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ORIGINAL ARTICLE

Dermatoglyphic Pattern of Fingertips among Bangladeshi Children with Acute Lymphoblastic Leukemia

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Abstract

Background: As dermatoglyphics and acute lymphoblastic leukemia have a genetic influence, there would be some correlation between the dermatoglyphics and Acute Lymphoblastic Leukemia. **Objectives:** The present study aims to compare and identify differences in fingertip dermatoglyphics between children diagnosed with acute lymphoblastic leukemia and those in a control group (healthy children). **Methodology:** This was designed as a case and control group study carried out in the Department of Anatomy, Sir Salimullah Medical College, Dhaka from January 2019 to June 2020. The participants were male children with acute lymphoblastic leukemia from Dhaka Shishu Hospital who served as cases and normal healthy children were selected from Sher-e-Bangla ideal school and Nobodhara Model School, Dhaka who served as controls. The study subjects were selected by convenient purposive sampling. The ink method as described by Cummins and Midlo in 1961 was used for taking the fingerprints. For detailed dermatoglyphics analyses different variables were studied by using 'MB-ruler' and 'Paint' software. Qualitative variables like finger ridge patterns in the distal phalanges were studied. **Results:** The present study in both hands consideration it was observed that the percentage of ulnar loop in ALL male children and healthy controls was 44.25% and 68.0% respectively, which was statistically significant (p value < 0.01). The percentage of whorl pattern was significantly higher ($p<0.01$) in ALL children (44.25%) than in healthy children (24.5%). The percentage of arch was higher ($p<0.05$) in cases than in controls (6.5%). Radial loop was uniformly distributed in both groups and was non-significant. **Conclusion:** Percentage distribution of whorls and arches was higher but ulnar loop was lower in the case than control. Radial loop was uniformly distributed in the case than in the control. *[Journal of Current and Advance Medical Research, July 2024;11(2):73-78]*

Keywords: Dermatoglyphics; acute lymphoblastic leukemia; fingertip; children

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Introduction

Dermatoglyphics is concerned with the study of friction ridge patterns on the skin of the palm, fingers, sole, and toes of humans and related species[1,2]. The ridge configurations are formed early during embryonic development, so they are genetically determined but can be influenced or modified by environmental factors in the intrauterine life[2]. The characteristics of dermatoglyphics develop between the 10th to 17th weeks of the gestational period and thus they reflect the events occurring during the second trimester[3]. After birth, it remain unchanged throughout the life[4]. So, it is used as a best tool of individual identification. The fingerprint pattern is used in methodological studies, and it is highly individualistic[5]. They are also clinically important as well, because they are affected by certain abnormalities of early development, including genetic disorders[6].

There are three types of fingerprint patterns i.e., arch, loop, and whorl. Among them arch has no triradius, loop has one triradius, and the most complex pattern is the whorl pattern has two triradius[5].

Acute lymphoblastic leukemia (ALL) is a malignant disorder resulting from a neoplastic clonal proliferation and accumulation of progenitors of both B and T lymphoid cells[3]. It is the most common malignant disease affecting children, accounting for approximately 30.0% of all childhood malignancies[7] and 70% of all childhood leukemias[8]. Cellular features of ALL in children suggest that the disease originates very early during embryogenesis. Fingerprints also develop at the same time as the blood-forming cells in the embryo. Both originate from the mesodermal tissue so any insult during embryogenesis that may lead to leukemic change can also produce abnormality in the distribution of dermatoglyphics[8].

This study was proposed to see is there any deviation of finger ridge pattern in ALL children from normal children.

Methodology

Study Settings and Population: This study was a cross-sectional analytical study with case and control groups, conducted in the Department of Anatomy at Sir Salimullah Medical College, Dhaka, Bangladesh from January 2019 to June 2020 for a period of one and a half years. Diagnosed children with Acute Lymphoblastic Leukemia were selected from the Department of Pediatric Hematology and Oncology in Dhaka Shishu Hospital (DSH). Confirmation of ALL was based on Bone Marrow findings, which were available in the hospital file of leukemia children. A normal control group was selected from Sher-E-Bangla Ideal School and Nobodhara Model School, Kuril, Dhaka, Bangladesh. The controls were supposed to be free from other diseases like epilepsy[9], pulmonary tuberculosis[10] and bronchial Asthma[11] that can affect the dermatoglyphic pattern and excluded by history taking from the guardians.

Study Procedure: During the selection of the study population, a data sheet of personal information filled up for both groups to avoid duplication. The ages of the study subjects of the two groups were confirmed by hospital and school admission records. Fingerprints of the case were collected with due permission from the hospital Director and the Head of the Hematology and Oncology Department of Dhaka Shisu Hospital. Fingerprints of control were collected with due permission from the concerned school authorities of the Sher-E-Bangla Ideal School and Nobodhara Model School, Kuril, Dhaka, Bangladesh.

