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A Comparative Study on the Qualitative Dermatoglyphic Traits in Healthy, High-Risk Individuals and Patients with Breast Carcinoma.

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Abstract

With a multitude of screening techniques designed for breast cancer, this study attempts to evaluate the relationship between qualitative dermatoglyphics across three age-matched subgroups - breast cancer patients, high-risk patients and healthy individuals.The study was carried out amongst 270 women, where 90 age-matched women were assigned to each sub-group. Dermatoglyphics of all fingers were collected after informed consent was given by standardised ink and paper method for a rolled fingerprint. Demographic details were taken via a verified pro forma.The most recurring patterns found were whorls, arches, radial loops, and ulnar loops. In women with breast cancer, it was found that all fingers displayed a higher frequency of whorls ($p<0.0001$), while in high-risk individuals arches were predominant ($p<0.0001$). Demographic factors such as age, religion and occupation also significantly contributed as significant parameters.Dermatoglyphics can prove to be a simple, practical, non-invasive and easily affordable screening technique for breast cancer patients which could hasten early diagnosis and treatment.

1. Introduction:

Cancer has proved itself to be a contemporary epidemic becoming one of the most dominant causes of morbidity and mortality worldwide.The alarming rate at which its prevalence in society is increasing accentuates the need for secondary prevention (i.e. early diagnosis and treatment) of this cancer. In the current scenario, there is a multitude of modern and more accurate imaging methods as diagnostic options for breast cancer including mammography, ultrasonography, magnetic resonance imaging, etc.[1] Yet, in most developing countries, only a small number of centres provide multimodality protocol-based diagnostic and treatment facilities. These multi-modality techniques also prove to bear a significant financial burden on the patient which leads to them presenting with the disease at a much later stage thereby delaying treatment[2].

Breast cancer has been attributed in equal parts due to genetic and environmental factors. Abundant research has been carried out to establish its genetic components. Dermal ridges were found to be an effective biomarker of genomic instability in breast cancer[3]. Dermatoglyphics could circumvent the after-mentioned burdens in diagnosing breast cancer at an early stage and could be an important prognostic factor[4]. Therefore this study aims to evaluate the type of fingerprints in three groups (i.e. patients with breast cancer, their corresponding aged - normal, and high-risk individuals) and compare them based on qualitative dermatoglyphic patterns to study their association among the three groups.

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2. Materials and Methods:

The study at hand was conducted in a tertiary health care institute in a case-control manner over the course of 2 months in an allied effort from the department of oncology & anatomy. The minimum number of candidates to include in the study was derived by adopting the following formula by Sakineh Abbasi et. al.[5]:

$$n = \frac{(p_1q_1 + p_2q_2) * (Z_{1-\alpha/2} + Z_{1-\beta})^2}{(p_1 - q_1)^2}$$

Where,

In Cancer Patients: 48.70% is the frequency;

In High-Risk Patients: 47.40% is the frequency;

In Normal Patients: 27.50% is the frequency;

Therefore, with 95% confidence and 80% power, a minimum of 90 normal Individuals, 90 High-Risk individuals and 90 Breast Carcinoma patients (age-related) were included in the study after informed consent was obtained from them.

Inclusion Criteria: The age group for the study was restricted to the group of 30 to 60 years. Breast cancer patients were included after histo-pathologically confirming their status. Then age-matched controls who had no self or familial history of breast cancer were enrolled. Those age-matched subjects who had a positive familial history of breast cancer in a first-degree relative, or any of the following two criteria[5] were grouped into the high-risk category:

1. Any previous history of surgery for any Non-cancerous Breast Condition, or non-cosmetic breast condition.
2. Menarche before the age of 13[6].
3. Menopause above the age of 50[6].
4. First live birth at or above the age of 30[7].

Exclusion Criteria: Subjects who did not fall into the age group or had inflammatory or benign breast lesions were excluded from the study.

The format for obtaining the rolled fingerprint of the patient was as follows:

A. The subject was explained the rationale of the project and was given a patient information sheet after which once all doubts were addressed, informed consent was taken.

