4.PHASE II

4.1 Introduction

Epidemiology is difficult to define, exemplified by Alexander Gillian’s comment ‘epidemiology is what epidemiologists do’ (Sartwell, 1972). While this statement sounds rather obvious, it reveals the issue that, even to those immersed in the subject – it is often difficult to define and explain. Nevertheless, it is probably still best defined in the words of epidemiologists. According to Buck et al (1988) the first published use of the word was the Spanish ‘epidemiologia’ in a study of bubonic plague in Spain in 1598; and it was derived originally from the Greek word ‘epidemion’, a verb meaning ‘to visit’ used in connection with human illnesses in the writings of Hippocrates. Originally used as the term for the study of epidemics, epidemiology is a continually evolving discipline evidenced by the changing definitions and emphasis.

All epidemiologists would generally agree that it concerns itself with populations rather than individuals, thus sitting within the discipline public health rather than clinical (medical) practice (Detels 1997). The basic definition of describing and analysing disease and health in the population also has broad agreement (Detels 1997). Through the historical development of epidemiology (as detailed earlier), not only have the subjects of interest (diseases and health conditions) grown through time, but the range of factors which the epidemiologist considers in the search for disease distribution and determinants has also markedly expanded. In this quest to describe and understand the causation of disease patterns in populations, a wealth of scientific methodology has developed in parallel
(Susser 1985, Rothman and Greenland 1998). However, remaining constant is the basic assumption in epidemiology – that the distribution of disease observed in a population is not random. The patterns of disease observed in a community are often caused by interaction of several factors in a multiple causation or multi-factorial aetiology of disease (Detels 1997), although there are the exceptions that may be associated with specific toxins (e.g. thalidomide).

Within these broad definitions, epidemiological approaches boil down to: describing the natural history of specific diseases in populations and analysing the aetiological determinants of disease (Last et al 2001). In addition, communicable disease epidemiology is still concerned with identifying epidemics in the population, while interventional (or experimental) epidemiology is focused on testing in controlled trials, either clinical or ‘community’ interventions (Buring and Hennekens 1997, Hoffmeister and Mensink 1997).

Descriptive epidemiology aims to describe the distribution of disease in terms of ‘time, place, and person’ factors of disease (Last et al 2001) – these correspond to the questions: ‘when?’, ‘where?’, and ‘who?’ In addition ‘what?’ and ‘how many?’ are investigated within descriptive epidemiology (Rothman and Greenland 1998). These questions relate to the aims of descriptive epidemiology, which are to: describe the extent and spectrum of disease; describe the natural history of disease; (begin to) identify disease aetiological factors through generating hypotheses for further study; predict disease trends; identify health needs of a community and evaluate public health intervention programmes (Detels 1997).
A series of methods have been developed for: study design, statistical analyses, data collection, classification, tabulation and presentation, followed by inference, and interpretation (Rothman and Greenland 1998). The advantages of descriptive epidemiology include their efficiency both in terms of time and cost – particularly as they utilise existing or routine data without the need to individually contact study subjects (dos Santos Silva 1999), however, the disadvantages are related to the limited data on exposures (risk factors) available, and to the strength of evidence and conclusions which can be drawn from such studies (Detels 1997).

Nevertheless, descriptive epidemiology provides a useful first step in the usual sequence of study design – by providing insights which inform and develop hypotheses which can be testing using analytical study designs.

Descriptive epidemiological studies are usually studies based on routine data. In general their advantages have been reported as being the speed and low cost with which they can be carried out without necessarily contacting the study subjects, but their main limitations have been described as being the limited number of variables routinely collected (Bain et al 1997).

Interpretation of findings from descriptive epidemiology needs to be done with caution and all potential sources of bias, confounding, and artefacts in the data need to be explored. To these ends, it is important that the methods of data collection, collation, and processing are understood (Dos Santos Silva 1999).
A range of descriptive epidemiology study designs have been described, including those which utilise individual-level data based on: comparing data from different geographical areas, migration studies based on place of birth or ethnicity, studies based on socioeconomic status or occupation, time-trend studies, record linkage studies and those based on aggregated population-level data – also known as ecological studies (Dos SantosSilva 1999).

