DERMATOGLYPHIC PATTERNS

AND ITS VARIATIONS IN SOUTH INDIAN ADULTS

Dissertation submitted in

partial fulfilment of the regulations for the award of

M.D.DEGREE

In

ANATOMY – BRANCH V

THE TAMILNADU DR. M.G.R MEDICAL UNIVERSITY

CHENNAI

May 2019

CERTIFICATE

This is to certify that the dissertation **"Dermatoglyphic patterns and its variations in South Indian adults"** is an original work done by Dr. K. Sangeetha, Post graduate student, Department of Anatomy, PSG Institute of Medical Sciences and Research, Coimbatore, under my supervision and guidance.

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DECLARATION

I solemnly declare that this dissertation "**Dermatoglyphic patterns and its variations in South Indian adults"** was done by me in the Department of Anatomy, PSG Institute of Medical Sciences & Research, Coimbatore, under the guidance of Dr.M.Jamuna, M.S, Professor, Department of Anatomy, PSG Institute of Medical Sciences & Research Coimbatore.

This dissertation is submitted to the Tamil Nadu Dr.M.G.R. Medical University, Chennai in partial fulfilment of the University regulations for the award of degree of M.D. Anatomy – Branch V examinations to be held in May 2019.

Place: Coimbatore

Date:

Dr.K.Sangeetha

ACKNOWLEDGMENT

I thank God for His grace and mercy.

I offer my humble and sincere thanks to my Professor, teacher and guide, Dr. M. Jamuna M.S. Professor of the Department of Anatomy, for lending me constant support, encouragement, motivation and valuable guidance.

I express my profound gratitude and respect to Dr. G. Amudha M.S. Professor and Head of the Department of Anatomy, for providing me all the support in completing the dissertation.

I express my gratitude to Dr. Ramalingam, Dean PSG IMS & R, Coimbatore for facilitating me to undertake this project in this esteemed institution.

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I thank all the assistant professors, postgraduate friends for their contributions and help. I am also thankful to all the technicians and non-teaching staff of our Department.

I extend my heartful gratitude to my parents, husband and daughter for their encouragement and moral support.

Dr.K.Sangeetha

PSG Institute of Medical Sciences & Research
Institutional Human Ethics Committee

Recognized by The Strategic Initiative for Developing Capacity in Ethical Review (SIDCER)
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To
Dr K Sangeetha
Postgraduate
Department of Anatomy
Guide: Dr M Jamuna / Dr R Senthil Kumar
PSG IMS & R
Coimbatore 641 004

Ref: Project No.16/323

Date: November 15, 2016

Dear Dr Sangeetha,

Institutional Human Ethics Committee, PSG IMS&R reviewed and discussed your application dated 30.09.2016 to conduct the research study entitled "*Dermatoglyphic patterns and its variations in South Indian adults*" during the IHEC meeting held on 21.10.2016.

The following documents were reviewed and approved:

1. Project submission form
2. Study protocol (Version 1 dated 30.09.2016)
3. Informed consent forms (Version 1.1 dated 09.11.2016)
4. Data collection tool (Version 1 dated 30.09.2016)
5. Permission letter from concerned Head of the Department
6. Current CVs of Principal investigator, Co-investigator
7. Budget

The following members of the Institutional Human Ethics Committee (IHEC) were present at the meeting held on 21.10.2016 at IHEC Secretariat, PSG IMS & R between 10.00 am and 11.00 am:

Sl. No.	Name of the Member of IHEC	Qualification	Area of Expertise	Gender	Affiliation to the Institution Yes/No	Present at the meeting Yes/No
1	Mr R Nandakumar (Chairperson, IHEC)	BA., BL	Legal Expert	Male	No	Yes
2	Dr. S. Bhuvaneshwari (Member-Secretary, IHEC)	MD	Clinical Pharmacology	Female	Yes	Yes
3	Dr S Shanthakumari	MD	Pathology, Ethicist	Female	Yes	Yes
4	Dr Sudha Ramalingam	MD	Epidemiologist, Ethicist Alt. member-Secretary	Female	Yes	Yes
5	Dr D Vijaya	M Sc., Ph D	Basic Medical Sciences (Biochemistry)	Female	Yes	Yes

The study is approved in its presented form. The decision was arrived at through consensus. Neither PI nor any of proposed study team members were present during the decision making of the IHEC. The IHEC functions in accordance with the ICH-GCP/ICMR/Schedule Y guidelines. The approval is valid until one year from the date of sanction. You may make a written request for renewal / extension of the validity, along with the submission of status report as decided by the IHEC.

PSG Institute of Medical Sciences & Research
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Following points must be noted:

1. IHEC should be informed of the date of initiation of the study
2. Status report of the study should be submitted to the IHEC every 12 months
3. PI and other investigators should co-operate fully with IHEC, who will monitor the trial from time to time
4. At the time of PI's retirement/intention to leave the institute, study responsibility should be transferred to a colleague after obtaining clearance from HOD, Status report, including accounts details should be submitted to IHEC and extramural sponsors
5. In case of any new information or any SAE, which could affect any study, must be informed to IHEC and sponsors. The PI should report SAEs occurred for IHEC approved studies within 7 days of the occurrence of the SAE. If the SAE is 'Death', the IHEC Secretariat will receive the SAE reporting form within 24 hours of the occurrence
6. In the event of any protocol amendments, IHEC must be informed and the amendments should be highlighted in clear terms as follows:
   a. The exact alteration/amendment should be specified and indicated where the amendment occurred in the original project. (Page no. Clause no. etc.)
   b. Alteration in the budgetary status should be clearly indicated and the revised budget form should be submitted
   c. If the amendments require a change in the consent form, the copy of revised Consent Form should be submitted to Ethics Committee for approval
   d. If the amendment demands a re-look at the toxicity or side effects to patients, the same should be documented
   e. If there are any amendments in the trial design, these must be incorporated in the protocol, and other study documents. These revised documents should be submitted for approval of the IHEC and only then can they be implemented
   f. Any deviation-Violation/waiver in the protocol must be informed to the IHEC within the stipulated period for review
7. Final report along with summary of findings and presentations/publications if any on closure of the study should be submitted to IHEC

Kindly note this approval is subject to ratification in the forthcoming full board review meeting of the IHEC.

Thanking You,

Yours Sincerely,

SECRETARY
PSG IMS&R
COIMBATORE-641004.
INSTITUTIONAL HUMAN ETHICS COMMITTEE

Dr S Bhuvaneshwari
Member - Secretary
Institutional Human Ethics Committee

PSG Institute of Medical Sciences & Research
Institutional Human Ethics Committee

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October 24, 2016

To
Dr K Sangeetha
Postgraduate
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Coimbatore

The Institutional Human Ethics Committee, PSG IMS & R, Coimbatore -4, has reviewed your proposal and discussed your request to conduct the study titled:

"Dermatoglyphic patterns and its variations in South Indian adults"

The following are the suggestions / recommendations made by the reviewer:

- Requested to collect personal details as personal record form, which needs date of birth of the participant to confirm the age (18 and above). Otherwise, please exclude first year MBBS students, as all of them won't be above 18 years
- Sample size differs in various places – Kindly make it uniform
- Requested to mention the Department of conduct of study and storage period in the English consent form
- Please indicate contact number of PI in the consent forms (English and Tamil)
- Kindly mention benefits (direct / indirect) of the study in the consent forms
- Initial interview time is the time spent by the PI to explain the participants about the study and to get consent from them. Kindly mention the same in the consent forms
- Please remove the term 'will' in the place of usage of data in English consent form

Decision: Approval pending minor modifications

Yours truly,

SECRETARY
PSG IMS&R
COIMBATORE-641004
INSTITUTIONAL HUMAN ETHICS COMMITTEE

Dr S Bhuvaneshwari
Member - Secretary
Institutional Human Ethics Committee

Proposal No. 16/323

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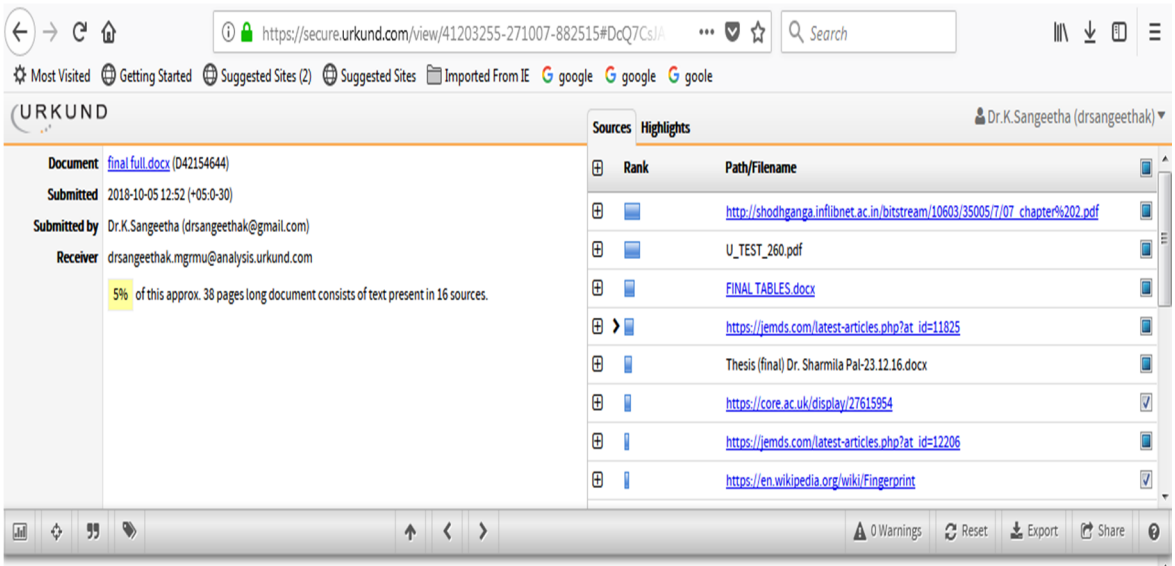

INTRODUCTION The most precious memories can fade, hair can grow grey, wrinkles appear over the face but the fingerprints are eternal and carved in stone. They are left on everything and undeniably not a secret. There is classicism in the style the ridges form motifs. It has enthralled the entire human race right from the ancient medieval period to the modern era.

Fingerprints are the most authentic form of evidence which is distinctive and perpetual. They are unique. As age advances the physical signs of ageing may commence, but the fingerprints remain unaltered.

The oldest of the documents of fingerprints dates back to 7000 B. C from Jericho. K.M.Kenyon in his book, "Archaelogy of the Holy Land" precisely explains the presence of thumbprints in the Neolithic bricks collected from this ancient city.

The prehistoric acknowledged portrayal is a hand showing patterns of the ridged skin discovered in a carving near Kejimkujik Lake, Nova Scotia. This carving gives an outline that the aboriginal carver though ignorant about the individuality and the attributes of the patterns of the fingerprints was fascinated by the fingerprints.

The Chinese were the forerunners to use fingerprints as a tool of identification.

The scientific study of fingerprints ante cedes to more than 150 years ago as pioneered by a Czech Physiologist and Professor of Anatomy, Jonnes Evangelistan Purkinje.

The skin over the palms, soles, fingers and toes contains ridges and grooves and is devoid of hair and sebaceous glands. There is plenitude of sweat glands and are comparatively larger in size. These factors play an important role in sense of touch and grip. They not only perform specialised function but also have configurations that make an individual unique.

Dermatoglyphics encompasses the science related to the study of all the integumentary features such as skin configurations on the fingers, palms, toes and soles. Inexhaustible research has been carried out in this inexorable mark of uniqueness time and time again.

The term "dermatoglyphics" was contrived by Harold Cummins. The etymon of dermatoglyphics is

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INTRODUCTION

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The term “dermatoglyphics” was contrived by Harold Cummins. The etymon of dermatoglyphics is sourced from Greek words “Derma” and “Glyphe”. (Derma –skin; Glyphe – to carve)

Conventionally dermatoglyphics is considered as a competent tool by physical anthropologists and population geneticists in the scrutiny of association between human races. Dermatoglyphics role in the field of medicine and genetics is recent and came into practice towards the end of nineteenth century.

Analysing the ridge configurations assured to contribute information whether a person has a chromosomal defect by a simple and inexpensive means (Schaumann and Alter 1976).

The dermal prints and the clinical scenario are useful in the diagnosis of inherited syndromes such as Down’s syndrome, Klinefelter syndrome, Noonan syndrome, Rubinstein Taybi syndrome and Trisomy 13. The dermatoglyphic

patterns vary in single gene mutations that cause malformations of hand and feet as in case of syndactyly, polydactyly and brachydactyly.

Initial researches in genetics were confined in studying the fingerprint pattern types and their frequencies. But the need for quantitative measuring of fingerprints arose during the mid 1920's which evolved as measurement of height and breadth of the fingerprint configurations and measuring the number of friction ridges.

The role of ridge count in genetics was augmented by Sarah Holt. She propounded that environmental factors had an impact in the development of ridges in utero. She had immense dossiers in the inherited finger ridge count analysis.

The credit of applying finger ridge count goes to Galton but its successful application in the field of genetics was contributed by Bonnevie. Thenceforth researchers spotted a genetic association between the ridge counts of related people.

There are also certain medical disorders in which there are characteristic finger pattern traits. Some of the medical disorders include congenital heart disease, diabetes mellitus, hypertension, leprosy, carcinoma breast, vitiligo, schizophrenia etc.

Dermatoglyphics has certain advantages that aids in diagnosing medical disorders.

- The ridge patterns once formed remain the same throughout life.
- Procuring and recording the pattern is simple, inexpensive and non-invasive

The pertinence of dermatoglyphics is in

- Preventing a disease
- Decipher an existing disease
- Identify people with genetic predilection to acquire certain diseases.

DIABETES MELLITUS

An epidemiologic transposition from communicable diseases to chronic non communicable diseases marked the dawn of 21st century. In consonance to the four stages of epidemiologic transition, India is in the fourth phase i.e. chronic degenerative and manmade diseases. One such metabolic disease that results in premature death and posing a major global health threat is diabetes especially Type 2 diabetes mellitus.

It has a multi factorial aetiology ranging from genetic influences to environmental factors that include highly developed socio economic status, modified living style and change in dietary habits.

There is decline of pancreatic beta cells even before the deficiency of insulin could result in hyperglycemia and a diagnosis of diabetes mellitus is arrived. Approximately one third of the population present with the after effects of the disease at the time of diagnosis.

The complications include almost all the cells, tissues and organs affected either directly or indirectly and depend on the austerity of the genetic competence and the extent of metabolic imbalance.

The life style modifications play an important role in prevention as well as delaying the onset of the disease in high risk individuals.

GLOBAL BURDEN OF THE DISEASE

According to World Health Organisation (WHO), in the year 2014, 422 million people had diabetes compared to 108 million in 1980. The prevalence is believed to inflate from 171 million in 2000 to 366 million in 2030.

Annually 3.2 million people, 8700 people per day and 6 persons per minute succumb to diabetes. This substantiates the data that in future diabetes will lead the causes of mortality and morbidity in addition to malignancy and cardio vascular disorders.

The deaths caused by diabetes accounts to 3.7 million in 2012 which includes 1.5 million deaths due to diabetes and 2.2 million deaths which are caused by the complications of the diabetes such as cardiovascular diseases, kidney diseases and tuberculosis.

STATUS OF DIABETES IN INDIA

India had 31.7 million people with diabetes in 2000 and topped the world. It is predicted that it would rise to 79.4 million in 2030.

The sophisticated and reliable methods of screening are accessible to Indian urban sectors but the rural population cannot avail these benefits. The rural population are more susceptible to the complications of the disease.

Apt interventions and unified endeavours are necessary to reduce the afflictions diabetes creates on the society. Voluminous research is continuously carried out to detect diabetes in the very early stages.

DERMATOGLYPHICS ROLE IN DIABETES MELLITUS

Heredity is one of the aetiological causes of diabetes mellitus as well as it has a role to play in dermatoglyphics. So it can be assumed that there can be some changes in the dermatoglyphic patterns of patients with diabetes mellitus. Hence dermatoglyphic analysis can be used as a simple screening tool.

High risk individuals can be predicted and preventive measures can be initiated starting from early childhood and adolescence. By this, the onset of diabetes mellitus can be postponed or prevented there by reducing the burden of the individual and the nation.

In the present study the qualitative and quantitative parameters of finger and palmar dermatoglyphics of medical students and patients with diabetes mellitus were studied. The variations encountered were analysed. Any peculiarities in the characteristics of dermatoglyphic configurations in patients with diabetes mellitus were ascertained.

EMBRYOLOGY OF EPIDERMAL RIDGES

Multitudinous studies are available in unveiling the embryogenesis of ridges as stated by Shaumann B et al (1976). The mechanisms behind the formation of papillary ridges are elucidated crystal clear in electron microscopic studies as mentioned by Penrose LS (1973).

The groundwork for the studies on developmental mechanism was by Cummins, Penrose and Hale.

During the preliminary stages of evolution of foetus the dermal ridge begins to differentiate. The resultant series of changes are genetically determined and further influenced by environmental factors.

In the development of upper extremities, limb bud develops as early as 4^{th} week. A hand paddle develops subsequently around 35 days with small protrusions of tissue that develops as fingers.

There is an association between foetal volar pads and epidermal ridges. Volar pads are mass of mesenchymal tissues which are located above the proximal end of the distal phalanx of the digits, inter digital, thenar and hypo thenar areas.

Around 6 weeks, the inter digital pads appear first followed immediately by thenar and hypo thenar pads. By 7-8 weeks the volar pads develop on the fingertips. They start to develop from the thumb and progress towards the little finger. During this period thenar crease begins to develop.

The flexion creases form around 9 weeks **(Kimura (1991)).**

Regression of the volar pads begins around 11 weeks followed by regression of the volar pads of the fingers.

Cummins (1929) stated that at approximately 16 weeks the volar pads gets completely merged with the outline of the fingers, palms and soles**.**

According to **Hale (1952),** when the volar epidermal cells divide, shallow ledges are formed.

Babler (**1991)** reported that the ledges later transform themselves into everlasting pattern on the volar surfaces. The interactions between the dermis and epidermis lead to the formation of primary ridges which are visually evident. They are otherwise called as glandular folds.

At approximately 15 weeks the volar surface is completely ridged due to the changes in the primary ridges.

At 6 months of gestation, the sweat glands duct ahead upwards, penetrate the glandular folds and reach the epidermis. At this time there is an increase in the number and size of the primary ridges which continues up to 17 weeks. This is the time when the pattern becomes perceptible. Secondary ridges appear between the glandular folds at around 17 weeks.

The indicators of fully formed epidermal ridges are

- Fully formed glandular folds
- Secretion by sweat glands
- Keratinisation

This is completed by six months of gestation. At this time, the surface of the skin reflects the underlying pattern. The furrows on the surface of the

epidermis harmonize with the furrow folds of stratum germinativum. Each epidermal ridge is formed over a glandular fold.

The development of the epidermal ridges on the sole is similar to palms except that each step occurs two or three weeks later.

Bonnevie (1924) suggested that the development of a pattern is largely dependent on the size and position of the volar pads. The prominent pads would lead to the formation of a complex pattern such as loops and whorls whereas a smaller pad would lead to the formation of simpler pattern such as arches.

She added that the volar pads positioned symmetrically on the fingertip would lead to the development of a centered pattern such as whorl and asymmetrically positioned pads would give rise to loops.

The time period when the epidermal ridges are formed was demonstrated histologically by **Babler in 1978**. The earliest pattern to develop was whorls and the last to develop was arch. He also stated that the height of the volar pad had no influence on the ridge count which confirmed Abel's (1936) hypothesis.

The findings of **Mulvihill and Smith (1969)** are tabulated as follows:

Pre-natal Development of the Fingerprints in Humans

6 weeks	Appearance of inter digital pads
7 -8 weeks	Development of volar pad; separation of thumb from the rest of the fingers thenar crease appears
9 weeks	Flexion crease appears
10 weeks	Nail fields and digital pads show constrictions

11 weeks	Regression of volar pads
13 weeks	Volar pads completely regress
12-14 weeks	Primary ridge formation
16 weeks	Volar pads completely merged
17 weeks	Secondary ridge formation
21 weeks	Complete formation of ridges

FACTORS INFLUENCING THE EMBRYOGENESIS

Several hypotheses have been codified apropos the factors that trigger the formation of epidermal ridges.

Cummins (1936) contemplated that the physical factors influence the epidermal ridge formation. The directions of the epidermal ridges are believed to be consequences of pressure and tension of the skin.

Genetic factors

Smith S et al (1955) states that to ascertain the mechanism of inheritance of fingerprint pattern stupendous indagation has been undertaken. These researches prove that the pattern appears to be a feature that is strongly inherited **(Holt (1968), Moenssens (1972), Bener (1982), Arietta et al (1992)).**

Sir Francis Galton in 1892 pioneered the studies on hereditary factors influencing epidermal ridges. He drew inspiration from the works of **Herschel and Gaulds (1916)** who laid the foundation in this field of research according to **Forbes A (1964).**

Primarily, certain degree of association exists between an individual's fingerprint and his parents and also with the race. The identical twins have

most of the general patterns in common. In case of monozygotic twins the similarities are much more common.

In the beginning it was proposed by **Galton F (1892)** that the individual traits of dermatoglyphic configurations were inherited as dominant, incompletely dominant, recessive single gene or polygenic with complete or incomplete penetrance and variable expression of genes.

Recent advances state that the polygenic system with a minimal activity of individual genes plays a major role in inheritance of dermatoglyphic configurations.

Environmental factors

Increased incidence of simian lines is known to occur in cases of thalidomide embryopathy.

Rubella syndrome as stated by **Achs R et al (1966)** is said to cause abnormal fingerprint patterns such as

- Increased frequency of simian lines
- Axial triradius located distally
- Presence of radial loops other than the second digit.

DERMATOGLYPHIC PATTERNS IN FINGERTIPS AND PALM

QUALITATIVE ANALYSIS

FINGERS

- Dermatoglyphic pattern
    - Arch
    - Loop

        - Whorl
        - Composite / compound

- Dermatoglyphic landmarks
        - Triradius
        - Radiants
        - Core

PALM

- Palmar pattern
        - Thenar (Th) and first interdigital area (I_1)
        - Second, third and fourth Interdigital areas (I_2, I_3 and I_4)
        - Hypothenar area (Ht)
- Palmar landmarks
        - Digital triradii
        - Axial triradius
        - Main line traced from each component

QUANTITATIVE ANALYSIS

FINGERS

- Ridge count
        - Total finger ridge count (TFRC)
        - Absolute finger ridge count (AFRC)

PALM

- a-b ridge count
- atd angle

Dermatoglyphic configurations can be scrutinized qualitatively as well as quantitatively. The qualitative analysis includes the fingertip and palmar patterns whereas quantitative parameters include ridge counts. The universally acknowledged classification of patterns of fingerprint is endorsed by Sir Francis Galton.

Minutae

The epidermal ridge travels in a circuitous fashion with non-uniform branching of ridges and terminates in an abrupt manner. They are termed as minutae and are distinctive to an individual as they differ in number, position and type. The minutae are allegiant and a beneficial tool for personal recognition.

Arch

They are the simplest among all the patterns. The ridges run parallel to one another from one side to the other with a distally bowed glide. Tri radius is absent. (***Figure 5)*** Based on the shape, Galton has divided the arches into the following sub types:

(i) Plain arch

(ii) Tented arch

Plain arch

Here the ridges align themselves from one end to the other end with a little curve in the centre.

Tented arch

This pattern resembles the outline of a tent and hence named as tented arch. Here the ridges run from one side to the other but in the middle they are supported by a vertical ridge with a tri radius.

Loop (*Figure 6)*

This is the most frequently occurring pattern. Here the ridges enter from one end re-curves for 180 degrees and then gains its exit through the same end. It appears like a hair pin bend. A tri radius is always present at the closed end.

Ulnar loop

When the loop pattern enters through the ulnar border of the finger it is called as ulnar loop.

Radial loop

When the ridges appear through the radial border of the finger and form a loop, it is called as radial loop.

Whorl (*Figure 4)*

The ridges are arranged in a circumferential manner around the core forming the pattern area. Core is present in the inner aspect either in the form of an island, circle, ellipse, a straight ridge or a hook shaped ridge. They have two tri radii, one confined to the radial side and the other on the ulnar side of the pattern area.

Concentric whorl

The ridges arrange in the form of concentric rings or ellipse around the core.

Spiral whorl

The ridges array themselves in a spiral fashion in a clockwise or anticlockwise mode around the core.

Mixed whorl

As the name implies, this pattern is a melange of circle, spiral or an ellipse.

Composite or compound (*Figure 7)*

A composite pattern comprises of two or more patterns belonging to the same or different type. The subtypes are as follows:

(i) Central pocket loop

(ii) Lateral pocket loop

(iii) Twinned loop

(iv) Accidental loop

Central pocket loop

In this type, around the core the ridges are arranged in the form of a whorl, the ridges surrounding them are arranged in the form of a loop. There are two delta points. Less than four re-curving ridges are present between the core and the delta that is present closest.

Lateral pocket loop

Two loops are present with the tri-radii lying on the same side of the ascending loop.

Twinned loop

As the name suggests, two loops are present and they clasp each other and they are termed as ascending loop and descending loop. In this case two tri-radii are formed and they lie on each side of the ascending loop.

Accidental

It is complicated and possesses same or different types of pattern having more deltas.

DERMATOGLYPHIC LANDMARKS OF FINGER TIPS:

The characteristic landmarks pertaining to finger tip dermatoglyphics are grouped as under:

- Triradius
- Radiants
- Core

Tri radius

It is a conflux of three ridges. In case of ulnar loops, the tri radius is always present on the radial side. The whorls have two tri radii present. The arches do not possess tri radii except in case of tented arch which has a tri radii in the centre.

Radiants

The ridges that stems out of the tri radius are called as the radiants. They form the structural lay out of a finger print pattern. Type lines are used to represent the radiants in illustrative explanations.

Core

The approximate centre of the pattern corresponds to the core. It is of immense help in the counting of ridges. It presumes various shapes, either in the form of a rod shaped ridge or just a dot.

PALMAR CONFIGURATION

Dermatoglyphic exploration is complete only when the palm has been analysed. For this reason, the palm has been divided into certain anatomical regions which roughly correspond to the site of the embryonic volar pads. Ten regions are identified in a hand. They correspond to the pads of the digits (1-5), inter digital areas (6-9) and hypo thenar eminence. The thenar eminence and first inter digital areas coalesce with one another.

Thenar (Th) and first inter digital area (I_1)

Anatomically both the areas are in close proximity to each other. Loops may occur but whorls are infrequent. They lack a true pattern and hence labelled as vestige pattern.

Second, third and fourth Inter digital areas

The distal region of the palm corresponding to the heads of the metacarpal bears the Inter digital areas. Laterally each inter digital area is bounded by digital tri radii which are present proximally to the base of the II to V digits. The tri radii associated with the corresponding base of the II digit to the base of the V digit are denoted as a, b, c and d respectively.

The second inter digital area (I_2) lies between tri radii a and b, the third inter digital (I_3) area is present between tri radii b and c and fourth inter digital area (I_4) lies between tri radii c and d.

The ridges align in the form of loops, whorls and vestiges in the inter digital areas. By and large loops frequently occur in the distal palmar areas. Whorls are infrequent and they do not appear typically. Often it is found as parallel

ridges or converging ridges that run in different directions. They do not epitomize true patterns.

I_3 and I_4 areas have true patterns whereas I_2 are devoid of true patterns.

Hypo thenar area (Ht)

Hypo thenar area lies above the hypo thenar prominences alongside the ulnar border of the palm. This area possesses true patterns which may be in the form of whorls, loops and tented arches. Vestiges and simple arches also appear. The pattern with highest incidence is arches. Three tri radii are present in whorl pattern.

PALMAR LANDMARKS

The following serves as imperative markers to study palmar dermatoglyphics:

- Digital tri radii-4
- Axial tri radius-1
- Main line traced from each component

Digital tri radii (*Figure 10)*

Four digital tri radii (a, b, c and d) are present along the bases of the digits II to V. Each tri radii has two radiants present at the base of the finger and a proximal radiant that leads to the formation of a main line. Therefore there are four main lines emerging from each of the digital tri radii and they are labelled as A, B, C and D respectively.

Axial tri radii (*Figure 10)*

It is located in relation to the axis of the fourth metacarpal bone along the proximal margin of the palm. The position of axial tri radius fluctuates

substantially. The normal location of axial tri radius is expressed as t and its variations are labelled by adding a primer to t as t'and t''. The more the number of primers the more is the degree of distal displacement.

t – Tri radius present near the wrist crease

t'- tri radius present near the centre of the palm

t''- tri radius present between the above two

t'''- tri radius distal to proximal transverse crease

Many methods are employed for determining the position of axial tri radius, one of them is by measuring the angle that is formed when two lines are drawn from the tri radius distally to the point where it meets the digital tri radii a and d.

Normally the proximal axial tri radius (t) is common compared to the distal axial tri radius (t'). The angle formed by the former is more than 45° and the angle formed by the latter is more than 56° and the t'' forms an intermediate angle.

QUANTITATIVE ANALYSIS

Ridge count (*Figure 8)*

Ridge count delineates the pattern size and ridge power. A line is drawn between the tri radius and the centre of the pattern. The number of ridges present between the two points is counted excluding the ridges of both the points. The notable features with respect to the pattern type are given below:

Arch

Simple arch- tri radius is absent and hence 0 count.

Tented arch- core is absent and hence 0 count.

Whorl

Two tri radii are present in a whorl and allow two different ridge counts. Since ridge count portrays the strength of the pattern, the ridge count with the larger value is taken into account.

On an average, the loop records around 12 and whorls score 19 ridges.

In case of left hand, the ridge counting is done from little finger to thumb and in case of right hand the ridge counting is done from the thumb to the little finger.

Total finger ridge count (TFRC)

It is the sum of the ridge count of all the ten fingers taking the higher ridge count of each finger, if there is more than one pattern is present. It signifies the pattern size.

Absolute finger ridge count (AFRC)

It is the sum of all the ridge counts of the ten fingers. The magnitude of the pattern size as well as pattern intensity can be derived from this count.

In the absence of whorl pattern the TFRC and AFRC are equal.

Palmar ridge count

a- b ridge count (*Figure 9)*

The ridge count commonly counted in palm is a-b ridge count. It refers to the number of ridges present between the tri radii a and b. Other ridge counts

such as b-c ridge count and c-d ridge count are usually not analysed as they do not convey significance in dermatoglyphic analysis.

atd angle (*Figure 11)*

Penrose pioneered the measurement of atd angle. This is obtained by drawing lines from axial tri radius (t) to digital tri radius (a) and from axial tri radius (t) to digital tri radius (d). It provides accurate results in dermatoglyphic analysis.

In the presence of more than one axial tri radii, the angle with maximal measurement is taken into account. It is dependent on skeletal growth, i.e. as age advances the length of the palm tends to increase on contrast to the width.

PALMAR FLEXION CREASES

They are the unyielding attachment of the skin to the underlying structures. Embryologically it differs from epidermal ridges. Because of its characteristic variations it is included in dermatoglyphic analysis.

Embryology of flexion crease

During the seventh week of intrauterine life the radial longitudinal crease or the thenar crease develops when the crown-rump length of the embryo is 27 cm in length. The distal and the proximal transverse crease are formed when the crown rump length is 46 mm in length approximately around nine weeks.

They are classified into the following types:

- Major crease
- Minor crease
- Secondary crease

Major crease

The following are the types of major creases

I. Radial longitudinal or thenar crease
II. Proximal transverse crease
III. Distal transverse crease

- The radial longitudinal crease is a curved one found to encircle the thenar eminence. It ends in the distal crease of the wrist along the radial side.
- The proximal transverse crease is located little above the middle of the palm. It is found to blend with the thenar crease or lies separately above it in the radial side, then sweeps along the palm and terminates along the medial border of the hypo thenar eminence.
- Between the proximal transverse crease and the heads of the metacarpals lies the distal transverse crease. The origin is from the space between the index and the middle finger and then sweeps along the palm and terminates in the ulnar border of the palm.

Variations

Simian crease and Sydney line arises when there is variation in the normal course of the transverse crease.

Simian crease

When the proximal and distal transverse creases get united as a single crease it is described as simian crease or simian line. Variations appear in the simian crease.

- Simian transitional type 1- the proximal and distal transverse crease have bridging crease between them.
- Simian transitional type 2- the fused transverse crease has proximal and distal twigs arising from it.

Sydney line

When the proximal transverse crease extends through the hypo thenar eminence and reaches the ulnar border it is termed as Sydney line. It is named so because it was first reported in the city of Australia by Purvis-Smith and Measer.

Minor crease

In conjunction with the major creases several minor creases are observed.

- Three longitudinal creases originate from the wrist and run towards the III, IV and V digits.
- Eline- located distally along the ulnar border of the palm between the distal transverse crease and crease of the metacarpophalangeal joint of the V digit.
- Hypo thenar crease - located in the hypo thenar eminence, runs from the proximal part of the wrist towards the ulnar side of the palm.
- Accessory distal crease- located distal to the distal transverse crease below the III and IV digit.

Secondary creases

Any visible crease excluding the major and minor crease is termed as secondary crease.

PREVALENCE OF DERMATOGLYPHIC ATTRIBUTES IN GENERAL POPULATION

The traits of dermatoglyphics observed in normal population are described below:

- Bilateral symmetry
- Gender differences
- Racial differences

Bilateral symmetry

The fingerprint patterns, ridge count and ridge breadth on the right and left hand of the same individual are never identical.

Gender differences

Notable differences in the dermatoglyphic features are observed between males and females both qualitatively as well as quantitatively.

The females show increased incidence of arches compared to the whorls and radial loops on the fingertip. They have narrow ridges compared to males.

The palms have increased pattern over the hypo thenar eminence and the fourth inter digital area.

The females have low total finger ridge count than males. In males the radial loops on the digits of right hand are greater than the digits of left hand. In females also the radial loops of right hand are higher than the left hand digits excluding the second and third digits.

The first study to put forth the gender differences was carried out by Holt in 1968. It was conducted in a British population after procuring the fingerprints

of 500 males and 500 females. The outcome of his study was presented in the form of percentages. Similar studies were performed by **Bonnevie (1916), Galton (1924)** and many others.

Racial differences

The distribution of fingerprints also displays differences among races. Galton observed statistically significant results when exploring the dermatoglyphic configurations of 5 different races namely Jews, English, Welsh, Basques and Africans.

Asians have increased frequency of occurrence of whorls compared to British. In Indians, mean values of total finger ridge count in males is 149 and females is 139 whereas in British the mean values in males is 145 and females is 127.

The highest frequency of whorls among all the major races in the world is shown by Chinese as reported by **Holt, 1968**.

Selection of control carries importance since distribution of fingerprints possesses racial variations.

The frequency distribution among the different pattern types was tabulated by **Plato** in the year **1973.**

AIMS AND OBJECTIVES

Aims

- To study the dermatoglyphic patterns in medical students and in patients with Type 2 diabetes mellitus.
- To determine and document the variations that is encountered.

Objectives

- To determine the predominant fingerprint pattern in male and female students as well as in diabetic males and females.
- To determine the distribution of fingerprint pattern in individual digits of both hands in the students and in diabetics.
- To study the sub types in arch, loop and composite patterns.
- To determine the total finger ridge count in the students as well as in diabetes patients.
- To calculate the a-b ridge counts in the students as well as in patients with diabetes mellitus.
- To measure the atd angle in the students as well as in diabetic subjects.
- To determine the significance in total finger ridge count, a-b ridge count and atd angle between males and females.

