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Dermatoglyphics in Patients with Hypothyreosis

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A B S T R A C T

About 15% of all females and 3% of all males suffers from hypothyreosis. The thyroid disease is the most frequent cause of hypothyreosis, and among people in Croatia who are suffering from that disease 90% have been affected by its autoimmune form. The thyroid diseases are supposed to be caused by the influence of various genetic and external factors and some forms of genetic influences have not yet been studied. Analysis of digito-palmar dermatoglyphics has been used in the research of the role of genetic predisposition in many various diseases. We have analyzed correlation of qualitative and quantitative traits between the group of 50 females suffering from hypothyreosis and a control group of 100 phenotypically healthy females. Quantitative statistical analysis using t-test has indicated only few significantly different variables, while the discriminant analysis has shown 76.9% correctly classified samples. The factor analysis has shown a high percentage of total variance within patients suffering from hypothyreosis, as well as the different structure of individual factors. Qualitative analysis has shown the heterogeneity between the two examined groups. The results of the research have proved that the qualitative characteristics are more unstable than the quantitative ones and they have also shown the instability of genes taking part in hypothyreosis development implying genetic predisposition of the disease.

Key words: *hypothyreosis, dermatoglyphics, genetic predisposition*

Introduction

Hypothyreosis is the systemic disease, caused by dysfunction of the thyroid gland. This disorder affects every cell in the human body by decreasing the metabolism of the organism. The prevalence of hypothyreosis has been increasing over the years. In most cases it affects the people at the age between 40 and 60 years. Prevalence of the subclinical hypothyreosis is 15% in females and 3% in male population. The thyroid disease is the most frequent cause of hypothyreosis. In Croatia, among the people suffering from hypothyreosis 90% have been affected by its autoimmune form. Autoimmune thyreoiditis is 15 times more frequent in females, especially those who are older than 45 years. The symptoms of hypothyreosis are numerable and untypical and can also indicate many other diseases which make it difficult to diagnose the disease differentially. Early diagnosis has an important impact on the development of the complications and the final prognosis. The substitutional therapy erases all pathological changes. If the disease is not recognized on time, circumstances could be fatal. The thyroid diseases are supposed to be caused by the influence of various genetic and external factors during the intrauterine period[1]. Low birth weight, level of estrogens, stress, infections, amount of iodine in food, smoking, many toxins and drugs also contribute to the development of the disease[1].

Dermatoglyphics are patterns on fingers, palms and soles. They start developing between the 5th and the 6th week of the intrauterine development and by the 21st week they are completely formed and remain unchanged[2–5]. Dermatoglyphics are relevant for the understanding of the human development[6–7] and for the differentiation during the early stage of embryogenesis, which makes them important in studies of the human medical pathology[2–5]. So far, digito-palmar dermatoglyphics have been used in many studies attempting to understand the

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genetic etiology of different diseases: breast cancer[8,9], bronchopulmonary[10] cancer, gastric cancer[11], larynx cancer[12], beta thalassemy[13], diabetes mellitus[14,15], psoriasis, vitilligo, alopecia areata[16], psoriatic polyarthritis[17], schizophrenia[18,19], malocclusion[20], adermatoglyphia (in ADULT syndrome)[21], myopia, developmental displacement of the hip, ankylosing spondylitis, cervix cancer, colorectal cancer, melanoma, polycystic kidney disease, myomas, palatoschisis, mental retardation, autism, hypothyreosis[22]. The results have shown differences of the dermatoglyphic features between patients and healthy subjects[8–22].

Studying of the dermatoglyphs is especially important in the diseases that are not etiologically cleared enough and where is possible to show and prove genetic conditionality for their development.

In the present study we tested the hypothesis of genetic predisposition of hypothyreosis[22]. Embryological development of the thyroid gland starts about the same time and from the same embryological layers as the development of the skin, from which the dermatoglyphs develop. Changes in embryological period could have influences on development of the hypothyreosis, but they could also have reflection on the expression of the dermatoglyphic patterns. We tested this hypothesis by comparing the dermatoglyphics of digito-palmar complex of group of patients suffering from hypothyreosis versus group of healthy individuals.

