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Quantitative Characterization on the Dermatoglyphics of the Fingers and Palms of Male Bulgarians

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Finger and palm ridge count for both hands in representative group of 1161 healthy men from 116 settlements in Bulgaria are determined. Computed are: ridge count on each finger, summed finger ridge count on both hands separately, total finger ridge count; ridge count on each interdigital area, summed palm ridge count on both hands separately, total palm ridge count. Descendent formulae about ridge count on fingers and interdigital areas are elaborated. The studied individuals are distributed according to summed finger and summed palm ridge count, and total finger and total palm ridge count too. Correlations between ridge count on single fingers and between ridge count on palm interdigital areas are computed. Highest is the correlation between ridge count on homologous fingers and between ridge count on homologous interdigital areas in right and left hand. Data could be used as norm in clinical and medico-anthropological investigations with theoretical and scientific applied purpose.

Key words: dermatoglyphics, finger ridge count, palm ridge count, correlation dependencies, Bulgarian men.

Introduction

The dermatoglyphic characterization of man is a part of his complete anthropological characteristics. The dermatoglyphic investigations could be differentiated conditionally in two sections: the first covering studies of variability in dermatoglyphic features for healthy populations, and the next investigating the genetic aspects of dermatoglyphics and its application in the clinical practice. It is taken for granted that dermatoglyphic features are determined polygenic but during the early stages of embryogenesis the influence of environmental factors hadn't to be neglected. Dermatoglyphics could be used for the differentiation of inherited and acquired pathology in different diseases. The dermatoglyphic status of healthy population had to be known when the diversions of dermatoglyphic characterization are evaluated in different diseases.

The finger and palm ridge count are quantitative dermatoglyphic features used more rarely than the papillary patterns by themselves. In Bulgaria are available data only about finger and palm ridge counts of healthy persons from Northeast Bulgaria [7] and some data about dermatoglyphic investigations of control groups when studying different diseases [9, 10].

The aim of the present study is to investigate the finger and palm ridge counts on both hands in representative group healthy Bulgarian men.

Material and Methods

Object of the study are the dermatoglyphic prints for both hands of 1161 healthy men from 116 settlements in the country. The digital and palm ridge counts are elaborated after P e n r o s e [5] and H o l t [3] methods. The analysis includes: the digital ridge count on each finger, the summed finger ridge count separately for both hands, the total finger ridge count; the palm ridge count on each interdigital area, the summed palm ridge count separately for both hands and the total palm ridge count for both hands. Correlations between ridge count on the single fingers and between ridge count on the single palm interdigital areas are computed by the coefficient of P e a r s o n [8]. The bilateral differences are evaluated by the t-criterion of Student at $P < 0.05$.

Results and Discussion

Finger ridge count

As it is well known the values of finger ridge count are conditioned by the frequency of model type finger papillary patterns. The highest ridge count corresponds to the whorl patterns (that's why they exert greatest influence to the total finger ridge count), followed by ulnar and radial loops. Highest is the mean ridge count on I-st digit in right (18.44 ± 0.17), and lowest — on II-nd digit in left (10.60 ± 0.20) (Table 1, Fig. 1). The descendent formula is identical for both hands — I>IV>V>III>II. So, the results obtained corresponds to the high frequency of whorls and loops on I-st and IV-th digits and to the high frequency of arches on II-nd digits in right and left hand of the investigated Bulgarian men [6]. The average ridge count is higher on all fingers in right, excepting the III-rd digit by which the difference is 0.11 in favor of left. Statistically significant is the bilateral difference for I-st and II-nd digits ($t = 8.58$ and $t = 4.11$ respectively) while the difference for the rest three fingers is very small. Considerably higher is the mean summed ridge count in right (71.12 ± 0.72) compared with its values in left (67.44 ± 0.71) ($t = 3.64$) (Table 1, Fig. 2). We calculated also the percent distribution of individuals according to the summed ridge count on both hands separately, i.e. whether the ridge count is equal on both hands, or it is higher in favor for right or in favor for left. Equal is the summed ridge count in right and in left for 4.67% of the persons. At 61.22% of the men the summed ridge count is higher in right, and at 34.11% of them it is higher in left. These data are in unison with these published by Holt in 1954 for 254 English males — 3.9%, 63.4% 32.7% respectively [after 3].

