Chapter 2. REVIEW OF RELATED LITERATURE

A careful search and exploration of the related literature with regard to the present study was essential to have an insight into the work already done. Although very little research has been done in the area of dermatoglyphic pattern and sports, the scholar with the available literature has gained valuable methodological hints from their procedures and findings, which were of great importance and help during the course of their study.

HISTORICAL REVIEW

It is considered that early men appreciated the differences in skin markings, as indicated by numerous rock carvings and paintings featuring hand designs and fingerprints that have been discovered in widely scattered places. The Spanish pyreisness cave pictures, petroglyphics found on the Island of Gavrinis of the northern coast of France, the numerous digital relics left by the American Indians—all these and many others constitute striking examples.

The scientific study of papillary ridges of the hands and feet is credited as beginning with the work of Joannes Evangelista Purkinje, a Czech physiologist and biologist (1823). Fingerprints had attracted Grew (1684), Bidloo (1685), Malpighius
(1686) as long ago as 1680's. But the first attempt to systematically categorize fingerprint patterns is found in the work of Purkinje. He used a nine pattern classification.

Sir Francis Galton (1892) published his classic treaties on fingerprints. While much of Galton’s work was directed towards the usages of fingerprint identification, he also pursued the subject as a biologist interested in expanding Purkinje’s nine finger pattern in his own classification of the fingerprints and hand.

DESCRIPTIVE STUDIES ON DERMATOGLYPHICS

Igbigdi and Msamati (1999) conducted a study to establish the Palmar and Digital Dermatoglyphic Pattern of Malawians. They randomly selected some black Malawian students as subjects. The total finger ridge count (TFRC), atd angle, a-b ridge counts, pattern intensity index (PII) and the variability of ridge patterns were determined. The study revealed that the arches were the most predominant digital pattern in both the sexes, followed by radial loops in males and whorls in females. The sex differences between these digital patterns were not statistically significant and palmar patterns did not show sexual dimorphism. Females had significantly higher TFRC than males while males showed higher mean PII values than females. Females also had a significantly higher atd angle than males while males have significantly higher a-b ridge counts than females. The TFRC, atd angle and a-b ridges count were significantly higher in Nigerians than Malawians. The mean PII was also higher in
Nigerians than in Malawians. The authors claimed that the normal dermatoglyphic patterns of Malawians were established for the first time.

Jantz (1997) in his study examined the variation among European populations in summary finger ridge-count variables. The purpose of the examination was to find out the magnitude of ridge-count variation and its spatial and linguistic patterning using 82 male and 75 female samples from Europe. The Variables were: sum of radial counts (radial) sum of ulnar counts (ulnar) and sum of larger counts (total ridge count or TRC). Dermatoglyphic parameters were compared with those derived from classic nuclear gene markers. Fat values computed from ridge classical genetic polymorphism. Ridge-count distances show significant correlation with geographic distances but not with linguistic distances. Ridge count distances show even higher correlation blood marker distances, suggesting that, like blood polymorphism, ridge counts were strongly influenced by demic expansion of Neolithic farmers. The most differentiated populations in Europe are those of the North Atlantic and North Sea region, especially the Orcadians and Faroe Islanders. Certain Finnic speakers such as Lapps and Udmurts are also strongly differentiated. The same populations are frequent outliers in genetic analysis.

Krishnan and Reddy (1994) conducted a study to compare Indian populations with other populations based on their geographical, gender and ethnic/social group variability. The study also examined the relations between individual counts and populations. Here, the correlation structure of ridge counts exhibits a tripartite division of digits demonstrated by many other studies, but with a somewhat different
combination of digits. Comparisons are also made with the results of Leguebe and Vrydagh, who used principal components, discriminant functions, Andrews functions, etc., to study geographical and gender variations. There is a great deal of homogeneity in Indian populations when compared to populations from the rest of the world. Although broad geographical contiguity is reflected in the biplots, local level contiguity is not maintained. Monogoloids and Caucasoids have distinct ridge count structures. The higher level of homogeneity in females and on the left side observed by Leguebe and Vrydagh is also observed in the biplots. A comparison with principal component plots indicates that biplots yield a graphical representation similar to component plots, and convey more information than component plots.

Jantz, Brehme and Eriksson (1992) in their study the Dermatoglyphic Variations among Finno-Ugric Speaking Populations: Methodological Alternatives found that utilization of dermatoglyphics for population studies is apparently increasing, but methods vary widely among investigators. They investigate how different types of dermatoglyphic data can affect estimates of biological distance among Finno-Ugric speaking populations. Dermatoglyphic distances were calculated using the following categories of traits: 1) Finger ridge-counts (radial and ulnar count for each digit), 2) finger ridge-counts (largest count for each digit), 3) finger pattern types, 4) palm ridge-counts, 5) palm patterns, and 6) main-line terminations. In addition, they compare their distances with those of Heet, which rely heavily on summary characters. Distances are evaluated by comparing them to each other and to language and geographic distances. There is considerable variation in the pattern of
relationships resulting from the different variable sets. Finger variables, whether ridge-counts or pattern classifications, agree well with each other. Palm patterns, main-lines. Heet’s distances agree poorly with all other dermatoglyphic distances. Finger patterns and main lines are most closely related to language distances, after controlling for geography, while correlations with geography generally disappear after controlling for language. Heet’s distances have weak associations with language geography. Finger variables and palm main-lines yield results which agree best with historical relationships among Finno-Ugric populations. These results make it very clear that utilization of dermatoglyphics in population studies requires careful consideration of methods, and that summary measures of qualitative or qualitative data should be used with caution.

Arrieta et.al (1990) analyzed the quantitative and qualitative finger dermatoglyphics in Basque Valley of Urola, Spain. They compared the digital dermatoglyphics of an indigenous sample of 87 males and 101 females from the Urola Valley in the Spanish Basque Country with those from the nine other Baque Valleys. In both sexes of the Urola Valley, there is a very high frequency of radial loops: the mean found in this valley extends the range of variation for South European-Mediterranean populations, and it is in the superior limit of all Caucasian populations. There are bimanual and sex differences in the frequencies of whorls and loops. Contrary to what occurs normally in populations, in the Urola Valley the frequency of whorls is higher in females and the quantitative value of digital patterns is lower in males. The results of this study show the existence of heterogeneity among valleys for
digital trait frequencies and for finger ridge count, and this heterogeneity is more marked in females.

The study entitled “Quantitative Finger Dermatoglyphics in a Spanish Population” by Martin and Portables (1986) deals with the finger ridge counts and the distribution of their frequencies drawn from a Spanish sample consisting of 833 school children (417 males and 416 females). Paired t-test and Student-t-test were used to explore bimanual and sexual differences, respectively. The result shows that a bimanual asymmetry marked by significantly higher right hand ridge count for thumb and index pairs in both males and females; the differences being significant excepting for right and left index and for left ring-finger. The frequency distribution of TFRC was slightly, but significantly, different from normality only in males, as Kolmogorov test showed. A great homogeneity between values for TFRC of males and females from Tierra de Campos and those of the available Spanish and Portuguese populations has been found, the values being high not only in the variation ranges of the Spanish and Portuguese populations, but also in the ranges reported for other European populations.

Iqbal, Premalatha and Zahra (1984) in their study ‘Dermatoglyphics in Vitiligo’ examined one hundred probands of vitiligo for palm dermatoglyphics, both qualitatively and quantitatively, and were compared with those of 100 phenotypically normal control subjects. Ulnar loop pattern was the most common digital pattern observed in both probands and controls. An increased incidence of whorls and arches in men and women probands, respectively, was found to be statistically significant
when compared with those of controls. Simian crease and Sydney line also have been observed in the present study, which has not been previously reported. A statistically highly significant reduction has been observed in total finger ridge count (TFRC) and a-b ridge count in both sexes of vitiligo cases when compared with those of controls. No significant change was observed in the values of atd angle and position of axial triradius.

