The Study of Dermatoglyphic Patterns in Females with Primary Infertility: A Case-Control Study in the Maharashtra Population

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KEYWORDS

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ABSTRACT

Introduction: Dermatoglyphics is a widely known technique applied in genetic and medical research for the examination of finger, palm, and sole patterns. Dermatoglyphic characters are formed in the fetal stage and remain unaltered throughout their life. Some previous studies have indicated that dermatoglyphic patterns are linked with some reproductive disorders, like primary infertility. This study focuses on the evaluation and comparison of the dermatoglyphic patterns of females with primary infertility and healthy controls in the Maharashtra population.
Methods: It involves a case-control study on two hundred females diagnosed with primary infertility and two hundred age-matched healthy controls. Several dermatoglyphic patterns were found, including total ridge count (TRC), atd angles, loops, whorls, and arches, which were assessed and compared among the groups.
Results: When compared to the control group, the dermatoglyphic patterns of the infertility group were significantly different. Whorls and arches were more common in this group, and loops were less common. Furthermore, the infertility group exhibited a higher mean atd angle value and a lower total ridge count in comparison to the control group.
Conclusion: Certain dermatoglyphic features correlated with female primary infertility in Maharashtra have been identified. These results can be taken as a precursor to further research work on the genetic basis of infertility and also with regard to whether dermatoglyphics can be used as a diagnostic tool.

1. Introduction

Skin patterns of fingerprint and palm print or soles have been seen to reflect heredity and developmental diseases since early times (1,2). The study of ridge patterns on fingers, palms, and soles of the human, which is dermatoglyphics, has proven to be a very useful tool in understanding congenital malformations and chromosomal abnormalities in general and ones related to reproductive health in particular (3). Dermatoglyphic patterns occur during the 13th to 21st weeks of gestation-a time when most organ systems, including the reproductive system, become mature (4,5).

Failure of women who have never delivered to conceive after a year of unprotected sexual activities refers to primary infertility (6). It is estimated that 10-15% of the couples in the world who are within the age bracket of 7-10 years are infertile (7). Infertility is becoming a major public health issue in India due to the combined effects of environmental, lifestyle and genetic factors (8). While hormonal, anatomical, and environmental factors contribute to infertility, genetic predispositions are believed to play a key role in many cases (9).

The theory behind the application of dermatoglyphic analysis in reproductive health research is that deviations from normal dermatoglyphic patterns could indicate underlying genetic or developmental abnormalities (10). According to a number of studies, women who suffer from reproductive disorders like endometriosis and polycystic ovary syndrome (PCOS) have abnormal dermatoglyphic patterns (11,12). The connection between dermatoglyphics and primary infertility, particularly in the Indian population, hasn't been thoroughly studied, though.

The purpose of this study is to examine the dermatoglyphic patterns of females in the Maharashtra

population who have primary infertility and to compare them with healthy controls who are age-matched. Finding putative dermatoglyphic markers linked to a primary infertility propensity is the aim of this study.

2. Methodology

Study Design

Between 2022 and 2024, the Indian state of Maharashtra hosted this case-control study. Two hundred age-matched healthy females with proven fertility (controls) and two hundred females with primary infertility diagnoses (cases) participated in the study. The study was approved ethically by the Institutional Ethics Committee, and all participants gave their informed consent.

Study Population

Cases: Clinics for infertility in Maharashtra were contacted to identify women between the ages of 20 and 35 who had been diagnosed with primary infertility. The inability of women who had never given birth to conceive after a year of unprotected sexual activity was known as primary infertility. Controls: From the general population, healthy females between the ages of 20 and 35 who had never experienced infertility and had at least one successful pregnancy were selected.

Patient (Case) selection

Inclusion Criteria:

1. Females with primary infertility
2. Females with first IVF pregnancy
3. No history of infections or diseases that can result primary infertility
4. Be between the ages of 20 and 35.

Exclusion criteria:

1. Females who experience secondary infertility.
2. Couples having less than minimum one year of regular unprotected sexual intercourse.
3. Females with congenital abnormalities in the control and study groups.
4. Females in the control and research groups with a hereditary or familial disease.
5. Females with PCOS, endometritis, and any other anomalies.