T a b l e 1. Statistical parameters of the ridge count on single fingers and Total ridge count in Bulgarian males

Statistics	Right hand						Left hand						Total both hands
	I	II	III	IV	V	I – V	I	II	III	IV	V	I – V	I – X
n	1091	1081	1104	1098	1112	960	1114	1085	1109	1104	1121	990	858
$\bar{x}$	18.44	11.75	11.98	16.03	13.35	71.12	16.38	10.60	12.09	15.69	13.09	67.44	137.84
S	5.60	6.69	5.85	5.50	4.83	22.38	5.79	6.63	5.96	5.54	4.48	22.37	43.55
$S_{\bar{x}}$	0.17	0.20	0.18	0.17	0.15	0.72	0.17	0.20	0.18	0.17	0.13	0.71	1.49
v	30.36	56.95	48.86	34.30	36.17	31.47	35.37	62.54	49.31	35.30	34.26	33.16	31.60
min	0	0	0	0	0	0	0	0	0	0	0	2	4
max	35	30	31	30	25	127	44	29	29	32	27	139	260

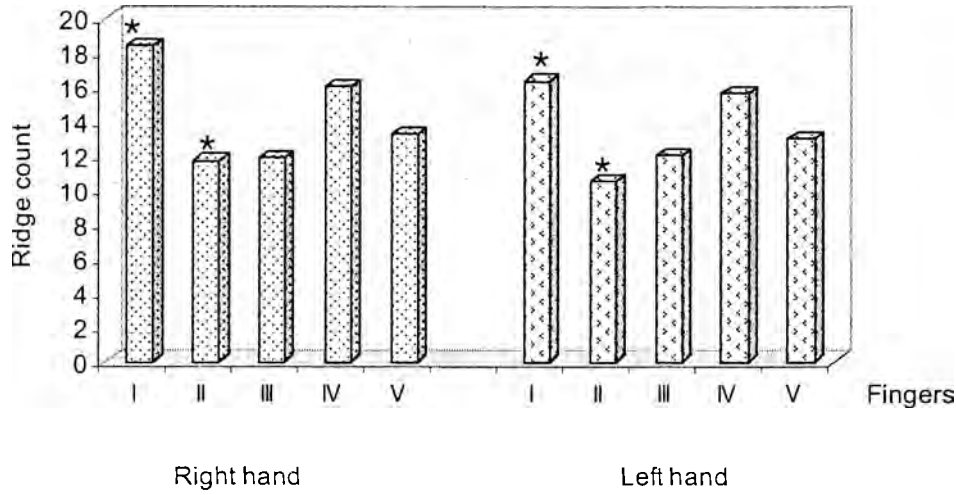

Fig. 1. Ridge count on separate fingers
* — $P < 0.05$

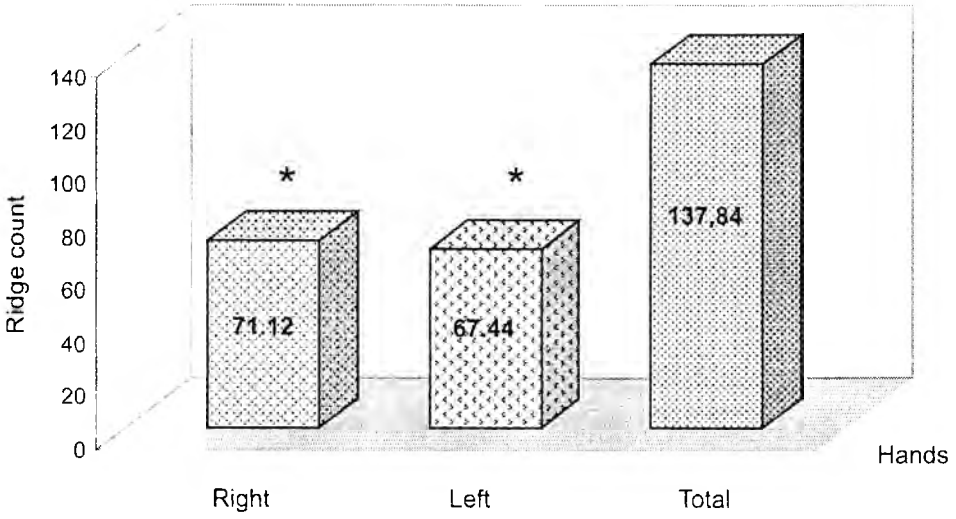

Fig. 2. Fife fingers' ridge count and total ridge count
* — $P < 0.05$

The distribution of individuals according to the summed ridge count from I-st to V-th digits shows that most of the males come into the interval 71 — 80 ridges in right, which coincide with the calculated mean value (x — 71.12 ± 0.72). In left again most are the individuals who have summed ridge count from I-st to V-th digits getting into the interval 71-80, but the average value falls into the former interval 61 — 70 ridges (x — 67.44 ± 0.71). The frequency distribution of summed ridge count is moved in left, or negatively skewed for both hands. The non-normality is better expressed in left hand compared with the right one (Fig. 3).

