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Malaria Detection Using Fingerprint Patterns: A Descriptive Study of Malaria-Positive Individuals in Nasarawa State, Nigeria

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ABSTRACT

Malaria detection remains a primary concern in most endemic regions of the world due to poor health care delivery. This study investigated the relationship between fingerprint patterns and malaria susceptibility in patients with Plasmodium falciparum infections. Giemsa's staining and live scan techniques were used for sample collection. A total of 384 individuals confirmed with malaria were enrolled for this study. Our findings revealed a dominance of loop patterns (52.1%) in the sampled population, followed by whorls (29.4%) and arches (18.5%). Though, the distribution of the fingerprint patterns against malaria were not significant, individuals with loop fingerprint pattern were more prone to malaria infection. The study suggests a potential link between fingerprint patterns and malaria susceptibility, with implications for the use of fingerprint analysis as a detective tool or additional screening tool both for malaria and other clinical infectious diseases. Further research is needed to confirm these findings and explore the potential applications of fingerprint pattern analysis in early disease diagnosis and prevention.

INTRODUCTION

Malaria remains the most clinically infectious, life-threatening mosquito-borne disease that has plagued humanity for centuries. According to the World Health Organization (WHO), the African region accounted for 94% of malaria cases and 96% of deaths in 2022 (WHO, 2023). Globally, it is estimated that 627,000 deaths occurred in 2021 (WHO, 2022), though this represents a small fraction of the over 200 million clinical cases that occur annually. New data from the World Health Organisation (WHO) revealed that an estimated 263 million malaria cases and 597,000 malaria deaths occurred worldwide in 2023 (WHO, 2024). This marks an increase of approximately 11 million cases when compared to 2022, with nearly the same number of deaths reported (WHO, 2023). Nigeria has the largest malaria burden in Africa and globally, with an estimated 66.7 million malaria cases in 2022, representing 27% of global malaria cases and 31% of deaths (WHO, 2023). The severe form of malaria caused 189,321 deaths in Nigeria in 2022, with approximately 80% occurring in children under 5 years of age, accounting for 39% of global malaria deaths in this age group (WHO, 2023). Thus, addressing this dreaded disease called malaria, particularly in the ever-growing population, remains a major health concern for the country.

Among the species of Plasmodium that infect humans, P. falciparum remains the most notorious, followed by P. vivax, with weaker contribution by P. ovale, P. malarae, and P. knowlesi (Okagu *et al.*, 2022). Upon injection into the host, the Plasmodium Parasites (MPs) flow through the bloodstream and migrate into the human host's liver and infect the hepatocytes. They then develop into schizonts and release many merozoites into the bloodstream to infect erythrocytes. Most of the pathological effects of malaria infection are accrued to the erythrocytic life cycle stage (Chandley *et al.*, 2023).

In addition to its health impact, malaria imposes a significant economic burden worldwide. Total funding for malaria control and elimination was estimated at $3.3 billion in 2020, with contributions from the governments of endemic countries totaling $1.1 billion, representing 33% of the total (WHO, 2022). The World Health Organization guidelines recommend microscopy testing as the gold standard for prompt diagnosis, closely followed by rapid diagnostic testing (RDT). Artemisinin-based combination therapy (ACT) remains effective for the treatment of malaria confirmed cases as it reduces the burden of the disease, transmission and prevention of deaths caused by the deadly parasite (WHO, 2021; WHO Guideline, 2022). However, in the underdeveloped countries such as Nigeria, diagnostic challenge persists due to the unavailability of skilled and experienced laboratory personnel, coupled with the dilapidated health infrastructure. This calls for novel approaches such as the use of fingerprint pattern in the diagnosis of the disease. This approach is devoid of the invasive use of blood testing mechanism in detecting a person's susceptibility to the malaria parasite.

Man's curiosity in the field of dermatoglyphics dates back through centuries, when the Chinese used it as a basis for fortune telling. About the same period, ancient Indians

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believed that the presence of ten whorls destined a person to be a 'Chakravarti' meaning "an emperor"(Athanikar, 1986, Lakshmi and Thenmozhi, 2014).