B. The subject was then asked to wash their hands with soap and water followed by drying them with a towel or tissue.

C. Using the ink and paper method, the subject was asked to roll the finger on the ink pad so that the entire fingerprint pattern area was evenly covered with ink.

D. While taking the rolled impression, the side of the finger bulb was placed upon the glossy paper. The finger was then rolled to the other side until it faced the opposite direction.

E. The fingerprint was preserved and the observations were recorded.

F. The same was repeated for the remaining fingers in both hands.

Statistical Analysis:The differences in qualitative (patterns) data were noted and their significance was measured concerning demographic factors using the chi-square test on InStat software where p values < 0.05 were considered significant with a 95% confidence interval.

3. Results:

The data was collected via a verified Pro-forma. A total of 90 age-matched individuals per group were included according to the set criteria. Qualitative analyses of the data were carried out by delineating the pattern found on the individual finger in both hands for the three groups. The patterns found were whorls, arches, radial loops, and ulnar loops.

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Table 1: Univariate analysis of Dermatoglyphic Pattern obtained in the three sub-groups.

Hand	Finger	Finger Print	Breast Cancer Patients	High Risk Individuals	Normal Individuals	Chi-Square	Degrees of Freedom	P-value
Right	Thumb	Whorl	64 (71.11%)	28 (31.11%)	61 (67.78%)	42.175	6	<0.0001
		Arch	18 (20.00%)	56 (62.22%)	24 (26.67%)			
		Ulnar Loop	5 (5.56%)	3 (3.33%)	3 (3.33%)			
		Radial Loop	3 (3.33%)	3 (3.33%)	2 (2.22%)			
	Index	Whorl	70 (77.78%)	24 (26.67%)	23 (25.56%)	70.470	6	<0.0001
		Arch	15 (16.67%)	61 (67.78%)	64 (71.11%)			
		Ulnar Loop	2 (2.22%)	1 (1.11%)	1 (1.11%)			
		Radial Loop	3 (3.33%)	4 (4.44%)	2 (2.22%)			
	Middle	Whorl	64 (71.11%)	33 (36.67%)	65 (72.22%)	36.890	6	<0.0001
		Arch	18 (20.00%)	51 (56.67%)	23 (25.56%)			
		Ulnar Loop	4 (4.44%)	4 (4.44%)	1 (1.11%)			
		Radial Loop	4 (4.44%)	2 (2.22%)	1 (1.11%)			
	Ring	Whorl	65 (72.22%)	22 (24.44%)	23 (25.56%)	59.250	6	<0.0001
		Arch	20 (22.22%)	63 (70.00%)	63 (70.00%)			
		Ulnar Loop	2 (2.22%)	1 (1.11%)	2 (2.22%)			
		Radial Loop	3 (3.33%)	4 (4.44%)	2 (2.22%)			
	Little	Whorl	71 (78.89%)	22 (24.44%)	63 (70.00%)	69.700	6	<0.0001
		Arch	15 (16.67%)	64 (71.11%)	22 (24.44%)			
		Ulnar Loop	2 (2.22%)	2 (2.22%)	4 (4.44%)			
		Radial Loop	2 (2.22%)	2 (2.22%)	1 (1.11%)			
Left	Thumb	Whorl	64 (71.11%)	32 (35.56%)	61 (67.78%)	43.604	6	<0.0001
		Arch	13 (14.44%)	51 (56.67%)	24 (26.67%)			
		Ulnar Loop	4 (4.44%)	4 (4.44%)	2 (2.22%)			
		Radial Loop	9 (10.00%)	3 (3.33%)	3 (3.33%)			
	Index	Whorl	74 (82.22%)	32 (35.56%)	64 (71.11%)	54.676	6	<0.0001
		Arch	10 (11.11%)	53 (58.89%)	20 (22.22%)			
		Ulnar Loop	4 (4.44%)	2 (2.22%)	4 (4.44%)			