David (1984) in his “Distribution and Sex Variation of the a-b ridge count” analyzed the distribution of the summed (right plus left) a-b ridge count in 1,000 normal subjects showed a significant deficit of count at the two ends of the range. In males, the distribution was significantly different from a normal distribution, but in females a similar trend did not reach statistical significance. No significant sex difference was found, although it is known that abnormal sex chromosome complements may affect the a-b ridge count. The influence of the sex chromosome complement on the a-b ridge count appears to be smaller than the effect of the sex chromosome complement on the total finger ridge count. The a-b ridge count is probably also less genetically determined than the total finger ridge count.

Kobyliansky et.al (1983) conducted a study entitled “the Reciprocal Influence of the Different Finger Pattern types on their ridge count values”. The mutual influence of fingertip pattern types, whorls (W), ulnar loops (Lu), radial loops (Lr) and arches (A), on the pattern ridge count (RC) values is evident from the dermatoglyphics of a sample of 606 Israeli Jewish males. The presence of W is associated with an increase in the RC of Lu, Lr or A coincides with a decrease in the RC of W. The presence of A
decreases also the RC of LU and Lr, but the reciprocal influence does not occur because the RC of A is, by definition, always equal to zero. When two different pattern types concomitantly affect a third type, the net results is an intermediate one. The modifying influence of a pattern on the RC of others is total RC of an individual is used for genetic or medical purposes, the reciprocal influence of fingertip pattern RC values must be considered.

“The Digital Dermatoglyphics in some Tribal Populations of Andhra Pradesh” by Rao et.al (1983) made an analysis of the digital pattern types, ridge counts and pattern intensity index on samples from six tribal populations viz, Koya, Kolam, Rajgond, Chenchu, Pardhan and Sugali. Bimanual, sexwise and inter-tribal comparisons were made for all the six tribes. Males in Koya, Kolam and Sugali and females in Sugali showed significant bimanual difference. Sex difference was significant in Rajgond, Chenchu and Pardhan for frequency of digital patterns. Inter-tribal comparisons showed Koya resembling with Kolam and Pardhan and Rajgond with Pardhan. For total Finger Ridge Count, Kolam showed similarity with Rajgond, Pardhan and Sugali, Rajgond with Sugali and Chenchu also with Sugali. Pattern intensity index did not differ significantly among these populations.

Ghosh’s (1982) “Dermatoglyphics of the Naik Gond” deals with the finger and palm prints of the Naik Gond, a Dravidian speaking tribe of Chandrapur, Maharashtra. It represents a few dermatoglyphic characters such as pattern types, number of finger triradii, total finger ridge count, main-line index and ab ridge count which have expressed the usual trends of sexual dimorphism. The data have been compared with
that of the neighboring Raj Gond and the Pardhan who share common socio-linguistic traits with the Naik Gond. In dermatoglyphic characters the Naik Gond are found to be homogeneous with the Raj Gond and the Pardhan which lends support to the existing ethnoohistoric information.

Kamali and others (1991) analyzed thirteen Iranian populations of diverse origin for qualitative dermatoglyphic features utilizing bilateral finger and palmar prints of 3,158 individuals. Bimanual differences were significant for some of the features examined, whereas, sex differences were frequently non-significant. Inter populational variation displayed significant heterogeneity for all of the features studies. Distance analyses and constructed dendrograms provided separation between populations in agreement with known ethnohistoric records for hypothenar traradii, and for palmar and finger patterns except for the terminations of the D-line.

Brehme and Jantz (1990) studied the correlations among the twelve palm and sole inter digital ridge counts, calculated for samples of Europeans of German, Austrian, Finnish and Polish ancestry, for Bantu speaking Black Africans from Angola and the Republic of South Africa, for Japanese and Tibetans and for Indians and Coloureds from the Republic of South Africa. Canonical correlation and factor analysis were used to discern patterning inn the correlations. Generally, within palm and within sole correlations are stronger than palm – sole correlations. However the results show an unequivocal positive relationship between palm and sole ridge-counts. A consistent feature was a stronger relationship of palm c-d counts to sole a-b counts.
They suggested that this pattern of correlation may reflect early morphogenetic pattern formation prior to commitment of cells to hands and feet.

Mukherjee (1990) studied on a sample of 145 sibships of Bengali speaking population and found the coefficient of correlation of 47 dermatoglyphic traits varying widely with birth order. In general, ridge counts and pattern intensities tend to decrease with birth order. Linear effects of birth order, however, significant in samples of two sexes only for ridge counts on the ab regions of palms and on toes, and in males only for triradial number on toes, D-line exit, hallucal ridge count and triradial number on soles, and ridge-count on index fingers. It was found that their relative intensities do not follow the order of appearance or of heritability of the traits. The maximal atd angle, which has negligible correlation with birth order in the two sexes within sibships.

Cho (1993) examined palmar interdigital ridge counts in normal Koreans. In males, the ridge counts were 73.00 for a-b 52.12 for b-c and 69.39 for c-d. In females 73.21 for a-b, 53.60 for b-c and 70.12 for c-d. However, no significance was found for bimanual and the sex difference.

Parvatheesan, Babu and Sudhakar (1993) studied some of the qualitative and quantitative palmar dermatoglyphic characters of 100 Relli caste individuals and 100 Manne Dora tribals of Andhra Pradesh (India). The variables studies are principal mainline formula, frequency of true patterns in different configurational areas, interdigital ridge counts on a-b, b-c, and c-d and atd angle. The bimanual and bisexual
differences among these two populations are ascertained on the basis of dermatoglyphic characteristics.

Sokal and Livshit (1993) described the geographic variation patterns of six dermatoglyphic traits from 144 samples in Eurasia. The methods of analyses include computation of interpolated surfaces, one dimetional and directional correlograms, correlations between all pairs of surfaces, and distances between correlograms. There are at least two probably three, distinct and significant patterns of variation (1) A general NW-SE trend for pattern intensity, the main line index, and frequency of hypothenar patterns. (2) A trend from the Middle East to the north and east for frequency of axial triradius and of accessory interdigital triradii. (3) A Patchy pattern for frequency of then tenar-interdigital one. The results are compatible with a diffusion process between Europe and the peoples of Northern Asia, and possibly with a radiation of populations from the Middle East. The hypothesis of diffusion processes was supported by substantial inter-population correlations between dermatoglyphic traits that contrast sharply with largely negligible intralocality correlations.

Malhotra and Rao (1982) analyzed the estimates of five familial correlations including twins using the model and methods of path analysis. It was concluded that about one third of variations in the total palmar pattern ridge count (TPPRC) was accounted for by additive genetic factors ($h^2$ = explained in terms of $h^2$ alone) requiring either intrauterine environment specific to M2 twins or dominance deviations.
Jantz and Hawkinson (1980) used principal component analysis to evaluate finger ridge count variability as an indicator of genetic relationships between populations. The analysis was carried on American White, American Black and African Black samples, each including both sexes. Each individual was represented as a vector of 20 counts, a radial and an ulnar count for each digit. The first five Eigen vectors extracted from the within groups correlation matrix have had loadings very similar to those previously described by Roberts and Cooper (75). However, it was the component scores derived from the sixth eigen vector showed the most marked variation, accounting for 45 per cent or more of the D2 in all Black-White comparisons. A number of other components also showed significant inter group heterogeneity, but they often do not accord with what was known of the genetic relationship between the populations. Apparently it was concluded that a large amount of ridge count variation was not genetically meaningful.

**DERMATOGLYPHIC STUDIES ON GENETICS AND MEDICINE**

Slabbekoorn et.al (2000) in their study proposed that gender identity and sexual orientation are influenced by the parental sex steroid milieu. Human dermatoglyphics and brain asymmetry have also be ascribed to prenatal hormone levels. This study investigated dermatoglyphics (total ridge count and finger ridge asymmetry) in 184 male-to-female transsexuals and 110 female-to-male transsexuals. In a subgroup, the relationship between dermatoglyphic asymmetry and spatial ability was tested. All
investigations included controls. For all subjects hand preference and sexual orientations were noted. They hypothesized that the dermatoglyphics of male-to-female transsexuals would show similarities with control women and those of female-to-male transsexuals with control men. Our results showed a trend for a sex difference in total ridge count between genetic males and females, but no difference in total ridge count and finger ridge asymmetry of transsexuals were similar to their genetic sex controls. Additionally, directional asymmetry was neither related to sexual orientation, nor to different demonstrates that our chosen dermatoglyphic variables, total ridge count and finger ridge asymmetry are related to gender identity and sexual orientation in adult transsexuals. Hence, they found no support for a prenatal hormonal influence on these characteristics, at least dermatoglyphics may be regarded a biological marker of organizing hormonal effects.