Dermatoglyphics/dactylography/dactyloscopy is the scientific study of epidermal ridge pattern on fingers, palm, and soles. The word Dactylography is taken from two Greek words, daktylos meaning finger and graphein meaning to write (Karmakar, 2007). This epidermal ridge develops due to friction (Mathiharan and Patnaik, 2005). The fingerprint is an impression of these friction skin ridges which is taken upon unglazed paper with the help of printer's ink (Vij, 2011). Identification means determination of individuality of a person. It may be complete (absolute) or incomplete (partial). It is used for personal identification, diseases condition, and in solving disputed paternity (Sontakke, 2018).

Fingerprint is an impression made by the papillary ridges on the ends of the fingers and thumbs. Fingerprints afford an infallible means of personal identification, because the ridge arrangement on every finger of every human being is unique and does not alter with growth or age. Fingerprints serve to reveal an individual's true identity despite personal denial, assumed names, or changes in personal appearance resulting from age, disease, plastic surgery, or accident. The practice of utilizing fingerprints as a means of identification, referred to as dactyloscopy, is an indispensable aid to modern law enforcement (Edgar, 2021).

The study of finger print is well documented on a number of important roles it plays in gender, age group classification, screening for abnormal anomalies, diagnosis of different diseases with genetic basis and relation to blood group system in some parts of the world (Paul & Lourde, 2006; Fayrouz *et al.*, 2012; Lakshmi & Thenmozhi, 2014). Studies have shown that there is a relationship between fingerprint pattern, various genetic factors and susceptibility to severe P. falciparum infection (Drouet, 2019; Mairiga *et al.*, 2023). There is however limited information reported on the place of fingerprint and infectious diseases. Due to the immense potentials of fingerprint as an effective means of identification, the need to explore the relationship between fingerprint patterns and common clinical disease like malaria susceptibility is imperative.

This work is therefore aimed at exploring the use of fingerprint pattern, a technique that is constant, individualistic, and easy to accomplish to determine an individual's susceptibility to malaria infection. The study and insight will enhance the skills and proficiencies of our laboratory scientist and physicians in predicting patients' status of infectious and other common clinical diseases without the conventionally invasive hematological and or pathological techniques. The outcome of this study will offer analysts and researchers the opportunity to use fingerprint analysis as a perspective to further establish individuals' uniqueness in the biomedical field.

MATERIALS AND METHODS

Study design

The study site was Nasarawa State. Nasarawa State with 13 local government areas is one of the 36 states in Nigeria and is situated in the North-Central geopolitical zone of Nigeria, bordering the Federal Capital Territory (FCT) to the north, Kaduna State to the northwest, Plateau State to the northeast, Taraba State to the east, and Benue State to the South. The state capital is Lafia, which is also the largest city. The state has an area of 26256km2 and a population of about 1,826883 at the 2006 census (Wikipedia, 2015), though is currently projected to be about 2,886,000 (Projection, 2022).