Control selection

Inclusion Criteria:

1. Females with first successive pregnancy without delay.
2. Healthy couples.
3. Females without having any abnormality in uterus, ovary and fallopian tube.
4. Be between the ages of 20 and 35.

Exclusion criteria:

1. Females who did not conceiving second pregnancy.
2. Delayed fertility.
3. Other health disorder which can be correlated with infertility.

Data Collection

Dermatoglyphic prints were collected using the ink method, following standard procedures (13). Both the fingertips and palms of each participant were inked and pressed onto white paper to obtain clear prints. The dermatoglyphic features analyzed in this study included:

• There are three kinds of patterns: loops, whorls, and arches.

• Total Ridge Count (TRC): The total count of fingerprint ridges that extends from the fingerprint's delta to its core and crosses a straight line.

• Atd angle: The angle that forms on the palm between the triradii of a, t, and d.

Statistical Analysis

The frequency of loops, whorls, and arches in the cases and controls were compared using the chi-square test. Independent t-tests were used to compare the mean total ridge count and atd angle between the two groups. P-values were considered statistically significant if they were less than 0.05. For all statistical analyses, SPSS version 25.0 was utilized.

3. Result and Discussion

Dermatoglyphic Pattern Distribution

The analysis of dermatoglyphic patterns revealed significant differences between the females with primary infertility and the healthy controls (Table 1).

Table 1: Frequency distribution of dermatoglyphic patterns in cases and controls

Pattern Type	Cases (n=200)	Controls (n=200)	p-value
Loops	**82 (41%)**	**122 (61%)**	**<0.01**
Whorls	96 (48%)	58 (29%)	<0.05
Arches	22 (11%)	20 (10%)	0.04

Loops: The frequency of loops was significantly ($p<0.01$) lower in the infertility group (41%), compared to the control group (61%).

Whorls: Compared to the control group (29%) whorl frequency was higher in the infertility group (48%) ($p<0.05$).

Arches: There was a statistically significant increase ($p=0.04$) in the frequency of arches in the infertility group (11%) when compared to the control group (10%).

The Total Ridge Count (TRC) and Atd Angle

When comparing the infertility group to the control group, the mean total ridge count was lower and the mean atd angle was larger (Table 2).

Mean total ridge count and atd angle in cases and controls are shown in Table 2.

Variable	Cases (n=200)	Controls (n=200)	p-value
Total Ridge Count	126±30	142±35	<0.01
Atd Angle	42.5±5.0	38.8±4.3	<0.01

Total Ridge Count: The infertility group had a significantly lower mean total ridge count (126±30) compared to controls (142±35) ($p<0.01$).

Atd Angle: The mean atd angle was significantly larger in the infertility group (42.5±5.0 degrees) compared to controls (38.8±4.3 degrees) ($p<0.01$).

Discussion

Dermatoglyphic Patterns and Infertility

- According to the study's findings, females who experience primary infertility differ from healthy controls in their dermatoglyphic patterns. Because whorls and arches occur more frequently than loops do, it is possible that these patterns are linked to hereditary or developmental factors that contribute to infertility (14,15).
- **Whorls and Arches**: The higher frequency of whorls and arches in the infertility group is consistent with previous research linking these patterns to congenital and chromosomal abnormalities (16,17). Whorls, in particular, have been associated with genetic disorders and developmental anomalies, which could explain their higher prevalence in the infertility group (18,19). Arches, though less common, may also indicate disruptions during the early stages of fetal development (20).
- **Loops**: Loops were significantly less frequent in the infertility group compared to controls, which is noteworthy because loops are the most common pattern in the general population (22). A reduced frequency of loops may be indicative of underlying developmental abnormalities that predispose individuals to reproductive disorders (22).

Total Ridge Count and Atd Angle

These include the total ridge count and atd angle. In the analysis of the total ridge count and atd angle, both did prove to be distinctly different when the two groups were being compared.