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		Radial Loop	2 (2.22%)	3 (3.33%)	2 (2.22%)			
	Middle	**Whorl**	71 (78.89%)	27 (30.00%)	60 (66.67%)	58.875	6	<0.0001
		Arch	9 (10.00%)	55 (61.11%)	25 (27.78%)			
		Ulnar Loop	4 (4.44%)	3 (3.33%)	3 (3.33%)			
		Radial Loop	6 (6.67%)	5 (5.56%)	2 (2.22%)			
	Ring	**Whorl**	68 (75.56%)	29 (32.22%)	27 (30.00%)	69.872	6	<0.0001
		Arch	11 (12.22%)	58 (64.44%)	60 (66.67%)			
		Ulnar Loop	5 (5.56%)	2 (2.22%)	2 (2.22%)			
		Radial Loop	6 (6.67%)	1 (1.11%)	1 (1.11%)			
	Little	**Whorl**	73 (81.11%)	32 (35.56%)	26 (28.89%)	71.857	6	<0.0001
		Arch	8 (8.89%)	53 (58.89%)	60 (66.67%)			
		Ulnar Loop	4 (4.44%)	2 (2.22%)	2 (2.22%)			
		Radial Loop	5 (5.56%)	3 (3.33%)	2 (2.22%)			

Right Hand :

As shown in *Table 1*, the patterns were analysed and statistical results are entailed as below.

In the thumb, it was found that in maximum patients with breast cancer 64 (71.11%) had whorls, while in high-risk individuals 56 (62.22%) had arches and 61 (67.78%) normal individuals had whorls. On performing 3 columns (sub-groups) x 4 rows (dermatoglyphic pattern) chi-square test on the right-hand thumb, it was found that the relative frequencies showed highly significant values ($\chi 2$ = 42.175; df = 6; p <0.0001).

In the index finger, it was found that in patients with breast cancer 70 (77.78%) had whorls, while in high-risk individuals 61 (67.78%) had arches and 64 (71.11%) normal individuals had arches. Chi-square test revealed the relative frequencies showed highly significant values ($\chi 2$ = 70.47; df = 6; p <0.0001).

For the middle finger, 64 (71.11%) patients with breast cancer had whorls, 51 (56.67%) high-risk individuals had arches and 65 (72.22%) normal individuals had whorls. The relative frequencies on univariate analysis showed favourably significant values ($\chi 2$ = 36.89; df = 6; p <0.0001).

On the ring finger, 65 (72.22%) breast cancer patients displayed whorls, while 63 (70.00%) high-risk individuals had arches and 63 (70.00%) normal individuals had arches. On examining the chi-square test, highly significant values were found ($\chi 2$ = 59.25; df = 6; p <0.0001).

Finally, in the little finger, the highest frequency of pattern found in the breast cancer sub-group was whorls with 71 (78.89%) patients, the high-risk individuals had maximum arches with 64 (71.11%) individuals and 63 (70.00%) normal individuals displayed whorls. The chi-square test revealed very significant values for the same ($\chi 2$ = 69.7; df = 6; p <0.0001).

Left Hand :

As entailed in *Table 1*, the patterns were analysed and statistical reviews were conducted via 3 columns (sub-groups) x 4 rows (dermatoglyphic pattern) chi-square test, following were the results obtained.

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In the thumb, the maximum patterns displayed in patients with breast cancer were whorls with 64 (71.11%) patients, while in high-risk individuals arches were predominately found with 51 individuals and 61 (67.78%) normal individuals had whorls. Chi-square test on the left-hand thumb revealed highly significant values ($\chi 2 = 43.604$; df = 6; $p < 0.0001$).

On the index finger, it was found that in patients with breast cancer 74 (82.22%) had whorls, while in 53 (58.89%) high-risk individuals arches were found and 64 (71.11%) normal individuals had whorls. Chi-square test revealed favourably significant values related to the relative frequencies ($\chi 2 = 54.676$; df = 6; $p < 0.0001$).

In the middle finger, 71 (78.89%) patients with breast cancer displayed whorls, 55 (61.11%) high-risk individuals showed arches and 60 (66.67%) normal individuals had whorls. On univariate analysis, the relative frequencies unfolded highly significant values ($\chi 2 = 58.875$; df = 6; $p < 0.0001$).