REVIEW OF LITERATURE

A lot of research work has been done extensively in the area of dermatoglyphic patterns and exploration of the literature related to the present study was important in order to have an insight into the study.

HISTORICAL REVIEW

ANCIENT AND MEDIEVAL PERIOD

The fingerprints and hand designs depicted in the rock carvings and paintings are standing examples of the early men who appreciated the differences in skin markings. The Pyreness cave pictures of Spain, petroglyphics present in the Island of Gavrinis of the northern coast of France, the excellent digital relics of the American Indians are exquisite examples. Carvings with ancient artifacts similar to the fingerprints have been discovered worldwide that belongs to prehistoric era. The clay tablets bearing fingerprints embedded on them was used for business transactions in ancient Babylon. In ancient India, Agastiya, an esteemed Vedic sage and an influential scholar wrote a text called Naadi which is said to predict the past, present and the future of all humans from fingerprints. By 246 BCE, Chinese impressed their fingerprints into the clay seals. There was a practice of recording the fingerprints of accused people by law personnel in Babylonian king Hammurabi's domain (1792-1750 BC).

17th AND 18th CENTURY

Nehemiah Grew (1684) the English physician, botanist and microscopist delivered a lecture on the markings present on the fingertips in the Royal College of Physicians of London. He described them as ridges of equal size and distance running parallel with one another.

Govard Bidloo (1685) a Dutch physician, published a book on anatomy which elucidated the ridges over the fingers. He described the fingerprints with his detailed drawings in his book on Human Anatomy, "Anatomia Humani Corporis" (Amsterdam: Utrecht Edition 1685).

Marcello Malphigi (1686) Professor of Anatomy, at the University of Barcelona first observed fingerprints under a microscope. He described the existence of ridges and sweat glands on the fingertips in his De externo tactus organo anatomica observation.

Johann Christoph Andreas Mayer (1788) a German anatomist, acknowledged that fingerprints are unique. He was the first to write about the basic tenets of fingerprint analysis. He described that there is no duplication of the arrangement of skin ridges in two persons nevertheless similarities can exist in some individuals

MODERN ERA

Malpighius (1665), Grew (1684), Bidloo (1685) started their work on finger print patterns as early as 1680's but the pioneer of the scientific study of the

papillary ridges of the hands and feet was **Joannes Evangelista Purkinje (1823).**

Purkinje, a Czech Physiologist and Professor of Anatomy at the University of Breslau initiated the first attempt of systemically categorizing fingerprint pattern in which he used a nine pattern classification. He classified them into nine categories as follows: central longitudinal stria, transverse curve, oblique strip, oblique loop, almond whorl, spiral whorl, ellipse, circle and double whorl.

Sir Charles Bell (1833) a Scottish surgeon and Anatomist, studied the structure and function of hands as mentioned in his book – "The Hand: Its mechanism and vital endowments as evincing design".

Sir William James Herschel (1858), British Chief Administration Officer, Bengal, India, was the first to use fingerprint in India as a mode of identification on a mass scale. The epidermal ridges are formed during the 3rd or 4th month of fetal life. The pattern remains unchanged and the size of the pattern increases parallel. This method was introduced by Sir Willaim Herchel.

Dr. Henry Faulds (1880) a Scottish surgeon in Tsukji Hospital, Tokyo, suggested that fingerprints can be procured from the scene of crime in his article in the Scientific journal, "Nature". He also proposed a method to record them with printing ink.

Juan Vucetich (1892) an Argentine chief police officer, used fingerprint and identified a woman named Francis Rojas, who committed a crime by murdering her two sons and cut her own throat in order to blame others. Eventually her fingerprint was left on a door and she was proved as the murderer. This was the first crime in which the identity of a murderer was proved by fingerprint pattern.

Harris Hawthorne Wilder (1897) was the first American to study dermatoglyphics. He named them as a, b, c, d tri radii points and invented the main line index, studied the thenar and hypothenar eminences, zone II, III and IV.

Kristine Bonnievie (1924) was the first to propose the qualitative genetic method on how the fingerprint characteristics can be inherited. She also emphasizes the embryological process that leads to expression of a particular pattern. The frequency of the patterns observed in her study "The palmar dermatoglyphics of Norwegian criminals in Oslo" was in close observations made by Galton in England.

Sir Francis Galton (1924) anthropologist, cousin of Charles Darwin enumerated the first practical method of fingerprint identification in his book: "Fingerprints". He elaborated the works of Purkinje and directed his work towards the usages of identification of fingerprint. He was responsible for the basic nomenclature of fingerprint pattern as arch, loop and whorls. He also demonstrated scientifically that fingerprints remain the same and are permanent

.He proposed the intricate details of identification of fingerprints which is still practiced and they are referred to as Galton's details.

Harold Cummins MD (1926) Professor of Anatomy in the Tulane University along with Midlo published "Fingerprints, palms and soles"(1943) which stands as the standard reference work in dermatoglyphics. Cummins has proved compelling in all aspects of fingerprint analysis right from anthropology to genetics, from embryology to the study of malformed hands. He amalgamated the diverse works of his forerunners along with his original research. His explorations in Down's syndrome studies predicted a genetic association to the disease based on the existence of the simian crease.

Sir Francis Galton is the Inventor of dermatoglyphics whereas Cummins is considered as the Father of dermatoglyphics.

DESCRIPTIVE STUDIES ON DERMATOGLYPHICS

Carl D.Enna (1969) conducted a pilot study on dermatoglyphics among individuals with leprosy irrespective of their age, sex and the type of leprosy and normal subjects. The radial loops were low in all the fingers and whorls high in the thumb, long and ring fingers in the leprosy group. In the non leprosy group the tented arch was not present in the thumb, long and little fingers. The distance measured between the distal crease of the wrist to the axial tri radius and also to the base of the middle finger in the leprosy patients were remarkably low. In spite of the fact that leprosy being an infectious

disease caused by Mycobacterium leprae, the hereditary vulnerability of the host is propounded as a supplementary element.

Jantz (1978) reported the fingerprint features of 126 male and 55 female Yoruba, a sub Saharan population. The occurrence of whorls was low and the finger ridge counts in male were significantly higher compared to the available data from Nigeria.

Jantz et al (1980) employed principal component analysis to assess finger ridge count as an index of genetic association between populations.

Malhotra et al (1982) stated that under the genetic influence the total palmar ridge count expressed one third of variations.

Ghosh (1982) described the dermatoglyphic patterns of Naik Gond, a Dravidian tribe of Chandrapur, Maharashtra. The fingerprint types, tri radii, total finger ridge count, main line index and a-b ridge count conveyed routine information of sexual dimorphism which were then compared with the Rajgond and the Pardhan tribes. The results were homogenous and reinforced their ethno-history.

Rao et al (1983) conducted a study among the tribes of Andhra Pradesh and determined the digital configurations, pattern intensity and ridge count. The Rajgond, Chenchu and Pardhan tribes had sex difference in the incidence of fingerprint pattern. The Koyas resembled the Pardhan and the Kolam and Rajgond resembled Pardhan in terms of digital pattern. The Kolam were

analogous with Rajgond, Pardhan with Sugali in terms of total finger ridge count. The pattern intensity proved to be insignificant.

Kobyliansky et al (1983) reported the influence of fingerprint patterns on the ridge count.

David (1984) surveyed the distribution and sex variation of the a-b ridge count of both hands. The impact of the sex chromosome complement on a-b ridge count was found to be trivial compared to the effect of sex chromosome complement on the total finger ridge count. He inferred that the inheritance of the a-b ridge count is less compared to total finger ridge count.

Martin et al (1986) dealt with the quantitative parameters of dermatoglyphics such as finger ridge counts in a Spanish population. A bimanual asymmetry existed with notable rise of right hand ridge count for thumb and index in both males and females. The frequency distribution of TFRC in males was different. The TFRC values in males and females showed similitude from Tierra de Campos as well as from the available Spanish and Portuguese population.

Mukherjee (1990) reported that the ridge counts and pattern intensities declined with birth order. A-t-d angle had minimal association with birth order.

The qualitative parameters of dermatoglyphics were analyzed in 3158 of thirteen Iranian population of diverse origin (Kamali et al1991). Notable heterogeneity existed for all the parameters between inter population.

Parvatheesan et al (1993) reported the frequency of fingerprints pattern, inter digital ridge counts on a-b, b-c and c-d and a-t-d angle in one hundred Relli caste individuals and one hundred Manne Dora tribals of Andhra Pradesh. The dermatoglyphic configurations formed the base in establishing the bimanual and bisexual differences between them.

The inter digital ridge counts in normal Koreans were demonstrated and reported as 73.00 for a-b, 52.12 for b-c and 69.39 for c-d in males and 73.21 for a-b, 53.60 for b-c and 70.12 for c-d in females respectively **(Cho et al 1993).**

Elizabeth de F.Penhalber (1994) reported over 30 dermatoglyphic parameters in a large normal Caucasoid population. The types of digital patterns, total ridge count, absolute ridge count, patterns on the palmar areas, main line index, T line index, position of axial tri radius and atd angle were some of the important parameters. Remarkable difference prevailed in the fingerprint pattern between men and women.

Krishnan and Reddy (1994) in their study found out the variability of finger ridge counts among the populations belonging to diverse geographical, ethnic and racial background. They studied the relation between individual counts and population and compared the Indian population with other population. The samples comprised of 117 males and 59 female Indian populations and 36 male and 27 female non-Indian populations. The mean was taken from the ten finger ridge count. The bi-plot technique developed by Gabriel (1981) was employed wherein the entire data was represented in a graphical manner. The ridge

counts showed a tripartite division of digits. The Indian population showed a great homogeneity when compared with other populations worldwide, but the contiguity is not preserved within the states of India. Distinct ridge count structures have been found in the Mongoloids and Caucasoids.

Jantz (1997) studied the variation among the European populations using summary finger ridge count variables. The variables that were employed were: sum of radial counts, sum of ulnar counts and sum of larger counts (total ridge count or TRC). The aim of this study was to find out the immensity of the ridge count variation with regards to spatial and linguistic pattern. The subjects were 82 male and 75 female from Europe. The dermatoglyphic parameters and the parameters derived from classic nuclear gene markers were compared. Fat values were derived from ridge classical genetic polymorphism. There was a striking correlation of ridge count distances with geographic distances but it was not observed with linguistic distances. This proved that the ridge counts were strongly influenced by demic expansion of Neolithic farmers. He concluded that the most metamorphosed populations in Europe were those of North Atlantic and North Sea region, notably the Orcadians and Faroe Islanders. Certain Finnic speakers such as Lapps and Udmurts also stood apart.

Igbigdi et al (1999) in his study established the palmar and digital dermatoglyphic pattern of Malawians. The Malawian students were selected randomly as subjects. The atd angle, a-b ridge counts, pattern intensity index (PII), total finger ridge count (TFRC) and the variability of ridge patterns were

ascertained. The most predominant digital pattern in both sexes was arches, radial loops in males and whorls in females. The TFRC was high in females compared to that of males while males had higher mean PII values than females. The atd angle was strikingly high in females. Males had significantly high a-b ridge counts than females. The arches were the principal fingerprint pattern in both sexes. In males the radial loop pattern dominated and in females it was the whorls. However sexual dimorphism was not observed since the digital patterns were statistically insignificant. The Nigerians showed outstandingly higher TFRC, atd angle, a-b ridge count and mean PII than Malawians.

The atd angle can be measured reliably. A software program can facilitate the measurement **(Emily K. Brunson 2015).**

DERMATOGLYPHICS – GENETICS AND MEDICAL DISORDERS

Uchida et al (1962) studied the dermatoglyphic configurations of fourteen patients of Trisomy 18, one patient who was probably 18Trisomy, five D1 trisomies and one D1 mosaic. He compared the results with 685 controls. The controls comprised of 557 school children around 8-10 years of age and 128 randomly admitted patients. All cases of D1Trisomy had the distal axial tri-radius on both palms and most of them had a simian crease.

T.J.David (1973) conducted a study on the dermatoglyphic configurations in patients with tuberous sclerosis. This study included 54 patients with tuberous sclerosis and 1000 controls. The end result was a small decrease in summed a-b

ridge count. He concluded that tuberous sclerosis does not possess special dermatoglyphic patterns. He also declared that the fingerprint pattern remains unchanged in single gene disorder.

Chris C.Plato (1973) recognized the dermatoglyphic patterns in Down's syndrome. This study comprised of 145 males and 120 females as cases and 108 males and 114 females as controls. The sub classifications of the C-line terminations and the hypo-thenar areas patterns were statistically significant. The presence of simian line was well established between cases and controls.

Mazakatsu Gotu et al (1977) performed dermatoglyphic studies in children with varied congenital diseases of the heart. The difference in total finger ridge count between the children and their mothers were statistically significant when compared with previous studies. This study also concluded that the fingerprint patterns could be inherited from mothers.

Padma et al (1980) explored the qualitative and quantitative parameters of fingerprints in patients with dystrophy. This study shows a rise in whorls pattern and a decrease in ulnar loops. The ridge intensity increased in the thenar, a-b area (area between the base of index finger and ring finger), b-c area (area between the base of middle finger and ring finger) and c-d area (area between the base of ring finger and little finger).

Robert S.Young (1982) analyzed the fingerprint features from the published reports of 128 patients with trisomy 9p syndrome and 27 patients with partial

monosomy anomalies. The characteristic features of dermatoglyphic patterns in patients with trisomy 9p:

- Absent palmar digital tri radii,
- Zygdacylous,
- Complex pattern of thenar and inter digits,
- Reduced TFRC,
- Alignment of transverse palmar ridge,
- Branchymesophalangy
- Simian crease.

The hallmarks of dermatoglyphic configurations in partial 9p monosomy individuals were:

- Dolichomesophalangy with accessory flexion creases,
- Rise in TFRC,
- Increased whorls,
- Distally displaced axial tri radius,
- Simian crease
- Dissociated palmar ridge

Herman J. Weinub (1985) studied the fingerprint patterns in 50 individuals with senile dementia of Alzheimer's type. The controls were 50 normal subjects. The cases showed a significant increase in ulnar loops and decreased incidence of arches and whorls.

Iqbal et al (1985) differentiated the qualitative and quantitative parameters of dermatoglyphics in one hundred probands of vitiligo from one hundred normal subjects. The following were the findings:

- Ulnar loops being the commonest pattern in both the groups
- Statistically significant incidence of whorls and arches in men and women probands
- Presence of simian crease and Sydney line
- Remarkably reduced TFRC and a-b ridge count in both men and women vitiligo cases

P.S.Igbibi (2001) reported the plantar and digital dermatoglyphic patterns in ninety nine aboriginal Malawian patients with diabetes, hypertension and diabetes with hypertension. The predominant ridge patterns in digits were arches in all groups of patients followed by loops. Differences in patterns of the digits were more pronounced compared to the plantar aspect. This study postulated that the results can be used to predict the occurrence of diabetes, hypertension and hypertension with diabetes in the children of Malawi.

Francisco Paez (2001) reported the fingerprint patterns in 72 DSM-III-R schizophrenia subjects and 72 normal individuals belonging to the same population. He described the following findings. The ridge count and the fluctuating asymmetry in the a-b ridge count were significantly lower in the subjects. Assessment of the severity of symptoms was done using positive and negative symptom scale (PANSS). He proferred that schizophrenia could be inter connected with central nervous system abnormalities.

Prashanth E. Natekar (2006) studied the fluctuation asymmetry correlation coefficient of thumb, subtotal ridge count and atd angle in histo-pathologically

confirmed carcinoma breast patients. It proved to be statistically significant on comparison with controls. The fluctuation asymmetry in breast carcinoma patients were high and were recorded as follows: Thumb (Z=2.01), subtotal ridge count (Z=2.10) and atd angle (Z=2.01). This study revealed that a potential impact prevailed between the genetic factor and the dermatoglyphic patterns in carcinoma breast patients.

Arezoo Jahanbin (2010) selected forty five unaffected parents of children affected with non familial bilateral cleft lip cleft palate and forty five parents of atleast two unaffected children. Dermatoglyphic patterns were obtained from each parent. The following parameters were assessed: 1.total ridge count 2. Atd angle 3. Fingerprint pattern types. The unaffected parents showed higher asymmetry of atd angle,the unaffected mothers showed higher asymmetry of fingerprint patterns in contrast to the controls. Arches predominated in unaffected fathers and proved significant. This study aids the proposition of genetic determinant in the parents of affected children in procuring this hereditary disorder.

Sunita U.Sawant (2013) performed a cross sectional study and compared the dermatoglyphic patterns of male schizophrenic patients with the fingerprints obtained from the normal community. The schizophrenic patients showed significant reduction in arch patterns ($p<0.001$) and increase in atd angle. He asserted that dermatoglyphic configurations can be used in the early diagnosis of the disease when clinical features of schizophrenia are suspected.

Warda Nazir Qazi1(2014) analyzed the finger print patterns of hundred females with recurrent pregnancy loss and hundred females without recurrent loss of pregnancy. This study unveiled a remarkable increase in total finger ridge count (TFRC), absolute finger ridge count (AFRC) in the cases. The above factors proved to be statistically significant. The valid presence of whorls, radial loops and atd angle and the decline in the incidence of ulnar loops in the females with recurrent pregnancy loss was evident. He declared that this study enfolds the association between recurrent pregnancy loss and heredity with the aid of dermatoglyphics.

Seile Yohannes (2015) critically reviewed the studies that propounded the relationship between dermatoglyphics and type2 diabetes mellitus that was performed over a period of 42 years (1972-2014). He proposed that owing to the notable reflection of patterns in affected individuals further explorations on a larger sample size are imperative.

Venkatesh Babu NS (2015) reported the dermatoglyphic patterns in a male child affected with ectodermal dysplasia. The type of epidermal ridges, axial tri radii and atd angle were studied and the findings did not show much of a variation.

Vijay Nayak (2015) reported that there is no remarkable differentiation in the incidence of ulnar and radial loops, arches and whorls in patients with Type 2 diabetes mellitus and normal subjects. The measurement of atd angle was

statistically significant in the diabetics and proved to be useful in the pre detection of diabetes.

Azra Mubeen Karnul (2015) demonstrated dermatoglyphic patterns of vitiligo males and females. The males presented with increased loop patterns on 2^{nd} 3^{rd} and 4^{th} digits in both hands. The whorls decreased in incidence. Arches dominated the patterns in females. The distal displacement of axial tri radii in the left hand of females and reduction in the atd angle in males were statistically significant. The divergence in the pattern may support as a marker for the diagnosis of vitiligo.

Muthiara Hidayah (2016) studied the fingerprint patterns, total finger ridge count, axial tri radii, a-b ridge count and atd angle in thirty students with simian crease and thirty students without simian crease in Minangkabau race of Indonesia. The simian crease group showed increased frequency of whorls. The other factors were insignificant compared to the control group. Apart from simian crease, atd angle was advocated as one of the determinants to foretell trisomy 21.

DERMATOGLYPHICS IN HEALTHY SUBJECTS

Overall loops were the common pattern followed by whorls and arches. The index, middle and little fingers showed loops while thumb and ring fingers had whorls. The predisposition for arches on the index finger was conspicuous in males (68%) than females (44%). No sexual dimorphism was evident. The

above findings were reported in one hundred and ten medical students of Sikkim- Manipal Institute of Medical Sciences, Gangtok **(Tanuj Kanchan et al 2006).**

Kanchan et al (2006) studied the fingerprint patterns of 110 medical students at Sikkim-Manipal Institute of Medical Sciences, Gangtok. In both the genders, loops were the predominantly occurring pattern which was followed by whorls and arches. The commonly occurring pattern on the index, middle and little finger were loops. Amidst the three, loops dominated the little finger (77.7%). Middle finger had 73.7% and index finger had 49.1% respectively. Whorls were common in the ring finger (55%) followed by thumb (53.6%) and index finger (38.2%). Arches were more marked on the index finger which was more pronounced in males (68%).

Sharma P et al (2007) analyzed the variations in fingerprints among the students of North, West, East and South India. The western cohort possessed arch pattern bilaterally. The north cohort had ulnar loops predominantly. The five cohorts had uniform distribution of whorls. The total ridge count was statistically significant between north and east cohort ($p<0.001$) and also between east and west cohort ($p<0.001$). The total ridge count showed sexual dimorphism in all the cohorts.

The whorls often occurred among males (52.19%) and females (55.69%) followed by loops. Males had 47.70% of loops and females had 42.81%. The total finger ridge count, absolute finger ridge count and the pattern intensity

index did not show statistical significant differences. This was reported by **Banik S.D et al (2009)** among Rengma Nagas, a major Mongoloid ethnic race in the North Eastern State of Nagaland, India.

Imtiaz Ahmed (2010) studied the fingerprints of medical students of PMC, Faisalabad. He asserted that ulnar loop is the leading pattern and more pronounced in male subjects. The second leading pattern is the whorl pattern more conspicuous in females. Radial loop presents in a sporadic manner.

Subir Biswas (2011) determined the dermatoglyphic patterns of Dhimals, a sub Himalayan tribe of West Bengal, India. The whorls (52.65%) were more common followed by loops (45.25%). The total finger ridge count in males was high compared to females.

Anibor E et al (2011) determined the fingerprint patterns, atd angle a-b ridge count and total finger ridge count in the Ijaws in Delta state of Nigeria. He reported that Ijaw males TFRC was higher than females ($p<.001$) but a-b ridge count was low on comparison with females ($p<.005$).the qualitative parameters of the digits such as arch, whorl and loop proved to be unique for an individual.

Muralidhar Reddy Sangam (2011) reported the frequency of dermatoglyphic patterns in 268 males and 238 females. Loops (56.3%) being the most common, followed by whorls (39.5%) and then arches (4.2%). The females showed higher loop pattern (60.5%) compared to males (52.3%) whorls were found more in males (44%) than females (34.3%). Arches were more common

in females (5.5%) than males (3.7%). Whorls were predominantly found in the thumb, index and ring fingers and minimal in the middle and little fingers which possessed loop pattern. Strikingly females had loops in all the digits except ring finger.

Sally B. Gutierez et al (2012) explored the fingerprint parameters obtained from the Puray's Dumagat-Remontados, Rodriguez, and Rizal, Philippines. The ulnar loop pattern dominated. Apart from the loop and whorl configurations, a distinctive attribute was the presence of club dent in at least one of the fingers. Males had higher TFRC.

Eboh D.E.O. (2012) assessed the fingerprint features of the Anioma and Urhobo population of Nigeria. The pattern that dominated the fingerprint in both the groups was loop followed by whorls and arches. The gender and finger print patterns did not show any association ($p>0.05$). A significant linkage persisted between ethnicity and finger print pattern ($p<0.05$).

Sayed Yunus Khadri et al (2013) stated that the notable fingerprint pattern in male was ulnar loop (38.42%) followed by plain whorl (24.04%). In females, ulnar loop was 44.56% followed by plain whorl (18.24%). The ridge count was higher in males and it was 12.4 and females it was 12 respectively. Ulnar loop proved to be the predominant fingerprint pattern in both genders.

Hansi D.Bansal et al (2014) conducted a dermatoglyphic study on 536 Marathi subjects of which 256 were males and 280 were females in the city of

Nagpur, India. The most commonly occurring pattern was ulnar loop (51.3%). No sexual dimorphism was present in this study.

Neeti Kapoor et al (2014) studied the dermatoglyphic configurations on 480 Muslim residents in Nagpur, Maharashtra, India. Loops were present in 50.25% of population followed by whorls (28%), composites (17.33%) and arches (4.42%).On further classification of loops, ulnar loops dominated (48.42%). The least common loop was found to be lateral pocket loop (1.58%). He recommended a new combined pattern index which included all the four pattern types.

Nithin Mathew et al (2015) determined the sub types in fingerprint pattern occurring in highest frequency among the South Indian population. Ulnar loop was the commonest type in both males and females. Among whorls, spiral whorls were the frequently occurring pattern. Plain arch among arches and twinned loop among composite were the common sub types observed. Considering gender wise distribution, the principal pattern in males and females was ulnar loop and the least commonly occurring pattern in males being composite loop and in females was tented arch.

The dermatoglyphic configurations of seventy male and seventy female students studying in first year of MBBS at Indira Gandhi Government medical College, Nagpur, India were analyzed by **Amit A.Mehta et al (2015).** He concluded by saying that loops predominantly occurred in both genders and arches were the least. Loops were prevalent more in the middle and little

finger. In males whorls occurred more in the ring finger. The index finger of both males and females had arches.

The frequency of distribution of fingerprint pattern among class XI and class XII students and teachers as reported by **Nagaraj et al (2015)** were as follows: 1. Loops (64%) being the commonest pattern 2. Composite pattern was least occurring. He concluded that the fingerprints pattern were gender based.

Molla Taye (2016) studied the fingerprint patterns and ridge counts among the students of university of Gondar, Northwest Ethiopia. He stated that the most frequently occurring dermatoglyphic pattern was ulnar loops (52.7%) followed by central pocket whorl (22%), and tented arch (13.53%). The total ridge count in males was higher than females.

Kapil Mandrah (2016) studied the thumbprints of 100 subjects of Dr. Harisingh Gour University, Sagar, Madhya Pradesh, India. This study focussed only on the whorl pattern in thumb and it constituted to 30-35%.

Siddapur R.K (2017) stated the link between fingerprint pattern and cognitive execution among the medical students of Velammal Medical Institute and Research. Incidently students with arch pattern fingerprint scored better in the intelligence test. Statistical analysis helped to differentiate that the female students with arch pattern of fingerprint surpassed in performance and accorded to the comprehensive superior accomplishment of the students with arch fingerprint pattern.

Nayan Kumar Das (2018) collected the fingerprints of two hundred medical students of Tezpur Medical College, Tezpur, Assam, India. He observed the following:

- Maximum number of loop (52.3%) followed by whorl (42.2%)
- Loops mostly occurred in the middle and little fingers and whorls in ring finger and thumb
- Statistically significant gender differentiation in the dispersal of fingerprint patterns
- Index finger show more of arches

DERMATOGLYPHICS AND DIABETES MELLITUS

Igbigbi P S et al (2001) documented that arches were the chief pattern followed by loops. Arches were absent in the first digit of diabetic patients. Loops appeared only in the first digit.

Irrespective of the onset of the affliction or the sequel kindled by Type 2 Diabetes mellitus, the dermatoglyphic print of patients endorse as a preventive tool in medicine. **(Ana Tarca 2006).**

Pramila padmini M et al (2011) reported the notable increase in TFRC and AFRC in the diabetic subjects of both genders. The female diabetics show more arches. The male diabetics show increased a-t-d angle. The female diabetics do not unveil remarkable attributes in a-t-d angle.

The frequency of loops being higher significantly while the whorl and arch patterns showed increased incidence insignificantly. The spiral whorl pattern was confined to the palmar areas in male diabetics. All the C-line patterns were decreased in diabetics except radial variety. The a-b ridge count, TFRC and AFRC in the diabetics were increased. The a-t-d angles were higher whereas the t-a-d angle and t-d-a angle were lower in diabetics. The above were the results observed by **Manoj Kumar Sharma et al (2012)** among fifty patients with diabetes versus fifty controls.

Shivaleela C et al (2013) reported that arches were less frequent in patients with Type 2 Diabetes mellitus and Ischemic heart disease. Whorls emerged higher than the other patterns and were statistically significant.

Rakate et al (2013) compared the fingerprint patterns of seventy five patients with diabetes mellitus and seventy five individuals without diabetes mellitus. The diabetics and non diabetics showed increased incidence of whorls and ulnar loop respectively. The TFRC and a-b ridge count were higher compared to the controls. The diabetics had a wider a-t-d angle.

Shrivastava et al (2013) reported that whorls were in majority in the diabetics of both genders. Loops were the most common in non diabetics of both genders.

Sumangala devi .K et al (2013) compared the dermatoglyphic configurations of Type 1 Diabetes mellitus patients against controls and postulated the following findings:

- The whorls are primarily limited in the 1st digit.
- The male diabetics show increased frequency of ulnar loops in all the digits except 1st digit.
- The radial loops confined to the 2nd digit.
- The mean axial tri radius is increased.
- Similarity exists in a-t-d and a-d-t angle.
- The a-b ridge count and TFRC are low.

Shivali Srivastava et al (2014) described the fingerprint patterns and a-t-d angle of patients with diabetes mellitus. The digital pattern manifested as a vital framework in distinguishing the diabetic and non diabetics. The whorl pattern prevailed more in diabetics and the ulnar loops were the cardinal pattern in non diabetics. The a-t-d angle in diabetics and non diabetics remained insignificant

Sudagar .M et al (2014) compared the palmar patterns in one hundred and fifty patients with diabetes mellitus with one hundred and fifty normal subjects. The a-b ridge count does not show statistical significance between cases and controls. The mean of a-t-d angle shows a marginal drop in diabetics in the present study. The position of axial tri radii is increased in the centre as well as proximally and decreased distally in cases.

Praveen Ojha et al (2014) reported the qualitative and quantitative parameters of fingerprint among one hundred subjects with type 2 diabetes mellitus. They were as follows:

- Increased frequency of whorls and decreased frequency of loops especially on the 2nd, 3rd and 4th digits.
- Deviation of axial tri radii radially
- Radial pattern of C main line
- Raised TFRC
- Raised AFRC
- Raised a-t-d angle
- Raised t-d-a angle
- Decreased t-d-a angle

Supriya P.Satpute (2015) collated the fingerprint patterns of diabetics in Maharashtra. There was an appreciable rise in the occurrence of whorls in female diabetics (37.85%). The male diabetics had more of ulnar loops (52.70%), decreased radial loops (1.45%) when compared to normal males. A statistically remarkable increase in pattern in hypothenar area (17%) was noted. The presence of simian crease and ridge dissociation are noted.

Vijay Nayak et al (2015) related the role of dermatoglyphic in predicting Type 2 Diabetes mellitus. The fingerprint patterns of fifty patients with diabetes mellitus were collected. He reported that the qualitative parameters did not prove much helpful but the quantitative parameters such as a-t-d angle remained helpful. The a-t-d angle was significantly higher (43.75) in diabetics than the normal population (38.35).

Sona Mohan et al (2015) reported the a-t-d, t-d-a and d-a-t angles of individuals with diabetes mellitus. The d-a-t angle of right hand of diabetics showed a statistically significant difference.

Tushar Nayak et al (2015) reported that the whorl pattern decreased in the female diabetics (30.25%) and the cases (33.4%). He stated that dactyl graph can be used as a mass screening modality for early detection and prevention of Non Insulin Dependent Diabetes Mellitus.

Anju Bala et al (2015) recorded the a-b ridge count and a-t-d angle of diabetic subjects. The females with diabetes mellitus, the right hands of male and the left hand of females with diabetes and hypertension had statistically significant a-b ridge count. The diabetes subjects and the diabetes with hypertension subjects had decreased a-t-d angle.

Ghosh J.R et al (2016) has clearly described the incidence of whorl, ulnar loop, radial loop, plain arch, tented arch and composite arch as 18.33%, 60%, 2%, 9%, 0.33% and 10.67% respectively. The most frequently occurring pattern was observed as ulnar loop and the pattern that occurred less was whorls. The incidence of plain arch and composite arch were on par in diabetics. Statistically significant results existed in the palmar patterns of diabetics ($p<0.05$).

Perumal et al (2016) disclosed the results of the qualitative and quantitative parameters of fingerprints conducted on patients with Type 2 Diabetes mellitus. The ulnar loop dominated in the left thumb, middle, ring and little fingers of male diabetics and in right thumb of female diabetics. The mean ridge count remarkably decreased in left thumb of male diabetics (14.90) when compared

to normal subjects (18.76) whereas it increased in female diabetics (15.24) when compared to normal individuals (14.62).

Anju Bala et al (2016) scrutinized the fingerprint lay out, atd angle, dat angle, adt angle, absolute finger ridge count (AFRC), total finger ridge count (TFRC), a-b ridge count, main line index and pattern index of one hundred patients with diabetes with one hundred patients with diabetes and hypertension. The following were the findings in patients with diabetes mellitus:

- The ulnar loops were more in the right hand of the male diabetics and lower in the left hand of male diabetics.
- The females had less ulnar loops in both hands.
- Higher atd angle
- D-a-t angle lower in right hand and higher in left hand
- Lower ridge count in male
- Higher ridge count in female
- TFRC and AFRC increased in male diabetics
- TFRC and AFRC decreased in female diabetics
- a-b ridge count decreased in male diabetics
- a-b ridge count increased in female diabetics

She highlighted that dermatoglyphic can be employed in childhood detection of Diabetes.

Ghosh J R et al (2016) proclaimed the outcome of his survey as mentioned below:

- Notable incidence of multiple tri radii ($p<0.05$).
- Low c-d ridge count, a-b ridge count, t-d ridge count with statistical significance.

Sehmi (2018) stated that dermatoglyphic can be considered as one of the best screening modality of diabetes mellitus which is cost effective.

No statistically significant differences prevail in the dermatoglyphic print of diabetics and non diabetic **(Manjusha Pet al 2018).**

MATERIALS AND METHODOLOGY

Ethical clearance

Ethical clearance was sought from the Institutional Human Ethics Committee (IHEC).

Study design

This is an Observational descriptive study involving the

- Fingerprint and palmar prints of medical students
- Fingerprint and palmar prints of patients with diabetes mellitus

Consent for the study

Informed and written consent was obtained from the study participants. For the participants who were unable to understand English, consent was taken in Tamil.

Study population

South Indian population

Sample size

- 200 medical students (100 males and 100 females)
- 50 patients with Type 2 Diabetes mellitus

Inclusion and exclusion criteria of samples

Medical students

Inclusion criteria

- Students aged above 18 years -25 years.
- Healthy students

Exclusion criteria

- Students with genetic disorders, medical disorders like asthma, epilepsy etc.
- Type 1 diabetes mellitus
- Deformities or injuries present in the palms and fingers.

Patients with Type 2 Diabetes mellitus

Inclusion criteria

- Clinically diagnosed and confirmed diabetics on medication
- aged between 30-60 years
- absence of genetic disorder

Exclusion criteria

- Patients with co-morbidities
- Amputated fingers and injured palms and fingers

Method of recording finger and palm print

The Standard Ink method designed by Cummins and Midlo in 1961 was employed for recording fingerprints and palmar prints. This method had the following advantages:

- Simple technique
- Transparency of prints
- Less time consuming
- Inexpensive

Required materials (*Figure 1)*

- Camel quick drying duplicate ink
- Cotton puff
- Round bottle
- Scale
- Pencil / pen
- Protractor - to measure the atd angle
- Needle – to count the ridges
- Magnifying lens
- Printed proforma sheets – for recording the prints
- Hand wash and towel – wash and dry the hands

Procedure

1. The participants were requested to wash their hands with soap and water and dried. Care was taken to remove all the greasy material.

2. A dab of ink was placed over the palm. The entire palmar surface was smeared with ink including the fingers. Uniformity in spreading the ink on the palm was taken care. Cotton puffs were used to fill the hollow areas. (***Figure 2)***

3. A round bottle was placed over the edge of a table. The printed proforma sheet was placed over the bottle.

4. The upper end of the paper was set to remain in contact with the bottle by placing the fingertips of the right hand over the sheet.

