UNIVERSITI PUTRA MALAYSIA

CLASSIFICATION OF ULTRASOUND BREAST MORPHOLOGY AMONG WOMEN OF DIFFERENT AGE GROUPS IN KLANG VALLEY, MALAYSIA

SHAHAD ABDULWAHHAB IBRAHEEM

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By

SHAHAD ABDULWAHHAB IBRAHEEM

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

March 2016

Dedicated with love to:

My parents, my beloved husband, my in laws, my sister and her husband my brothers and also my friends

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

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March 2016

Chairman : Professor Rozi Mahmud, MBBS UM, Mmed Rad UKM, Consultant Radiology
Faculty : Medicine and Health Sciences

The present study analyzed the normal types of breast morphology, breast echo structure using ultrasound evaluation while examining the difference in breast morphytes among Malaysian females according to age groups. This was carried out with the main aim of providing an indepth knowledge to professionals so as to enhance their efficiency in the interpretation of B-mode ultrasound images and to also provide the standard size of each breast tissue. Breast morphology results were recorded according to different factors which are age groups, race, socio-demographic factors, family information, gynecological information, family history of breast cancer, physial activity, anthropometric measurements and supplements usage among repondents in Golden Horses Health Sacntuary.

An analytic cross-sectional study design was used to determine the morphology of normal breast among the respondents at the imaging department of Golden Horses Health Sanctuary, Sri-Kembangan located in Klang Valley, Selangor, Malaysia. Ultrasound breast images of the respondents were captured using Philips ultrasound iu22 with linear array probe L17-5 (5-17MHz) while using radial position with depth 3.5-4.0cm and again 86%-87% for the left and right breast. The use of proportionate probability sampling method was used for the selection of respondents for this study. A pretested self-administered questionnaires written in Malay Langauge was administered to the respondents in order to collect the data. The prevalence of premenopausal and postmenopausal age were 35.66 ± 8.20 and 57.43 ± 5.43 years respectively. The average age of the respondents in first menstrual phase was 12.01±0.64 years.

Findings of the study showed that there was a significant association between ethnicity and ultrasound breast morpholgy. Findings of ultrasound images showed that Indians ethnic owned the highest mean score in all breast tissue in pre menopausal age group compared with Malay and Chinese ethnic, subcutaneous fat was 7.61 ± 7.05mm, glandular tissue in Indian ethnic respondents was 22.51 ± 8.79

mm for right upper outer. The mean of fat lobules in right lower outer for Indian ethnic and Malay respondents in pre-menopausal were 26.57 ± 12.05 and 27.10 ± 11.51 mm respectively, while in Chinese ethnic respondents were 15.84 ± 9.51mm. The average value of ethnic groups was approximately the same in the four quadrants of right and left breast in pre-menopausal and post-menopausal age group for support ligaments, pectorals fascia, pectorals muscle and duct. Approximately the left breast has the same values as right breast in each breast tissue. However, Chinese ethnic showed highest frequency of parenchyma pattern and dense breast as compared with results of mammography. There was also significant association between breast morphology and most socio-demographic factors tested in this study and BMI in most quadrants of both breast while no significant association between Cholesterol level, supplements (calcium and vitamines) and physical activity was observed. Finally, this study observed that the prevalence and wide range size of ultrasound breast tissue between premenopausal and postmenopausal women were varied among the three ethnic groups. The findings of this study also revealed that ultrasound can be a good first row image modality in breast imaging.

Keywords: Breast ultrasound, Breast morphology, Ages, Premenopausal, Postmenopausal, Ethnics, BMI.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

KLASIFIKASI MORFOLOGI ULTRASOUND PAYUDARA DI KALANGAN WANITA DARIPADA KUMPULAN UMUR YANG BERBEZA DAN ETNIK DI LEMBAH KLANG, MALAYSIA

Oleh

SHAHAD ABDULWAHHAB IBRAHEEM

Mac 2016

Pengerusi : Profesor Rozi Mahmud, MBBS UM, Mmed Rad UKM, Pakar Perunding Radiologi
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Kajian ini bertujuan menganalisis jenis morfologi payudara yang normal, struktur payudara menggunakan penilaian ultrabunyi bagi mengenalpasti perbezaan "morphytes" payudara di kalangan wanita Malaysia mengikut umur dan keturunan. Tujuan utama kajian ini adalah untuk memberi pengetahuan yang informatik kepada profesional bagi meningkatkan kecekapan mereka dalam tafsiran imej ultrasound B-mod dan juga menyediakan saiz piawai bagi setiap tisu payudara. Data morfologi payudara telah direkodkan mengikut faktor-faktor seperti umur, bangsa, sosio - demografi, sejarah keluarga, maklumat sakit puan, sejarah keluarga yang menghidap kanser payudara, aktiviti fizikal, pengukuran antropometri dan penggunaan supplemen dikalangan responden dari Golden Horses Health Sacntuary.

Satu reka bentuk kajian analisis keratan rentas telah digunakan untuk menentukan morfologi normal payudara di kalangan responden dari Jabatan Pengimejan, Golden Horses Health Sanctuary, Sri Kembangan yang terletak di Lembah Klang, Selangor, Malaysia. Imej ultrabunyi payudara responden telah dianalisis menggunakan "ultrasound Philips" dengan "linear probe array" L17-5 (5-17MHz) menggunakan kedudukan kedudukan radial dengan kedalaman 3.5-4.0cm dan peratusan sebanyak 86 % -87 % untuk payudara kiri dan kanan. Penggunaan kaedah "proportionate probability sampling" telah digunakan bagi pemilihan responden kajian ini. Satu soal selidik telah diberikan kepada responden untuk mengumpul. Prevalens umur wanita premenopause adalah 35.66 ± 8.20 dan posmenopause adalah 57.43 ± 5.43 tahun. Purata umur responden dalam fasa menstruasi pertama ialah 12.01 ± 0.64 tahun.

Hasil kajian menunjukkan bahawa terdapat hubungan yang signifikan secara statistik antara etnik dan morfologi ultrabunyi payudara. Penemuan imej ultrabunyi menunjukkan bahawa responden premenopause etnik India mempunyai skor purata yang tertinggi bagi semua tisu berbanding responden Melayu dan Cina etnik. Lemak subkutaneus adalah 7.61 ± 7.05 dan 7.33 ± 6.9 mm, tisu glandular untu kanan ‘luar yang lebih rendah' dan 'lebih rendah dalaman' untuk responden India 22.51 ± 8.79 dan 22.80 ± 10.08 mm, purata lemak lobule di kanan in right 'lower outer' dan 'lebih rendah dalaman' responden India etnic, responden premenopause Melayu dan responden postmenopause Melayu ialah 26.57 ± 12.05, 27.10 ± 11.51, 22.52 ± 12.21 dan 15.26 ± 8.46mm. Manakala, responden Cina etnik mempunyai purata sebanyak 15.84 ± 9.51 dan 17.91 ± 10.65 mm.

Nilai purata sokongan ligamen bagi responden premenopause dan postmenopause India etnik adalah lebih tinggi dalam empat kuadran kanan dan dada kiri berbanding responden Melayu dan Cina etnik. Manakala nilai purata pectorals fascia responden premenopause dan posmenopause Melayu dan India etnic adalah lebih kurang sama bagi empat kuadran kanan dan dada kiri berbanding responden Cina etnik. Nilai purata kumpulan etnik lebih kurang sama bagi empat kuadran kanan dan dada kiri responden premenopaus dan postmenopause untuk otot pectorals dan saluran payudara sebelah kiri mempunyai nilai yang sama seperti payudara kanan bagi setiap tisu payudara. Manakala responden Cina menunjukkan kekerapan tertinggi bagi corak 'parenchyma' dan kepadatan payudara bila dibandingkan dengan keputusan mamografi.