**Descriptive cross-sectional study**

Cross-sectional studies form a class of research methods that involve observation of all of a population, or a representative subset, at one specific point in time. Cross-sectional studies are descriptive studies (neither observational nor experimental) in nature. Cross-sectional studies are carried out at one time point or over a short period. They are usually conducted to estimate the prevalence of the outcome of interest for a given population, commonly for the purposes of public health planning. The sample frame used to select a sample and the response rate determine how well results can be generalised to the population as a whole. The sample used in a large cross-sectional study is often taken from the whole population. This is the optimum situation: if the sample is selected using a random technique it is likely that it will be highly representative. The advantages of cross-sectional studies are that it is relatively inexpensive depending on the sample size and type of investigation and takes up little time to conduct, can estimate prevalence of outcome of interest because sample is usually taken from the whole population, many outcomes and risk factors can be assessed, useful for public health planning,
understanding disease etiology and for the generation of hypotheses and there is no loss to follow-up. The disadvantage is that only a snapshot: the situation may provide differing results if another time-frame had been chosen.

Quantitative data collection methods are centered on the quantification of relationships between variables. Quantitative data gathering instruments establish relationship between measured variables. When these methods are used, the researcher is usually detached from the study and the final output is context free. Measurement, numerical data and statistics are the main substance of quantitative instruments. With these instruments, an explicit description of data collection and analysis of procedures are necessary. An approach that is primarily deductive reasoning, it prefers the least complicated explanation and gives a statement of statistical probability. The quantitative approach is more on the detailed description of a phenomenon. It basically gives a generalization of the gathered data with tentative synthesized interpretations.

Quantitative approach is useful as it helps the researcher to prevent bias in gathering and presenting research data. Quantitative data collection procedures create epidemiological postulations that reality is objective and unitary, which can only be realized by means of transcending individual perspective. This phenomenon in turn should be discussed or explained by means of data analysis gathered through objective forms of measurement. The quantitative data gathering methods are useful especially when a study needs to measure the cause and effect relationships evident between pre-
selected and discrete variables. The purpose of the quantitative approach is to avoid subjectivity by means of collecting and exploring information which describes the experience being studied.

Quantitative methods establish very specific research problem and terms. The controlled observations, mass surveys, laboratory experiments and other means of research manipulation in qualitative method makes gathered data more reliable. In other words, subjectivity of judgment, which is not needed in a thesis discussion, can be avoided through quantitative methods. Thus, conclusions, discussion and experimentation involved in the process are more objective. Variables, both dependent and independent, that are needed in the study are clearly and precisely specified in a quantitative study. In addition, quantitative method enables longitudinal measures of subsequent performance of the respondents. Fryer (1991) noted that qualitative researchers aim to decode, describe, analyze and interpret accurately the meaning of a certain phenomena happening in their customary social contexts. The focus of the researchers utilizing the framework of the interpretative paradigm is on the investigation of authenticity, complexity, and contextualization, mutual subjectivity of the researcher and the respondent as well as the reduction of illusion.

4.2 Objective

To determine the prevalence of dental caries and different dermatoglyphic patterns (fingers) in the population and subsequently assess the reliability of specific dermatoglyphic patterns (fingers) in predicting the susceptibility to dental caries.
To assess the dentition (deciduous and permanent) association in relation to specific finger dermatoglyphic patterns

To analyse for any difference in the number of specific finger dermatoglyphic pattern between the right and left hand fingers.

4.3 Study Design

Variables

- Caries status: presence or absence of caries
- Dermatoglyphic patterns: Loops, Whorls and others in fingers
- Dentition: Deciduous and permanent dentition
- Pattern difference in Hands: Left and right hand


Population

Urban and suburban population across all socio-economic status in and around Chennai, Hyderabad, Bangalore and Trivandrum. Since dental caries is the most common disease in dentistry we decided to conduct a survey across the population. The study was conducted in the form of camps across schools, colleges, community camps in residential areas across ages 5-35 years and gender so we can assess the trend in order to test our hypothesis. The survey had been conducted in stages adhering strictly to ethical considerations. The first phase was that permission was sought from the concerned authorities and then subsequently information pamphlets were displayed and distributed among the population. After procuring the informed consent, volunteers were then screened and data was collected.
Inclusion Criteria

Subjects in the age group between 5 – 35 years with no caries, carious teeth /Filled teeth /Extracted due to caries.

