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Dermatoglyphic variations in population of jammu division and their correlations with pulmonary tuberculosis and coronary artery disease

[1]Dr. Aijaz Ahmad Patloo , Demonstrator, Department of Anatomy, Government Medical College, Srinagar, India
[2]Dr. Sunanda Raina , EX Principal & Professor &Head ,Department of Anatomy GMC Jammu, India
[3]Dr. Nuzhat Bashir, Demonstrator, Department of Anatomy, SKIMS Medical College, Bemina Srinagar, India
Corresponding Author: Dr. Aijaz Ahmad Patloo, Demonstrator, Department of Anatomy, Government Medical College, Srinagar, India

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Abstract

Background: Dermatoglyphics, the ridged skin covering our palms and sole, are not only found on human beings. All primates have ridged skin, and it can also be found on the paws of certain mammals and on the tails of some monkey species. Palmar creases develop during the 2nd and 3rdmonth of intrauterine life and are not influenced by movement of hand in-utero. They are ofconsiderable clinical interest because they are affected by certain abnormalities of early development
including genetic disorders.

Materials and Methods: The present study was conducted on 100 patients, 50 patients with confirmed diagnosis of Pulmonary tuberculosis and 50 patients of confirmed Coronary artery disease who visited the outpatient and inpatient department of Chest Disease Hospital and outpatient and inpatient department of Cardiology at Government Medical College Jammu. 50 subjects were taken as controls and it was seen that they do not suffer from any disease and are not on any medication.

Aim: The present attempt is to study the dermatoglyphic variations in population of Jammu Division and their correlations with Pulmonary tuberculosis and Coronary artery disease.

Results: The results showed that percentage of ulnar loops were more among the people of Jammu Division who were taken as controls and the percentage of whorls dominated in patients of Pulmonary tuberculosis and Coronary artery disease.

Conclusion: Dermatoglyphics in Pulmonary Tuberclosis &Coronary artery disease showed significant variation as compare to normal. Presence of above dermatoglyphic features will help us to predict that these individuals may be susceptible for Pulmonary tuberculosis &Coronary artery disease. It warrants further research in the same direction

Keywords: Dermatoglyphics, Pulmonary Tuberculosis, Coronary artery disease , Finger Prints, Loops, Arches,

Whorls.

Introduction

All primates have ridged skin. It can also be found even on the paws of certain mammals and on the tails of some monkey species. In human and animals, dermatoglyphics are present on fingers, palms, toes and soles. This helps shed light on a critical period of embryogenesis, when the architecture of major organ system is developing**.** The entire human body is clothed with skin which happens to be the largest and most important organ of the body. It performs many vital functions in the life of an individual. The skin on the ventral sides of the hands i.e. palm and plantar sides of the feet i.e. sole is exclusively designed and corrugated with ridges and configurations which are functionally useful as they help in the grasping without which the objects would easily slip away from the hands

Dermatoglyphics have been extensively used to characterize and differentiate human population hence are highly suitable for studying population variations. Dermatoglyphic features due to its permanency, genetic influence as well as number of easily observable and measurable characters may be considered one of the most suitable parameters for population variability. Dermatoglyphics is a growing discipline and its easy and ready applicability render it as a useful tool to the clinician. Since most of the investigations needed to confirm the diagnosis in hereditary disorders are complex and expensive, dermatoglyphics can be effectively employed with other clinical signs as a screening procedure.

The present attempt is to study the dermatoglyphic variations in population of Jammu Division and their correlations with Pulmonary tuberculosis &Coronary artery disease. Tuberculosis is a specific infectious disease caused by Mycobacterium tuberculosis. The disease primarily affects the lungs and causes Pulmonary tuberculosis. Tuberculosis remains a worldwide public health problem despite the fact that the causative organism was discovered more than 100 years ago and highly effective drugs and vaccine are available making tuberculosis a preventable and curable disease

In India 1.8 million persons develop tuberculosis every year out of which 0.8 million are new smear positive highly infectious cases. Incidence of tuberculosis in India is 170 per 100,000 population per year. Prevalence of tuberculosis in India is185 per 100,000 population per year. Genetic contribution is one of the causes of Pulmonary tuberculosis.