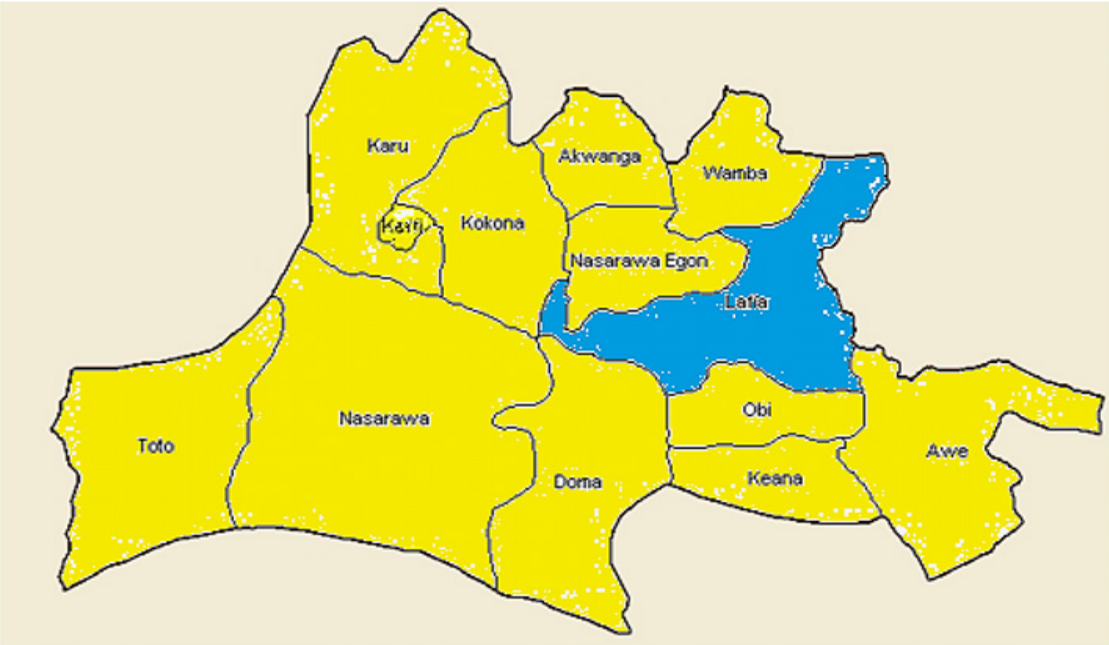

Figure 1: Map of Nasarawa State showing study area (source: Google screenshot)

Ethical approval and consent

Ethical approval was obtained from the Nasarawa State Health Research Ethics Committee (NHREC Protocol No: 18/06/2017) while oral consent was obtained from the subjects who offered to participate in the study upon meeting the criteria for the selection.

Sample Size

The sample size was calculated with a 95% Confidence Interval (CI) and precision level of 5% using the standard sample size calculation formula described by Naing *et al.*, (2006).

$n = Z2P(1 - P)/d2$

Where:

n = Sample size if the target population is > 10,000

Z = Z statistic for a level of confidence (For 95% confidence level, Z = 1.96)

P = Expected prevalence or proportion (in proportion of one; if 50%, P = 0.5) and

d = Precision (in proportion of one; if 5%, d = 0.05).

Given that Z = 1.96, P = 0.5, d = 0.05 and substituting the values, sample size was calculated thus:

n = 1.96 x 1.96 x 0.5 (1 – 0.5) ÷ 0.05 x 0.05

n = 3.8416 x 0.5 x 0.5 ÷ 0.0025

n = 0.9604 ÷ 0.0025

n = 384.16

Approximately, 384 positive samples were collected and used for the study.

A total of 384 malaria patients confirmed with Plasmodium falciparum after diagnoses in hospitals in the three senatorial zones who volunteered to participate were included in this study.

Sample Collection and analysis

Blood sample was collected by Medical Laboratory Scientist using venipuncture technique. The arm of the patient was tied with a tourniquet and the position of the veins was disinfected using a swab soaked in methylated spirit. Blood was collected into ethylene diamine tetraacetic acid (EDTA) tube and was transported to the hematology unit of the laboratory for analysis.

Malaria parasite detection and count

Thick and thin blood film smear were made to determine the parasite density as described by WHO criteria for malaria parasite density (WHO, 2000; Cheesebrough, 2005). Thin film was made to identify the species of the malaria parasite (Cheesebrough, 2005).

Changes in parasitized red blood cells help to identify plasmodium species and to detect mixed infection of malaria parasite. The number of asexual P. falciparum and other species per 100 leukocytes were counted and if ten or more parasites were identified, then the number was recorded, a blood sample was regarded as negative if the examination of thick films failed to show the presence of asexual parasites. The parasite count in relation to the leukocyte count was converted to parasite per micro liter of blood (assuming 6000 leukocytes per micro liter of blood) using the formula below:

$$\text{Parasites/}\mu\text{l of blood} = \frac{\text{No. of parasites counted x 6000}}{\text{No. of leukocyte counted}}$$

