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RESEARCH

Evaluation of palmar creases of healthy young individuals of different countries

Farklı ülkelerin sağlıklı genç bireylerinin palmar çizgilerinin değerlendirilmesi

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Abstract

Purpose: This study aims to evaluate the potential effects of gender and country factors on palmar creases by examining the palmar creases of young adults from various countries.

Materials and Methods: The study involved a total of 220 volunteers, including 120 males and 100 females aged 18-30, from seven different countries (Jordan, Sudan, Somalia, Iran, Iraq, Tanzania and Turkey), as well as students from Karabuk University. Hand types were evaluated based on palmar creases and the number of origins for both hands. Total Degree of Transversality (T-DoT) values for palmar creases were calculated. Classification of palmar creases and comparison of T-DoT values for both hands were performed between genders and countries.

Results: The study analyzed 440 hands from 220 individuals, identifying 1 Simian, 8 Suwon, and 5 Sydney-type hands, while categorizing the remaining 426 hands as normal type. Regarding the number of palmar crease origins, it was observed that there was a single origin in 3 hands, two origins in 309 hands and three origins in 119 hands. Significant associations were found between genders and countries in the number of palmar crease origins. In addition, significant differences in right hand T-DoT values were found between genders and countries.

Conclusion: In spite of limitations in sample selection and size, these results are important in providing a basis for future in-depth research on palmar creases at later stages, although generalizability to the specific countries represented in the sample may be limited. Consequently, this study highlights variations among countries concerning both the number of palm crease origins and right-hand T-DoT values.

Keywords: Palmar crease types, total degree of transversality, gender, country, ethnic group.

Öz

Amaç: Bu çalışmanın amacı, farklı ülkelerden genç yetişkinlerin palmar çizgilerini inceleyerek, cinsiyet ve ülke faktörlerinin palmar çizgiler üzerindeki potansiyel etkilerini değerlendirmektir.

Gereç ve Yöntem: Çalışmaya Karabük Üniversitesi öğrencisi olan 18-30 yaş aralığında 7 farklı ülkeden (Ürdün, Sudan, Somali, İran, Irak, Tanzanya, Türkiye) 220 gönüllü birey (120 erkek, 100 kadın) dahil edildi. Bireylerin her iki elindeki palmar çizgiler ve orijin sayısına göre el tipi değerlendirmesi gerçekleştirildi. Palmar çizgilerin Total Degree of Transversality (T-DoT) değerleri hesaplandı. Her iki el için de palmar çizgi sınıflandırmaları ve T-DoT değerleri cinsiyetler ve ülkeler arasında kıyaslandı.

Bulgular: Çalışmada 220 kişiden 440 el analiz edilmiş ve 1 Simian, 8 Suwon ve 5 Sydney tipi el tespit edilirken, kalan 426 el normal tip olarak sınıflandırılmıştır. Palmar crease orijin sayısı ile ilgili olarak, 3 elde tek orijin, 309 elde iki orijin ve 119 elde üç orijin olduğunu gözlemlendi. Bu çalışmada cinsiyetler ve ülkeler arasında palmar çizgi tipleri açısından istatistiksel olarak anlamlı bir fark tespit edilmese de palmar çizgi orijin sayıları açısından cinsiyetler ve ülkeler arasında istatistiksel olarak anlamlı ilişkiler saptandı. Ayrıca, sağ el T-DoT değerleri açısından cinsiyetler ve ülkeler arasında anlamlı farklılıklar bulundu.

Sonuç: Bu çalışmanın örneklemin belirli ülkelerden seçilmesi ve örneklem büyüklüklerinin sınırlı olması sonuçların genelleştirilebilirliğini sınırlasa da elde edilen bu bulgular, palmar çizgiler konusunda ilerleyen aşamalarda daha derinlemesine araştırmalara temel oluşturacak olması bakımından önemlidir. Sonuç olarak, bu çalışma hem palmar çizgi kökenlerinin sayısı hem de sağ el T-DoT değerleri bakımından ülkeler arasındaki farklılıkları vurgulamaktadır.

Anahtar kelimeler: Palmar çizgi tipleri, total degree of transversality, cinsiyet, ülke, etnik grup.