For the ring finger, 68 (75.56%) breast cancer patients had whorls, while 58 (64.44%) high-risk individuals had arches and 60 (66.67%) normal individuals had arches. On analysing the chi-square test, highly significant values were obtained ($\chi 2 = 69.872$; df = 6; $p < 0.0001$).

Finally, in the little finger, the highest frequency of pattern found in the breast cancer sub-group was whorls with 73 (81.11%) patients, the high-risk individuals had maximum arches with 53 (58.89%) individuals and 60 (66.67%) normal individuals displayed arches. The chi-square test revealed very significant values for the same ($\chi 2 = 71.857$; df = 6; $p < 0.0001$).

Demographic details were used as independent variables to further analyse the importance of dermatoglyphic patterns amongst the various sub-groups.

Firstly, on comparison between age and the dermatoglyphic patterns in the three sub-groups, the following was found (mean age amongst all individuals was found to be: 51.78 ≈ 52 years across all sub-groups as they were age-matched). The cohort was divided into two groups according to age as depicted in *Table 2:*

a. >52 years: 48 members in each sub-group;

b. <= 52 years: 42 members in each sub-group;

Table 2 Comparison between age and dermatoglyphic patterns in the three sub-groups.(Average age found was: 51.78 ≈ 52 years)

Age	Hand	Finger Print	Breast Cancer Patients	High Risk Individuals	Normal Individuals	Chi-Square	Degrees of Freedom	P-value
<52	Right	Whorl	182 (75.83%)	67 (27.92%)	119 (49.58%)	125.22	6	<0.0001
		Arch	41 (17.08%)	160 (66.67%)	108 (45.00%)			
		Ulnar Loop	8 (3.33%)	5 (2.08%)	8 (3.33%)			
		Radial Loop	9 (3.75%)	8 (3.33%)	5 (2.08%)			
	Left	Whorl	196 (81.67%)	81 (33.75%)	130 (54.17%)	149.70	6	<0.0001
		Arch	24 (10%)	149 (62.08%)	94 (39.17%)			

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		Ulnar Loop	7 (2.92%)	8 (3.33%)	12 (5.00%)			
		Radial Loop	13 (5.42%)	2 (0.83%)	4 (1.67%)			
>=52	**Right**	**Whorl**	152 (72.38%)	60 (28.57%)	114 (54.29%)	89.271	6	<0.0001
		Arch	45 (21.43%)	137 (65.24%)	90 (42.86%)			
		Ulnar Loop	7 (3.33%)	6 (2.86%)	3 (1.43%)			
		Radial Loop	6 (2.86%)	7 (3.33%)	3 (1.43%)			
	Left	**Whorl**	155 (73.81%)	71 (33.81%)	108 (51.43%)	105.74	6	<0.0001
		Arch	27 (12.86%)	121 (57.62%)	95 (45.24%)			
		Ulnar Loop	13 (6.19%)	5 (2.38%)	1 (0.48%)			
		Radial Loop	15 (7.14%)	13 (6.19%)	6 (2.86%)			

For the cohort of individuals who were younger than the mean age (i.e. <52 years):

*Right Hand:*In the breast cancer patient sub-group, it was found that whorls predominated with 182 (75.83%) whorls across the age group. While in high-risk individuals, on the right hand, 160 (66.67%) arches were found to be the dominating group. Finally, the normal individuals displayed maximum whorls with 119 (49.58%) frequency followed very closely by arches with 108 (45.00%). On univariate analysis, highly significant values were found when measuring the age group (<52 years) with the frequency of qualitative dermatoglyphic patterns ($\chi 2$ = 125.22; df = 6; p <0.0001).

Left Hand: In the breast cancer patient sub-group, it was found that whorls predominated with a frequency of 196 (81.67%) whorls across the age group. While in high-risk individuals, on the left hand, 149 (62.08%) arches were found to be the dominating group. Finally, the normal individuals displayed maximum whorls with 130 (54.17%) frequency. Univariate analysis displayed highly significant values in comparison measuring the age group (<52 years) with the frequency of qualitative dermatoglyphic patterns ($\chi 2$ = 149.7; df = 6; p <0.0001).