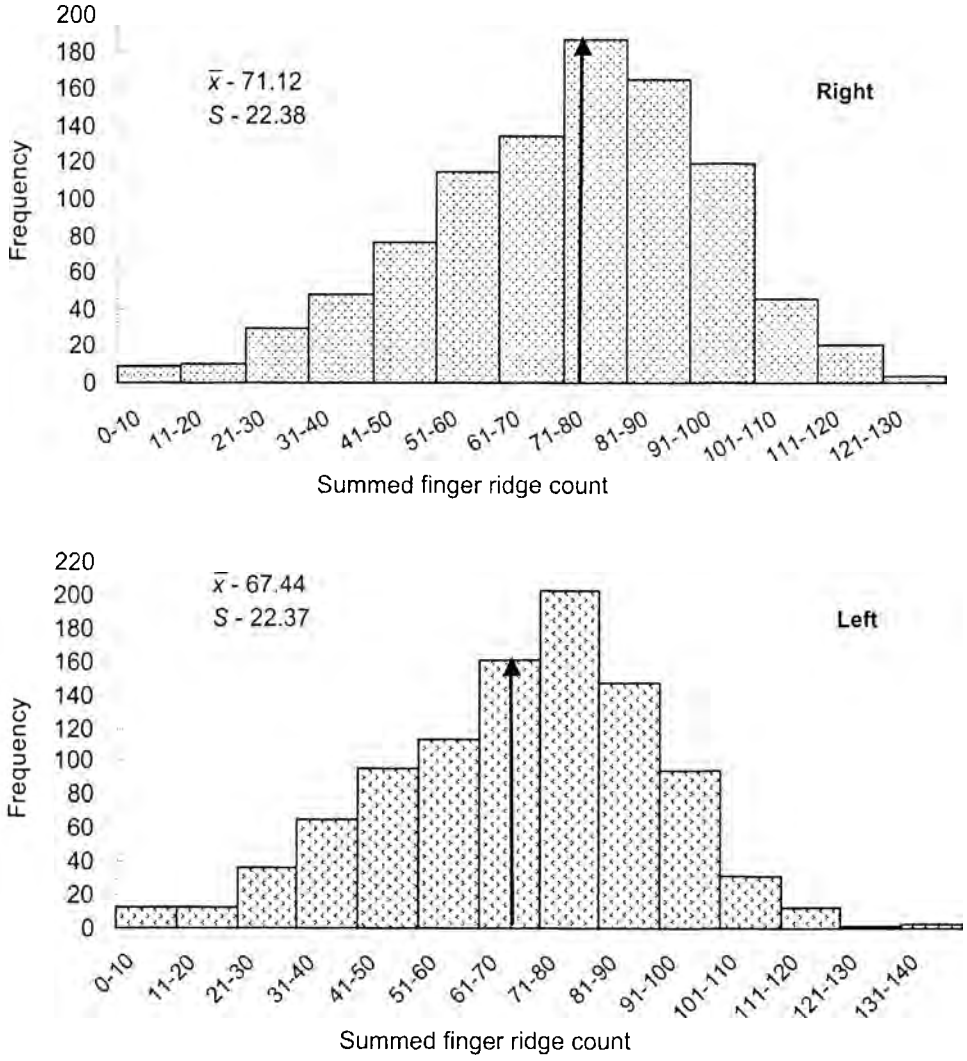

Fig. 3. Distribution of the individuals according to their summed finger ridge count

The obtained total finger ridge count (TFRC) for both hands of the investigated males is 137.84 ± 1.49 (Table 1). The distribution of the individuals according to their TFRC is asymmetrical, moved in left (Fig. 4). This result is probably determined by the distribution of summed ridge count in left hand. Analogical are the results in the investigations of Holt, 1955 for 825 English males [after 3] and Karev, 1979 for 1065 Bulgarian males [8]. The negative skewness in the frequency distribution is accepted by Holt as an indicator for the influence of comparatively small genes number over TFRC determination. In the case when big number of genes has an appreciable effect on the TFRC determination, the curve of frequency distribution had to be similar to the Gaussian one [3].

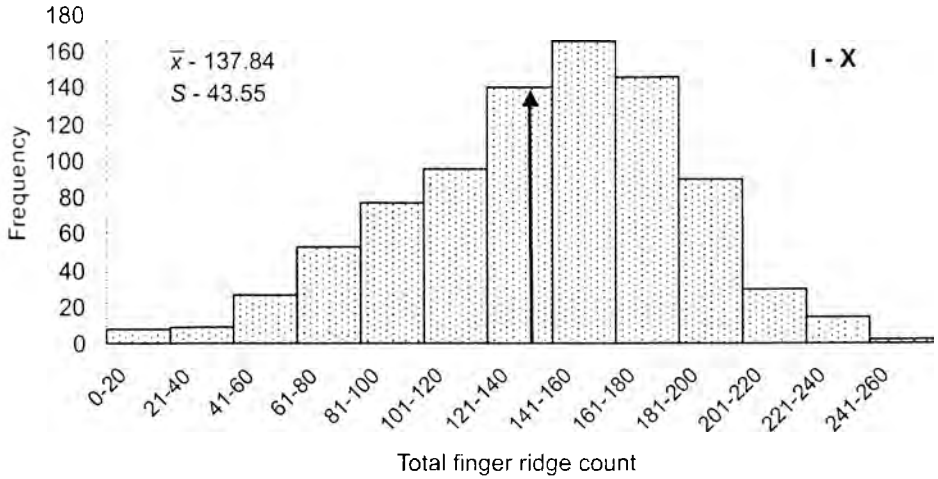

Fig. 4. Distribution of the individuals according to their total finger ridge count

Correlation between ridge count on single digits

The values of correlation coefficients about finger ridge count are presented in Table 2. The highest correlation coefficients are established between the ridge count on homologous fingers in right and left. The correlation coefficients range from $r = 0.725$ for the I-st finger pair to $r = 0.786$ for the IV-th finger pair. High correlation dependence but moderate degree was established for the neighbor finger pair (II-III, III-IV and IV-V). Such dependence was found about the neighbor fingers of the same hand, as well as about the fingers of different hands within the same pair, as for instance, II-nd left — III-rd right, etc. We suppose that the results obtained are in unison with the advanced hypothesis by De W i l d e [1] for the presence of one complete system of finger ridges, which during the early stage of hand formation in embryogenesis period continue from one digit to another. Lowest correlation was established between ridge count on the thumb and other fingers. The correlation coefficients range from $r = 0.364$ to $r = 0.473$. Other authors have published also similar results about correlation dependence between ridge count on single digits [3, 4].