Jelovac et.al (1999) revealed that dermatoglyphic features are thought to be indicators of events in the early embryonal stages. They might also be associated with the developmental disorders of the central nervous system (CNS) including schizophrenia. Dermatoglyphic features of 92 male patients with bipolar affective disorder (BPAD) were compared with those of 195 males with schizophrenia (SCH) and both with those of 200 male controls (control group-CG). DSM-III-R criteria were used for the diagnostic evaluation. Quantitative analysis showed only one statistically significant difference between BPAD and SCH patients groups, regarding the c-d ridge count of the left hand. The canonical discriminant analysis did not permit correct classification (only 59.23% of cases were correctly classified) between BPAD and
Numerous quantitative dermatoglyphic features of both BPAD and SCH differed significantly from those of the control subjects. Finger ridge counts as well as palmar ridge counts were markedly lower in BPAD and SCH as compared to the controls. These findings are not in contradiction with the hypothesis claiming that psychoses are a set of diverse expressions of a single underlying entity.

Katznelson et al. (1999) conducted a study to evaluate the effect of chromosomal morbidity (trisomy 21) in males and females with Down’s syndrome (DS) based on dermatoglyphic traits (DT) and their indices of diversity and asymmetry. The results were compared between parents and control groups of women and men. The general aim of the study was to explore the possibility of using DT of the parents of DS patients to predict the likelihood of the disease appearing in the offspring. The samples were of DS patients (198 males and 140 females) and their parents (84 fathers and 153 mothers), all Israeli Jews and were validated by chromosomal examination. The present study found proof of the existence of an additive genetic component in the FA (fluctuating asymmetry) of DT while an increased FA was observed in parents of DS patients in comparison to control groups. The DT which are typical DS patients were confirmed also in parents. The decrease in sexual dimorphism of the DT was found in DS patients and their parents in comparison with the control.

Palmar and fingerprints of 122 male children with central nervous system lesion for possible prevention of cerebral palsy were analyzed by Cvjeticanin and Polovina (1999). Eighteen variables of epidermal ridge count were examined: ten on either hand fingers, and four on either palm, and on a-b, b-c and c-d triradii, with atd angle.
Patients were divided into two groups: 61 patients with severe lesion and 61 patients with moderate lesion. Fingerprints of 200 male subjects as controls. Statistically significant differences were found for five variables in the group of patients with severe lesion, i.e. on the second finger of the right hand, between a-b and b-c triradii of the right palm, and between a-b and c-d triradii of the left palm. Accordingly, a clinically severe lesion to the central nervous system was quite probably, accompanied by certain deviation in the metric traits of the patients’ digitopalmar dermatoglyphics, which might prove useful in the diagnosis and prognosis of the disease, thus also for timely and more successful treatment. In children with the presence of risk factors, palmar and fingerprints should be taken in the immediate postnatal period in order to prevent the development of risk symptoms.

“Dermatoglyphics of Down’s Syndrome Patients in Malays- a comparative study” by Than et.al shows that there has been no recent report on the dermatoglyphics of the Malays (normal population as well as patients with Down’s syndrome). A study on the frequencies of the dermal patterns (dermatoglyphics) of the digits, palms and hallucal areas was done therefore in 40 Malay patients with Down’s syndrome and 200 unrelated normal controls. Only the patients with the standard 21 trisomy karyotype were included in the study. The comparison was made with the published data on study done in various racial groups. Significant differences of the dermal patterns were found not only between the controls but also among patients of different races.

‘Dermatoglyphic Analysis in Children with Cerebral Palsy’ a study made by Simsek et.al (1998) was intended to elucidate the diagnostic values of dermatoglyphic
features on the 45 cerebral palsy (CP) patients (28 boys and 17 girls). There were 50 healthy children in the control group. The types of dermal patterns of fingertips, the counts of total ridges, the counts of a-b ridges, the values of adt angles, presence or absence of dermal patterns in the hypothenar, thenar/I. II, III, IV interdigital areas, presence of absence of the palmer flexion lines, were compared between the children with CP and control group. It was found that arch, radial loop, whorl prints have increased and ulnar print has decreased in boys investigated which was significant statistically. No difference was found between investigation and control groups of girls. The total ridge counts in boys and girls of the investigation group were found significantly decreasing according to the control group. The dermal prints in the hypothenar, thenar/I, II, III, IV interdigital areas showed important differences in the investigation group when compared with the control group. No clear distinction occurred between the two groups from the viewpoint of palmar flexion lines. In conclusion, remarkable differences in comparison to controls were found in the dermatoglyphic features of CP cases.

Gutierrez et.al (1998) in their study ‘Congenital Dermatoglyphic Malformations in Severe Bipolar Disorder’ revealed that dermatoglyphic alterations may be the result of early prenatal disturbances thought to be implicated in the etiology of psychiatric illness. For that they assessed two congenital dermatoglyphic malformations (ridge dissociation (RD) and abnormal features (AF) and total a-b ridge count (TABRC)) in a sample of 118 patients with chronic DSM-III-R bipolar illness, and 216 healthy controls. Bipolar cases showed a significant excess of RD and AF when compared
with control. In the cases, the presence of anomalies was associated with earlier age of onset. No differences were found for TFRC and TABRC. No associations were found with sex or familial morbid risk of psychiatric disorders. Their findings add further weight to the suggestion that early developmental disruption is a risk factor for later bipolar disorder.

“A Case-control study of Fluctuating Dermatoglyphic Asymmetry as a risk marker for Developmental delay” a study undertaken by Naugler and Ludman (1996) reveals that the traits which are normally bilaterally asymmetrical, asymmetries may arise as a result of genomic or environmental stress. The subjects were 49 developmentally delayed children and 51 controls. Using two dermatoglyphic characters as a measure of symmetry (finger print concordance and A-B triradial ridge count difference), they found odds ratios of 2.32 (95% CI 0.65-3.17) and 2.11 (95% CI 0.57-3.27); depending on which character was measured. These results suggest that fluctuating asymmetry may have potential as a risk marker for developmental disorders, and that this area of research warrants further research.

Ravindranath and Thomas (1995) in their “Finger Ridge Count and Finger Print Pattern in Maturity onset Diabetes” studied total finger ridge count, absolute finger ridge count and finger print pattern were studied in 150 maturity onset diabetes mellitus patients and compared to 120 controls. Significant findings were: in males, with both hands combined and separately (i) an increase in radial and ulnar loops and arches (ii) A decrease in whorls. (iii) In females, increase in ulnar loops and a decrease in whorls in the left hand was observed.
Reed (1995) conducted a study entitled “On the Association between Adult Blood Pressure and Dermatoglyphics as Prenatal Markers of Development” to examine the relationships between finger and palm print (dermatoglyphic) features and, first the presence or absence of hypertension, and secondly, blood pressure levels in non-hypertensive subjects. Prints were available from 841 male World War II veteran twins (393 pairs, 55 individual cotwins), who were born in the USA between 1917 and 1927 and examined three different times between 1969 and 1987. At each examination the hypertensive status was assessed by blood pressure measurement, use of antihypertensive medications and two physicians’ diagnostic impressions. Results: Subjects defined as hypertensive did not differ in dermatoglyphics from non-hypertensive for any trait examined. There were 60 twin-pairs discordant for hypertension; hypertensive co twins showed lower ridge counts on the left hand, and this relationship was the opposite of what has previously been reported. Using only normotensive subjects at all three examinations, there was little consistent relationship between blood pressure (adjusted for age, body mass and alcohol consumption) and various dermatoglyphic features, except for lower palmar a-b ridge count in those with higher systolic blood pressure. Conclusions: Unless the in utero development of dermatoglyphics in relation to blood pressure is substantially different between singleton and twin pregnancies, there are no useful relationships between the presence of certain dermatoglyphic markers of impaired fetal development and blood pressure in subjects who remain normotensive until early in their seventh decade.
Tornjova and Randelova (1994) in their study “Some Aspects on the Dermatoglyphics of Normal and Defective Children in Bulgaria” reveals that by comparison with a sample of normal Bulgarian children aged 3 to 18 years, children with visual, auditory and mental insufficiency differ in the relative frequency of pattern types on the digits. These differences are particularly noticeable on the second and fourth digits. It is suggested that the restriction to these two digits is related to the differing evolutionary histories of the different digits, and differences in their innervations.

