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ORIGINAL RESEARCH

Association Between Dermatoglyphic Patterns and Functional Constipation in Children: A Case-Control Study

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Abstract

Objective and Aim

Functional constipation (FC) is the most common gastrointestinal complaint in childhood. Dermatoglyphics are epidermal ridges used to study the role of genetic factors in various diseases. As they originate from ectoderm during same embryonic period with enteric nervous system, a potential ontogenetic link may exist. It was aimed to investigate the relationship between FC and dermatoglyphics, and to illuminate the etiology.

Materials and Methods

This prospective case-control study was conducted on children aged 2-12 years who applied to our hospital pediatric surgery polyclinic. The case group was included 86 children with FC, while control group was consisted of 86 without constipation. Children's dermatoglyphic sample patterns, the ridge counts, and palmar angles were taken with the help of a printer, digitized, and the findings were compared using SPSS vers.23.0. A p value <0.05 was accepted statistically significant.

Results

An increase in the number of whorl pattern on the left hand's V. finger was detected in FC (p=0.024). In girls' first finger on the left hand, an increase in the number of whorls and a decrease in the number of ulnar loops were observed (p=0.025). In boys with FC,

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the right hand "dat" angle was lower (p=0.048), but the number of whorls was similar. In terms of arch positivity, no significant difference was found between the groups.

Conclusion

No direct relationship was found between dermatoglyphics and FC. However, the "dat" angle, the number of whorl and ulnar loops patterns may be used as additional markers to aid in elucidating the etiology of FC.

Keywords: Child, Constipation, Dermatoglyphics, Etiology, Ontogenetic.

Abbreviations

FC: Functional constipation; **RCs:** Ridge counts; **TRC:** Total Ridge counts; **FCG:** Case group; **CG:** Control group; **BSFS:** Bristol Stool Form Scale; **W:** Whorl pattern; **UL:** Ulnar loop pattern; **RL:** Radial loop pattern; **A:** Arch pattern; **ENS:** Enteric nervous system

1. Introduction

In children, 3% of primary healthcare visits and 25% of pediatric gastroenterology consultations are due to constipation complaints (1). Constipation is classified into organic and functional categories, with functional constipation (FC) comprising 95% of cases. The etiology is multifactorial; however, the most common mechanism has been reported being a vicious cycle of stool withholding or delayed defecation (2-4). The high prevalence of family history in affected children and numerous twin studies suggest that genetic factors may play a role in the development of FC (5-8).

Dermatoglyphics are unique patterns of lines on the palmar and plantar surfaces. Even in the identical twins, each person's dermatoglyphics are different. These patterns fully form between the 10-18th weeks of prenatal development and remain constant throughout an individual's life (9-12). Sometimes either due to hereditary reasons, the pressure of intrauterine factors, or external environmental factors, chromosomal aberrations occur in the fetus. Since dermatoglyphics are also at the influence of these factors; it may especially illuminate individual-specific aspects of early embryonic development. Consistent with this, chromosomal aberrations have been reflected in the form of increased palmar angle, variation in pattern frequency or ridge counts (RCs) between a-b triradii (12). Due to their rapid and non-invasive nature, these aberrations in dermatoglyphics have increasingly been utilized to identify predispositions to certain ailments, genetically inherited diseases, personality disorders, and criminal tendencies (10-16). Also, it has been found to be significantly associated with certain microbiome counts (17). Despite their ontogenetic linkage, studies examining the relationship between dermatoglyphics and constipation are limited, and their findings are inconsistent (18-22). Notably, current studies have been solely focused on fingerprint pattern types, without other important markers such as RCs, a-b RCs or palmar angles. In both English and Turkish literature search using the keywords 'Dermatoglyphics' was not revealed any study focused on this relationship in Turkish children.

This study aims to explore the possible association between FC and dermatoglyphics, and to contribute to its etiology, by examining detailed patterns such as palmar angles, a-b and total RCs.