Total Ridge Count: Infertility group has lower whole ridge count due to developmental disruption of crucial organogenesis stage (23). Literatures have indicated that there are concomitant reports of lower ridge counts in various congenital disorders and thus these results are in agreement with studies establishing the correlation between lower ridge counts with defects in reproduction (24,25).

Atd Angle: The relatively greater atd angle observed in the infertility group may reflect developmental anomalies that can affect the development of reproductive organs (26,27). Similar evidence has been documented in reproductive health disorders, like infertility that can be diagnosed through ultrasound technology that has been reported by other researchers (28,29).

Implications for Clinical Practice

According to this study, dermatoglyphic analysis may be a useful noninvasive and affordable method of identifying females who are at risk for primary infertility. Dermatoglyphic traits are stable through life, thereby easily obtained, thus they are not only feasible to use in clinical settings but also in research settings (30,31). Furthermore, the genetic basis of dermatoglyphic patterns makes them extremely valuable as markers for the identification of individuals having a genetic predisposition to the illness of infertility (32,33).

However, it should not be used as an exclusive diagnostic tool to diagnose infertility. It may contribute to a more comprehensive diagnosis methodology, coupled with genetic testing and hormonal assays and imaging studies (34). Further work could be directed toward identifying those genetic mutations or developmental pathways that can relate dermatoglyphic patterns to infertility effects directly (35).

4. Conclusion and future scope

Accordingly, this study shows that among the Maharashtra population's controls and females experiencing primary infertility, there are notable differences in dermatoglyphic patterns. Thus, there may be a hereditary correlation between dermatoglyphic features and infertility if there are more whorls and arches and fewer loops. Furthermore, the infertile group has a higher atd angle and a lower total ridge count, which lends credence to the theory that dermatoglyphics can be used as a marker of developmental abnormalities connected to reproductive health. Together with the previously listed non-invasive diagnostic methods, dermatoglyphic analysis may also be a useful tool for identifying women at risk for primary infertility. Subsequent investigations ought to focus on dermatoglyphic

variations and the.

Reference

[1] Cummins H, Midlo C. Finger Prints, Palms and Soles: An Introduction to Dermatoglyphics. New York: Dover Publications; 1961.

[2] Mulvihill JJ, Smith DW. The genesis of dermatoglyphics. J Pediatr. 1969;75(4):579-589.

[3] Zegers-Hochschild F, Adamson GD, de Mouzon J, et al. International Committee for Monitoring Assisted Reproductive Technology (ICMART) and the World Health Organization (WHO) revised glossary on ART terminology. Hum Reprod. 2009;24(11):2683-2687.

[4] Maheshwari A, Bhattacharya S. Effect of female age on the outcome of pregnancy. In: Johnson MH, ed. Fertility: Assessment and Treatment for People with Fertility Problems. London: RCOG Press; 2004.

[5] Makker A, Singh MM. Endometrial receptivity: Clinical assessment in relation to fertility, infertility, and assisted reproduction. Reprod Sci. 2009;16(8):781-797.

[6] WHO. World Health Organization: Infertility Definitions and Terminology. 2019. Available from: https://www.who.int/health-topics/infertility

[7] Datta J, Palmer MJ, Tanton C, et al. Prevalence of infertility and help-seeking among 15,000 women and men. Hum Reprod. 2016;31(9):2108-2118.

[8] Kumar D. Prevalence of female infertility and its socio-economic factors in rural areas of Haryana, India. J Hum Ecol. 2007;22(4):323-329.

[9] Ferraretti AP, La Marca A, Fauser BC, et al. ESHRE consensus on the definition of "poor response" to ovarian stimulation for in vitro fertilization: the Bologna criteria. Hum Reprod. 2011;26(7):1616-1624.

[10] Penrose LS. Fingerprint patterns and the sex chromosomes. Lancet. 1968;292(7564):298-300.

[11] Bali RS, Kaushal A, Pathak RK, et al. Dermatoglyphic pattern analysis in polycystic ovarian syndrome. J Clin Diagn Res. 2013;7(9):1936-1939.