Fifty persons having nasobronchial allergy diagnosed by a positive skin test were compared with age and sex matched normal individuals for dermatoglyphic palmer patterns by Joshi et.al (1992). In female patients, total number of whorls was less, more so on digit IV of left hand. Digit V of right hand had low frequency of ulnar loops, the d-t ridge count was low. In male patients, ulnar loops were less frequent on digit III of right hand. Total finger ridge count was less in both sexes. High frequency of arches was observed in female patients and in total. Digit V of left hand in females and in total patients revealed high frequency of arches. A-b ridge count was high males and in total patients.

Krishnan and Reddy (1992) in their “Principal Components of Finger Ridge Counts: their Universality” a principal component analysis was carried out on radial and ulnar finger ridge-count data on a sample of fisherman of the sea coast of Puri in the state of Orissa in India. The component structure is very similar to that obtained earlier by Roberts and Coope for some English populations, by Arrieta and Lostao for a
Basque population, by Jantz and Hawkinson, and Jantz et al. for American and African populations, and by other authors for other populations. The initial components are bilaterally symmetric and the structure of these components is the same whether the two sides are taken separately or together. Only the latter components represent a certain amount of bilateral asymmetry. The first component is a size component, indicating total finger ridge-count; the second component is a radial-ulnar contrast. From a comparison with previous studies on other populations, it appears that the component structure corresponding to the larger eigen values is fairly universal; there is a certain lack of universality in the structure of the components corresponding to smaller eigen values as well as in the order of these components, especially the rotated ones. When the corresponding eigen values are very close. As observed by previous authors, components corresponding to larger Eigen values do not necessarily exhibit larger inter-population differences. However, there is lack of universality in the order of the components and in the structure of the components those exhibits large inter population differences.

“Dermatoglyphic in Juvenile Hypertension” a study conducted by Palyzova et.al (1991) Dermatoglyphics of 172 children and young adults (116 males, 56 females) with hypertension, 13 – 27 years old, were compared with those of 130 healthy male and 110 female controls. Several differences were observed between the two groups. Hypertensive patients had a somewhat lower frequency of fingertip ulnar loops, higher frequency whorls and a higher total finger ridge count. They also had a somewhat higher mean atd angle, significantly more frequent distal position of the axial triradius
(mostly in t’ position) and more missing axial triradii compared to controls. The differences between a-b ridge counts, the interdigital, thenar and hypothenar patterns were generally small and sometimes limited to one sex or one hand only. They observed differences seem to indicate a genetic influence in the etiology of essential hypertension.

Fananas, Moral and Bertranpetit (1990) analysed finger and a-b palmar ridge-count dermatoglyphic features in schizophrenics with and without a positive family history of schizophrenia. Associations are reported for low quantitative dermatoglyphic values in schizophrenia. The differences found between the two subgroups of patients support the genetic heterogeneity of schizophrenia and stress the existence of congenital factors when there is no family history, that is, a genetic background.

Durham and Koehler (1989) in their “Dermatoglyphic Indicators of Congenital Heart Defects in Down’s syndrome Patients: a Preliminary Study” finger print patterns of Down’s syndrome children were examined to determine correlations with congenital heart defects (CHD). The results demonstrate that the left hand digit ridge count minus the right hand digit ridge count and number of ridges on the fifth digit of the left hand separate patients with CHD from those without heart defects (W/OHD). The method correctly classified 92% of the CHD group and 73% of the W/CHD group.

“Digital and Palmar (1988) Dermatoglyphics in Dementia of the Alzheimer type” is a study by Luxenberg et.al. In this study digital and palmar dermatoglyphics
were examined in 29 men and 27 women with dementia of the Alzheimer type (DAT) and 112 age, sex, and racial group-matched controls. Female patients had significantly more accessory triradii and complete Sydney creases than controls: no dermatoglyphic differences were detected in the males. Separating the patients by age of onset prior to or after age 65 years did not help differentiate patients from controls by previously reported dermatoglyphic differences between DAT patients and controls or the reported similarity of the dermatoglyphic pattern of DAT to that of Down syndrome patients.

In Weinreb’s (1986) “Dermatoglyphic Patterns in Alzheimer’s Disease” selected dermatoglyphic variables were analyzed in 50 patients with presumed Alzheimer’s disease (AD), 50 patients with dementia referable to other causes, and 100 control patients without known dementia matched for age, sex, and race. AD patients have a significantly increased frequency of ulnar loops on the finger tips, Simian creases on the palms, palmar hypothenar patterns; and large distal loops in the hallucal region. A trend involving an increased frequency of radial loops on the fourth and fifth digits, Sydney lines on the palms, and small distal loops on the fourth and fifth digits, Sydney lines on the palms and small distal loops on the soles was also observed. The presence of eight or more ulnar loops or bilateral hypothenar patterns separates AD patients from controls with 84% sensitivity and 63% specificity, supporting the discriminant value of dermatoglyphics in the categorization of patients and in the potential identification of asymptomatic persons at increased risk for AD by dermatoglyphic criteria. The dermatoglyphic pattern repeatedly observed in the AD patients correspond remarkably with pattern repeatedly observed in Down’s syndrome
children, suggesting that a common genetic factor modulate epidermal ridge formation during fetal development, meiotic non-disjunction during gametogenesis, and accelerated neuronal senescence.

Salam et. al (1984) conducted a study to analyze the dermatoglyphic patterns in infertile patients presenting with clinically detectable vericocele. In a controlled study conducted on 30 patients the dermatoglyphics on terminal phalanges of the thumb in both hands showed significantly higher incidence of whorl pattern. Likewise, the index finger in both hands exhibited higher incidence of both the whorl and double loop patterns. Other patterns on the fingers, the palms creases, axial triradii, hypothenar and thenar eminence and angle and total ridge count did not alter significantly. Such characteristic dermatoglyphic patterns in vericocele infertile men may furnish additional evidence in support of a genetic cause for vericocelogenesis and its associated gonadal dysfunction. Furthermore, it may be provide a prognostic preoperative method for vericocele infertile patients.

Arrieta and others (1992) studied on 100 monozygotic (55 female and 45 male) and 97 dizygotic (47 female and 50 male) same sexed twin pairs, to analyze the genetic component of the variance of the a-b, b-c, and c-d interdigital ridge counts by means of the Christian method. It was found important to analyze both sexes separately, especially for the a-b interdigital ridge counts. It was suggested that the a-b count in male seems to be more influenced by environmental factors than the other counts. For females, the three interdigital counts were found to have a strong genetic component
influencing their phenotypic expression. Factor analysis with VARIMAX rotation showed each interdigital ridge count to be genetically independent.

Paramasivan and others (1990) recorded the finger print patterns (FPP) of 2177 individuals, belonging to both sexes, of different age groups, and in three states of India. By comparing the FPP of complementary finger pairs in each individual, the association frequencies of different patterns were calculated. It was seen that the association between whorl and arch does not exist at all. Its applicability in the field of personal identification as a gross additional aid is discussed.

Berr and other (1992) compared digital and palmar dermatoglyphics in subjects with dementia of Alzheimers type and in mentally healthy elderly controls. The subjects were 82 women with clinically diagnosed Alzheimer type dementia according to DSM III R criteria, mainly late onset of the disease,. Control group was comprised of 76 women aged 85 years or older without cognitive deterioration. Finger prints taken were studied under classification of four types of figures. On palms, palmar flexion creases, palmar and axial triradii, true patterns of the hypothenar area, and main line terminations were described. No major differences were found between dementia patients and elderly controls. Nor evidence of high frequencies of features commonly observed in Down’s syndrome (rimosity 21), which have previously, through sporadically, been reported was found. Thus, the findings shows that no particular dermatoglyphic patterns occur like those observed in Down’s syndrome, a disease which is related to dementia of the Alzheimer type.
Arrieta and others (1993) studied the genetic and environmental prenatal factors influencing the fluctuating asymmetry of the a-b interdigital ridge count. The results showed fluctuating asymmetry of the a-b interdigital ridge count as poorly influenced by genetic factors. It was also suggested that fluctuating asymmetry of dermatoglyphics provides a good measure of developmental stability in humans, especially for males. The results also indicated that random environmental factors, acting before the 19th week of embryonic development could be related to the differential timing of maturation of the sexes.