For the cohort of individuals who were older than the mean age (i.e. >=52 years):

*Right Hand:*The breast cancer patient sub-group displayed a high frequency of 152 (72.38%) across the age group. While in high-risk individuals, on the right hand, 137 (65.24%) arches were found to be the dominating group. Finally, the normal individuals sub-group displayed maximum whorls with 114 (54.29%) frequency. Univariate analysis when measuring the age group (>=52 years) with the frequency of qualitative dermatoglyphic patterns was found to be highly significant ($\chi 2$ = 89.271; df = 6; p <0.0001).

Left Hand: In the breast cancer patient sub-group, it was found that whorls predominated with a frequency of 155 (73.81%) whorls across the age group. While in high-risk individuals, on the left hand, 121 (57.62%) arches were found to be the dominating group. Finally, the normal individuals displayed maximum whorls with 108 (51.43%) frequency followed closely by arches with 95 (45.24%). Univariate analysis depicted highly significant values in comparison measuring the age group (>=52 years) with the frequency of qualitative dermatoglyphic patterns ($\chi 2$ = 105.74; df = 6; p <0.0001).

Secondly, religion was taken as a demographic factor to compare the difference in the fingerprint

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patterns across the designated sub-groups as shown in *Table 3*.

Table 3 Comparison between religion and dermatoglyphic patterns in the three sub-groups.

Religion	Hand	Finger Print	Breast Cancer Patients	High Risk Individuals	Normal Individuals	Chi-Square	Degrees of Freedom	P-value
Hindu	Right	Whorl	308 (73.33%)	120 (28.57%)	206 (50.86%)	183.76	6	<0.0001
		Arch	86 (20.48%)	276 (65.71%)	182 (44.94%)			
		Ulnar Loop	14 (3.33%)	10 (2.38%)	9 (2.22%)			
		Radial Loop	12 (2.86%)	14 (3.33%)	8 (1.98%)			
	Left	Whorl	328 (78.10%)	144 (34.29%)	212 (52.35%)	223.77	6	<0.0001
		Arch	46 (10.95%)	250 (59.52%)	173 (42.72%)			
		Ulnar Loop	19 (4.52%)	11 (2.62%)	13 (3.21%)			
		Radial Loop	27 (6.43%)	15 (3.57%)	7 (1.73%)			
Muslim	Right	Whorl	26 (86.67%)	7 (23.33%)	27 (60%)	36.335	6	<0.0001
		Arch	0 (0.00%)	21 (70.00%)	16 (35.56%)			
		Ulnar Loop	1 (3.33%)	1 (3.33%)	2 (4.44%)			
		Radial Loop	3 (10.00%)	1 (3.33%)	0 (0.00%)			
	Left	Whorl	23 (76.67%)	8 (26.67%)	26 (57.78%)	21.893	6	0.0013
		Arch	5 (16.67%)	20 (66.67%)	16 (35.56%)			
		Ulnar Loop	1 (3.33%)	2 (6.67%)	0 (0.00%)			
		Radial Loop	1 (3.33%)	0 (0.00%)	3 (6.67%)			

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For the cohort of individuals who identified as Hindu:

*Right Hand:*The breast cancer patient sub-group displayed a high frequency of 308 (73.33%) among the members. While in high-risk individuals, on the right hand, 276 (65.71%) arches were found to be the dominating group. Finally, the normal individuals sub-group displayed maximum whorls with 206 (50.86%) frequency, closely followed by 182 (44.94%) arches. Univariate analysis when measuring the religion with the frequency of qualitative dermatoglyphic patterns was found to be highly significant ($\chi2$ = 183.76; df = 6; p <0.0001).

*Left Hand:*In the breast cancer patient sub-group, it was found that whorls highly predominated with a frequency of 328 (78.10%) whorls across the age group. While in high-risk individuals, on the left hand, 250 (59.52%) arches were found to be the dominating group. Finally, the normal individuals displayed maximum whorls with 212 (52.35%) frequency followed closely by arches with 173 (42.72%). Univariate analysis depicted highly significant values in comparison measuring the age group (>=52 years) with the frequency of qualitative dermatoglyphic patterns ($\chi2$ = 223.77; df = 6; p <0.0001).