Also the knowledge of dermatoglyphics can be globally utilized for the prevention and screening of major causes of mortality in the present day scenario like coronary artery disease.

Coronary artery disease is defined as impairment of heart function due to inadequate blood flow to the heart compared to its needs, caused by obstructive changes in the circulation to the heart. It is the cause of 25%-30% deaths in most industrialized countries. Taking into consideration genetic predisposition of dermatoglyphics and Coronary artery disease, present study is carried out to find out the correlation between them, so that dermatoglyphics can prove to be a helpful tool in the diagnosis of predisposition towards the disease at an earlier age.

Aims and Objectives

1. To analyze the prevalent pattern of Dermatoglyphics in population of Jammu Division of North India.

2. To determine prevalent Dermatoglyphic parameters in patients of Pulmonary tuberculosis & Coronary artery disease

Materials And Methods

1. The present study was conducted on 100 patients, 50 patients with confirmed diagnosis of Pulmonary tuberculosis and 50 patients of confirmed Coronary artery disease who visited the outpatient and inpatient department of Chest Disease Hospital and outpatient and inpatient department of Cardiology at Government Medical College Jammu.

2. 50 subjects were taken as controls and it was seen that they do not suffer from any disease and are not on any medication.

The materials used for the study were: Kores printer ink, Clean glass slab, Bond paper, Rubber roller, Magnifying lens, Soap, Cotton swabs, Scale, Pointer. After taking informed consent from the subjects, they were asked to wash their hands with soap and water so as to remove any oil or dirt. Standard Indian ink method was used for taking impressions with Kores duplicating ink. A small drop of duplicating ink was squeezed out on a glass slab and spread on it evenly by rolling the roller over the ink on the slab so that a thin layer was formed. Fingertip of both the hands were impregnated with ink, one by one, by placing the finger on its edge on the slab and then rolling it over gently to the other edge by applying continuous correct pressure. After the fingers were inked, rolled impressions were taken on A4 sheet of bond paper one by one. Rolled fingerprints were taken because they show the full pattern area. The prints were then subjected to dermatoglyphic analysis with the help of magnifying hand lens, scale and ridge counting was done with the help of sharp needle. The quantitative parameter observed were the types of patterns of individual digit or finger i.e. loop, arch, whorl and composite. **The quantitative parameter observed were:** 1. The ridge counts of individual fingers of both right and left hands.

2. Total finger ridge count. For finger ridge counting, the basic dermatoglyphic landmarks were considered i.e. triradius and core. A triradius is formed by confluence of three ridge systems and core is the approximate centre of the pattern.

Results

In present study all the data obtained from both Pulmonary tuberculosis &Coronary artery disease group and controls were analysed qualitatively and quantitatively then depicted in the form of tables and graphs as under.

Table 1: Distribution of Pattern types in Control Group (n=50) in the right, left and both hands.

Pattern Type	Right Hand Digits		Left Hand Digits		Both Hand Digits	
	No.	%age	No.	%age	No.	%age
Arches	21	8.40	27	10.80	48	9.60
Radial	60	24.0	36	14.4	96	19.20
Ulnar	100	40.0	142	56.8	242	48.4
Whorls	67	26.8	45	18.0	112	22.40
Composi	2	0.80	0	0	2	0.40
Total	250	100	250	100	500	100

In the frequency distribution of pattern in Control group, ulnar loops (100; 40.0%) had the highest occurrence in the right hand digits, followed by whorls (67; 26.8%). Similarly, in the left hand digits, ulnar loops (142; 56.8%) had the highest occurrence followed by whorls (45; 18.0%).Taking average of ten fingers, overall 24.2 (48.4%) had ulnar loops, 11.2 (22.40%) had whorls, 9.6 (19.20%) had radial loops, 4.8 (9.60%) had arches and 0.02 (0.40%) subjects had composite type of pattern among control group.

Fig. 1: Bar Chart Showing distribution of Pattern types in Control group in the right, left and both hands.

