Sudan University of Sciences and Technology

College of Graduate Studies

Morphometric Study of the Femur Neck in Adult Sudanese Population Using CT

دراسة قياس أشكال عنق عظمة الفخذ عند السكان السودانيين البالغين باستخدام الأشعة المقطعية

Thesis submitted for partial fulfillment of M.Sc. degree in Diagnostic Medical Imaging

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الاية:

قال تعالى:

﴿وَلَقَدْ خَلَقْنَا الإِنسَانَ مِنْ سُلالَةٍ مِنْ طِين (12) ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي قَرَارٍ مَكِينٍ (13) ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظَامًا فَكَسَوْنَا الْعِظَامَ لَحْمًا ثُمَّ أَنشَأْنَاهُ خَلْقًا آخَرَ فَتَبَارَكَ اللَّهُ أَحْسَنُ الْخَالِقِينَ(14)﴾

(المؤمنون(12-14))

DEDICATION

Allah there are no good nights without thanking you and there are no good days without obeying you... And there are no good moments without mentioning you... And there is no perfumed hereafter without your forgiveness... There is no paradise without seeing you.

To the one who hit the message and led the nation to the light... He advised the nation... To the prophet of mercy and the light of the world Mohamed peace be upon him

To the one whom Allah prestige and dignity him ... To teach me tender without waiting... To carry his name proudly... I ask Allah to reach at your age to see the fruit picking has come after a long waiting and your star will remain guided by today and tomorrow and forever... Dear Dad

To my angel in life... To the meaning of love and the meaning of compassion and dedication... Smile of my life and the mystery of existence... your prayers was the secret of my success and the cure of my injuries… to my favorite person in the world.. Beloved mother

To my life partner and my supporter through this project my husband and lover.

To whom pleasant by sisterhood and specialized by their loyalty and giving. And deep inside them there is nothing but honesty, and they were with me in the paths of my better and sweet days of my life to those who were with me on the road of success and goodness… to those who I knew how to find them and they taught me not to lose them … My friends.

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Great thanks to Allah for allowing me to succeed in the completion of this research. Also extend the thanks to our teacher and supervisor Dr. Hussein Ahmed Hassan Ahmed Dean of the Faculty of Radiology Karary University And special thanks to Mohamed Alshafie for helping me and guiding me to the right path in this research . And I ask Allah that rewarded us all good. To those who taught us letters of gold, and the words of pearls and phrases from the highest and phrases evacuated in science to their knowledge and thoughts beacon letters which illuminated us to succeed in science and biography to our professors and customers.

Abstract

The morphology of proximal femur is an essential parameter in the design and development of implant for total hip replacement (THR). Inappropriate implant design and size could affect outcome of the surgery with reported complications such as stress shielding, micro motion and loosening. The problem of study was that hip joint are most frequently affected by severe injury that make it to be replaced by artificial one ;so its most important to To establish standard measurements of the proximal femur neck in adult Sudanese population.the study found ;

Regarding sex-related differences, and according to our finding there is significant statistical difference between genders where the (CH) was found to be larger in males than females, and also (CN) was found to be larger males than females and the same results was found according to (LN), while according to the (FNA)is also was found to be larger males than females and also(LN) was found to be larger males than females , and also (FNA) was found to be larger males than females. And regarding the differences between right and left proximal femur neck there is no significant different according to the result showed by the statistical analysis.the study concluded that

In our study 100 subjects, 200 femurs were included in the morphemtry of the proximal femur neck, were 4 parameters were measured and the result was that there was no significant difference between right and left femoral and there were significant difference between male and female subjects where most parameters were larger in males than females.

الخلاصة

مورفلوجيا عظم الفخذ القريبة هي عامل اساسي في تصميم وتطوير زرع لاستبدال الورك الكلي (THR) قد يؤثر تصميم وحجم الزرع غير المناسبين على نتائج العملية الجراحية مع المضاعفات المبلغ عنها مثل التزريع ضد الاجهاد و الحركة الدقيقة والتفكك .تكمن مشكلة الدراسة غالبا ما يتاثر مفصل الورك بالاصابة الشديدة التي تجعل استبداله بمفصل اصطناعي لذلك من الاهمية انشاء قياس اشكال عنق عظمة الفخذ عند السكان السودانيين .وجدت الدراسة ان

فيما يتعلق بالاختلافات المرتبطة بالجنس ' ووفقا للنتائج التي توصلنا اليها ' يوجد فرق احصائي كبير بين الجنسين حيث تم العثور على محيط راس عظم الفخذ في الذكور اكبر من الاناث وكذلك محيط عنق عظم الفخذ وجد ان الذكور اكبر من الاناث ونفس النتائج تم العثور عليها وفقا لطول عنق عظم الفخذ بينما وفقا لزاوية عنق الفخذ وجد ان الاناث اكبر من الذكور .

وفيما يتعلق بالاختلافات بين عنق عظم الفخذ الايمن والايسر لا يوجد اختلاف كبير حسب النتيجة التي اظهرها التحليل الاحصائي .خلصت الدراسة الي ان

في دراستنا ل100 موضوع , تم تضمين 200 عظم الفخذ , تم قياس ل4 عوامل وكانت النتيجة انه لم يكن هناك فرق كبير بين الفخذ الايمن والايسر, حيث كانت معظم العوامل اكبر في الذكور من الاناث .

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LIST OF ABBREVIATIONS

THR	Total Hip Replacement
CT	Computed Tomography
CH	Circumference of the Head of the femur
3D	Three Dimension
2D	Two Dimension
CN	Circumference of the Neck of the femur
LN	Length of the Neck of the femur
FNA	Femoral Neck Angle
SPSS	Statistical Package for Social Sciences

CHAPTER ONE

Introduction

CHAPTER ONE

1. Introduction:

The morphology of proximal femur is an essential parameter in the design and development of implant for total hip replacement (THR). Inappropriate implant design and size could affect outcome of the surgery with reported complications such as stress shielding, micro motion and loosening. Most of these implants were designed and manufactured from the European and North American region which presumably based on the morphology of their respective population. The use of such implants in other regions such as Sudan may not be appropriate as the design may not take into consideration the morphology of the local population. As far as the authors are aware, no study has been documented regarding the morphology of proximal femur for the Sudanese population which can be largely found in the South East Asian countries such as Malaysia, Brunei, Singapore, Indonesia, Thailand and the Philippines.(Abdul-Kadir 2008)

The use of implants designed based on other populations posed at least two potential major issues. First and foremost is the difference of the anthropometry of the proximal femur between ethnics due to differences in lifestyle, physique, applied force and their distribution. This can be seen from numerous data presented in various studies for the western and eastern population Another issue is implant-morphology mismatch that might cause difficulties during implant placement and could lead to accelerated deterioration of the implant life thus affecting short-term and long-term outcome of the surgery.(Caetano 2007)

Due to the importance of anthropometry for the success of hip joint replacement, this study analyses the morphology of the proximal femur for the Sudanese population. The data that will be provided in this study could be used in the design and development of implants suited for local population as well as assisting in decision making during clinical practices.(Caetano 2007)

1.2 Objectives:

1.2.1 General:

To establish standard measurements of the proximal femur neck in adult Sudanese population using Computed Tomography (CT).

1.2.2 Specific:

- To show if there is significant difference in the measurement between the right and the left femur neck.

- To show if there is significant difference in the measurement of the femur neck b etween male and female subjects.

1.3 Justification:

Hip joint are most frequently affected by severe injury that make it to be replaced by artificial one ; so its most important to establish standard morphometry of proxi mal femur neck in Sudanese population.

1.4 Possible outcomes:

The possible outcomes of this research are established measurement of proximal fe mur neck of adult Sudanese population.

CHAPTER TWO

Literature review

CHAPTER TWO

2.1 Anatomy:

The femur is the only bone in the thigh. The two femurs converge medially toward the knees, where they articulate with the proximal ends of the tibiae. The angle of convergence of the femora is a major factor in determining the femoral-tibial angle. In females the femora converge more than in males because the pelvic bone is wider in females. In the condition *genu valgum* (knock knee) the femurs converge so much that the knees touch one another. The opposite extreme is *genu varum* (bow-leggedness). In the general population of people without either *genu valgum* or *genu varum*, the femoral-tibial angle is about 175 degrees (Bojsen-Moller).

The femur is the longest and, by most measures, the strongest bone in the human body. Its length on average is 26.74% of a person's height,[4] a ratio found in both men and women and most ethnic groups with only restricted variation, and is useful in anthropology because it offers a basis for a reasonable estimate of a subject's height from an incomplete skeleton.