Fingerprint collection and analysis

The fingerprints of all malaria-confirmed patients were collected and analyzed using a live scan method as illustrated by Cummins and Midlo (1943). The fingerprint patterns (loops, whorls, and arches) were analyzed since they were more visible to human eyes. Fingerprint analysis process 'ACE-V (analysis, comparison, evaluation and verification) was used to reach a determination on each print. Loops for instance were accessed as the most ordinarily up-to-the-minute highlights on a person's fingerprints whose edges starts trickling out of a crosswise of the fingertip, circle from place to place the focal point of finger cushion, and back to a similar course where they began from. Because of an individual area of arm bones Radia and Ulna, any loop opening endlessly from thumb is an ulnar loop, and the one which opens near the thumb is a radial loop (Hsieh *et al.*, 2003; Hoover, 2012). The arches were assessed as tented patterns that are portrayed by a straight upstanding edge at the center of a straightforward arch pattern (Kanchan and Chattopahyay, 2006; Jain, 2015). While the whorls are portrayed by two deltas and one focal roundabout center which may come in various forms as winding, concentric circles, vertically compact circles or the state of eye of a peacock quill. The edges start from one end, rise and hover towards the middle and go down towards the opposite end (Imaq, 2004; Hoover, 2012).

Figure 2: Loop

Figure 3: Whorl

Figure 4: Arch

Statistical Analysis

All data were inputted into Microsoft Excel then exported to SPSS version 21.0 (SPSS, Chicago, IL, USA) for descriptive analysis. Pearson's chi-square test was used to determine the association between fingerprint pattern, demographic factors and the malaria parasite. Correlation test was conducted to calculate and compare the categorical variables. Graphs were represented using descriptive bar charts to display association where necessary. P values < 0.05 were considered statistically significant at a confidence interval of 95%.

RESULTS AND DISCUSSIONS

Distribution of Malaria in relation to gender and age

The results of this study are represented in a table and in figures as shown below. A total number of 384 individuals infected with malaria were considered for this study. The gender distribution of the participants reveals that there were more females (59.9%) than males (40.1%). Regarding age, majority (38.5%) of the individuals were between the age of 21-30 years, followed by those aged 31-40 (27.3%); as shown in table 1.

Table 1: Distribution of Malaria Infection by Gender and Age

Characteristics	Frequency(number)	Percentage(%)
Gender		
Female	230	59.9
Male	154	40.1
Age (years)		
10-20	39	10.2
21-30	148	38.5
31-40	105	27.3
41-50	44	11.5
51-60	37	9.6
61-70	11	2.9

The distribution of malaria infection by gender and age is shown in Table 1 above. Females were more infected than males, and the age group 21-30 years had the highest infection rate in the study (see Figure 5 and Figure 6 for details).

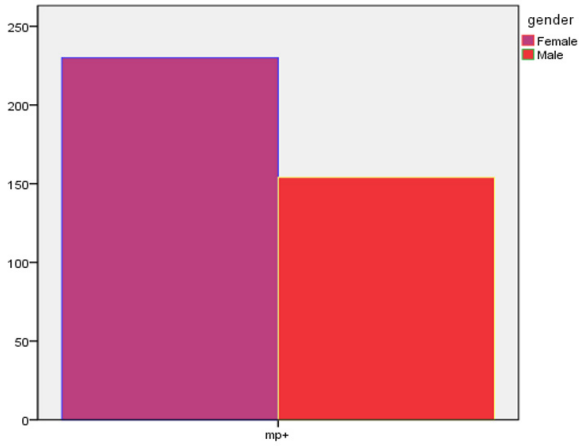

Figure 5: Gender Distribution in the sampled Malaria population

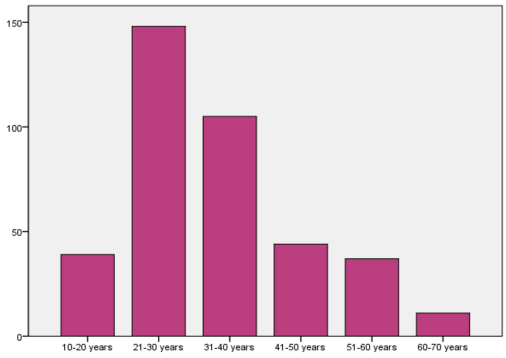

Figure 6: Age distribution in the malaria population

Distribution of fingerprint patterns in the sampled population

The distribution of fingerprint pattern in the sampled malarious population showed 200(52.1%) loop, 113(29.4%) whorl and 71(18.5%) arch respectively as shown in figure 7.