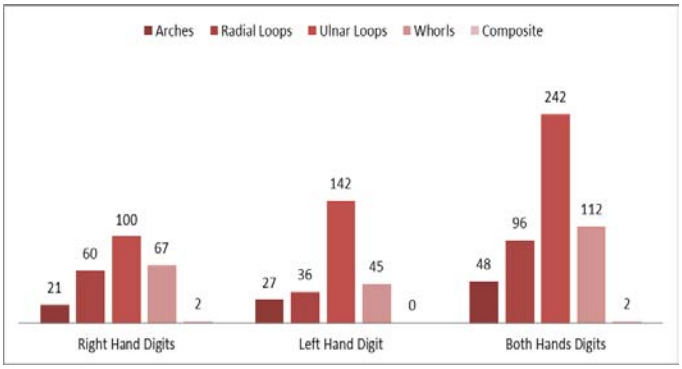

Table 2: Distribution of Pattern types in Pulmonary Tuberculosis Group (n=50) in right, left and both hands

Pattern Type	Right Hand Digits		Left Hand Digits		Both Hand Digits	
	No.	%age	No.	%age	No.	%age
Arches	7	2.80	10	4.00	17	3.40
Radial	37	14.80	31	12.4	68	13.60
Ulnar	84	33.6	87	34.8	171	34.20
Whorls	122	48.80	119	47.6	241	48.20
Composi	0	0	3	1.20	3	0.60
Total	250	100	250	100	500	100

In the frequency distribution of pattern in Pulmonary tuberculosis group, whorls 122 (48.80%) had the highest occurrence in the right hand digits, followed by ulnar loops 84 (33.60%). Similarly in the left hand digits, whorls 119 (47.6%) had the highest occurrence, followed by ulnar loops 87 (34.8%). Overall whorls (241; 48.20%) had the highest occurrence in Pulmonary tuberculosis group followed by ulnar loops (171; 34.20%) while composite pattern had (3; 0.60%) least occurrence.

Fig. 2:Bar Chart showing distribution of pattern types in Pulmonary tuberculosis group in the right, left and both hands.

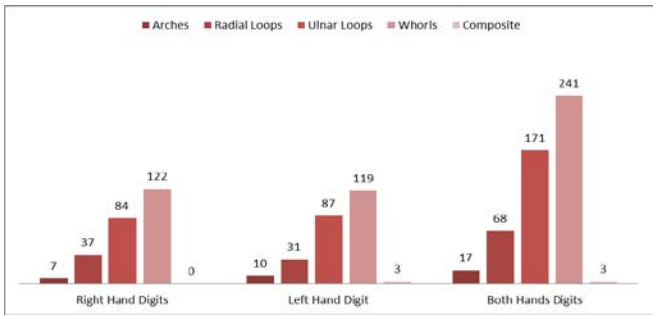

Table 3: Relationship of dermatoglyphic patterns in Control group and Pulmonary tuberculosis group.

Pattern Type	Control Group		Pulmonary Tuberculosis		Statistical Inference
	No.	%age	No.	% age	
Arches	48	9.60	17	3.40	t=2.64422
Radial	96	19.20	68	13.60	t=2.22912
Ulnar	242	48.40	171	34.20	t=2.43607
Whorls	112	22.40	241	48.20	t=4.88156
Composi	2	0.40	3	0.60	t=0.39736
Total	500	100	500	100	–

- Relationship of arches in Control group and Pulmonary tuberculosis group was statistically significant (p=0.016489) due to few number of arches in Pulmonary tuberculosis group.
- Relationship of radial loops in Control group and Pulmonary tuberculosis group was statistically significant (p=0.038785) due to few number of radial loops in Pulmomary tuberculosis group.
- Relationship of ulnar loops in Control group and Pulmonary tuberculosis group was significant (p=0.025465) due to few number of ulnar loops in Pulmonary tuberculosis group.
- Relationship of whorls in Control group and Pulmonary tuberculosis group was statistically highly

significant (p=0.000120) due to more number of whorls in Pulmonary tuberculosis group.

➢ Relationship of composite pattern in Control group and Pulmonary tuberculosis group was statistically not significant (p=0.62).

Fig 3: Bar Chart showing relationship of dermatoglyphic patterns in Control group and Pulmonary tuberculosis group.