2. Materials and Method

This study was conducted in accordance with the ethical principles stated in the "Declaration of Helsinki" and ethical approval was obtained from the Non-Interventional Clinical Research Ethics Committee of our university on 10.02.2021, with decision number 2021-02/34. The parents/legal guardians of all participants and the children aged 7 to 12 years signed informed consent and assent forms, respectively. The subjects' identities were omitted to protect their privacy.

This prospective case-control study was conducted between February 1 and August 31, 2021, on children aged 2-12 years who admitted to the pediatric surgery polyclinic

of our hospital. With the sample size calculation, based on an effect size (d)=0.5, α=0.05, and power (1-β)= 0.90323, was determined 86 children diagnosed with FC according to the ROMA IV criteria needed to be included in the case group (FCG). The control group (CG) was consisted of 86 children of similar age without constipation and who did not meet any exclusion criteria.

Children with organic pathologies that contribute to the etiology of constipation, such as anal stenosis/atresia, anteriorly placed anus, imperforate anus, intestinal stricture, anal stricture, masses, prune-belly syndrome, gastroschisis, Down syndrome, muscular dystrophies, hypothyroidism, hypercalcemia, hypokalemia, diabetes mellitus, diabetes insipidus, multiple endocrine neoplasia, Hirschsprung disease, pseudo-obstruction, intestinal neuronal dysplasia, spina bifida or other spinal defects, spinal trauma, neurofibromatosis, celiac disease, cystic fibrosis, cow's milk protein allergy, inflammatory bowel diseases, scleroderma, systemic lupus erythematosus, were not included to the study. Additionally, children with deformities preventing the assessment of hand dermatoglyphics, those using certain medications (anticholinergics, narcotics, antidepressants, antacids etc.), those with a history of lead poisoning or vitamin D intoxication, children with adaptation problems, and those whose parents did not sign the consent forms were also excluded.

The families of children who met the inclusion criteria were informed about the study. Voluntary parents or their children were filled out a 19-question data form prepared by the researchers through face-to-face interviews. With the form was ascertained information about the children's age, gender, medical conditions, medication use, dietary and bowel habits, time of first meconium passage, and family history of constipation. The children's nutritional status was assessed based on the number of main meals, number of snacks, daily water consumption, daily milk consumption, daily servings of fruit, and weekly servings of vegetables. At the end, the Bristol Stool Form Scale (BSFS) was used to determine the severity and type of constipation based on stool shape and consistency (23).

Dermatoglyphic samples from all children were obtained using a digital scanner (CanoScan LIDE 60, Canon, Beijing, China) and transferred to a computer. During image acquisition, the palm was placed flat against the scanner surface, with the thumb positioned at approximately a 30–40° angle and the remaining fingers held in 10–15° abduction. For each child, four color images were captured for each participant at a resolution of 300 dpi. These JPG files were subsequently analysed with ImageJ software (NIH, Bethesda, MD, USA) to determine fingertip pattern types, digital ridge counts, the a–b ridge count, and palmar angles (adt-dat-atd) (Figure 1).

Fingertip patterns were classified according to the Cummins and Midlo system as whorl (W), ulnar loop (UL), radial loop (RL), or arch (A) (24,25). The presence of at least one A-type fingerprint pattern was classified as ‘arch positivity’. Except for arch patterns, ridge counts were obtained by identifying the central point of the pattern and counting the dermal ridges intersected by a line drawn between this center and the corresponding triradii. A perpendicular line was extended from the pattern center toward the most distant triradii, and the number of crossed ridges was recorded as the ridge count for that digit. For arch patterns, the ridge count was designated as zero. Ridge counts from all ten fingers were then summed to obtain the total ridge count.

Statistical Analysis

The data analysis was conducted using the Statistical Package for the Social Sciences version 23.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as mean, standard deviation, frequency, and percentage. The normality of the data distribution was assessed via the Shapiro-Wilks test, Kolmogorov-Smirnov test, Q-Q plots, and histogram graphics. To compare not-normally distributed data, Mann-Whitney U Test was used for variables consisting of two categories. Categorical data were compared using the Chi-square test for 2×2 layout tables, whereas the Extended

Fisher's Exact Test was employed for 2×4 contingency tables with small sample sizes due to low (<5) expected cell frequencies. A p-value of <0.05 was considered statistically significant.