Terdapat juga hubungan yang signifikan antara morfologi payudara dan kebanyakan faktor-faktor sosio-demografi yang diuji dalam kajian ini terutamanya faktor BMI dalam kebanyakan kuadran bagi kedua-dua payudara. Manakala, tiada hubungan yang signifikan dapat diperhatikan antara morfologi payudara dengan tahap kolesterol, makanan tambahan (kalsium dan vitamin) dan aktiviti fizikal responden. Akhir sekali, kajian ini mendapati bahawa kekerapan dan saiz tisu ultrabunyi payudara antara wanita premenopausal dan posmenopaus adalah sama di antara ketiga-tiga kumpulan etnik. Hasil kajian ini juga menunjukkan bahawa kaedah ultrabunyi boleh menjadi modaliti baik bagi memperolehi imej berkualiti dalam pengimejan payudara.

Kata kunci: Ultrsound payudara, Morfologi Payudara, Umur, Premenopause, Putus Haid, Etnik, BMI.

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"In the name of Allah, the most beneficent and the most merciful"

First and foremost, all praise is due to Allah Almighty *subhanahu wa-ta'ala,* on whom we ultimately depend on, for his endless blessing and allowing me to achieve what I have achieved today.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
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LIST OF ABBREVIATIONS

%	Percentage
<	Less than
>	Greater than
≥	Greater than or equal
2D	Two Dimension
3D	Tree Dimension
ACR	American College Of Radiology
ANOVA	Analysis of variance
BI	Breast Image
BIRADS	Breast Imaging, Reporting and Data System
BMI	Body Mass Index
CALC	Centre for the Advancement of Language Competence
CI	Confidence Interval
cm	Centimetre
cm^2	Square centimetre
cm^3	Cubic centimetre
CT	Computed Tomography
CTLM	Computed Tomography Laser Mammography
df	Degree of freedom
DICOM	Digital Imaging and Communications in Medicine
ERT	Estrogen Replacement Therapy
et al	And others
GHHS	Golden Hourse Health Sentuary
HDL	High-Density Lipoprotein
HEPA	Health-Enhancing Physical Activity
HRT	Hormone Replacement Therapy
IPAQ	International Physical Activity Questionnaire
L	Left
LDL	Low-Density Lipoprotein
LIQ	Lower Inner Quadrant
LOQ	Lower Outer Quadrant
MET	Metabolic Equivalent of Task
MHz	Megahertz
min	Minute
mm	Millimetre
MOH	Ministry Of Health
MRI	Magnetic Resonance Image
n	Number
NLSY	National Longitudinal Survey Of Youth
P	P value
p	Page
PE	Physical Examination
PEM	Positron-Emission Mammography
PET	Positron-Emission Tomography
PW	Pulsed Wave
R	Right
ROI	Region of Interest

RR	Relative Risk
SD	Standard Deviation
SES	Socio Economic Status
SPSS	Statistical Package For The Social Science
UIQ	Upper Inner Quadrant
UOQ	Upper Outer Quadrant
UPM	Universiti Putra Malaysia
US	Ultrasound
WHO	World Health Organization
yr	Year

CHAPTER 1

INTRODUCTION

1.1 Breast Imaging

Over the years breast imaging modality has played an important role in helping radiologist in the identification of breast morphology, primary screening of cancer, diagnosis and characterization of lesions, staging and restaging, treatment selection, monitoring treatment progress and in the determination of cancer recurrence, (Sree et al., 2011). Physical examination, mammogram or similar imaging method could be used in the examination of a suspected area in the breast; a combination of the different modalities could even be used if necessary (Prasad and Houserkova, 2007). Some of the modalities which can be used in breast imaging include the following:

A. Mammography
B. Positron- Emission Tomography (PET)
C. Computed Tomography Laser Mammography (CTLM)
D. Magnetic Resonance Image (MRI)
E. Ultrasound (US)

1.1.1 Ultrasound (US)

Breast ultrasound history can be traced as far back as in the early 1950's when a sonographic examination of the female breast was carried out by Wild and Reid in 1952 for the purpose of experiment. The use of this technique was unsuccessful due to the low technical standard. Following this development of Wild and Reid, Was the introduction of gray-scale imaging by Kossoff in 1972 which allowed the vivid visualization of complex breast tissue structures. Additional advances related to the clinical use of this technique took place in Japan, Australia and in the United States where two principle approaches were used as a guide to achieving the set goals for the research. The use of ultrasound as an auxiliary for mammography in detection of breast cancer in early stage gave rise to the innovation of an automated system for the purpose of examining the entire breast. The development of advanced manual scanning modalities restricted the use of ultrasound to only specific inquiries in particular patients with probably special problems related to breast cancer. Today in the field of radiology, the use of hand-held high-resolution real time scanners, operating at frequencies of 5-10 MHz with a penetration depth of about 6cm, has become predominant among practitioners. The existence of this feature will enhance advancement in real-time manual breast scanning. The German Association of National Service Physician, on December 7, 1985 provided a guideline to ensure the quality of personnel and instrumentation for the examination and detection of breast cancer. Even though, the transducer is the most important ultrasound tool with an adequate operating frequency of at least 5MHz, higher frequencies are still being tested (Leucht, 1992; Destounis, 2006 and Powers and Kremkau, 2011).

It is hoped that far beyond the present performance of mammography, other breast scanning modalities will be able to prevent the prevalence of cancer-caused deaths by means of early detection. One of the major benefits of the use of ultrasound for breast scanning is its ability to detect many other abnormalities which may not be cancer but require biopsy (Carkaci et al., 2011).

1.2 Ultrasound Machines

Medical instrument manufacturers across the globe have designed and produced several ultrasound machines; some of the known manufacturers of ultrasound instruments include General Electric, Toshiba, Siemens, Philips, Aloka, and Madison. Each of these instruments is used according to condition of a patient and the body organ to be examined. Even though, the brands and companies are different, the concepts and procedures are generally the same and can be used with no reservation as they are all convenient safe for use with little to zero risk and do not require any preparations from patients. The procedures are also non-invasive and painless so individuals can immediately resume normal activities after testing. In this part some major elements of the ultrasound machine, specifically the ones for breast imaging, are introduced (Lopchinsky et al., 2000).

Figure 1.1: A sample of the ultrasound machine (Medical ultrasound, 2015).

1.2.1 Modes of Operations

Several different modes of the ultrasound are used in medical imaging. In this study, only B-mode was used

1.2.2 B-Mode

This is a pulsed imaging ultrasound in which there is transmission of pulse which is listened to by the transducer for a short period of time (Staveros, 2004). The B-mode ultrasound imaging modality which was the first to be used for diagnostic purpose, collects the same information also serves the function of detecting the direction from where the echo emanates from and also records the strength of the different echoes collected. The image captured becomes recognizable and is used to check for abnormalities.

The B-mode image which was the first ultrasound diagnostic tool, can be used in the evaluation of abnormalities; through constant use, an abnormality in the breast is easily recognized (Martin, 2010).