5. The fingers and the palm were subsequently rolled over by applying minimum pressure so that the bottle and the paper moved forwards. In this way the palmar and finger prints were obtained.

6. In addition to this, the rolled fingerprints were recorded in the boxes provided in the proforma sheets. (***Figure 3)***

7. The fingers were smeared with ink using cotton puffs and were gently rolled. The thumb was rolled from medial to lateral side and all the other fingers were rolled from lateral to medial side.

8. The prints obtained were checked for clarity of the prints and was repeated if necessary.

9. Then the participants were asked to wash their hands.
10. The same procedure was repeated for left hand also.
11. The prints were scanned and saved.

12. The impressions were analysed using a magnifying lens. The qualitative and quantitative parameters were analysed and recorded in the same paper.

RESULTS

QUALITATIVE ANALYSIS

Fingertip pattern in medical students

The finger prints were obtained from 200 medical students which consisted of 2000 digital prints. The patterns and the sub types were analysed. Loops were the predominant fingertip pattern among the students in both right and left hands. Among 2000 digital prints that were analysed, 1210 were loops, 607 were whorls, 110 were arches and 73 were composite.

The percentage of loops was 60.5%, whorls were 30.35%, arches were 5.5%, and composite was 3.65%. ***(Graph 1)***

Among the loops, the ulnar loop was commonest with 1177 digital prints with 58.85%. Radial loop was observed in 33 digital prints with 1.65%. The loops frequently occurred in the little finger of both hands followed by middle finger and were least in the ring finger.

The whorls predominantly occurred in the ring finger of both hands.

The arches were found more in the index finger of both hands. Simple arches were in 75 in number (2.5%) and tented arches were 35 in number (1.75%). Tented arch was absent in the left little finger.

Among the composite pattern 36 digital prints were double loop (1.5%) followed by 30 digital prints with central pocket loop (1%), 5 prints with lateral pocket loop (0.16%) and 2 prints with accidental loop (0.06%).

The distribution of the type of patterns were analysed for males and females.

Fingertip pattern in males

Loops were the predominant pattern. Among the 1000 fingertips, loops were 605 in number, whorls 308 in number, arches 53 in number and composite 34 in number. The percentage of loops was 60.50%, whorls were 30.80%, arches were 5.30% and composite was 3.40% in both right and left hands. ***(Graph 2)***

Among the 605 loops, 588 prints (58.8%) were ulnar loops and 17 prints (1.7%) were radial loops. Radial loop was absent in the right thumb.

Simple arches were in 35 digital prints (3.5%) and tented arches were in 18 fingertip prints (1.8%).

Among the 34 digital prints with composites, 19 prints were double loop, 12 prints were central pocket loop, 1 print was lateral pocket and 2 prints were accidental loop. Their percentages were 1.9%, 1.2%, 0.1% and 0.2% respectively.

The ulnar loop was predominantly present in the little finger followed by middle finger and index finger in the right hand. It was less frequent in the ring finger.

In the left hand the little finger showed highest frequency of ulnar loops followed by thumb and the middle finger.

Arches commonly occurred in the index finger of both hands and occurred least in the little finger.

The whorls were found frequent in the ring finger in both hands. Of the total 308 whorl fingertip prints, 106 digital prints with whorls occurred in the ring finger.

The double loop (1.9%) was the commonly occurring composite pattern followed by the central pocket loop (1.2%). The least was lateral pocket (0.1%). The accidental loop occurred only in the right middle finger and was not present in the left hand.

Finger tip pattern in females

The most frequently distributed fingertip pattern was loops (60.5%) followed by the whorls (29.9%), arches (5.7%) and composites (3.9%). ***(Graph 3)***

The total number of loops present in the fingertips was 605 which comprised of 589 fingertips with ulnar loops (58.90%) and 16 fingertips with radial loops (1.6%).

The ulnar loops predominantly occurred in the 149 fingertips of little finger of both hands followed by 133 fingertips of middle finger. The ulnar loops were least in the ring finger (80 digital prints).

The radial loops were absent in the left ring finger.

The whorls occurred in 299 fingertips (29.9%). Of the 299 whorl digital prints, 108 digital prints appeared in the ring finger of both the hands.

The total number of arches was present in 57 fingertips (5.7%) of which 40 fingertips had simple arch (4%) and 17 fingertips had tented arch (1.7%).

Simple arch was absent in the left ring finger and tented arch was absent in the right little finger.

Arches frequently occurred in the index finger of both hands.

The frequently occurring composite pattern was central pocket loop (1.8%) followed by double loop (1.7%) and lateral pocket loop (4%). In the right hand accidental loop was absent. In the left hand, both accidental loop as well as lateral pocket loop was absent.

Distribution of fingerprints in individual digits

Thumb

The commonest pattern in thumb was loop. In the right thumb the second commonest pattern was whorl which occurred in 66 fingertips followed by composite in 16 fingertips and arch in 10 fingertips. In the left thumb, loop was followed by whorl, arch and composite in 54, 12 and 9 fingertips.

The total number of loops present in the fingertips of right thumb was 109 and the in the left thumb was 125.

Whorl pattern is low in the left thumb (in 54 digital prints) compared to the right thumb.

Index finger

Loop was the predominantly occurring pattern. Loop was followed by whorl, arch and composite in both the index fingers. Loop pattern accounted to 122 fingertips in the right and 120 fingertips in the left.

The number of arches was high in both the right (in 25 digital prints) and left (in 25 digital prints) index fingers compared to others.

Lateral pocket loop and accidental loop were completely absent in both the sides.

Middle finger

The major pattern found in both the middle fingers was loop pattern. The distribution of the pattern types in the right middle finger was loop (in 137 digital prints), whorl (in 37 digital prints), composite (in 14 digital prints) and arch (in 12 digital prints).

The left middle finger showed loop (in 126 digital prints), whorl (in 58 digital prints), arch (in 10 digital prints) and composite (in 6 digital prints) configurations in increasing order of occurrence.

Ring finger

The dominant pattern in the ring finger was whorls in both the sides. In the right ring finger the whorls were 109 followed by loops (in 78 digital prints), arches (in 8 digital prints) and composites (in 5 digital prints).

In the left finger the whorls (in 105 digital prints) were followed by loops (in 90 digital prints), composites (in 3 digital prints) and arches (in 2 digital prints). Lateral pocket loop and accidental loop were absent in both the ring fingers. In addition to it, simple arch was absent in left ring finger.

Little finger

The principal pattern found in the little finger of both the sides was loop. The number of loops that appeared in the fingertip of right hand was 153 and left hand was 150.

The second leading pattern was whorls (in 40 digital prints), composites (in 4 digital prints) and arches (in 93 digital prints) in the right little finger and whorls (in 460 digital prints), arches (in 3 digital prints) and composite (in 1 digital print) in the left little finger.

Lateral pocket loop and accidental loop were absent on the right. In the left, double loop, lateral pocket loop, accidental loop and tented arch were absent. ***(Graph7&8)***

Sub types in loop pattern

The total number of loops present was 1210 (60.5%). Of this ulnar loops were 1177 (58.85%) and radial loops were 33 (1.65%). The right hand had 599 loops and the left hand had 611 loops in the fingertips.

The ulnar loops occurred more in the little finger of both sides and in both genders. Males had 148 ulnar loops in the fingertips of little finger and females had 149 ulnar loops in the fingertips of little finger.

In males, the radial loops occurred more in the index finger of both the sides. Radial loop was absent in the right thumb.

In females, radial loop was absent in the left ring finger. The total number of radial loops present in right and left hand fingertips was 16.

The total number of loops, ulnar loop and radial loop were more in the left hand than the right hand.

Sub types in arch configuration

110 digital prints had arches. They constituted 5.5% of the total fingerprint pattern. The number of simple arch was 75 and tented arch was 35. The number of arches present in the right hand (in 58 digital prints) was more than the left hand (in 52 digital prints).

Arches were chiefly present in the index finger of both sides and in both genders.

In males the percentage of simple arch was 3.5% and tented arch was 1.8%. Simple arch was absent in the left ring finger and little finger. Tented arch was absent in the right and left little finger.

In females the percentage of simple arch was 4% and tented arch was 1.7%. Simple arch was absent in the left ring finger and tented arch was absent in the left little finger.

The frequency of occurrence of arches was high in the right hand.

Sub types in composite pattern

The total number of composites was in 73 digital prints. The percentage of double loop was 1.5%, central pocket loop was 1%, lateral pocket loop was 0.16% and accidental loop was 0.06%.

The number of double loop was more in males (19 in number). The number of central pocket loop was more in females (18 in number).

The right hand (45 in number) had more composites than left hand (28 in number).

In the right hand accidental loop occurred in the middle finger alone. Lateral pocket loop occurred in the thumb and middle finger.

In the left hand, double loop was absent in the little finger. Accidental loop and lateral pocket loop were absent in left hand. ***(Graph 11&12)***

Finger tip pattern in patients with diabetes mellitus

500 fingerprints were obtained and analysed. Whorls were the chief pattern to occur followed by loops, arches and composites.

Of the 500 fingertip prints, 223 prints were whorls, 197 digital prints were loops, 58 digital prints were arches and 22 digital prints were composites. The percentage of whorls was 44.6%, loops 39.4%, arch 11.6% and composites 4.4%. ***(Graph 4)***

The whorls were equally distributed in all the digits.

Among the loop pattern, ulnar loop was the commonest to occur. It was in 193 digital prints. The radial loop was in 2 fingertips. The percentage of ulnar loop was 38.6% and radial loop was 0.8%. Ulnar loop was distributed more in the thumb of both hands.

The percentage of simple arch and tented arch were 10.2% and 1.4% respectively. Simple arches occurred more in the left hand (33 in number) compared to the right hand (25 in number).

In the right hand, tented arch appeared only in the index finger and ring finger. In the left hand, tented arch was absent in all the fingers except the middle finger. Simple arch was absent in the right ring finger.

The total number of composites present was in 22 fingertips (4.4%) which comprised of 10 prints with double loop, 8 prints with central pocket loop, 3 prints with lateral pocket loop and 1 print with accidental loop. The percentage of double loop, central pocket loop, lateral pocket loop and accidental loop were 2%, 1.6%, 0.6% and 0.2% respectively.

Finger tip pattern in male diabetes patients

A total of 250 finger tip prints were obtained. The whorls were the pattern that occurred commonly followed by loops, arches and composites. The total number of whorls observed in the fingertips was 108, loops in 104 digital prints, arch in 24 digital prints and composites in 14 fingertips and their percentages were 43.2%, 41.6%, 9.6% and 5.6% respectively. ***(Graph 5)***

There was equal distribution of whorls in both the hands as well as in all the digits.

The ulnar loop (40.8%) was in 102 digital prints and radial loop (0.8%) was in 2 fingertips. The radial loop was absent in all the digits except the right index finger and left middle finger.

The number of simple arch to occur was in 22 digital prints and tented arch was in 2 digital prints with 8.8% and 0.8%. Simple arch was absent in the right ring finger. Tented arch was absent in the left hand.

Composites were in 14 digital prints which were sub divided into 9 digital prints with double loop, 4 digital prints with central pocket loop and 1 digital print with lateral pocket loop. Accidental loop was absent. The

percentage of double loop, central pocket loop, lateral pocket loop and accidental loop were 3.6%, 1.6%, 0.4% and 0% respectively.

Fingerprint pattern in female diabetes patients

The whorl configuration was the predominant pattern in female diabetes subjects (46%). The next common pattern was the loop (37.2%) followed by arch (13.6) and composite (3.2%). ***(Graph 6)***

The total number of whorls was present in 115 digital prints with an equal distribution in all the digits.

The ulnar loop (36.4%) was distributed evenly in all the digits whereas the radial loop (0.8%) appeared only in the right thumb and left index finger.

The number of simple arches were in 29 digital prints (11.6%) and tented arches were in 5 digital prints (2%). The simple arch was absent in the right ring finger. In the right hand the tented arch appeared in the index and ring finger. In the left hand it occurred in the middle finger alone and was absent in the other digits.

The total of 8 composite digital prints were sub divided into 1 double loop digital print (0.4%), 4 central pocket loop digital prints (1.6%), 2 lateral pocket loop digital prints (0.8%) and 1 accidental loop digital print (0.4%). In the left hand only the central pocket loop was present and the other entire sub types of composite pattern were absent. The right hand showed all the sub types of composite pattern.

Distribution of finger print pattern in individual digits of diabetes patients

Thumb

Loop pattern was predominant in the right and left thumb followed by whorl and arch. The composite pattern did not occur in both the thumbs. Tented arch was absent in both the thumbs.

Index finger

Whorls were the commonly occurring pattern in both the index fingers followed by the loops, arch and composites. Tented arch was absent in the left index finger.

Middle finger

The number of whorls and loops in the right middle finger were equal. In the left, whorls occurred frequently followed by loops and arches. Tented arch and radial loop was absent in the right. In the left, double loop and accidental loop were absent.

Ring finger

Whorls were the predominant pattern in both the sides followed by loops, arches and composite.

The right ring finger did not possess simple arch, radial loop, lateral loop and accidental loop. The tented arch, radial loop, double loop, lateral pocket loop and accidental loop were absent in the left ring finger.

Little finger

Whorls followed by loops, arches and composites were the patterns distributed in the little finger of both sides.

The right little finger did not possess tented arch, radial loop, central pocket loop, lateral pocket loop and accidental loop. In the left the tented arch, radial loop and the entire composite pattern were absent. ***(Graph 9&10)***

QUANTITATIVE ANALYSIS

Total finger ridge count in medical students

The total finger ridge count in medical students was 24261 ridges. Among the 24261 ridges 53.90% (13077 ridges) were present in males and 46.09% (11184 ridges) were present in females.

The number of ridges present in the right hand was 12100 ridges (49.87%) and in the left hand were 12161 ridges (50.12%). The mean value of ridge counts in the right and left hands were 60.5 ± 10.10 and 60.80 ± 10.27. The mean value of the total finger ridge count was 121.30 ± 17.48. ***(Graph 13)***

Total finger ridge count in males

The total ridge count of males was 13077 ridges of which 6512 ridges were present in right hand (49.79%) and 6565 ridges were present in the left hand (50.20%).

The mean value of the total finger ridge count, ridge count in the right hand and ridge count in the left hand were 130.77 ± 16.33, 65.12 ± 10.3 and 65.65 ± 9.55 respectively.

Total finger ridge count in females

The female subjects had a total of 11184 ridges. Among those ridges 5588 ridges were present in the right hand (49.96%) and 5596 ridges were present in the left hand (50.03%).

The mean value of total ridge count, ridge count in the right and left hands were 111.81 ± 12.91, 55.88 ± 7.42 and 55.96 ± 8.56 respectively.

a- b ridge count in medical students

The total a-b ridge count was 13808 ridges with a mean value of 69.04 ± 3.99.

The a-b ridge count obtained in the right hand was 6908 ridges (50.02%) and in the left hand were 6900 ridges (49.97%) and their corresponding mean value value were 35.54 ± 2.77 and 34.5 ± 2.82. ***(Graph 14)***

Among the 13808 ridges, 49.25% (6801 ridges) were present in males and 50.74% (7007 ridges) were present in females.

a- b ridge count in males

The a-b ridge count in males was 6801 ridges (49.25%) with a mean value of 68.01 ± 3.71. Among the 6801 ridges, 3428 ridges (50.40%) were present in the right hand and 3373 ridges (49.59%) were present in the left hand.

The mean value of the a-b ridge count in right and left hands were 34.28 ± 2.59 and 33.73 ± 2.77 respectively.

a- b ridge count in females

The number of a-b ridges present in females was 7007 ridges with 50.74%. Of the 7007 ridges, 3480 ridges (49.66%) were present in the right hand and 3527 ridges (50.33%) were present in the left hand.

The mean value of the a-b ridge count, a-b ridge count of right hand and a-b ridge count of the left hand were 70.07 ± 4.01, 34.8 ± 2.94 and 35.27 ± 2.67 respectively.

atd angle in males

The mean value of atd angle in the right hand of males was 39.35 ± 3.77 and in the left hand was 38.35 ± 3.27. The range of the atd angle was between 30° to 50°. ***(Graph 15)***

atd angles in females

The mean value of atd angle in the right palm was 39.81 ± 5.13 and in the left palm was 39.83 ± 4.84. The range of the atd angle was found to be between 30° and 50°. ***(Graph 15)***

Total finger ridge count in diabetes patients

The total finger ridge count was 5600 ridges with a mean value of 113.2 ± 14.05. Among the 5600 ridges, 51.01% (2857 ridges) constituted ridges from right hand and 50.23% (2813 ridges) constituted ridges from the left hand.

The mean value of the total finger ridge counts were 57.14±10.54 and 56.26 ± 11.32 respectively. ***(Graph 16)***

Total finger ridge count in male diabetes patients

Among the 2870 ridges (51.25%) of the male diabetes subjects, 1387 ridges (48.32%) were present in the right hand and 1493 ridges (52.02%) were present in the left hand.

The mean value of the total finger ridge count, total finger ridge count in right and left hands were 114.8 ± 15.56, 55.48 ± 9.36 and 59.72 ± 10.55.

Total finger ridge count in female diabetes patients

The total finger ridge count of female diabetes patients was 2790 ridges (49.82%) with a mean value of 111.6 ± 12.49.

The mean value of total finger ridge count in the right hand was 58.8 ± 11.55 and left hand was 52.8 ± 11.21. There were 1470 ridges (52.68%) in the right hand and 1320 ridges (47.31%) in the left hand.

a- b ridge count in diabetes patients

The a - b ridge count in the diabetes patients was 3088 ridges, of which 1518 ridges (49.15%) were present in the right palm and 1570 ridges (50.84%) were present in the left palm. ***(Graph 17)***

The mean value of a-b ridge count was 61.76 ± 8.55 and the mean value of a-b ridge counts of right and left side were 30.36 ± 6.03 and 31.4 ± 5.29.

a- b ridge count in male diabetes patients

The number of a-b ridges was 1563 in number (50.61%) with a mean value of 62.52±8.05. Among the 1563 a-b ridges that were present in male diabetes patients, 773 ridges (49.45%) was present in the right hand with a

mean value of 30.92 ± 5.72 and 790 ridges (50.54%) were present in left hand with a mean value of 31.6 ± 4.91.

a- b ridge count in female diabetes patients

The a- b ridge count in female diabetes patients was 1525 ridges (49.38%) with a mean value of 61± 9.11. 745 ridges (48.85%) were present in the right hand with a mean value of 29.8 ± 6.40 and 780 ridges were present in the left hand with a mean value of 31.2 ± 5.73.

atd angle in diabetes subjects

The range of the atd angle in diabetes patients existed between 34° and 52°. The mean value of atd angle in the right palm was 42.86±4.43 and left was 41.76 ± 7.14. ***(Graph 18)***

atd angle in male diabetes subjects

The mean value of atd angle of male diabetes subjects was 41.52 ± 4.25 in the right palm and 40.28 ± 4.25 in the left palm respectively.

atd angles in female diabetes subjects

The mean value of atd angle in the right hand was 44.2 ± 4.27 and in the left hand was 43.24 ± 3.13.

Statistical significance between gender and the quantitative parameters

Statistical significance between the total finger ridge count in male and female medical students:

Independent t test revealed that among the 2000 digital prints, the total finger ridge counts in males (130.77 ± 16.33) was statistically higher than that in females (111.81 ± 12.91) t(198) =9.091, p=0.000.

Statistical significance between a-b ridge count in male and female medical students:

Among the 2000 digital prints, independent t test revealed the a-b ridge count in females (70.07 ± 4.01) was statistically higher than the a-b ridge count of males (68.01 ± 3.71) t(198) = -3.768, p=0.000.

Statistical significance between atd angle in male and female medical students:

Independent t test revealed that the atd angle of females (79.64 ± 7.91) was statistically higher than that of males (77.7 ± 5.23) t (198) = -2.045, p=0.042.

Statistical significance between total finger ridge count in male and female diabetics:

Independent t test revealed that there was no statistically significance between the total finger ridge count in males (114.80 ± 15.56) and the total finger ridge count in females (111.60 ± 12.49) t (48) = 0.802, p = 0.427.

Statistical significance between a-b ridge count in male and female diabetics:

By means of Independent t test it was found that there was no statistical significance between the a-b ridge count in males (62.52 ± 8.05) and females (61.00 ± 9.11) t (48) =0.625, p = 0.535.

Statistical significance between atd angle in male and female diabetics:

Independent t test disclosed that the atd angle in females (87.44 ± 5.13) was statistically higher when compared to the atd angle in males (81.80 ± 7.82) t (48) = -3.013, p = 0.004.

Statistical correlation between the quantitative parameters

A Pearson product – moment correlation was employed to determine the relationship between the total finger ridge count, a-b ridge count and the atd angle.

Statistical correlation of the quantitative parameters among the students:

There was a positive relation between the atd angle and the a-b ridge count, which was statistically significant at 0.05, r (198) =0.163, p=0.021.

There was a strong negative correlation between the total finger ridge count and a-b ridge count which was statistically significant at 0.01, r (198) = -0.22, p=0.001.

There was no statistically significant correlation between the total finger ridge count and the atd angle.

Statistical correlation of the quantitative parameters among the diabetics:

There was no significant correlation between the total finger ridge count, a-b ridge count and the atd angle.

DISCUSSION

QUALITATIVE ANALYSIS

Finger print pattern

The percentage of the different types of finger print patterns observed in the present study was

- Loops - 60.5%
- Whorls – 30.35%
- Arches – 5.5%
- Composite – 3.65%

Nithin MS et.al (2015) reported the fingerprint patterns of south Indian population. The findings were: Loops accounted for 57.1%, whorls 30.35%, composite 6.35% and arches 6.2 %.

Eboh DEO (2012) revealed that the digital dermatoglyphic patterns of Anioma and Urhobo students in Southern Nigeria and stated that loop was the dominant pattern followed by whorls and arches as given below:

Nigerian population	Loop	Whorl	Arch
Anioma	54.6%	28.4%	17%
Urhobo	56.6%	29.1%	14.6%

Gangadhar et.al (2003) reported that the predominantly occurring fingerprint pattern in the Adikarnatakas belonging to the Mysore city of Karnataka was loops (57.11%) which were followed by whorls (27.89%) and arches (15.00%).

Igbigbi P.S et.al (2005) stated that the ulnar loops were the commonly occurring pattern and arches were the least among the Kenyan and Tanzanian population.

Jaja B.N et.al (2008) reported that the ulnar loops were the most prevalent ridge configuration followed by whorls, arches and radial loops.

The predominance of ulnar loop than the whorls and arches observed in the present study (60.5%) was in consonance with the previous studies conducted by **Kobyliansky E et al (1987)** (57.12%), **Demarchi DA et al (1997)** (57.05%), **Igbigbi PS et al (2002)** (81.38%), **Karmakar B et al (2007)** (60.2%), **Rastogi et al (2010)** (60.95%), **Gutierez SB et al (2012)** (55.4%), **Khadri S Y et.al (2013)** (42.77%), **Bhavana et al (2013)** (58.9%), **Soman MA et al** (2013) (60.9%), **Wijerathne B et al (2013)** (58.53%), **Nanakorn et al (2013)** (50.9%) and **Nithin et.al (2015)** (57.1%). ***(Table 1)***

The distribution of whorl pattern in the current study is 30.35% which coincided with the reports of **Demarchi DA et al (1997)** (36.5%), **Karmakar B et al (2007)** (34.3%), and **Basu et al (2016)** (31.8%). ***(Table 7)***

Banik SD et al (2009) reported that the whorls were the most predominant pattern (53.94%) among the Nagas, a tribal mongoloid population in Nagaland but in the present study only 30.35% was observed. The other study that had a high incidence of whorl pattern was done by **Ching Cho (1998)** in New Zealand which was 51.15%.

The studies which had the chief dermatoglyphic configuration as whorls were those conducted by **Ching Cho (1998)** in the New Zealand Samoans (51.15%), **Banik S.D et.al (2009)** in the Rengma Nagas of Nagaland, India (53.94%) and **Subir Biswas (2011)** among the Dhimals of North Bengal, India (52.65%). The above studies reported that was whorls followed by loops.

Fingerprint pattern in males

The incidence of the different patterns of dermatoglyphic configurations in males recorded in the current study was loops 60.50%, whorls 30.80%, arches 5.30% and composite 3.40%. The chief pattern in males observed in the present study was loops which was similar to the studies conducted by **Penhalber EF et al (1994)** (64.07%), **Igbigbi PS et al (2005)** (78.96%) and **Ei – Sawwa et al (2017)** (50.6%) ***(Table 2)***

On comparing our results of loops being the predominant pattern with the studies reported from India, it was similar to the reports of **Nithin SM et al (2015)** (55.7%), **Bansal HD et al (2015)** (52.96%) and **Roshani S et al (2016)** (59.04%).

Our results were in contrast to the studies of **Ghosh et al (2011)** (18.23%) and **Soman MA et al (2013)** (46.8%) in which the whorls were the predominant pattern.

Narahari S et al (2006) reported that the loops were common (48.34%) but the prevalence of whorls was higher (43.83%).

The incidence of composites reported in the present study was low (3.40%) compared to the reports of **Khadri SY et al (2013)** (26.22%).

Fingerprint pattern in female students:

The most predominant fingerprint pattern in the current study was loops (60.50%) followed by whorls (29.90%), arches (5.7%) and composites (3.9%).

The predominance of loops were in consonance with the studies of Park KS et al (1984) (51.4%), **Penhalber EF et al (1994)** (64.24%), **Igbigbi PS (2005)** (76.36%), **Nithin SM et al (2015)** (58.5%), **Bansal HD (2015)** (55.32%), **Roshani S et al (2016)** (66.36%) and **El-Sawwa et al (2017)** (53%). ***(Table 3)***

The incidence of loops was high (60.50%) in the present study when compared to the studies of **Narahari S et al (2006)** (48.66%) and **Khadri SY et al (2013)** (46.24%).

The prevalence of composites was low in the current study (3.9%) when compared to the reports of **Khadri SY et al (2013)** (26.88%).

The percentage distribution of arches in the current study was 5.7% which was low when compared to the study of **Soman MA et al (2013)** (44.64%)

Sub type of loop pattern in male medical students

The percentage of distribution of ulnar loop and radial loop in the present study were 58.8% and 1.7%. The incidence of ulnar loops was in concordance with the studies of **Penhabler EF et al (1994)** (59.30%), **Rosa A et al (2009)** (60.4%) and **Roshani et al (2016)** (57.38%). ***(Table 4)***

Certain studies showed high incidence of ulnar loop, as reported by **Igbigbi PS et al (2005)** in Kenyans which was 72.62% and Tanzaniyans was 67.22%.

The study which had the lowest incidence of ulnar loop was reported by Anibor E et al (2011) which were 33.86%.

The incidence of ulnar loop of the current study was very high compared to a study conducted in India by **Khadri SY et al (2013)** (38.42%).

The distribution of radial loop in the current study was 1.7% which was similar to the reports of previous studies of **Park KS et al (1984)** (2.9%), **Crawford MH (1992)** (2.45%), **Sangam MR et al (2011)** (1.4%), **Nanakorn et al (2013)** (1.9%) and **Kapoor et al (2014)** (1.50%).

Sub type of loop pattern in female medical students

The incidence of ulnar loop and radial loop among females in the current study was 58.90% and 1.6% respectively. On comparing the incidence of ulnar loop with that of the previous studies the present values were in accordance with the reports documented by **Laha NN et al (1974)** (56.4%), **Crawford MH (1984)** (56.8%), **Penhabler EF et al (1994)** (60.37%), **Sangam MR et al (2011)** (58.1%) and **Bansal HD et al (2015)** (53.42%). ***(Table 5)***

The values observed in the current study were high compared to the studies of **Banik et al (2009), Khadri SY et al (2013)** and **Kapoor et al (2014)** which were conducted in North India and the prevalence of ulnar loop reported was 40.58%, 44.56% and 46% respectively.

The percentage distribution of radial loops in the present study was 1.6%. Our findings were similar to the previous studies of **Banik et al (2009**) (1.94%), **Rosa A et al (2009)** (1.69%), **Khadri SY et al (2013)** (1.68%), **Nanakorn et al (2013)** (1.4%), **Bansal H D et al (2015)** (1.9%) and **Roshani et al (2016)** (1.81%).

Igbigbi PS et al (2005) documented that the Kenyans and Tanzaniyans had increased incidence of loop pattern in females which was different when compared to the Caucasians which served as a tool in differentiating population groups.

Finger print pattern in individual digits

Nanakorn et al (2013) reported that in Thais, the radial loops occurred commonly on the index finger (9.1%), whorls were common on the thumb (39%) and little finger (34.1%) and double whorl was more common on the little finger (6.9%). The females had more number of ulnar loops on the right little finger (69%). The arches were significantly more in the left middle finger (5.3%) of females when compared to males.

Banik et al (2009) documented in his study that the first, second and fourth digit showed increased whorls (75%, 58.11% and 60.10%). Ulnar loop dominated the third (50.96%) and fifth digit (76.92%). Increased frequency of distribution of radial loop was found in second digit (12.98%). Increased frequency of simple arch was observed in fifth digit (0.49%) and tented arch was observed in third digit (0.96%). Among the females whorls were present more in the first, second, third and fourth digit (72.82%, 68.45%, 54.66% and 61.65%). The ulnar loop was predominant in the fifth digit (78.16%).

Kamarkar B et al (2002) analysed the finger prints among five ethnic groups of west Bengal. He reported that the ulnar loop was the most frequently occurring pattern and the order of occurrence in the digits in the left was V> III > I > IV > II and the right was V > III > I > II > IV for both the sexes. The whorls occurred similarly for males and females in both hands and the order of occurrence was IV > I > II > III > V.

In the current study, the commonest pattern in thumb was the loop pattern for males (57.5%) and females (59.5%). The index finger also had increased occurrence of ulnar loop but the percentage distribution was more in males (62.5%) when compared to females (58.5%). The middle finger also had increased prevalence of loop. In males it was 64% and in females it was 67.5%. in the ring finger there was increases incidence of whorl pattern in males and females (53% & 54%). The ring finger had increased occurrence of ulnar loop. Among all the digits the ulnar loop was found more in the little finger in both the genders (75.5% & 76).(table).The arches occurred more in the index finger and the composites occurred more in the thumb. ***(Table 8, 9, 10 &11)***

Fingerprint pattern in diabetes subjects

In the current study the percentage distribution of dermatoglyphic configurations are loops- 39.4%, whorls – 44.6%, composite – 4.4% and arches – 11.6%. The predominant fingerprint pattern that was observed in the present study was whorls followed by loops, arches and composites. The studies that reported whorls as the predominant pattern were by **Shivaleela C et al (2013)** (37.6%) and **Marera DO et al (2015)** (35.13%). (Table) The studies which had loops as the predominant pattern were by **Nayak T et al (2015)** (58.9%) and **Ghosh JR et al (2016)** (31%).

In the current study the diabetic males and females showed increased frequency of whorls (41.6% & 46%) and loop pattern was the second most

common in male and female diabetes subjects. This was similarly reported in the studies

The predominant pattern of whorls followed by loops was similarly observed in the studies of **Barta et al (1978), Sant et al (1983), Banerjee et al (1985), Rakate et al (2013), Ojha P et al (2014) and Srivastava S et al (2014).** This finding was in contrast to the findings of **Ravindranath et al (1995)** who reported that the diabetic subjects had increased loop pattern and decreased whorl pattern.

The frequency distribution of ulnar loop in males was 40.8% which was high when compared to the reports of **Marera DO et al (2015)** (14.6%) and low when compared to the study of **Nayak T et al (2015)** (57.66%). Our findings were similar to the studies of **Ojha P et al (2014)** (46.2%) and **Srivastava S et al (2014)** (43.5%). ***(Table 12, 13 & 14)***

Fingerprint pattern in individual digits in diabetes subjects

In the present study, the whorl pattern appeared equally in the index, middle and ring finger (48%). The ulnar loops were more in the thumb and the little finger (44%). The radial loop was absent in the middle, ring and little finger. Simple arch was found to occur in the thumb and middle finger higher when compared to the ring finger. The double loop occurred only in the ring finger (6%).The little finger did not have any composite pattern (0%).

Sumangala Devi et al (2016) reported that the whorls were predominantly appearing in the thumb in both genders in diabetes individuals.

In the current study it was found that the whorls were evenly distributed in all the digits.

Ojha P et al (2014) reported that the index, middle and ring finger in male and female diabetics show increased incidence of whorls and decreased incidence of loops.

According to the study of **Sumangala Devi et al (2016),** in female diabetics, whorls chiefly occurred in thumb, ulnar loop was the dominant pattern in all the digits and radial loops occurred only in the index finger.

She documented that the male diabetics had frequently occurring ulnar loops in all the digits except the thumb and the radial loops occurred only in the index finger.

In the current study it was found that the ulnar loop was equally distributed in all the digits and the thumb had the increased incidence of ulnar loops (48%). The radial loop was observed in the index and middle finger (2%). ***(Table 15 & 16)***

Total finger ridge count in medical students

The mean value of total finger ridge count of males in the current study was 130.77 ± 16.33. This was slightly higher than the value of the study reported by Savant SU et al (2013) which was reported as 127.86 ± 51.5 and lower than the reports of Karnul AM et al (2015) which was reported as 137.36.

The mean value of total finger ridge count in females in the current study was 111.81 ± 12.91. ***(Table 17)***

Kamarkar et al (2012) reported that the mean value of total finger ridge count in males was 160.81 and females were 155.96. the observations made in the present study was in concordance with this study in view of significantly higher total finger ridge count in males compared to that of females.

Park KS et al (1995) reported that the mean value of total finger ridge count in males was raised (140.4 ± 41.2) when compared to females (129.8 ± 40.6).

The total finger ridge count of males exceeded than the females and this was documented in the studies of **Schwidetzky et al (1977).**

Kobiliyansky E et al (2006) reported that the mean value of total finger ridge count in males (152.27) was raised when compared to females (140.93).

In the present study the mean value of the total finger ridge count in the right and left hands of males were 65.12 ± 10.3 and 65.65 ± 9.55. This was lower than the results of the study conducted by **Penhabler EF et al (1994)** which was 71.29±23.22 and 68.15±23.38.

Jantz et al (1974) reported that the Mongoloid population had the highest total finger ridge count (Bhutanese 155.35 and Tibetans 156.23) when compared to the American whites (134.74) and American blacks (130.53). She

also reported that the the lowest total finger ridge count was observed in the African blacks (123.50).

Bhashin MK et al (2007) stated that the mean value of total finger ridge count in India was 141.26. The range of the total finger ridge count varied from 107.60 in Jats of Delhi to 183.60 in Car Nicobarese. They also reported that the mean value of total finger ridge count when compared to other zones it was lowest in South zone (131.48). The present value of 121.30 is lower when compared to 131.48.

a - b ridge count in medical students

The mean values of a –b ridge count in the present study was 69.04 ± 3.99, in the right hand was 35.54 ± 2.77 and in the left hand was 34.5 ± 2.82. ***(Table 18)***This coincided with the reports of Oladipo GS et al (2007).