Exclusion Criteria

- Children and adults with genetic, congenital and developmental anomalies
- Adults with systemic diseases
- Patients with hereditary and environmental structural defects in teeth.

Since dermatoglyphic pattern is reported to be altered in many genetic conditions and the susceptibility of teeth with heredity and environmental defects to dental caries is different from normal condition, such subjects were excluded from the study. Literature reports of possible association of certain systemic diseases like diabetes mellitus, malignancies apart from the physical state of the subjects made us exclude adults with systemic disease.

The study was planned in 4 major cities which will represent the population in South India. Hence, in order to achieve equal distribution of sample size, the weighted average was calculated based on the total population and caries incidence of the individual cities namely Chennai, Trivandrum, Bangalore and Hyderabad, which was subsequently used to determine the sample size. The sample size was calculated with a
confidence level of 95% and p=0.5 for the population from the standard tables.

**Sample size**: 10,250 subjects

The study was conducted by proportionate sampling in schools, colleges, government, private, corporate offices and as camps in residential areas of the 4 cities. The study was conducted over a period of six months and data scrutiny was done over a period of 4 months.

A small nucleus, Central Survey Unit, was set up in the Department of Oral Pathology, Saveetha Dental College and Chennai-77. For the fieldwork, the principal investigator selected and formed field teams consisting of three dentists to assess the dental status and two volunteers to record the finger prints. Great care was taken to ensure that the quality of the data collection met stringent standards.

With the human ethical committee approval from Saveetha University, considering the ethical issue and confidentiality of fingerprints of subjects, permission was obtained through written consent forms before recording the fingerprints. Brief case history with clinical examination and DMFT index was recorded on a printed A4 bond sheet. The subject’s hand were cleaned and dried before imprinting. The finger print of the subjects were taken using a stamp pad; a thin layer of stamp pad ink was applied to the fingers and imprint recorded on the bond sheet. (APPENDIX). The same procedure was repeated in relation to the other hand. Prints were dried and studied using a magnifying lens to identify the finger patterns. After taking the imprints of all fingers, ink was removed by using oil, soap and water.
Evaluation of Patterns

The various patterns of finger prints were analyzed according to the standard guidelines for classification of patterns. The data recorded was entered in Microsoft excel sheet and subjected to statistical analysis.

The study was designed as a double blinded assessment to increase the validity of results and was done by forensic fingerprint experts, retired from CB-CID, Tamilnadu Police. A data interpretation form containing the finger outline of both left and right hand was given which had the same code as the case sheet as the analyzers were blinded to the dental status.

Finger prints

The finger prints were studied for qualitative parameters.

Qualitative Parameters

The prints were assessed on the basis of their shapes and presence of triradii (Confluence of 3 ridges). The “Galton detail” system of classification divided the fingerprints in 3 main classes (Galton 1965).

a. Whorl: These are the patterns so constructed that the characteristic ridge courses follow circuits around the core. The shape of the pattern area may be either circular or elliptical. Whorls have two triradii and may have various shapes like spiral whorl, whorl double loop, whorl symmetrical but all are designated as whorl in our study.

b. Loop: It is simple in contrast to the whorl. It possesses only one triradii. Twist site of ridges is called head of the loop. From the
opposite extremity of the pattern, the ridges flow to the margin of digits. Radial loops and ulnar loops are 2 variants but all were designated as loops in our study.

c. Arches and others: The plain arch is composed of ridges which pass across the finger with slight bow distally. There is no triradii. Since the pattern has no triradii, the ridge count cannot be done. Accidental, pockets are other very minor variants.

All the patterns in the 10 fingers were counted in the study rather than just by the predominant number of loops, whorls or others to label the subject with loop pattern, whorl pattern in order to avoid bias.