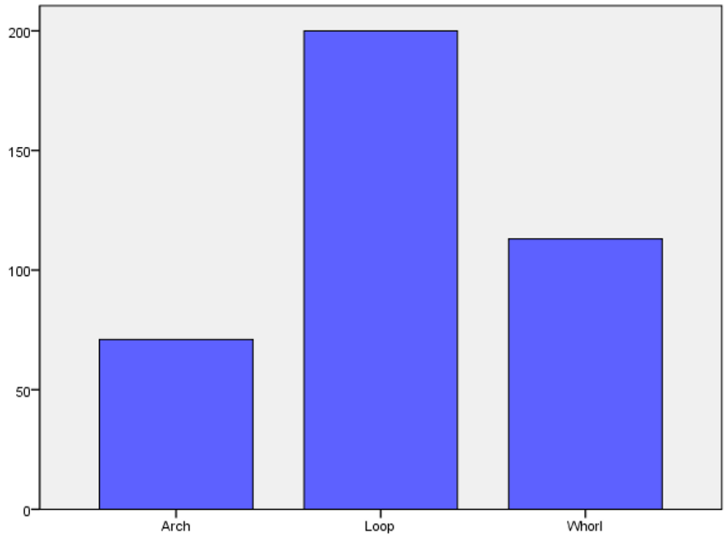

Figure 7: Distribution of fingerprint pattern in the malaria population

Distribution of fingerprint pattern in relation to gender status of the malaria population

They are a total number of 230(59.1%) females and 154(40.1%) males. The distribution of fingerprint pattern in females are 123(53.5%) loop, 60(26.1%) whorl and 47(20.4%) arch while the distribution of fingerprint pattern in males are 77(50.0%) loop, 53(34.4%) whorl and 24(15.6%) arch respectively (Figure 8). A Pearson chi-square value of 3.562 and non-significant p-value of 0.168 were obtained.

Distribution of age groups in fingerprint pattern of malaria individuals.

The association between the fingerprint pattern and the age groups of individuals in the sampled malaria population is shown in figure 9. The outcome revealed that individuals within the age range 10-20 years had 17(43.6%) loop, 14(35.9%) whorl and 8(20.5%) arch. 21-30 years were 76(51.4%) loop, 45(30.4%) whorl and 27(18.2%) arch. 31-40 years had 54(51.4%) loop, 34(32.4%) whorl and 17(16.2%) arch. 41-50 years had 25(56.8%) loop, 9(20.5%) whorl and 10(22.7%) arch. 51-60 years had 21(56.8%) loop, 7(18.9%) whorl and 9(24.3%) arch. 60-70 years had 7(63.6%) loop and 4(36.4% whorl respectively. A Pearson chi-square value of 8.411 and non-significant p-value of 0.589 were obtained.

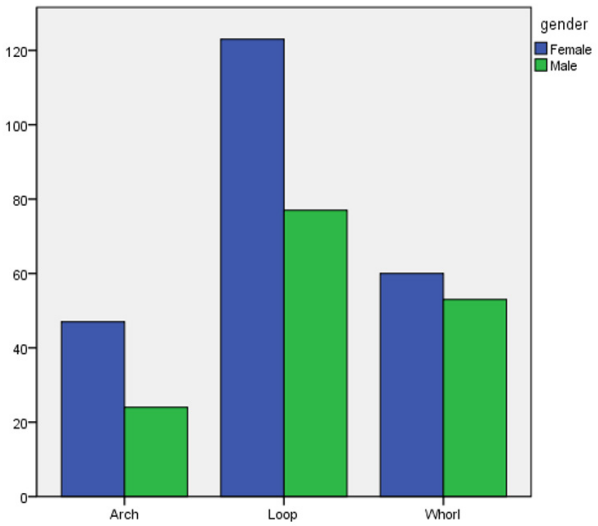

Figure 8: Gender distribution of fingerprint patterns in the sampled malaria population