In the same vein, the B-mode echography is also known as B-mode sonography, 2D mode, and sonogram. The B-mode data ultrasound (Brightness-mode) is presently the most popular form of ultrasound imaging modality which displays the 2D-map of B-mode data. The different types of the displayed B-mode images are as listed below:

Two Dimensional Modes

Gray-Scale

Real-Time Mode

Compound B-Mode (B-Mode Ultrasound, 2015)

1.2.3 Transducers

A piezoelectric transducer is an imaging modality which is encased in a housing of different forms. When used for scanning it produces a sound wave with strong but usually short electrical pulses which causes the transducer to ring at the desired frequency usually between 2 to 18MHz. this sound produced by the transducer is focused either by the shape of the transducer, a lens in front of the transducer, or a complex set of the control pulses from the ultrasound scanner machine (Beamforming). While the wave runs through the body to establish a focus at a desired depth, an arc-shaped sound wave is produced from the face of the transducer. The rubber-like material which the transducer is made of enables the sound wave to be efficiently transmitted into the body under examination; usually a water-based gel is applied on the patient's skin before the scanning begins. In using this imaging modality, there is usually a partial reflection which emanates from the layers of various tissues especially areas of the body where there is change of density such as the blood cells in blood plasma, small structures in organs, etc. Some of the reflections sent to the body returns back to the transducer in the same manner which it was sent out. This returned sound wave makes the transducer vibrate thereby, enabling the transducer convert the vibrations into electrical pulses which runs through the ultrasonic scanner and are transformed to digital images which can be interpreted by a radiologist.

There are different types of transducers that are equipped with ultrasound machines.

I. Linear Array Transducer: Linear array transducer elements are rectangular and arranged in a line (Figure 1.2).

Figure 1.2: A linear transducer (Medical ultrasound, 2015).

II. Rectangular Array Transducer: which is also known as matrix transducer contains elements which are arranged in rectangular order.
III. Annular Array Transducer: this transducer contains elements which are arranged in circular pattern and are used for focusing on the beam.
IV. Vector Array Transducer: Vector array transducers have phasing that is applied to linear sequenced arrays to steer pulses in various directions (Whittingham, 2010 and B-Mood Ultrasound, 2010).

In this study, only the linear probe was used because this probe is used for breast imaging.

1.3 Scanning Technique

The breast contains a number of anatomic landmarks and as such high-resolution breast imaging systems must be use appropriately with the right examination technique for optimum effect to be achieved. It is important to employ the use of an organized pattern of transducer movements. There are basically two components in the examination: Transverse/Para-sagital and Radial

I. Transverse and para-Sagittal Scan: in most cases this scanning technique allows a total survey of the breast. The number of passes required using this technique depends on the breast size and image field width of the transducer. While using this technique the professional ought to examine the breast in a grid pattern in both the transverse and para-sagital plane while overlapping each scanning movement to ensure the coverage of the whole breast.

II. Radial scans: this scanning technique is preferred by some examiners is their best scanning method because it follows the natural anatomic course of mammary ducts and lobules. Here, the breast which is naturally divided into four quadrants is scanned in radial pattern with the probe rotating around the nipple (figure 1.3) (Griffiths, 2000).

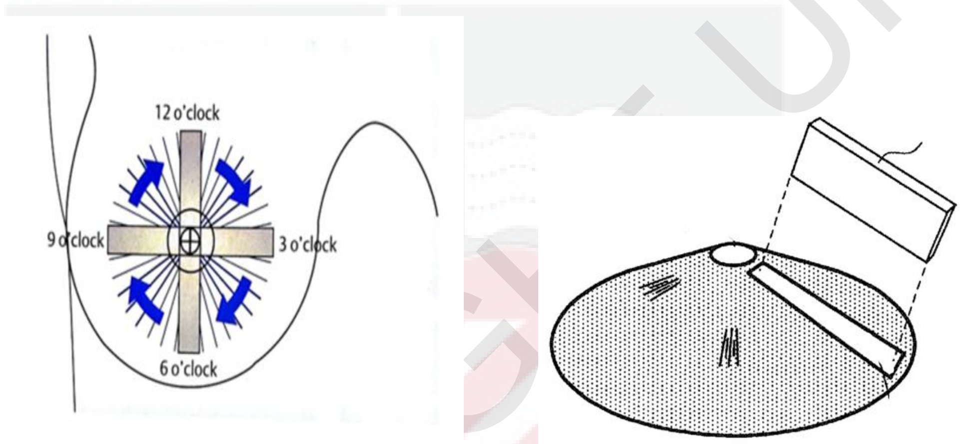

Figure 1.3: Radial position of breast ultrasound scans (Madjar and Mendelson, 2011).

1.4 Breast Anatomy

The anatomy of breast presents the breast as a modified sweat gland which is positioned between the clavicle and the sixth to eight ribs on the anterior surface of the chest. Breast tissue can be found as far as the sternum and laterally to midaxillary line and most times extends around the lateral margin of the major muscle of the pectorals; sometimes seen high in the axilla and rarely reaching its apex. The shape and size of breast vary and can vary according to age with a normal volume of 200-300cm^3 and a diameter of fixation area which ranges from 12 to 15cm.. The breast is made up of different combination of tissue components which is determined by age, hormonal influences, structural changes (congenital, degenerative or pathologic), and individual characteristics (Sohn et al., 1999 and Madjar and Mendelson, 2011) (Table 1.1).

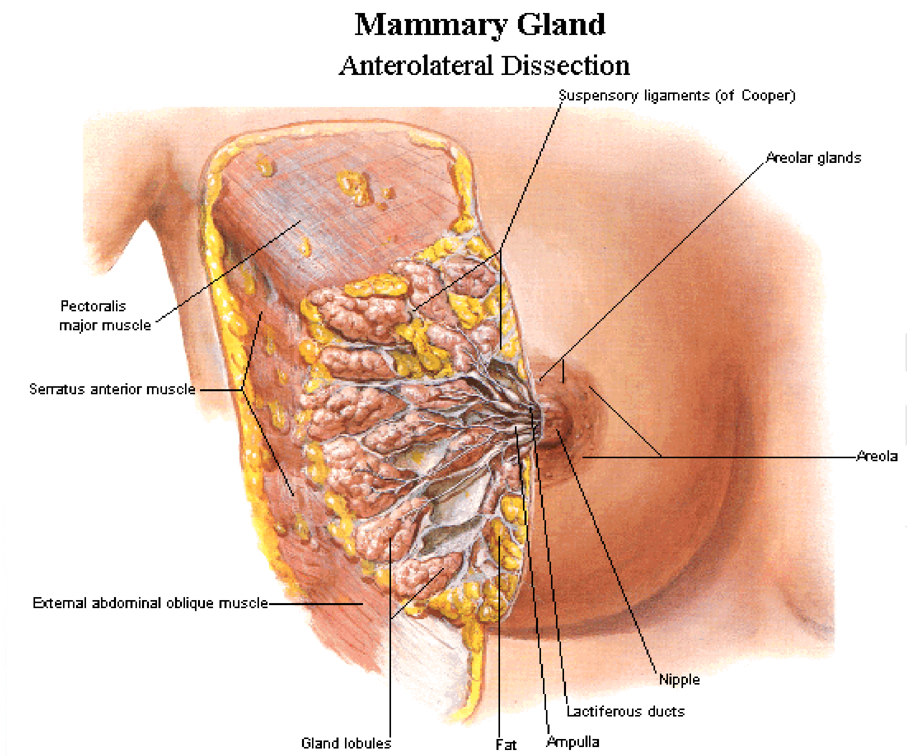

Figure 1.4: Normal breast anatomy (anterolateral dissection) (Netter, 2006).

Table 1.1: Gross anatomy of female breast (sequence of tissue layers from anterior to posterior) (Madjar and Mendelson, 2011).