The mean values of a –b ridge count in males in this study was 68.01 ± 3.71 and females was 70.07 ± 4.01. On comparison with the studies conducted previously such as **Penhabler EF et al (1994), Igbigbi PS et al (2005), Kobiliyansky E et al (2006), Ozyurt B et al (2010), Karmakar B et al (2012)** and **Sharma MK (2012)** the current values were low. ***(Table 20)*** A statistically significant result was observed between the –b ridge counts of females than males.

atd angle in medical students

The mean value of atd angle obtained in present study in the right and left hand of males and females were 39.35 ± 3.77, 38.35 ± 3.27, 39.81 ± 5.13

and 39.83 ± 4.84 respectively. The mean atd angle of male was 77.7±5.23 and female was 79.64±7.9. ***(Table 19)***

Rosa A et al (2009) reported the mean atd angle in male and female as 79.6±14.4 and 76.7 ± 9.1.

The results of the current study were low compared to the study of **Penhabler EF et al (1994)** which reported that the atd angle varied from 41.27±5.59 to 43.16 ± 7.76 in the right hand and 41.66 ± 6.04 to 43.33 ± 8.16 in the left hand of males. In females it ranged from 42.33 ± 6.03 to 43.84 ± 7.64 and 43.06 ± 6.72 to 44.82 ± 8.65 in the right and left hands respectively.

In the present study the atd angle in female was more than male and was statistically significant and was similar to the study of **Penhabler EF et al (1994).**

The findings observed in the present study were lower when compared to the studies of **Enna CD et al (1969), Savant SU et al (2013), Oladipo GS et al (2007), Karnul AM et al (2015)** and **Anibor E et al (2011).** ***(Table 21)***

Total finger ridge count in diabetes subjects

The total finger ridge count reported in the present study was 113.2 ± 14.05. In males the mean value of total finger ridge count of right and left hands was 55.48 ± 9.36 and 59.72 ± 10.55 and in females it was 58.8 ± 11.55 and 52.8 ± 11.21. ***(Table 22)***

Ojha P et al (2014) reported the total finger ridge count in patients with type 2 diabetes mellitus in Udaipur region. He documented that the mean value of total finger ridge count in males was 85.58 ± 17.08 and in females was 84.96 ± 22.88.

Sumangala Devi K et al (2016) reported that the mean value of total finger ridge count in males was 75.62 ± 7.20 and in females was 67.33 ± 6.14.

The mean value of total finger ridge count of right and left hands of males were 74.62 and 73.60 and in females it was 72.70 and 74.54 as reported by **Rakate NS et al (2013).**

Ghosh JR et al (2016) reported that the mean value of total finger ridge count in the right hand was 82.03 ± 28.02 and in the left hand was 88.50 ± 24.07.

Igbigbi PS et al (2004) reported that the mean value of total finger ridge count in male was 123 ± 3.82 and in females was 140.15 ± 39.82.

In the present study the values are lower and were 114.8 ± 15.56 and 114.8 ± 15.56. The mean value of total finger ridge count was similar to the study of **Padmini MP et al (2011)** which was 106.25 ± 31.6 in case of males and 110.94 ± 32.59 in case of females. The current study did not show any significant changes in the total finger ridge count between males and females. ***(Table 25)***

a –b ridge count in diabetes subjects

The mean value of a – b ridge count in males in the right and left hands were 30.92 ± 5.72 and 31.6 ± 4.91 and in females it was 29.8 ± 6.40 and 31.2 ± 5.73 respectively. ***(Table 23)***

Dam PK et al (2006) stated that the mean value of a –b ridge count in males in the right was 37.61 and in the left was 38.72 and in females it was 39.42 and 40.34.

Sudagar M et al (2014) documented that the mean value of a – b ridge count in diabetics were 34.97 ± 5.33.

Ghosh JR et al (2016) reported that the mean value of a – b ridge count in the right and left palms were 31.70 ± 3.11 and 34.20 ± 2.91 respectively.

On comparing the results of the current study with the previous studies it was found that the values of the present study were low compared to the studies of **Igbigbi PS et al (2004), Sharma MK et al (2012), Rakate NS et al (2013), Sudagar M et al (2014), Sumangala Devi K et al (2016)** and **Shekar S (2018)** and high compared to the studies of **Padmini MP et al (2011)** and **Bala A et al (2016).** ***(Table 26)***

atd angle in diabetes subjects

Nayak V et al (2015) reported that the mean value of atd angle among the type 2 diabetes mellitus patients of Maharashtra accounted for 43.5 degrees in the right and 44 degrees in the left palm.

Mohan S et al (2015) in her study reported that the mean value of atd angle in the right was 40.85 ± 3.62 and in the left was 40.37 ± 4.00.

In a study conducted by **Ojha P et al (2014),** it was observed that the mean value of atd angle in males in the right was 79.48± 6.14 and left was 79.96 ± 6.14 and in females was 78.32 ± 8.32 and 77.88 ± 8.42 respectively.

Srivastava S et al (2014) reported that the mean value of atd angle in diabetic patients was 47.2 ranging from 34.2 to 80.4.

Ghosh JR et al (2016) reported that the mean value of atd angle in the right and left palms were 49.23 ± 15.49 and 48.37 ± 13.22

In the current study, the mean value of atd angle in males in the right was 41.52 ± 4.25 and left was 40.28 ± 4.25 and in females in the right hand was 44.2 ± 4.27 and in the left hand was 43.24 ± 3.13. ***(Table 24)***

The observations were similar to the previous studies of **Bala A et al (2016), Sharma MK et al (2012)** and **Shekar S (2018).** The values were low when compared to the studies of **Igbigbi PS et al (2004)** and **Ojha P et al (2014).** The values of the current study were higher than the reports of **Rakate NS et al (2013).**

The atd angle determined in the present study was higher in females when compared to that of males and this coincided with the studies of **Igbigbi PS et al (2004), Padmini MP et al (2011), Sharma MK et al (2012), Sumangala Devi K et al (2016)** and **Bala A et al (2016).** ***(Table 27)***

CONCLUSION

The papillary ridges pertaining to the hands were studied extensively by classifying into qualitative and quantitative parameters.

The fingertip patterns, its distribution in individual digits, the sub types in arch, loop and composite pattern were the qualitative parameters. The quantitative parameters were the total finger ridge count, a – b ridge count and the atd angle measurements. The above parameters were obtained from 200 medical students and 50 patients with Type 2 Diabetes mellitus.

The embryology of the epidermal ridges and the factors affecting the embryogenesis were discussed.

Right from the historical preview up-to the recent scientific dermatoglyphic research were explored correlating its significance in the fields of population studies as well as in genetics and medical disorders. The dermal configurations in normal healthy individuals as well as in diabetes individuals were also discussed.

On studying the dermal configurations of the medical students the observations were

- Loops were the predominant pattern, particularly the ulnar loops.
- The dominant pattern observed in the thumb, index finger, middle finger and little finger was loop and in the ring finger it was the whorl.
- The total finger ridge count in males was statistically higher than that of females.

- The a – b ridge count in females was statistically significant when compared to males.
- The atd angle in female proved to be statistically significant when compared to that of males.
- The quantitative parameters exhibit sexual dimorphism.

On analysing the dermal configurations of diabetes subjects the following findings were concluded

- Whorls were the principal pattern
- The chief pattern in the thumb was loop, index finger, middle finger, ring finger and little finger had whorls.
- The atd angle in females was statistically higher when compared to males.
- There was no difference observed in the total finger ridge count and a – b ridge count between males and females.

The observations of the present study were compared with the studies done previously. Many differences were encountered and they were attributed to the geographical and genetic factors.

The medical students and the diabetic individuals show a different cardinal pattern which emphasises the fact that dermatoglyphics can be initiated as a screening tool in the early detection of Type 2 Diabetes mellitus. Future studies can be conducted on a large sample size.

The limitations of this study are as follows:

- The fingerprint pattern analysis would be more validating if it is done on a larger sample.
- The parameters of the diabetic subjects could be compared with that of normal individuals.

Considerable explorations in dermatoglyphics affirm that there is a very high degree of accuracy in diagnosing a disease from analysing the fingerprints alone.

Thus the famous icon of hand that once used to prophecy has come to be percieved as a compelling tool in diagnosing genetic and medical disorders by the researchers of medical science.

Figure 1: Materials required for taking fingerprint

- Camel quick drying duplicate ink
- Cotton puff
- Round bottle
- Scale
- Pencil / pen
- Protractor - to measure the atd angle
- Needle – to count the ridges
- Magnifying lens
- Printed proforma sheets – for recording the prints
- Hand wash and towel – wash and dry the hands