T a b l e 2. Correlation coefficients between the finger ridge counts

Finger		Right					Left				
		I	II	III	IV	V	I	II	III	IV	V
Right	I	1.000	0.453	0.442	0.426	0.473	0.725	0.434	0.428	0.414	0.452
	II	-	1.000	0.657	0.525	0.511	0.435	0.744	0.685	0.552	0.496
	III	-	-	1.000	0.585	0.517	0.401	0.600	0.761	0.600	0.493
	IV	-	-	-	1.000	0.636	0.364	0.503	0.617	0.786	0.626
	V	-	-	-	-	1.000	0.417	0.472	0.516	0.616	0.778
Left	I	-	-	-	-	-	1.000	0.443	0.418	0.379	0.431
	II	-	-	-	-	-	-	1.000	0.655	0.519	0.482
	III	-	-	-	-	-	-	-	1.000	0.656	0.524
	IV	-	-	-	-	-	-	-	-	1.000	0.623
	V	-	-	-	-	-	-	-	-	-	1.000

Palm ridge count

The results about palm ridge count show that biggest is the number of papillary ridges found on II Interdigital Area (IA) (between triradii **a - b**) in both hands, followed after a descendent order by IV IA (**c - d**) and III IA (**b - c**). Higher are the mean values of **a - b** ridge count on left hand in comparison to right one, while the **c - d** ridge count is higher on right hand compared to left one. Both differences are statistically significant ($t = 3.16$ and $t = 5.88$ respectively) (Table 3, Fig. 5).

T a b l e 3. Statistical parameters of the palmar interdigital ridge count and Total ridge count in Bulgarian males

Statistics	Right hand				Left hand				Total both hands
	a-b	b-c	c-d	a-d	a-b	b-c	c-d	a-d	a-d
n	1088	1030	1023	978	1111	1025	995	972	885
x	37.29	24.88	34.55	97.03	38.05	24.48	33.02	95.74	193.37
S	5.94	5.55	5.78	13.13	5.62	5.42	6.23	13.28	25.45
Sx	0.18	0.17	0.18	0.42	0.17	0.17	0.20	0.43	0.86
v	15.93	22.30	16.72	13.54	14.77	22.14	18.86	13.87	13.16
min	20	8	13	55	9	8	8	45	100
max	66	46	58	154	60	40	51	141	295