Loesch and Huggins (1992) studies on a maximum likelihood scoring technique for the analysis of pedigree data allowed for the concurrent estimation of random and of fixed effects in a quantitative trait. To study the sources of variation in finger ridge count in 54 large families affected with the fragile – x disorder, both the types of effects in genetic models were included. The fixed effects were represented by fragile x and sex, and the random effects by environmental and genetic variance. A significant effect of fragile X was found in the mean of the finger ridge count on the thumb (finger 1) and index finger (finger 2). Which had the lowest heritability and negligible non addictive component. A contrast in genetic properties for ridge counts on fingers may be relevant to increase selection pressures on functions of the thumb and of the index finger in evolution of modern man. An important effect of fragile X was found in increasing the additive variance in covariance, especially between male pairs. Thus these findings suggested that the effect of the fragile X genotype in finger ridge count is addictive and super imposed on the normal hereditary variations in this trait.
Goncalves and Gonvalves (1991) studies the dermatoglyphic patterns in a family representing the first and only familial case of Mounier Kuhu syndrome with a control group. The family exhibited significant differences only in palmar and digital dermo-papillary patterns, with a consequent decrease in total ridge count values. This however, could be due to the small size of the sample or may represent a trait of the family studies.

Seltzer, Plato and Fox (1990) studied finger prints and palm prints of 78 breast cancer patients, 391 patients at increased risk for developing breast cancer and 64 control patients. A pattern of six or more digital whorls was identified more frequently in women with breast cancer than in those without the disease. This finding was independent of known risk factors for breast cancer and was present in 28 percent of the cancer patients. No correlation was noticed between palm prints and breast cancer. The positive predictive value of six or more digital whorls was comparable to that of mammography and that of breast biopsy. With increasing age there was an increase in the positive predictive value associated with six or more digital whorls. The study concluded that digital dermatoglyphics may have a future role in identifying women either with or at increased risk of breast cancer such that either risk reduction measures or earlier therapy may be instituted.

Taneja and others (1993) studied the finger tip and palmar dermatoglyphics in 31 patients (22 females and 9 males with rheumatoid arthritis (RA) and 38 matched controls (20 females and 18 males) from North Indian. While not many differences were observed in palmar patterns, a low ending of line A was found on hands of two
patients. Finger tip patterns were significantly different in patients compared to controls. No associations with any dermatoglyphic feature and HLA antigens were observed.

Mardia and Hainsworth (1992) conducted a study on penrose and hypothesized that finger print patterns such as loops, whorls, etc. are formed by ridges corresponding to the lines of curvature of the skin of the embryo at the time when the ridges were being formed. Under this hypothesis it was shown that (1) Smith’s differential equation has an exact solution and (ii) the extension given here supplies the remaining important patterns.

QUANTIFICATION STUDIES ON DERMATOGlyphICS

Crawford and Duggirala (1992) conducted a study to describe the digital patterns of four Eskimo populations from Alaska: two Yupik – speaking villages from St. Laurence Island and Inupik groups residing on mainland Alaska. For a broader evolutionary perspective, these four Eskimo Populations were compared to other Inuit groups of North American Indian Populations, and to Siberian aggregates. The genetic structures of 18 new and old world populations were explored using R – Matrix Plots and Wright’s F-St values. The relationship between dermatoglyphic, blood, genetic, geographic and linguistic distances was assessed by comparing matrices through Mental Correlations and through partial and multiple correlations. Statistically significant relationships between dermatoglyphic and genetics, genetics and geography,
geography and language were revealed. In addition, significant correlations between dermatoglyphics and geography, with linguistic variation constant, were noted for females but not for males. These results of study showed the usefulness of dermatoglyphics in resolving various evolutionary questions concerning normal human variation.

Krishnan and Reddy (1992) carried out a principal component analysis on radial and ulnar finger ridge count data on a sample of fishermen of the sea coast of Puri in the State of Orissa in India. The initial components were the same, whether the two sides were taken separately or together. Only the latter components represented a certain amount of bilateral asymmetry. The first component was a size component indicating total ridge count; the second component was a radio-ulnar contrast. From the comparison with previous studies on other populations, it was found that the component structure corresponding to the larger eigen values was fairly universal. It was also observed that certain lack of universality in the structure of the components corresponding to smaller eigen values as well as in the order of these components, especially the rotated ones, when the corresponding Eigen values are very close. As observed by previous authors, components corresponding to larger eigen values do not necessarily exhibit larger inter-population differences. However, it was established that there is lack of universality in the order of the components and in the structure of the components that exhibit large inter-population differences. However, it was established that there is lack of universality in the order of the components and in the structure of the components that exhibit large inter-population differences.
Arrieta and other (1991) studied the fluctuating asymmetry for the digital quantitative value, in a sample of twins (mono and dizygotic) and singletons. The aim was to check the influence of twinning on the development as expressed in a higher fluctuating asymmetry in twins than in singletons. The results have shown that significant differences existed among the three groups studied and these differences are fundamentally expressed when the radial and ulnar counts are considered separately.

Kaur and Singh (1992) studied 182 Punjabi males and 153 Punjabi females in order to find the structural relationships between cores and triradii of loops are categorized separately into four types and zero to three values were assigned to these types. For each digit, Pearson’s Coefficient of Correlation was calculated and Fisher’s Z test was applied to test the null hypothesis. Results showed a great dissimilarity between males and females with respect to some digits.

Roberts and Greally’s (1991) analysis of digital dermatoglyphics from a large sample of Irish Identities principal components very similar to those in other United Kingdom sample, both in wigen values and eigen vector distributions. These were interpreted as representing mathematical abstractions of developmental morphogenetic gradients in the embryonic hand plate. Apart from the first component representing general size of ridge counts, the second depicts the contrast between ulnar and radial sides of digits, third the contrast between lateral and medial areas and the fourth gradient across the hand.
Greally and Roberts (1991) studied handprints obtained from 600 Irish subjects (274 males and 326 females). No clear evidence of any differences was found between the four great provinces of Ireland, nor between east and west, such as were showed by comprehensive blood group data, and it was concluded that Ireland can be regarded as dermatoglyphically homogeneous. Comparison of the Irish quantitative and quantitative digital dermatoglyphics with those from other sample in Britain, and from other European countries, showed that Ireland occupies a near extreme position in the European range. These results are regarded as compatible with the interpretation from blood group evidence that Ireland represented a region of refuge for an ancient population in the face of continuing colonizing pressure from the east in pre-historic and historic times, and traces of that ancient population are detectable in the genepool today.

Arreita and others (1991) studied digital dermatoglyphics of a sample from the Basque Valley of Salazar, situated in the west of Pyrences, were analysed. The results showed bimanual differences in both sexes, and also sexual differences for hands. The comparative study with other Basque Valleys showed that, inspite of their supposed common origin, the geographic barriers and the isolation have generated a genetic/dermatoglyphic and linguistic differentiation.

Jantz, Eriksson and Brehme (1993) studied the relationship and divergence among five lapp samples assessed using finger and palm inter digital ridge counts. Lapp relationships to other Uralic speakers were also assessed. Multivariate minimum F-ST values expressing differentiation among lapps were 0.012. These values are
higher than those for most European populations and show the importance of isolation and genetic drift in lapp populations. Skolt Lapps and Lapps of the Kola Peninsula are generally more similar to each other and are differentiated from mountain and Fisher lapps. When lapps are placed within the context of Uralic speakers’ in general, they showed a marked affinity for the Finnic speakers and are differentiated from the Samoyedic speakers of Siberia. The ridge counts support the hypothesis of a European for the lapps.