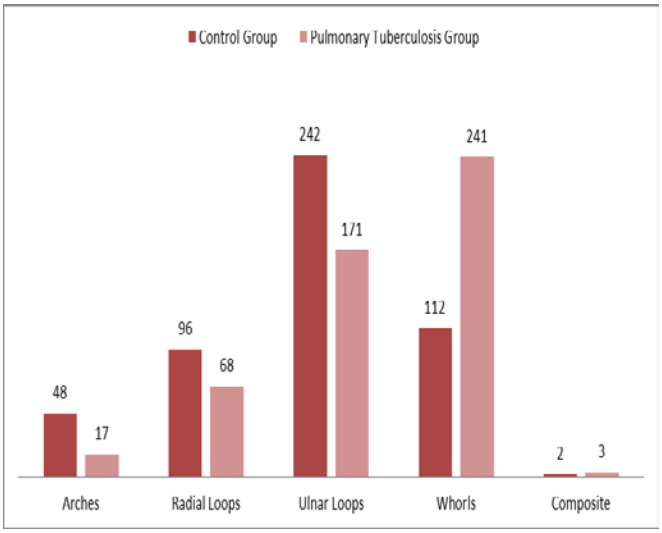

Table 4: Relationship of total finger ridge count(TFRC) in Control group and Pulmonary tuberculosis group.

Parameter	Control Group	Pulmonary Tuberculos	Statistical Inference
TFRC	108.6000 ±20.5573	144.8800± 16.49693	t=9.73273; p=0.000000;

➢Relationship of mean total finger ridge count in Control group and Pulmonary tuberculosis group was statistically highly significant (p=0.000000).

Table 5: Distribution of Pattern types in Coronary Artery Disease Group (n=50) in right, left and both hands

Pattern Type	Right Hand Digits		Left Hand Digits		Both Hand Digits	
	No.	%age	No.	%age	No.	%age
Arches	12	4.80	7	2.80	19	3.80
Radial	29	11.60	39	15.60	68	13.6
Ulnar	41	16.4	47	18.80	88	17.6
Whorls	168	67.2	153	61.20	321	64.20
Composi	0	0	4	1.6	4	0.80
Total	250	100	250	100	500	100

In the frequency distribution of pattern in Coronary artery disease group, whorls (168; 67.2%) had the highest occurrence in the right hand digits followed by ulnar loops (41; 16.4%). Similarly, in the left hand whorls (153; 61.20%) had the highest occurrence, followed by ulnar loops (47; 18.80%). Overall whorls (321; 64.20%) had the highest occurrence followed by ulnar loops (88; 17.6%) while composite pattern had least (4; 0.80%) occurrence.Taking average of ten fingers, Overall 32.1 (64.20%) had whorls, 8.8 (17.6%) had ulnar loops, 1.9 (3.80%) had arches and 0.4 (0.80%) subjects had composite type of pattern among Coronary artery disease group.

Fig 4: Bar Chart showing distribution of pattern types in Coronary artery disease group in the right, left and both hands.

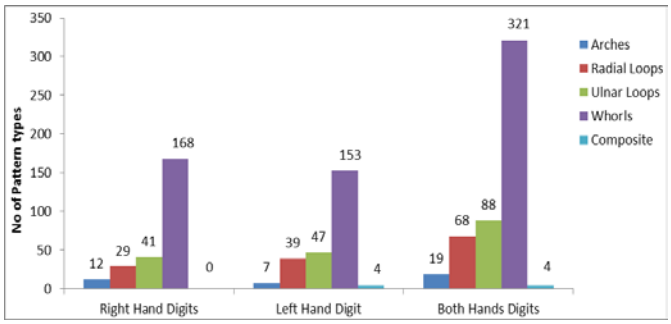

Table 6: Relationship of dermatoglyphic patterns in Control group and Coronary artery disease group.

Pattern Type	Control Group (n=50*10=500)		Coronary Artery Disease Group (n=50*10=500)		Statistical Inference
	No.	%age	No.	% age	
Arches	48	9.60	19	3.80	t=2.390074.
Radial Loops	96	19.20	68	13.60	t=2.183436.
Ulnar Loops	242	48.40	88	17.60	t=6.632566.
Whorls	112	22.40	321	64.20	t=7.99846; p=0.00000
Composite	2	0.40	4	0.80	t=0.670829.
Total	500	100	500	100	_

➢Relationship of arches in Control group and Coronary artery disease group was statistically significant (p=0.027991) due to few number of arches in Coronary artery disease group.