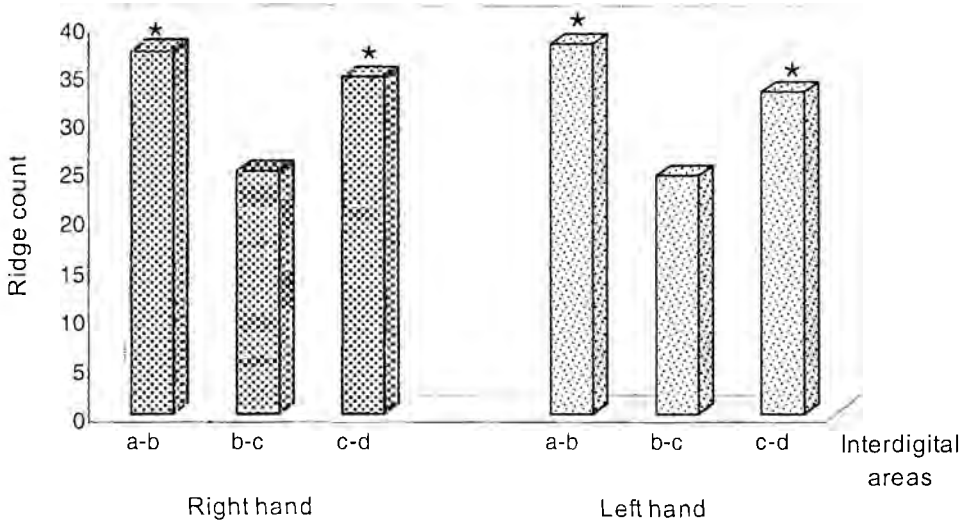

Fig. 5. Palm ridge count on separate interdigital areas
* — $P < 0.05$

Considering the three IA, the summed ridge count **a-d** is higher in right hand (97.03 ± 0.42) than it is in left hand (95.74 ± 0.43) ($t = 2.15$) (Table 3, Fig. 6). The values of summed ridge count range from 55 ridges to 154 ridges in the right hand and from 45 to 141 ridges in the left one. As about finger ridge count, we calculated also the per cent

distribution of individuals who have equal ridge count on both hands, or higher ridge count in favor for right or in favor for left. The summed palm ridge count is higher on the right hand for most of the males (54.01%). Least are the individuals having equal summed ridge count on both hands (6.33%), and 39.66% have higher summed ridge count in left hand.

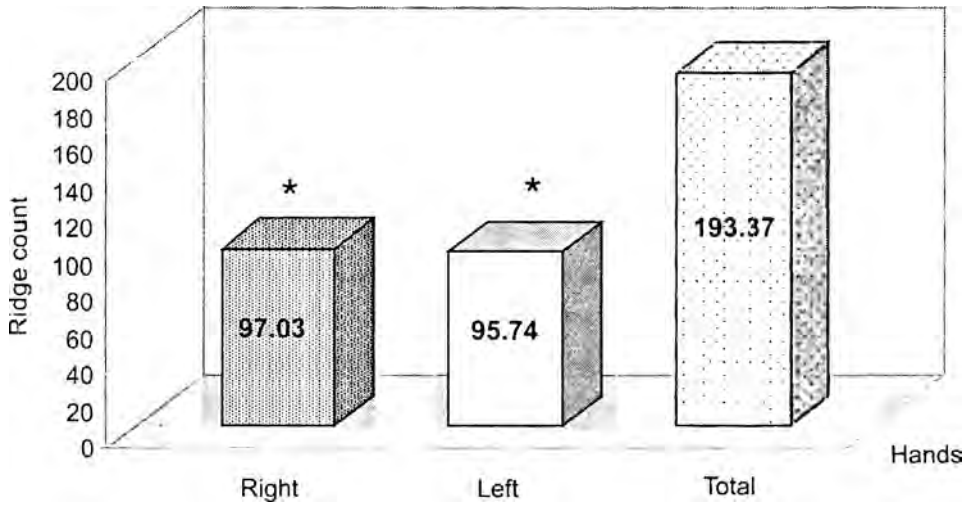

Fig. 6. Palm ridge count on right, left and both hands
* — $P < 0.05$

The distribution of individuals after summed palm ridge count **a-d** shows that most of them have ridge count within the interval 91 — 100 on both hands. These results coincide with the established mean values for both hands. The frequency distribution of the summed palm ridge count is practically symmetrical in contrast to the frequency distribution of the summed finger ridge count (Fig. 7).

The mean value of total palm ridge count (TPRC) for both hands is 193.37 ± 0.86 (Table 3). The established minimal total ridge count is 100, and the maximal is 295. The frequency distribution of the individuals according to their TPRC is almost symmetrical but slightly moved in left (Fig. 8).