The femur is categorized as a long bone and comprises a diaphysis, the shaft (or body) and two epiphysis or extremities that articulate with adjacent bones in the hip and knee (Bojsen-Moller 2001).

Fig (2.1): showed the position of the femur in the human body

2.1.1 The proximal part of the femur:

The head of the femur, which articulates with the acetabulum of the pelvic bone, composes two-thirds of a sphere. It has a small groove, or fovea, connected through the round ligament to the sides of the acetabular notch. The head of the femur is connected to the shaft through the neck or *collum*. The neck is 4–5 cm. long and the diameter is smallest front to back and compressed at its middle. The collum forms an angle with the shaft in about 130 degrees. This angle is highly variant. In the infant it is about 150 degrees and in old age reduced to 120 degrees on average. An abnormal increase in the angle is known as coxa valga and an abnormal reduction is called coxa vara. Both the head and neck of the femur is vastly embedded in the hip musculature and cannot be directly palpated. In skinny people with the thigh laterally rotated, the head of the femur can be felt deep as a resistance profound (deep) for the femoral artery. (Bojsen-Moller 2001)

The transition area between the head and neck is quite rough due to attachment of muscles and the hip joint capsule. Here the two trochanters, greater and lesser trochanter, are found. The greater trochanter is almost box-shaped and is the most

lateral prominent of the femur. The highest point of the greater trochanter is located higher than the collum and reaches the midpoint of the hip joint. The greater trochanter can easily be felt. The trochanteric fossa is a deep depression bounded posteriorly by the intertrochanteric crest on medial surface of the greater trochanter. The lesser trochanter is a cone-shaped extension of the lowest part of the femur neck. The two trochanters are joined by the intertrochanteric crest on the back side and by the intertrochanteric line on the front. (Bojsen –Moller 2001)

A slight ridge is sometimes seen commencing about the middle of the intertrochanteric crest, and reaching vertically downward for about 5 cm. along the back part of the body: it is called the linea quadrata (or quadrate line).

About the junction of the upper one-third and lower two-thirds on the intertrochanteric crest is the quadrate tubercle located. The size of the tubercle varies and it is not always located on the intertrochanteric crest and that also adjacent areas can be part of the quadrate tubercel, such as the posterior surface of the greater trochanter or the neck of the femur. In a small anatomical study it was shown that the epiphysial line passes directly through the quadrate tubercle.(Lozanoff 1985)

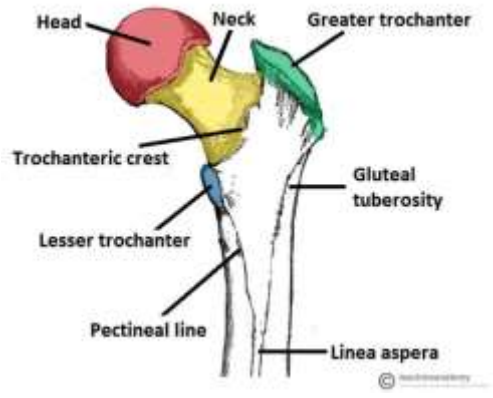


Fig (2.2): proximal part of the femur neck .

2.1.2 Body:

The body of the femur (or shaft) is long, slender and almost cylindrical in form. It is a little broader above than in the center, broadest and somewhat flattened from before backward below. It is slightly arched, so as to be convex in front, and concave behind, where it is strengthened by a prominent longitudinal ridge, the linea aspera which diverges proximal and distal as the medial and lateral ridge. Proximal the lateral ridge of the linea aspera becomes the gluteal tuberosity while the medial ridge continues as the pectineal line. Besides the linea aspera the shaft has two other bordes; a lateral and medial border. These three bordes separates the shaft into three surfaces: One anterior, one medial and one lateral. Due to the vast musculature of the thigh the shaft cannot be palpated (Bojsen-M0ller 2001)

The third trochanter is a bony projection occasionally present on the proximal femur near the superior border of the gluteal tuberosity. When present, it is oblong, rounded, or conical in shape and sometimes continuous with the gluteal ridge (6). A structure of minor importance in humans, the incidence of the third trochanter varies from 17–72% between ethnic groups and it is frequently reported as more common in females than in males.(Gilbert 2010)

Distal part of the femur:

Is larger than the proximal part of the femur. It is somewhat cuboid in form, but its transverse diameter is greater than its antero-posterior (front to back). It consists of two oblong eminences known as the condoles . (Bojsen - Moller 2001)

Anteriorly, the condyles are slightly prominent and are separated by a smooth shallow articular depression called the patellar surface. Posteriorly, they project considerably and a deep notch, the Intercondylar fossa of femur, is present between

them. The lateral condyle is the more prominent and is the broader both in its antero-posterior and transverse diameters. The medial condyle is the longer and, when the femur is held with its body perpendicular, projects to a lower level. When, however, the femur is in its natural oblique position the lower surfaces of the two condyles lie practically in the same horizontal plane. The condyles are not quite parallel with one another; the long axis of the lateral is almost directly antero-posterior, but that of the medial runs backward and medialward. Their opposed surfaces are small, rough, and concave, and form the walls of the intercondyloid fossa. This fossa is limited above by a ridge, the intercondyloid line, and below by the central part of the posterior margin of the patellar surface. The posterior cruciate ligament of the knee joint is attached to the lower and front part of the medial wall of the fossa and the anterior cruciate ligament to an impression on the upper and back part of its lateral wall.(Bojsen-Moller2001)

The articular surface of the lower end of the femur occupies the anterior, inferior, and posterior surfaces of the condyles. Its front part is named the patellar surface and articulates with the patella; it presents a median groove which extends downward to the intercondyloid fossa and two convexities, the lateral of which is broader, more prominent, and extends farther upward than the medial.(Bojsen-Moller 2001)

Each condyle is surmounted by an elevation, the epicondyle. The medial epicondyle is a large convex eminence to which the tibial collateral ligament of the knee-joint is attached. At its upper part is the adductor tubercle and behind it is a rough impression which gives origin to the medial head of the gastrocnemius. The lateral epicondyle which is smaller and less prominent than the medial, gives attachment to the fibular collateral ligament of the knee-joint. (Struthers 1881)

2.2 Development:

The femur develops from the limb buds as a result of interactions between the ectoderm and the underlying mesoderm, formation occurs roughly around the fourth week of development. (Bojsen-Moller 2001)

By the sixth week of development, the first hyaline cartilage model of the femur is formed by chondrocytes. Endochondral ossification, begins by the end of the embryonic period and primary ossification centers are present in all long bones of the limbs, including the femur, by the 12th week of development. The hindlimb development lags behind forelimb development by 1–2 days. (Bojsen-Moller 2001)

2.3 Function:

The femur is the only bone in the thigh, it serves as an attachment point for all the muscles that exert their force over the hip and knee joints. Some biarticular muscles – which cross two joints, like the gastrocnemius and plantaris muscles – also originate from the femur. In all, 22 individual muscles either originate from or insert onto the femur.(Caetano 2007)

In cross-section, the thigh is divided up into three separate fascial compartments divided by fascia, each containing muscles. These compartments use the femur as an axis, and are separated by tough connective tissue membranes (or septa). Each of these compartments has its own blood and nerve supply, and contains a different group of muscles. These compartments are named the anterior, medial and posterior fascial compartments. (Caetano 2007)

2.4 Previous Studies:

- The study was done in 2011 in Malay population by faculty of Biomedical Engineering and health science at university of technology Malaysia, department of radiology, International Islamic university Malaysia, the study showed that there is no significant differences between left and right femoral for all parameters. However significant difference was found between male and female subjects. (Calis 2004), (Crooijmans HJA 2009).

- The was done in 2010 in Brazilian population by (UFF) university , department of Biomedical Engineering , the study showed no significant differences between right and left femoral while there were a significant differences between male and female subjects.(Calis 2004)

- The study was done in 2011 in Chilean population by School of Medicine. Universidad de Concepción, Chile. The study showed that no significant differences in the size of the circumference of the femoral head, the size and thickness of the femoral neck, and the angle of the femoral neck were found between right-side and left-side samples.(Imura 1999).