3. Results

The study was conducted on a total of 172 children, with equal numbers in both FCG and CG (Table 1). In FCG, 55.8% of the children were girls; while 61.6% in the CG (p>0.05). The mean ages of children in FCG and CG were 8.12±2.72 and 8.31±2.38 years, respectively.

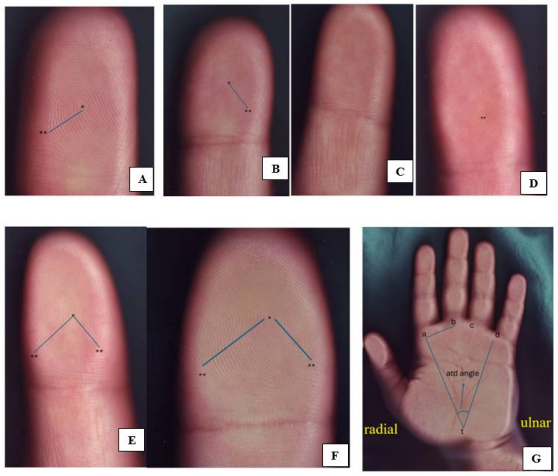

Figure 1. Types of fingerprint patterns and palmar angles: A: Ulnar loop; *: core; **: delta; B: Radial loop; C: Plain arch; D: Tented arch; E: Plain whorl; F: Spiral Whorl; G: Palmar angles and a-b ridge (a, b, c, d: The digital triradii of the palm)

No statistically significant difference was found between the groups regarding the time of first meconium passage (p=0.497). It was observed that 97.7% of the FCG and 100% of the CG passed meconium within the first 24 hours. The groups were also statistically similar in terms of nutritional status (p>0.05). A family history of constipation was reported in 55.8% of the FCG, which was significantly higher than in the CG (p=0.009), (Table 1).

When evaluated according to the ROMA IV criteria, 98.8% of the constipated children experienced painful-hard-difficult defecation; 80.2% had large stool caliber; 22.1% reported stool that clogged the toilet, and 9.8% had a history of stool incontinence at least once a week following toilet training. According to BSFS, 7% of the children in the FCG had severe constipation, 61.6% had mild constipation, and 46.5% defecated two times or less per week (Table 2).

Table 1. Comparison of sociodemographic data and nutritional characteristics of the groups

	Case, n (%)	Control, n (%)	p	X^2
Sex of children				
Girl	48 (55.8)	53 (61.6)	0.439	0.600
Boy	38 (44.2)	33 (38.4)		
Family history of constipation				
Positive	48 (55.8)	31 (36.0)	**0.009***	6.766
Negative	38 (44.2)	55 (64.0)		
First passage of meconium				
< 24 hours	84 (97.7)	86 (100)	0.497	0.506
24-48 hour	2 (2.3)	-		
Number of daily main meals				
Twice	16 (18.6)	12 (14)	0.409	6.830
Three times	70 (81.4)	74 (86)		
Number of daily snacks				
None	2 (2.3)	3 (3.5)	0.082	6.702
Once	18 (20.9)	22 (25.6)		
Twice	50 (58.1)	56 (65.1)		
Three times	16 (18.6)	5 (5.8)		
Daily water consumption				
<0.5 liter	6 (7)	1 (1.2)	0.135	5.563
0.5-1 liter	36 (41.9)	32 (37.2)		
1-1.5 liter	36 (41.9)	39 (45.3)		
>1.5 liter	8 (9.3)	14 (16.3)		
Daily milk consumption				
None	45 (52.3)	42 (48.8)	0.349	2.108
0-0.5 liter	33 (38.4)	40 (46.5)		
0.5-1 liter	8 (9.3)	4 (4.7)		
Number of fruit servings daily				
None	12 (14)	15 (17.4)	0.379	3.141
Once	69 (80.2)	70 (81.4)		
Twice	8 (5.8)	1 (1.2)		
Number of vegetable servings weekly				
0-2 times	52 (60.5)	49 (57)	0.568	1.140
3-4 times	30 (34.9)	35 (40.7)		
5-7 times	4 (4.7)	2 (2.3)		

*p<0.05 statistically significant, X^2: Chi Square

When fingerprint RCs, TRC, a-b RCs, and palmar angles were evaluated separately for the right and left hands; no statistically significant differences were found (p>0.05), (Table 3).

