis. Although the formula will give us the "normal" size for a particular subject, the subjects almost always request a larger size.

OBJECTIVES

OF

STUDY

2.0 OBJECTIVES OF STUDY

We attempt to evaluate and measure breast anthropometric measurements in the Malay female population in Malaysia and achieve an aesthetically perfect breast size with regards to height and weight (Body Mass Index).

2.1 General

To obtain a baseline of normal parameters of the breast and nipple-areolar complex among the healthy, single nulliparous Malay population in Malaysia with aesthetically perfect breasts.

2.2 Specific

1. To determine the normal parameters of the breast and nipple-areolar complex among Malays in Malaysia.

2. To compare the difference in breast volume between the right and left breast of individuals within the study population.

3. To study the relationship between the breast volume and the height and weight of individuals.

4. To evaluate the variation in breast volume in regards to Body Mass Index.