- The study was done in 2014 in Japan population by Department of Orthopedic Surgery, Nagasaki University Graduate School of Biomedical Sciences, and Nagasaki; the study showed that there are no significant differences between left and right femoral for all parameters. However significant difference was found between male and females subjects.(Calis 2004)

- The study was done in 2015 in Korean population by Department of anatomy , the Catholic university of Korea , the study showed that there is a significant difference between male and females in the measurements of Circumferences of the Head of the femur (CH). (H.M.Karakas 2008),(A.Harma)

CHAPTER THREE

MATERIAL&METHODS

CHAPTER THREE

3.1 Material:

3.1.1 Patients

100 patients male and females with age (18-95), measurement study area

3.1.2 CT SCANNER

Best care hospital (Siemens Go) ,32 Slice

3.2 Methods:

3.2.1 CT technique of pelvis:

Patient position:

Patient is scanned in supine position on the examination couch, usually lying flat on his/her back.

3.2.2 Method of Measurements:

All patients were scanned by following guide line CT examination acquired on:

- 32 CT slice machine.
- A 5mm section slices thickness was obtained from iliac crest to the pubic symphysis by 5mm slice thickness. 3D images were reconstructed from 2D images to obtain the measurements of the femur nec
- Four measurements were obtained from 3D images of the femur :
  1. Circumference of the head of the femur (CH).

2. Circumference of the neck of the femur (CN).
3. Length of the femur neck (LN).
4. Femoral neck angle (FNA).

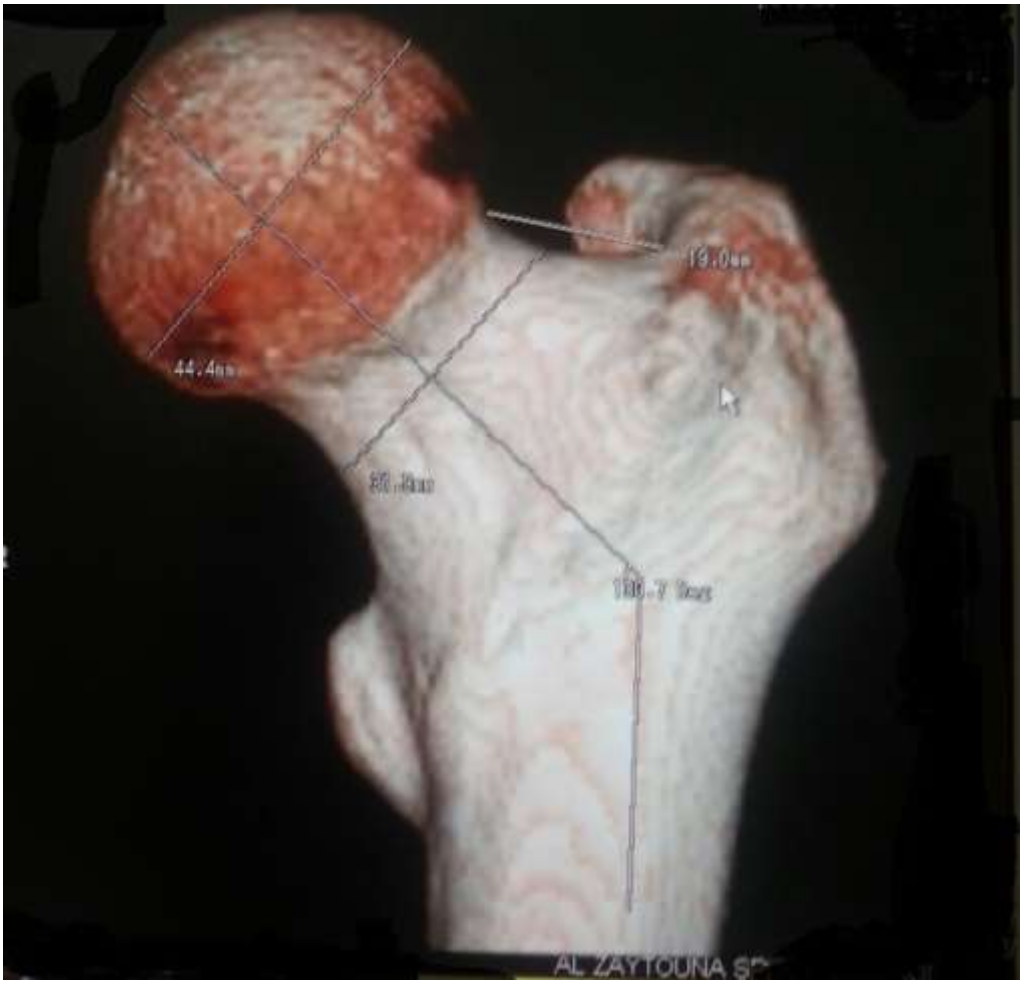


Fig (3.1): shows the measurements of the proximal femur neck

3.2.3 Data Analysis:

Statistical methods: Descriptive statistics were carried out for continuous variables using mean, median, standard devotion and inter –quartile range. Microsoft word and excel used to generate graphs, tables etc... For descriptive statistics and correlation study, statistical package for social sciences (SPSS) was used.

3.2.4 Ethical Consideration:

In order to protect and respect the rights of the participants who were imaged and their imaging scans used in the study the following steps was taken:

1. Approval to conduct the study was obtained from SUMASRI Institutional Review Board (SIRB) and ethical of UMST was approved.
2. Informed written consent was obtained to Best Care Hospital.
3. To ensure confidentiality and privacy of the study subjects, each imaging scan was de- identified and given a code on the check list . The code is only known by the researcher.

CHAPTER FOUR

RESULT

CHAPTER FOUR

RESULT

The data collection of this study was analyzed in descriptive statistics manner to measure the femur neck by measures the following parameters (CH, CN, LN ,FNA) the following results will explain in tables and graphs way in more details.

Table (4.1) shows general statistics :

		Age	CH RT	CH LT	NC RT	NC LT	LN RT	LN LT	FNA RT	FNA LT
N	Valid	100	100	100	100	100	100	100	100	100
	Missing	0	0	0	0	0	0	0	0	0
Mean		50.31	4.317100	4.299100	3.321400	3.2462	2.235600	2.191500	44.34	41.25
Std. Deviation		15.951	.3659340	.3915318	.3638126	.36741	.3892763	.4099159	5.555	5.564
Range		63	1.4800	1.7200	1.6200	1.70	1.6800	1.7100	30	34
Minimum		18	3.5900	3.3700	2.4500	2.58	1.4700	1.2200	23	18
Maximum		81	5.0700	5.0900	4.0700	4.28	3.1500	2.9300	53	52