TABLE 1
DESCRIPTIVE STATISTICS AND T-TEST OF QUANTITATIVE DERMATOGLYPHIC CHARACTERISTICS BETWEEN PATIENTS WITH HYPOTHYREOSIS AND HEALTHY CONTROLS

Variable	Hypothyreosis N=50		Controls N=100		t-test
	$\overline{X}$	SD	$\overline{X}$	SD	p<
FRR 1	15.60	7.49	15.80	6.43	0.867
FRR 2	11.36	7.70	10.88	6.50	0.689
FRR 3	10.80	6.82	11.11	5.53	0.706
FRR 4	13.98	6.84	15.13	5.49	0.765
FRR 5	11.72	5.30	11.77	5.19	0.268
a-b rcR	39.60	4.76	39.35	5.74	0.791
b-c rcR	27.48	4.60	26.84	5.29	0.467
c-d rcR	32.70	5.36	37.03	6.43	0.001
atd R	45.40	7.16	43.74	5.37	0.114
FRL 1	13.24	7.32	14.36	6.08	0.323
FRL 2	10.12	7.23	11.38	6.81	0.297
FRL 3	10.56	7.15	11.07	5.95	0.645
FRL 4	13.66	6.73	14.82	5.61	0.266
FRL 5	11.60	4.97	12.24	4.84	0.451
a-b rcL	35.92	5.45	39.90	6.76	0.001
b-c rcL	27.64	5.98	26.60	5.56	0.293
c-d rcL	33.34	5.41	34.76	7.17	0.220
atd L	44.92	7.04	44.60	6.42	0.779

Materials and Methods

In our research we have analyzed digito-palmar dermatoglyphs of 50 females with the confirmed diagnosis of hypothyreosis[22]. Control group consisted of 100 phenotypically healthy subjects of the same population[23]. The digito-palmar prints were taken and quantitative and qualitative dermatoglyphic features were analyzed according to the standard Cummins and Midlo methods[5].

The analysis of quantitative digito-palmar dermatoglyphic features (descriptive statistics, t-test, discriminate and factor analysis) included 18 variables (finger ridge counts on right and left hand and their asymmetry: FRR1, FRR2, FRR3, FRR4, FRR5, FRL1, FRL2, FRL3,

TABLE 2
RESULTS OF THE CLASSIFICATION OF THE INVESTIGATED GROUPS (FEMALES WITH HYPOTHYREOSIS AND CONTROL GROUP) – DISCRIMINATION FUNCTION

	Classification results				
	N	Correctly classified	%	Incorrectly classified	%
Patients	50	39	78.0	11	22.0
Control group	97	74	76.3	23	23.7

A 76.9% of original grouped cases correctly classified.

TABLE 3
FACTOR ANALYSIS FOR THE VARIABLES IN THE GROUP OF PATIENTS WITH HYPOTHYREOSIS

Variables	Factor I	Factor II	Factor III	Factor IV	Factor V
FRR1	0.829				
FRR2	0.888				
FRR3	0.876				
FRR4	0.765				
FRR5	0.753				
a-b rcR		0.435		0.378	0.635
b-c rcR			0.758		–0.352
c-d rcR		0.729			
atd R		0.772			
FRL1	0.790		0.419		
FRL2	0.838				
FRL3	0.848				
FRL4	0.880				
FRL5	0.681		–0.432		
a-b rcL		0.426		0.780	
b-c rcL			0.780		
c-d rcL		0.468		–0.533	0.524
atd L		0.600	–0.381		
Characteristic value	6.946	2.392	1.811	1.216	1.086
Variance percentage	38.589	13.287	10.064	6.754	6.032