Breast Tissues
Skin
Subcutaneous fat
Cooper ligaments
Superficial mammary fascia
Breast parenchyma with
Lobules
Lactiferous ducts
Interlobar connective tissue
Fat
Deep mammary fascia
Retromammary fat
Muscle fascia
Pectorals major muscle
Pectorals minor muscle
Ribs and intercostals muscles
Pleura

The breast is made up of adipose, glandular, and connective tissues surrounded by anterior and posterior leaf of superficial fascia of the thorax. A layer of superficial subcutaneous fat with a thickness that is determined by the age and constitution of the woman covers the glandular tissue of the breast (Figure 1.4).

Generally it is perceived that in young women the breast tissue is mostly made up of parenchyma and just little fat except young women that have nursed infants; their breast tissue is predominantly consisting of fat. However, in some young girls, the breast contains a significant portion of fat especially if the breasts are big. As a young woman ages, the glandular tissue of the breast is replaced by fat and connective tissue. On the other hand, the breasts of older women who have received postmenopausal hormone replacement may experience an increase in fibroglandular density while many older women may have mammogrphically dense breasts with the density reflecting the fibrous (rather than glandular) predominance of their breast tissue. This should be considered in breast examinations as it will influence the overall interpretation of clinical, sonographic and mammographic findings (Sencha et al., 2013).

1.5 Ultrasound Anatomy of Female Breast

Breast structures show a range of echo characteristic Table (1.2). An ultrasound image of normal breast could be dynamic depending on the phase of menstrual cycle in fertile women and the age of the patient also changes as a result of anatomic and constitutional characteristics of women and the relationship between fatty, glandular and connective tissues (Figure 1.5). When conducting a breast ultrasound, it is important to make a comparison of the structures of the left and right breast so as to be able to take note of dynamic changes in ultrasound image in the current cycle phase. There are certain types of breast constitution that are differentiated through the use of ultrasound: juvenile, early reproductive, premenopausal, postmenopausal, and the gland during pregnancy and lactation (Madjar and Mendelson, 2011).

Table 1.2: Echogenicity of various breast tissues (Madjar and Mendelson, 2011).

Anatomic Structure	Echogencity
Skin	Hyperechoic
Subcutaneous fat	Hypoechoic
Cooper ligaments	Hyperechoic
Parenchyma (glandular tissue)	Hyperechoic
Fat lobules	Hypoechoic
Retromammary fat	Hypoechoic
Pectorals fascia	Hyperechoic
Pectorals muscle	Hypoechoic
Ducts	Anechoic
Nipple	Hypoechoic

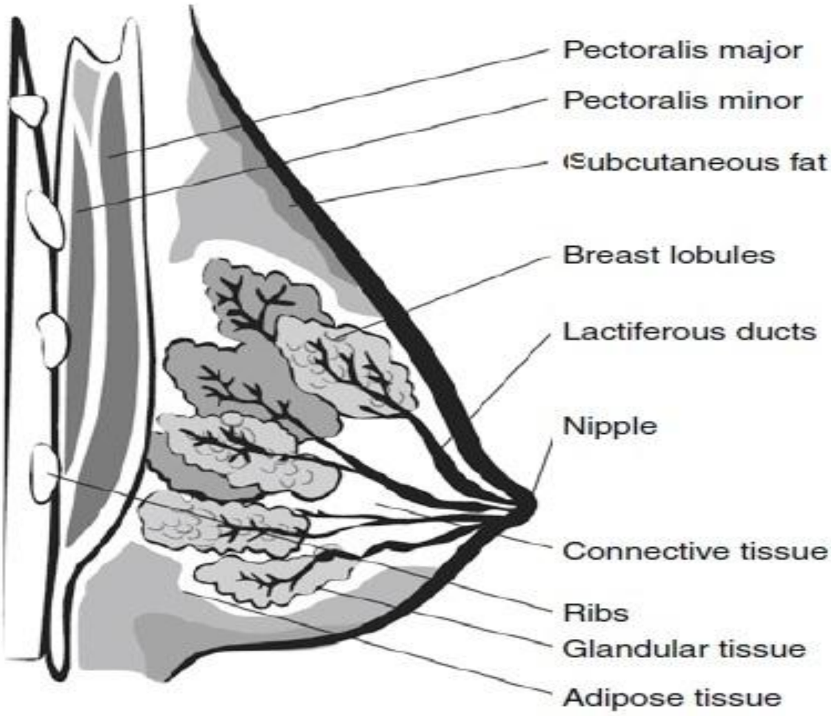

Figure 1.5: Breast anatomy with gray scale (echogenicity of breast tissues) (Sencha et al., 2013).

In fertile women, US, as a rule, assesses the status of the following breast structures (Figure 1.6) and (Figure 1.7):

A. Subcutaneous adipose layer
B. Superficial leaf of the fascia
C. Parenchyma (glandular tissue)
D. Lactiferous ducts
E. Cooper's ligaments
F. Nipple
G. Back leaf of the fascia
H. Retro mammary space
I. Regional lymph nodes