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INTRODUCTION

Palmar creases are genetically controlled structural features and surface markings specific to the mobile regions of the hand[1]. These skin creases aid in determining the positions of underlying joints[1-3]. Radial longitudinal creases, proximal transverse creases, and distal transverse creases form the primary categories of major palmar creases[4-6]. It is recognized that there are four different types of palmar creases based on the interplay between proximal and distal transverse creases[4]. These include the normal-type palmar crease, Simian-type palmar crease, Suwon-type palmar crease, and Sydney-type palmar crease[4,5].

The Total Degree of Transversality (T-DoT) is a quantitative analysis method based on palmar creases on the palm[7]. The identification of increased T-DoT values in Down syndrome and reduced T-DoT values in Rheumatoid Arthritis (RA) patients demonstrates that this method has the potential to offer supplementary clinical information[7,8]. This topographical approach could potentially serve as a tool to evaluate palmar crease variants and explore wrinkle variations among diverse ethnic groups[9].

The types of palmar creases form during embryonic and early fetal stages and generally remain primarily constant throughout an individual's lifetime[10,11]. Genetic and environmental factors combine to determine the palmar crease type[12]. Palmar creases are important markers used in criminal investigations, forensic medicine, and the detection of many congenital diseases[4,13]. Palmar crease types are also genetic variables that can vary among populations and can be used to investigate the anthropological characteristics of a community[4,6,13].

In this study, we aim to investigate the possible effects of gender and country factors on palmar creases by analyzing the palmar creases of young adults from different countries. In this way, we aim to contribute to the literature by improving our understanding of the diversity of palmar creases in individuals from different geographical regions and clarifying any connections with gender and identity origins. Our hypothesis assumes that there are significant differences in palmar creases patterns in different countries, which may be influenced by both gender and country of origin.

MATERIALS AND METHODS

Sample

A total of 220 volunteer individuals took part in the study, including 120 males and 100 females, aged between 18 and 30, from seven different countries (Jordan, Sudan, Somalia, Iran, Iraq, Tanzania, Turkey). All participants were university students. Participants with no a history of genetic disorders or injuries to the hands or wrists were allowed to participate in the study. Participants who did not meet these inclusion criteria outlined were excluded from the study. Since only volunteers who met our inclusion criteria and accepted our invitation were included in the study, the number of individuals not included in the research remains indeterminable.

Participants were given explanations of the procedures in their native language, and written informed consent was obtained. This study was designed following ethical principles and received approval from the Karabük University non-interventional ethics committee under decision number 2022/1149 and the research was carried out in compliance with the Declaration of Helsinki. The research was conducted by a team of four anatomists at Karabük University, demonstrating sufficient expertise and competence in the field.

Procedure

All participants were assigned unique codes specific to their country, thereby anonymizing their identity. Demographic information, such as gender and age, was associated with their corresponding codes and organized accordingly. Hand images and the corresponding codes were acquired using a scanner connected to a laptop and recorded digitally. Based on the obtained images, the palmar creases on both hands of individuals were classified as Normal, Simian, Suwon, and Sydney (Fig. 1).