Table 2. Defecation habits of case group

	Children with Constipation n (%)
Number of weekly defecations	
≤ 2	40 (46.5)
>2	46 (53.5)
Painful, hard and difficult defecation	
Yes	85 (98.8)
No	1 (1.2)
Large-diameter stools that may obstruct the toilet	
Yes	19 (22.1)
No	67 (77.9)
Large-diameter defecation	
Yes	69 (80.2)
No	17 (19.8)
At least 1 episode/week of fecal incontinence after the acquisition of toileting skills¶	
Yes	8 (9.8)
No	74 (90.2)
Bristol stool scale	
Tip I (Very Constipated)	6 (7)
Tip II (Slightly Constipated)	53 (61.6)
Tip III (Normal)	17 (19.8)
Tip IV (Normal)	6 (7)
Tip V (Lacking Fiber)	4 (4.7)
Tip VI (Inflammation)	-
Tip VII (Inflammation)	-

¶Since they had not received toilet training, four children from the case group were not included.

However, fingerprint pattern types were analysed according to groups, and an increased number of W patterns were found on the left hand's V. finger in the FCG (p=0.024). When ranked by frequency of fingerprint patterns in both groups and on both hands, a decreasing trend was observed in the order: UL, W, A, and RL (Table 4).

However, no significant difference was found between the groups regarding the presence of A-type patterns (p=0.432), (Table 5).

Dermatoglyphic patterns were analyzed separately by gender. In both genders, UL was the most common fingerprint pattern on both the right and left hands, while RL was the least common. In boys with FC, a decrease in the right hand's "dat" angle was observed (p=0.048). In girls with FC, an increase in the W-type pattern and a decrease in the number of UL patterns on the left hand's first finger were noted (p=0.025), (Table 3, 4).

Discussion

Normal gastrointestinal activity depends on the coordinated function of the intrinsic neural circuits of the enteric nervous system (ENS) (26). As the largest division of the peripheral nervous system, the ENS is embedded within the gut wall and forms extensive connections with enteroendocrine cells, immune components of the gastrointestinal tract, the peripheral and central nervous systems, and the gut microbiota. Positioned between the mucosa and smooth muscle layers, it governs not only gastrointestinal motility but also secretion, nutrient uptake, immune modulation, and barrier defense (27).

The neurons and glial cells that constitute the ENS are not generated within the gut. Instead, they derive from neural crest cells that migrate into and colonise the developing gastrointestinal tract. Although these cells enter the gut later than resident epithelial and mesenchymal cells, they respond to many of the same secreted signaling cues. Consequently, several molecular pathways that regulate the development of smooth muscle, interstitial cells of Cajal, and epithelial cells also influence enteric neural crest-derived cells (26).

FC is the most common reported gastrointestinal complaint in childhood. Early diagnosis and effective management are essential for preventing potential complications and improving quality of life (1,2,28). Certain forms of FC are believed to reflect a neuropathic variant of slow-transit constipation, characterized by impaired motility. In general, the loss of enteric neurons and/or glia in disease is often accompanied by disturbances in gastrointestinal function (29). Although these abnormalities may not be demonstrated in some cases by conventional histological examinations, subtle alterations within the ENS are thought to be present in such patient (30). Similarly, comparable disruptions in ENS structure and function have been documented in inflammatory bowel disease, affecting motility and visceral

Table 3. Children's fingerprint ridge counts and palmar angles.