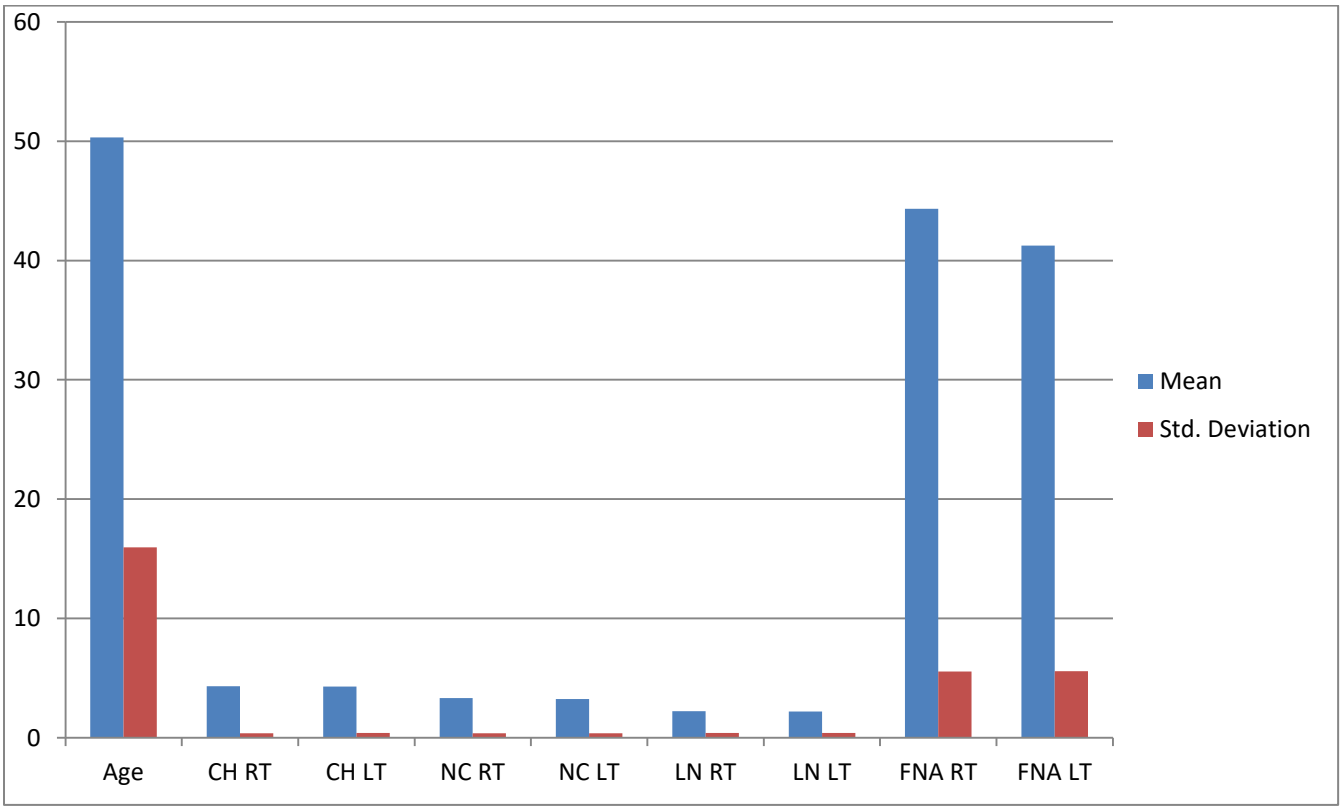


Figure (4.1)shows general statistics

Table (4.2) Gender distribution:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	50	50.0	50.0	50.0
	Male	50	50.0	50.0	100.0
	Total	100	100.0	100.0	

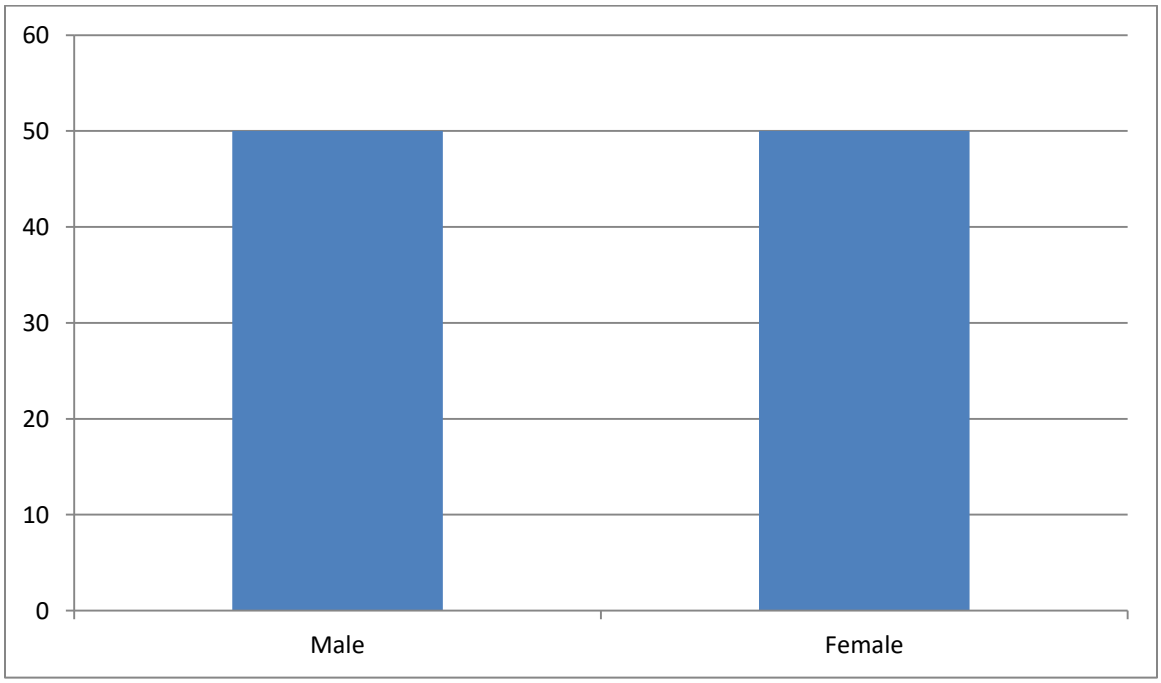


Figure (4.2) Gender distribution

Table (4.3) Age distribution:

Age Group	Frequency	Percentage
15-35	19	19%
35-55	43	43%
55-75	32	32%
75-95	6	6%
Total	100	100%

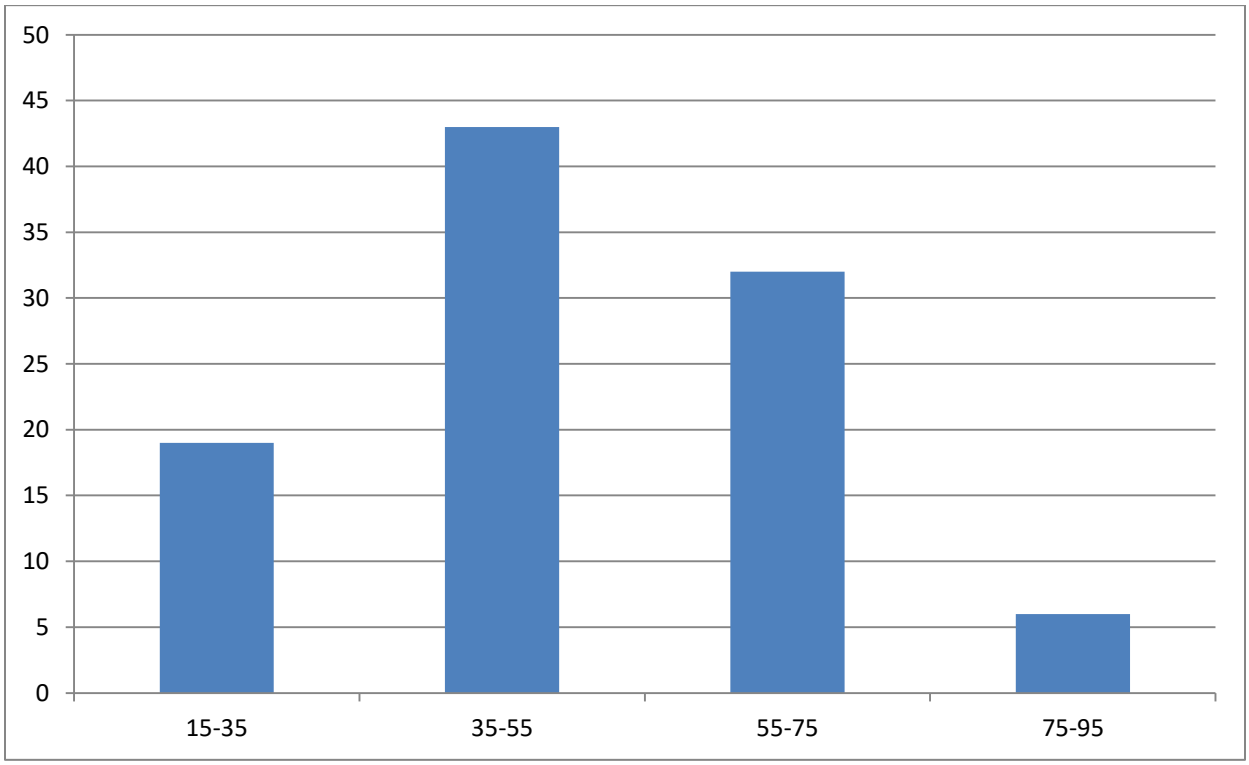


Figure (4.3) Age distribution

Table (4.4) General Male statistics :

		Age	CH RT	CH LT	NC RT	NC LT	LN RT	LN LT	FNA RT	FNA LT
N	Valid	50	50	50	50	50	50	50	50	50
	Missing	0	0	0	0	0	0	0	0	0
Mean		50.20	4.538800	4.537400	3.5326	3.4392	2.165600	2.138400	44.46	41.80
Std. Deviation		17.344	.3410107	.3471741	.29928	.35310	.3690758	.4445147	4.390	5.035
Range		61	1.2600	1.5500	1.29	1.54	1.5300	1.6200	20	21
Minimum		20	3.8100	3.5400	2.78	2.74	1.4700	1.3000	33	31
Maximum		81	5.0700	5.0900	4.07	4.28	3.0000	2.9200	53	52