Figure 2: Procedure for taking fingerprint

Palmar surface and fingers smeared with ink

Fingers and palm rolled over the paper kept over the bottle

Figure 3: Fingerprints recorded in the boxes

Figure 4: Whorl pattern

Figure 5: Arch pattern

Figure 6: Loop pattern

Figure 7: Composite pattern

Figure 8: finger ridge count

Figure 11: atd angle

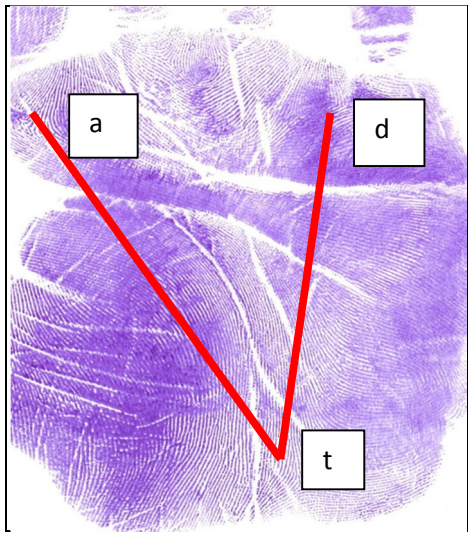


Figure 9: a –b ridge count

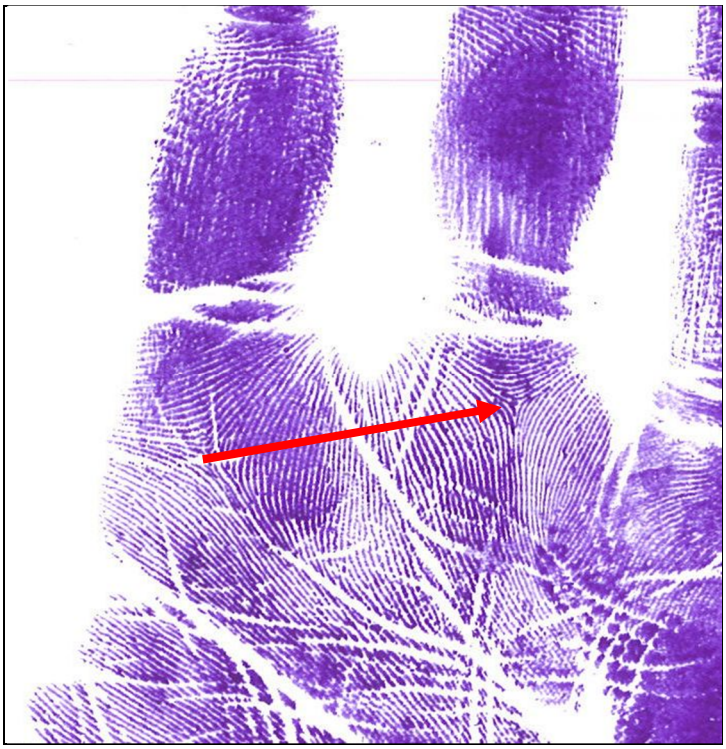


Figure 10: Digital and palmar tri radii

Tri radii a

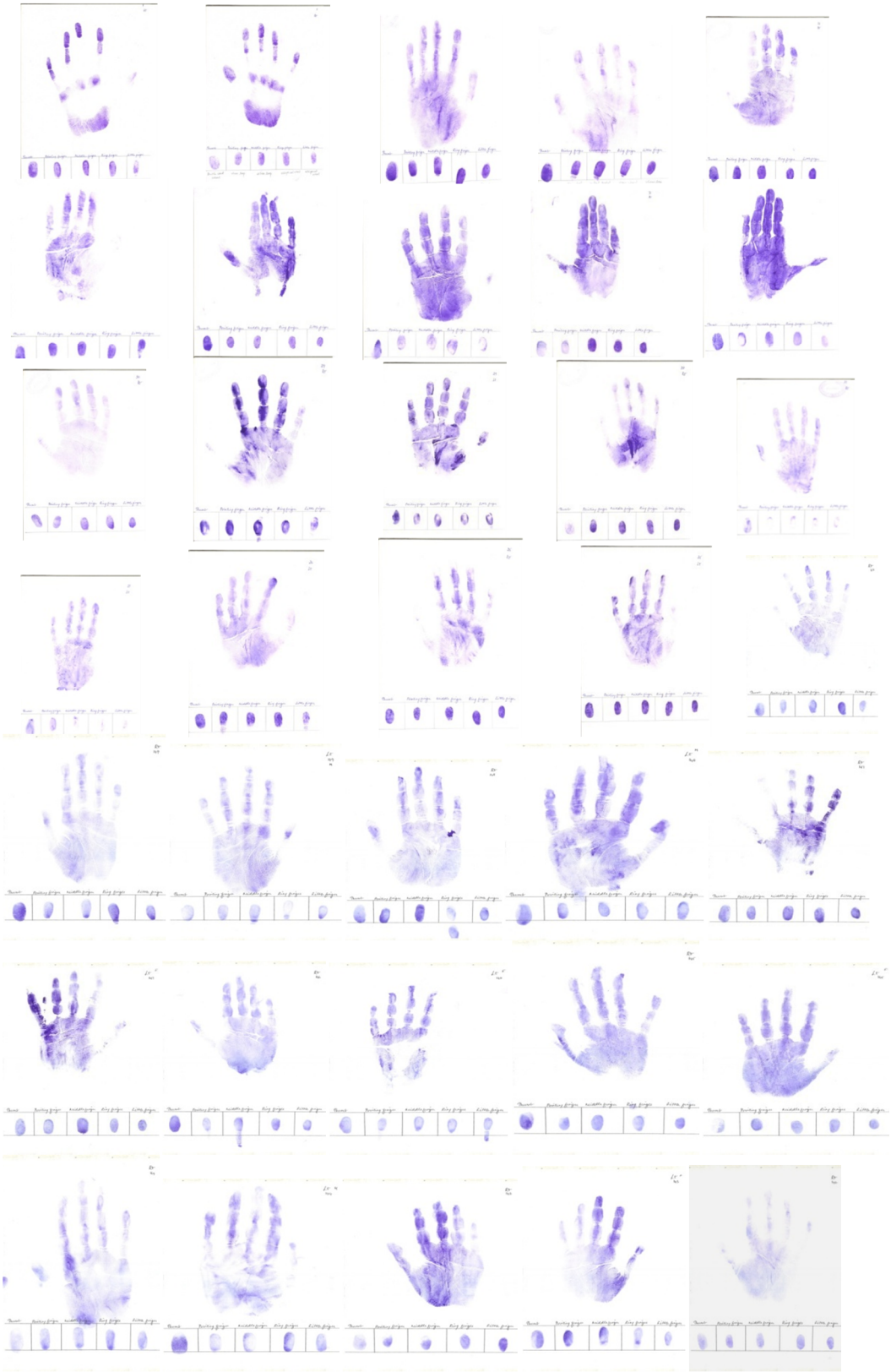
Tri radii b

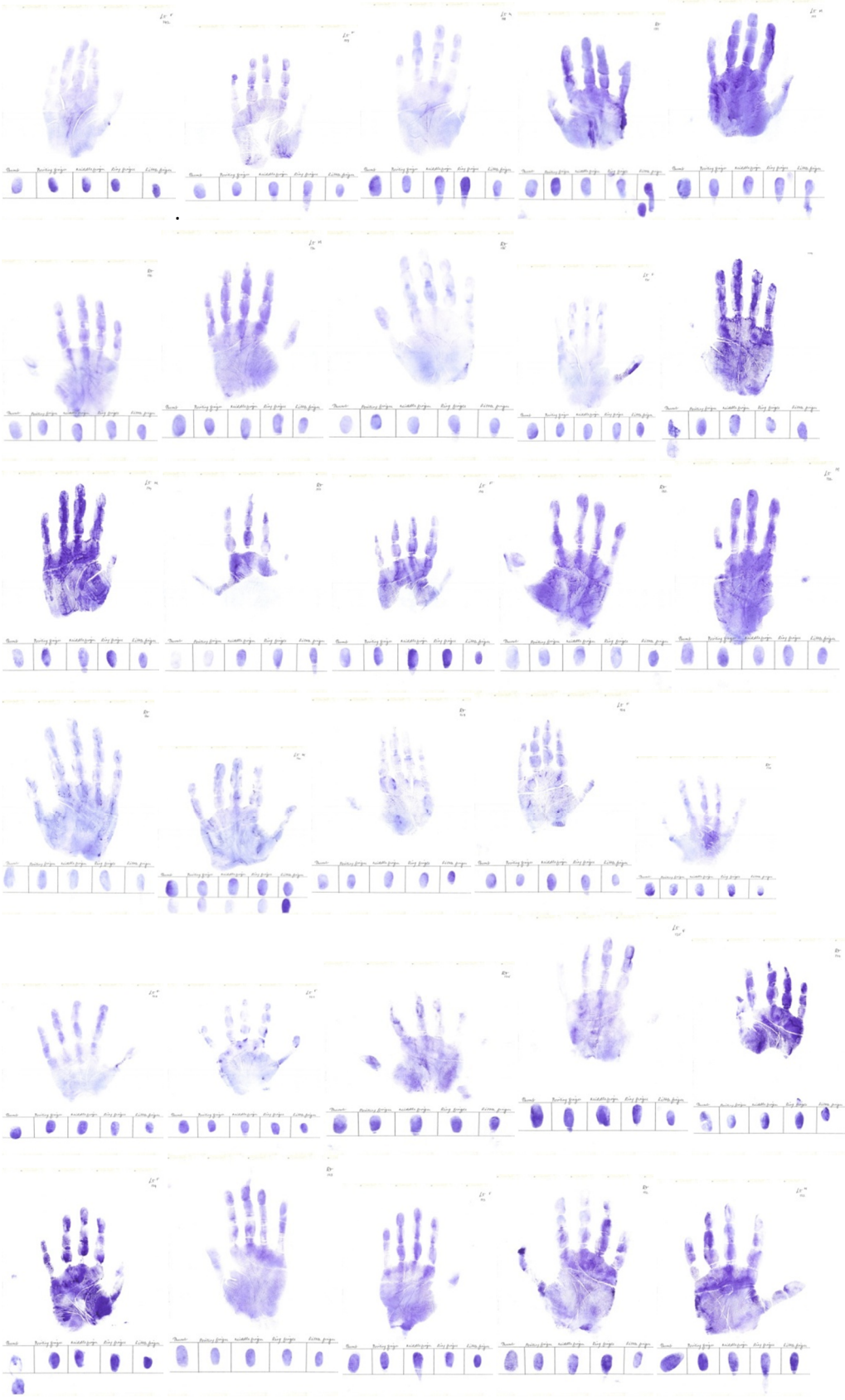
Tri radii c

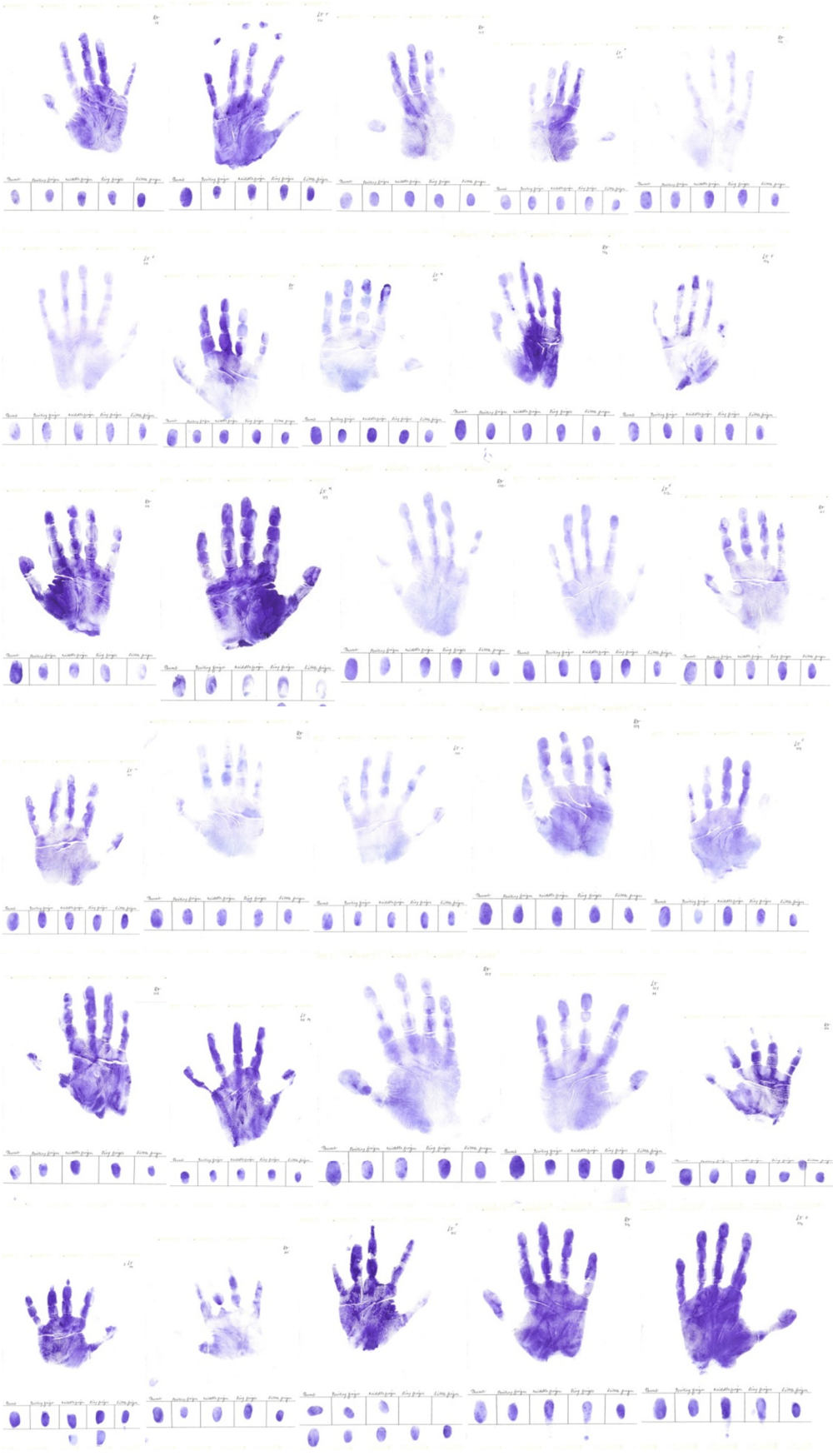
Tri radii d

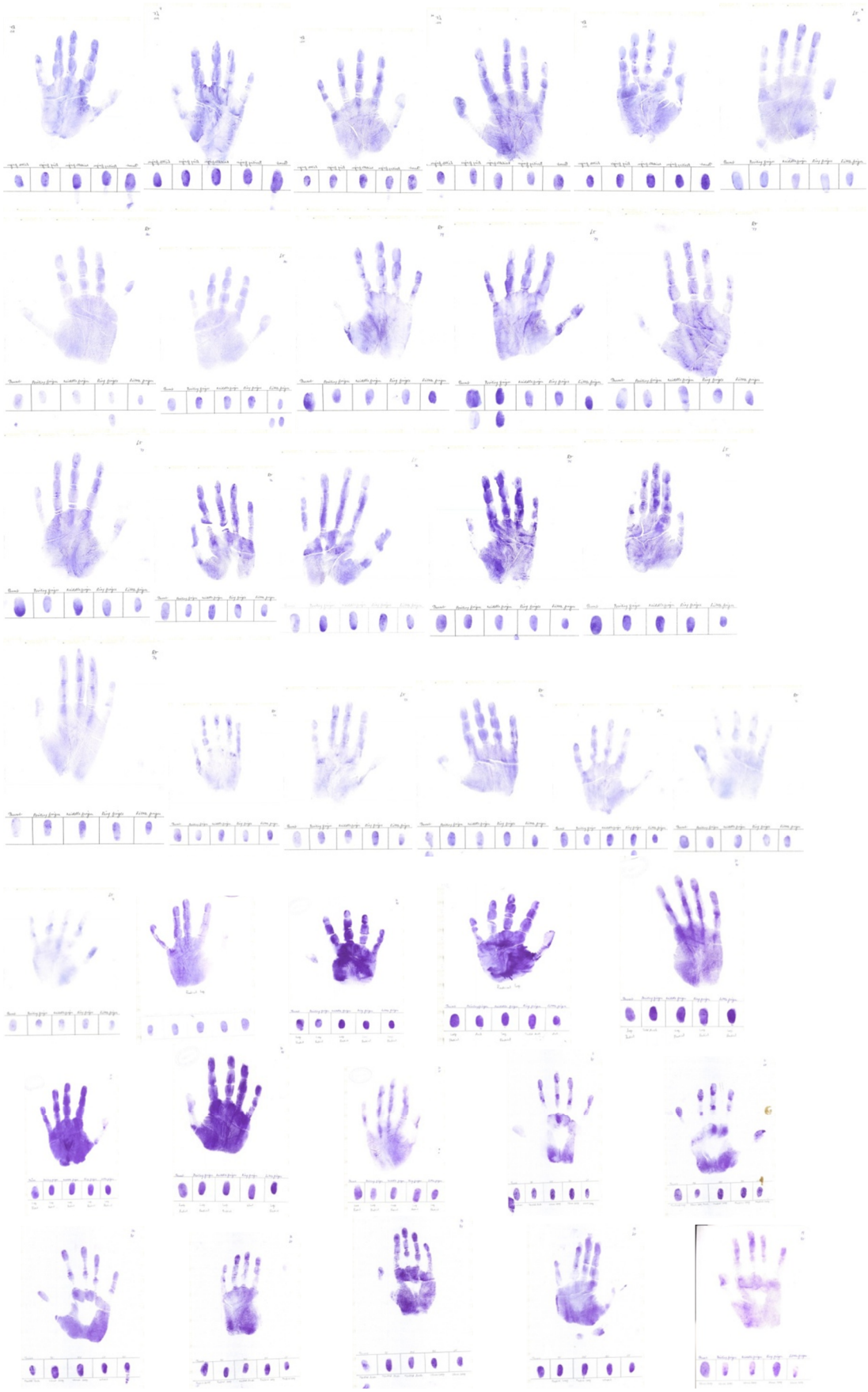
Tri radii t

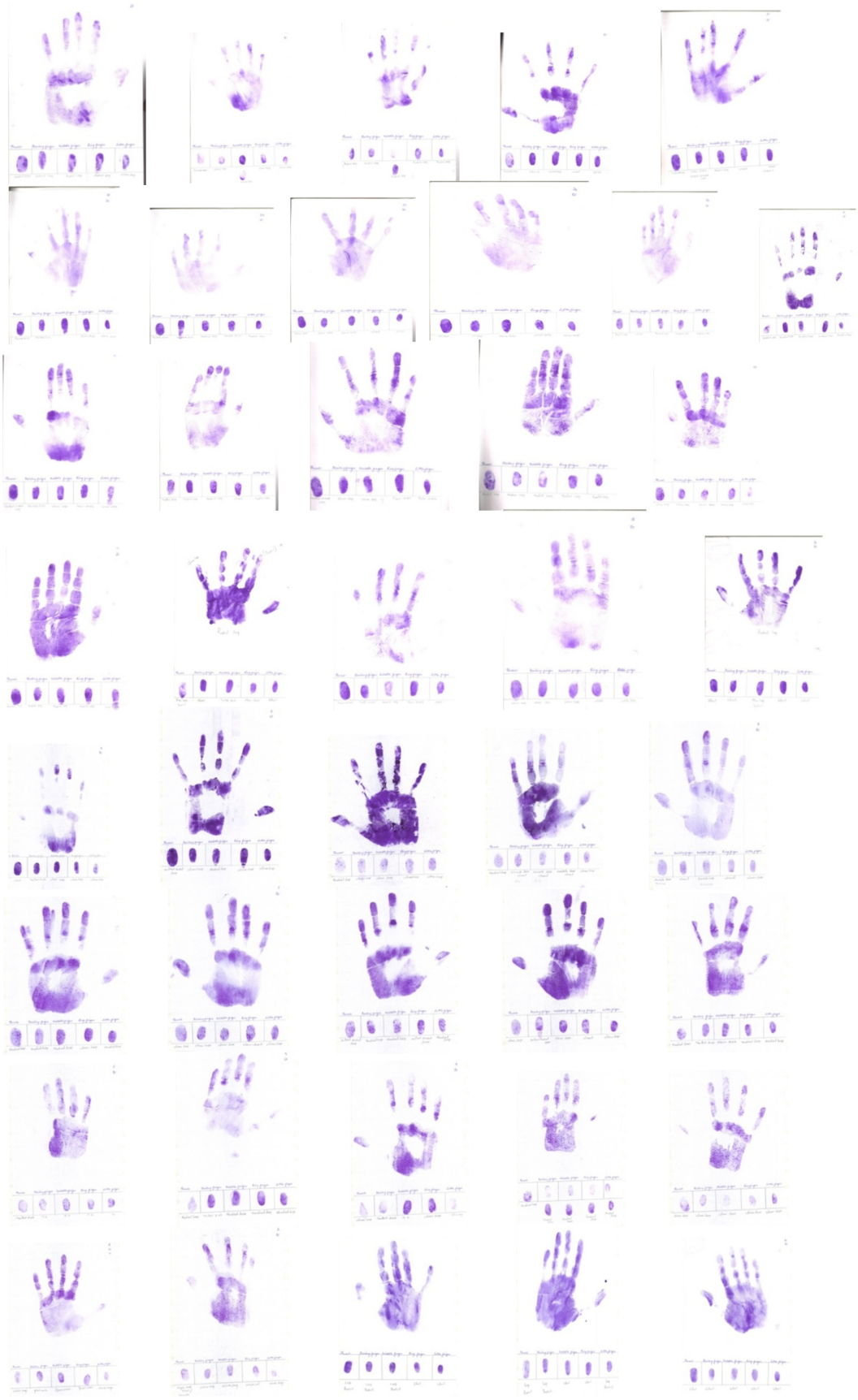
Fingerprints of medical students

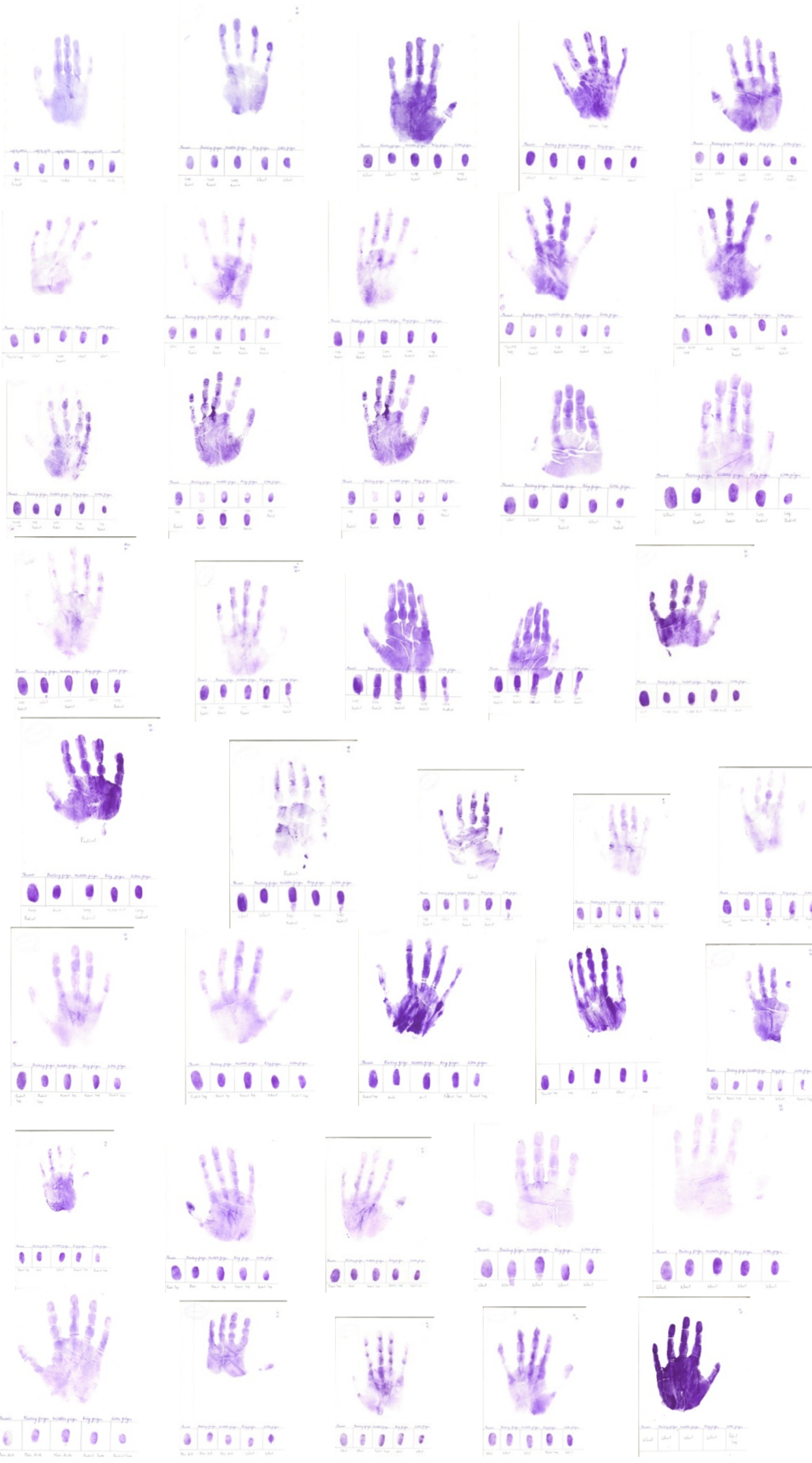


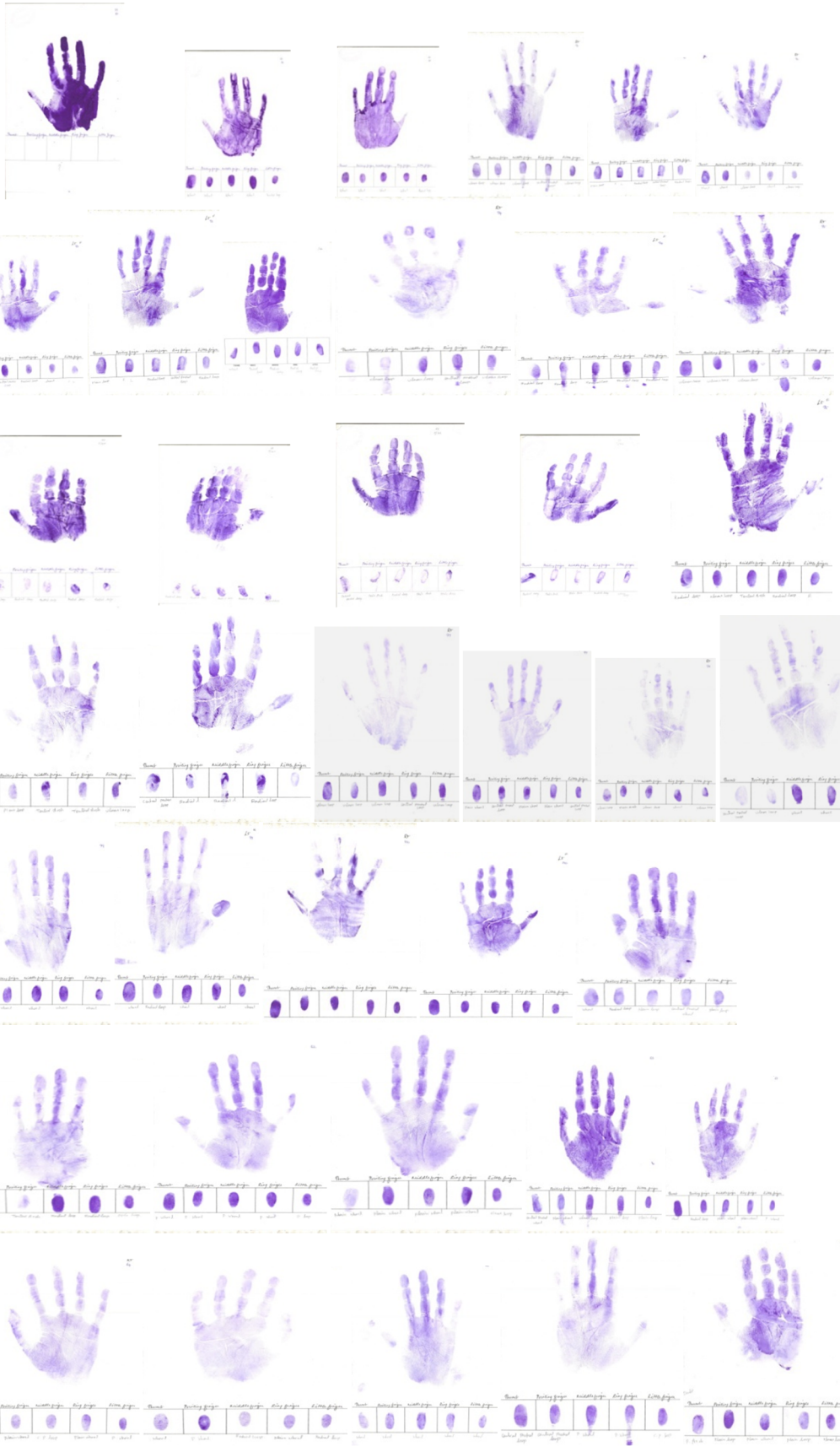


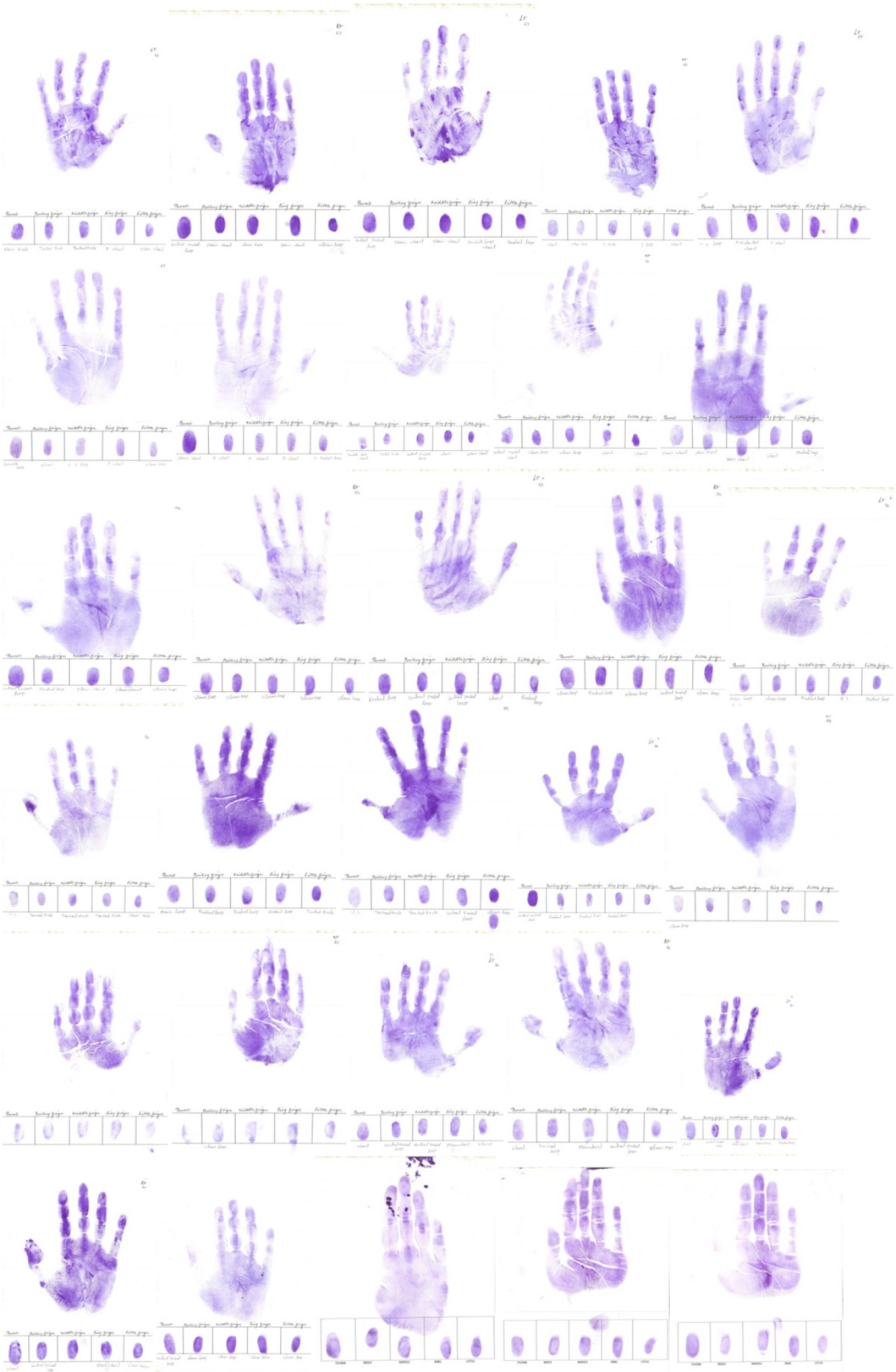


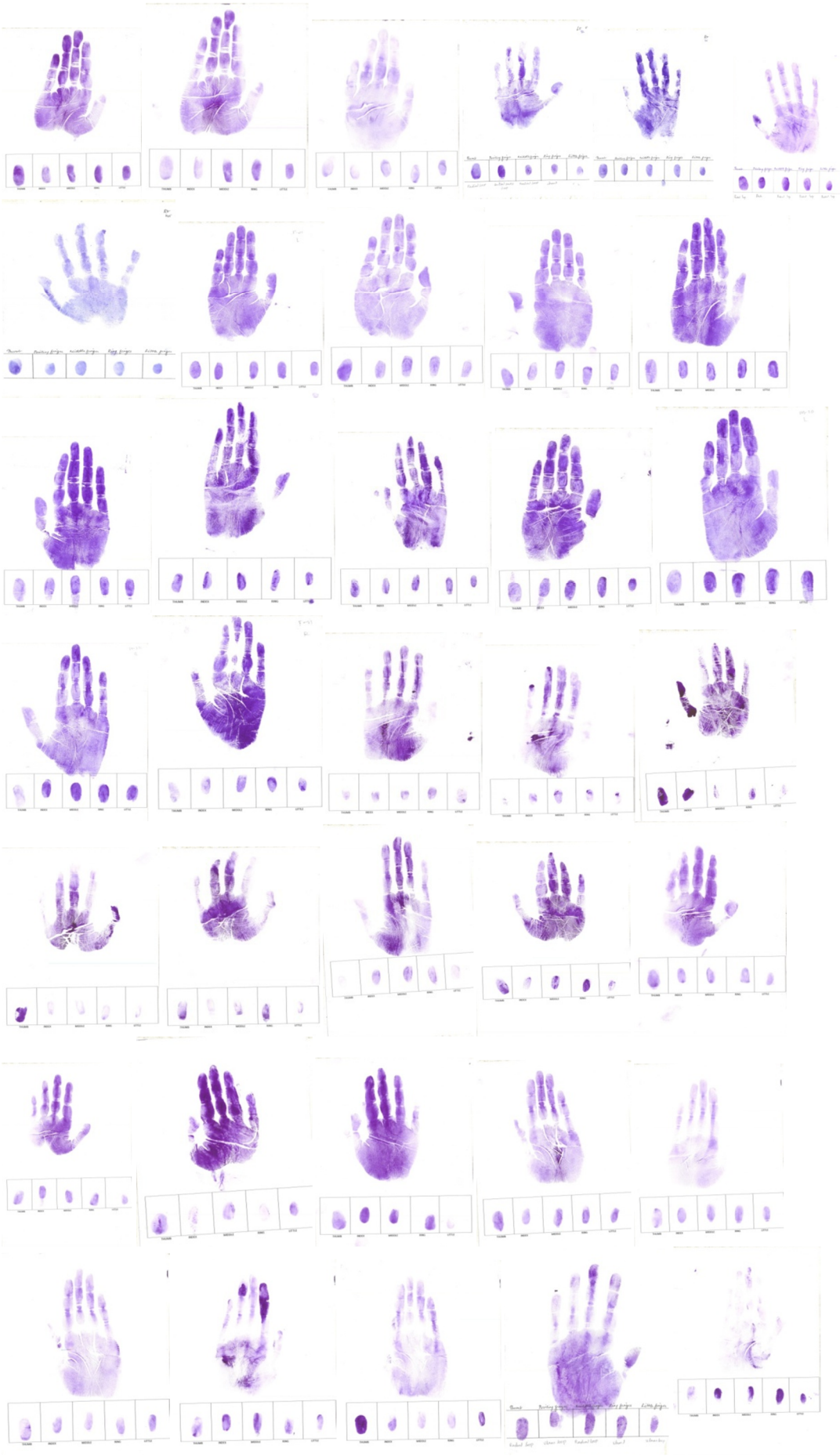


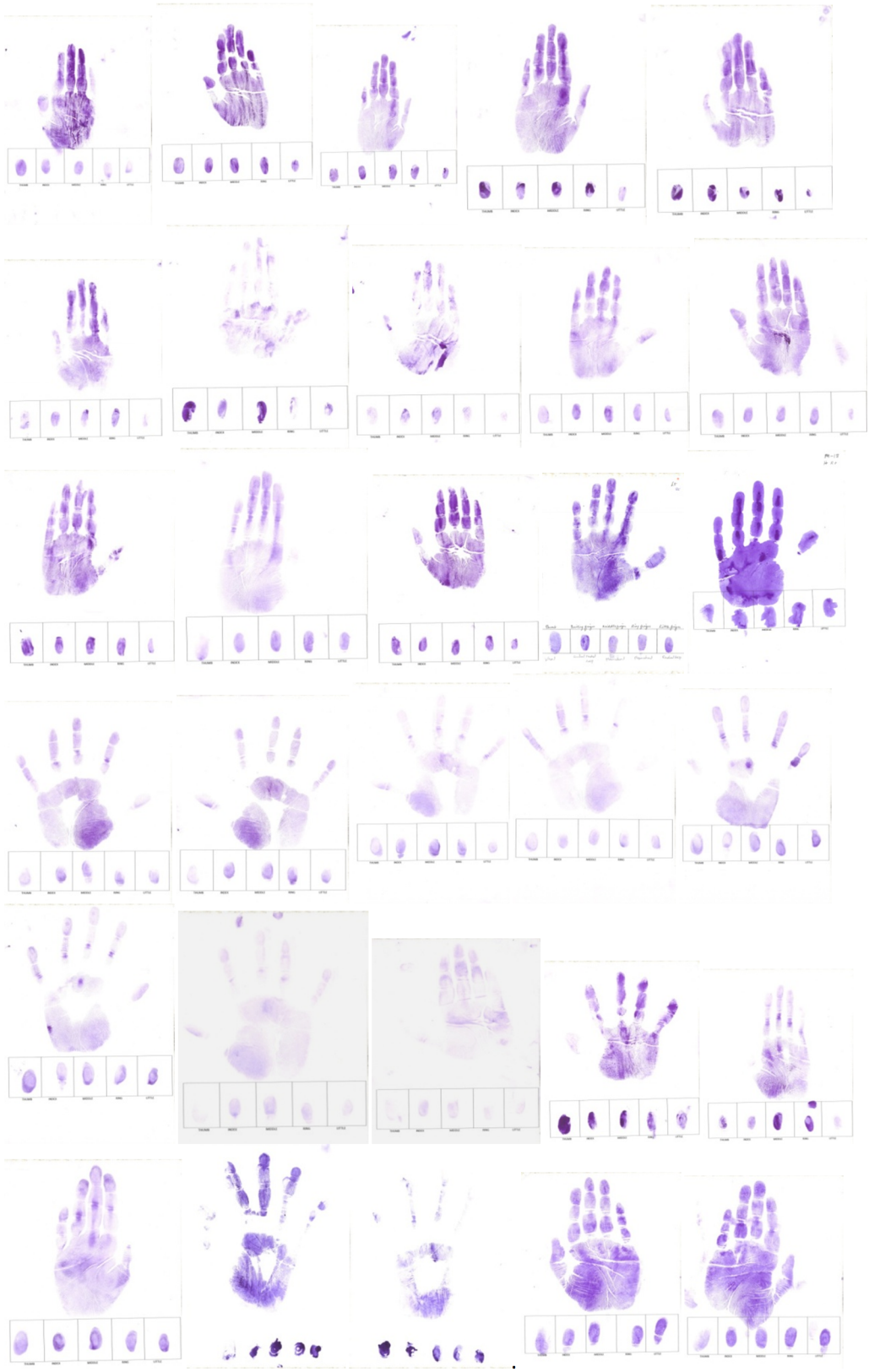


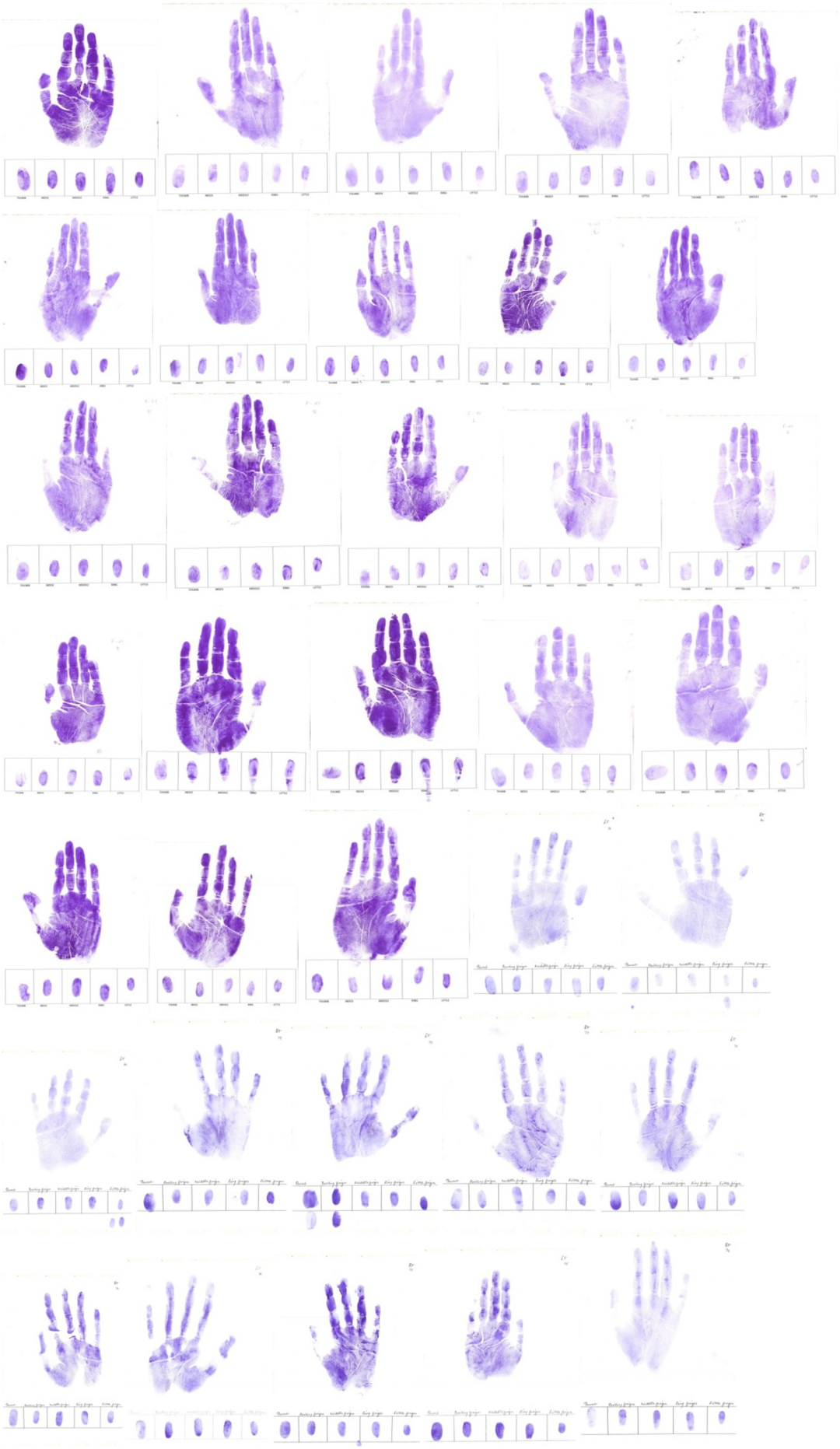


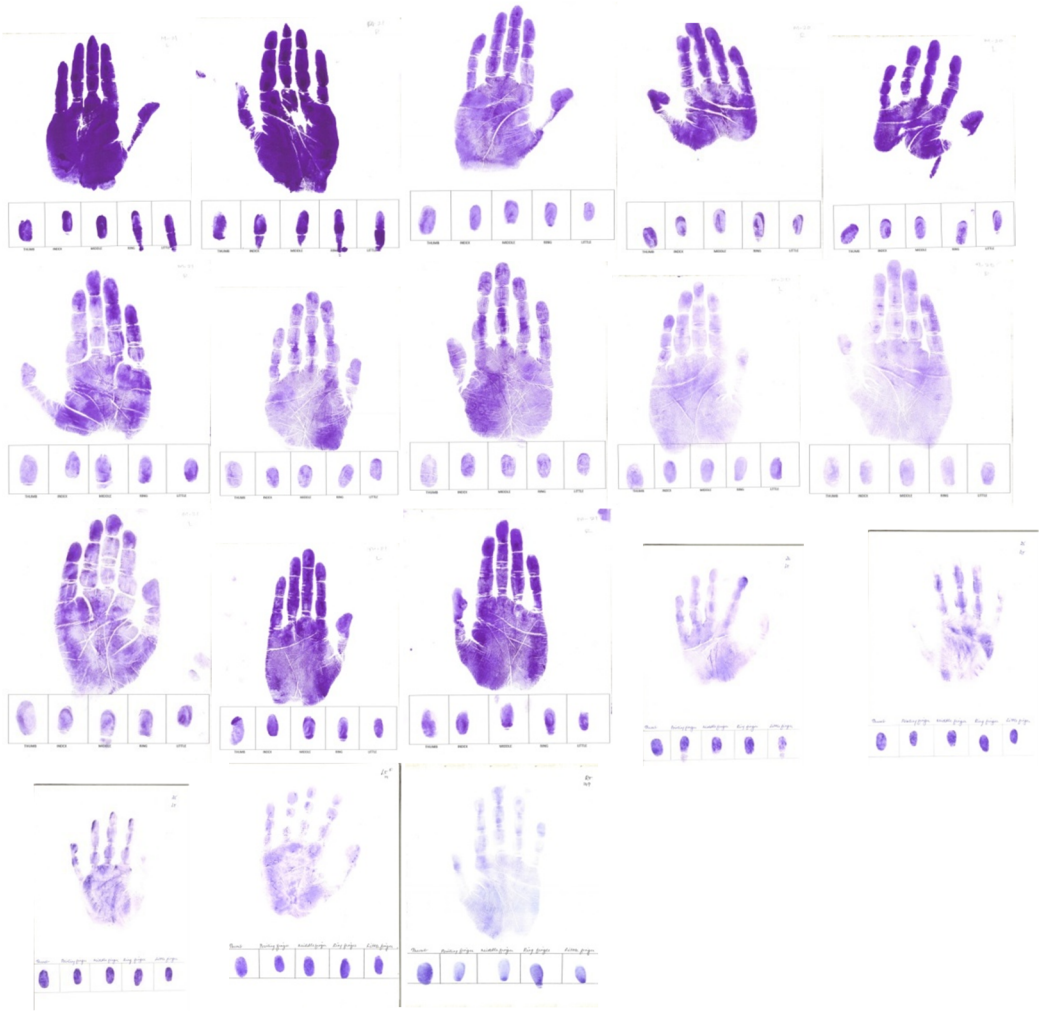












fingerprints of diabetes subjects

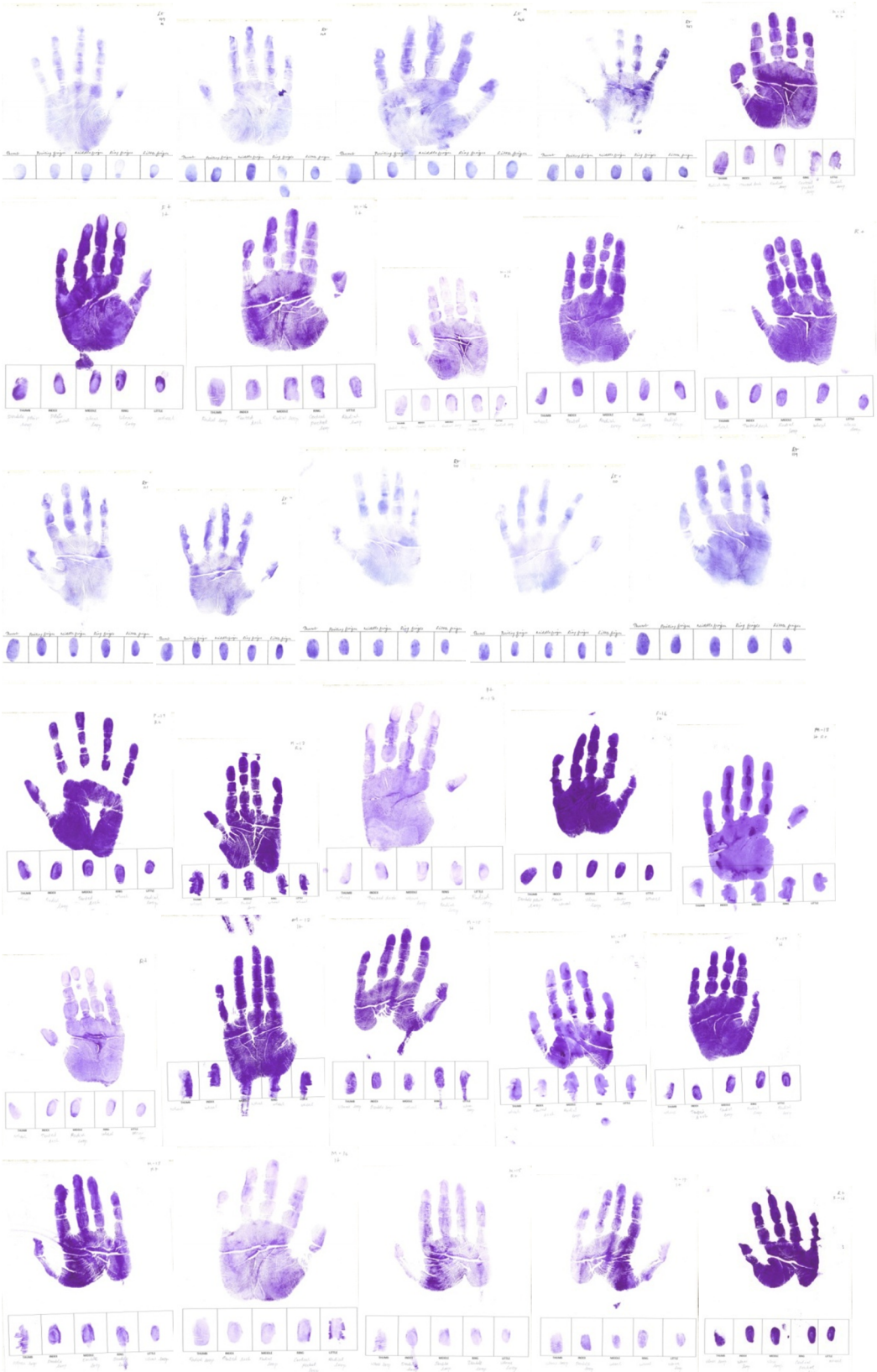


Table 1: Comparison of distribution of fingerprint patterns in medical students with that of reference studies:

S no	Author	Study Location	Year	Sample size	Fingertip pattern (%)			
					L	W	C	A
1	Kobyliansky E et al	Middle -east	1987	253	57.12	39.56	-	3.32
2	Demarchi DA et al	Argentina	1997	500	57.05	36.5	-	6.3
3	Ching cho	New Zealand	1998	202	47.25	51.15	-	1.6
4	Igbigbi PS et al	Africa	2002	270	81.38	8.61	-	10
5	Karmakar B et al	Russia	2007	547	60.2	34.3	-	5.5
6	Banik SD et al	Nagaland	2009	207	44.92	53.94	-	1.14
7	Rastogi et al	India	2010	200	60.95	32.55	-	6.5
8	Biswas S et al	India	2011	202	45.2	52.65	-	4.32
9	Gutierez SB et al	Philippines	2012	50	55.4	42.4	-	2.2
10	Khadri S Y et.al	India	2013	1000	42.77	21.14	26.17	5.58
11	Bhavana et al	India	2013	200	58.9	29.6	-	11.5

12	Soman MA et al	India	2013	300	60.9	32.3	-	6.8
13	Wijerathne B et al	Sri Lanka	2013	434	58.53	36.54	-	4.93
14	Nanakorn et al	Thailand	2013	2134	50.9	45.3	-	3.8
15	Etta H et al	Nigeria	2014	897	25.9	29.2	21.5	23.4
16	Nithin et.al	South India	2015	200	57.1	30.35	6.35	6.2
17	***Current study***	***Tamil Nadu, India***	***2018***	***200***	***60.5***	***30.35***	***3.65***	***5.5***

*L- Loop; W- Whorl; C- Composite; A- Arch

Table 2: Comparison of distribution of fingerprint patterns in males with that of reference studies:

S no	Author	Study Location	Year	Sample size	Fingertip pattern (%)			
					L	W	C	A
1	Park KS et.al	Korea	1984	804	44.5	51.2	-	2.1
2	Penhalber E F et.al	Brazil	1994	300	64.07	21.67	10.9	3.3
3	Igbigbi P S et.al	Nairobi	2005	164	78.96	16.05	-	4.99
4	Igbigbi P S et.al	Dar-es-Salaam	2005	180	74.08	21.03	-	4.89
5	Narahari S et al	Andhra Pradesh India	2006	60	48.34	43.83	4.37	3.5
6	Ghosh et al	West Bengal India	2011	225	18.23	36.45	-	2.85
7	Khadri SY et al	Bijapur, India	2013	500	39.3	24.04	26.22	10.44
8	Soman MA et al	India	2013	150	46.8	54.9	-	55.4
9	Nithin SM et al	Kerala	2015	100	55.7	31.8	7.3	5.2

		India						
10	Bansal H D et.al	Nagpur, India	2015	256	52.96	29.06	16.42	1.56
11	Roshani S et al	Luck now, India	2016	420	59.04	33.21	-	7.73
12	El – Sawwa et al	Lebanon	2017	50	50.6	40	-	9.4
13	***Current study***	***Tamil Nadu, India***	***2018***	***100***	***60.50***	***30.80***	***3.40***	***5.30***

*L- Loop; W- Whorl; C- Composite; A- Arch

Table 3: Comparison of distribution of fingerprint patterns in females with that of reference studies:

S no	Author	Study Location	Year	Sample size	Fingertip pattern (%)			
					L	W	C	A
1	Park KS et.al	Korea	1984	2121	51.4	45.7	-	2.9
2	Penhalber E F et.al	Brazil	1994	300	64.24	20.17	9.17	6.43
3	Igbigbi P S et.al	Nairobi	2005	140	76.36	20.75	-	2.89
4	Igbigbi P S et.al	Dar-es-Salaam	2005	120	82.50	14.17	-	3.3
5	Narahari S et al	Andhra Pradesh India	2006	90	48.66	40.89	3.44	7
6	Khadri SY et al	Bijapur, India	2013	500	46.24	18.24	26.88	8.64
7	Soman MA et al	India	2013	150	53.2	45.1	-	44.64
8	Nithin SM et al	Kerala India	2015	100	58.5	28.9	5.4	7.2

9	Bansal H D et.al	Nagpur, India	2015	280	55.32	24	16.41	4.28
10	Roshani S et al	Luck now, India	2016	330	66.36	26.51	-	7.11
11	El – Sawwa et al	Lebanon	2017	50	53	38.4	-	8.6
12	***Current study***	***Tamil Nadu, India***	***2018***	***100***	***60.50***	***29.90***	***3.9***	***5.7***

*L- Loop; W- Whorl; C- Composite; A- Arch

Table 4: Comparison of prevalence of ulnar and radial loop pattern in males with the reference studies:

S.NO	AUTHOR	STUDY POPULATION	YEAR	SAMPLE SIZE	LOOP PATTERN (%)	
					ULNAR	RADIAL
1	Park KS et.al	Koreans	1984	804	41.6	2.9
2	Crawford MH	Eskimos	1992	81	48.6	2.45
3	Penhalber EF et al	Brasilians	1994	300	59.30	4.77
4	Igbigbi PS et.al	Kenyans	2005	164	72.62	6.34
5	Igbigbi PS et.al	Tanzaniyans	2005	180	67.22	6.86
6	Banik et al	Indians	2009	104	43.96	3.36
7	Rosa A et al	Spanish	2009	50	60.4	3.8
8	Sangam MR et al	Indians	2011	268	50.8	1.4
9	Anibor E et al	Nigerians	2011	100	33.86	0.24
10	Khadri SY et al	Indians	2013	500	38.42	0.88
11	Nanakorn et al	Thais	2013	724	47.7	1.9
12	Kapoor et al	Indians	2014	240	50.83	1.50
13	Bansal H D et al	Indians	2015	256	49.21	3.75
14	Roshani et al	Indians	2016	420	57.38	0.66
15	***Current study***	***Indians***	***2018***	***100***	***58.8***	***1.7***

Table 5: Comparison of prevalence of ulnar and radial loop pattern in females with the reference studies

S.NO	AUTHOR	STUDY POPULATION	YEAR	SAMPLE SIZE	LOOP PATTERN (%)	
					ULNAR	RADIAL
1	Laha NN et al	Indians	1974	50	56.4	2.8
2	Park KS et.al	Koreans	1984	2121	49.2	2.2
3	Crawford MH	Eskimos	1992	83	56.8	2.2
4	Penhalber EF et al	Brasilians	1994	300	60.37	3.87
5	Igbigbi PS et.al	Kenyans	2005	140	69.65	6.71
6	Igbigbi PS et.al	Tanzaniyans	2005	120	75.00	7.50
7	Banik et al	Indians	2009	103	40.58	1.94
8	Rosa A et al	Spanish	2009	25	70.2	1.69
9	Sangam MR et al	Indians	2011	238	58.1	2.7
10	Anibor E et al	Nigerians	2011	100	17.68	0
11	Khadri SY et al	Indians	2013	500	44.56	1.68
12	Nanakorn et al	Thais	2013	1410	50.2	1.4
13	Kapoor et al	Indians	2014	240	46	2.17
14	Bansal H D et al	Indians	2015	280	53.42	1.9
15	Roshani et al	Indians	2016	330	64.52	1.81
16	***Current study***	***Indians***	***2018***	***100***	***58.90***	***1.6***

Table 6: Comparison of prevalence of ulnar and radial loop pattern in medical students with the reference studies

S.NO	AUTHOR	LOCALE	YEAR	SAMPLE SIZE	LOOP PATTERN (%)	
					ULNAR	RADIAL
1	Gutierez SB et al	Philipinnes	2012	50	54.2	1.2
2	Tamgire DW et al	Wardha	2013	100	59.2	1.8
3	Basu et al	India	2016	50	59.4	2.8
4	Gaikwad et al	India	2016	72	51.6	3
5	***Current study***	***India***	***2018***	***200***	***58.85***	***1.65***

Table 7: Comparison of prevalence of whorl pattern in medical students with the reference studies

S.NO	AUTHOR	LOCALE	YEAR	SAMPLE SIZE	%
1	Kobyliansky E et al	Middle -east	1987	253	39.56
2	Demarchi DA et al	Argentina	1997	500	36.5
3	Ching cho	New Zealand	1998	202	51.15
4	Igbigbi PS et al	Africa	2002	270	8.61
5	Karmakar B et al	Russia	2007	547	34.3
6	Banik SD et al	Nagaland	2009	207	53.94
7	Gutierez SB et al	Philipinnes	2012	50	42.4
8	Tamgire DW et al	Wardha	2013	100	28
9	Basu et al	India	2016	50	31.8
10	Gaikwad et al	India	2016	72	42
11	***Current study***	***India***	***2018***	***200***	***30.35***

Table 8: Fingerprint patterns in individual digits of males (%)

PATTERN		T	I F	M F	R F	L F
ARCH	S	4	8.5	3.5	1	0.5
	T	2	4	2	1	0
LOOP	U	57	59	63	41	74
	R	0.5	3.5	1	2	1.5
WHORL		30.5	22.5	25	53	23
COMPOSITE	DL	4	1	3.5	0.5	0.5
	CP	2	1.5	0.5	1.5	0.5
	LP	0	0	0.5	0	0
	A	0	0	1	0	0

*T – Thumb, IF – Index Finger, MF – Middle Finger, RF – Ring Finger, LF – Little Finger, S – Simple Arch, T – Tented Arch, U – Ulnar Loop, R – Radial Loop, DL – Double loop, CP – Central Pocket, LP – Lateral Pocket,
A - Accidental

Table 9: Fingerprint patterns in individual digits of females (%)

PATTERN		T	I F	M F	R F	L F
ARCH	S	3.5	9.5	3.5	1.2	2
	T	1.5	3	2	1.5	0.5
LOOP	U	57.5	56	66.5	40	74.5
	R	2	2.5	1	1	1.5
WHORL		29.5	23.5	22.5	54	20
COMPOSITE	DL	2.5	2.5	2	0.5	1
	CP	1.5	3	2.5	1.5	0.5
	LP	2	0	0	0	0
	A	0	0	0	0	0

*T – Thumb, IF – Index Finger, MF – Middle Finger, RF – Ring Finger, LF – Little Finger, S – Simple Arch, T – Tented Arch, U – Ulnar Loop, R – Radial Loop, DL – Double loop, CP – Central Pocket, LP – Lateral Pocket,
A - Accidental

Table 10: Fingerprint pattern of individual digits in males (%)

PATTERN	T	I F	M F	R F	L F
ARCH	6	12.5	5.5	2	0.5
LOOP	57.5	62.5	64	43	75.5
WHORL	30.5	22.5	25	53	23
COMPOSITE	6	2.5	5.5	2	1

*T – Thumb, IF – Index Finger, MF – Middle Finger, RF – Ring Finger, LF – Little Finger