	Right Hand			Left Hand		
	Case Gr Mean±SD	Control Gr Mean±SD	p	Case Gr Mean±SD	Control Gr Mean±SD	p
I. FRC						
Totally	15.88±4.19	15.39±4.74	0.377	16.53±4.05	15.81±4.48	0.265
Girl	15.64±4.83	14.39±5.03	0.123	16.18±4.34	15.11±4.88	0.159
Boy	16.15±3.24	17.00±3.75	0.400	19.97±3.65	16.93±3.54	0.991
II. FRC						
Totally	10.50±6.20	9.73±6.30	0.448	10.72±6.25	10.63±6.28	0.856
Girl	11.08±5.83	10.26±6.31	0.640	10.97±5.61	11.58±6.07	0.569
Boy	9.76±6.63	8.87±6.29	0.435	10.39±7.03	9.09±6.39	0.289
III. FRC						
Totally	11.10±6.09	10.31±5.45	0.139	11.76±5.59	11.16±4.80	0.187
Girl	11.02±6.60	10.30±5.46	0.185	11.91±5.23	11.83±4.42	0.687
Boy	11.21±5.45	10.33±5.52	0.412	11.55±6.07	10.09±5.25	0.109
IV. FRC						
Totally	14.36±4.70	14.08±4.42	0.652	13.53±5.17	13.14±5.40	0.756
Girl	14.02±5.21	14.11±4.41	0.910	13.37±5.23	13.30±5.08	0.989
Boy	14.78±3.99	14.03±4.51	0.499	13.73±5.14	12.87±5.84	0.652
V. FRC						
Totally	13.20±3.95	12.58±3.75	0.446	12.23±3.78	11.74±4.42	0.903
Girl	13.29±4.34	12.60±3.44	0.424	12.25±4.41	11.81±4.54	0.948
Boy	13.07±3.43	12.54±4.23	0.862	12.21±2.84	11.63±4.28	0.702
TRC						
Totally	65.03±18.45	62.10±15.81	0.157	64.77±18.21	62.48±16.34	0.268
Girl	65.06±19.24	61.67±15.36	0.216	64.70±17.72	63.34±14.72	0.507
Boy	65.00±17.65	62.78±16.73	0.564	64.86±19.06	60.63±18.73	0.341
atd angles						
Totally	44.93±5.10	44.12±5.64	0.193	44.04±5.16	42.94±5.36	0.160
Girl	44.54±4.87	44.16±5.95	0.485	43.39±5.03	42.90±5.16	0.645
Boy	45.42±5.41	44.06±5.18	0.247	44.86±5.26	43.00±5.76	0.123
dat angles						
Totally	56.59±4.31	56.55±3.31	0.975	58.31±4.52	58.53±3.76	0.236
Girl	56.91±4.81	56.05±2.95	0.147	58.87±4.97	58.45±3.39	0.889
Boy	56.18±3.60	57.36±3.73	**0.048***	57.60±3.83	58.66±4.34	0.094
adt angles						
Totally	78.47±5.83	79.31±5.26	0.454	77.63±5.31	78.52±4.30	0.392
Girl	78.54±5.95	79.77±6.05	0.262	77.72±4.40	78.64±4.56	0.353
Boy	78.39±5.75	78.57±3.64	0.764	77.52±6.33	78.33±3.91	0.817
a-b ridge count						
Totally	40.32±4.76	39.99±5.31	0.999	40.00±4.79	38.46±5.53	0.111
Girl	40.91±5.16	40.07±4.56	0.368	40.08±4.85	38.49±5.27	0.113
Boy	39.57±4.13	39.84±6.39	0.312	39.89±4.76	38.42±6.01	0.563

FRC: Fingerprint ridge counts, TRC: Total ridge count, *p<0.05 statistically significant, Mann-Whitney U Test was used in analysis (Girls; Case Gr/Control Gr=48/53, Boys; Case Gr/Control Gr=38/33)

sensitivity (27). Despite growing understandings, the mechanisms responsible for the assembly of enteric neural circuits that control gut function remain incompletely defined, and the contribution of early embryogenetic processes to the etiology of FC continues to be an important area of investigation.