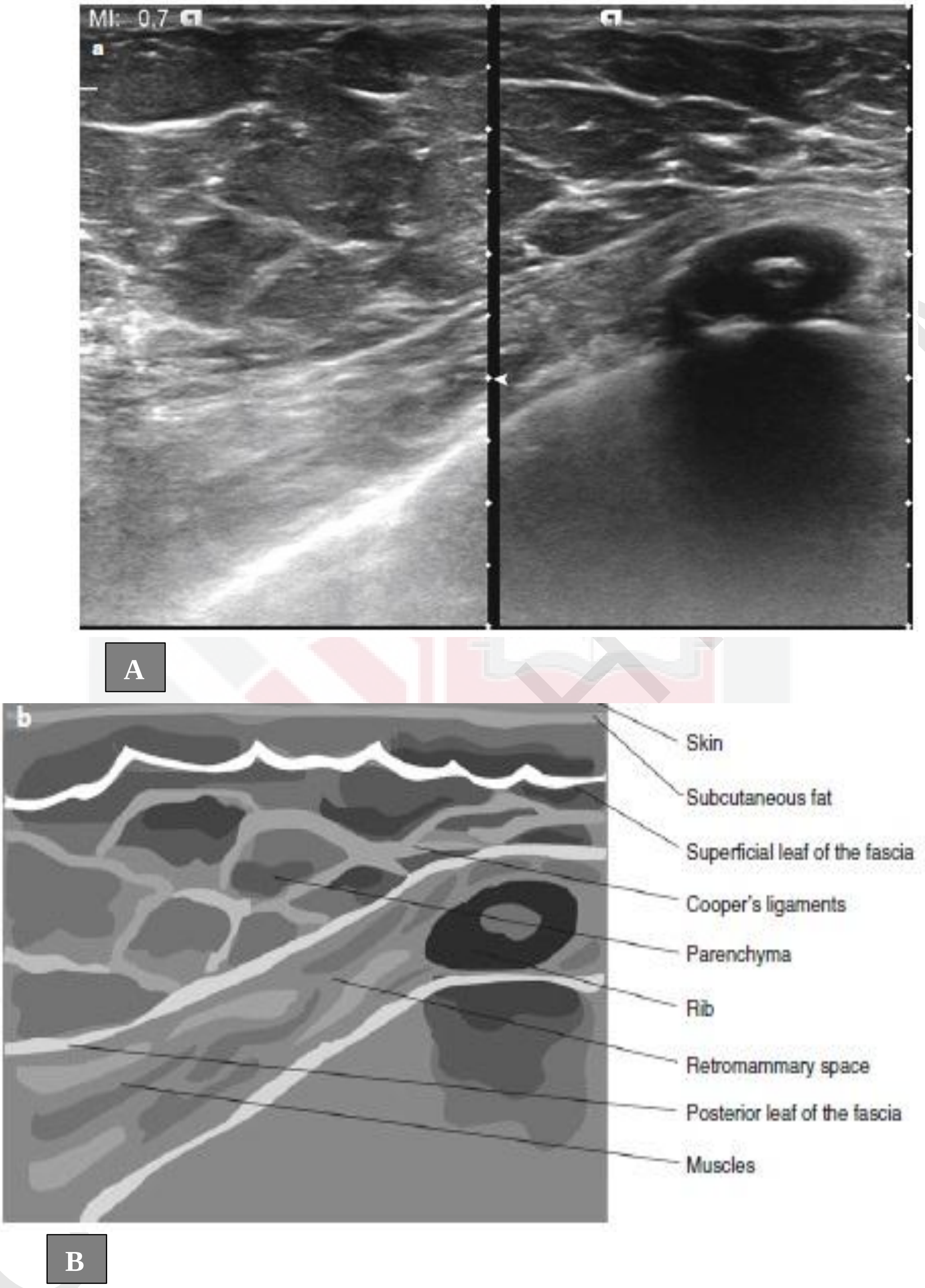

Figure 1.6: Normal breast US: (A) Grayscale US (B) Graphic (Sencha et al., 2013).

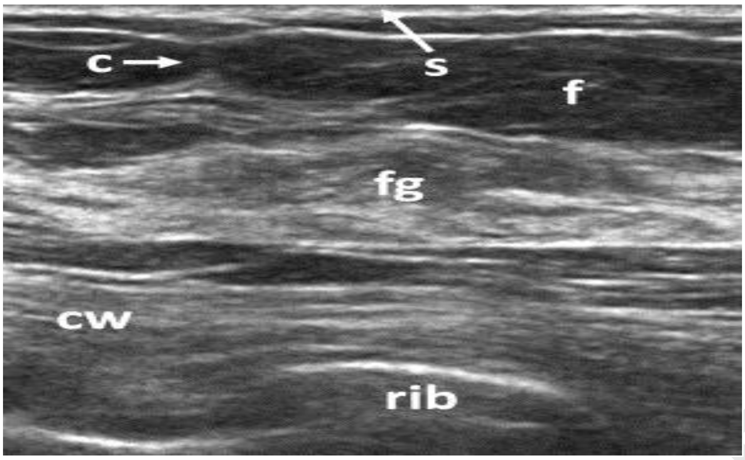

Figure 1.7: Normal ultrasound breast anatomy. Gray-scale sonographic imaging of the normal female breast. The breast is covered by hyperechoic skin (s). Within the breast is fat (f) and a variable amount of fibroglandular breast tissue (fg), all positioned over the chest wall (cw), with visible ribs. Note that Cooper ligaments (c) are visible as they connect to fascia and skin (s) (Jesinger, 2014).

The frequency of the ultrasound probe and also the class of ultrasound scanner determines the possibility of assessing the condition of the breast. Probes with frequency of 10MHz and above allow for a clear differentiation of superficial and profound surfaces of derma of breast skin, but in situations whereby the frequency of the probe is between 5-7.5MHz it is difficult to differentiate between the skin and subcutaneous fat of the breast. Normal skin is imaged as homogeneous echogenic layer of 0.5–7 mm thickness. Prior to puberty and in early fertility, the thickness of the skin usually ranges from 0.5 to 2 mm. The skin thickness reaches 2–4 mm in pre-menopausal, post menopause, pregnancy, and lactation. Adipose tissue is characterized by decreased or normal echogencity and homogeneous-enough structure with linear echogenic incorporations, which often exhibit vague acoustic shadows (Figure 1.8). A patient's constitution and age determines the thickness of adipose layer of the breast; the adipose layer increases with age (Massengale and Brem, 2002).

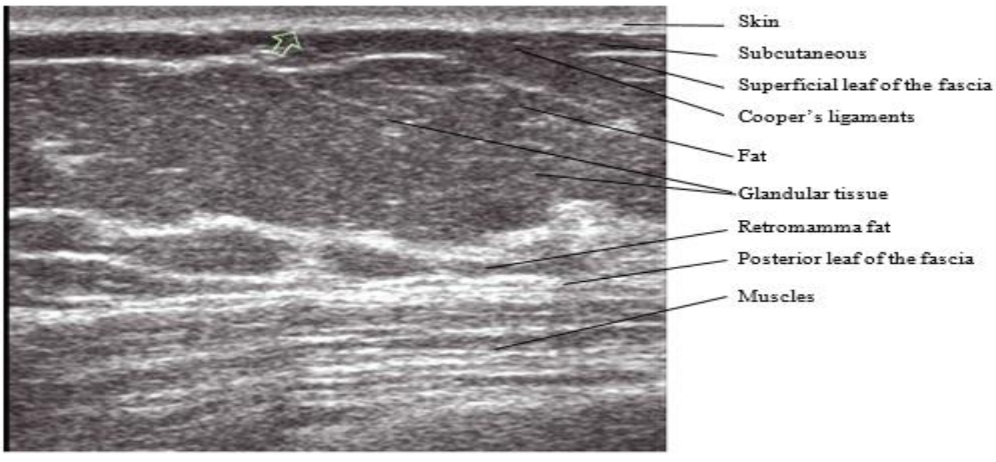

Figure 1.8: Subcutaneous fat layer of normal breast (arrow) in grayscale US (Sencha et al., 2013).

In normal circumstances, the adipose tissue in young women is seen as a thin layer between the skin and glandular tissue, but conditions such as age and childbirth may cause the thickness of the adipose layer to increase alongside minimal increase in echogenicity. Furthermore, mammary involution caused by menopause might cause the irregularity of the adipose tissue due to the development of connective tissue usually known as echogenic linear structures. Cooper's ligaments become thicker and often form adipose lobules with lateral acoustic shadows (Massengale and Brem, 2002).

Parenchyma (glandular tissue) normally looks like a layer with slightly decreased echogenicity and irregular echotexture. In anatomical terms, glandular lobule and glandular lobe are two different things. Nevertheless, owing to the fact that glandular lobules and lobes have no actual capsule, US fails to differentiate them (Table 1.3).

Table 1.3: Parenchymal pattern in breast ultrasound (Madjar and Mendelson, 2011).

Parenchyma Echogenicity	Age	Readability
Homogeneous Hyperechoic	Young women	Good
Heterogeneous Hyperechoic	Middle aged women	Good or moderate
Predominantly Hypoechoic	Older women	Moderate
Heterogeneous Hypoechoic	Young and middle aged women	Poor

Madjar et al. (2008), states that the increase or decrease in echogenicity of glandular tissue is determine by the patient's age, endocrine status, and ratio of glandular and adipose tissues. Phase of menstrual cycle could influence change in the echogenicity of parenchyma. The decrease of echogenicity of glandular tissue depends on Proliferative processes. The glandular tissue in young women is more or less seen as a uniform layer where the tissue is often hyperechoic or isoechoic. An increase in granularity caused by echogenic fields of glandular tissue against hypoechoic lactiferous ducts can be observed in the second stage of a menstrual cycle (Figure 1.9A).