4.4 Results and Observation

The total sampling population in the present study: 10, 250.

The total sampling population in the present study: 10,250. In the total sampling population, the prevalence of population having dental caries was 36% and those not having dental caries was 64%. (Bar chart I) The percentage of different age groups in the study is as follows. 56.6% of the population was <10 years old, 38.8% of the population was between 10-20 years of age, 4.6% between 20-30 years and 1.2% between 30-35 years of age. (Bar Chart II).

The prevalence of whorl pattern in the total population is 55 % (5603), (Bar Chart III). The distribution of whorls in the population is as follows 45% of the population has no whorls, 25% of the population as 1-3 whorls and 30% of the population had >3 whorls. The prevalence of loop pattern in the total population is 82% (8389) (Bar Chart IV). The distribution of loops in the population is as follows 18% of the population had no loops,
6% of the population had 1-3 loops and 76% of the population had > 3 loops. The prevalence of other patterns in the total population is 20.2%. (Bar Chart V)

There is statistically highly significant difference in the number of subjects having whorl pattern with carious teeth when compared to subjects who have whorl pattern with no carious teeth (p<0.001) (Table 1).

The prevalence of total population having loop pattern 81.8% and the population who have loop pattern in association with no caries (Bar Chart VI) and caries were statistically significant at p<0.001 (Table 1).

The prevalence of total population having other pattern 20.2% and the population who have other pattern in association with carious teeth is 8.16% and with no caries is 12.06%.

The prevalence of total population who are having whorls in association with deciduous teeth is 15.45% and permanent tooth is 39.20%. (Bar Chart VII)

The prevalence of total population who are having loops in association with deciduous teeth is 56.85% and permanent teeth are 24.98%. (Bar Chart VIII)

The prevalence of population percentage having whorls + caries teeth in association with deciduous dentition is 8.5%, the prevalence of population percentage who are having whorls and no caries teeth in association with deciduous dentition is 6.87%. (Bar Chart IX)

The prevalence of population percentage having whorls + caries teeth in association with permanent dentition is 20.05%, the prevalence of population percentage who are having whorls and no caries teeth in
association with permanent dentition is 19.15%. There was a significant statistical difference between the above 2 variables (p<0.001). (Bar Chart IX)

The prevalence of population percentage having loops and caries teeth in association with deciduous dentition is 25.34. The prevalence of population percentage that are having loops and no caries teeth in association with deciduous dentition is 31.51%. (Bar Chart IX)

The prevalence of population percentage having loops +caries teeth in association with permanent dentition is 9.59 %. The prevalence of population percentage that is having loops and no caries teeth in association with permanent dentition is 15.39%. (Bar Chart IX)

The prevalence of whorls and caries with permanent teeth is high (19.15%) when compared to prevalence of whorls and caries with deciduous teeth that is (8.51%).

The prevalence of loop and caries with deciduous teeth is high (25.34%) when compared to prevalence of loop and caries with permanent teeth that is (9.59%).

The association of whorls and deciduous teeth with carious teeth is not significant when compared to loops and deciduous teeth with carious teeth. (p > 0.4).

The association of whorls and permanent teeth with carious teeth is highly significant when compared to loops and permanent teeth with carious teeth. (p<0.001)

Also as the number of whorls increase there is more prevalence of carious teeth.
There is statistically no significant difference in the association of loop and caries with permanent teeth when compared to loop+ no caries with deciduous teeth\((p>0.2891)\) which means there is significant association of loop and caries in deciduous teeth and loop and no caries in permanent teeth.

Further, it was observed that there is significant difference in the association of whorl and caries in 14-35 yrs age group when compared to loop and caries in 14-35yrs of age group, \((p<0.001)\). The prevalence of whorl and caries in 14-35 yrs of age group is high 7.49% when compared to loop and caries in 14-35yrs age group that is 5.55%. The prevalence of whorl and no caries in 14-35yrs of age group is low 3.64% when compared to loop and no caries in 14-35yrs age group that is 7.15% (Bar Chart X) (Table 2).