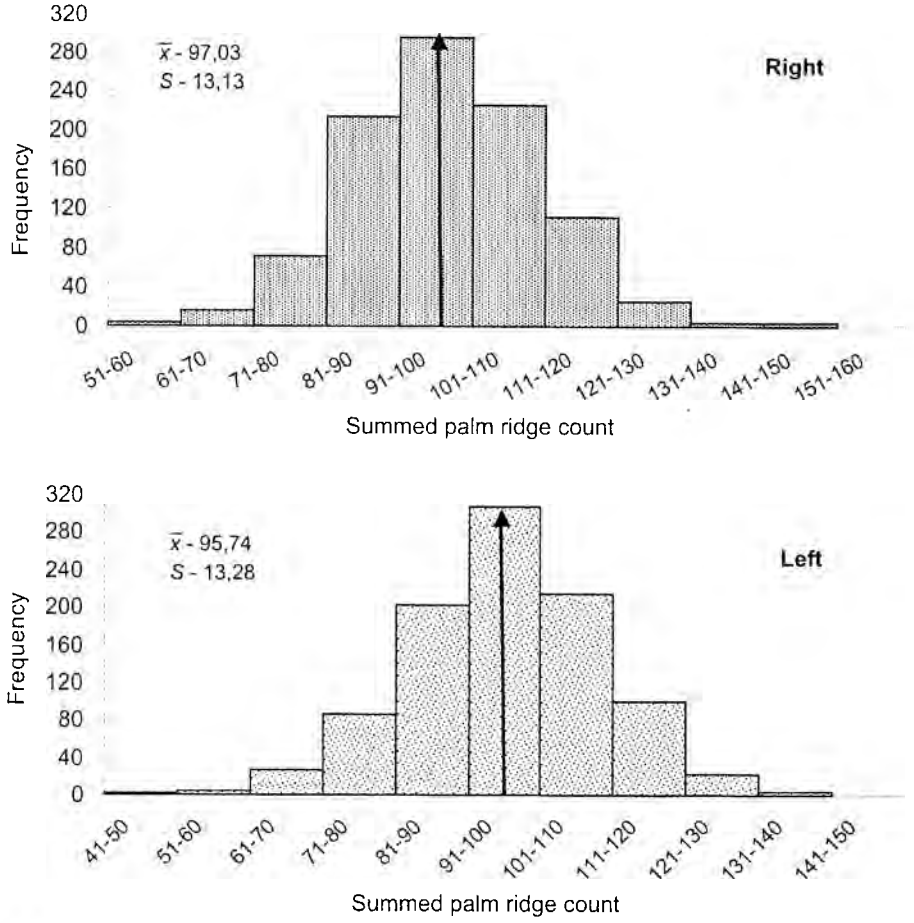

Fig. 7. Distribution of the individuals according to their summed palm ridge count

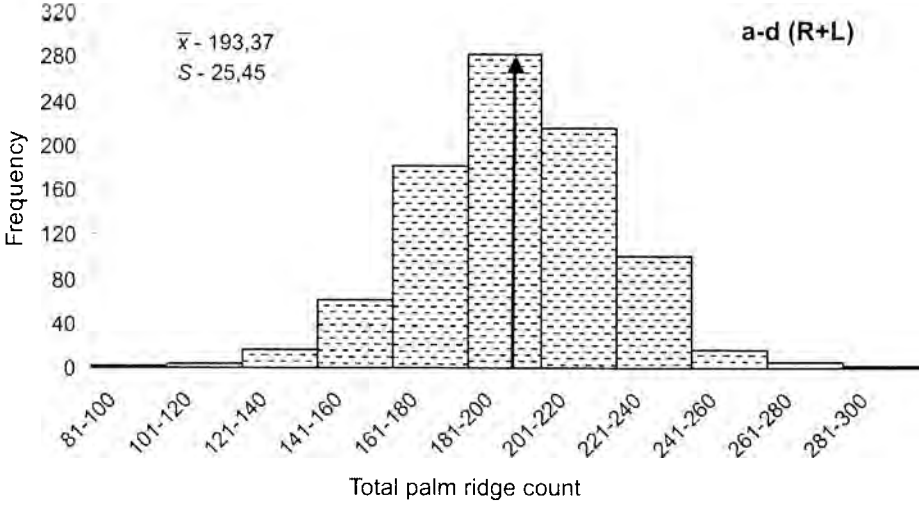

Fig. 8. Distribution of the individuals according to their total palm ridge count