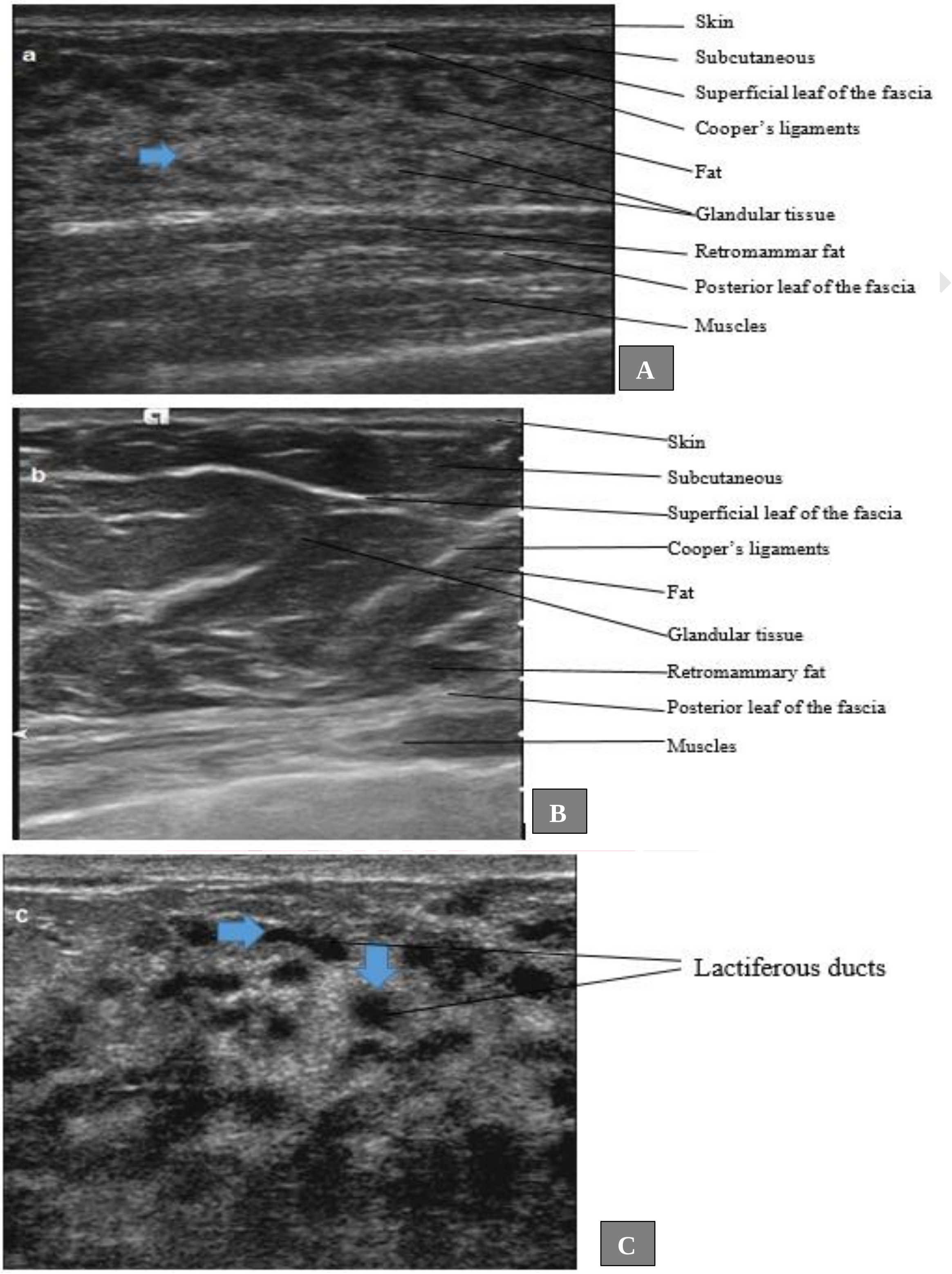

Figure (1.9): Breast parenchyma in grayscale US. (A) Reproductive age (B) Menopause (C) Lactation period (Sencha et al., 2013).

In reproductive age constitutional features, childbirths, status of endocrine, duration of lactation period and number of pregnancies are the major determinants of the ratio of parenchyma and stromal components present in the breast of an individual. The upper-outer quadrants of the breast records the utmost thickness of the glandular tissue while the inner quadrants contains the least; the thickness of this layer usually comes as a result of age, post pregnancy and post lactation (McCormack and Silva, 2006).

The presence of hypoechoic adipose lobes and echogenic fields of fibrous tissue appears to be more than that of glandular tissue with the glandular tissue being of more echogenicity (Figure 1.11B). Numerous degree of ductal ectasia is usually defined in lactation period with a substantial level of increase (about 25-30mm) in the thickness of glandular tissue and grainy-like structure of the parenchyma (Figure 1.11C). In a case whereby the patient is up to 40years and above, a decrease in the glandular and adipose tissue is observed where the glandular becomes thin and not exceeding 4mm. In this case, most part of the breast is made up of adipose lobes which are observed as uniform structures of decreased echogenicity covered with echogenic rims of connective tissue fibers (Figure 1.10)(Sencha et al., 2013).

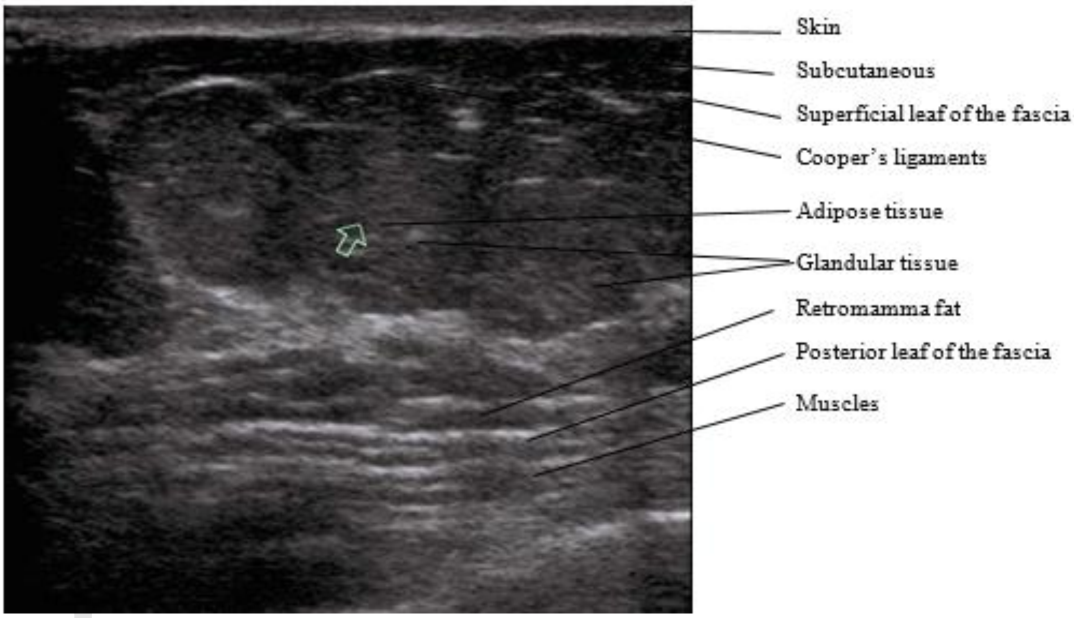

Figure 1.10: Adipose lobes (arrow) of normal breast in grayscale US (Sencha et al., 2013).