We further analyzed the frequency of whorls+ carious teeth in right, left and right and left hand. Overall population with whorls and carious teeth in right hand is 49.06%. Overall population with whorls and carious teeth in left hand is 23.01%. Overall population with whorls and carious teeth in right and left hand is 27.92. There is statistically highly significant difference in association of whorls + caries in right hand when compared to left and right and left hand.\((p \text{ value } < 0.001)\) (Bar Chart XI)

The results have shown significant association between finger dermatoglyphic pattern and dental caries in the population studied in phase II including the variables that were studied in this phase.

On plotting the ROC curve for sensitivity vs specificity done for the second phase of survey, the graph shows, results for the correlation...
between existence of caries and number of whorls. The sensitivity shows 72.8 and specificity shows 40.2. The criterion or the cut off point being ≤4. The value “4” is given for the number of whorls which is >4 in the subject and the value “3” is given for 1-3 whorls. This is indicating that when the number of whorls are ≤4 when there are whorls which is equal to more than 4 whorls then there is an increased chances of its correlation with caries. This suggests that there is a positive correlation between caries and the whorl pattern.
4.5 Tables and Graphs:

BAR CHART: I

DISTRIBUTION OF POPULATION HAVING CARIOUS TEETH

% of Carious Teeth

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Absence</th>
<th>Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00%</td>
<td>20.00%</td>
<td>40.00%</td>
</tr>
<tr>
<td>60.00%</td>
<td>80.00%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Bar Chart showing percentage distribution of carious teeth

Bar Chart- II

Bar chart showing age distribution of the study population
Bar Chart showing percentage distribution of population having whorl pattern.

Bar chart showing percentage distribution of population having loop pattern.
Bar Chart showing percentage distribution of population having other patterns.

Bar chart showing prevalence of loop pattern in association with no caries and with carious teeth in the total population.
Bar chart showing distribution of whorl pattern in deciduous and permanent teeth in subjects with caries and without caries.

Bar chart showing distribution of loops in deciduous and permanent teeth in subjects with caries and without caries.
There is significant difference in the association of whorl + caries in 14-35 yrs age group when compared to loop + caries in 14-35yrs of age group, (p<0.00001).

Cone diagram showing association of whorls, caries and loop in population in the age group of 14-35 years.
Bar diagram showing association of whorls, caries and loop in population in the age group of 14-35 years.

Bar diagram showing distribution of whorls in right, left, both right and left hands in subjects with caries.
ROC curve showing association of whorls and dental caries.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Sensitivity</th>
<th>95% CI</th>
<th>Specificity</th>
<th>95% CI</th>
<th>+LR</th>
<th>95% CI</th>
<th>LR</th>
<th>95% CI</th>
<th>-PV</th>
<th>95% CI</th>
<th>+PV</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤2</td>
<td>0.59</td>
<td>[0.3-0.8]</td>
<td>100.00</td>
<td>98.9-100</td>
<td>1.00</td>
<td>1.0-1.3</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤3</td>
<td>0.025</td>
<td>[0.000-0.1]</td>
<td>100.00</td>
<td>98.9-100</td>
<td>1.00</td>
<td>1.0-1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤4</td>
<td>0.366</td>
<td>[0.24-0.42]</td>
<td>73.27</td>
<td>72.1-74.4</td>
<td>1.15</td>
<td>1.1-1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤5</td>
<td>0.726</td>
<td>[0.71-0.74]</td>
<td>40.05</td>
<td>38.7-41.4</td>
<td>1.21</td>
<td>1.2-1.2</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤7</td>
<td>1.000</td>
<td>[0.99-1.00]</td>
<td>0.00</td>
<td>0.0-0.07</td>
<td>1.00</td>
<td>1.0-1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Area under the ROC curve (AUC) = 0.559
Standard Error = 0.00556
95% Confidence interval = 0.549 to 0.569
z-statistic = 10.678
Significance level P (Area=0.5) = <0.0001

Youden index = 0.1282
Associated criterion = ≤4
ROC curve showing association of loops and dental caries.