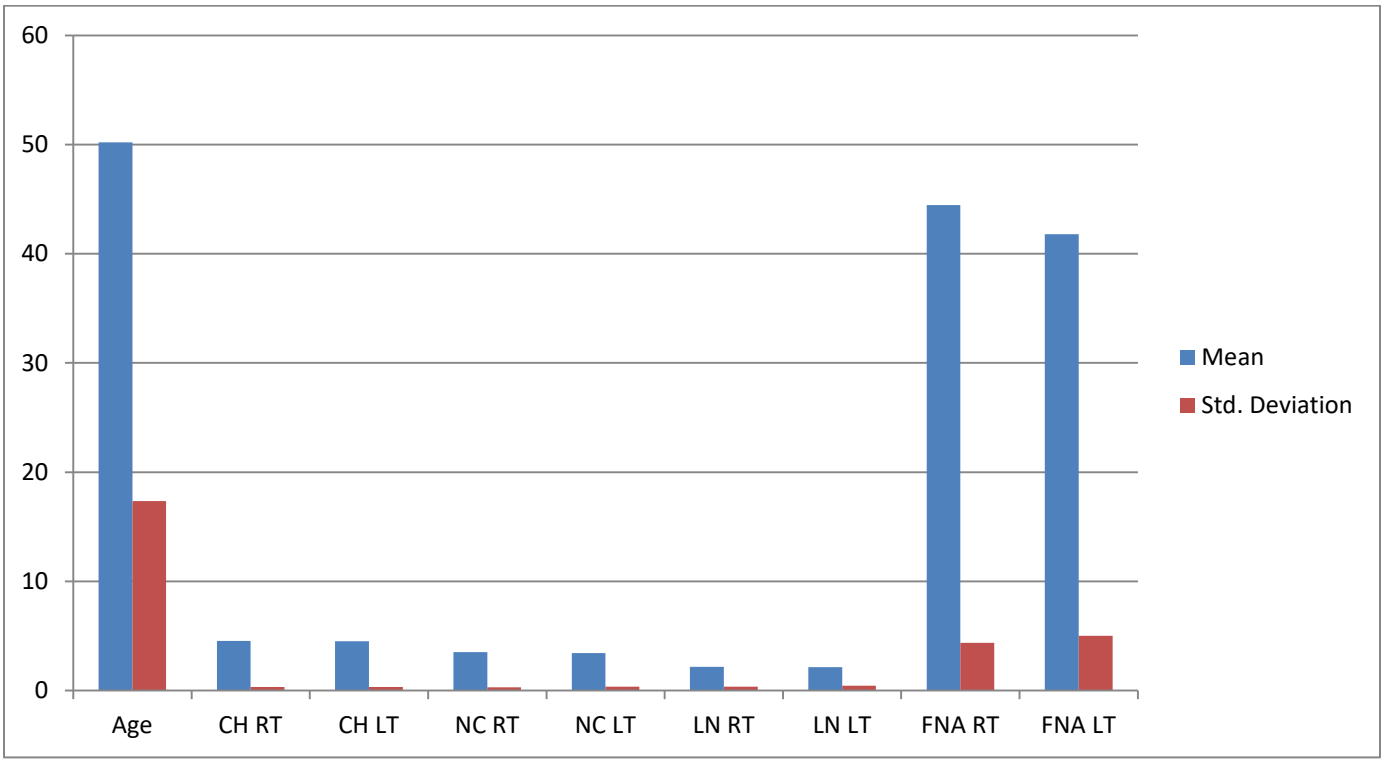


Figure (4.4) General Male statistics

Table (4.5) General Female statistics :

		Age	CH RT	CH LT	NC RT	NC LT	LN RT	LN LT	FNA RT	FNA LT
N	Valid	50	50	50	50	50	50	50	50	50
	Missing	0	0	0	0	0	0	0	0	0
Mean		50.42	4.095400	4.060800	3.111020	3.0532	2.305600	2.244600	44.22	40.70
Std. Deviation		14.602	.2322754	.2707423	.2946495	.26841	.3999345	.3689766	6.560	6.048
Range		62	1.1500	1.2000	1.3000	1.01	1.6100	1.7100	30	30
Minimum		18	3.5900	3.3700	2.4500	2.58	1.5400	1.2200	23	18
Maximum		80	4.7400	4.5700	3.7500	3.59	3.1500	2.9300	53	48

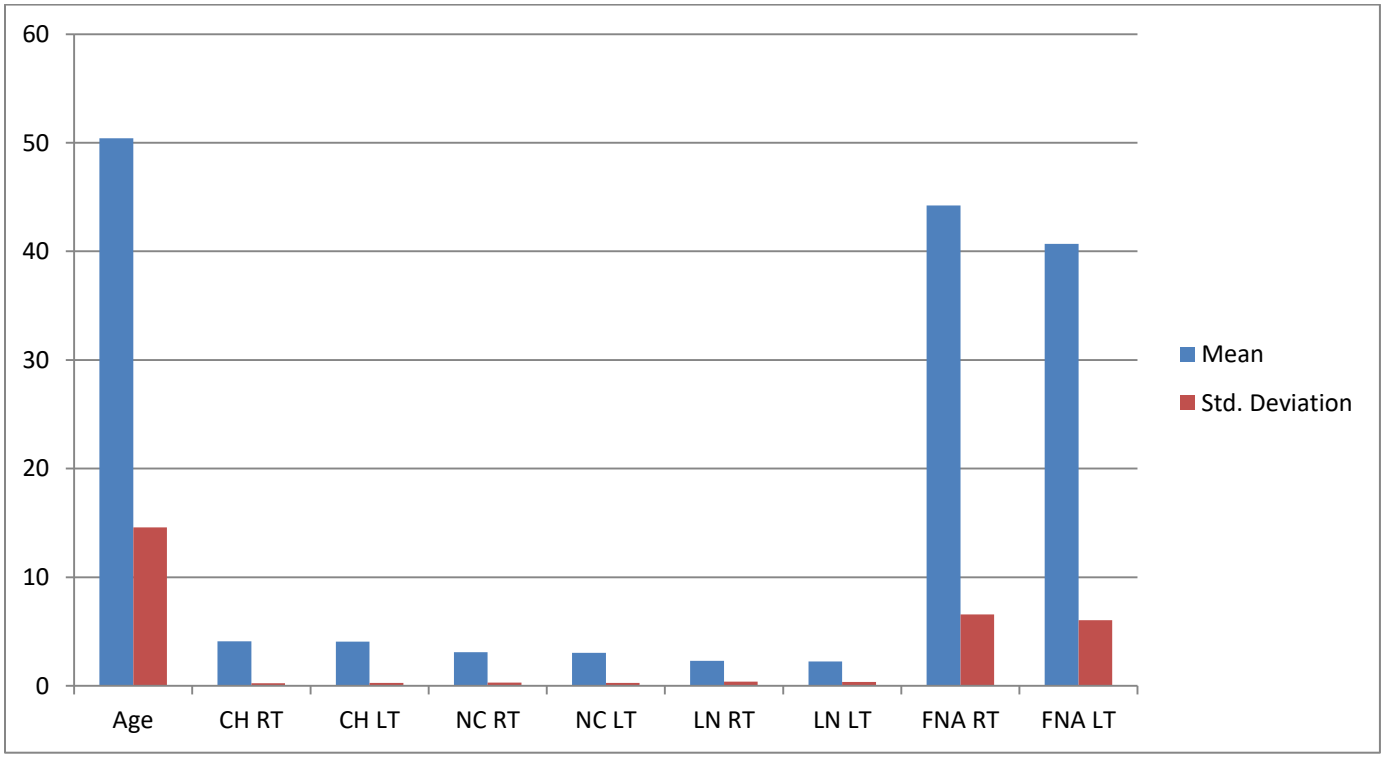


Figure (4.5) General Female statistics

Table (4.6) correlation between Age and CH RT :

		Age	CH RT
Age	Pearson Correlation	1	.326**
	Sig. (2-tailed)		.003
	N	100	100
CH RT	Pearson Correlation	.326**	1
	Sig. (2-tailed)	.003	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