TABLE 4
FACTOR ANALYSIS FOR THE VARIABLES IN THE GROUP OF THE HEALTHY CONTROL SUBJECTS

Variables	Factor I	Factor II	Factor III	Factor IV	Factor V
FRR1	0.651		0.395		0.488
FRR2	0.679				
FRR3	0.839				
FRR4	0.728				
FRR5	0.732				
a-b rcR		0.643			
b-c rcR		0.634	0.517		
c-d rcR		0.644			
atd R	0.394	0.575		–0.355	
FRL1	0.651		0.419		0.348
FRL2	0.819				
FRL3	0.779				
FRL4	0.653			0.413	
FRL5	0.739				
a-b rcL		0.624			0.468
b-c rcL		0.464	0.605	0.445	
6 c-d rcL		0.657			
atd L	0.386	0.572		–0.448	
Characteristic value	5.825	3.180	1.448	1.153	1.027
Variance percentage	32.359	17.667	8.044	6.407	5.707

FRL4, FRL5; palmar ridge-counts on the right and left hand: a-b rcR, b-c rcR, c-d rcR, a-b rcL, b-c rcL, c-d rcL; and the atd angles: atdR, atdL). Separately we analyzed qualitative patterns of the fingers (frequency of whorls, arches and loops), the frequency of patterns on palms and the axial triradius position. In order to evaluate differences between the two investigated groups we used the χ^2-test.

TABLE 5
ASYMMETRY FOR DIGITAL AND PALMAR VARIABLES IN THE GROUP OF PATIENTS WITH HYPOTHYREOSIS AND GROUP OF THE HEALTHY CONTROL SUBJECTS

Variable		Asymmetry	t-test	p<
S FRC	Hypothyreosis	8.72	0.412	0.681
	Controls	8.25		
ab rc	Hypothyreosis	5.60	2.077	0.040
	Controls	4.08		
bc rc	Hypothyreosis	3.48	0.689	0.487
	Controls	3.15		
cd rc	Hypothyreosis	4.80	–0.524	0.601
	Controls	5.21		

Results

The descriptive statistics and statistical analysis of the quantitative dermatoglyphics traits of the two investigated groups (females with hypothyreosis and control – healthy group) using t-test has not indicated the significant difference (Table 1). The only statistically significant differences were found on the palms for the a-b ridge counts left and c-d ridge counts right.

The discriminant analysis of the two investigated groups has shown 76.9% correctly classified samples (Table 2). The results of the factor analysis for the patients

TABLE 6
THE FREQUENCIES OF PATTERNS ON FINGERS IN BOTH EXAMINED GROUPS HYPOTYREOSIS PATIENTS AND HEALTHY CONTROLS

Right hand	Whorl %		Ulnar loop %		Radial loop %		Arch %	
	Hypothyr.	Contr.	Hypothyr.	Control	Hypothyr.	Control	Hypothyr.	Control
1	52.0	51.0	38.0	46.0	0.0	0.0	10.0	3.0
2	34.0	42.0	38.0	22.0	10.0	25.0	18.0	11.0
3	20.0	29.0	60.0	60.0	2.0	4.0	18.0	7.0
4	28.0	58.0	62.0	38.0	0.0	1.0	10.0	3.0
5	14.0	24.0	82.0	75.0	0.0	0.0	4.0	1.0
Total right	29.6	40.8	56.0	48.2	2.4	6.0	12.0	5.0
Left hand	Whorl %		Ulnar loop %		Radial loop %		Arch %	
1	44.0	40.0	38.0	54.0	6.0	1.0	12.0	5.0
2	34.0	40.0	32.0	32.0	12.0	18.0	22.0	10.0
3	16.0	24.0	58.0	67.0	8.0	0.0	18.0	1.0
4	24.0	35.0	58.0	61.0	8.0	0.0	10.0	4.0
5	12.0	12.0	74.0	84.0	10.0	1.0	4.0	2.0
Total left	26.0	30.20	52.0	59.60	8.80	4.0	13.20	4.4
Total	27.8	35.50	54.0	53.90	5.6	5.0	12.6	4.7