Correlation between ridge count on single interdigital areas

The values of correlation coefficients about palm ridge count are presented in Table 4. Highest are the correlation coefficients between ridge counts on the single interdigital areas and the summed palm ridge count (**a-d**) on same hand, as well as, the correlation coefficients between ridge counts for the homologous interdigital areas on left and right hand (with the exception of **c-d** ridge count). The values range between $r = 0.736$ to $r = 0.852$. Moderate correlation (**r** = 0.688) was established between **c-d** ridge count for right and left hand. Lowest is the correlation between palm ridge count for the neighbor interdigital areas on the same hand. The correlation coefficients range between $r = 0.314$ to $r = 0.417$. G. Floris and G. M. Sanciu have investigated 116 men of Sardinian origin and have established similar to our correlation dependences and coefficients for the ridge count on interdigital areas **a-b**, **b-c** and **c-d** [2].

Table 4. Correlation coefficients between the palm ridge counts of interdigital areas

Hand		Right				Left			
		a-b	b-c	c-d	a-d	a-b	b-c	c-d	a-d
Right	a–b	1.000	0.391	0.400	0.795	0.744	0.395	0.373	0.647
	b–c	-	1.000	0.314	0.736	0.393	0.759	0.445	0.680
	c–d	-	-	1.000	0.752	0.421	0.305	0.688	0.621
	a–d	-	-	-	1.000	0.688	0.632	0.657	0.852
Left	a–b	-	-	-	-	1.000	0.376	0.417	0.768
	b–c	-	-	-	-	-	1.000	0.397	0.748
	c–d	-	-	-	-	-	-	1.000	0.802
	a–d	-	-	-	-	-	-	-	1.000

Conclusion

The results in the present representative investigation together with the elaborated and published data by us till now for another dermatoglyphic features give notion about the entire morphological characterization of hands' skin relief in Bulgarian males. The data could be used also as a norm in the clinical and medico-anthropological investigations with theoretical and scientific applied purpose.

References

1. De Wilde, A. G. Reflections on ridge systems or the development of glyphologics. – Coll. Anthropol., **6**, 1982, No 2, 111-120.
2. Floris, G., G. M. Sanciu. I conteggi intertriradiali palmari nei Sardi: Nota preliminare. – Antropologia Contemporanea, **12**, 1989, No 1-2, 51-55.
3. Holt, S. The genetics of dermal ridges. – Illinois, Charles C. Thomas, Springfield, 1968. 195 p.
4. Kobyliansky, E., S. Micle. Finger patterns characteristics as determinants of total ridge count variability. – Inter. J. of Anthripol., **1**, 1986, No 1, 49-58.
5. Penrose, L. S. Memorandum on Dermatoglyphic Nomenclature. – Birth Defects Original Article Series, **4**, 1968, No 3, 1-12.

6. Tornjova - Randelova, S., D. Paskova - Topalova. Dermatoglyphics in Bulgarians – Finger Patterns. — Acta Morhol. et Anthropol., 6, 2001, 137-143.
7. Калинов, К. Статистически методи в поведенческите и социалните науки. С., НБУ, 2001. 445 с.
8. Карев, Г. Нормален дерматоглифски статус на българите от Североизточна България (канд. дис.). София, 1979. 216 с.
9. Сивков, С. Сравнително антропологично проучване на шизофренно болни от гледна точка на невроонтогенетичната хипотеза за шизофренията. (канд. дис.). Пловдив, 2000. 140 с.
10. Торньова - Ранделова, С. Дерматоглифика при здрави деца и деца със зрителна, слухова и интелектуална недостатъчност (канд. дис.). София, 1986. 214 с.