➢Relationship of radial loops in Control group and Coronary artery disease group was statistically significant (p=0.042483) due to few number of radial loops in Coronary artery disease group.

➢Relationship of ulnar loops in Control group and Coronary artery disease group was statistically highly significant (p=0.000003) due to few number of ulnar loops in Coronary artery disease group.

➢Relationship of whorls in Control group and Coronary artery disease group was statistically highly significant (p=0.000000) due to more number of whorls in Coronary artery disease group.

➢Relationship of composite pattern in Control group and Coronary artery disease group was statistically not significant (p=0.510852).

Fig 5: Bar chart showing relationship of dermatoglyphic patterns in Control group and Coronary artery disease group.

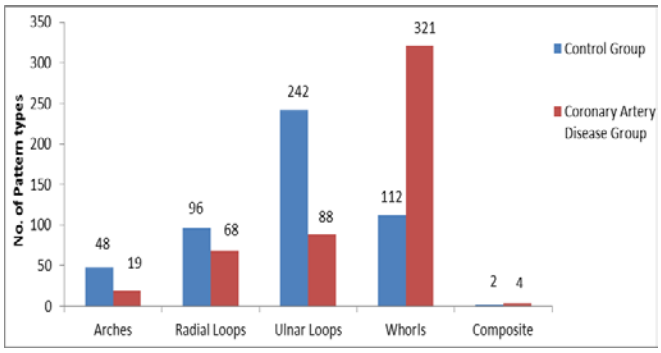

Table 7: Relationship of total finger ridge count (TFRC) in Control group and Coronary artery disease group.

Parameter	Control Group Mean±SD	Coronary Artery	Statistical Inference
TFRC	108.6000±20.5573	139.6800 ± 20.95129	t=7.98723; p=0.0000

➢ Relationship of mean total finger ridge count in Control group and Coronary artery disease group was statistically highly significant (p=0.000000).

Discussion

Pulmonary tuberculosis caused by Mycobacterium tuberculosis is now becoming the major health Problem in developing countries. Host genetic factors such as Human Leucocyte Antigen (HLA) and non HLA genes are associated with the susceptibility of tuberculosis. As there is a link between susceptibility of tuberculosis with genetic markers, present study was done to predict the genetic susceptibility of tuberculosis. The dermatoglyphics can play an important role in revealing the individuals who are susceptible to Pulmonary tuberculosis owing to genetic constitution. It will also

be contributing in the evaluation of genetic susceptibility to the disease of known contacts of Pulmonary tuberculosis, so that appropriate intervention can be done.

In the present study, the results revealed highest occurrence of whorls (49%) in Pulmonary tuberculosis subjects, followed by ulnar loops (34.20%), radial loops (13.60%), arches (3.40%) and composite pattern (0.40%). These observations can be an additional support in diagnosing patients of Pulmonary tuberculosis.The relationship of fingertip pattern in control group and Pulmonary tuberculosis group showed significant variations with respect to whorls (p=0.000120), ulnar loops (p=0.025465), radial loops (p= 0.038785).

The value of total finger ridge count in Pulmonary tuberculosis patients was significantly raised (144.88+_16.49) and showed significant variation when compared with controls (p=0.000120).

Genetic contribution is one of the causes of Pulmonary tuberculosis. Susceptibility to Pulmonary tuberculosis in India has been linked to mannose binding protein gene. Significant association has been found between IL-1 Gene clusters and host susceptibility to tuberculosis [6].

A study conducted by Sidhu LS et al, 1978 observed no statistical significant differences in fingerprint patterns in Pulmonary tuberculosis patients compared with controls. The present study is not in agreement with their studyas in our study we observed significant statistical differences in fingerprint patterns in Pulmonary tuberculosis patients as compared to controls.

Palmar dermatoglyphics in Pulmonary tuberculosis patients were studied byBabu SS et al, 2005 and observed that whorl pattern was predominant (56.6%) with a decrease in loop pattern (32.1%) as compared to controls and the difference was highly significant ($p<0.01$). Difference in mean total finger ridge count of controls and study group was found to be highly significant.

The results of present study are in agreement with their study as we also observed higher percentage (48.20%) of whorls and lower percentage (3.40%) of arches. Mean total finger ridge count was also significantly higher as compared to controls.