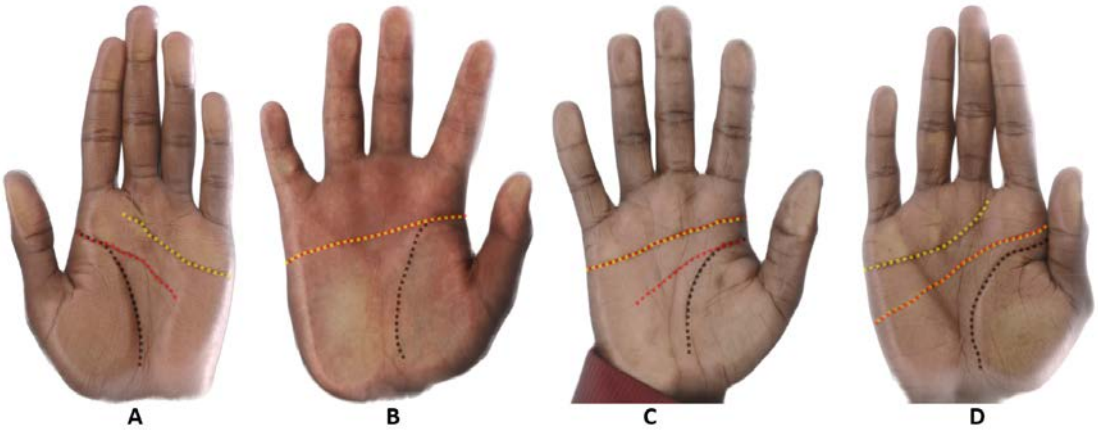

Figure 1. Palm crease types according to the relationship between primary palmar creases A) Normal-type hand crease; all palmar creases are separate. B) Simian hand crease; In addition to the radial longitudinal palmar crease, there is a crease in which the proximal and distal transverse creases are combined, starting from the lateral edge of the palm and ending at the medial edge. C) Suwon-type hand crease; In addition to the radial longitudinal palmar crease and the proximal transverse palmar crease, there is a crease in which the proximal and distal transverse creases are combined. D) Sydney-type hand crease; In addition to the radial longitudinal palmar crease and the distal transverse palmar crease, there is a crease in which the proximal and distal transverse creases are combined.

Classification was performed based on the number of origins of palmar creases, ranging from 1 to 3[3] (Fig. 2).

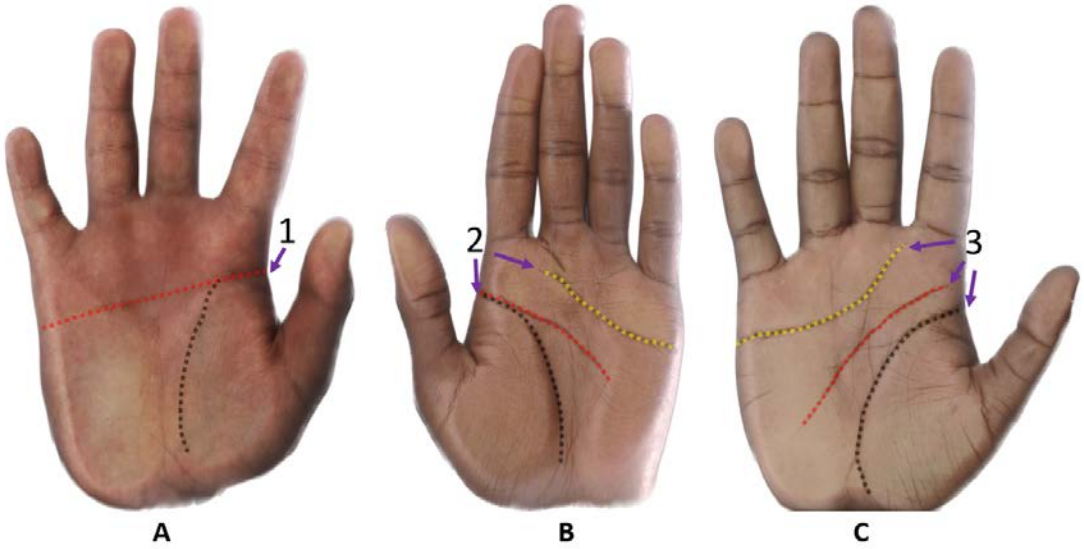

Figure 2. Classification of the palmar crease by the number of origins A) One origin. B) Two origins. C) Three origins.

Finally, total degree of transversality of palmar creases was calculated. By placing a 100 x 100 coordinate axis on the palm, the coordinates of the starting and ending points of palmar creases were determined, and a T-DoT value was calculated for each hand (Fig. 3). This method was applied as described in the literature[4,7,14].

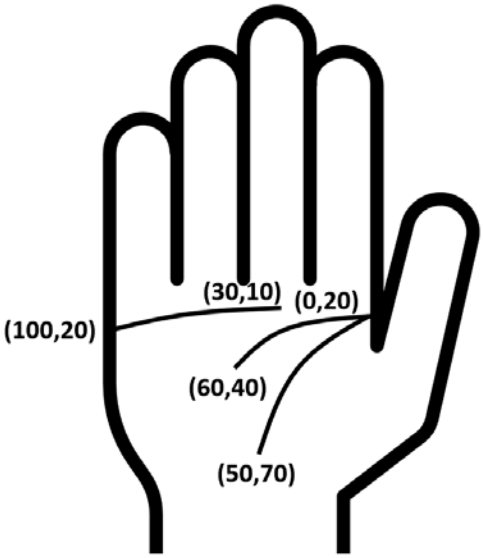

Figure 3. Coordinating the creases and calculating the total degree of transversality (T-DoT). T-DoT=(Sum of differences of X coordinates of all creases)/(Sum of differences of X coordinates of all creases). T-DoT= (50+60+70)/(50+20+10).