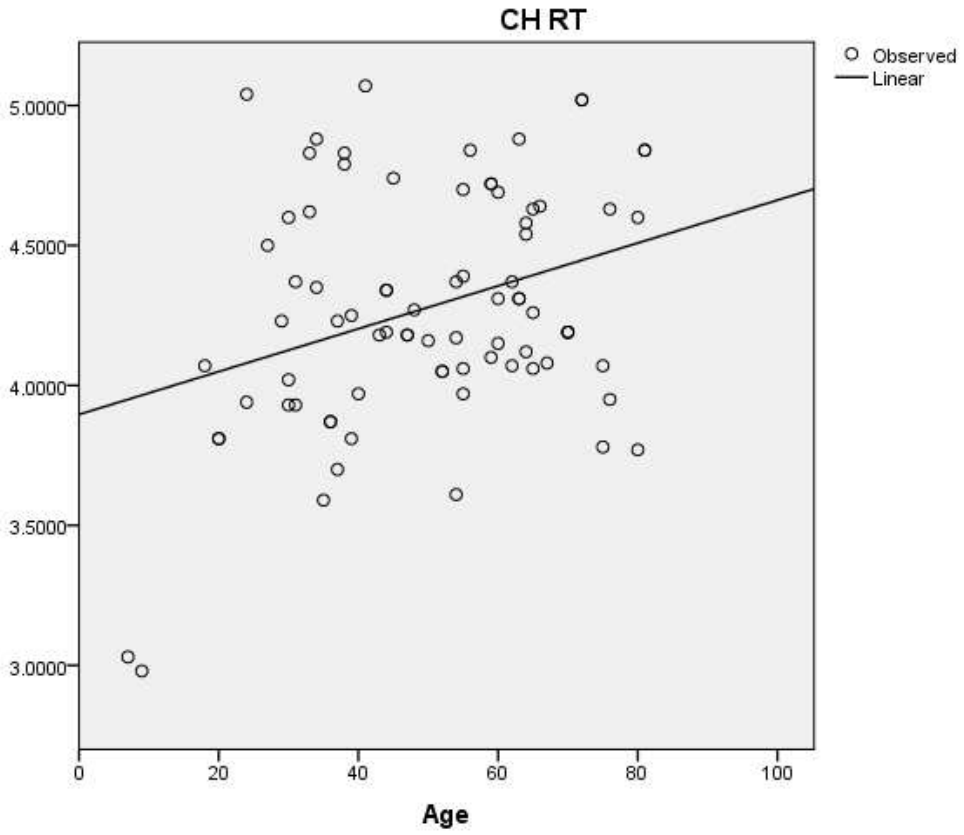


Figure (4.6) correlation between Age and CH RT

Table (4.7) correlation between Age and CH LT :

		Age	CH LT
Age	Pearson Correlation	1	.414**
	Sig. (2-tailed)		.000
	N	100	100
CH LT	Pearson Correlation	.414**	1
	Sig. (2-tailed)	.000	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

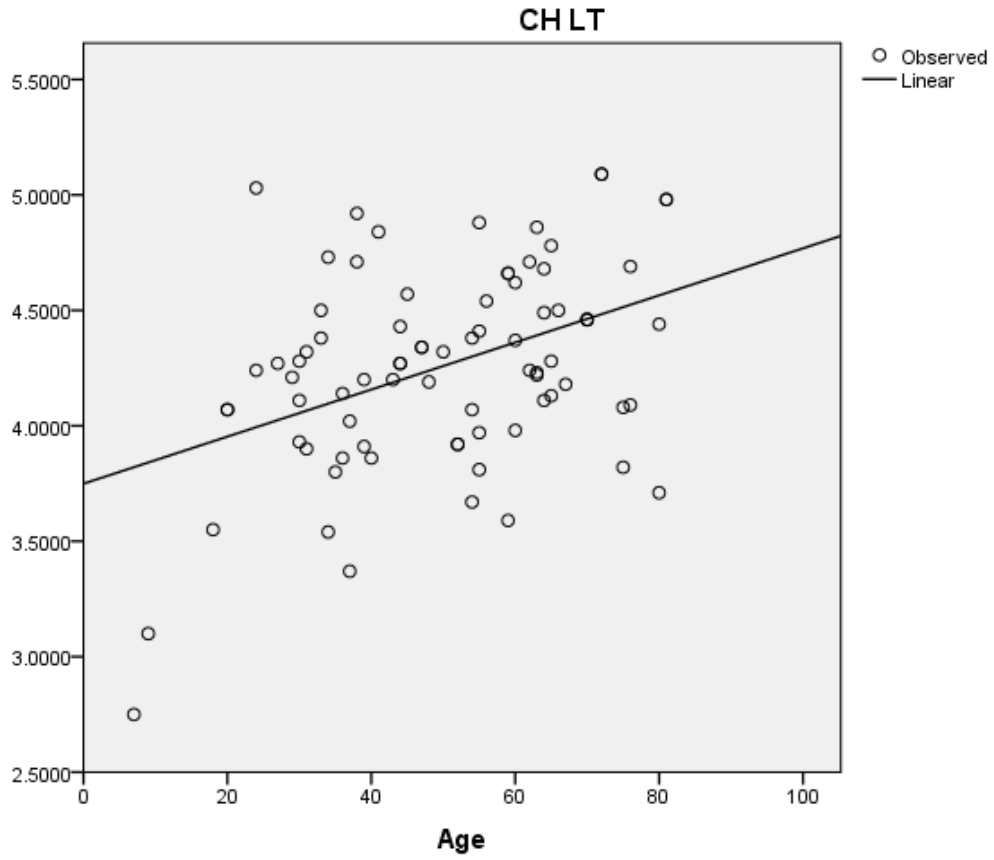


Figure (4.7) correlation between Age and CH LT

Table (4.8) correlation between Age and NC RT :

		Age	NC RT
Age	Pearson Correlation	1	.370**
	Sig. (2-tailed)		.001
	N	100	100
NC RT	Pearson Correlation	.370**	1
	Sig. (2-tailed)	.001	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

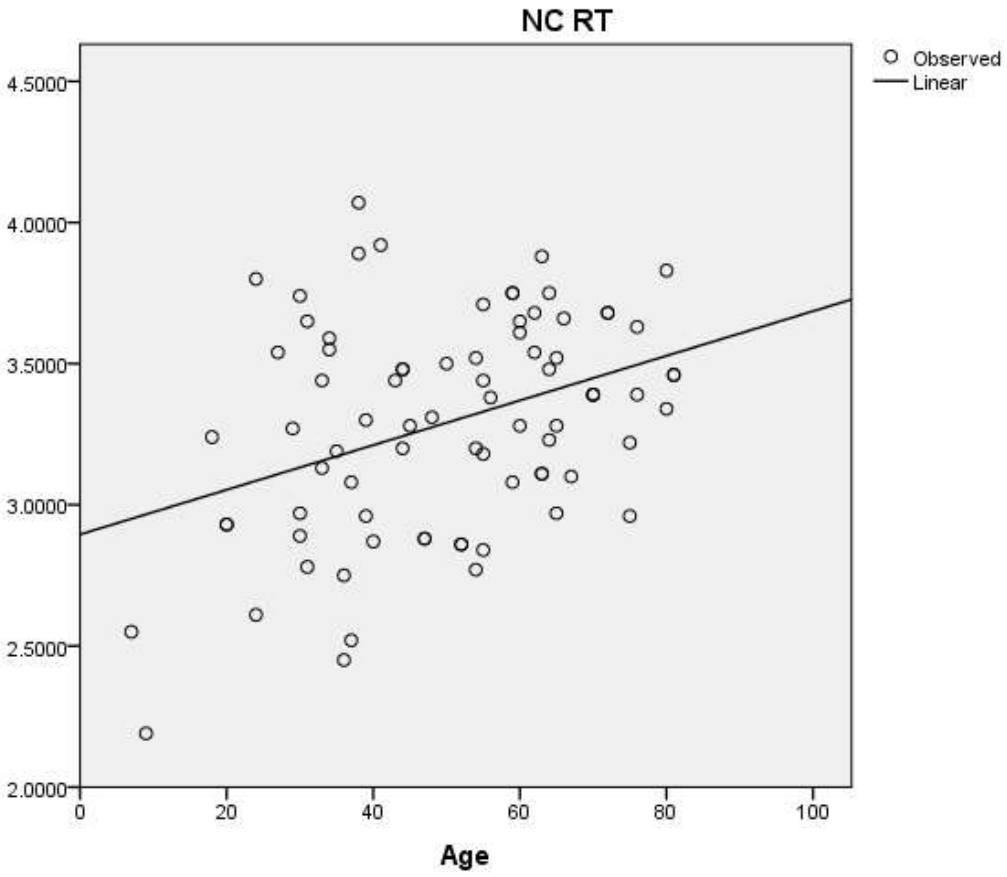


Figure (4.8) correlation between Age and NC RT

Table (4.9) correlation between Age and NC LT:

		Age	NC LT
Age	Pearson Correlation	1	.317**
	Sig. (2-tailed)		.004
	N	100	100
NC LT	Pearson Correlation	.317**	1
	Sig. (2-tailed)	.004	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