Chaudhari J et al, 2011studied Palmar dermatoglyphics of 100 Pulmonary tuberculosis patients of Bhavnagar District and observed no statistically significant difference in fingerprint pattern between male and female and total cases and controls.

The present study findings are not in agreement to the above study wherein significant variation in fingerprint pattern was observed between cases and controls.

Palmar dermatoglyphic patterns in Pulmonary tuberculosis patients were collected from 100 diagnosed patients by Khairnar KB et al, 2012 and many dermatoglyphic patterns seen in Pulmonary tuberculosis patients were found to be statistically significant as compared to controls.

The results of present study are in consonance with their study as we also observed statistically significant dermatoglyphic patterns in Pulmonary tuberculosis patients as compared to controls.

Navgire VR & Meeshram MM, 2013 studied palmar dermatoglyphics in Pulmonary tuberculosis and found significant increase in total finger ridge count and absolute finger ridge count in both hands of Pulmonary tuberculosis cases as compared to controls, which is in agreement with the present study, which also showed increased total finger ridge count.

Dermatoglyphics as a diagnostic tool is now well established in number of diseases which have strong hereditary basis. Myocardial infarction is multifactorial in origin reflecting a complex interaction between multitude of genetic factors and environmental factors, so certain dermatoglyphic variation is to be expected in it.

The present study was carried out to analyze the prevalent pattern of dermatoglyphics in p ulmonary tuberculosis & coronary artery disease and control groups in the population of Jammu Division of North India. Dermatoglyphic markers taken into consideration in the present study were fingertip ridge pattern and total finger ridge count. The results of the study revealed that in population of Jammu region the frequency of fingertip patterns of both hands was ulnar loops (48.4%) > whorls (25%) > radial loops (19.20%) > arches (9.60%) > composite (0.40%).

Manara et al, 2011 studied digital and palmar dermatoglyphics in 30 patients of coronary artery disease and 30 controls. In finger dermatoglyphics coronary artery disease patients showed higher frequencies of whorl patterns but lower frequencies of ulnar loop, radial loop and arch patterns than controls. The mean total finger ridge count of coronary artery disease patients was lower than the controls.

This study is in partial agreement with the observations of the present study. In the present study coronary artery disease patients also exhibited increase in frequency of whorls and lower frequencies of ulnar loop, radial loop and arch patterns but the mean total finger ridge count was increased in patients of coronary artery disease.

A similar study was done by Kumar N et al, 2012 on 60 patients with ischemic heart disease and 60 controls. All the patients with ischemic heart disease exhibited an increase in frequency of whorls, ulnar loops, radial loops and a decrease in frequency of arches.The present study also agrees with the above study in significantly higher frequency of whorls and lower frequency of arches in ischemic heart disease as compared to controls.

Rekha P & Senthil Kumar, 2012[l]studied dermatoglyphic patterns among 75 myocardial infarcted subjects and equal number of healthy subjects. The results indicated that there is a significant relation between the tented arch type of fingerprint and the risk of myocardial infarction.The present study is in contrast to the above study in having significantly higher frequency of whorls and lower frequency of arches in patients of myocardial infarction as compared to controls.

The results of present study are in consonance with a study conducted by Salunkhe and Mudiraj, who observed that there was a significant increase in the percentage of whorls and decrease in percentage of loops and arches in coronary artery disease patients as compared to controls, as we also observed higher percentage of whorls (48.20) and lower percentage of ulnar loops(34.20%), radial loops (13.60%) as compared to control group.

Conclusion

The present study used dermatoglyphic markers such as fingertip ridge pattern and total finger ridge count to analyze the prevalent pattern of dermatoglyphics among the population of Jammu Division. The results showed that percentage of ulnar loops were more among the people of Jammu Region and the percentage of whorls dominated in patients of Pulmonary tuberculosis. These features can be used in early detection of Pulmonary tuberculosis in the society. This will definitely have an impact on reducing mortality

and morbidity from these diseases.Finally it can be said that dermatoglyphics is not only related to the diagnosis of a disease but more to its prognosis, its main purpose is not to give a new definition to an existing disease but to identify individuals who are genetically more susceptible to develop certain diseases. If any association can be established then it can be used as a cheaper way to screen the populations who are at risk and they may be watched to see for any early onset of symptoms.