For the cohort of individuals who identified as Muslim:

*Right Hand:*Breast cancer patients displayed a frequency of 26 (86.67%) among the 6 members who identified as Muslim. While in high-risk individuals, on the right hand, 21 (70.00%) arches were found to be the dominating group. Finally, the normal individuals sub-group displayed maximum whorls with 27 (60%). On conducting univariate analysis while measuring religion as a parameter with the frequency of qualitative dermatoglyphic pattern, it was found to be highly significant ($\chi2$ = 36.335; df = 6; p <0.0001).

Left Hand: In the breast cancer patient sub-group, it was found that whorls highly predominated with a frequency of 23 (76.67%) whorls across the age group. While in high-risk individuals, on the left hand, 20 (66.67%) arches were found to be the dominating group. The normal individuals displayed maximum whorls with a frequency of 26 (57.78%). Univariate analysis depicted significant values in measuring religion as a contributory parameter with the frequency of qualitative dermatoglyphic patterns ($\chi2$ = 21.893; df = 6; p=0.0013).

Thirdly, based on the workload in the occupation, the members were divided into 3 categories:Heavy duty, Moderate duty&Low duty.

As depicted in *Table 4*, significant results were attained in two groups which had significant results ($\chi2$ = 215.5; df = 6; p <0.0001) in the left hand of a frequency of 325 (78.31%) in the breast cancer group, 236 (59.00%) in the high-risk group and 214 (53.5%) in the normal individual group.

Table 4: Correlation between occupation and dermatoglyphic patterns in the three sub-groups.

Occupation	Hand	Finger Print	Breast Cancer Patients	High Risk Individuals	Normal Individual	Chi-Square	Degrees of Freedom	P-value
Heavy	Right	Whorl	16 (80.00%)	12 (40.00%)	17 (42.50%)	14.171	6	0.0278
		Arch	3 (15.00%)	18 (60.00%)	20 (50.00%)			
		Ulnar Loop	0 (0.00%)	0 (0.00%)	2 (5.00%)			
		Radial Loop	1 (5.00%)	0 (0.00%)	1 (2.50%)			
	Left	Whorl	15 (75.00%)	10 (33.33%)	18 (45.00%)	70.470	6	**<0.0001**
		Arch	4 (20.00%)	19 (63.33%)	20 (50.00%)			

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		Ulnar Loop	0 (0.00%)	1 (3.33%)	2 (5.00%)			
		Radial Loop	1 (5.00%)	0 (0.00%)	0 (0.00%)			
Moderate	**Right**	**Whorl**	305 (73.49%)	108 (27.00%)	211 (52.75%)	13.767	6	0.0323
		Arch	83 (20.00%)	268 (67.00%)	173 (43.25%)			
		Ulnar Loop	15 (3.61%)	10 (2.50%)	9 (2.25%)			
		Radial Loop	12 (2.89%)	14 (3.50%)	7 (1.75%)			
	Left	**Whorl**	325 (78.31%)	138 (34.50%)	214 (53.5%)	215.50	6	**<0.0001**
		Arch	44 (10.6%)	236 (59.00%)	166 (41.5%)			
		Ulnar Loop	20 (4.82%)	11 (2.75%)	10 (2.50%)			
		Radial Loop	26 (6.27%)	15 (3.75%)	10 (2.50%)			
Low	**Right**	**Whorl**	13 (86.67%)	7 (35.00%)	5 (50.00%)	15.237	6	0.0185
		Arch	0 (0.00%)	11 (55.00%)	5 (50.00%)			
		Ulnar Loop	0 (0.00%)	1 (5.00%)	0 (0.00%)			
		Radial Loop	2 (13.33%)	1 (5.00%)	0 (0.00%)			
	Left	**Whorl**	11 (73.33%)	4 (20.00%)	6 (60.00%)	15.411	6	0.0173
		Arch	3 (20.00%)	15 (75.00%)	3 (30.00%)			
		Ulnar Loop	0 (0.00%)	1 (5.00%)	1 (10.00%)			
		Radial Loop	1 (6.67%)	0 (0.00%)	0 (0.00%)			

4. Discussion:

This study set out to emphasise the importance of early diagnosis amidst the rising prevalence of breast cancer across the world. Most of the current techniques of diagnosis either prove to be very expensive or might not be available for the common person in a rural setting[2]. Therefore fingerprints or dermatoglyphics come as a much-needed respite to the problem. Dermatoglyphics prove to be non-invasive, cheap and easily reproducible in remote areas. The genetic linkage of mutations associated with dermatoglyphics and breast cancer also gives thorough backing for it as a predictability model[8].