Procedure of Taking Fingerprint: Procedure of taking hand print: At first total procedure was briefly described to the Registrar of Pediatric Hemato Oncology, Department of Dhaka Shishu Hospital and to the guardian of the children with acute lymphoblastic leukemia, and for the normal control group, both the principal and the class teacher were explained about the nature of the work. Informed consent had been taken from the children's guardian before obtaining their fingerprints. The hands of each child were washed with liquid soap before inking to remove dirt from the hands.

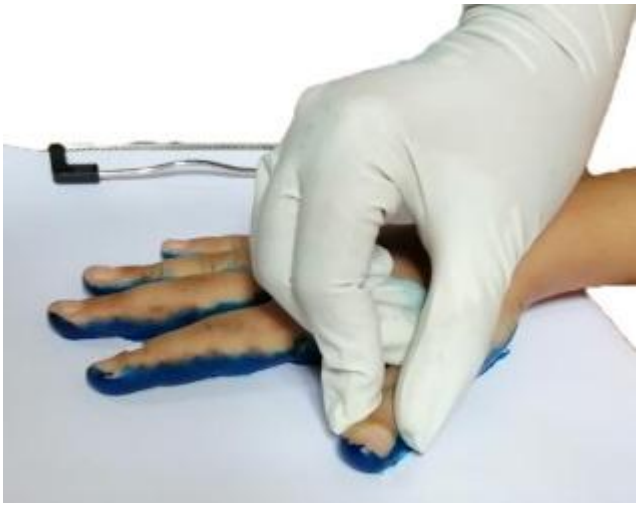

Figure I: Showing steps of taking hand print (rolling of thumb from side to side)

Then, hands were wiped with a towel. White papers were fixed on a clipboard to take a print of the fingertips of the right and left hands. The clipboard was placed on a wooden table. Dermatoglyphic prints were obtained using the "Ink & Paper Method," as described by Cummins[12]. The required amount of ink was poured into a clean and dry flat-bottom container.

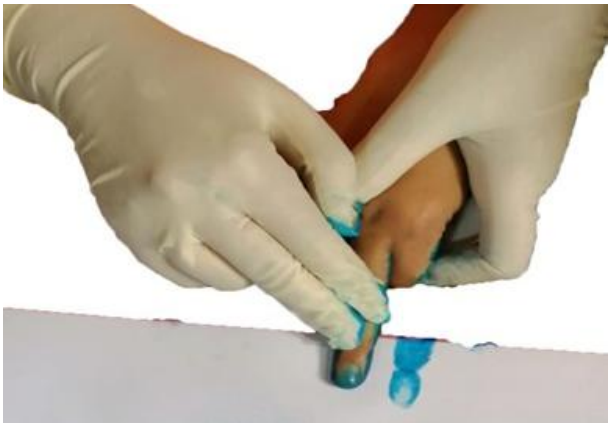

Figure II: Showing Steps of Taking Finger Print Separately

Finger roller was moved in the ink until the ink was spread thinly and homogenously in the roller. Both hands fingertips were painted with the help of the roller. The thin film of ink was applied uniformly over the digits. After ensuring that fingers inked properly, fingerprint was taken on the white paper fixed on clip board. Finally, fingers were rolled from radial to ulnar side (Figure:1&2). Sometimes finger print was distorted and double impression occurred, on the ground of this situation individual finger print were collected separately by inking only the fingertip. Then both hands of the individual were cleaned with turpin oil, liquid soap under running tap water and dried with paper towel. The painted papers were examined with magnifying glass (4X & 6X) and scanned copy also saved in the laptop to analysis the dermatoglyphics pattern by zooming option.

Statistical Analysis: Data obtained from this study were checked and edited after collection. All the data obtained were recorded using an Excel spreadsheet (Microsoft Office 2010; Microsoft, Redmond, WA). Then the data were expressed as mean ± standard deviation (mean±SD) with range. All quantitative data of this study were compared by an unpaired student "t" test using a computer-based program SPSS Excel version 20 (Statistical Package for Social Science). Data were analyzed keeping in view the objectives of the study.

Ethical clearance: To avoid any medicolegal questions for the collection of fingerprints from the study subjects, a written clearance from the Institutional Ethics Committee of Sir Salimullah Medical College, Dhaka was taken [Ref: SSMC/2019/248].

Results

In Table 1, the mean ± SD of age (in years) in the case group was 7.15 ± 1.03. The minimum age was 3 years, and the maximum age was 12 years. The mean±SD of age (in years) in the control group was 10.6 ± 1.97. The minimum age was 8 years, and the maximum age was 16 years.