Cooper's ligaments are connective tissue septa, which derived from fascia perpendicular to the anterior surface of the skin. On an ultrasound image the Cooper's ligament appear as thin echogenic linear structures which surround adipose lobules and have the ability to generate lateral acoustic shadows thereby imitating breast lesions. Age is a factor which influences the density of the Cooper's Ligament structure making it denser with more acoustic shadows being expressed in an ultrasound image (Figure 1.11).

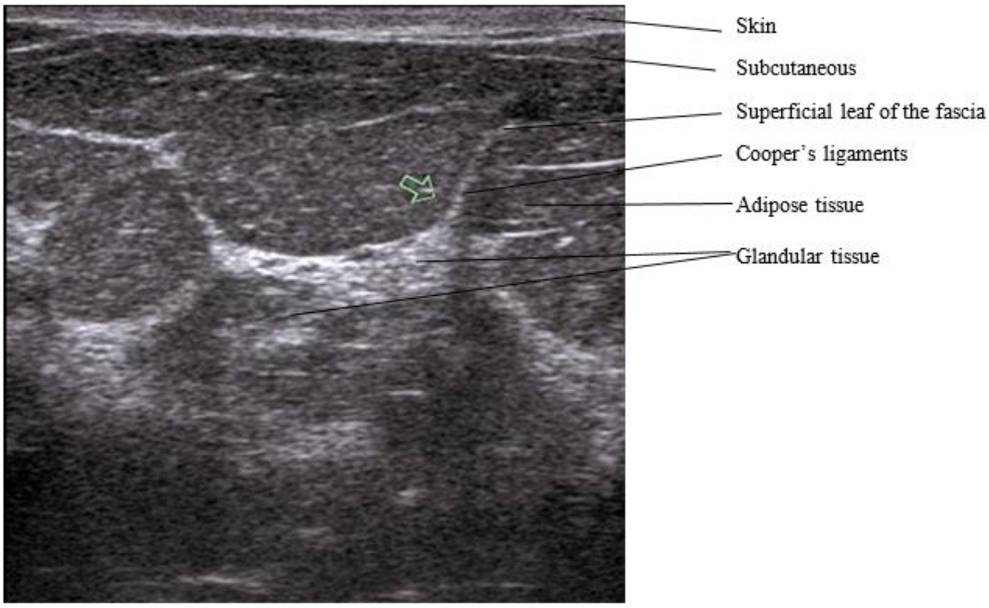

Figure (1.11): Cooper's ligaments (arrow) of normal breast in grayscale US (Sencha et al., 2013).

The image produced by an ultrasound scan is determined by the probe frequency, phase of menstrual cycle and age of the patient. The use of a probe with linear of 5.0-7.5MHz to scan the breast in the first phase of a menstrual cycle identifies terminal and inter-lobar ducts which are smaller than 2mm or is even unable to distinguish them. The class of ducts which are located in the sub-areolar area could be up to 3–5 mm. On the other hand, it is always possible to detect inter-lobar ducts which are as small as 1 mm during the first phase of a menstrual cycle using probes with the frequency of 10–12 MHz due to the high frequency. In the second phase of menstrual cycle which comes before the menstruation itself, the ducts usually become larger than 2 mm (Figure 1.12) and are imaged as hypoechoic tubular structures aimed at the region of the sub-areolar. The echogenicity of ducts reduces to anechoic therefore providing the opening for the differentiation of inter-lobar and main lactiferous ducts. It is easier to get a clear image of the ducts during pregnancy and lactation because their diameter usually exceeds 2 mm and up to 3.5-4 mm during lactation.

The visible difference between ultrasound images of the ducts taken in the first and second phase of the menstrual cycle become lesser due to variation in age, hormonal replacement therapy and the endocrine status of a woman.

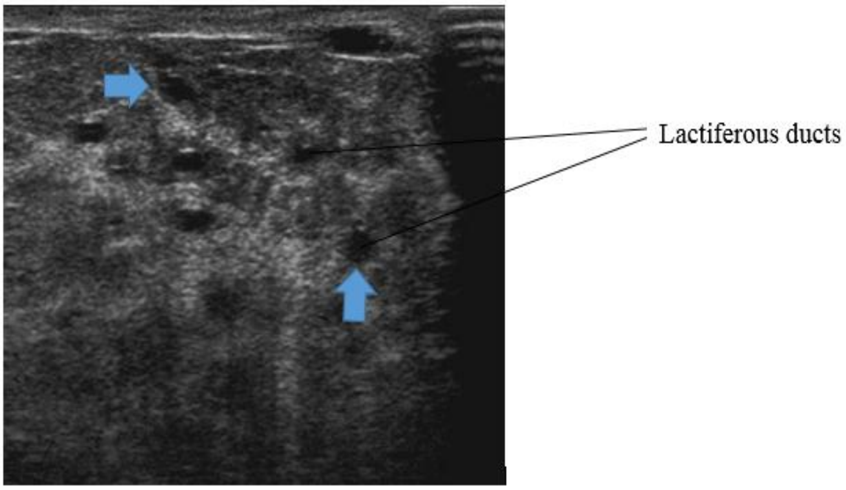

Figure (1.12): Lactiferous ducts of the normal breast (arrows) in grayscale US. (Sencha et al., 2013).

The retro-mammary space which is often imaged as a thin uniform echogenic linear structure, is usually barricaded by the back leaf of the fascia (Figure 1.13).

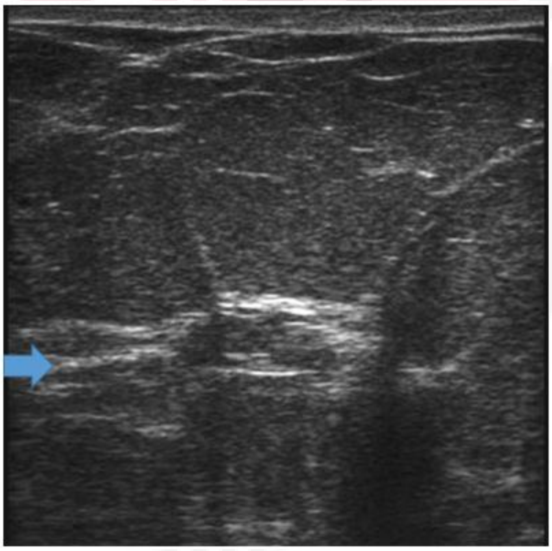

Figure 1.13: The back leaf of the fascia (arrow) of normal breast in grayscale US (Sencha et al., 2013).

Isolated hypoechoic structures with septa define the major and minor pectoralis. There is often a variation in the echogenicity and uniformity of the ribs due to the amount of osteal and cartilagenous component which determines the echo-texture of the ribs. The nipple is basically defined as a round-like structure of average or decreased echogenicity with relatively homogeneous structure and accurate even contours (Figure 1.14). Sometimes posterior acoustic shadow resulting from connective tissue structures accompanies the nipple (Sencha et al., 2013 and Stavros, 2004).

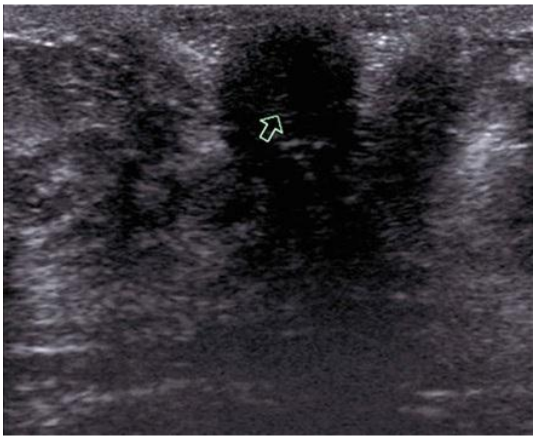

Figure 1.14: Nipple (arrow) of normal breast in grayscale US (Sencha et al., 2013).