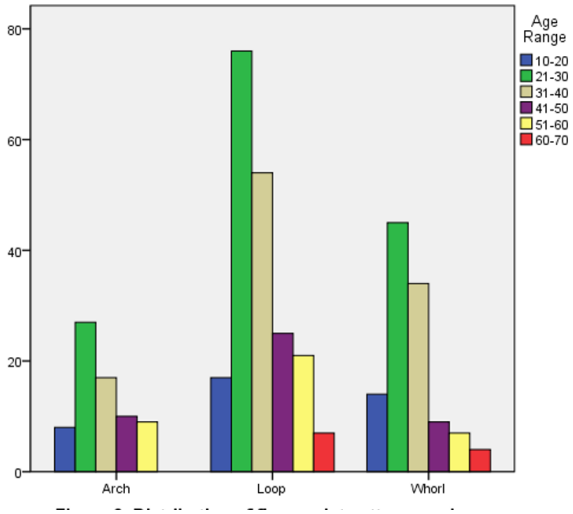

Figure 9: Distribution of fingerprint patterns and age range of the sampled malaria population.

Discussion

For centuries, humans have been fascinated by dermatoglyphics, with ancient Chinese civilizations employing it as a means of divination and fortune telling. About the same period, ancient Indians believed that the presence of ten whorls destined a person to be a 'Chakravarti' meaning "an emperor"(Athanikar, 1986, Lakshmi and Thenmozhi, 2014). Human fingerprint has been considered as the most trustworthy criteria for identification, as it cannot be changed with time even up to the death of an individual. In the court of law, fingerprint-proof is undeniably the most dependable and acceptable evidence to date. Fingerprint designs are exclusive in each human and the chance of two individuals having identical fingerprints is an exceptional case about one in sixty-four thousand million, similarly, even the fingerprint minutiae patterns of the undistinguishable twins are different, and the ridge pattern of each fingertip remain unchanged from birth till death (Patil and Ingle, 2020). The present research tries to investigate the association of fingerprint patterns and malaria susceptibility in patients of Nasarawa State, Nigeria.

In the present study, the distribution of fingerprint patterns revealed that the most extensive fingerprint pattern in the malarious population was the loops (52.1%), followed by whorls (29.4%) and arch patterns (18.5%). These results are similar to the published report by Mairiga *et al.*, (2023), where it was observed that the fingerprint patterns were 51.36% loop, 32.12% whorl and 16.36% arch. The findings of Zaitoon *et al.*, (2021) conducted on an ordinary population also reported similar outcome, where the loop fingerprint pattern dominated with 60-70%, followed by 25-35% whorl and 5% arch. The similar findings between Mairiga *et al.*,(2023) and the present study could be tied down to the nature of study, which focused on malaria. Other studies that reported contrary findings, such as greater arch or whorls focused on diseases that were genetically predisposed, such as schizophrenia and diabetes mellitus (Jhingan *et al.*, 1990; Uta, 1997; Tarca and Barabolski, 2003; Tarca and Tuluc, 2005; Ameer *et al.*, 2014; Roshani *et al.*, 2016, Smail *et al.*, 2019; Mehta and Mehta, 2015).

The relationship between fingerprint patterns and disease susceptibility is complex and multifaceted. Research suggests that fingerprint patterns are determined by a combination of genetic and environmental factors, including blood pressure, hormonal mix, and maternal diet during fetal development (Rodger, 2018). The theory behind dermatoglyphics posits that disturbances in fetal development can lead to changes in fingerprint configurations, making each individual's fingerprints unique.

Our study found that the degree of parasitemia was high among patients with the loop fingerprint pattern, both in gender and across age groups. This finding has implications for the potential use of fingerprint patterns as a detective tool or additional screening tool for identifying early risk factors both in malaria and other clinical diseases. The high prevalence of loop patterns in our study population may suggest a potential link between loop patterns and malaria susceptibility, although further studies in multi-states are needed to confirm this association.