Table 11: Fingerprint pattern of individual digits in females (%)

PATTERN	T	I F	M F	R F	L F
ARCH	5	12.5	5.5	3	2.5
LOOP	59.5	58.5	67.5	41	76
WHORL	29.5	23.5	22.5	54	20
COMPOSITE	6	5	4.5	2	1.5

*T – Thumb, IF – Index Finger, MF – Middle Finger, RF – Ring Finger, LF – Little Finger

Table 12: Comparison of distribution of fingerprint patterns in diabetes subjects with that of reference studies

S no	Author	Study Location	Year	Fingertip pattern (%)			
				L	W	C	A
1	Shivaleela C et al	India	2013	24	37.6	-	14.4
2	Nayak T et al	India	2015	58.9	33.4	-	7.7
3	Marera DO et al	Uganda	2015	29.43	35.13	-	6
4	Ghosh JR et al	India	2016	31	18.33	10.67	4.66
5	***Current study***	***India***	***2018***	***39.4***	***44.6***	***4.4***	***11.6***

*L- Loop; W- Whorl; C- Composite; A- Arch

Table 13: Comparison of distribution of fingerprint patterns in male diabetes subjects with that of reference studies

S no	Author	Study Location	Year	Fingertip pattern (%)				
				UL	RL	W	C	A
1	Ojha P et al	India	2014	46.2	0.4	49.8	-	3.6
2	Srivastava S et al	India	2014	43.5	0.8	48.2	-	7.5
3	Nayak T et al	India	2015	57.66	-	35.5	-	6.83
4	Marera DO et al	Uganda	2015	14.6	11.87	14.13	-	2.73
5	***Current study***	***India***	***2018***	***40.8***	***0.8***	***41.6***	***5.6***	***9.6***

*U – Ulnar Loop, R – Radial Loop, C- Composite; A- Arch

Table 14: Comparison of distribution of fingerprint patterns in female diabetes subjects with that of reference studies:

S no	Author	Study Location	Year	Fingertip pattern (%)				
				UL	RL	W	C	A
1	Ojha P et al	India	2014	50	1.2	46	-	2.8
2	Srivastava S et al	India	2014	37.9	3.2	43.7	-	15.2
3	Nayak T et al	India	2015	60.75	-	30.25	-	9
4	Marera DO et al	Uganda	2015	20.6	11.8	21	-	6
5	***Current study***	***India***	***2018***	***36.4***	***0.8***	***46***	***3.2***	***13.6***

*U – Ulnar Loop, R – Radial Loop, C- Composite; A- Arch

Table 15: Fingerprint patterns in individual digits of diabetic males (%)

PATTERN		T	I F	M F	R F	L F
ARCH	S	6	8	10	6	14
	T	0	0	0	4	0
LOOP	U	48	40	44	40	32
	R	0	2	2	0	0
WHORL		46	42	32	48	48
COMPOSITE	DL	0	6	4	2	6
	CP	0	2	6	0	0
	LP	0	0	2	0	0
	A	0	0	0	0	0

*T – Thumb, IF – Index Finger, MF – Middle Finger, RF – Ring Finger, LF – Little Finger, S – Simple Arch, T – Tented Arch, U – Ulnar Loop, R – Radial Loop, DL – Double loop, CP – Central Pocket, LP – Lateral Pocket,
A - Accidental

Table 16: Fingerprint patterns in individual digits of diabetic females (%)

PATTERN		T	I F	M F	R F	L F
ARCH	S	16	12	16	8	12
	T	0	2	2	6	0
LOOP	U	44	32	28	34	44
	R	2	2	0	0	0
WHORL		42	48	48	48	44
COMPOSITE	DL	0	0	0	2	0
	CP	0	2	2	4	0
	LP	0	2	2	0	0
	A	0	0	2	0	0

*T – Thumb, IF – Index Finger, MF – Middle Finger, RF – Ring Finger, LF – Little Finger, S – Simple Arch, T – Tented Arch, U – Ulnar Loop, R – Radial Loop, DL – Double loop, CP – Central Pocket, LP – Lateral Pocket,
A - Accidental

Table 17: Mean value of total finger ridge count in medical students

SEX	RIGHT HAND	LEFT HAND	TOTAL (R + L)
MALE	65.12 ± 10.3	65.65 ± 9.55	130.77 ± 16.33
FEMALE	55.88 ± 7.42	55.96 ± 8.56	111.81 ± 12.91
TOTAL	60.5 ± 10.10	60.80 ± 10.27	121.30 17.48

* R – Right hand, L – Left hand

Table 18: Mean value of a - b ridge count in medical students

SEX	RIGHT HAND	LEFT HAND	TOTAL (R + L)
MALE	34.28 ± 2.59	33.73 ± 2.77	68.01 ± 3.71
FEMALE	34.8 ± 2.94	35.27 ± 2.67	70.07 ± 4.01
TOTAL	35.54 ± 2.77	34.5 ± 2.82	69.04 ± 3.99

* R – Right hand, L – Left hand

Table 19: Mean value of atd angle of medical students

SEX	RIGHT HAND	LEFT HAND
MALE	39.35 ± 3.77	38.35 ± 3.27
FEMALE	39.81 ± 5.13	39.83 ± 4.84

Table 20: Comparison of mean value of a - b ridge count of medical students in the current study with reference studies

AUTHOR	POPULATION	YEAR	MALE	FEMALE
Penhabler EF et al	Caucasoids	1994	81.14±10.07	80.65±10.74
Igbigbi PS et al	Kenyan	2005	89.60±15.36	87±17.34
Igbigbi PS et al	Tanzaniyan	2005	85.42±19.80	83.42±18.90
Kobiliyansky E et al	Israeli Jews	2006	80.41±11.27	80.24±11.74
Ozyurt B et al	Turks	2010	82.96±8.69	84.63±6.73
Karmakar B et al	Muzeina Bedouins	2012	79.60±12.71	81.33±11.71
Sharma MK	Indians	2012	78.95±11.32	72.24±9.44
Current study	***Indians***	***2018***	***68.01 ± 3.71***	***70.07 ± 4.01***

Table 21: Comparison of mean value of atd angle of medical students in the current study with reference studies

AUTHOR	LOCALE	YEAR	SEX	RIGHT	LEFT
Enna CD et al	USA	1969	M + F	41.2	41.2
Oladipo GS et al	Nigeria	2007	M	40±0.89	39.9±0.89
			F	41.6±0.81	42.1±0.80
Rosa A et al	Spain	2009	M	79.6±14.4	
			F	76.7±9.1	
Jaja et al	Ogoni	2008	M	39.57	
			F	42.09	
Anibor E et al	Nigeria	2011	M	42.80	
			F	41.54	
Anibor E et al	Ndokwa	2012	M	39.39	
			F	40.97	
Karnul AM et al	India	2015	M	43.04	43.16
			F	41.72	42.46
Current study	***India***	***2018***	***M***	***39.35 ± 3.77***	***38.35 ± 3.27***
			F	***39.81 ± 5.13***	***39.83 ± 4.84***

* M - Male; F - Female

Table 22: Mean value of total finger ridge count in diabetes patients

SEX	RIGHT HAND	LEFT HAND	TOTAL (R + L)
MALE	55.48 ± 9.36	59.72 ± 10.55	114.8 ± 15.56
FEMALE	58.8 ± 11.55	52.8 ± 11.21	111.6 ± 12.49
TOTAL	57.14 ± 10.54	56.26 ± 11.32	113.2 ± 14.05

* R – Right hand, L – Left hand

Table 23: Mean value of a – b ridge count in diabetes patients

SEX	RIGHT HAND	LEFT HAND	TOTAL (R + L)
MALE	30.92 ± 5.72	31.6 ± 4.91	62.52 ± 8.05
FEMALE	29.8 ± 6.40	31.2 ± 5.73	61 ± 9.11
TOTAL	30.36 ± 6.03	31.4 ± 5.29	61.76 ± 8.55

* R – Right hand, L – Left hand

Table 24: Mean value of atd angle in diabetes patients

SEX	RIGHT HAND	LEFT HAND
MALE	41.52 ± 4.25	40.28 ± 4.25
FEMALE	44.2 ± 4.27	43.24 ± 3.13

Table 25: Comparison of mean value of total finger ridge count of diabetes subjects in the current study with reference studies

AUTHOR	LOCALE	YEAR	MALE	FEMALE
Igbigbi PS et al	Malawi	2004	123.72±3.82	140.15±39.82
Ojha P et al	India	2014	85.58±17.08	84.96±22.88
Bala A et al	India	2016	87.54±19.88	81.76±29.36
Sumangala devi et al	India	2016	75.62±7.20	67.33±6.14
Ghosh JR et al	India	2016	82.03±28.02	88.50±24.07
Shekar S et al	India	2018	121.9±39.88	132.68±40.83
Current study	***India***	***2018***	***114.8±15.56***	***111.6 ± 12.49***

Table 26: Comparison of mean value of a - b ridge count of diabetes subjects in the current study with reference studies

AUTHOR	LOCALE	YEAR	SEX	RIGHT	LEFT
Dam PK et al	India	2006	M	37.61	38.72
			F	39.42	40.34
Sharma MK et al	India	2012	M	39.6±4.5	39.68± 3.39
			F	38±4.69	38.4±4.69
Rakate NS et al	India	2013	M	36	37
			F	34.66	35.33
Bala A et al	India	2016	M	20.54±8.14	20.68±7.31
			F	21.46±8.52	21.22±8.83
Shekar S	India	2018	M	35.92±6	37.42±5.66
			F	37.2±5.13	37.07±6.01
Current study	***India***	***2018***	***M***	***30.92 ± 5.72***	***31.6 ± 4.91***
			F	***29.8 ± 6.40***	***31.2 ± 5.73***

* M - Male; F - Female

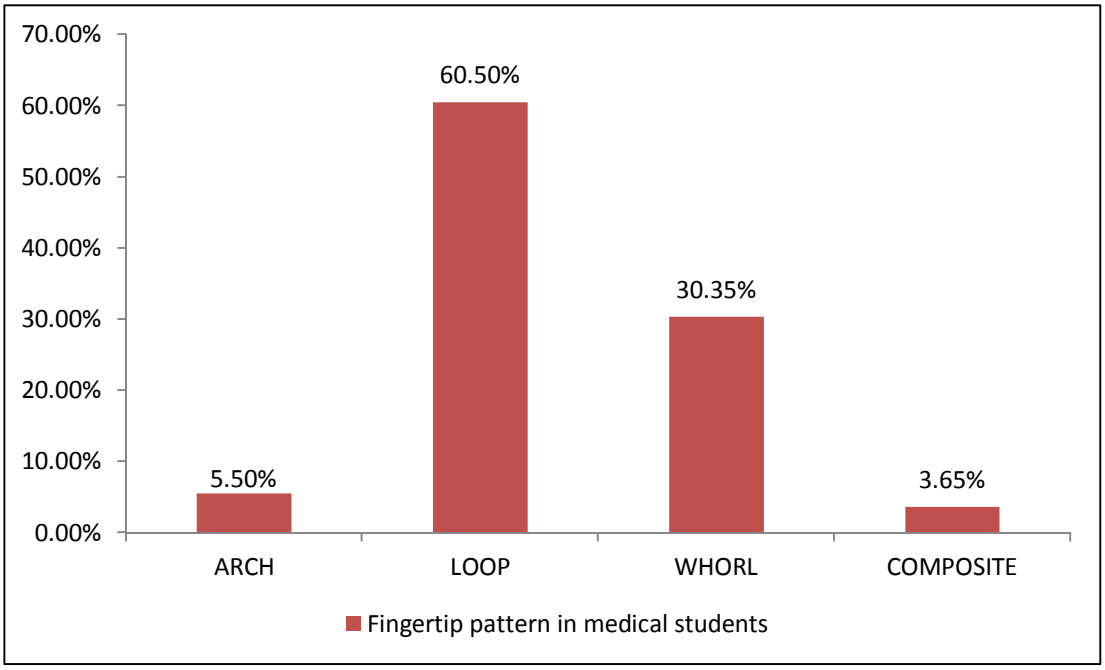
Table 27: Comparison of mean value of atd angle of diabetes subjects in the current study with reference studies

AUTHOR	LOCALE	YEAR	SEX	RIGHT	LEFT
Sharma MK et al	India	2012	M	42.12±7.56	39.92±3.68
			F	45.2±7.75	44.52±8.61
Rakate NS et al	India	2013	M	37.98	39
			F	36.41	36.95
Ojha P et al	India	2014	M	79.48±6.14	79.96±6.14
			F	78.32±8.32	77.88±8.42
Bala A et al	India	2016	M	41.48±7.31	40.86±5.02
			F	43.38±6.46	43.56±6.39
Sumangala devi et al	India	2016	M	38.44±2.96	39.69±2.52
			F	44.854.32	44.88±4.32
Current study	***India***	***2018***	***M***	***41.52 ± 4.25***	***40.28 ± 4.25***
			F	***44.2 ± 4.27***	***43.24 ± 3.13***

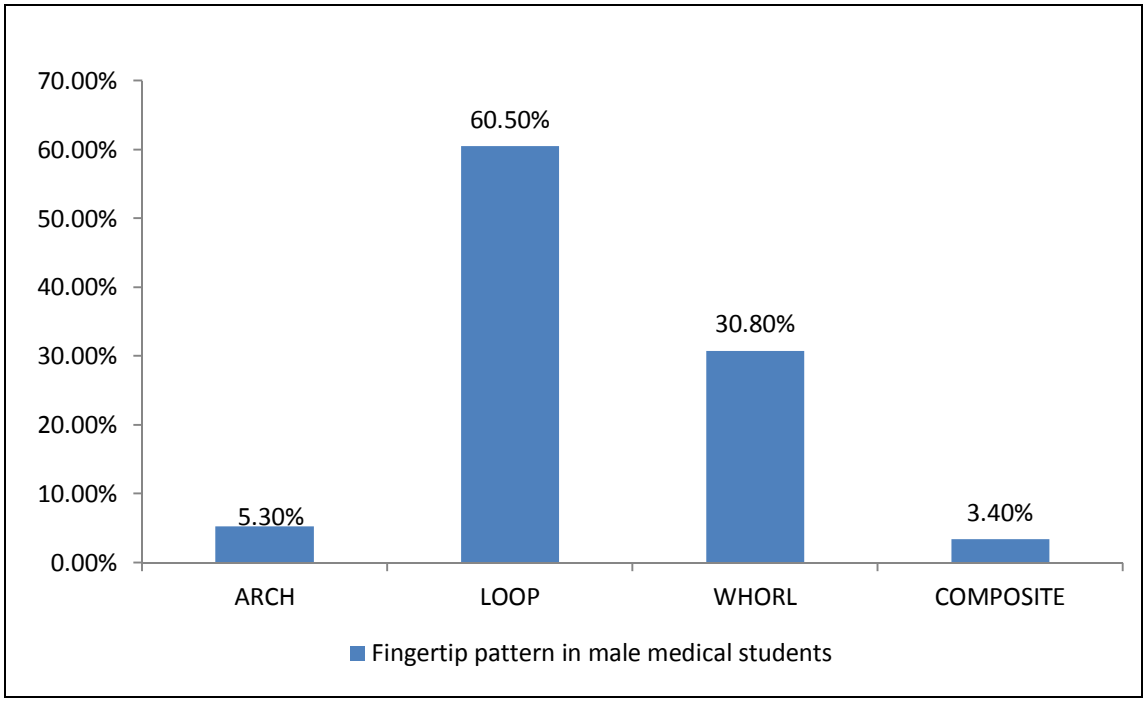
* M - Male; F – Female

GRAPHS

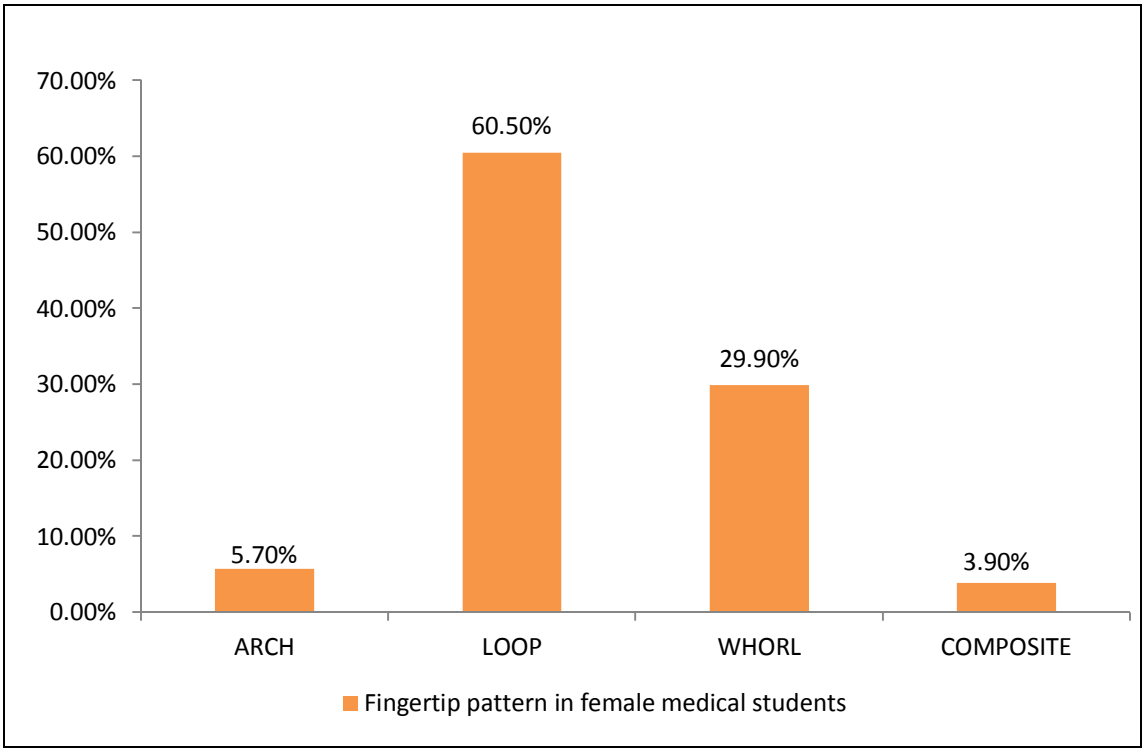
Graph 1: Percentage distribution of fingertip pattern of medical students



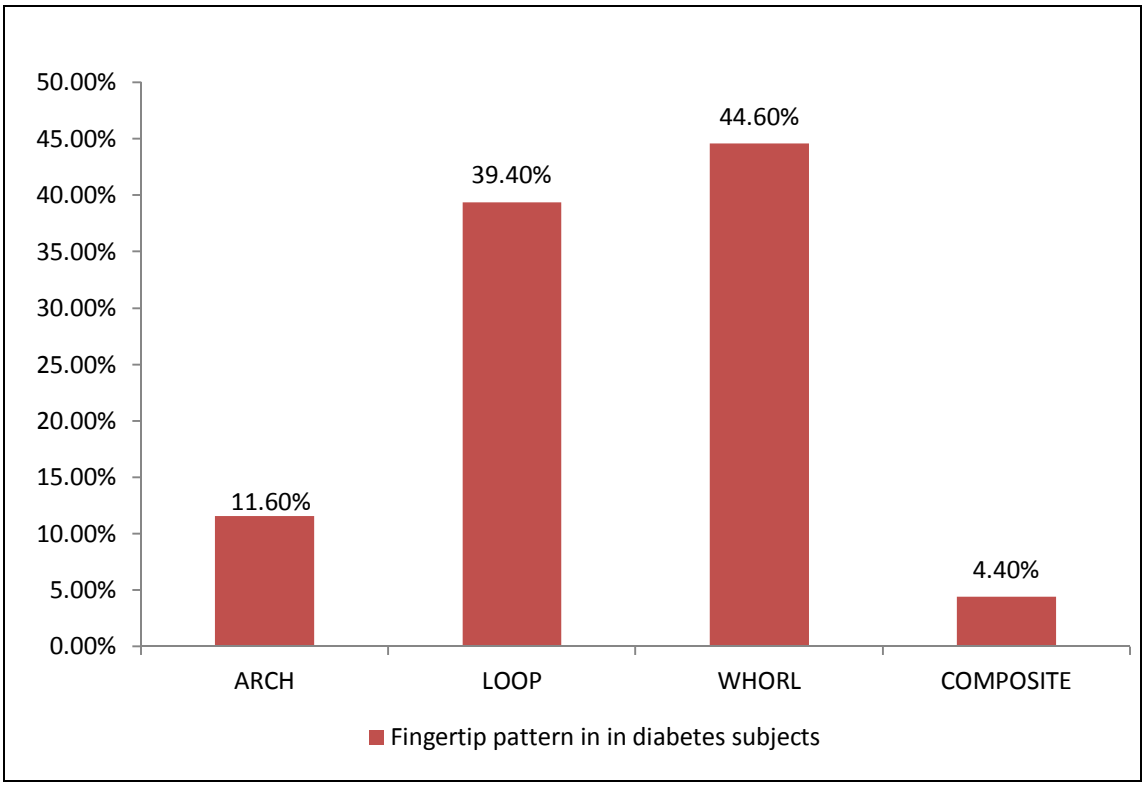
Graph 2: Percentage distribution of fingertip pattern of male medical students



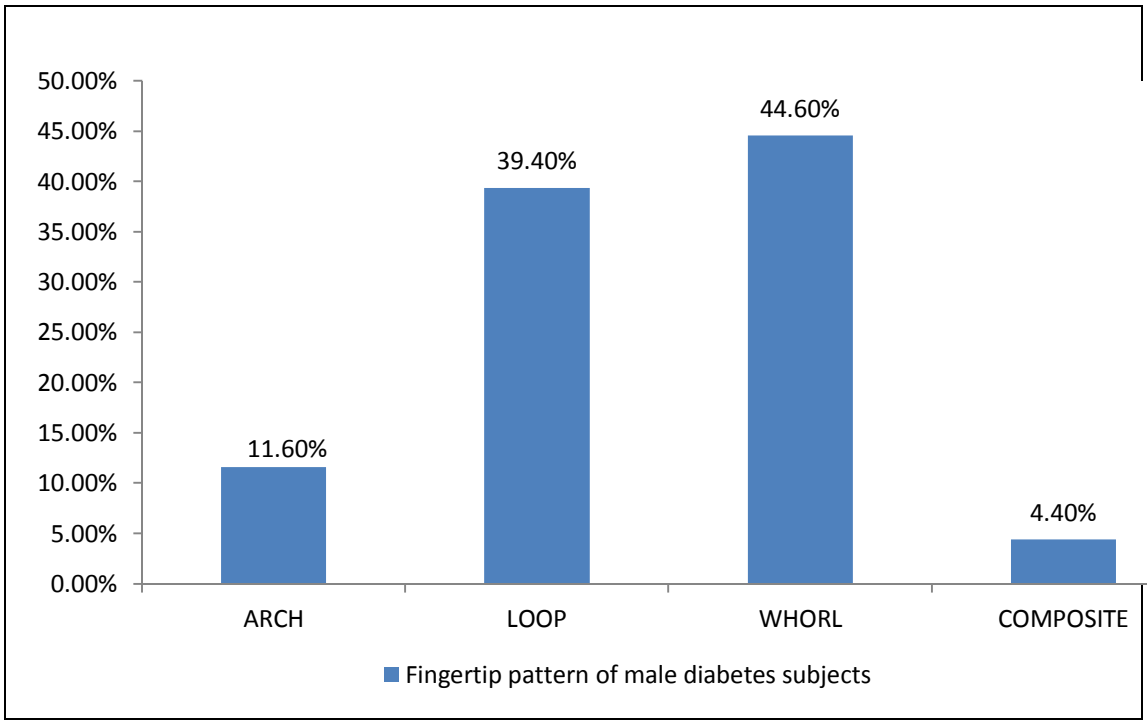
Graph 3: Percentage distribution of fingertip pattern of female medical students



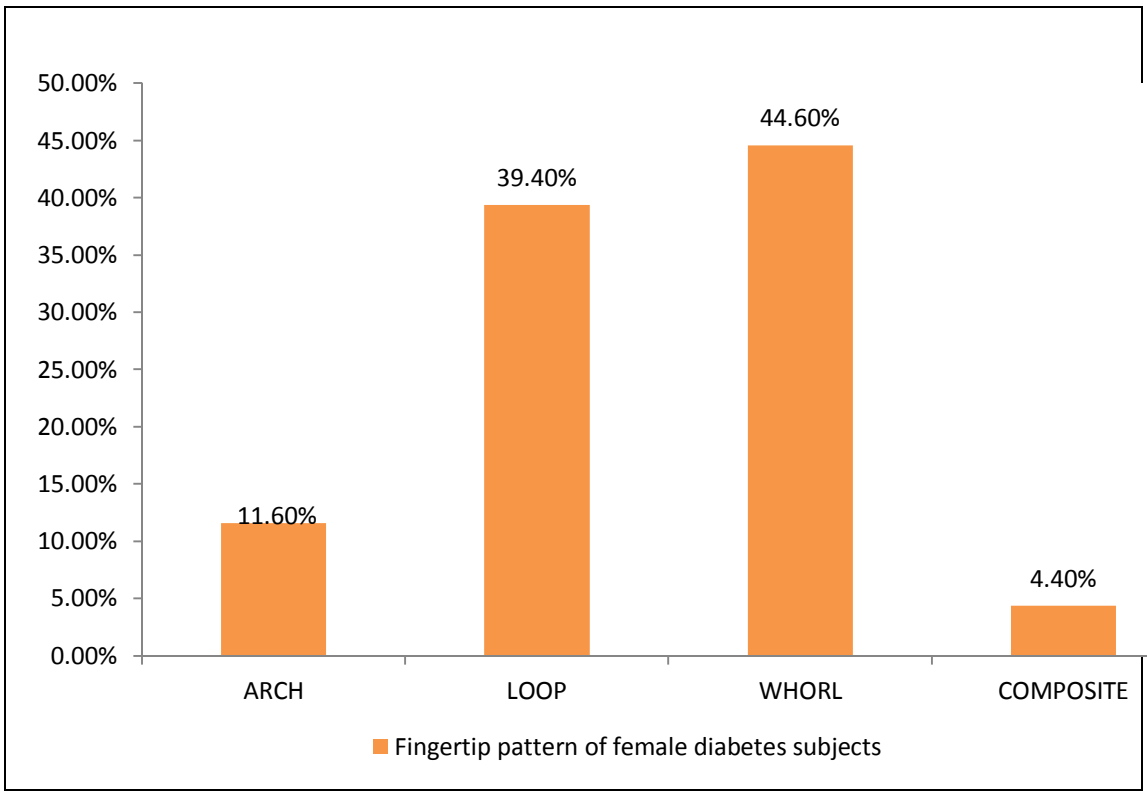
Graph 4: Percentage distribution of fingertip pattern of diabetes subjects



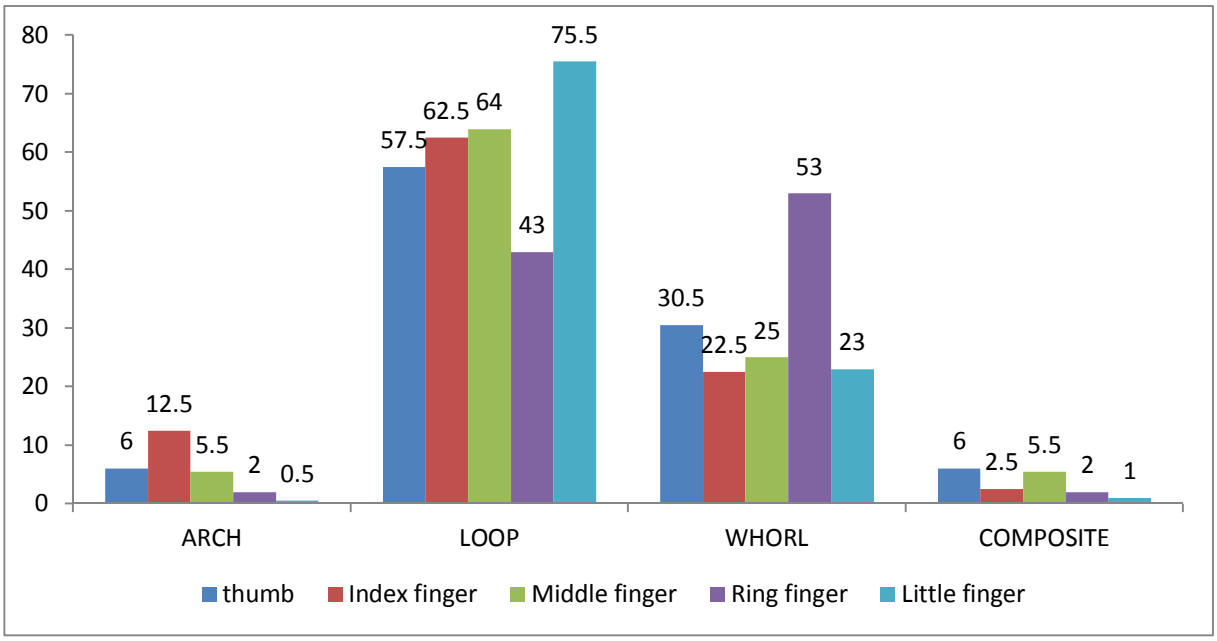
Graph 5: Percentage distribution of fingertip pattern of male diabetes subjects



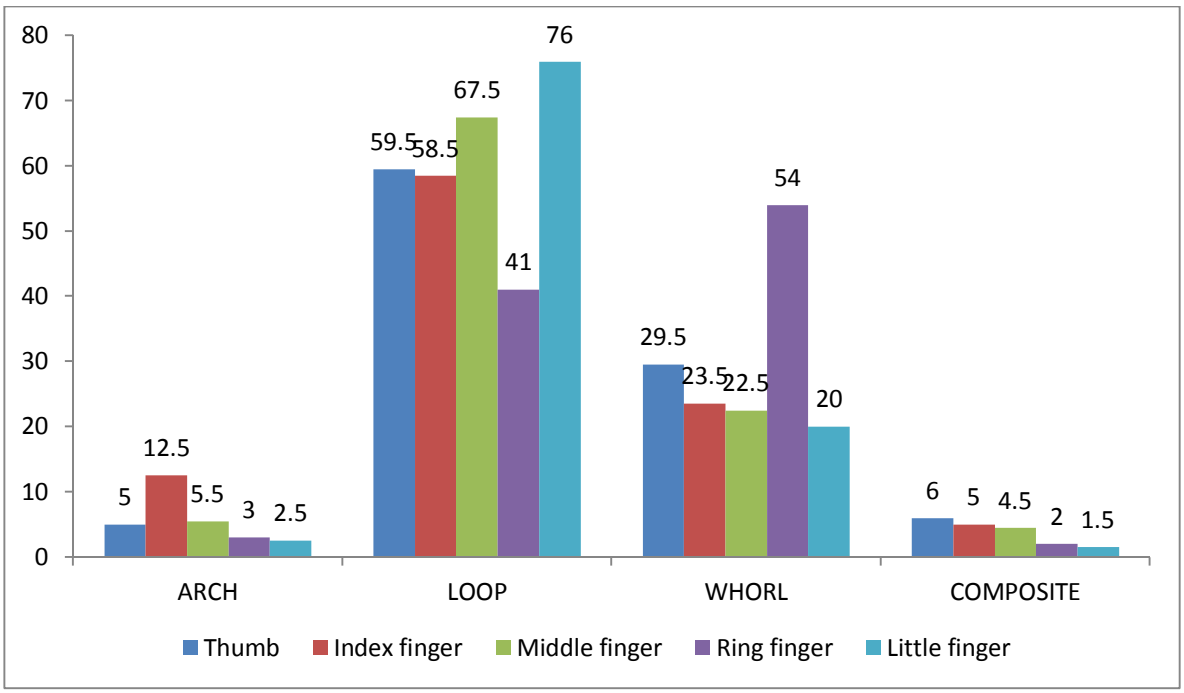
Graph 6: Percentage distribution of fingertip pattern of female diabetes subjects



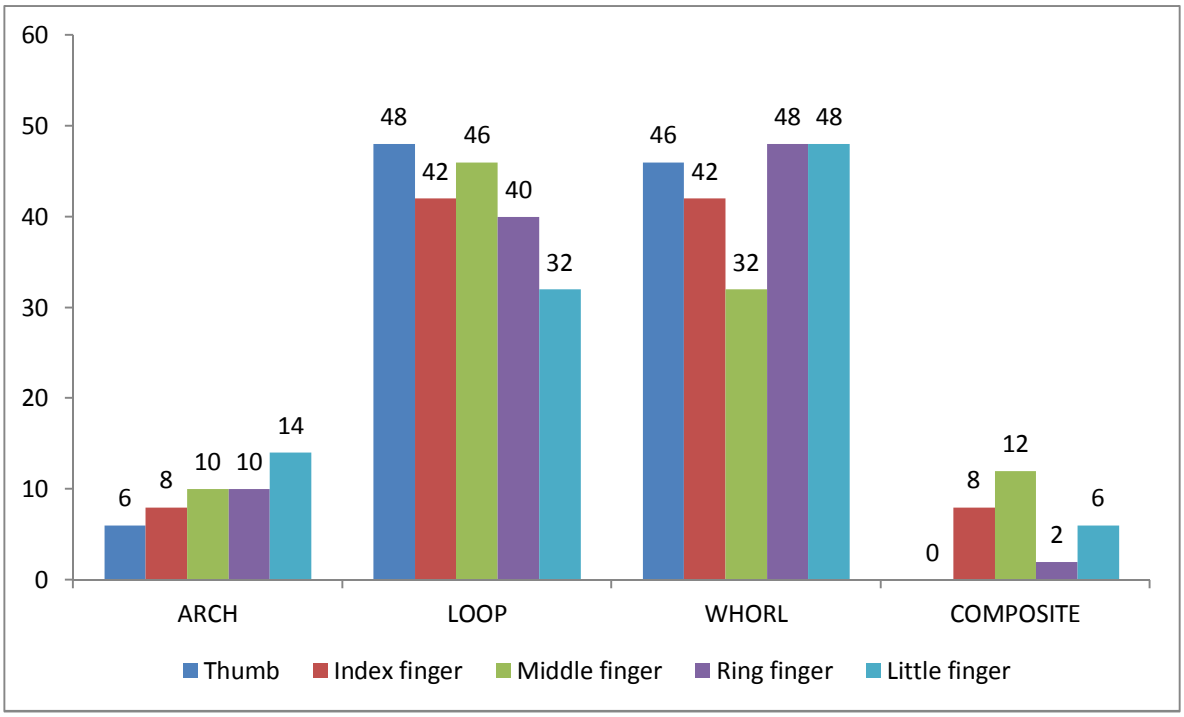
Graph 7: Percentage distribution of finger print pattern in individual digits of male medical students