1.6 Problem Statement

The role of ultrasound in breast imaging cannot be under estimated as long as there is a continuous need for breast scanning in order to detect abnormalities (Simmons, 2004). To this end, a number of studies have been conducted to detect the abnormalities which lies in breast tissues without any found to have been conducted regarding the ultrasound scanning of breast tissue normality which is also very vital in breast diagnosis. This study was conducted to bridge this gap so as to expel the argument between normality and abnormalities which over the years have become a great blunder in the diagnosis of breast. In order to establish a referencing data base for the average size of and factors which influence the development of these tissues, Malaysia was selected as the sampling medium due to its ethnic diversity; samples were collected based on the three major ethnic groups and ages of the females. In any diagnostic and prognostic activity, an ultrasound of the normal breast morphology, a specialized radiologist alongside an experienced sonography is the major factors to be considered for a successful scan of the breast.

1.7 Significant of the Study

This study investigated the extent of the problem and factors associated with breast morphology. No standard record for normal breast morphology among women of different ages and ethnic groups in Malaysia exist and to this end this research was conducted to provide a standard ultrasound breast morphology which can aid any examiner understand the breast morphologies of Malaysia women according to ethnic and age distribution. However, the conducted was mainly concerned with evaluation of mammography which was capital intensive and involving radiation (Robertson, 2011). The main reason for conducting this study was to obtain knowledge and information on breast morphology within the Malaysian population involving different age and ethnic groups. This study also serves as a contribution to the body of academic and professional knowledge.

1.8 Objectives

1.8.1 General Objective

To classify the ultrasound breast morphology of Malaysian females located in Klang Valley district according to their age and ethnic distribution.

1.8.2 Specific objectives:

1. To describe the breast morphology of Malaysian women in the three major ethnic groups in pre-menopause and post-menopause period (univariate).
2. To determine the association of breast parenchyma pattern, socio-demographic characteristic, physical activity and taking of dietary supplements with age and ethnic groups (multivariate).
3. To compare the mean score of breast morphology between right breast and left breast (bivariate).
4. To compare the mean score of breast morphology among ethnic groups (multivariate).

1.9 Research Hypothesis

1. There is a significant association between age groups and breast morphology.
2. There is a significant association between ethnic groups and breast morphology.
3. There is a mean difference of breast morphology between premenopausal and postmenopausal.
   - I. There is a mean difference of subcutaneous fat between premenopausal and postmenopausal.
   - II. There is a mean difference of glandular tissue between premenopausal and postmenopausal.
   - III. There is a mean difference of fat lobules between premenopausal and postmenopausal.
   - IV. There is a mean difference of cooper`s ligament between premenopausal and postmenopausal.
   - V. There is a mean difference of pectoral fascia between premenopausal and postmenopausal.
   - VI. There is a mean difference of pectoral muscle between premenopausal and postmenopausal.
4. There is an association between physical activity and breast morphology.
5. There is an association between supplements and breast morphology.
6. There is a significant mean difference of breast morphology between ethnic groups.

1.10 Conceptual Framework

Figure 1.18 shows the factors associated with breast morphology and the important variables which were examined in this study. Socio-demographic characteristics such as age, ethnicity, religion, socioeconomic status, educational status, marital status hormones, menstrual cycle and menopause status of an individual have been shown to influence the breast morphology. The educational level could eventually have an influence on the knowledge of breast development among females

One major determinant of energy output is physical activity which is important in balancing the energy and controlling weight and BMI. Thus, low physical activity and poor dietary habits can result into obesity which will in turn affect the breast tissue. However the dietary pattern and genetic factor were not considered in this study. On the other hand, supplements which include vitamins, minerals and herbs have been shown to be related with breast morphology and can also affect menstrual status, menopausal status, weight, BMI and Cholesterol level.

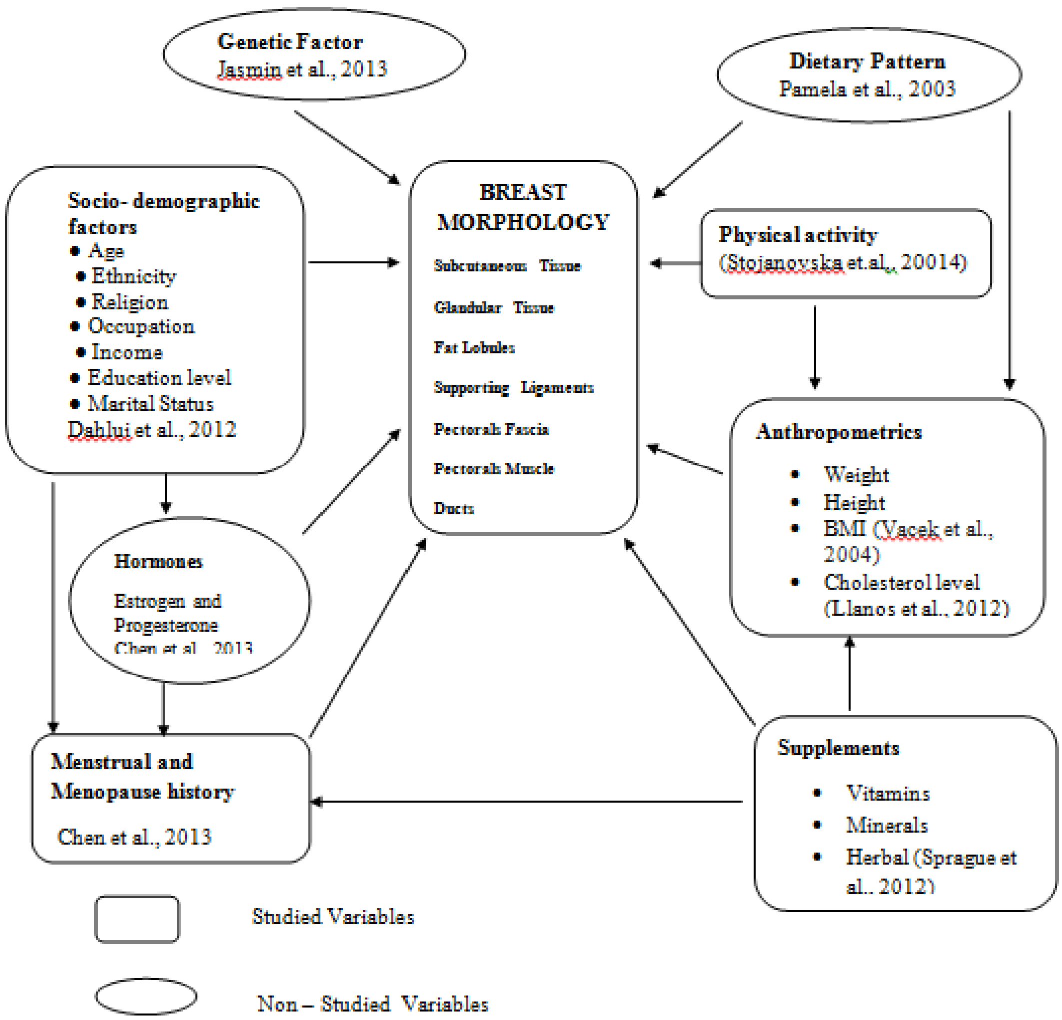

Figure 1.15: Conceptual framework of breast morphology.

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