Statistical analysis

The data was analyzed using the SPSS 25.0 software package. The normal distribution of age and T-DoT data was assessed using the Kolmogorov-Smirnov test. An independent sample t-test was used to evaluate age differences between genders. The distribution of palmar crease classifications in both hands based on gender and country was assessed using the Monte Carlo Pearson Chi-Square test. The power (1-beta) for the analysis of palmar crease type calculated on this study for both hands is 0.846, considering a type I error (Alfa) of 0.05, a total sample size of 440 and an effect size of 0.22. The Mann-Whitney U test was used to compare T-DoT values between left and right hands based on gender. The Kruskal-Wallis test and Bonferroni-adjusted Mann-Whitney U test were used to compare left and right hand T-DoT values among countries. A statistical significance level of $p<0.05$ was accepted.

RESULTS

A total of 220 individuals (120 males, 100 females) aged between 18 and 30 years were included in this study, representing 7 countries: Jordan, Sudan, Somalia, Iran, Iraq, Tanzania, and Turkey. Among the participants, 203 individuals (111 male, 92 female) had dominant right hands, while 17 individuals (10 male, 7 female) had dominant left hands. The mean age of males was 22.10±3.08 years and that of females, it was 21.62±3.64 years. No statistically significant age difference was observed between gender groups ($p=0.30$) (Table 1).

Table 1. Participant distribution by countries and genders

	Male	Female	Total
Jordan	20	10	**30**
Sudan	19	17	**36**
Somalia	19	17	**36**
Iran	18	12	**30**
Iraq	15	14	**29**
Tanzania	11	12	**23**
Turkey	18	18	**36**
Total	120	100	**220**

When palmar creases were assessed by type in 440 hands of 220 individuals, 1 Simian, 8 Suwon, and 5 Sydney-type hands were identified, while the remaining 426 hands were categorized as normal-type. According to the analyses performed using the Monte Carlo Pearson Chi-Square test, no statistically significant difference in palmar crease types between genders was observed for the right hand ($p=0.153$). Similarly, in the analysis for the left hand, no statistically significant difference in palmar crease types between genders was found ($p=0.162$). These results showed no statistically significant association

between genders in the distribution of palmar crease types (Table 2).

Table 2. Palmar crease classification by gender

	Right Hand			Left Hand		
	Male	Female	p-value	Male	Female	p-value
Normal	118	94	0.153	115	99	0.162
Simian	0	1		0	0	
Suwon	2	2		4	0	
Sydney	0	3		1	1	

When palmar creases were evaluated by country, it was observed that all participants of Somalia and Iraq origin had normal type hands, and the single Simian-type hand belonged to the right hand of Jordanian females. According to the analyses performed using the Monte Carlo Pearson Chi-Square test for the right hand, no statistically significant difference in palmar crease types was detected among countries (p=0.471). Similarly, in the analysis for the right hand, no statistically significant difference in palmar crease types among countries was observed (p=0.435). These results showed no statistically significant relationship in the distribution of palmar crease types among countries (Table 3).

Table 3. Classification of the palmar crease by country and side of the hands

	Right Hand					Left Hand			
Country	Normal	Simian	Suwon	Sydney	p-value	Normal	Suwon	Sydney	p-value
Jordan	27	1	2	0	0.471	29	1	0	0.435
Sudan	35	0	1	0		36	0	0	
Somalia	36	0	0	0		36	0	0	
Iran	29	0	0	1		27	2	1	
Iraq	29	0	0	0		29	0	0	
Tanzania	22	0	0	1		23	0	0	
Turkey	34	0	1	1		34	1	1	
Total	212	1	4	3		214	4	2	

When palmar crease origin numbers were assessed, three hands had 1 origin, 309 hands had 2 origins, and 119 hands had 3 origins. According to the analyses performed using the Monte Carlo Pearson Chi-Square test for the right hand, no statistically significant difference in the number of palmar crease origins was observed between genders (p=0.184). On the other hand, based on the Monte Carlo Pearson Chi-Square test results for the left hand, a statistically significant difference in the number of palmar crease origins was found between genders (p=0.001). These results showed that although there is no statistically significant difference between genders in terms of the number of palmar crease origins in the right hand, there is a significant relationship between genders in the number of palmar crease origins in the left hand (Table 4).