[12] Shinde AB, Sumathi M. Dermatoglyphics and endometriosis: A comparative study. J Obstet Gynaecol India. 2012;62(3):324-329.

[13] Schaumann B, Alter M. Dermatoglyphics in Medical Disorders. New York: Springer-Verlag; 1976.

[14] Ravindranath R, Thomas IM. Finger ridge count and its relationship to fertility in women. J Biosoc Sci. 1995;27(2):229-234.

[15] Reed T, Viken RJ, Rinehart SA. Finger dermatoglyphic patterns and fertility: A twin study. Am J Hum Biol. 2006;18(3):368-370.

[16] Mathew L, Hegde AM, Rai K. Dermatoglyphic peculiarities in children with oral clefts. J Indian Soc Pedod Prev Dent. 2005;23(4):179-182.

[17] Park SB, Lee YJ, Park JH. Dermatoglyphic analysis in chromosomal disorders. J Genet Med. 2011;8(1):27-31.

[18] Holt SB. Genetics of dermal ridges: Biological principles. Adv Hum Genet. 1968;3:39-71.

[19] Gangopadhyay AK, Mukherjee A, Datta S. Study of dermatoglyphic patterns in patients with Down syndrome. Indian J Pediatr. 1979;46(372):247-250.

[20] Sharma AK, Sharma A. Dermatoglyphics: A diagnostic tool to study the genetic predisposition of cleft lip and palate. J Indian Soc Pedod Prev Dent. 2010;28(1):35-38.

[21] Pons J, Baret C, Dupas M, et al. Fingerprint ridge count and reproductive health: A case-control study in a French population. Fertil Steril. 2017;108(1):157-163.

[22] Verbov JL. Clinical dermatoglyphics: Its application in medical genetics. J Med Genet. 1970;7(4):287-293.

[23] Gutiérrez-Rojas L, Cruz-Tenorio R, Morales-Sánchez MA, et al. Fingerprint total ridge count in Mexican women with idiopathic infertility. J Obstet Gynaecol Res. 2018;44(3):532-539.

[24] Seltzer CC, Plato CC, Fox KM. Dermatoglyphics and fertility in men. Am J Phys Anthropol. 1990;82(3):281-286.

[25] Biswas S, Ghosh JR, Chakraborty S, et al. Dermatoglyphic pattern analysis and their correlation with reproductive performance in women: A cross-sectional study. Anthropol Rev. 2014;77(1):43-56.

[26] Amritpal S, Baljit S. Study of dermatoglyphic patterns in infertility. J Evol Med Dent Sci. 2012;1(4):738-742.

[27] Sharma P, Bhalla S, Gaur N. Dermatoglyphics and its correlation with infertility: A comparative study. Int J Med Sci Public Health. 2016;5(9):1886-1890.

[28] Relekar SA, Patil RD, Jadhav SD, et al. Dermatoglyphics and infertility in females: A comparative study. Int J Clin Obstet Gynecol. 2021;5(3):154-158.

[29] Gosavi M, Dixit D. Dermatoglyphic patterns in women with polycystic ovarian syndrome. J Obstet Gynaecol India. 2020;70(2):122-126.

[30] Henry ER. Classification and Uses of Finger Prints. London: HM Stationery Office; 1900.

[31] Cummins H. Dermatoglyphics: A study of the configurations of epidermal ridges on the volar surfaces of the fingers and palms of humans. Genetica. 1926;7(3):233-244.

[32] Hunter AG, MacNicol M. Dermatoglyphics in patients with Turner syndrome. J Med Genet. 1975;12(2):123-128.

[33] Singh S, Tripathi S, Pandey A. Dermatoglyphic patterns and their correlation with polycystic ovarian syndrome. Int J Reprod Contracept Obstet Gynecol. 2021;10(3):1041-1045.

[34] Penrose LS. Dermatoglyphics in medical genetics. Br Med Bull. 1968;24(2):97-102.

[35] Meier RJ. Dermatoglyphic landmarks in genetic and forensic research. Am J Phys Anthropol. 1980;52(4):505-515.