A study conducted in India by Sridevi NS, et. Al.[9] which found statistically significant differences in the fingertip pattern (qualitative) in cases of breast cancer compared to the control

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group. This, therefore, draws conjectures into the possibility of genetic influences on the dermal patterns in breast cancer and could be employed as a risk assessment strategy for non-symptomatic women.

Screening techniques have always been employed to accurately detect breast cancer. Mammography has been known to be the gold standard due to its noninvasive, relatively inexpensive, and reasonable sensitivity[7]. Yet, studies have indicated that the effectiveness of this cancer screening modality has declined in recent times. Despite 20-30 years of mammography screening, mortality rates have not decreased with problematic over-diagnoses[10]. Therefore, the recommendations by Autier P. et. al. delve into the need to find a novel and efficacious method for breast screening.

This is where dermatoglyphics come into play. Due to the polygenic inheritance of these patterns, they can be closely related to other diseases which are incumbent on genetic factors. In suspicion of a specific mutated gene, testing for other individualised genes should be exerted. One such is breast cancer which has been documented to a myriad of highly penetrant genes such as BRCA1, BRCA2, PTEN, TP53, CDH1, STK11, etc.[11] while the other is dermatoglyphics. These patterns have also been a predictive factor for genetically inheritable diseases such as Down's syndrome and Klinefelter's syndrome. Quantitative dermatoglyphics such as ridge count has been the foremost factor for predicting thalassemia, thyroid and gynaecological cancers[12]. Therefore this study implores studying the effectiveness of the predictive modality, qualitative dermatoglyphics, in breast cancer patients when compared to age-related normal, and high-risk individuals.

The fingerprint has been described as an easily affordable marker to detect susceptible individuals. The current rise in Artificial Intelligence (AI) has also drawn significant attention as a predictable mode for breast cancer risk with greater accuracy[13]. AI and dermatoglyphics therefore could work in a combined method for - early diagnosis and treatment - secondary prevention of breast cancer.

This study, therefore, highlighted the importance of the qualitative patterns configured across three sub-groups. The frequencies of whorls in breast cancer patients on both hands as entailed in the result section in comparison to the high predominance of arches on both hands in high-risk patients underscores the significance of dermatoglyphics in breast cancer by other studies[5].

Certain demographic factors such as age, occupation and religion have been highly influential parameters for breast cancer[14]. These factors are also highly dependent on the individual's environmental attributes and conditional development [3]. Therefore dermatoglyphics proves to be a stable parameter and an effective one at that when considering digital patterns.

5. Limitations:

Although this study might have identified whorls as the predominating pattern with higher frequency in both hands for breast cancer patients and arches for high-risk individuals, the consistency might vary from place to place due to differing dermatoglyphic according to ethnicities as mentioned by Ojigho EJJ. et. al.[15].

Another limitation found was that a small number of patients who were receiving chemotherapy had experienced a loss of fingerprints or expressed very faint fingerprints which were difficult to perceive. On reviewing the literature, it was found that similar chemotherapy-induced adermatoglyphia was found in other patients too[16]. These patients were not included in the study to ensure maximum efficacy in interpreting the dermatoglyphics.

6. Conclusion:

Most breast cancer patients are diagnosed late with more than half of the patients presenting to doctors in advanced stages where survival rates are marginal, so by this method, we can get a simple, practical, non-invasive and easily affordable screening technique to serve the purpose. This technique could also be employed for non-symptomatic women who might have a positive family history of breast cancer as a part of risk assessment for early diagnosis and treatment.

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