4Table 4. Classification of palmar crease origin number by gender

	Right Hand				Left Hand			
	1 origin	2 origin	3 origin	p-value	1 origin	2 origin	3 origin	p-value
Male	2	87	31	0.184	1	98	21	0.001
Female	0	66	34		0	62	38	
Total	2	153	65		1	160	59	

When evaluating the number of palmar crease origins by country, it was observed that all individuals with 1 origin were Jordanian. Among Jordanian, Somalia, Iranian, Iraqi, and Turkish individuals, the most common hand type based on origin numbers was 2 origins. In contrast, the most common hand type among Sudanese and Tanzanian individuals was 3 origins. According to the Monte Carlo Pearson Chi-Square tests performed for both hands, a statistically significant difference in the number of palmar crease origins was found among countries (p=0.001 for the right hand, p=0.001 for the left hand). These results indicate the presence of a statistically significant relationship among countries in terms of the number of palmar crease origins (Table 5).

Table 5. Palmar crease origin number classification by country

	Right Hand				Left Hand			
Country	**1 origin**	**2 origin**	**3 origin**	**p-value**	**1 origin**	**2 origin**	**3 origin**	**p-value**
Jordan	2	22	6	0.001	1	27	2	0.001
Sudan	0	19	17		0	17	19	
Somalia	0	28	8		0	28	8	
Iran	0	25	5		0	26	4	
Iraq	0	24	5		0	23	6	
Tanzania	0	9	14		0	10	13	
Turkey	0	26	10		0	29	7	
Total	2	153	65		1	160	59	

The Mann-Whitney U test was used to compare T-DoT data between genders for both the left and right hands. No significant difference was observed between genders for the T-DoT value of the left hand (p=0.464). However a significant difference was found between genders, for the right hand T-DoT value (p=0.007), suggesting that this value was statistically higher in females (Table 6).

Table 6. Left and right hand T-DoT values by gender

	Male (Mean±SD)	**Female (Mean±SD)**	**p-value**
Left T-DoT	1.73±0.29	1.76±0.31	0.464
Right T-DoT	1.72±0.28	1.80±0.30	0.007

The comparison of T-DoT values for the left and right hands across countries was performed using the Kruskal-Wallis test. No significant difference was found among countries for the left hand (p=0.219), but a significant difference was observed for the right hand (p=0.001). According to the Bonferroni-corrected Mann-Whitney U test conducted to determine the origin of significance, statistically significant differences were found between Turkey and Jordan (p=0.001), Tanzania (p=0.009), Somalia (p=0.002), Sudan (p=0.012), and Iran (p=0.033) for the right hand (Fig. 4, Table 7).

Table 7. Left and right hand T-DoT values by country

	Jordan	Sudan	Somalia	Iran	Iraq	Tanzania	Turkey	p-value
Left T-DoT (Mean±SD)	1.71±0.29	1.67±0.27	1.71±0.29	1.71±0.26	1.77±0.27	1.76±0.36	1.89±0.33	0.219
Right T-DoT (Mean±SD)	1.64±0.29	1.74±0.29	1.68±0.29	1.73±0.24	1.84±0.29	1.69±0.29	1.97±0.24	0.001