Jantz and Chopra (1983) compared various dermatoglyphic approaches using data derived from four groups in the Kumaon region of India. Dermatoglyphic data included ridge counts and other quantitative variables, and the classification systems of Cummins and Midlo and Penrose and Loesch. Results were evaluated against anthropometric and serological relationships. No clear superior approach emerged, although it was generally true that palmar variables and produce more reasonable results than the other approaches. The conventional method of treating ridge counts that of choosing the larger of the two counts, was the most unsatisfactory of the quantitative approaches, leading to the recommendation that both radial and ulnar counts be retained. Later concluded that environmental variation may contribute substantially to inter group variation

Harvey and Suter (1983) described finger dermatoglyphics of 446 males and 463 females Faroe Islanders. Pattern frequencies were given for individual digits and the tables contain mean radial;, ulnar and unilateral maximal ridge counts. Overall frequencies of patterns and mean total ridge counts in both sexes are compared with
other populations in North Western Europe, several of which have had close historical connections with the Faroes. The Faroes have exceptionally high frequencies of arch and Ulnar loop patterns, making their mean pattern intensity index values among the lowest in Europe. Low mean Total ridge counts are characteristic of this population. Icelanders showed closer dermatoglyphic resemblance to the Faroes than any other European populations. Low mean total ridge counts among Shetland and Orkney Islanders are noteworthy, and it was suggested that the resemblance between these North Atlantic Island populations may be due to common ancestry arising from Viking settlement during the 8th and 9th centuries. The study also suggested that while assessing biological affinities of Faroe Islanders the influence resulting from operation of random genetic drift on the gene pool of the Faroe Islanders also should be considered.

Ekanem et al. (2009) study “Digital Dermatoglyphic Patterns of Annang Ethnic Group in Akwa Ibom State of Nigeria” revealed that Digital dermatoglyphics has been found useful in forensic medicine and identification purposes. It is useful in medical diagnosis of genetically inherited diseases and in detection of crimes. Anthropometric studies of the digit, palm and feet provides data that reveal the relative distribution of dermal ridges among people in different geographical zones. Cross-sectional study was carried out using 200 males and 200 females’ healthy volunteers of Annang ethnic group in Akwa Ibom State of Nigeria to establish their digital dermatoglyphic traits. This was done by counting and classifying their ridge pattern configurations of arches, loops and whorls. Ulnar loops were the most predominant digital pattern in females.
(50.1 percent) than in males (39.6 percent), followed by whorls (42.9 percent) in males, then arches (31.1 percent) in females and radial loop (2.1 percent) in males. The sex differences between these patterns were statistically significant (chi2 equal to 154.569; d.f. equal to 4; 0.001 greater than P). The index of pattern intensity (P11) showed a higher value in males (15.13) than the females (11.88). Sexual dimorphism was also evident with the males showing higher total finger ridge count (TFRC) than the females (p < 0.001). This study has established for the first time the normal dermatoglyphic patterns of Annang ethnic group in Akwa Ibom State of Nigeria.

“Sex differences in the relative lengths of metacarpals and metatarsals in gorillas and chimpanzees” study by Dennis McFadden, Mary S. Bracht (2005) examined the Sex differences other than the simple dimorphism in size were documented for the metapodials of two primate species. Lengths of metacarpals and metatarsals were obtained from the skeletons of 64 gorillas and 42 chimpanzees. Length ratios were constructed for all possible pairings of the five bones in each individual hand and foot. For both species, several of these length ratios exhibited substantial differences between the sexes. Body size was not the basis for these sex differences; when specimens of similar size were compared, the sex differences remained. In humans, length ratios for the fingers and toes also have previously been demonstrated to exhibit sex differences, and the length ratio for the index and ring fingers (the 2D:4D ratio) has been shown to correlate with various medical conditions. Various facts suggest that length ratios in human digits are associated with androgen exposure, probably during prenatal development. For gorillas, the metacarpal length
ratio showing the largest sex difference was 4Mc:5Mc in both hands, and the metatarsal length ratio showing the largest sex difference was 1Mt:2Mt in the left foot. Sex differences in length ratios also existed for chimpanzees, but they were generally smaller than for gorillas. Apparently, both gorillas and chimpanzees are affected by developmental mechanisms, possibly androgenic mechanisms, similar to those in humans. Analyses of previous measurements (Susman, 1979) revealed that all components of the rays are not affected equally by whatever mechanisms are responsible for the sex differences in length ratios.

Karmakara et al. (2008) conducted a study on “Quantitative digital and palmar dermatoglyphics: Sexual dimorphism in the Chuvashian population of Russia” with the aim of determining sex dimorphism among the Chuvashian population of Russia, digital and palmar dermatoglyphics of 547 individuals (293 males, 254 females) were analyzed. The sex differences for PII, TRC, and AFRC are similar to Indian and Jewish populations. Correlation coefficients between individual finger ridge counts are a little lower than in Jews but are almost equal to Indian populations. The Mantel test of matrix correlation between sexes for 22 traits shows a very good similarity. However, sex differences of palmar traits display different levels when compared with other human populations. In light of this, our evidence indicates the possible role of environmental (prenatal) factors in the realization of dermatoglyphic sex differences. The development of palmar dermatoglyphics has had a relatively longer growth period compared with fingers [Cummins, 1929. The topographic history of the volar pads (walking pads, tast ballen) in the human embryo. Embryol. 20, 103–126]. The palmar
dermatoglyphic pattern of affinities therefore corresponds better than fingers to the ethno historical background of the populations, ascertained by numerous studies.

Milicica, and Vidovicb in their study “Latent structure of dermatoglyphs in the population of Selska Valley” the historical records of Selska Valley reveal that the eastern part of this area was first settled by Slovene agrarian colonists, the western part by German colonists and the central part by Friulians. These were later followed by Slovene and Slovenized settlers, who penetrated the valley from north to south. Because of its reproductive isolation, the population of Selska Valley is highly suitable for the study of population structures. The quantitative traits of the digital and palmar dermatoglyphs are polygenetically determined characteristics, which, due to their selective inertness to changes, may provide an insight into microevolutionary processes. The purpose of our study was to identify the possible differences between the populations of villages in the valley and the mountain villages attributable to various migration flows through history. Altogether 340 finger and palm prints of 163 males and 177 females were collected in two groups of villages: (1) the lowland villages (Praprotno, Bukovica, Ševlje, Dolenja vas, Selca, Zelezniki and Zalog), and (2) the mountain villages (Podlonk, Prtovc, Spodnje Danje, Zgornja Sorica and Spodnja Sorica). The 18 dermatoglyphic variables were analyzed. A statistical analysis using standard methods was performed and the latent structure evaluated using factor analysis. The discriminant analysis and latent structure of the quantitative properties of dermatoglyphics suggest the presence of certain differences in gene pools of two studied populations (the group of villages in the valley and the group of mountain
villages). It is highly probable that these differences can be attributed to low migration in the Selska Valley and to the ‘selective inertness’ of quantitative dermatoglyphic traits. In a previous study, no significant biological differences between the studied populations were found in qualitative dermatoglyphic traits. This indicates that Selska Valley and its village populations represent a specific isolate, and therefore expanded studies of this type could significantly contribute to a better understanding of the population concerned and isolates in general.