Dermatoglyphics, which are permanent epidermal ridge patterns, provide insight into embryonic development (14-16). The rationale for considering dermatoglyphic patterns as an embryogenetic marker for FC is based on the shared ectodermal origin of fingertip epidermis and the ENS, and both develop during similar stages of intrauterine life. In this early period of life, the ectoderm gives rise to the anterior and posterior regions of the gastrointestinal tract, all ENS neurons and glia, as well as the skin.

Table 4. Distribution of children's fingerprint dermatoglyphic pattern types

Finger	Right Hand									Left Hand								
	Case Gr				Control Gr				p	Case Gr				Control Gr				p
	W	UL	RL	A	W	UL	RL	A		W	UL	RL	A	W	UL	RL	A	
I.																		
Totally	38	46	1	1	31	52	-	3	0.336[a]	40	44	1	1	29	54	-	3	0.193[a]
Girl	22	24	1	1	16	34	-	3	0.214[a]	24	22	1	1	14	36	-	3	**0.025***[a]
Boy	16	22	-	-	15	18	-	-	0.777	16	22	-	-	15	18	-	-	0.777
II.																		
Totally	27	29	14	16	26	28	14	18	0.985	27	34	9	16	29	32	10	15	0.975
Girl	15	19	7	7	19	13	11	10	0.428	13	22	7	6	21	18	7	7	0.548
Boy	12	10	7	9	7	15	3	8	0.306[a]	14	12	2	10	8	14	3	8	0.608[a]
III.																		
Totally	19	52	-	15	14	58	-	14	0.571	14	59	2	11	14	64	2	6	0.627[a]
Girl	11	27	-	10	9	36	-	8	0.481	9	34	-	5	10	40	1	2	0.461[a]
Boy	8	25	-	5	5	22	-	6	0.731	5	25	2	6	4	24	1	4	0.970[a]
IV.																		
Totally	31	53	-	2	30	53	-	3	1.000[a]	37	44	-	5	33	46	-	7	0.738
Girl	16	30	-	2	23	28	-	2	0.646[a]	20	25	-	3	20	30	-	3	0.899[a]
Boy	15	23	-	-	7	25	-	1	0.126[a]	17	19	-	2	13	16	-	4	0.636[a]
V.																		
Totally	10	76	-	-	8	77	-	1	0.804[a]	17	67	-	2	8	71	1	6	**0.024***[a]
Girl	4	44	-	-	7	46	-	-	0.432	8	38	-	2	4	45	-	4	0.352[a]
Boy	6	32	-	-	1	31	-	1	0.113[a]	9	29	-	-	4	26	1	2	0.157[a]
Totally																		
(n)	125	256	15	34	109	268	14	39	-	135	248	12	35	113	267	13	37	-
(%)	29	60	3	8	25	63	3	9	-	31	58	3	8	26	63	3	8	-
Girl	68	144	8	20	74	157	11	23	-	74	141	8	17	69	169	8	19	-
Boy	57	112	7	14	35	111	3	16	-	61	107	4	18	44	98	5	18	-

[a] Extended Fisher's Exact Test was used in the analysis if the minimum expected count is less than 5. The Chi Square test was used in the other analyses. *p<0.05 statistically significant, A: Arch type pattern, UL: Ulnar loop, RL: Radial loop, W: Whorl type. (Girls; Case Gr/Control Gr=48/53, Boys; Case Gr/Control Gr=38/33)

In literature, five studies have been found that investigate the relationship between these easily identifiable dermatoglyphic patterns and constipation. Two authors (18,19) argued that dermatoglyphics were associated with childhood FC, while the other three studies (20-22) found no such relationship.

Table 5. Arch type pattern in children

	Case n (%)	Control n, (%)	p	X^2
Arch type pattern				
Yes	30 (34.9)	35 (40.7)	0.618	0.432
No	56 (65.1)	51 (59.3)		

The studies differ in terms of population characteristics. Gottlieb et.al. examined fingerprint dermatoglyphic patterns in 155 adult patients with gastrointestinal complaints. They found that 64% of those who reported constipation and abdominal pain before the age of 10 had one or more digital arches. They emphasized a strong association between arch-type dermatoglyphic patterns and constipation (18). However, the high percentages found might partly be a result of a selection bias, as the recruitment site of the total study population was a gastrointestinal clinic and study conducted on adults. Staiano et.al. carried out a comparative analysis of dermatoglyphic patterns in 45 children diagnosed with chronic idiopathic constipation (22 of whom also had concurrent abdominal pain, and 23 without),

alongside 15 children with Hirschsprung disease and a CG of 35 children. The study revealed a heightened prevalence of arch-type dermatoglyphics in children who suffer from severe chronic idiopathic constipation, especially among those who also experienced abdominal pain (19). Similarly, the study population was small and generalizability was low.