Table 1: Age in Years in Case and Control Groups

Groups (N= 80)	Mean ± SD (range)
Case (n= 40)	7.15 ± 1.03 (3 - 12)
Control (n= 40)	10.6 ± 1.97 (8 - 16)

Case = Acute Lymphoblastic Leukemia male children; Control = Normal male children; N = Total sample size; n = sample size in groups

Table 2: Comparison of Finger Ridge Pattern in Distal Phalanges of Hands in Case and Control Groups

Hands in Groups (N= 80)	Finger Ridge Pattern in Distal Phalanges			
	Ulnar Loop	Radial Loop	Whorl	Arch
Right Hand				
• Case Group (n= 40)	85(42.5%)	3(1.5%)	93(46.5%)	19(9.5%)
• Control Group (n=40)	134(67.0%)	3(1.5%)	49(24.5%)	14(7.0%)
P value	0.000**	0.923ns	0.000**	0.041*
Left Hand				
• Case Group (n= 40)	92(46.0%)	2(1.0%)	84(42.0%)	22 (11.0%)
• Control Group (n= 40)	138(69.0%)	3(1.5%)	47(23.5%)	12(6.0%)
P value	0.000**	0.871ns	0.000**	0.036*
Both Hands				

Hands in Groups (N= 80)	Finger Ridge Pattern in Distal Phalanges			
	Ulnar Loop	**Radial Loop**	**Whorl**	**Arch**
• Case Group (n= 40)	177(44.25%)	5(1.25%)	177(44.25%)	41(10.25%)
• Control Group (n= 40)	272(68.0%)	6(1.5%)	96(24.0%)	26(6.5%)
P value	0.000**	0.843 ns	0.000**	0.028*

Comparison between groups done by unpaired student's 't' test; ** = Significant at P value <0.01, * = Significant at P value <0.05, ns = Not significant; Case = Acute Lymphoblastic Leukemia male children, Control = Normal male children; N = Total sample size, n = sample size in groups

Table 2 shows the frequency and percentage-wise distribution of various dermatoglyphic patterns in the distal phalanges of hands in the case and control groups. It was observed that in the right hand, the percentage of ulnar loop was lower in cases (42.5%) than in controls (67.0%), and when compared between the two groups difference was statistically highly significant (p<0.01).

The percentage of whorl was higher in cases 46.5% than control group, 24.5% and the difference was statistically highly significant (p<0.01). Similarly, the arch pattern was higher in cases 9.5% than in controls 7.0% and the difference was statistically significant (P<0.05). Radial loop was 1.5% in both groups and was statistically nonsignificant.

In the left hand, the percentage of ulnar loop was lower in cases 46% than in controls 69% and when compared difference was statistically highly significant (p<0.01). The percentage of whorl was higher in cases 42.0% than in controls 23.5% and was found to be statistically highly significant (P<0.01). Similarly, the percentage of arch was higher in case 11.0% than control 6.0% and when compared was found to be statistically significant (p<0.05). Radial loop was 1.0% in cases and 1.5% in controls which was statistically non-significant.

In both hands, percentage of ulnar loop was lower in cases 44.25% than controls 68.0% and when compared difference was statistically highly significant (p<0.01). The percentage of whorl was higher in cases 44.25% than controls 24.0% and was found to be statistically highly significant (P<0.01).

Similarly, percentage of arch was higher in cases 10.25% than control 6.5% and when compared was found statistically significant (p<0.05). Radial loop was 1.25% in cases and 1.5% in control which was statistically non-significant.

Discussion

Dermatoglyphics are biological traits of human and it is widely used in anthropological, genetical and medical studies. Dermatoglyphics are very important in the study of population variation, personal identification, twin study, selection of athletes, paternity disputes, association with diseases etc. as the dermatoglyphics pattern are permanent. Dermatoglyphics is studied and used in diagnosis of various diseases which have hereditary basis, because epidermal ridge patterns are under genetic influence[2].

The relation between characteristic dermatoglyphics and medical genetically based diseases could be explained by the fact that dermal ridge differentiation takes place in the first trimester of fetal development and its configurations are genetically determined[3] The association between dermatoglyphics and acute lymphoblastic leukemia in children was studied briefly by Edelstein et al[13] The present study is concerned with acute lymphoblastic leukemia, which is proved to be based on a genetic factor. Cellular aberration in cases of leukemia is mesodermal in origin and its development occurs from the third to eighth week of fetal development, known as an embryonic period[3].