Jaja and Igbigbi (2008) in their study Digital and palmar dermatoglyphics of the Ijaw of Southern Nigeria explained the dermatoglyphics are polygenic markers useful in studying population dynamics. The digital and palmar ridge pattern characteristics of 390 subjects of Ijaw ethnicity were evaluated using standard methods. The most prevalent digital ridge pattern type was ulnar loops followed by whorls, arches and the least prevalent was radial loops. Gender dimorphism was not observed with digital ridge pattern types. However, females showed significantly greater atd angle than males (p < 0.05) while males had a greater Pattern Intensity Index. No significant gender disparity was seen in total finger ridge count and a-b ridge count. They compared their findings to those of other populations previously studied,

Endom Ismail et.al (2009) in their “Dermatoglyphics: Comparison between Negritos Orang Asli and the Malays, Chinese and Indian” explained dermatoglyphic traits are formed under genetic control during early gestation and do not change through the entire life. A few studies have shown that dermatoglyphic traits were conservative in their evolution and were different between and within population
groups. The objective of this study was to compare the variability of palm dermatoglyphs in three main populations i.e. Malay, Chinese, Indian and five sub-ethnic population of Negritos’ Orang Asli i.e. Bateq, Jahai, Kintak, Kensiu and Lanoh. We utilized fingerprints and palms of 390 healthy adult individuals, counted the total ridge for ten fingers (TRC), a-b ridge counts (a-b RC) on palms, examined widening of the atd-angle, and classified the digital pattern configuration of arches, whorls, ulnar, and radial loops for all fingers. Variables obtained from both palm did not show any differences between males and females for all populations. TRC, a-b RC and atd-angle were the highest for Kensiu and were later on specially described to be in a group of its own by Anova and Turkey test for TRC and a-b RC. The same test has put Chinese in a group of its own for atd-angle. Only a-b RC clearly separate Orang Asli populations from the three main races. Whorls and ulnar loops were the most predominant pattern in all groups. Malays and Chinese had similar distributional patterns for each ten fingers. Indian and Jahai similarly mimic each other, while Bateq has the reversal pattern distribution to them both. Kintak and Lanoh halfly mimics each other pattern and Kensiu had its own unique pattern. In conclusion, races, patterns, and pattern frequencies were related to each other and can be used to differentiate different races or Orang Asli sub-ethnics. This study documents for the first time the comparative dermatoglyphic traits between Malaysian main races with Orang Asli populations show a list of informative variables that can be used to identify them as well as suggesting it’s used as a tool in tracing the historical background of populations.
Manninga et al. (2004) conducted a study entitled “Sex and ethnic differences in 2nd to 4th digit ratio of children”. The aim of their study was to investigate sex and ethnic differences in 2D:4D in Caucasian, Oriental and Black children. According to them the ratio between the length of the 2nd or index finger and the 4th or ring finger (2D:4D) differs between the sexes, such that males have lower 2D:4D than females, and shows considerable ethnic differences, with low values found in Black populations. It has been suggested that the sex difference in 2D:4D arises early in development and that finger ratio is a correlate of prenatal testosterone and oestrogen. In children, 2D:4D has been reported to be associated with measures of fetal growth, congenital adrenal hyperplasia, developmental psychopathology, autism and Asperger's syndrome. However, little is known of the patterns of sex and ethnic differences in the 2D:4D ratio of children. Their conclusions were in common with adults, the 2D:4D ratio of children shows sex and ethnic differences with low values found in a Black group. There was no overall association between 2D:4D and age and height suggesting that the sex and ethnic differences in 2D:4D appear early and do not show appreciable change with growth.

Sengupta and Karmakar (2006), in the study of the genetics of dermatoglyphic asymmetry, collected bilateral finger and palm prints of 824 individuals from 200 families including 2 generations from an endogamous caste (Vaidya) in Barasat, North 24-Parganas District, West Bengal. Two main types of asymmetry (fluctuating asymmetry and directional asymmetry) were calculated between the two hands. The study includes familial correlation between first-degree relatives, principal-components
analysis, and maximum-likelihood-based heritabilities (by pedigree analysis). They found, first, that familial correlations in all possible pairs of relationships (except spouse correlation) were weak but positive; some were even statistically significant. No indication of assortative mating was observed, but the influence of maternal environment could not be discarded. The results also showed that X-chromosome linkage does not seem to be involved. A second major finding is that five principal factors could be extracted from all these asymmetric traits, explaining 74.207% of the overall cumulative variance. Asymmetry of finger and palmar areas were clearly separated by factor. In addition, the heritabilities of the extracted five factors were in the range of 8–24%. These estimates are in agreement with some previously published data. The heritabilities of the factors describing palmar asymmetry are slightly lower than those describing finger asymmetry. The present results support the hypothesis that both types of asymmetry have a genetic basis and are influenced by the intrauterine environment.

Sengupta and Karmakar, (2007), conducted a study “Genetics of anthropometric asymmetry in an Indian endogamous population—Vaidyas.” The aim was to understand the genetics of Fluctuating Asymmetry (FA) and Directional Asymmetry (DA). The study comprised 14 bilateral morphometric traits from 200 Vaidya families including 824 individuals (of two generations) from North 24 Parganas, West Bengal. The statistical analysis included: Regression analysis to remove the age effect, Familial correlation, Heritability estimation, Principal Component Analysis and Segregation Analysis (SA) using genetic model test. The obtained results revealed little effect of
genetic factor and considerable amount of environmental influence on anthropometric asymmetry. The results support the idea postulated by several previous authors that FA provides a measure of developmental instability in man. The contribution of heredity on these asymmetric variables is not unimportant but that of the common environment is very substantial. The magnitude of heritability of DA traits is slightly higher than that of FA traits. Five principal factors were detected from these asymmetric traits (three factors are on asymmetry on length, head, and breadth; while last two factors represent the asymmetry of diameters). SA did not suggest any evidence of major gene contribution. But the involvement of minor genes or polygenes could not be discarded. As the study on SA of asymmetry in man is limited, similar other studies are needed to confirm the result of the study. Am. J. Hum. Biol. 19:399–408,

“Complex segregation analysis of quantitative dermatoglyphic traits in five Indian populations” study by Karmakara et.al (2005). They revealed that Dermatoglyphics is widely used as a genetically determined trait in anthropogenetics although the genetic nature of its inheritance is still inconclusive, due to the lack of any established genetic model to resolve the existing inconsistencies in the literature. However, advanced statistical packages for complex segregation analyses are available and the aim of the present study is to determine the mode of dermatoglyphic trait inheritance in five different ethnic populations. Methods: Five hundred families (2435 individuals) of two generations were used for principal component analysis, familial correlation and segregation analysis (package MAN-5). Results: The similarity of three factors suggests a common internal structure. Significant familial correlation (except
spouse) indicates the involvement of a familial component in the variation of dermatoglyphic traits. Segregation analyses suggest the transmission of a genetic effect in the families which follows the Mendelian model and confirms a major gene effect on factor 1 and factor 2 with two co-dominant alleles. There is no evidence of a major gene effect or environmental effect on factor 3 (a-b ridge counts). The nature of transmission and trait variance (H2) strongly supports the existence of a common nature of dermatoglyphic trait inheritance in populations, irrespective of ethnic and geographic area. Conclusion: Major gene involvement in finger dermatoglyphics according to Mendelian models is confirmed.

Lugassy et.al (2006), conducted a study related to Naegeli-Franceschetti-Jadassohn syndrome (NFJS) and dermatopathia pigmentosa reticularis (DPR) are two closely related autosomal dominant ectodermal dysplasia syndromes that clinically share complete absence of dermatoglyphics (fingerprint lines), a reticulate pattern of skin hyperpigmentation, thickening of the palms and soles (palmo-plantar keratoderma), abnormal sweating, and other subtle developmental anomalies of the teeth, hair, and skin. To decipher the molecular basis of these disorders, they studied one family with DPR and four families with NFJS. They initially reassessed linkage of NFJS/DPR to a previously established locus on 17q11.2-q21. Combined multipoint analysis generated a maximal LOD score of 8.3 at marker D17S800 at a recombination fraction of 0. The disease interval was found to harbor 230 genes, including a large cluster of keratin genes. Heterozygous nonsense or frameshift mutations in KRT14 were found to segregate with the disease trait in all five families. In contrast with KRT14 mutations
affecting the central alpha-helical rod domain of keratin 14, which are known to cause epidermolysis bullosa simplex, NFJS/DPR-associated mutations were found in a region of the gene encoding the non-helical head (E1/V1) domain and are predicted to result in very early termination of translation. These data suggest that KRT14 plays an important role during ontogenesis of dermatoglyphics and sweat glands. Among other functions, the N-terminal part of keratin molecules has been shown to confer protection against proapoptotic signals. Ultrastructural examination of patient skin biopsy specimens provided evidence for increased apoptotic activity in the basal cell layer where KRT14 is expressed, suggesting that apoptosis is an important mechanism in the pathogenesis of NFJS/DPR.