The first study to report opposing findings was conducted by Drongowski. In this study, the dermatoglyphic patterns of 77 children with constipation (39 with FC and 38 with organic constipation) were compared with those of 84 children diagnosed with inguinal hernia. The study concluded that the presence of an arch pattern on any finger was not a reliable screening marker for constipation, and no significant association was identified between dermatoglyphic patterns and neither FC nor organic constipation (20). Jackson et.al. analysed fingerprint patterns across three groups whose mean age of onset 2.65 years: They included 30 children with refractory constipation needing surgery, 30 children who underwent appendectomy for appendicitis, and 169 first-degree relatives from both groups. The presence of a significantly increased arch pattern on at least one finger was categorized as a positive dermatoglyphic finding. However, the study concluded that the presence of an arch pattern was not associated with severe childhood constipation and had no diagnostic value (21). Unfortunately, a more detailed statistical assessment of the data was not available, and the small number of participants restricts the certainty of the conclusions. Goshima et.al. explored the dermatoglyphic traits of 35 children with severe constipation, 45 with mild constipation, 51 children with normal bowel habits, and the mothers of all these children, aged 2-12 years. The study concluded that there was no significant association between the presence of arch-type dermatoglyphics and constipation in neither children nor their mothers. Only a slight concordance was reported in cases of concurrent constipation between children and their mothers (22).

Similarly, in our study, no significant difference was identified in the presence of arch-type patterns between children with and without constipation. When examining the distribution of fingerprint patterns by frequency, it was revealed a significantly higher number of W pattern on the left hand's fifth finger in children with FC compared to the CG. When these patterns were examined by gender, a notable association with constipation emerged in girls, characterized by an increase in W patterns and a decrease in UL patterns on the left hand's first finger. Likewise, in boys, an increase in W patterns on the right hand's fifth finger was linked to constipation. Due to the lack of detailed data on non-arch patterns in literature, our findings could not be directly compared with other studies. However, in a recent study has been reported that the dermatoglyphic characteristics might be a valuable tool to describe the nature of schizophrenia and its clinical subtypes. The arch pattern type in the right ring finger was detected as a specific marker in schizophrenic patients (31).

Since the scarcity of studies on the relationship between fingerprint RCs and palmar angles with constipation, our findings were interpreted with the studies conducted by Atasu (38) in Türkiye, other relevant literature, and our CG. In our study, in both groups the highest fingerprint RCs were observed on the left hand's first finger, while the lowest was found on the right hand's second finger. Among girls, the highest RC was consistently noted on the left hand's first finger in both groups. However, in boys, the highest count was observed on the left hand's first finger in the case group, and on the right hand's first finger in the CG. In national and international studies conducted on children the highest fingerprint RCs have been reported on the right hand's first finger, and the lowest on the left hand's second finger (32-34). Our findings aligned with the general trend of the highest RC occurring on the first finger and the lowest on the second finger. However, the variations in whether these counts were higher on the right or left hand may reflect population-specific characteristics or differences in the methodologies employed

for dermatoglyphic sampling and counting. Furthermore, similar to the findings of Holt (33), our study showed a gradual decrease in fingerprint RCs in the order first, fourth, fifth, third, and second fingers in both genders. When RCs were examined individually for each finger, no statistically significant differences were observed neither between the groups nor genders.