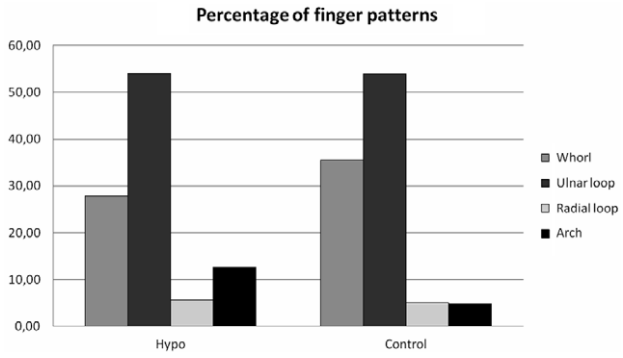

Fig. 1. Total frequencies of patterns on all ten fingers in both hypotyreosis patients (n=50) and healthy control group (N=100).

are presented in Table 3 in female patients and in Table 4 for the healthy control group. In the latent structure five factors were extracted in the both groups. The percent of total variance in the group of patients was 74.725%, while for the control group was 70.184%. The largest percent of total variance (38.589%) was found in the first factor within group of patients, while in the control group that percent was 6% lower (32.359%). The factor analysis has shown a high percentage of total variance within patients suffering from hypothyreosis, as well as the different structure of individual factors. In healthy control group all palmar variables are presented on the second factor, and b-c ridge count is also on the third factor. In the group of patient's b-c ridge count is not on the palmar second factor, it is extracted on the third factor.

The asymmetry A between homologous fingers[24,25] for the group of patients with hypothyreosis was 8.72 and for the control group was 8.25 and the difference is not statistically significant (Table 5). Statistically significant differences in asymmetry is found only for a-b ridge count ($t=1.981$; $p<0.05$).

The analysis of qualitative dermatoglyphics traits has shown more heterogeneity between the two examined groups (Table 6; Figure 1). The results of χ^2-test revealed statistically significant difference between the two investigated groups on finger patterns at the probability level of $p<0.001$ ($\chi^2=27.592$) and for the frequency of the axial triradius position at the probability of $p<0.003$ ($\chi^2=13.425$) (Table 7).

Difference for the palm patterns frequencies was detected for the 3rd ($\chi^2=22.154$; $p<0.001$) and for the 4th interdigital area ($\chi^2=34.571$; $p<0.001$), while difference for the hypothenar was lower ($\chi^2=5.808$; $p<0.016$) (Table 8).

TABLE 7
RESULTS OF THE χ^2-TEST FOR THE DIGITAL PATTERNS AND AXIAL TRIRADIUS POSITION

	χ^2	df	p<
Finger patterns	27.592	3	0.001
Axial triradius position	13.425	3	0.003

Discussion

About 15% of all females and 3% of all males suffers from hypothyreosis. The thyroid diseases are supposed to be caused by the influence of various genetic and external factors. The role of genetic and hereditary influences on the etiology of the disease is very actively studied[1].

In the present study, evaluating the dermatoglyphic features of the two different groups, we have tried to examine the hypothesis of genetic predisposition of the disease. Quantitative statistical analysis using t-test has indicated only few significant different results while the discriminant analysis has shown 76.9% correctly classified sample. The main discriminant variables were palmar variables c-d ridge count right, a-b ridge count left, and fourth finger ridge count on both hands[22].