Table 1: p value - Chi-square test - Pattern vs caries

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Pattern vs caries</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sig &lt; 0.001</td>
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</tr>
<tr>
<td>1</td>
<td>Whorls vs caries</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>2</td>
<td>Loop vs caries</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>3</td>
<td>Others vs caries</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>

Table 2: p value - Chi-square test – Pattern vs Caries vs Age

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Dermatoglypic pattern</th>
<th>Age</th>
<th>Whorl (p value)</th>
<th>Loop (p value)</th>
<th>Others (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>&lt; 10</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>10-20</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>0.518</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>20-30</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>0.103</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>30-35</td>
<td>p=0.295</td>
<td>p=0.087</td>
<td>0.903</td>
</tr>
</tbody>
</table>
4.6 DISCUSSION

Epidemiology of any disease is a very helpful tool to assess the actual status of the disease among population at a given point of time before progressing into the different factors and understanding of the disease. To ensure data of high validity and reliability, the WHO stepwise recommendations by use of its standard methodology for gathering of information from surveys on the growing burden of dental caries particularly in children in the suggested indicator age groups from 5-35 years was adopted. It is noteworthy to mention that this is the largest survey conducted in a population of 10,250 subjects in India in the field of dentistry with only the national health survey conducted in 2004 done as cluster sampling in 19 states with 300 subjects having a large population size. The frequency of occurrence of dental caries in our study was 36% between the age of 5-35 clearly indicating the fact that the overall goal for service provision for oral health care must be to increase the proportion of children and adults with caries-free teeth; to reduce the dmft/DMFT with special emphasis on the dt/DT component; and to reduce the number of missing or extracted teeth due to caries through preventive measures. To many, dental caries has become an intellectual bore – the disease is solved; there are no more scientific challenges; it is time to move on to more challenging fields. Dental caries continues to be a public health problem in India and going by the international surveys still worldwide; that the enigma of dental caries is worthy of the attention of the finest scientific minds and the application of the most sophisticated techniques from epidemiology to molecular biology.
The relative roles of heredity and environmental (nature v/s nurture) in the pathogenesis of dental caries has intrigued clinical and basic researchers for decades. There are numerous host resistance and risk factors for dental caries that are genetically determined (Mandel, 1994). It is critical to realize that genes and environment do not act independently of each other and the appearance or magnitude of heritability may differ with various environments. Also, Slayton et al (2005), showed an association between genetic variation of tuftelin – 1 (TUFT1) locus 1q21 and dental caries. Deeley et al (2007) suggested that variation in the amelogenin gene (AMELX) locus Xp22.31-p22.1 is related to dental caries.

The pattern of dental caries is similar in members of the same family over several generations and hence inheritance of this susceptibility is suspected. There are inherited traits that alter the susceptibility to dental caries in humans. Genetic variations in the host factors may contribute to increased risks for dental caries. Environmental factors such as diet, oral hygiene habits also play a large role in causing dental caries.

The type of fingerprints is unique and is based on the genetic characteristics of each individual. These dermal patterns once formed remain constant throughout life. Dermatoglyphics is considered as a window of congenital abnormalities and is a sensitive indicator of intrauterine anomalies. Dermatoglyphics had been a useful tool in understanding basic questions in biology, medicine and genetics and at times served as a tool to predict occurrences and risks of biomedical events.
The scientific foundation for fingerprint individuality is incredibly important before commenting on its relevance to a disease process. We therefore analysed the prevalence of specific fingerprint pattern in our study population. There are three basic dermatoglyphic patterns; whorl, loop and arch and others. The average frequency of whorl, loops and other very rare forms (arches) in whole world population is 25%, 71% and 5% respectively.

In this study, the prevalence of whorl pattern in the total population is 54.6%, the prevalence of loop pattern in the total population is 81.7%, and the prevalence of other patterns in the total population is 20.2% respectively. It is again one of the largest surveys done in Indian population till now. It is noteworthy to state that only developed countries like United states of America have documentary fingerprints of all their citizens but again utilise them only for forensic and identification purposes and have no information on the prevalence of the specific dermatoglyphic pattern.