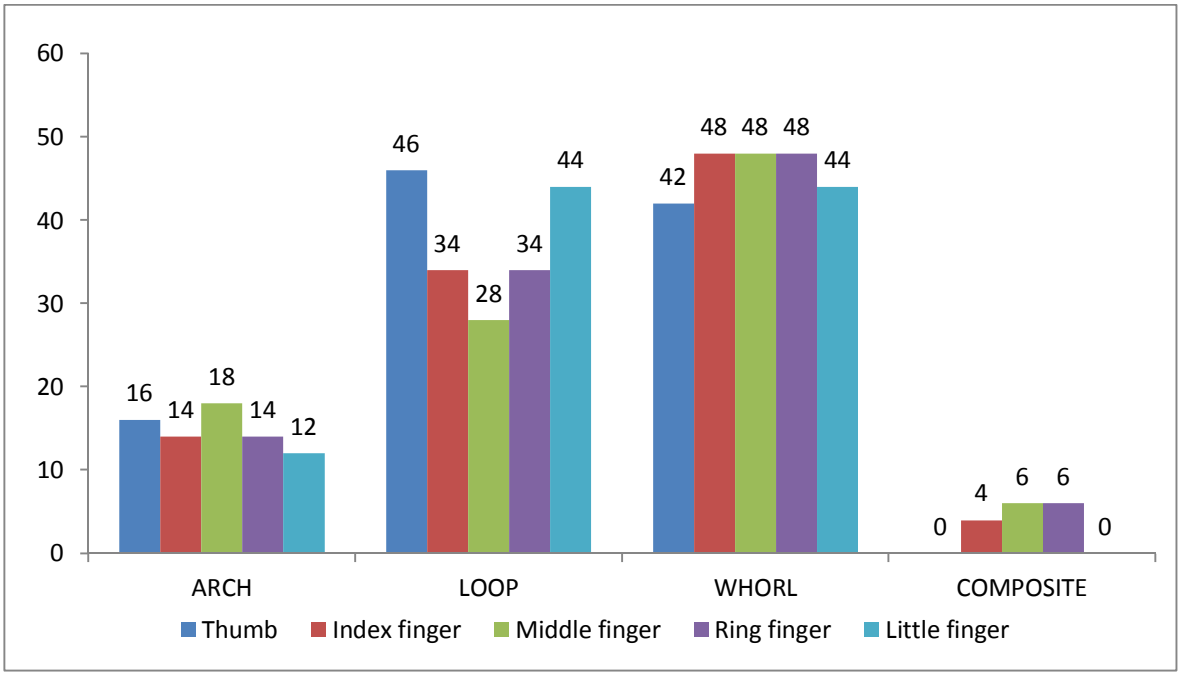
Graph 8: Percentage distribution of finger print pattern in individual digits of female medical students



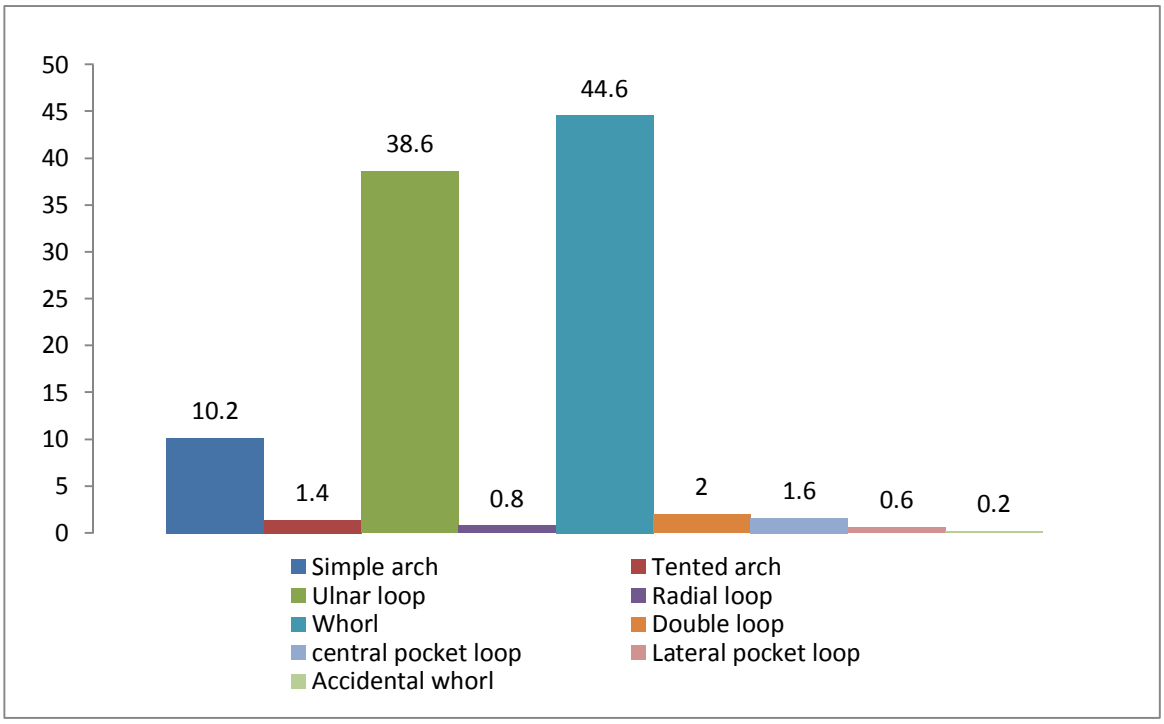
Graph 9: Percentage distribution of finger print pattern in individual digits of male diabetes subjects



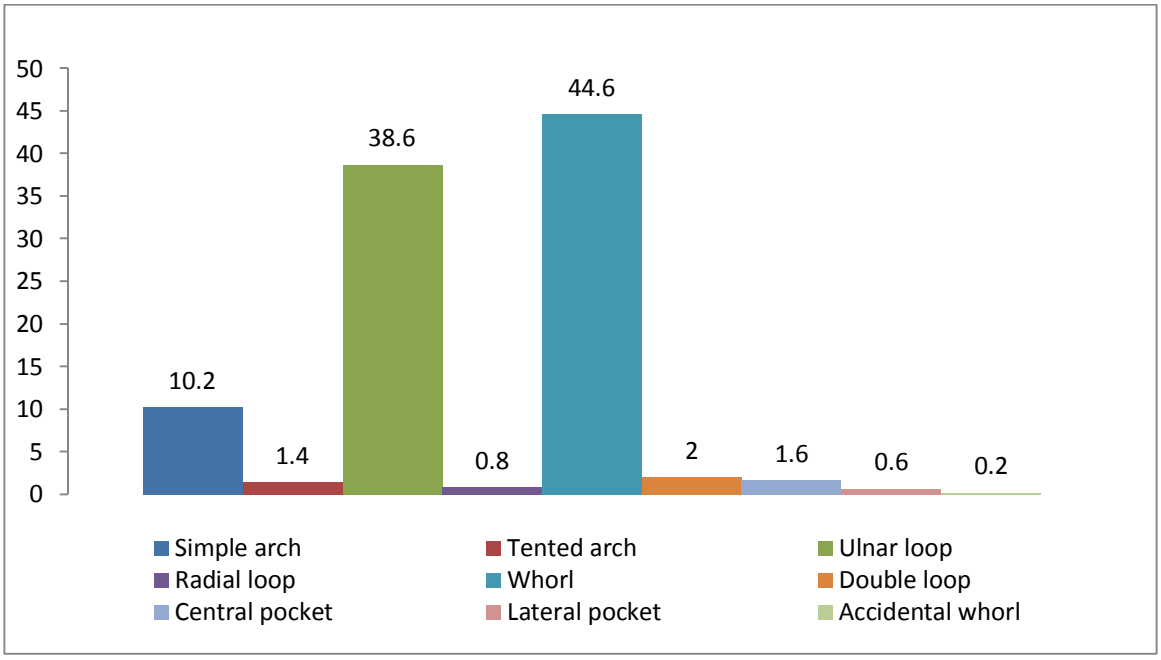
Graph 10: Percentage distribution of finger print pattern in individual digits of female diabetes subjects



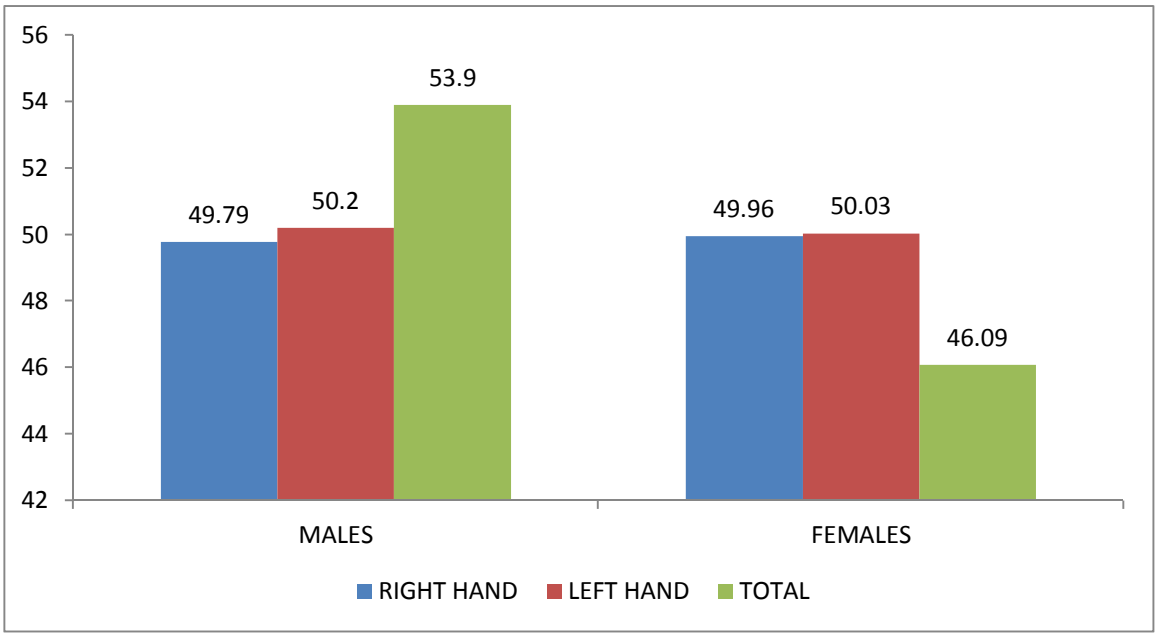
Graph 11: Percentage distribution of subtypes of fingerprint pattern of medical students



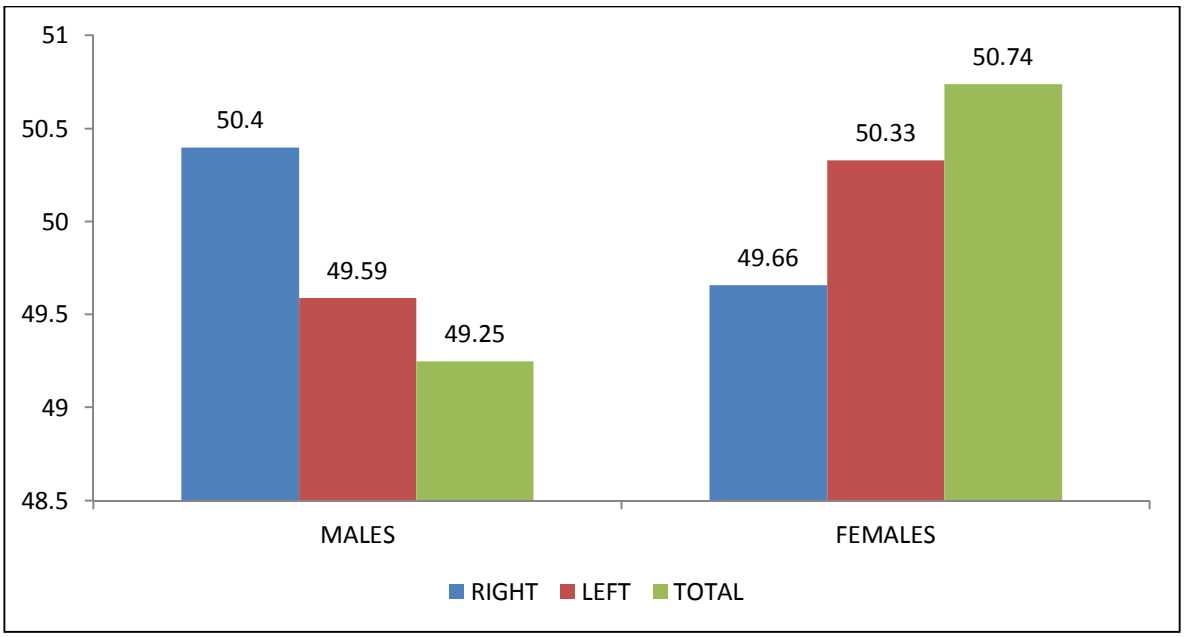
Graph 12: Percentage distribution of subtypes of fingerprint pattern of diabetes subjects



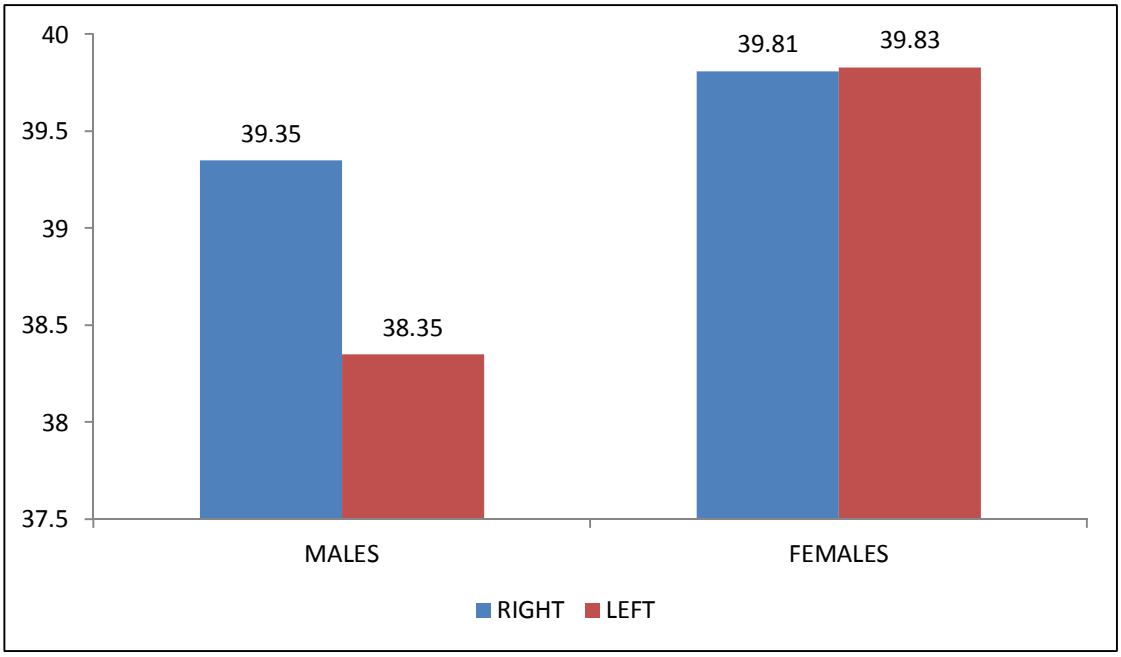
Graph 13: Percentage distribution of total finger ridge counts in male and female medical students



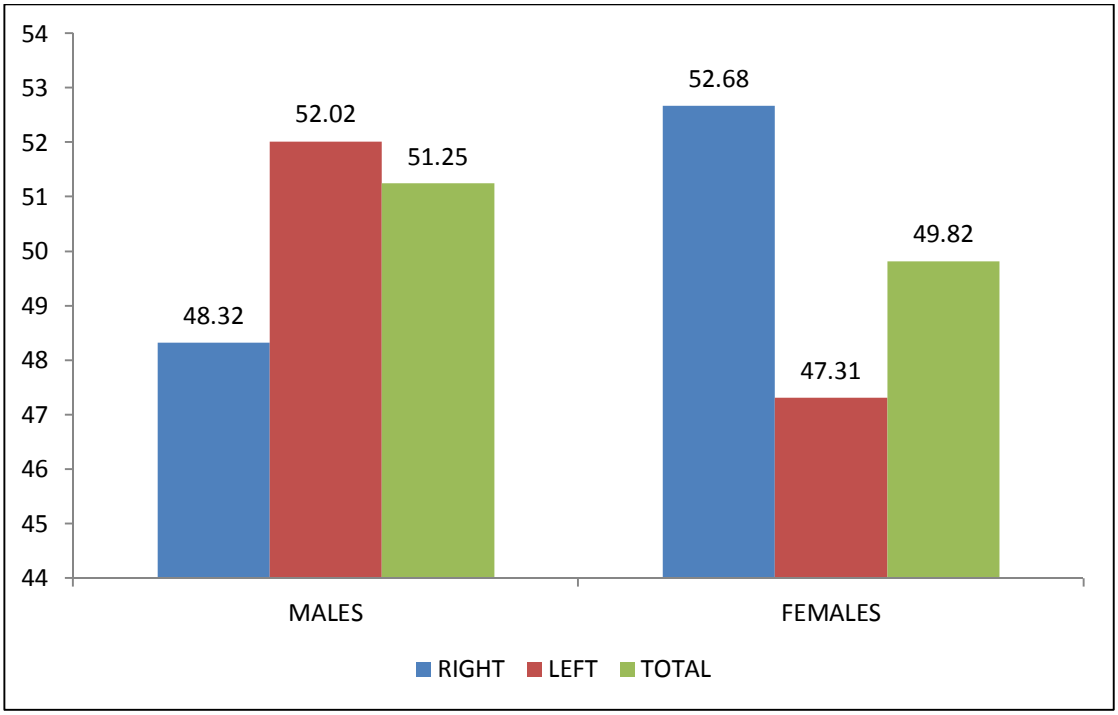
Graph 14: Percentage distribution of a - b ridge counts in male and female medical students



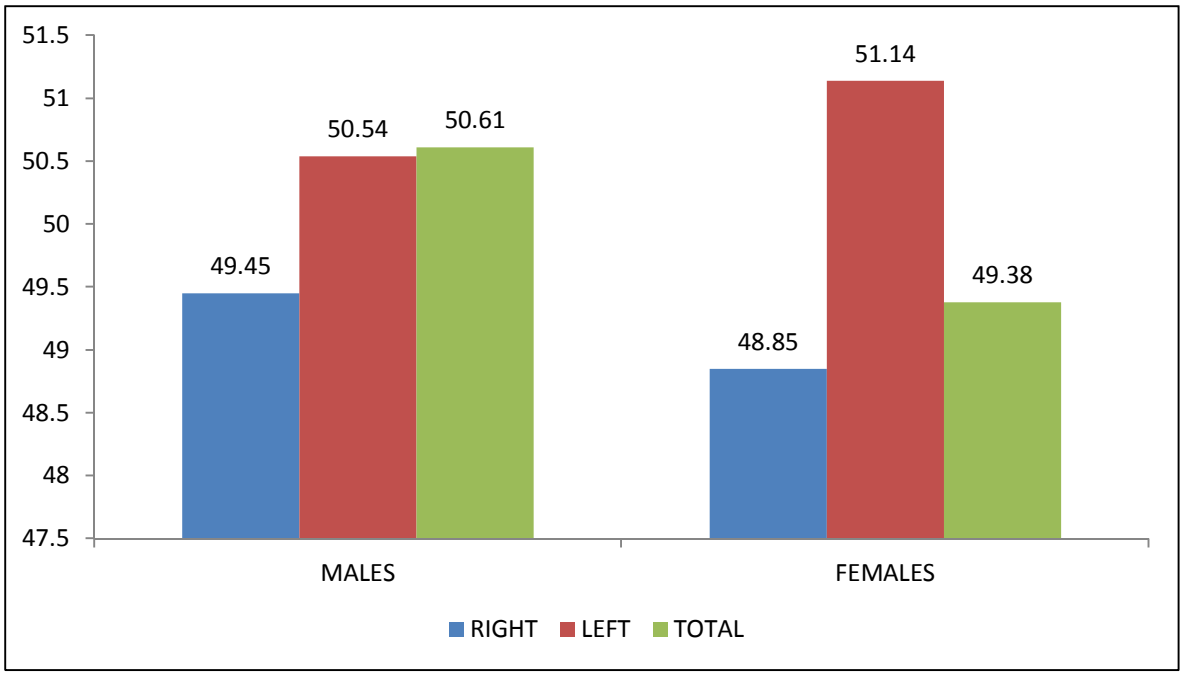
Graph 15: Mean value of atd angle in male and female medical students



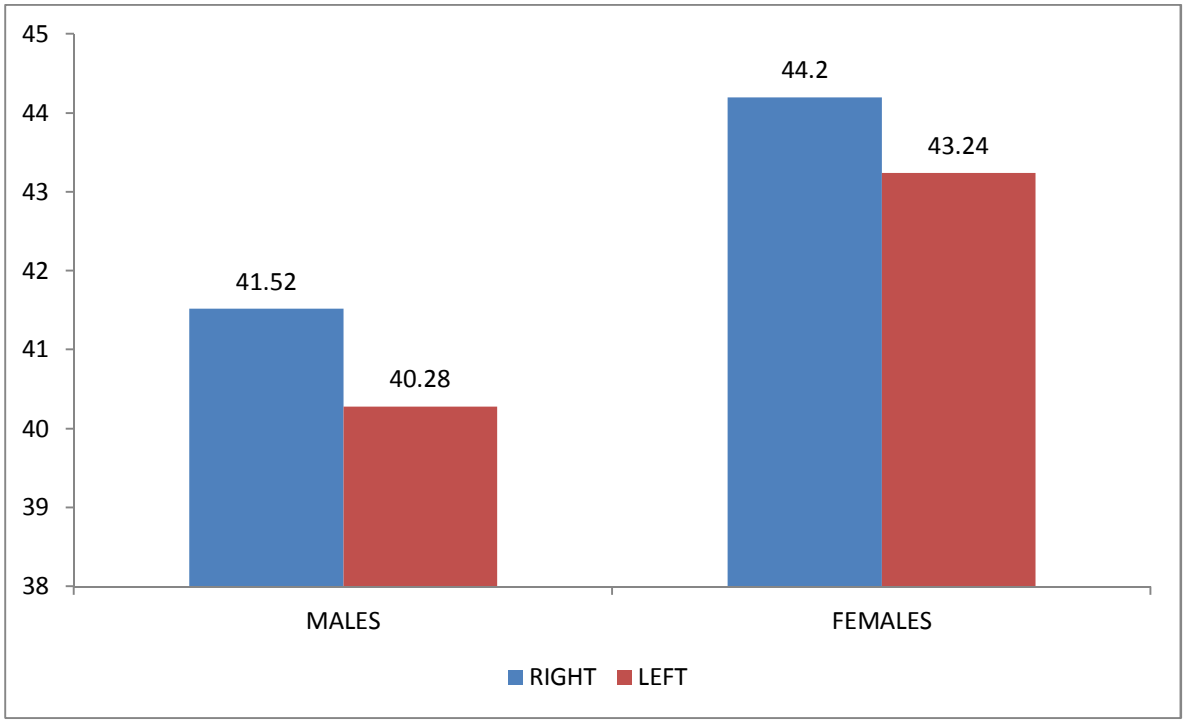
Graph 16: Percentage distribution of total finger ridge counts in male and female diabetes subjects



Graph 17: Percentage distribution of a - b ridge counts in male and female diabetes subjects



Graph 18: Mean value of atd angle in male and female diabetes subjects



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ANNEXURES

ANNEXURE 1: ENGLISH CONSENT FORM

PSG Institute of Medical Science and Research, Coimbatore
Institutional Human Ethics Committee
INFORMED CONSENT FORMAT FOR RESEARCH PROJECTS

(strike off items that are not applicable)

I / We (write name of the investigator(s) here), ____ Dr.K.Sangeetha,M.D.Anatomy-First year post graduate
am / are carrying out a study on the topic: DERMATOGLYPHIC PATTERNS AND ITS VARIATIONS IN SOUTH INDIAN ADULTS

as part of my / our research project being carried out under the aegis of the Department of: ANATOMY

(*Applicable to students only*): My / our research guide is: Dr.M.Jamuna

The justification for this study is:
There has been a strong correlation between dermatoglyphic patterns and certain genetically inherited disorders.This study aims to bring the different patterns and variations in fingerprints.

Primary Objective: The objectives of this study are: 1.To determine the predominant fingerprint pattern in both genders.
2.To determine the predominant fingerprint pattern in both sides.
3.To determine the predominant fingerprint pattern in individual digits of both hands.

Secondary Objective: To determine the variations in finger prints and significance.

Sample size: __400
Study volunteers / participants are (specify population group & age group): MBBS students from first year to final year 100 boys and 100 girls (18-25 years)

Location: PSG IMS&R

We request you to kindly cooperate with us in this study. We propose collect background information and other relevant details related to this study. We will be carrying out:

Initial interview (specify approximate duration):_____NA___ minutes.

Data collected will be stored for a period of __3___ years. We will / will not use the data as part of another study.

NA

Health education sessions: Number of sessions: _____. Approximate **duration** of each session:

___NA_____ minutes.

Clinical examination (Specify details and purpose): NA

Blood sample collection: Specify quantity of blood being drawn: NA

No. of times it will be collected: NA

Whether blood sample collection is part of routine procedure or for research (study) purpose:

1. Routine procedure 2. Research purpose

Specify **purpose**, discomfort likely to be felt and side effects, if any: NA

Whether blood sample collected will be stored after study period: Yes / No, it will be destroyed

Whether blood sample collected will be sold: Yes / No

Whether blood sample collected will be shared with persons from another institution: Yes / No

Medication given, if any, duration, side effects, purpose, benefits: NA

Whether medication given is part of routine procedure: Yes / No (If not, state reasons for giving this medication)

Whether alternatives are available for medication given: Yes / No (If not, state reasons for giving this particular medication)

NA

Final interview (specify approximate duration):_____ mts. If **photograph** is taken, purpose:

Benefits from this study: NIL

Risks involved by participating in this study: NIL

How the **results** will be used:

If you are uncomfortable in answering any of our questions during the course of the interview / biological sample collection, **you have the right to withdraw from the interview / study at anytime.** You have the freedom to withdraw from the study at any point of time. Kindly be assured that your refusal to participate or withdrawal at any stage, if you so decide, will not result in any form of compromise or discrimination in the services offered nor would it attract any penalty. You will continue to have access to the regular services offered to a patient. You will **NOT** be paid any remuneration for the time you spend with us for this interview / study. The information provided by you will be kept in strict confidence. Under no circumstances shall we reveal the identity of the respondent or their families to anyone. The information that we collect shall be used for approved research purposes only. You will be informed about any significant new findings - including adverse events, if any, – whether directly related to you or to other participants of this study, developed during the course of this research which may relate to your willingness to continue participation.

Consent: The above information regarding the study, has been read by me/ read to me, and has been explained to me by the investigator/s. Having understood the same, I hereby give my consent to them to interview me. I am affixing my signature / left thumb impression to indicate my consent and willingness to participate in this study (i.e., willingly abide by the project requirements).

Signature / Left thumb impression of the Study Volunteer / Legal Representative:

Signature of the Interviewer with date: Witness:

Contact number of PI:

Contact number of Ethics Committee Office: During Office hours: 0422 2570170 Extn.: 5818
After Office hours: 9865561463

ANNEXURE 2: TAMIL CONSENT FORM

பூ.சா கோ மருத்துவக்கல்லூரி மற்றும் ஆராய்ச்சி நிறுவனம், கோவை

மனித நெறிமுறைக் குழு

ஒப்புதல் படிவம்

DR. K.சங்கீதா ஆகிய நாள், பூ.சா.கோ மருத்துவக்கல்லூரியின் உடற்கூறியல் துறையின் கீழ், கைரேகையின் வடிவங்களும் அதன் வேறுபாடுகளும் என்ற தலைப்பில் ஆய்வு மேற்கொள்ள உள்ளேன்.

என் அய்வு வழிகாட்டி (மாணவர்களுக்கு மட்டும்) : Dr.M.ஜமுனா

ஆய்வுமேற்கொள்வதன் அடிப்படை : கைரேகை என்பது எல்லோருக்கும் ஒரே விதமாக இருப்பது இல்லை. ஒவ்வொருவருக்கும் வேறுவிதமாக இருக்கும். சர்க்கரை நோய் உள்ளவர்களுக்கு கைரேகையில் உள்ள வேறுபாடுகளை கண்டறிய இந்த ஆய்வு மேற்கொள்ளப்படுகிறது.

ஆய்வின் நோக்கம் : சர்க்கரை நோய் உள்ளவர்களுக்கு கைரேகையில் உள்ள வேறுபாடுகளை காண உள்ளோம்.

ஆய்வில் பங்கு பெறும் நபர்களின் எண்ணிக்கை : 50

ஆய்வில் பங்கு பெறுவோர் மற்றும் வயது : சர்க்கரை நோய் உள்ளோர் (30-60 yrs)

ஆய்வு மேற்கொள்ளும் இடம் : எண்டோகிரைனாலஜி டிபார்ட்மென்ட்

இந்த ஆய்வில் எங்களுடன் ஒத்துழைக்குமாறு கேட்டுக் கொள்கிறோம்

ஆய்வு செய்யும் முறை : கையில் மை போட்டு, பேப்பரில் அச்சிட்டு எந்த அசௌகரியமும் இல்லாமல் ஆய்வு செய்யப்படும்.

இந்த ஆய்வில் கிடைக்கும் தகவல்கள் **3** வருடங்கள் பாதுகாக்கப்படும். இந்த தகவல்கள் வேறு ஆய்விற்கு பயன்படுத்தப் பட மாட்டாது.

சுகாதாரக்கல்வி அமர்வுகள்_____ முறை ஒரு அமர்வுக்கான நேரம் _____ நிமிடங்கள் பொருந்தாது.

மருத்துவ பரிசோதனைகள் : பொருந்தாது

இரத்த மாதிரி சேகரிப்பு : பொருந்தாது

இரத்த மாதிரி எடுப்பது வழக்கமான சிகிச்சைக்காகவோ அல்லது இந்த ஆய்விற்காகவா? : பொருந்தாது

இதனால் ஏகற்படக்கூடிய அசௌகரியங்கள் / பக்க விளைவுகள் : பொருந்தாது

இரத்த மாதிரிகள் ஆய்விற்குப் பின் பாதுகாக்கப்படுமா? :பொருந்தாது

சேகரிக்கப்பட்ட ரத்தம் விற்கப்படுமா? : பொருந்தாது

சேகரிக்கப்பட்ட இரத்தம் வேறு நிறுவனத்துடன் பகிர்ந்து கொள்ளப்படுமா? :

பொருந்தாது

மருந்துகள் ஏதேனும் கொடுக்கப்படவிருந்தால் அவை பற்றிய விவரம் : பொருந்தாது

மருந்துகள் கொடுக்கப்படுவது வழக்கமான சிகிச்சைமுறையா : பொருந்தாது

கொடக்கப்படும் மருந்துகளுக்கு மாற்று உள்ளதா : பொருந்தாது

ஆய்வில் பங்கு பெறுவதால் ஏற்படும் பலன்கள் : இல்லை

ஆய்வில் பங்கேற்பதால் ஏற்படும் அசௌகரியங்கள் / பக்க விளைவுகள் : இல்லை

ஆய்வின் முடிவுகள் எந்த முறையில் பயன்படுத்தபடும் : ஆராய்ச்சிக்காக

இந்த ஆய்வின் கைரேகை எடுப்பதற்கோ உங்களுக்கு ஏதேனும் அசௌகரியம் இருந்தால், எந்த நேரத்தில் வேண்டுமானாலும் ஆய்விலிருந்து விலகிக்கொள்ளும் உரிமை உங்களுக்கு உண்டு. ஆய்விலிருந்து விலகிக் கொள்வதால் உங்களுக்கு அளிக்கப்படும் சிகிச்சை முறையில் எந்த வித பாதிப்பும் இருக்காது என்று உங்களுக்கு உறுதியளிக்கிறோம். மருத்துவ மனையில் நோயாளிகளுக்கு அளிக்கப்படும் சேவைகளை நீங்கள் தொடர்ந்து பெறலாம். இந்த ஆய்வில் பங்கேற்க ஒப்புக் கொள்வதால் வேறு எந்த வதமான கூடுதலான பலனும் உங்களுக்கு கிடைக்காது . நீங்கள் அளிக்கும் தகவல்கள் இரகசியமாக வைக்கப்படும். ஆய்வில் பங்கேற்பவர்கள் பற்றியோ அவர்கள் குடும்பத்தைப் பற்றியோ எந்தத் தகவலும் எக்காரணம் கொண்டும் வெளியிடப்படமாட்டாது என்று உறுதியளிக்கிறோம். நீங்கள் அளிக்கும் தகவல்கள் , அங்கீகரிக்கப்பட்ட ஆய்விற்கு மட்டுமே பயன்படுத்தப்படும். இந்த ஆய்வு நடைபெறும் காலத்தில் குறிப்பிடத்தகுந்த புதிய கண்டுபிடிப்புகள் அல்லது பக்க விளைவுகள் ஏதும் ஏற்பட்டால் உங்களுக்குத் தெரிவிக்கப்படும். இதனால் ஆய்வில் தொடர்ந்து பங்கு பெறுவது பற்றிய உங்கள் நிலைப்பாட்டை நீங்கள் தெரிவிக்க ஏதுவாகும்.

ஆய்வுக்குட்படுபவரின் ஒப்புதல் இந்த ஆய்வைப் பற்றிய மேற்கூறிய தகவல்களை நான் படித்து அறிந்து கொண்டேன் / ஆய்வாளர் படிக்கக் கேட்டுத் தெரிந்து கொண்டேன். ஆய்வினைப் பற்றி நன்றாக புரிந்து கொண்டு இந்த ஆய்வில் பங்கு பெற ஒப்புக் கொள்கிறேன். இந்த ஆய்வில் பங்கேற்பதற்கான எனது ஒப்புதலை கீழே கையொப்பமிட்டு / கைரேகை பதித்து நான் தெரிவித்துக் கொள்கிறேன்.