Dermatoglyphics development begins nearly at the same time (fifth to sixth week of fetal development). It originates as an interaction between ectoderm (skin) and mesoderm (dermis and subcutaneous tissue)[3]. Therefore, any aberration in cellular structure of blood forming cells may also leads to change in dermatoglyphics of the same individual

Different Finger Ridge Pattern

Ulnar Loop: In the present study, the prevalence of the ulnar loop in the right hand was 42.5% in the case group and 67.0% in the control group. In the left hand, it was 46.0% in the case group and 69.0% in the control group. When considering both hands, the frequencies were 44.25% in the case group and 68.0% in the control group. The percentage of ulnar loops was lower in male children with acute lymphoblastic leukemia (ALL) than in healthy male children, and this difference was statistically significant (P < 0.01). Similar findings were reported

by Rathee et al[5], Ludmila et al[14], Julian[15], and Menser and Smith[16]. However, in contrast to these results, Abd Alla and Mohameed[17] found a higher prevalence of ulnar loops in cases than in controls. Till et al[18] and Wertelecki et al[19,] observed a uniform distribution of ulnar loops between the case and control groups, with no statistically significant difference.

Radial Loop: The percentage of radial loops in the right hand was 1.5% in both groups, while in the left hand, it was 1.0% in cases and 1.5% in controls. When considering both hands, the percentages were 1.25% in cases and 1.5% in controls. In the present study, the difference in radial loop frequency between the case and control groups was not statistically significant for the right hand, left hand, or both hands combined. These results are consistent with the findings of Rathee et al[5], Till et al[17], Wertelecki et al[19], Ludmila et al[14], Julian[14], and Menser and Purvis-Smith[16]. However, Abd Alla and Mohameed[17] reported contrasting results, observing a lower radial loop count in cases compared to controls.

Loop (Both Ulnar and Radial): The percentage of loops in the right hand was 44% in cases and 68.5% in controls, while in the left hand, it was 47% in cases and 70.5% in controls. When considering both hands, the percentages were 45.5% in cases and 69.5% in controls. In the present study, the loop pattern was less frequent in cases than in controls, and this difference was statistically significant ($P < 0.01$). These findings are in agreement with those reported by Sama et al. (2019) and Bukelo et al. (2010)[20].

Whorl Pattern: The percentage of whorl patterns in the right hand was 46.5% in cases and 24.5% in controls, while in the left hand, it was 42% in cases and 23.5% in controls. When considering both hands, the prevalence was 44.25% in cases and 24.0% in controls. The present study demonstrated a significantly higher frequency of the whorl pattern in cases than in controls for the right, left, and both hands ($P < 0.01$).

Similar findings were reported by Sama et al[3], Rathee et al[5], Bukelo et al[20], Wertelecki et al[19], Julian[15], and Menser and Purvis-Smith[16], although their results were not statistically significant. In contrast, Abd Alla and Mohameed[17], as well as Till et al[18], observed a significantly lower prevalence of the whorl pattern in cases13 than in controls. Ludmila et al[14] also reported a lower whorl frequency in cases, though their results were not statistically significant.

Arch Pattern: In the present study, the percentage of the arch pattern in the right hand was 9.5% in cases and 7.0% in controls, while in the left hand, it was 11.0% in cases and 6.0% in controls. When considering both hands, the prevalence was 10.25% in cases and 6.5% in controls. The percentage of the arch pattern was higher in male children with acute lymphoblastic leukemia (ALL) in the right hand, left hand, and both hands compared to healthy control children, with a statistically significant difference ($P < 0.05$).

These findings align with the studies conducted by Abd Alla and Mohameed[17], Till et al[18] and Menser and Purvis-Smith[16], although their results were not statistically significant. On the other hand, Sama et al[3], Bukelo et al[20], and Julian[15] found a uniform distribution of the arch pattern between case and control groups. Conversely, the findings of Rathee et al[5], Wertelecki et al[19], and Ludmila et al[14] differed from the present study. They reported a lower percentage of the arch pattern in ALL patients than in healthy controls, though the differences were not statistically significant.

To the best of our knowledge, no published research on the fingertip dermatoglyphic patterns of acute lymphoblastic leukemia exists in our country.

Conclusion

In the present study, considering both hands, the percentage of ulnar loops in male children with acute lymphoblastic leukemia (ALL) and healthy controls was 44.25% and 68%, respectively, with a statistically significant difference. The percentage of whorl patterns was significantly higher in children with ALL than in healthy children. The percentage of arch patterns was also higher in cases than in controls. Radial loops were uniformly distributed in both groups, showing no significant difference.

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None

Conflict of Interest
We declare that we have no conflict of interest.

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Contributions to authors: Rawshon Ara: conceptualization, methodology, data collection, results, writing original draft; Md. Nur-Uz-Zaman: Data analysis, supervision; Nazmun Nahar: SPSS analysis; Fahmida Mannan: write the manuscript;

Sk. Amin Mohi Uddin: write the data analysis; Zamilur Rahman: Referencing, discussion; Nusrath Mourin: Literature review**.** All authors read and approved the final manuscript.

Data Availability
Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate
Ethical approval for the study was obtained from the Institutional Review Board. As this was a prospective study the written informed consent was obtained from all study participants. All methods were performed in accordance with the relevant guidelines and regulations.

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