The prevalence of total population having whorl pattern 54.7% and the total population who have whorl pattern in association with carious teeth is 26%. There is statistically highly significant difference in the number of subjects having whorl pattern with carious teeth when compared to subjects who have whorl pattern with no carious teeth (p<0.001). However, the prevalence of population percentage having whorls + caries teeth in association with permanent dentition is 20.05%, the prevalence of population percentage who are having whorls + no caries teeth in association with permanent dentition is 19.15%. There was a significant statistical difference between the above two variables (p<0.001).
The prevalence of total population having loop pattern 81.8% and the population who have loop pattern in association with no carious teeth is 46.90% and when subjects who have loop pattern with carious teeth is 34.93% but both were statistically significant (p<0.001).

The prevalence of total population having other pattern 20.2% and the population who have other pattern in association with carious teeth is 8.16% and with no caries 12.06%.

The above statistical data significance for caries and loop can be correlated with the facts that loops is the most common observed pattern in the population and furthermore the chronology of the deciduous teeth development does not coincide with the fingerprint formation. Hence we further analysed the pattern distribution between the deciduous and permanent dentition. Also, the average age in the study had mixed dentition making it relevant to assess the dentition status.

Loop+ caries and whorl+ caries in relation to deciduous and permanent dentition cannot be compared because the variables are independent.

The association of whorls + permanent teeth with carious teeth is highly significant when compared to loops + permanent teeth with carious teeth (p<0.001).

There is statistically no significant difference in the association of loop+ caries with permanent teeth when compared to loop+ no caries with deciduous teeth( p= 0.2891) which means there is significant association of loop+ caries in deciduous teeth and loop and no caries in permanent teeth.
It is thus evident that the association of whorl + caries in permanent and deciduous teeth is significant when compared to whorls + no caries in permanent and deciduous teeth association, through which it is evident that there is significant association between whorl + carious association. There is also increased prevalence of caries with increase in the number of whorl patterns in the subjects.

Furthermore, the association of loop + no caries in permanent and deciduous teeth is high when compared to loops + caries in permanent and deciduous teeth association, through which it is evident that there is no significant association between loop + caries.

The relevance of other types (arches and others) is very minimal to offer significant correlation in all aspects of this study. Their relevance studied from various studies have shown arches to be extremely reliable in congenital disorders.

Extensive investigations into chromosomal disorders like Down’s syndrome, Turners syndrome etc and their dermatoglyphic manifestations have been analyzed. Significant studies have also been conducted for predicting dermatoglyphics in breast cancers and schizophrenia (Engler1982, Shakibaei et al 2011). This trend persisted in dental research with Atasu et al (1995, 1996) for congenital hypodontia and microdontia, Reddy et al (1997) for molar relation, Polat (2000) for bruxism and Mathew et al (2005) for oral clefts. Atasu M (1998) and Sharma A (2009) have studied this relation in a very small size of 24 patients and 90 patients respectively and only in children.
Basically, the pattern of the skin lines on the finger is formed in the second trimester of the foetus and it does not change for each individual during the life. The dermal ridges develop in relation to the volar pads, which are formed by the 6th week of gestation and reach maximum size between 12-13th week continues beyond 24th week. Ridge patterns on the fingers and palms are first evident during weeks 14-22 of gestation at the sites where embryonic volar pads subside (Babler1987). Ridge patterns remain unchanged after the second trimester and are highly influenced by genetics with total ridge count being correlated 0.96 in monozygotic twins (Hall 2000, Medland et al 2007) although heritability is lowest (approx. 0.50) for the thumb and little finger. Individual differences in prenatal environment (androgen exposure and stress) and developmental stability also play a role in ridge formation (King et al 2009).

The detailed relationship between prenatal hormones and individual differences in ridge counts is unclear. Ridge counts are influenced by both the type and size of finger ridge patterns. These patterns are in turn affected by the timing of the involution of localized elevations of tissue found on the fingertips called volar pads (Medland et al 2007). If ridge patterns develop early, before volar pads have completely subsided, whorl patterns (which lead to higher ridge counts) will develop. Later development of ridges result in arch patterns, and loops are formed from development at intermediate stages (Babler 1978).
Some suggest that developmental rate is associated with the effects of fetal and environmental androgens (King et al. 2009) is responsible for the differences in ridge pattern formation.