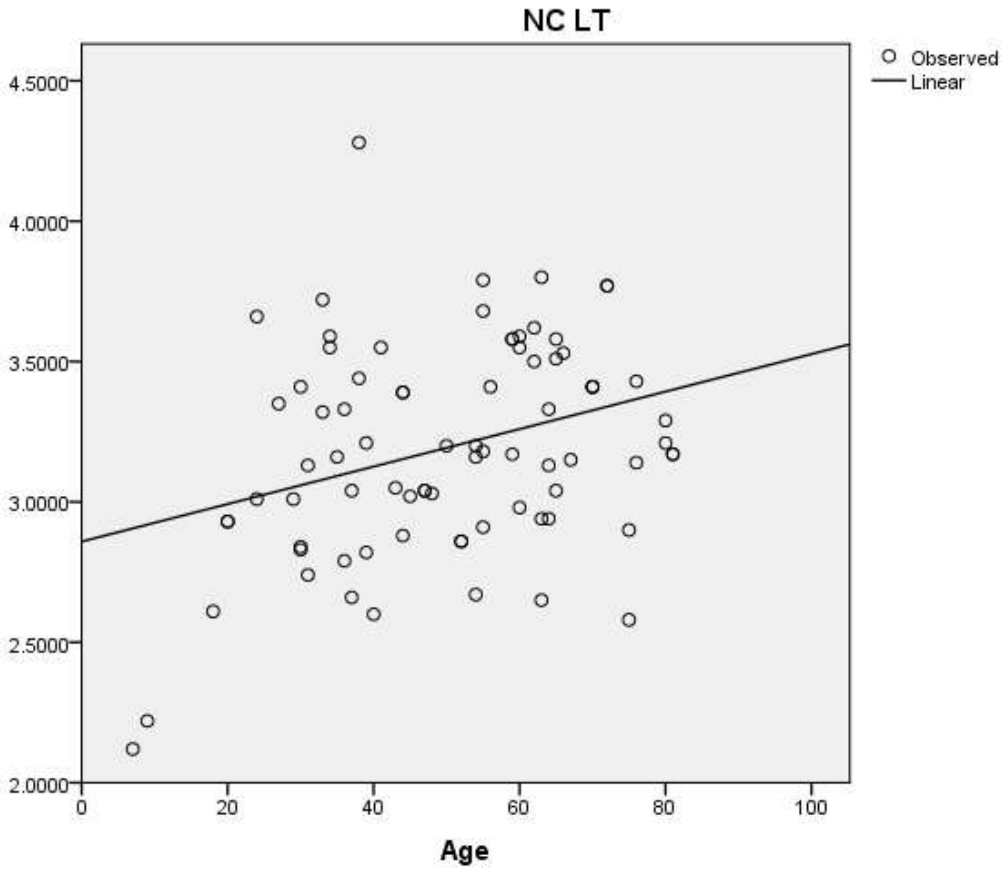


Figure (4.9) correlation between Age and NC LT

Table (4.10) correlation between Age and LN RT:

		Age	LN RT
Age	Pearson Correlation	1	-.185-
	Sig. (2-tailed)		.065
	N	100	100
LN RT	Pearson Correlation	-.185-	1
	Sig. (2-tailed)	.065	
	N	100	100

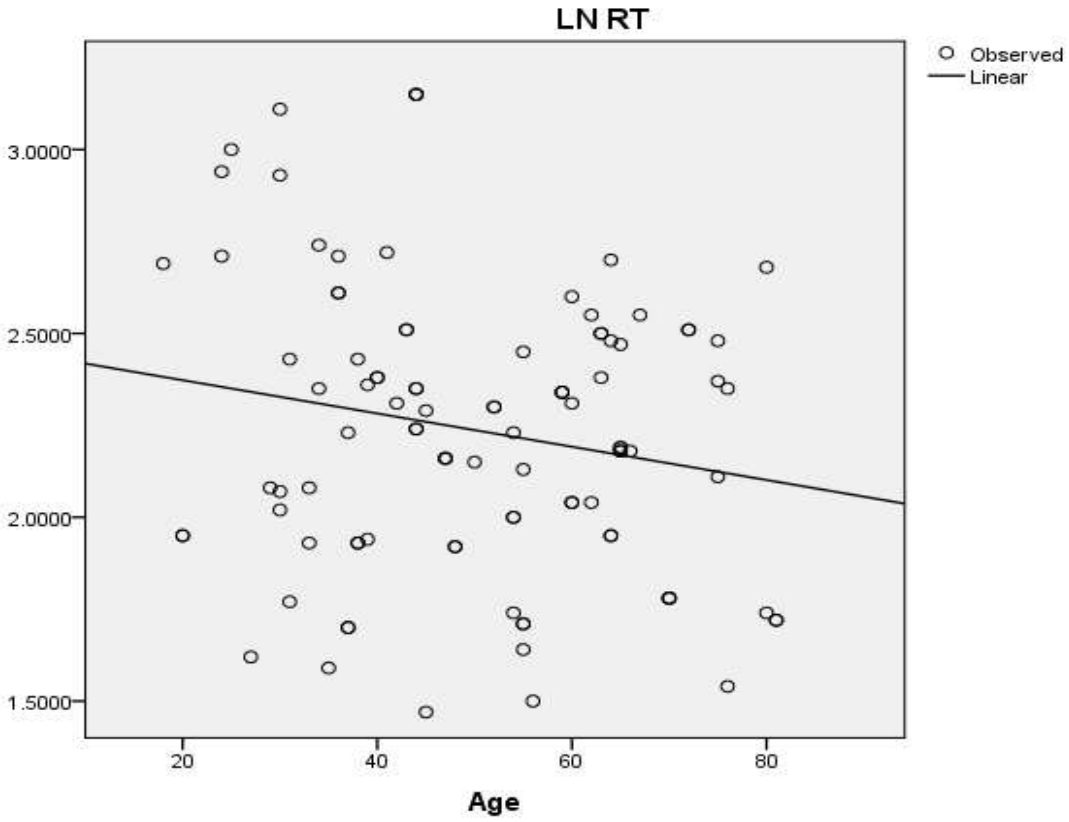


Figure (4.10) correlation between Age and LN RT

Table (4.11) correlation between Age and LN LT:

		Age	LN LT
Age	Pearson Correlation	1	-.090-
	Sig. (2-tailed)		.372
	N	100	100
LN LT	Pearson Correlation	-.090-	1
	Sig. (2-tailed)	.372	
	N	100	100

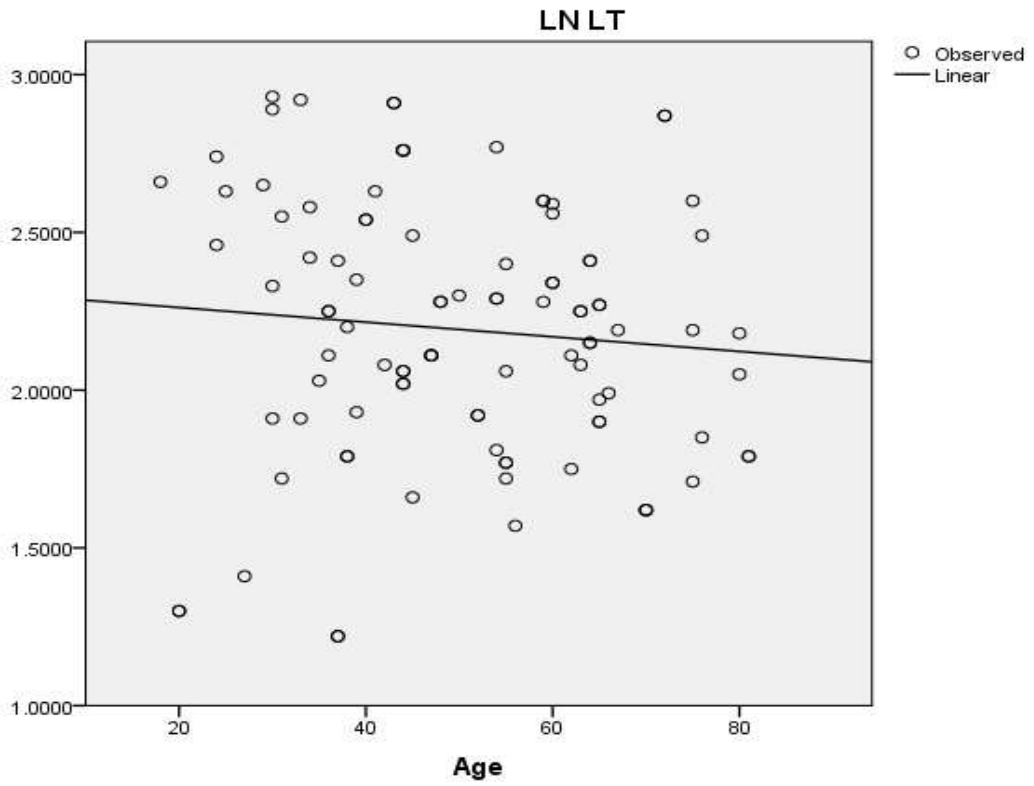


Figure (4.11) correlation between Age and LN LT

Table (4.12) correlation between Age and FNA RT:

		Age	FNA RT
Age	Pearson Correlation	1	.027
	Sig. (2-tailed)		.787
	N	100	100
FNA RT	Pearson Correlation	.027	1
	Sig. (2-tailed)	.787	
	N	100	100

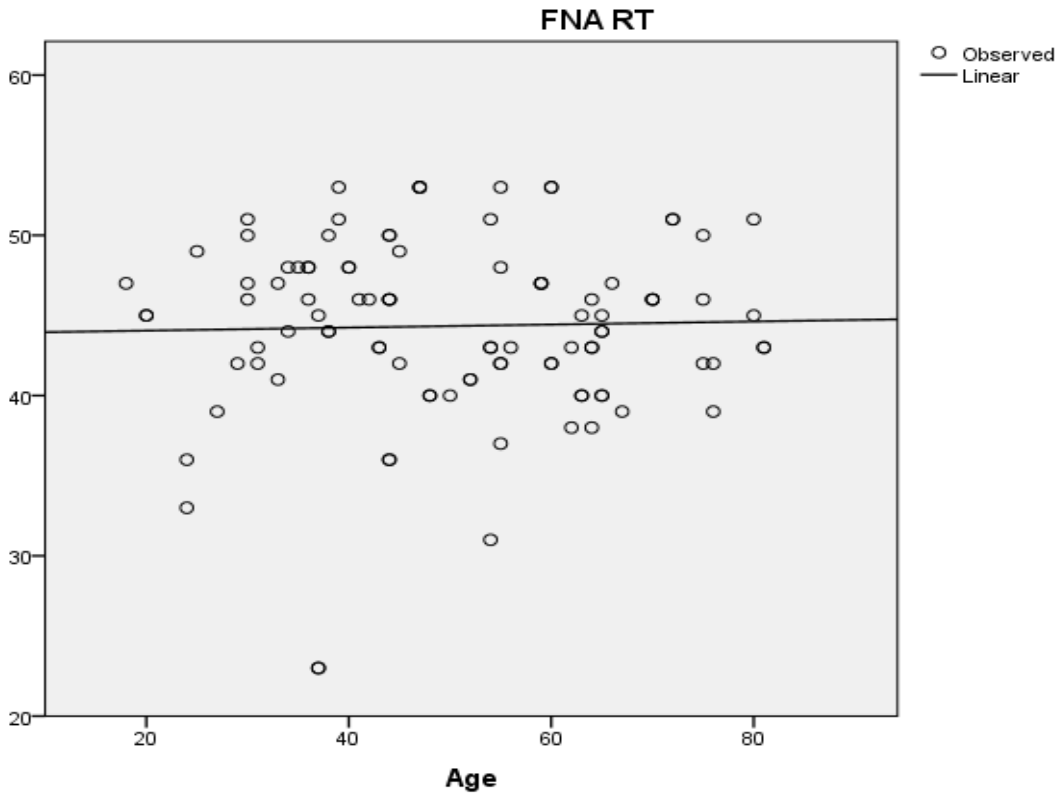
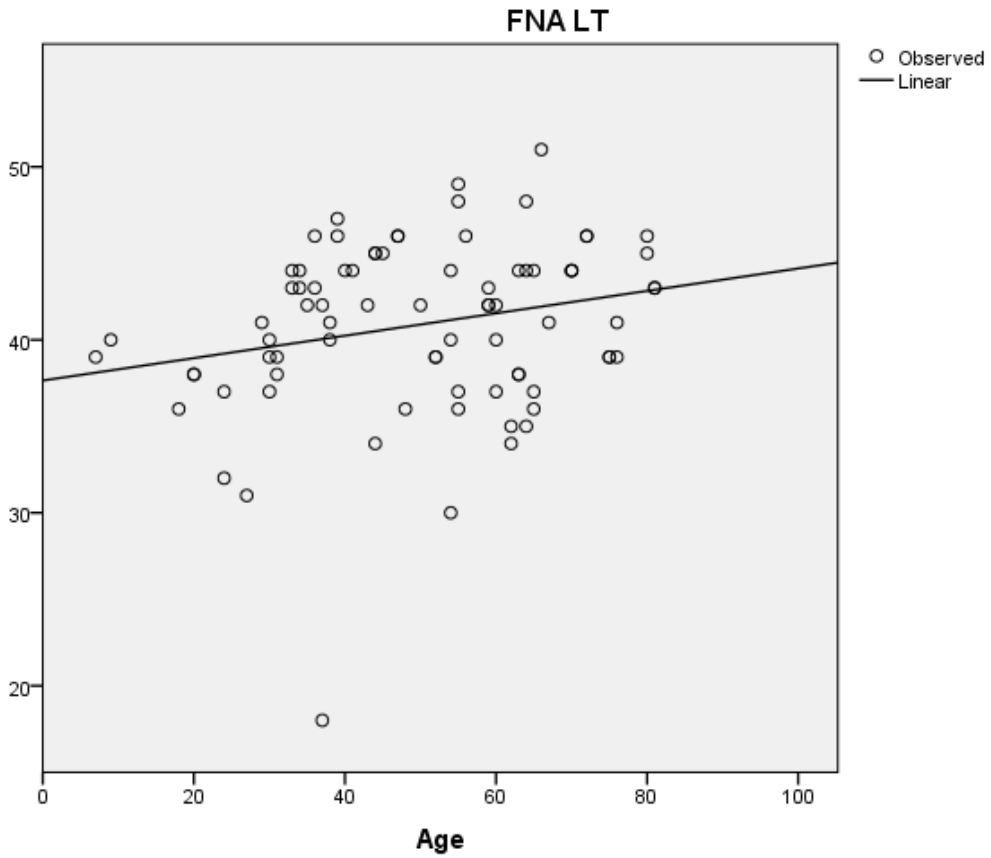


Figure (4.12) correlation between Age and FNA RT

Table (4.13) correlation between Age and FNA LT:

		Age	FNA LT
Age	Pearson Correlation	1	.233*
	Sig. (2-tailed)		.037
	N	100	100
FNA LT	Pearson Correlation	.233*	1
	Sig. (2-tailed)	.037	
	N	100	100

*. Correlation is significant at the 0.05 level (2-tailed).



Figure(4.13) correlation between Age and FNA LT

CHAPTER FIVE

Discussion ,Conclusion & Recommendations

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Discussion ,Conclusion & Recommendations

5.1 Discussion:

This study establishes standard measurements of proximal femur neck. In this study: Each patient contributed only one set of measurements, There was a wide range of age variation in the contributed patients, The patients were selected retrospectively, the measurements were taken routinely, The population used was mixed and there were no pre selections for maternal age, race and parity or fetal sex, Normal ranges were described by tables for regression lines from which the median and standard deviation was calculated.

Regarding sex-related differences, and according to our finding there is significant statistical difference between genders where the (CH) was found to be larger in males(4.53)than females(4.07), and also (CN) was found to be larger males(3.48)than females(3.08) and also(LN) was found to be larger males(2.14) than females(2.27) , and also (FNA) was found to be larger males(43.13) than females(42.46). And regarding the differences between right and left proximal femur neck there is no significant different according to the result showed by the statistical analysis.

5.2 Conclusion:

In our study 100 subjects, 200 femurs were included in the morphemtry of the proximal femur neck, were 4 parameters were measured and the result was that there was no significant difference between right and left femoral and there were significant difference between male and female subjects where most parameters were larger in males than females.

5.3 Recommendations:

- Larger sample size for further studies.
- A few studies have been performed in different parts of the world for established measurements of the femur neck but there is no such documented studies regarding Sudanese population.
- Further studies should be performed in order to estimate differences among various ethnicity/races especially in Sudan and to establish the normal standard data in Sudan.

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Appendix

Fig (1): shows a 53 years old male 3D of proximal femur neck with the measurements**.**