TRC is known to be genetically inherited and can vary depending on factors such as gender, existing medical conditions, and ethnic background (25,32,35). In a study from Türkiye, the mean TRC was reported as 150.79±2.89 in boys and 133.6±2.89 in girls (32). Polat et.al. evaluated the mean TRC in patients with juvenile hypertension aged 19-35 and compared it with CG. It was found to be higher in the case group in both gender (35). No literature was found regarding mean TRC values specifically in individuals with constipation. In our study, the mean TRC was found to be lower in both genders (126.87±34.53 in boys and 127.43±32.06 in girls). Although the difference was not statistically significant, the mean TRC in the FCG was higher compared to CG. Additionally, no significant variation in mean TRC was observed neither between genders nor the right/left hands. The conflicting results may be attributed to individual characteristics, age distribution of our children, or variations in the methods used for fingerprint collection and analyzing.

The literature also contains reports indicating that the a-b RC decreases in schizophrenia (31) and increases in Multiple Sclerosis (36) and coronary artery diseases (37). However, in our study, no significant difference was found, leading to the conclusion that the a-b RC cannot be used as an etiological parameter for FC.

Angles formed between the a, d, and t triradii points on the palm have been assessed in various studies with different sample populations, and significant differences have been observed. For instance, an increase in atd angle has been reported in breast cancer (38), malocclusion (39), hypertension (40), bronchial asthma (41), and Familial Mediterranean Fever (42). Only in a study, a decrease in the atd angle of the left hand has been observed in boys with Hodgkin's disease (43). Similarly, in the adt angle was revealed a decrease in bronchial asthma patients (41). The dat angle has been reported wider in Multiple Sclerosis (36), while narrow in Familial Mediterranean Fever (42). In our study, the right hand "dat" angle was lower in boys with FC.

Our study holds significant importance due to the limited number of studies assessing the relationship between dermatoglyphics and constipation, as well as the unfortunate lack of consensus in the literature. Previous studies have primarily focused on analyzing fingerprint patterns alone. In contrast, our study provides a more comprehensive examination of dermatoglyphic data. In addition to fingerprint patterns, we also evaluated fingerprint RCs, TRC, a-b RCs, and the angles between the adt, atd, and dat triradii. Furthermore, while earlier studies presented data without distinguishing between genders, our study analyzed both the general population and separately evaluated boys and girls, allowing us to obtain more detailed results. Additionally, to the best of our knowledge, our study is the first in Türkiye to explore the relationship between constipation and dermatoglyphics.

However, some limitations should be considered when interpreting our data. Firstly, the diagnosis of FC was based on the Rome IV criteria, which rely on subjective reports from families and do not include objective data such as laboratory tests, imaging, or physical examination findings. We included younger children in our study, anticipating that their participation would enhance the investigation of our hypothesis, despite the potential challenges. Furthermore, palmar angles can vary depending on the correct positioning of the hand during dermatoglyphic sampling. Although efforts were made to minimize this issue, standardization of angle measurements may be influenced in this age group. Due to the lack of studies using parameters other than fingerprint patterns, our data could only be compared with our CG and not with findings in the literature. This limitation, however, can be viewed as a

contribution to the existing body of knowledge.

Conclusion

Based on the data obtained from our study, it is not possible to directly determine the etiology of FC solely by examining dermatoglyphic findings. However, the other significant dermatoglyphic findings identified in our study, if supported by similar research with larger sample sizes, could potentially be utilized in elucidating the etiology FC. In the literature, the presence of arch type patterns in children with constipation has been a topic of debate; however, our study did not find a significant association between arch patterns and FC.

The significantly higher prevalence of a positive family history in the case group suggests that genetic factors may play a larger role in the determination of FC etiology than previously thought. Family physicians should evaluate their registered populations within their specific contexts, considering individual risks. In this regard, dermatoglyphics could be employed as an additional parameter in assessing the predisposition to FC, particularly in children with a family history of FC.

Ethics Committee Approval

This study was conducted in accordance with the ethical principles stated in the "Declaration of Helsinki" and approved by the institutional ethics committee of Sivas Cumhuriyet University Clinical Research Ethics Committee (Approval Number/ Date: 2021-02/34, 10.02.2021).

Conflict of interest

The authors declare no conflict of interest.

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