The potential use of fingerprint patterns as a biomarker for disease susceptibility is an area of growing interest. Fingerprint patterns are unique to each individual and remain unchanged throughout life, making them a potentially useful tool for identifying individuals at risk of certain diseases. However, more research is needed to fully understand the relationship between fingerprint patterns and disease susceptibility.

CONCLUSION

This study demonstrates a potential association between fingerprint patterns and malaria susceptibility. The dominance of loop patterns in the sampled population suggests that fingerprint analysis may be a useful tool for identifying individuals at risk of malaria. However, further studies are needed to confirm these findings and explore the potential applications of fingerprint analysis in disease diagnosis and prevention.

Recommendations

1. Further studies are needed to confirm the association between fingerprint patterns and malaria susceptibility.
2. Fingerprint analysis should be explored as a potential tool for identifying individuals at risk of malaria.
3. The development of fingerprint-based diagnostic tools could provide a non-invasive and cost-effective method for early malaria screening.

Limitations

1. Limited sample size and geographic scope may not be representative of the entire population.
2. The study focused on Plasmodium falciparum infections, and findings may not be generalizable to other malaria species.
3. Further research is needed to control for potential confounding variables and confirm the association between fingerprint patterns and malaria susceptibility.

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Conflict of Interest

The authors declare that they have no financial or other relationships that might lead to any conflict

REFERENCES

Ameer, Y., Zafar, R., Abbasi, A. M. H., Rasheed, M. A., Habib, H., Salahuddin, T., Warriach, S. A . , Tariq, A., & Ahmed, T. (2014). Finger prints pattern variation in diabetic patients. *PJMHS, 8*(1), 162.

Athanikar KA. (1986) Dermatoglyphics in deaf-mute – An early diagnostic tool. *Indian J Otolaryngol* 38,1-5

Chakravorty S, Williams TN (2015).. Sickle cell disease: a neglected chronic disease of increasing global health importance. Arch Dis Child. *Jan 100*(1), 48-53. PubMed| Google Scholar.

Chandley, P., Ranjan, R., Kumar, S., & Rohatgi, S. (2023). Host-parasite interactions during Plasmodium infection: Implications for immunotherapies. *Frontiers in Immunology, 13*, Article 1091961. https://doi.org/10.3389/fimmu.2022.1091961

Chattopadhyay, S. & Kanchan, T.(2006). Distribution of fingerprint patterns among medical students. *Journal of Indian Academy of Forensic Medicine, 28, 65-68*.

Cheaveau, J., Mogollon, D. C., Mohon, M. A. N., Golassa, L., Yewhalaw, D., & Pillai, D. R. (2019). Asymptomatic malaria in the clinical and public health context. *Expert Review of Anti-Infective Therapy, 17*(12), 997–1010. https://doi.org/10.1080/14787210.2019.1693259

Cheesbrough, M. (2005). Examination of blood for parasites. In *District Laboratory Practice in Tropical Countries* (1st ed.). Cambridge University Press.

Cheesbrough, M. (2022). Examination of blood for parasites. In *District Laboratory Practice in Tropical Countries* (2nd ed.). Cambridge University Press.

Newman, H. H. (1944). [Review of the book Finger prints, palms and soles: An introduction to dermatoglyphics, by H. Cummins & C. Midlo]. *American Journal of Physical Anthropology, 2*(2), 227–229. https://doi.org/10.1002/ajpa.1330020212

Drouet, J. (2019) Researchers find correlation between blood type and susceptibility to severe malaria. *Medicine and Health Sciences.*

Fayrouz, I. N., Farida, N., & Irshad, A. H. (2012). Relation between fingerprints and different blood groups. *Journal of Forensic and Legal Medicine, 19*(1), 18–21. https://doi.org/10.1016/j.jflm.2011.09.004

Hoover, J. Edgar (2012). "Fingerprint". Encyclopedia Britannica, I – Z Volume 2. *Springer Science & Business Media.* P. 439.