Also the knowledge of dermatoglyphic pattern in patients with coronary artery disease is an interesting matter and little information is available about this relation.Dermatoglyphic features due to its permanency, genetic influence may be considered as one of the most suitable parameters for population variability. The present study used dermatoglyphic markers such as fingertip ridge pattern and total finger ridge count to analyze the prevalent pattern of dermatoglyphics among the population of Jammu Division. The results showed that percentage of ulnar loops were more among the people of Jammu Region and the percentage of whorls dominated in patients of Coronary artery disease.The characteristic digital dermatoglyphic patterns such as increased total finger ridge count and high incidence of whorl pattern are associated with Coronary artery disease. These features can be used in early detection of Coronary artery disease in the society. This will definitely have an impact on reducing mortality and morbidity from these diseases.

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References

1. Anderson MW, Haug PJ, Critchfield G: Dermatoglyphic features of Myocardial Infarction patients. abst Amer JPhysl Anthropol, 1981; 55(4): 523-27.
2. Biswas **S**.Finger and palmar dermatoglyphic study among the Dhimals of North Bengal, India. Anthropol 2011; 13 (3): 235-38
3. Cummins H, Keith HH, Midlo C, Montgomery RB, Wilder, Wilder IW. Revised methods of interpreting and formulating palmar dermatoglyphics. Am J Phys Anthropol 1929;12(3):415-73
4. Jalali F, KO Hajian-Tilaki**:** A Comparative Study of Dermatoglyphic Pattern in Patients with Myocardial Infarction and Control Group. Acta Medica Iranica, 2002,40(3): 187-91
5. Park K. Epidemiology of chronic non-communicable diseases and conditions. In: Park K, editor. Park's:Textbook of preventive and social medicine. 20th ed.Jabalpur:Banarsidas Bhanot;2009. pp.315-58
6. Rashad MN, Mi MP, Rhoads G**:** Dermatoglyphic studies of myocardial infarction patients. Abst Hum Hered 1978;28:1–6.
7. Rathva A, Baria D, Rathod H, Maheria P, Mahyavanshi D , Patel M. A study of quantitative analysis of dermatoglyphic in coronary artery disease patients. Indian J Basic Appl Med Res 2013;2(8):831-40
8. Selvaraj P, Narayanan PR, Reetha AM. Association of functional mutant homozygotes of the mannose binding protein gene with susceptibility to Pulmonary tuberculosis in India. Tuber Lung Dis 1999; 79(4): 221-27

9. Manara A, Habib MA, Rahman MA, Ayub M, Begum N , Hossain S. Digital and Palmar dermatoglyphics in myocardial infarction. J Armed Forces Med Coll Bangladesh 2011; 7(2): 4-8
10. Kumar N, Veerabhadrappa HC, Manjunath GN, Swamy RM, Dipanjan. Study of correlation between ischemic heart disease and dermatoglyphics. Res J Pharmaceut Biol Chem Sci 2012; 3(4): 989-92
11. Rekha P, Senthil Kumar S. A study of dermatoglyphic patterns in myocardial infarction. Int J Anat Sci 2012; 3(1): 8-11
12. Sidhu LS, Sharma A, Singal P, Bhatnagar DP. A study of relationship between Pulmonary tuberculosis and palmar dermatoglyphic traits. Anthropol Anz 1978; 36(3): 219-23
13. Babu SS, Powar BP, Khare ON.Palmardermatoglyphics in Pulmonary tuberculosis. J Anat Soc India 2005;54 (2): 1-9
14. Chaudhari J, Sarvaiya B, Patel SV, Rathod SP, Singel TC. A study of Palmar dermatoglyphics of Pulmonary tuberculosis patients in Bhavnagar district. Natl J Integr Res Med 2011; 2(2): 50-52
15. Navgire VR, Meshram MM.Study of Palmar dermatoglyphics in pulmonary tuberculosis. Int J Cur Res Rev 2013; 5(14): 111-14
16. Khairnar KB, Kate DP, Bhusari PA, Shukla K. Palmar dermatoglyphics and Pulmonary tuberculosis. Int J Health Sci Res 2012; 2(2): 54-62