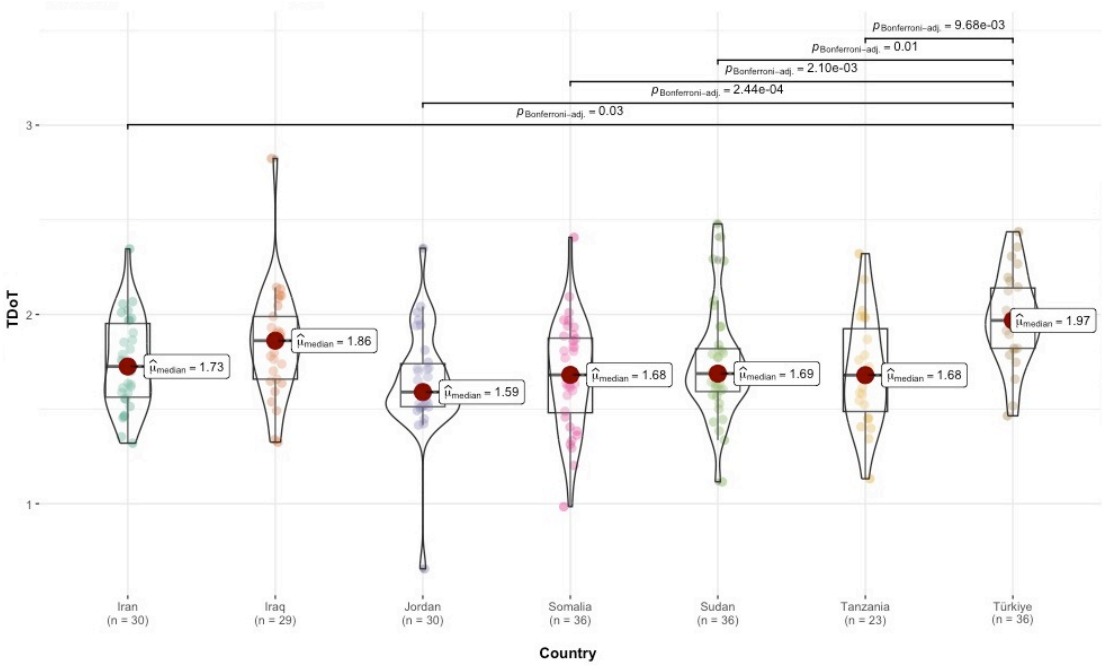

Figure 1. Post hoc comparison of right hand T-DoT values between countries Mann Whitney U test with Bonferroni correction.

DISCUSSION

In this study, we examined the palmar creases of young adults from different countries and evaluated the influence of gender and country factors on these characteristics. The results of our study showed that the normal type and the 2-origin hand type were the most common hand types for both genders and all countries, for both hands. Our findings revealed no statistically significant difference in palmar crease types between genders. However, a significant difference was observed in terms of palmar crease origin numbers between genders. While females exhibited a higher prevalence of 2-origin creases in the left hand, it was observed that females had significantly higher average T-DoT values than males in the right hand. These results indicate an influence of gender on the palmar creases morphology.

No significant difference was found in palmar crease types among countries; however, a statistically significant relationship was found regarding the origin numbers of palmar crease between countries. Significant differences in right-hand T-DoT values were observed between Turkey and Jordan, Tanzania, Somalia, Sudan, and Iran. These results suggest the

potential association of palmar crease morphology and ethnic origin.

Many studies in the literature[2,4-6,15], have determined that palmar crease types exhibit variations in terms of race, ethnicty, and geography. According to these investigations, the prevalence of Simian, Suwon, and Sydney-type palmar creases varies among ethnic groups. For instance, the prevalence of the Simian crease type has been observed to increase from Europeans to East Asians[2]. Similarly, variations in the prevalence of Suwon and Sydney creases among different ethnic groups have been reported (Table 8)[2,4-6,15].

Niu et al.[16] raised the question of whether certain palmar crease features are unique to specific ethnicities, indicating a potential ethnic specificity in palmar crease characteristics. Basu et al.[17] mentioned that a single palmar flexion crease, known as a simian crease, has been associated with various chromosomal anomalies and clinical syndromes. Moreover, Offei et al.[18] linked specific palmar crease type patterns to delayed development and learning difficulties. This highlights the possibility that palmar creases may differ between different ethnic groups, suggesting that genetic, ethnohistorical, and environmental factors may contribute to these variations[15]. In our study, no significant differences were detected in terms of palmar crease types among countries. Additionally, no statistically significant difference was found between palmar crease types and genders. Sharma and Sharma[5] stated that the simian and suwon types are more common in males, and the sydney type is more common in females among the population of Central India. Park et al.[4] reported the simian, Sydney, and Suwon creases were more common in males than in females in Korean population. Furthermore, Yusuf et al.[19] demonstrated a strong association between palm crease type and gender. There are no significant differences for palmar types in our study may potentially be attributed to the relatively small sample size or the geographical proximity of some countries. Working with larger sample groups could produce more powerful results in statistical analysis and allow us to see potential relationships more clearly. Belay et al.[20] emphasized that the palmar crease patterns are influenced by the primary palmar crease origin points, and all palmar crease variant types showed an association with a primary palmar crease origin point. Based on our classification according to the number of palmar crease origins, significant differences were observed between genders and countries. This result showed that differences in the number of origins can be observed even with a small sample size.