பங்கேற்பவரின் பெயர் / முகவரி :

பங்கேற்பவரின் கையொப்பம் / கைரேகை / சட்டப்பூர்வ பிரதிநிதியின் கையொப்பம்

தேதி :

ஆய்வாளரின் கையொப்பம்

தேதி

ஆய்வாளரின் தொலைப்பேசி எண்

மனித நெறிமுறை குழு அலுவலகத்தின் தொலைபேசி எண்

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ANNEXURE 3: Statistics – Independent t test to determine the statistical significance between gender and quantitative parameters in medical students: *(page 1 of 2)*

Group Statistics					
	GENDER	N	Mean	Std. Deviation	Std. Error Mean
Total finger ridge count	male	100	130.77	16.330	1.633
	female	100	111.84	12.919	1.292
Total a-b ridge count	male	100	68.01	3.713	.371
	female	100	70.07	4.013	.401
atd angle	male	100	77.70	5.235	.523
	female	100	79.64	7.912	.791

Statistics – Independent t test to determine the statistical significance between gender and quantitative parameters in medical students: *(page 2 of 2)*

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Total finger ridge count	Equal variances assumed	3.635	.058	9.091	198	.000	18.930	2.082	14.824	23.036
	Equal variances not assumed			9.091	188.042	.000	18.930	2.082	14.822	23.038
Total a-b ridge count	Equal variances assumed	1.060	.304	-3.768	198	.000	-2.060	.547	-3.138	-.982
	Equal variances not assumed			-3.768	196.816	.000	-2.060	.547	-3.138	-.982
atd angle	Equal variances assumed	15.689	.000	-2.045	198	.042	-1.940	.949	-3.811	-.069
	Equal variances not assumed			-2.045	171.741	.042	-1.940	.949	-3.813	-.067

Statistics –Pearson Correlation to determine the statistical correlation between total finger ridge counts and total a – b ridge count in medical students:

		Total finger ridge count	Total a-b ridge count
Total finger ridge count	Pearson Correlation	1	-.224**
	Sig. (2-tailed)		.001
	N	200	200
Total a-b ridge count	Pearson Correlation	-.224**	1
	Sig. (2-tailed)	.001	
	N	200	200

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

Statistics –Pearson Correlation to determine the statistical correlation between atd angle total a – b ridge count in medical students:

		atd angle	Total a-b ridge count
atd angle	Pearson Correlation	1	.163*
	Sig. (2-tailed)		.021
	N	200	200
Total a-b ridge count	Pearson Correlation	.163*	1
	Sig. (2-tailed)	.021	
	N	200	200

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

Statistics –Pearson Correlation to determine the statistical correlation between total finger ridge counts and total atd angle in medical students:

		Total finger ridge count	atd angle
Total finger ridge count	Pearson Correlation	1	-.048
	Sig. (2-tailed)		.496
	N	200	200
atd angle	Pearson Correlation	-.048	1
	Sig. (2-tailed)	.496	
	N	200	200

Statistics – Independent t test to determine the statistical significance between gender and quantitative parameters in diabetics: *(page 1 of 2)*

Group Statistics					
	GENDER	N	Mean	Std. Deviation	Std. Error Mean
Total finger ridge count	male	25	114.80	15.564	3.113
	female	25	111.60	12.490	2.498
Total a-b ridge count	male	25	62.52	8.058	1.612
	female	25	61.00	9.120	1.824
atd angle	male	25	81.80	7.826	1.565
	female	25	87.44	5.132	1.026

Statistics – Independent t test to determine the statistical significance between gender and quantitative parameters in diabetics: *(page 2 of 2)*

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Total finger ridge count	Equal variances assumed	.107	.746	.802	48	.427	3.200	3.991	-4.825	11.225
	Equal variances not assumed			.802	45.849	.427	3.200	3.991	-4.835	11.235
Total a-b ridge count	Equal variances assumed	1.347	.251	.625	48	.535	1.520	2.434	-3.374	6.414
	Equal variances not assumed			.625	47.283	.535	1.520	2.434	-3.376	6.416
atd angle	Equal variances assumed	4.004	.051	-3.013	48	.004	-5.640	1.872	-9.403	-1.877
	Equal variances not assumed			-3.013	41.420	.004	-5.640	1.872	-9.419	-1.861

Statistics –Pearson Correlation to determine the statistical correlation between total finger ridge counts and total a – b ridge count in diabetics:

		Total atd angle	Total a-b ridge count
Total atd angle	Pearson Correlation	1	-.084
	Sig. (2-tailed)		.564
	N	50	50
Total a-b ridge count	Pearson Correlation	-.084	1
	Sig. (2-tailed)	.564	
	N	50	50

Statistics –Pearson Correlation to determine the statistical correlation between total atd angle and total a – b ridge count in diabetics:

		Total atd angle	Total a-b ridge count
Total atd angle	Pearson Correlation	1	-.197
	Sig. (2-tailed)		.170
	N	50	50
Total a-b ridge count	Pearson Correlation	-.197	1
	Sig. (2-tailed)	.170	
	N	50	50

Statistics –Pearson Correlation to determine the statistical correlation between total finger ridge counts and atd angle in diabetics:

		Total finger ridge count	atd angle
Total finger ridge count	Pearson Correlation	1	.055
	Sig. (2-tailed)		.703
	N	50	50
atd angle	Pearson Correlation	.055	1
	Sig. (2-tailed)	.703	
	N	50	50

ANNEXURE: MASTER CHART OF MEDICAL STUDENTS

S.No	GENDER	RT	RI	RM	RR	RL	LT	LI	LM	LR	LL	RTFRC	LTFRC	TTFRC	Ra-b	La-b	Ta-b	Ratd	Latd	Tatd
1	M	Ct	Lu	Lu	W	W	W	Lu	W	W	W	81	76	157	35	29	64	36	35	71
2	M	W	Lu	Lu	W	Lu	Lu	A	W	W	Lu	64	46	110	33	36	69	39	39	78
3	M	Lu	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	W	65	55	120	34	32	66	38	42	80
4	M	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	W	W	65	80	145	39	31	70	36	38	74
5	M	Lu	Lu	Lu	W	W	Lu	Lu	Lu	W	W	63	65	128	35	36	71	44	41	85
6	M	Lu	Cc	Lu	W	Lu	Cc	Lu	Lu	Cc	Lu	68	65	133	36	32	68	37	38	75
7	M	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	Lu	Lu	67	71	138	34	34	68	35	42	77
8	M	Ct	W	Ca	Lu	Lu	Lu	W	W	W	Lu	64	74	138	36	33	69	40	40	80
9	M	W	Lu	Lu	W	W	Lu	Lu	Lu	Lu	Lu	77	74	151	31	30	61	38	39	77
10	M	W	A	Lu	Lu	Lu	Lu	Lu	Lu	W	Lu	46	64	110	38	37	75	36	39	75
11	M	W	A	Lu	Lu	Lu	Ct	A	Lu	Lu	Lu	71	59	130	36	33	69	37	38	75
12	M	W	Lu	Lu	Lu	Lu	Lu	Lu	Lu	W	Lu	72	65	137	38	36	74	38	40	78
13	M	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	W	Lu	74	81	155	32	34	66	40	38	78
14	M	Lu	Lu	Lu	Lu	Lu	Lu	Cc	Lu	Lu	Lu	67	58	125	36	32	68	39	34	73
15	M	W	Lu	Lu	Lu	Lu	Lu	Lu	Lu	W	Lu	71	77	148	32	35	67	35	46	81
16	M	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Ct	W	Lu	71	67	138	38	36	74	35	36	71
17	M	W	W	Cl	W	Lu	Lu	Lu	Lu	Lu	Lu	68	64	132	36	37	73	39	38	77
18	M	A	Lu	Lu	Lu	Lu	Lu	Lu	Lu	W	Lu	68	71	139	30	33	63	36	35	71
19	M	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	70	75	145	34	30	64	35	33	68

20	M	Lu	At	Lu	Lu	Lu	W	Lu	Lu	W	Lu	58	78	136	35	39	74	36	38	74
21	M	Lu	W	Lu	W	W	Ct	W	Lu	W	W	68	69	137	38	32	70	50	36	86
22	M	At	At	W	A	Lu	At	A	Lu	At	Lu	25	29	54	36	31	67	40	35	75
23	M	Lu	Lu	Lu	Lu	W	W	Lu	W	Ct	W	81	66	147	33	37	70	38	36	74
24	M	W	W	Lu	W	Lu	Ct	W	Lu	Lu	Lu	58	73	131	36	32	68	35	35	70
25	M	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	W	Lu	76	69	145	32	36	68	36	36	72
26	M	W	W	Lu	W	Lu	Lu	Lu	Lu	W	Lu	75	65	140	30	38	68	36	45	81
27	M	A	Lu	Lu	Lu	Lu	W	Lu	W	W	Lu	53	62	115	39	31	70	36	38	74
28	M	At	Lu	Ct	Lu	Lu	Lu	Lu	Lu	Lu	Lu	50	63	113	35	29	64	43	39	82
29	M	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	W	Lu	70	65	135	35	31	66	38	38	76
30	M	Lu	At	Ct	Lu	Lu	Lu	Lr	W	Lu	Lu	52	64	116	36	36	72	39	46	85
31	M	W	W	Lu	W	W	W	Lr	W	W	Lu	62	68	130	32	32	64	42	38	80
32	M	Lu	Lu	Lu	W	W	Lu	Lu	Lu	W	W	71	68	139	33	37	70	37	36	73
33	M	W	Lu	Lu	Lu	Lu	Lu	A	At	At	Lu	69	52	121	36	36	72	36	35	71
34	M	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	W	Lu	67	66	133	32	31	63	36	37	73
35	M	W	W	W	Lu	W	W	W	W	Lu	W	73	74	147	35	32	67	34	38	72
36	M	A	Lu	Lu	W	Lu	Lu	Lu	Lu	W	Lu	54	77	131	36	36	72	38	40	78
37	M	A	At	Lu	W	Lu	Lu	Lu	Lu	W	Lu	41	65	106	36	31	67	36	39	75
38	M	Lu	Lu	Lu	W	Lu	Lu	At	Lu	Lu	Lu	69	64	133	32	38	70	38	38	76
39	M	Lu	Lu	Lu	Lu	W	Ct	Ct	W	W	Lu	74	81	155	30	37	67	38	36	74
40	M	W	W	W	W	W	A	Lu	W	W	Lu	73	54	127	35	36	71	36	38	74
41	M	W	Lu	Lu	Lu	Lu	A	Lu	Lu	W	Lu	81	63	144	36	34	70	38	36	74

42	M	W	Lu	Ca	Lu	Lu	Lu	Lu	W	W	Lu	71	71	142	30	36	66	39	38	77
43	M	Lu	Lu	Lu	W	Lu	Lu	W	Lu	W	Lu	72	75	147	36	34	70	35	42	77
44	M	W	Lu	Lu	W	Lu	Lu	A	Lu	W	Lu	78	59	137	36	38	74	46	38	84
45	M	Lu	Lu	A	Lu	Lu	Lu	W	A	Lu	Lu	64	64	128	35	32	67	38	36	74
46	M	Lu	Lu	Lu	W	Lu	Lu	W	Lu	Lu	Lu	70	71	141	36	34	70	42	38	80
47	M	Lu	Lu	Lu	At	Lu	Lu	A	W	W	Lu	53	54	107	36	35	71	38	42	80
48	M	Lu	Lu	Lu	Lu	Lu	Lu	W	Lu	W	Lu	75	79	154	33	34	67	50	40	90
49	M	Lu	Lu	A	Lu	Lu	Lu	A	Lu	Lu	Lu	56	50	106	32	36	68	39	43	82
50	M	Lu	Lu	Lu	W	Lu	A	A	A	W	Lu	69	30	99	32	38	70	35	35	70
51	M	W	W	Lu	Lr	Lu	Lu	Lu	Lu	W	Lu	65	67	132	32	32	64	40	39	79
52	M	Lu	Lu	A	W	W	Lu	Lu	Lu	W	Lu	65	77	142	31	30	61	38	42	80
53	M	W	W	Lu	Lu	Lu	W	Lu	Lu	Lu	W	72	70	142	35	31	66	36	36	72
54	M	Lu	Lu	Lu	W	Lu	Lu	Lu	W	W	W	68	70	138	35	35	70	38	36	74
55	M	W	Lu	Lu	W	Lu	W	Lu	Lu	W	W	72	60	132	38	33	71	41	38	79
56	M	W	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	Lu	68	68	136	36	31	67	38	42	80
57	M	Lu	Lu	W	Lu	Lu	Lu	Lu	Lu	Lu	Lu	66	74	140	31	35	66	36	39	75
58	M	W	A	W	W	W	Lu	W	W	W	W	54	75	129	35	36	71	39	48	87
59	M	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	69	68	137	36	33	69	39	41	80
60	M	W	W	W	W	Ct	W	W	W	W	Lu	82	81	163	36	37	73	42	42	84
61	M	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	61	61	122	38	33	71	37	38	75
62	M	W	W	W	W	Lu	W	W	W	W	Lu	80	76	156	36	35	71	46	39	85
63	M	Lu	Lu	Lu	Lu	Lu	W	Lu	W	Lu	w	64	61	125	32	36	68	41	42	83

64	M	W	Lu	Lu	W	Lu	W	A	Lu	Lu	w	70	50	120	36	31	67	48	37	85
65	M	W	A	W	W	W	W	W	W	W	W	60	81	141	35	32	67	35	39	74
66	M	A	Lu	A	W	Lu	Lu	Lr	At	W	W	44	55	99	36	30	66	40	40	80
67	M	W	Lu	Lu	W	Lu	W	W	W	W	Lu	65	54	119	29	36	65	36	36	72
68	M	W	Lu	Lu	Lr	Lr	W	Lu	Lu	Lu	Lu	67	72	139	31	32	63	45	42	87
69	M	W	W	W	W	W	W	W	W	W	W	78	71	149	35	31	66	41	38	79
70	M	Lu	Lu	Lu	Lu	Lu	At	At	Lu	Lu	Lu	67	45	112	36	30	66	38	37	75
71	M	Lu	Lu	Ct	W	Lu	W	W	Lu	W	W	68	56	124	28	35	63	46	45	91
72	M	Lu	Lu	Lu	W	Lu	W	A	Lu	Lu	Lu	73	61	134	39	36	75	42	41	83
73	M	W	Lu	Ct	Lu	Lu	Lu	Lu	Lu	Lu	Lu	65	73	138	32	38	70	37	38	75
74	M	Lu	A	A	A	A	Lu	Lu	Lu	W	W	26	64	90	31	37	68	44	36	80
75	M	Lu	Lu	Lu	W	Lu	Lr	Lu	Lu	Lu	Lu	66	64	130	36	31	67	42	36	78
76	M	W	A	W	Lu	Lu	Lu	Lu	Lu	Lu	Lu	50	69	119	35	28	63	45	39	84
77	M	W	Lu	W	W	W	Lu	W	W	Lu	W	72	68	140	33	36	69	38	36	74
78	M	Lu	W	Lu	W	W	Ct	W	W	W	Lu	68	64	132	38	36	74	39	41	80
79	M	Lu	Lu	Ct	W	W	Lu	Lu	w	Lu	Lu	69	65	134	36	32	68	34	36	70
80	M	Lu	W	Lu	Lu	W	Lu	Lu	Lu	Lu	Lu	66	65	131	32	33	65	36	36	72
81	M	Lu	Lu	Lu	W	Lu	Lu	W	Lu	Lu	W	62	68	130	31	30	61	38	35	73
82	M	Lu	W	W	Lu	W	Lu	Lu	W	Lu	Lu	65	65	130	36	38	74	40	42	82
83	M	Lu	Lu	Lu	Lu	Lu	Lu	Ct	Ct	W	Lu	63	62	125	35	36	71	42	36	78
84	M	Cc	Lr	W	W	Lu	W	W	W	Lu	Lr	80	80	160	33	32	65	43	45	88
85	M	W	W	W	W	Lu	W	W	W	W	Lu	71	79	150	35	30	65	41	39	80

86	M	W	Lr	Lr	Lr	Lu	W	Lr	Lr	Lr	Lr	63	62	125	36	35	71	44	38	82
87	M	W	Lu	Lu	W	Lu	Lu	W	Lu	Lu	Lu	66	68	134	35	34	69	35	35	70
88	M	Lu	W	W	W	W	Lu	Lu	W	W	W	71	67	138	37	30	67	38	38	76
89	M	Lu	A	W	W	W	W	Lu	Lu	Lu	Lu	49	60	109	31	36	67	37	30	67
90	M	W	W	Lu	W	Lu	Lu	W	W	W	Lc	62	63	125	32	34	66	45	35	80
91	M	Lu	Lu	Lu	W	Lu	Lu	W	Lu	Lu	Lu	59	61	120	33	35	68	47	41	88
92	M	Lu	At	At	Lu	Lu	Lu	Lu	Lu	Lu	Lu	39	61	100	36	39	75	46	38	84
93	M	Lu	Lu	W	W	Lu	W	Lu	Cc	W	Lu	62	63	125	31	32	63	41	32	73
94	M	Lu	Lu	Lu	Cc	Lu	Lu	Lu	Lu	Lu	Lu	66	63	129	38	30	68	38	30	68
95	M	Lu	Lu	Lu	Lu	Lu	Lu	Lr	At	Lu	Lu	61	50	111	36	39	75	42	33	75
96	M	Lu	Lu	Lu	Lu	Lu	Cc	Lu	Lu	Lu	Lu	58	62	120	32	32	64	47	38	85
97	M	Lu	Lu	Lu	Cc	Lu	W	Cc	W	W	Cc	64	75	139	28	28	56	44	39	83
98	M	LU	At	Lu	W	Lu	Cc	Lu	W	Lu	Lu	54	62	116	36	34	70	46	36	82
99	M	Ct	Lu	Lu	W	Lu	Lu	W	W	W	Lu	63	64	127	32	33	65	38	39	77
100	M	W	W	W	W	W	W	W	W	W	Lu	Lu	74	70	144	29	30	59	35	45	80
101	F	Lu	A	W	W	Lu	Lu	Lu	Lu	Lu	Lu	Lu	48	60	108	29	33	62	45	40	85
102	F	Lu	Lu	A	A	Lu	Lu	Lu	Lu	Lu	Lu	Lu	35	60	95	36	35	71	39	42	81
103	F	Lu	W	W	W	Lu	W	Lu	Lu	Lu	Lu	62	62	124	36	39	75	42	41	83
104	F	W	W	Lu	W	W	W	W	Lu	W	Lu	61	57	118	34	37	71	36	43	79
105	F	W	Lu	Lu	W	A	Lu	Lu	Lu	W	Lu	44	59	103	35	33	68	36	46	82
106	F	Lu	W	At	At	Lu	W	W	Lu	Lu	Lu	33	60	93	31	39	70	31	41	72
107	F	W	Lu	Lu	W	W	Lu	Lu	Lu	W	W	58	58	116	36	36	72	32	42	74

108	F	Lu	W	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	56	56	112	36	37	73	30	45	75
109	F	Lu	Lu	W	W	Lu	A	Lu	Lu	W	Lu	59	50	109	35	31	66	38	41	79
110	F	Lu	W	Lu	W	Lu	Lu	Lu	Lu	Lu	Lu	60	63	123	37	39	76	40	42	82
111	F	Lu	Lu	Lu	Lu	At	Lu	Lu	A	Lu	Lu	52	52	104	34	33	67	35	43	78
112	F	Lu	W	W	W	Lu	Lu	Lu	Lu	Lu	Lu	60	64	124	31	34	65	42	42	84
113	F	Lu	Lu	Lu	W	Lu	Lu	Lr	W	W	Lu	63	62	125	38	29	67	36	45	81
114	F	Lu	Lu	W	W	Lu	Lu	Lu	Lu	W	W	59	61	120	34	33	67	35	34	69
115	F	Lu	Lu	Lu	Lu	Lu	Lu	Lu	W	Lu	Lu	59	57	116	36	36	72	31	36	67
116	F	W	W	Lu	Lu	Lu	W	W	W	W	Lu	61	61	122	31	30	61	37	32	69
117	F	W	W	W	W	W	W	W	W	W	W	64	62	126	31	36	67	39	30	69
118	F	Lu	Lu	W	W	Lu	Lu	W	W	W	Lu	59	62	121	35	31	66	48	36	84
119	F	Lu	Lu	W	W	Lu	W	W	W	Lu	Lu	59	64	123	30	37	67	36	38	74
120	F	Lu	W	Lu	Lu	Lu	Lu	Lu	W	W	Lu	61	57	118	34	32	66	33	34	67
121	F	Ct	W	W	W	W	W	W	W	Lu	W	63	59	122	31	33	64	33	30	63
122	F	Lu	At	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	46	60	106	35	32	67	30	30	60
123	F	Lu	Lu	Lu	W	Lu	Lu	Lu	A	W	W	61	50	111	39	36	75	38	37	75
124	F	Lu	W	Cc	Lu	Lu	Cc	Lu	Cc	W	Lu	58	59	117	34	38	72	39	36	75
125	F	W	Lu	Ct	W	Ct	Lu	Ct	Lu	W	W	60	61	121	30	36	66	31	34	65
126	F	W	Lu	Lu	Lu	Lu	Lu	Lu	W	Lu	Lu	56	63	119	37	33	70	34	41	75
127	F	Lu	Lu	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	63	63	126	35	39	74	33	40	73
128	F	Cl	W	Lr	Lr	Lu	W	Lr	Lu	Lu	Lu	61	63	124	36	29	65	42	47	89
129	F	Lu	Lu	Lu	Lu	Lu	At	A	At	W	Lu	62	26	88	29	37	66	32	34	66

130	F	Cl	Lu	W	W	W	W	Lu	W	W	W	57	62	119	38	38	76	32	30	62
131	F	Lu	A	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	49	59	108	36	36	72	36	32	68
132	F	W	W	W	W	Lu	W	W	W	W	Lu	57	61	118	34	33	67	46	40	86
133	F	Lu	Lr	At	Lr	Lr	W	Lr	Lu	Lu	W	48	62	110	34	33	67	50	43	93
134	F	Lu	Lr	Lu	Lu	Lu	Lr	Ct	W	W	Lu	60	57	117	38	30	68	38	39	77
135	F	W	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	60	60	120	36	38	74	36	46	82
136	F	Lr	A	Lu	W	Lu	W	Ct	Lu	Lu	Lu	45	61	106	39	39	78	36	45	81
137	F	W	Ct	Lu	Ct	Ct	Lu	Lu	Lu	Lu	W	58	62	120	35	34	69	38	38	76
138	F	Cc	A	Lu	W	W	Lu	Lu	A	W	W	47	49	96	38	38	76	30	42	72
139	F	Lr	Lu	Lu	W	W	Lu	Lu	W	Lu	W	58	62	120	31	30	61	30	32	62
140	F	Lu	Lu	Lu	Lu	Lu	Lu	W	Lu	W	Lu	58	58	116	33	38	71	38	36	74
141	F	Lu	Lu	Lu	W	Lu	Lu	W	W	W	W	58	59	117	36	37	73	38	30	68
142	F	W	Lu	Lu	W	Lu	A	A	Lu	Lu	Lu	58	35	93	33	36	69	36	34	70
143	F	Lu	Lu	Lu	W	Lu	Lu	A	At	W	W	59	33	92	39	31	70	34	38	72
144	F	Cc	Cc	W	W	W	Lu	Lu	At	At	Lu	62	35	97	36	38	74	39	36	75
145	F	Ct	W	W	W	Lu	Lu	Lu	W	Lu	W	61	56	117	30	33	63	30	46	76
146	F	Lu	Lu	Ct	Lu	Lu	Lu	Lu	Lu	W	Lu	60	61	121	36	34	70	38	39	77
147	F	W	Lu	Lu	A	Lu	Lu	A	Lu	Lu	Lu	46	47	93	32	39	71	30	41	71
148	F	W	W	Lc	W	Cc	Lu	Lu	W	W	W	65	63	128	28	32	60	38	31	69
149	F	Lu	Ct	Ct	W	Lu	Lu	A	Ct	Lu	Lu	61	49	110	29	38	67	42	30	72
150	F	W	A	Lu	Lu	W	Lu	W	W	W	Lu	50	60	110	33	38	71	40	33	73
151	F	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	W	Lu	57	59	116	33	36	69	43	41	84

152	F	Lu	Lu	Lu	W	Lu	Lr	A	Lu	W	Lu	59	51	110	36	38	74	44	46	90
153	F	At	Lu	Lu	A	Lu	Lu	At	Lu	W	Lu	36	52	88	37	34	71	46	40	86
154	F	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	W	Lu	60	54	114	38	38	76	48	47	95
155	F	Lu	Lu	Lu	W	Lu	W	At	Lu	W	Lu	60	47	107	39	33	72	41	38	79
156	F	Lu	Lu	A	W	Lu	Lu	Lu	Lu	W	Lu	47	63	110	35	36	71	42	42	84
157	F	W	Cc	Lu	W	Lu	Lu	Lu	Lu	W	Lu	62	64	126	36	31	67	39	39	78
158	F	Cc	Lu	Lu	W	W	Lu	Lu	Lu	Lu	Lu	59	56	115	37	32	69	48	30	78
159	F	Lu	Lu	Lu	Lu	Lu	Lu	Cc	Lu	W	Lu	59	60	119	38	35	73	43	34	77
160	F	Lu	Lu	Lu	W	Lu	W	W	Lu	W	W	61	57	118	36	33	69	37	45	82
161	F	W	Lu	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	61	60	121	34	38	72	45	40	85
162	F	At	Lu	A	W	Lu	A	At	At	W	Lu	34	22	56	36	33	69	41	37	78
163	F	Lu	Lu	Lu	W	Lu	Lu	At	Lu	W	Lu	58	45	103	37	38	75	46	44	90
164	F	W	W	Lu	W	Lu	W	Lu	Lu	W	Lu	57	60	117	36	36	72	42	42	84
165	F	Lu	Lu	Lu	W	Lu	A	Lu	W	W	W	60	46	106	38	35	73	50	40	90
166	F	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	W	W	62	60	122	39	33	72	41	38	79
167	F	W	W	Lu	W	W	Lu	W	At	W	W	59	47	106	33	36	69	42	48	90
168	F	Lu	Lu	Lu	Cc	Cc	Lu	Lu	Lu	Cc	A	60	48	108	30	30	60	45	46	91
169	F	Lu	Lu	Lu	W	W	W	W	Lu	W	Lu	60	60	120	38	36	74	48	39	87
170	F	Lu	W	Lu	Lu	Lu	Lu	W	Lu	W	W	59	62	121	35	38	73	43	41	84
171	F	Ct	Lu	Lu	Lu	Lu	Lu	Lu	Lu	W	Lu	59	57	116	30	33	63	44	46	90
172	F	Ct	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	56	54	110	33	36	69	41	38	79
173	F	W	W	Lu	W	Lu	W	Lu	Lu	Lu	Lu	61	64	125	36	34	70	48	40	88

174	F	Lu	Cc	Lu	W	Lu	Lu	Lu	Lu	Lu	Lu	60	58	118	33	38	71	43	41	84
175	F	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	57	59	116	34	36	70	46	47	93
176	F	Lu	A	Lu	At	Lu	A	At	Lu	W	A	33	24	57	36	34	70	42	36	78
177	F	W	Cc	Cc	Lu	Lu	Lu	Lu	Lu	Lu	Lu	58	57	115	38	36	74	45	45	90
178	F	Cl	Lu	Lu	Lu	Lu	Lu	Lu	Lu	W	Lu	57	59	116	38	37	75	41	48	89
179	F	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	60	58	118	37	38	75	39	40	79
180	F	W	A	W	W	W	W	W	W	W	W	49	60	109	33	37	70	42	42	84
181	F	A	A	Lu	Lu	Lu	A	A	Lu	Lu	Lu	35	37	72	39	34	73	41	39	80
182	F	W	W	Lu	W	W	W	W	W	Lu	W	61	60	121	33	36	69	46	41	87
183	F	W	A	W	W	Lu	W	W	W	W	Lu	47	56	103	30	38	68	43	39	82
184	F	W	Lu	Lu	W	Lu	W	Lu	Lu	Lu	Lu	60	61	121	38	32	70	47	42	89
185	F	W	W	Lu	Lu	Lu	W	Lu	W	W	Lu	58	56	114	34	34	68	42	41	83
186	F	W	A	Cc	W	W	Lu	W	Lu	W	Lu	45	59	104	31	33	64	39	46	85
187	F	W	A	Lu	W	Lu	W	W	W	Lu	Lu	46	62	108	36	36	72	42	39	81
188	F	W	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	58	56	114	38	38	76	40	48	88
189	F	Cl	Lu	W	W	W	Lu	Lu	Lu	W	W	59	58	117	33	36	69	41	42	83
190	F	Lu	Lu	At	Lu	Lu	Lu	A	Lu	Lu	Lu	46	47	93	30	37	67	42	38	80
191	F	Lu	W	Lu	W	Lu	W	Lu	W	Lu	Lu	60	58	118	39	36	75	43	40	83
192	F	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	Lu	60	58	118	38	38	76	48	40	88
193	F	Lu	W	Lu	Lu	Lu	Lu	W	Lu	Lu	Lu	62	59	121	34	38	72	46	47	93
194	F	W	W	W	W	Lu	Lu	Lu	W	W	Lu	55	58	113	38	34	72	39	42	81
195	F	Lu	W	W	Lu	Lu	Lu	Lu	Lu	Lu	Lu	57	59	116	34	39	73	42	43	85

196	F	Lu	Lu	Lu	Lu	Lu	W	Lu	Lr	W	Lr	59	58	117	36	38	74	41	45	86
197	F	Lu	Lu	Lu	Cc	Lu	Lu	Cc	Cc	W	Lr	56	57	113	36	36	72	38	39	77
198	F	W	W	W	W	Lu	W	W	W	W	W	61	63	124	28	37	65	42	44	86
199	F	Lu	Lu	Lu	Lu	Lu	W	Lu	Lu	Lu	Lu	56	61	117	38	39	77	45	40	85
200	F	Lu	Lu	A	W	Lu	Lu	Lu	Lu	Lu	A	47	48	95	39	34	73	41	45	86

ANNEXURE: MASTER CHART OF DIABETES SUBJECTS

S.No	GENDER	RT	RI	RM	RR	RL	LT	LI	LM	LR	LL	RTFRC	LTFRC	TTFRC	Ra-b	La-b	Ta-b	Ratd	Latd	Tatd
1	M	Lu	Lu	Lu	W	Lu	W	Lu	Lu	Lu	Lu	58	60	118	25	37	62	36	35	71
2	M	W	W	Lu	W	W	W	W	Lu	W	Lu	60	52	112	36	36	72	39	39	78
3	M	Lu	W	W	Lu	W	Lu	A	W	Lu	A	60	66	126	28	34	62	45	42	87
4	M	W	W	Lu	W	Lu	W	W	Lu	W	Lu	56	64	120	39	32	71	36	38	74
5	M	W	W	Cd	Lu	A	Lu	Lu	W	Lu	W	70	68	138	34	30	64	44	41	85
6	M	Lu	A	Lu	Lu	A	Lu	W	A	W	Lu	64	72	136	28	35	63	44	38	82
7	M	A	Cd	A	At	W	W	Lu	Lu	A	Lu	56	60	116	36	39	75	42	42	84
8	M	W	Lu	Lu	W	Lu	Lu	W	W	A	W	47	64	111	22	24	46	40	40	80
9	M	Lu	Lu	W	Lu	A	Lu	W	Lu	W	Lu	47	66	113	34	28	62	38	39	77
10	M	A	Lu	Lu	W	Cd	W	Lu	Lu	Lu	W	53	74	127	28	26	54	45	39	84
11	M	Lu	Lu	Lu	Lu	Lu	Lu	A	Lr	W	Lu	44	52	96	39	26	65	37	44	81
12	M	W	Lu	W	Lu	W	W	Lu	Cc	W	W	62	68	130	37	39	76	38	40	78
13	M	W	Lu	Lu	W	W	Lu	W	Lu	A	Lu	48	56	104	34	34	68	40	38	78

14	M	Lu	W	W	Lu	W	W	Cc	W	Lu	W	56	48	104	38	28	66	39	34	73
15	M	W	A	Lu	W	Lu	Lu	W	W	W	W	41	67	108	20	26	46	42	46	88
16	M	Lu	Lu	Cd	Lu	Cd	W	Cd	Lu	Lu	Lu	56	55	111	25	37	62	35	36	71
17	M	W	Lu	Lu	Lu	Lu	Lu	W	A	W	W	58	68	126	26	27	53	48	48	96
18	M	Lu	W	W	W	W	W	Lu	Cc	W	A	48	63	111	24	39	63	36	35	71
19	M	W	Lr	Lu	W	Lu	Lu	W	W	Lu	W	62	73	135	29	34	63	49	45	94
20	M	Lu	Lu	W	W	W	W	Lu	W	W	W	47	62	109	28	28	56	42	38	80
21	M	W	Lu	W	W	W	Lu	W	A	W	A	63	41	104	34	25	59	50	48	98
22	M	Lu	W	A	Lu	W	Lu	W	Lu	Lu	W	32	30	62	35	34	69	40	35	75
23	M	W	W	Lu	W	Cd	W	W	Cl	W	W	68	53	111	34	28	62	46	46	92
24	M	Lu	W	W	Cd	W	Lu	Lu	Lu	Lu	A	70	47	117	24	28	52	44	45	89
25	M	W	Lu	W	At	W	A	Cd	Cc	Lu	W	61	64	125	36	36	72	43	36	79
26	F	Lu	At	Lu	At	Lu	W	Lr	W	Lu	W	53	47	100	37	33	70	45	45	90
27	F	Lu	Lu	Lu	Cc	W	Lu	W	Lu	Cc	W	52	61	113	29	26	55	36	47	83
28	F	W	W	Lu	W	Lu	Lu	W	W	Lu	Lu	47	56	103	26	39	65	43	39	82
29	F	W	W	W	W	W	W	Lu	W	W	W	53	56	109	39	28	67	48	48	96
30	F	Lu	Lu	Lu	W	W	A	W	Lu	Lu	Lu	53	46	99	26	26	52	48	46	94
31	F	W	W	W	Lu	W	Lu	A	A	W	Lu	52	56	108	39	27	66	42	42	84
32	F	Lu	W	W	Lu	Lu	A	A	A	Lu	W	65	55	120	23	24	47	37	41	78
33	F	Lu	W	W	Lu	Lu	Lu	W	W	Lu	Lu	79	30	109	23	37	60	49	43	92

34	F	Lu	Cl	Cl	Lu	W	W	Lu	W	Lu	W	44	53	97	37	30	67	46	37	83
35	F	Lu	W	W	Lu	Lu	Lu	W	W	A	Lu	67	51	118	28	26	54	42	45	87
36	F	Lr	W	A	Lu	W	W	W	Lu	Lu	W	52	49	101	27	25	52	48	40	88
37	F	Lu	W	W	Lu	Lu	Lu	Lu	W	W	Lu	43	65	108	23	27	50	40	42	82
38	F	W	W	Cc	Lu	W	W	W	W	A	A	76	49	125	28	36	64	46	43	89
39	F	A	W	W	Lu	Lu	Lu	W	At	W	Lu	72	43	115	38	38	76	38	41	79
40	F	W	W	Ca	Lu	W	W	Lu	A	A	Lu	65	36	101	20	39	59	45	45	90
41	F	W	W	W	Lu	Lu	Lu	Lu	Lu	W	W	65	37	102	25	36	61	38	46	84
42	F	Lu	Lu	A	Lu	Lu	Lu	A	W	W	W	65	63	128	38	37	75	46	38	84
43	F	Lu	Cc	A	At	Cc	W	Lu	W	A	W	77	54	131	24	25	49	47	42	89
44	F	Lu	Lu	Lu	Lu	Lu	Lu	A	Lu	W	W	42	58	100	29	28	57	46	47	93
45	F	W	Lu	W	Lu	W	W	Lu	W	W	Lu	48	40	88	39	39	78	44	49	93
46	F	Lu	Lu	W	W	W	A	A	Lu	Lu	W	68	75	143	26	37	63	42	45	87
47	F	W	Lu	Lu	At	Lu	W	Lu	W	W	A	48	68	116	34	39	73	47	42	89
48	F	W	W	A	W	A	W	W	Lu	Lu	Lu	51	69	120	25	27	52	50	40	90
49	F	A	A	A	Lu	W	W	W	W	W	A	58	62	120	24	26	50	40	43	83
50	F	W	Lu	Lu	W	A	A	W	W	W	Lu	75	41	116	38	25	63	52	45	97

S.No: serial number; sex-1-male; 2- female RT – right thumb; RI- right index finger; RM- right middle finger; RR-right ring finger; RL- right little finger; LT- left thumb; LI- left index finger; LM- left middle finger; LR- left ring finger; LL- left little finger;R TFRC- right total finger ridge count; LTFRC- left total finger ridge count; TTFRC- total finger ridge count; Ra-b- right a-b ridge count; La-b- left a-b ridge count; Ta-b- total a-b ridge count; Ratd – right atd angle; Latd- left atd angle; Tatd – total atd angle