The epidermal ridges of the fingers and the palms as well as facial structures like lip, alveolus, palate and the permanent tooth are initiated from the same embryonic tissue (ectomesenchyme) during the same embryonic period. The genetic message in the genome whether normal or abnormal is deciphered during this period and is reflected by dermatoglyphics. Thus with genetic susceptibility and added environmental factors the proneness for caries due to abnormality in the tooth structures like alterations in dental hard tissues like structure of dental enamel, tooth eruption and development may be reflected in the dermatoglyphics namely whorl and loop patterns.

An experimental study by administration of testosterone to pregnant rhesus monkeys showed an effect of early dosage on total ridge counts of the offspring (Okajima 1975). Early exogenous testosterone exposure decreased the ridge counts and ridge complexity in the rhesus offspring. The authors noted that the period within which testosterone affected dermatoglyphics began and ended before the time ridges actually began to form. This implies that although human ridge formation can be seen by week 14 of gestation (Okajima 1975), the period of effect for environmental factors plays a vital role. As this concept holds good for any epithelial mesenchymal interaction our study rejects the null hypothesis thereby establishing dermatoglyphics could indicate a genetic susceptibility to dental caries.
As we have not done a prospective study and no follow up, our findings that there is a significant difference in the association of whorl + caries in 14-35 yrs age group when compared to loop + caries in 14-35yrs of age group. \( p < 0.001 \) further clarified the association. This relation has given the clarity that dermatoglyphics can mostly predict the caries occurrence in permanent dentition.

Hands and arms may be as dimorphic as jaws and brows. Homeobox (Hoxa and Hoxd, recently PHOXMedland et al, 2007) genes are required for the development of both the growth and patterning of the digits as well as the formation of tooth. Humans are also dimorphic in the number and pattern of dermal ridges on their palms, soles, and digits (Holt 1968). As \( R > L \) ridge count asymmetry is more common we thought it will be relevant to our study.

Hence, we further analyzed the frequency of whorls+ carious teeth in right, left and right and left hand as with relevance to the brain dominance in function of the right and left side and more so from facts from multivarious studies done on disease correlation and dermatoglyphics. There was statistically highly significant difference in association of whorls+ caries in right hand when compared to left and right and left hand. \( p < 0.001 \).

Thus from our observations and study, it can be summarized that, Dental caries susceptibility in permanent teeth of an individual increases with an increase in the incidence of whorl pattern, with high degree association in right hand. Also loop was the most commonly observed pattern in non carious subjects of permanent teeth.
4.7 Conclusion

- The association of whorl with dental caries studied across varied age groups, further validates the findings of our phase I.
- In the Phase II study, further there was statistically highly significant difference in the number of subjects having whorl pattern with carious teeth when compared to subjects who have whorl pattern with no carious teeth (p<0.001)
- Also, there was statistical significance at p<0.001 among the population who have loop pattern in association with no caries
- The association of whorls and permanent teeth with carious teeth was highly significant when compared to loops and permanent teeth with carious teeth. (p<0.001). There is statistically highly significant difference in association of whorls and caries in right hand when compared to both hands and left hand. (p value < 0.001) with more prevalence of carious teeth.
- The results have shown significant association between finger dermatoglyphic pattern and dental caries in the population studied in phase II including the hands that were studied in this phase.
- On plotting the ROC curve for sensitivity vs specificity done for the second phase of survey, there was correlation between existence of caries and number of whorls. The sensitivity was 72.8 and specificity was 40.2 which once again reveal a positive correlation between caries and the whorl pattern.
• The association of whorls with dental caries studied across varied age groups, further validates the findings of our phase I. As evident from the ROC curve there is a definite correlation between dermatoglyphics and dental caries.

• Although dermatoglyphic examination is technique sensitive, but once applied, can give new dimension and reliable parameter to dentistry.

• Our observations have revealed the susceptibility to dental caries through its convincing association with the heritable dermatoglyphic traits as a valid marker.