Hoover, J. Edgar. (2021). *Fingerprint. Encyclopedia Britannica.*

Jhingan, H. P., and G. C. Munjal (1990). dermatoglyphics in male catatonic schizophrenics *IndianJ.Psychiatary, 32*(2), 188-192.

Johannes, N. O.A. (2024). Empowering Namibia's fight against malaria: drawing inspiration from China's remarkable malaria elimination journey. *Journal of Innovative Research, 2*(2), 1-8. https://doi.org/10.54536/jir.v2i2.2682.

IMAQ. (2004). *IMAQ vision concepts manual.* National Instruments.

Jain, V., & Singh, A. K. (2015). An approach for minutia extraction in latent fingerprint matching. *International Journal, 6*(1), 51-58.

Lakshmi Prabha, J., & Thenmozhi, R. (2014). A short review on dermatoglyphics. *Journal of Pharmaceutical Sciences and Research, 6*(4), 200–202.

Mairiga, J. P., Habibu, T., Okon, E., & Chukwu-Eze, U. S. (2023). Detecting malaria susceptibility in patients using fingerprint pattern. *International Journal of Research and Innovation in Applied Science, 8*(1), 1–9.

Mehta, A. A., & Mehta, A. A. (2015a). Study of fingerprint patterns in type II diabetes mellitus. *International Journal of Anatomy Research, 3*(2), 1046-1048.

Meye, B., Kenguele, H. M., Ekambou, L. M., Guitouka, S. M., Eya'ama Mve, R., & Emane, K. A. (2025). Malaria prevalence and associated risk factors among pregnant women attending the prenatal care unit of the Ntoum Department Hospital (Northwest Gabon). *American Journal of Life Science and Innovation, 4*(1), 36-44. https://doi.org/10.54536/ajlsi.v4i1.4680

Okagu, I. U., Aguchem, R. N., Ezema, C. A., Ndefo, J. C., & Udenwobele, D. I. (2022). Molecular mechanisms of hematological and biochemical alterations in malaria: A review. *Molecular and Biochemical Parasitology, 247,* Article 111446. https://doi.org/10.1016/j.molbiopara.2021.111446

Patil, V., & Ingle, D. R. (2020). An association between fingerprint patterns with blood group and lifestyle-based diseases: a review. *Artificial Intelligence Review, 54,* 1803-1839.

Paul, A., & Lourde, R. (2006). A study on image enhancement techniques for fingerprint identification. In *2006 IEEE International Conference on Video and Signal Based Surveillance* (pp. 42). IEEE. https://doi.org/10.1109/AVSS.2006.31

Dobson, R. (2018, February 5). Some of the diseases that could be detected from your fingerprint: Cancer, asthma, diabetes. *Daily Mail*. https://www.dailymail.co.uk/health/article-5355153/What-fingerprints-say-health.html

Roshani, S., Pallavi, I., Prabhakar, S., & Amita, S. (2016). Comparative study on the dermatoglyphic pattern among diabetic (type-2) and non-diabetic adults in North Indian population. *European Journal of Pharmaceutical and Medical Research*, 430-433.

Țarcă , Ana and Barabolski, C. (2003) Pathology of Dermatoglyphics In Infantile Autism, *The Journal Of Preventive Medicine 11* (1), 11-17

Țarcă, A., & Tuluc, E. (2005). Dermatoglyphics in insulin-dependent diabetes or diabetes mellitus type 1 (T1DM). *The Journal of Preventive Medicine, 13*(1–2), 43–53.

Uta F (1997) *Autism and Asperger Syndrome*. Cambridge Univ. Press, 1997, 37-183

WHO (2021) *Word Malaria Report, 1st edn*. World Health Organization,Geneva.https://www.who.int/teams/global-malaria programme/reports/world-malariareport.

World Health Organization. (2022). *Malaria key facts*.

World Health Organization. (2022). *World Malaria Report 2022*.

World Health Organization. (2023). *World Malaria Report 2023*.

World Health Organization. (2024). *World Malaria Report 2024*.