The factor analysis has shown a high percentage of total variance within patients suffering from hypothyreosis, as well as the different structure of individual factors. Five factors were extracted in the patients group with the percent of total variance 74.725%. Five factors also were extracted in the control group with the percent of total variance 70.184. The largest percent of total variance (38.589%) was found in the first factor within group of patients, while in the control group that percent was 6% lower (32.359%). As Chopra[26] concluded that the first factor »since all the variables of finger considered in the study are included here, this factor may be regarded as general size factor« and provide more information due to its underlying structure[27,28]. In our results the differences in total variance on the first factor within group of patients compared with the control group suggests that there is possible genetic influence on the digital ridge patterns in patients suffering from hypothyreosis. On the second factor in control group all palmar variables

TABLE 8
RESULTS OF THE χ^2-TEST FOR THE PALMAR PATTERNS

	Hypothyreosis	Controls	χ^2	df	p<
Thenar and 1st interdigital area	13	7	2.930	1	0.087
2nd interdigital area	2	4	0.828	1	0.363
3rd interdigital area	52	78	22.154v	1	0.001
4th interdigital area	52	19	34.571	1	0.001
Hypothenar	35	22	5.808	1	0.016

were extracted while on the patient group the b-c ridge count of both hands is on the third factor. Asymmetry was calculated between homologous fingers and the difference is not statistically significant, but for the a-b ridge count on palms we found significant difference.

The analysis of the qualitative dermatoglyphic traits of the digito-palmar complex showed the statistically significant differences $p<0.001$ for the finger variables, and from the Figure 1 we can note that the frequency of whorls is lower and of arches is higher in patients suffering from hypothyreosis. Statistically significant difference ($p<0.003$) was also found for the frequency of the axial triradius position on palms. The palmar patterns in the 3rd and 4th interdigital area showed the statistically significant differences at probability level of $p<0.001$ and $p<0.016$ for the hypothenar area. Arrieta[29] found that three interdigital ridge counts (a-b, b-c and c-d ridge counts – correspond to the 2nd, 3rd and 4th interdigital area) seems to have great genetic component in phenotypic expression in females.

The results of those researches have proved that the qualitative characteristics are more unstable than the quantitative ones and they have also shown the instability of genes taking part in hypothyreosis development implying genetic predisposition of the disease.

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DERMATOGLIFI U BOLESNIKA S HIPOTIREOZOM

SAŽETAK

Na svijetu oko 5 do 10% stanovništva boluje od hipotireoze, od toga 15% žena, a 3% muškaraca. Prevalencija ove bolesti raste s godinama, a veća je od 40. do 50. godine života. Najčešći uzrok je bolest same štitnjače pa se tako u Hrvatskoj u 90% slučajeva javlja kao autoimuna bolest. Autoimuni tireoiditis je 15 puta češći u žena, a naročito iznad 45. godine života. Ne karakterističnost simptoma i njihovo preklapanje s nizom drugih bolesti otežava diferencijalno dijagnosticiranje hipotireoze. Pretpostavlja se da bolesti štitnjače nastaju utjecajem raznih genetskih i vanjskih činitelja. Kako su dermatoglifi pokazatelji fenomena rasta i diferencijacije tijekom razdoblja rane embriogeneze, analiza digito-palmarnih dermatoglifa korištena je u istraživanju uloge nasljeđa u ovoj bolesti. U radu je provedena analiza

razlika kvalitativnih i kvantitativnih svojstava dermatoglifa digito-palmarnog kompleksa između skupine od 50 žena oboljelih od hipotireoze i kontrolne skupine od 100 fenotipski zdravih žena. Statističkom obradom kvantitativnih svojstava t-testom nije dobivena signifikantna razlika, dok je diskriminacijska analiza pokazala visok postotak (76,9%) pravilno klasificiranog uzorka. Faktorskom analizom dobiven je viši postotak objašnjene varijance u bolesnica s hipotireozom, kao i različita struktura pojedinih faktora. Analiza kvalitativnih svojstava pokazala je također značajnu heterogenost između dviju ispitivanih skupina. Rezultati istraživanja potvrda su veće labilnosti kvalitativnih svojstava u odnosu na kvantitativna te nestabilnosti gena koji sudjeluju u razvoju hipotireoze, što ukazuje na genetsku predispoziciju same bolesti.