Table 8. Prevalence of palmar crease type according to countries in the literature

Study	Country	Simian(%)	Suwon(%)	Sydney(%)
Oyinbo et al[2]	Nigeria	4.1	0	0.19
Park et al[4]	Korea	12.6	0.5	2.5
Sharma et al[5]	India	14.4	2.4	3.6
Efe et al[9]	Nigeria	5	0	0
Present study	Jordan	1.67	5	0
	Sudan	0	1.39	0
	Somalia	0	0	0
	Iran	0	3.33	3.33
	Iraq	0	0	0
	Tanzania	0	0	2.17
	Turkey	0	2.78	2.78

This study presents a comprehensive evaluation of the T-DoT method used in the analysis of palmar creases. T-DoT, as described by Dar and Schmidt[7] proves to be as a valuable tool for the quantitative analysis of palmar creases. The ability of this method to objectively evaluate the morphological diversity of palmar creases underscores its potential as a significant indicator in clinical and anthropological studies. The literature shows higher T-DoT values in individuals with Down syndrome compared to the normal population[7], while lower T-DoT values have been observed in patients with Rheumatoid Arthritis (RA)[12]. These results suggest that various diseases can affect the morphological characteristics of palmar creases and that T-DoT value could serve as a notable biomarker in clinical settings. Comparative analyses based on gender and occupation have indicated significant differences in T-DoT values[4,9,14].

Specifically, females were observed to have higher T-DoT values than males[4] consistent with the T-DoT results of our study on the right hand. In a study by Efe et al.[9] in Nigeria, no significant differences in T-DoT were found between two different ethnic groups. However, our study observed significant differences in right-hand T-DoT values among different countries. These results demonstrate that T-DoT may be influenced by various factors affecting the structural characteristics of palmar creases. The implication from our study is that T-DoT should be considered as an essential indicator for understanding the variability of palmar creases in different populations and for anthropological investigations is noteworthy.

The limitations of our study should be taken into consideration. The selection of specific countries for the sample and the limited sample sizes may limit the generalizability of the results. Additionally, it should be noted that the insufficient number of participants who were predominantly left-handed as the dominant hand limited our ability to make comparative analyses based on the dominant hand. Furthermore, the fact that the data obtained only from young adults suggests that different results may occur in geriatric and pediatric populations. However, conducting the study on individuals from seven different countries underscores the uniqueness and strength of our research. For future research, conducting more comprehensive studies with more extensive and diverse age groups of participants is recommended. Particularly, research involving broader participant groups from different age may contribute to a better understanding of the age-related changes and development of palmar creases.

In conclusion, this study represents a significant stride in assessing the influence of gender and country factors on the morphology of palm creases. The findings suggest that palm creases may serve as a valuable parameter in numerous genetic and anthropological investigations. While no significant differences in palmar crease types among countries were found in this study, a statistically significant relationship was observed among countries regarding the number of palm crease origins. Additionally, significant differences were found among countries in terms of right-hand T-DoT values. These findings will serve as a basis for more in-depth future research on palmar creases.

Author Contributions: Concept/Design: ŞT; Data acquisition: NEŞ. RSB; Data analysis and interpretation: NEŞ; Drafting manuscript: NEŞ; Critical revision of manuscript: ŞT, ZÖ; Final approval and accountability: NEŞ, RSB, ZÖ, ŞT; Technical or material support: NEŞ, RSB, ZÖ, ŞT; Supervision: ZÖ, ŞT; Securing funding (if available): n/a.
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