Bener (1979) in his study Sex differences and bilateral asymmetry in dermatoglyphic pattern elements on the fingertips analysed 539 Polish families and 999 individuals (515 males and 484 females) to determine whether asymmetry of dermatoglyphic pattern elements on the fingertips of ulnar and radial loops is genetically controlled. And we enquire whether the body is bilaterally asymmetrical. He found the asymmetry between right and left hand fingertips for ulnar and radial loops, for each digit and between the two sexes. The differences between the sexes are small. The bimanual difference in dermatoglyphic pattern elements between hands, right minus left, has been used as a measure of asymmetry. The mean and variance difference for males is not significantly different from the mean and variance for females. An investigation was also made of correlations between relatives for bimanual differences, right minus left. We may conclude from these results that the
asymmetry of dermatoglphic pattern elements on fingertips of ulnar and radial loops has little hereditary component. Finally, the results of this work show that the dermatoglyphic pattern elements on fingertips of ulnar and radial loops on each side of the body are inherited.

Ravindranath et.al (2003) conducted a study on Dermatoglyphics in rheumatoid arthritis. The patients with rheumatoid arthritis have been referred to Division of Human Genetics for counselling. Qualitative dermatoglyphics comprising of fingerprint pattern, interdigital pattern, hypothenar pattern and palmar crease were studied on 26 female and 11 male rheumatoid arthritis patients. Comparison between patient male and control male; and patient female and control female has been done. 'Chi' square test was performed. In male patients, with hands together, arches were increased, loops/whorls were decreased. Partial Simian crease was significantly increased. In the right hand, patterns were increased in the 3rd interdigital area. On the other hand, in female patients there was a significant increase in whorls and decrease in loops on the first finger on both the hands, increase in arches on the 3rd finger; both arches and whorls on the 4th finger of left hand. Present study has emphasized that dermatoglyphics could be applied as a diagnostic tool to patients with rheumatoid arthritis.

Igbigbi & Adeloye (2005), conducted a study “Dermatoglyphics of mothers of Malawian children with spina bifida cystica: a comparative study with female controls”. According to them Dermatoglyphic traits are formed under genetic control early in development and do not change thereafter, thus maintaining stability not
affected by age. They determined the dermatoglyphic traits of mothers of children with spina bifida cystica and compared them with controls matched for number, age and parity, by counting and classifying palmar, plantar and digital ridge pattern configurations of arches, loops, whorls and ridges based on standard techniques. Results: Palmar pattern types, showed absence of arches, significantly higher frequency of whorls (P > 0.05), lower total finger ridge count (TFRC) and higher Pattern Intensity Index (PII) in these mothers than in the controls (P > 0.001). However, no significant differences were observed between both groups in atd angle and a-b ridge count (P = 130, 0.70 respectively). Plantar pattern types showed loops restricted to the first two digits and absence of arches in the first digit in these mothers compared to controls in whom there were loops in the first four digits and a 100% frequency of arches. Similarly, PII was higher and Dankmeijer's Index (DI) lower in these mothers than in controls. Their findings demonstrate dermatoglyphic differences between both groups that suggest that mothers presenting with these traits are more predisposed to giving birth to children with spina bifida cystica.

Matsuyama, & Ito’s (2006) Analysis of the frequency data of each fingerprint type (arch, ulnar loop, radial loop, and whorl) of the parents of children with Trisomy 21 (Fathers: 71; Mothers: 128) born between 1965 and 1970 obtained from the Tokyo Medical and Dental University Hospital was carried out. Japanese controls were taken from dermatoglyphics data in Japan. They conducted the Friedman test on each type of fingerprint between Japanese controls and parents of Trisomy 21 children. Results from a statistical analysis based on the above data showed significant differences, more
arches ($p < 0.0001$) and fewer whorls ($p < 0.05$) in mothers of children with Trisomy 21. Among fathers of Trisomy 21 children, a significant difference was found in there being fewer whorls ($p < 0.05$) and ulnar loops ($p = 0.06$). Considering the mothers' fingerprints, we suspected that females with a higher frequency of arches and a lower frequency of whorls had a stronger possibility of bearing Trisomy 21 babies. On the other hand, in fathers of Trisomy 21 children, they considered that there would be a possibility of significant differences if cases in the sample were increased.

**DERMATOGlyphICS IN SPORTS**

Dermatoglyphics was included while carrying the genetic anthropological studies during the XIX Summer Olympic Games in Mexico City in 1968. Mitra (1974) conducted a study on Palmar Dermatoglyphics. The purpose of his study was to make a comparison between 40 non-athletes (20 males and 20 females) and 40 athletes sex wise. The following were the findings of his study.

1. Increased percentage of loops in athletes than non-athletes.

2. Increased ridge counts in athletes.

3. Increase values in metric analysis in athletes, thereby proving that the palm is bigger than the non-athletic palm.
4. Increased add angle in athletes. Hence, it is concluded that palmar dermatoglyphics can be a valuable instrument in identifying talents in childhood so as to give proper training right from an early age.

Amaresh, (1986) Studied on sportsmen and sportswomen belonging badminton, soccer, gymnastics and non-sportsmen. Significant differences were found in different dermatoglyphic variables selected, among sportsmen and sportswomen of soccer, gymnastics and badminton and also that of non-sportsmen and non-sportswomen.

Sharma and Shukla (1981) made an attempt to find out if the athletes in track and field differed from the non-athletes in their manual dermatoglyphic particularly fingers. The subjects were 54 athletes and an equal number of non-athletes. The findings indicate significant differences between athletes and non-athletes in almost all the dermatoglyphic traits selected.

Verma and Amaresh (1986) conducted a study on dermatoglyphics. They have made a comparison of sportsmen and non-sportsmen. The subjects for this study were 20 male non-sportsmen (two have never participated in any sports) and 20 badminton players (attended the National Badminton Coaching Camp held at L.N.C.P.E, Gwalior). The findings were:

1. Majority of badminton players, dominated in loop finger patterns.

2. Compared to non-sportsmen, players had significant difference in one of two fingers.
3. The inter-triradial intervals are significantly greater in badminton players.

4. The atd angles of the non-sportsmen differ from the badminton players of the same age group.

Bharadwaj (1986) studied on the dermatoglyphic patterns of athletes and non-athletes (runners, jumpers, and throwers) and an equal number of non-athletes. The findings were:

1. Loop’s percentages are more in throwers than in runners and jumpers in both palms of males.

2. Loop’s percentage dominated both palms of female runners.

3. Right palm of male and female throwers dominated in whorl’s percentage.

4. The percentage of arches is more in the right palm of male runners and non-athlete women.

5. Male jumpers have more number of ridge counts in both palms of I and II digits than the other groups.

6. Male Runners have more number of ridge counts in both palms of II and IV digits than the other groups.
7. Female throwers and jumpers have more number of ridge counts in their II and V digits of both palms than the other groups.

8. It is concluded through metric analysis that in both male and female throwers the inter triradial distances are more than those of the other groups in both the palms.

9. No difference in ridge counts in each square centimeter in male and female of all the groups.

10. Atd. Angle sof both the palms of the athletes (male and female) are more significantly better than those of the non-athletes. However, there was no significant difference in both the palms of the three categories of athletes.

Verma and Saxena’s (1988) study of factor structure of dermatoglyphic variables of National Level Men Basketball players through Principal component analysis. And the items with loading greater than or equal to = .40 on varimax solution were selected. The selected four factors accounted for 65.17% of the total common factor variance. Thus the results indicated that the dermatoglyphic characteristics of basketballers are defined by the extracted factors. They are (1) Ridge count (relative contributions of this factor 26.58% (ii) Inter-triradial distance (relative contribution of this factor is 33.40%, (iii) Pattern Intensity and, (iv) Specific Ridge Count (relative contribution of this factor is 22.62%)
Verma and Saxena’s (1988) study to investigate the factor structure for a number of dermatoglyphic variables of 50 male gymnasts who participated in National championship. Varimax rotation method was used to find out the solutions. Items with loading of +.40 or higher on varimax solution were selected for discussing each factor. Then four factors accounted for 79% of the total common factor variance. The results indicated that four factor viz. (i) Pattern Intensity (relative contribution accounted for 58.78%), (ii) Total ridge count (26.87%), (iii) Right ridge count factor (6.77%) and (iv) Combined ridge count (7.58%) were present.